# EXHIBIT 1

February 25, 2013

*VIA ELECTRONIC AND U.S. MAIL*

Board of Forestry and Fire Protection
ATTN: George Gentry, Executive Officer
PO Box 944246
Sacramento, CA 94244-2460
<VegetationTreatment@fire.ca.gov>

**RE: Draft Programmatic EIR for the Vegetation Treatment Program**

Dear Mr. Gentry:

The Endangered Habitats League (EHL) submits the following comments on the Draft Program EIR (DPEIR) for the Board of Forestry's proposed statewide Vegetation Treatment Program (VTP), which would affect up to 38 million acres, or more than a third of the land area of the State of California. EHL is southern California's only regional conservation organization, and it and its members have a direct stake in maintaining the health of Southern California's unparalleled biodiversity and the native ecosystems that support it. We have been active participants in State of California Natural Community Conservation Planning (NCCP) and have worked extensively with both Riverside and San Diego Counties on fire management.

Proposed to reduce the severity and frequency of wildland fires, this massive program not only lacks a reasoned justification based on science and substantial evidence, but is so vaguely defined as to preclude reasoned and meaningful assessment of its environmental impacts. Moreover, the DPEIR relies on speculation, not substantial evidence, in concluding that the burning or other modification of millions of acres of vegetation will not have significant air quality and climate change impacts. Finally, the DPEIR relies on a self-fulfilling set of project objectives that only the Project can satisfy, and presents a narrow range of alternatives that wholly excludes consideration of the beneficial effects of avoiding the placement of structures in high fire risk areas, limiting vegetation treatment to the Wildland Urban Interface (WUI), and strengthening structures' resistance to fire events. For all of these reasons—and as more fully described below—the DPEIR does not satisfy the California Environmental Quality Act's (CEQA) procedural and substantive requirements.

As a substantive matter, the VTP indefensibly treats the diverse ecological regions of the state with the same broad brush. For the scrub systems of Southern California in particular, its management prescriptions—to the extent they can be gleaned from the DPEIR—are bereft of scientific basis and lack demonstrable efficacy. Furthermore, the illusion that fire safety can be manufactured through vegetation removal would encourage the continued expansion of the Wildland Urban Interface, and the resulting vicious cycle of additional home construction, catastrophic fire, and escalating costs to the taxpayer. For existing homes and communities, better and proven alternatives are available.

Due to these fundamental problems with the proposed VTP, we respectfully request that the project be *withdrawn* and rethought. As you consider these and other comments, we urge CALFIRE to step back and develop a different and more comprehensive program. We offer our collaboration and assistance on a program that would:

- focus on actual structures at risk rather than habitat clearance,
- reflect regional differences in natural resources and the built environment,
- put fewer structures at risk through better land use planning,
- incorporate the most current science,
- invite participation by citizens and independent experts, and
- allow public oversight as the program is implemented.

Our more detailed comments are presented below.

**CEQA's Mandates**

"[T]he Legislature intended [CEQA] 'to be interpreted in such manner as to afford the fullest possible protection to the environment within the reasonable scope of the statutory language.'" (*Laurel Heights Improvement Assn. v. Regents of University of California* (1988) 47 Cal.3d 376, 390.) Indeed, "[t]he EIR is the primary means of achieving the Legislature's considered declaration that it is the policy of this state to 'take all action necessary to protect, rehabilitate, and enhance the environmental quality of the state.' [Citation.] . . . An EIR is an "environmental 'alarm bell' whose purpose it is to alert the public and its responsible officials to environmental changes before they have reached ecological points of no return." [Citations.] The EIR is also intended "to demonstrate to an apprehensive citizenry that the agency has, in fact, analyzed and considered the ecological implications of its action." [Citations.] "Because the EIR must be certified or rejected by public officials, it is a document of accountability. If CEQA is scrupulously followed, the public will know the basis on which its responsible officials either approve or reject environmentally significant action, and the public, being duly informed, can respond accordingly to action with which it disagrees. [Citations.] The EIR process protects not only the environment but also informed self-government." (*Id.* at p. 392.)

"When assessing the legal sufficiency of an EIR [as an informational document], the reviewing court focuses on adequacy, completeness and a good faith effort at full disclosure." [Citation.] "The EIR must contain facts and analysis, not just the bare conclusions of the agency." [Citation.] "An EIR must include detail sufficient to enable those who did not participate in its preparation to understand and to consider meaningfully the issues raised by the proposed project." (*Association of Irritated Residents v. County of Madera* (2003) 107 Cal. App. 4th 1383, 1390.)

## I. The DEIR Fails to Provide a Sufficiently Detailed Project Description to Permit Reasoned Analysis of Environmental Impacts.

For an environmental document to adequately evaluate the adverse impacts of a project, it must first provide a comprehensive description of the project itself. "'An accurate, stable and finite project description is the *sine qua non* of an informative and legally sufficient EIR.'" (*San Joaquin Raptor/Wildlife Rescue Center v. County of Stanislaus*, 27 Cal.App.4th 713, 730 (1994) (quoting *County of Inyo v. City of Los Angeles*, 71 Cal.App.3d 185, 193 (1977).) This is because "'[a]n accurate project description is necessary for an intelligent evaluation of the potential environmental effects of a proposed activity.'" *Id.* (quoting *McQueen v. Bd. of Directors*, 202 Cal.App.3d 1136, 1143 (1988)).[1] Moreover, without a sufficiently detailed project description, public participation is rendered impossible. (See *County of Inyo* v. *City of Los Angeles, supra, at p.* 197 ["A curtailed, enigmatic or unstable project description draws a red herring across the path of public input"].) Thus, while every detail is not necessary, the law requires that EIRs describe proposed projects with *sufficient* detail and accuracy to permit informed decision-making. (*See* Guidelines §15124.)

The DEIR here fails to meet this basic threshold. Indeed, all the reader knows about what will happen on an unspecified 38 million acres in the State is summed up in one single paragraph out of a more than 1300-page document:

> The general suite of treatments likely to be initiated under the Proposed Program in any decade would comprise about 2.16 million acres and would include:
> • Prescribed fire (underburn, jackpot burn, broadcast burn, pile burn, establishment of control lines) – about 53% of treatments,
> • Mechanical (chaining, tilling, mowing, roller chopping, masticating, brushraking, skidding and removal, chipping, piling, pile burning) – about 18% of treatments,
> • Manual (hand pull and grub, thin, prune, hand pile, lop and scatter, hand plant, pile burn) – about 10% of treatments,
> • Prescribed herbivory (targeted grazing or browsing by cattle, horses, sheep, or goats) – about 10% of treatments,

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[1] CEQA requires that the environmental review document contain a full and accurate description of the proposed project. (*See, e.g., Mira Monte Homeowners Assn. v. County of Ventura* (1985) 165 Cal. App.3d 357, 366; *Santiago County Water Dist. v. County of Orange* (1981) 118 Cal. App.3d 818, 829-831; *County of Inyo v. UCB of Los Angeles* (1977) 71 Cal. App. 3d 185; 14 Cal. Code Reg. § 15124. *See also Berkeley Keep Jets Over the Bay Committee v. Board of Port Commissioners* (2001) 91 Cal. App. 4th 1344; *Stanislaus Natural Heritage Project v. County of Stanislaus* (1996) 48 Cal. App. 4th 182, 201; *Rio Vista Farm Bureau Center v. County of Solano* (1992) 5 Cal. App. 4th 351, 369-370; *Sacramento Old UCB Assn. v. UCB Council*, *supra,* 229 Cal. App. 3d at 1023; 14 Cal. Code Reg. § 15378(a).)

• Herbicides (ground applications only, such as backpack spray, hypohatchet, pellet dispersal, etc.) – about 9% of treatments.

Even these percentages are statewide *averages*, providing no indication what combination of treatments will happen at a particular location. The type of treatment (or combination of treatments) at a particular location is not defined, but is instead subject to an unlimited set of vague "factors."[2] Moreover, the location of any of the areas where the VTP would be

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[2] Prescriptions would incorporate the appropriate vegetation treatment(s) (techniques, methods) described above in order to create specific end results, such as shaded fuel breaks, fuel reduction zones, or improvement of browse or forage for wildlife or domestic stock. The number and type of vegetation treatments will be selected based on a number of parameters, *which may include, but are not limited to*:
• Management program or objectives for the site
• Historic and current conditions
• Opportunities to prevent future problems
• Opportunities to conserve desirable vegetation
• Effectiveness and cost of the treatment methods and follow-up maintenance treatments
• Available funding
• Success of past treatments, or treatments conducted under similar conditions
• Recommendations by local experts
• Characteristics of the target plant species, including size, distribution, density, life cycle, and life stage during which the plant(s) is (are) most susceptible to treatment
• Non-target plant species potentially impacted by the treatment
• Fuel configuration (amount, arrangement, and size classes)
• Land use
• Size of the target area
• Topography, slope, and aspect of the treatment area
• Accessibility of the treatment area
• Soil characteristics of the treatment area
• Weather conditions at the time of treatment, particularly wind speed and direction, precipitation prior to or likely to occur during or after application, and time of year
• Proximity of the treatment area to sensitive areas, such as wetlands, streams, or habitat for plant or animal species of concern, rare plants and habitat structure vital to species survival and reproduction, air and water quality, soil productivity and cultural resources
• Potential impacts to humans, fish, and wildlife
• Need for subsequent revegetation
• Maintenance of prior treated area
• Ability/Willingness of landowner to maintain treated area
These parameters would be considered before treatment methods are selected. Before vegetation treatment or ground disturbance occurs, CALFIRE would consult specialists or databases for sensitive areas within the project area. The project sites would likely have to be surveyed for listed or proposed state or federally threatened or endangered species and rare plants and for evidence of cultural or historic sites.

implemented is not defined with sufficient specificity to place a landowner or reader on notice that he or she may be directly affected. There are no maps with sufficient detail to put affected landowners or residents on notice of what will occur; vague estimates of ill-defined treatment in vaguely defined "bioregions" shed no light on what will actually happen. The reader has no way of knowing whether vegetation will be razed completely or lightly thinned, or whether exposure to smoke from prescribed fires or chemicals from herbicides will result.

Instead, the DPEIR is loaded with repetitive statements concerning the generalized impact of the proposed treatment methods in various contexts, many of them out of state, and most irrelevant to the specific and diverse vegetation communities throughout the state. These general statements provide no basis for determining the extent of impact on the physical environment, and certainly do not provide substantial, credible evidence that impacts from the project will not be significant. Indeed, it is impossible to glean what the impacts will be from the information provided.

The biological impacts "analysis" contained in the DPEIR illustrates this point. The DPEIR acknowledges, correctly, that "a project would have a significant impact on wildlife if it would have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the DFG or USFWS." (DPEIR at p. 5.5-9.) One such species is the federally threatened and state-listed California Gnatcatcher, a highly territorial subspecies of thrush found in coastal Southern California that depends for its survival on healthy stands of coastal sage scrub within its territory. The DPEIR acknowledges that Southern California shrub ecosystems "will be treated extensively . . . by all treatment types." (DPEIR at p. 5.5-64.)

Even though the Project could result in total obliteration of its habitat and type conversion, the DPEIR concludes that there will be no significant impact on *any* special status species, necessarily including the gnatcatcher. Instead of addressing habitat loss, the DPEIR blithely asserts that "most shrub-dwelling wildlife will be able to avoid direct mortality by flying away." (DPEIR at p. 5.5-23.) The DPEIR does acknowledge that "since prescribed burning is usually designed to reduce shrub cover, wildlife that live or nest in shrubs or are reliant on shrub cover will be affected for several years by this treatment. But the DPEIR then inexplicably changes course and concludes that "these birds avoid dense, overgrown shrub-lands and so may benefit from treatments that create a better-proportioned mosaic of shrub mixed with open areas." (DPEIR at p. 5.5-64.)

Nothing in the Project description, however, supports the conclusion that Project implementation will produce "a better-proportioned mosaic of shrub mixed with open areas." Indeed, since the Project description does not describe the extent and magnitude of damage to the gnatcatcher's coastal sage scrub habitat from "extensive" use of "all treatment types," there is no way to evaluate the correctness of the DPEIR's conclusion that the "indirect effects of the VTP in the South Coast Bioregion are likely to be positive" and that impacts to the gnatcatcher will be "negligible." (DPEIR at p. 5.5-64 to 5.5-65.) To the contrary, the intrepid reader who has digested the entire DPEIR still has no idea what the impacts of the Project will be on the gnatcatcher *or the literally hundreds of other special status species affected by the Project*.

It might be asserted that the "programmatic" nature of the DPEIR excuses its lack of analysis and the impossibility of applying CEQA significance thresholds given the lack of an adequate project description. But whether a lead agency prepares a "program" EIR or a "project-specific" EIR under CEQA, the requirements for an adequate EIR remain the same. (See Guidelines § 15160.) "Designating an EIR as a program EIR also does not by itself decrease the level of analysis otherwise required in the EIR." (*Friends of Mammoth* v. *Town of Mammoth Lakes Redevelopment Agency,* 82 Cal.App.4th 511 (2000).) Even a program-level EIR must contain "extensive detailed evaluations" of a plan's effects on the existing environment. (S*ee Envt'l Planning and Info. Council* v. *County of El Dorado,* 131 Cal.App.3d 350, 358 (1982).

It might also be asserted that proposed mitigation will ensure that no significant effects will occur. Indeed, in the context of impacts to special status species, the DPEIR explicitly relies on Minimization Management Measure 5 (MMR-5) to support its conclusion that no significant impacts will occur. This measure states:

> 5. A database search will be conducted for each project by a query of the most reasonably available sources and databases for biological information, including but not limited to, the CNDDB and BIOS. The search shall include a minimum search area of nine (9) USGS Quadrangles surrounding the project area. In cases where the project area extends into multiple quadrangles all adjacent quadrangles shall be included. Surveys may be necessary to determine presence/absence of special status plants or animals and to determine and evaluate site-specific impacts. The applicant will evaluate the potential direct and indirect impacts caused by the Project. The wildlife agencies shall be notified in writing with the Project scoping information (including the evaluation of direct and indirect impacts and the results of the database search), and asked for comments and recommendations. The lead agency as a result of consultation with the appropriate State or Federal agencies, or a qualified biologist, will *modify project design*, and/or incorporate mitigation to avoid significant adverse environmental impacts to special status species and other species. If avoidance is not possible, appropriate take permits (Federal Endangered Species Act (ESA) or California ESA) will be required.

But what "*modifications* to project design" will occur, or what will suffice to reduce impacts when the *original* project design is *itself* unknown is also unknown. Indeed, reliance on such a standard-less and vague measure is analogous to reliance on illegal deferred mitigation. (See *Endangered Habitats League v. County of Orange* (2005) 131 Cal.App.4th 777, 794 [a "mitigation measure [that] does no more than require a report be prepared and followed, or allow approval by a county department without setting any standards" is illegal deferred mitigation.].)

The DPEIR is thus legally inadequate because it fails to carry out the most fundamental purpose of CEQA—to promote informed decision-making. As the court stated in *San Joaquin Raptor v. County of Stanislaus* (1994) 27 Cal. App. 4th 713:

> "'the ultimate decision of whether to approve a project, be that decision right or wrong, is a nullity if based upon an EIR that does not provide the decision-makers, and the public, with the information about the project that is required by CEQA.' (*Santiago County Water Dist. v. County of Orange* (1981) 118 Cal. App.3d 818, 829.) The error is prejudicial 'if the failure to include relevant information precludes informed decision making and informed public participation, thereby thwarting the statutory goals of the EIR process. (*Kings County Farm Bureau v. City of Hanford* (1990) 221 Cal. App.3d 692, 712.)'" (*Id*. at 721-722.)

Until a more detailed project description is provided that will enable mandatory significance thresholds to be applied with substantial evidence, the DPEIR is legally inadequate as a matter of law.

## II. The DPEIR Fails to Provide Substantial Evidence that the Project Will Achieve Stated Project Purposes for Non-Forested Areas.

Failing to make any meaningful distinction in its approach to vegetation management to account for California's vast ecological diversity, the DPEIR does not substantiate its claim underlying the need for clearing wild-land vegetation. The DPEIR states:

> "Changes in vegetation have resulted in increases in hazardous fuels and increased threat. Much of this change in threat can be attributed to fire exclusion policies instituted over the past 100 years**."** (DPEIR at P. ES-2.)

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This statement is generalized for every bio-region of the state, from alpine areas, temperate coastal rainforests, chaparral and desert. The scientific evidence, however, does not support this claim as applied to all of these vegetation communities. As detailed by a wide representation of expert fire ecologists, the DPEIR fails to supply substantial evidence that 2.16 million acres of vegetation treatment over a decade will actually further stated Project objectives.

Factual assertions made in an EIR must be supported by substantial evidence based on CEQA's narrow definition of the term:

> "Argument, speculation, unsubstantiated opinion or narrative, evidence which is clearly inaccurate or erroneous, or evidence of social or economic impacts which do not contribute to, or are not caused by, physical impacts on the environment, is not substantial evidence. Substantial evidence shall include facts, reasonable assumptions predicated upon facts, and expert opinion supported by facts." (Pub. Res. Code

§21082.2(c).)

Thus, while agency studies are generally afforded deference, a "clearly inadequate or unsupported study is entitled to no judicial deference." (*Berkeley Keep Jets Over the Bay Comm. v. Board of Port Comms.* (2001) 91 Cal. App. 4th 1344, 1355.)

Here, the underlying premise upon which the Project is justified is that, following the prescribed treatments, large, destructive wildland fires will occur significantly less frequently in virtually all the relevant bio-regions of the state. From this premise a broad suite of resulting Project benefits are inferred:

--"reduced impacts from wildland fire compared to the Status Quo due to previously treated areas;"
--"wildfire extent is likely to be slightly reduced after the first decade of treatments;"
--"slightly to moderately beneficial impacts on wildlife;"
-- **"**a negligible to moderate adverse effect to some special status wildlife species**;"**
-- "slightly adverse to slightly beneficial impact on invasives;"
-- "a slightly adverse effect on CO2 levels and climate change in the short term". . . "leading to a slight reduction in total carbon emissions after 30 years of treatments;" (SEE DPEIR at p. ES-10.)
-- "reduce impacts to air quality from wildfires as a result of treatments which reduce the severity of fire on treated acres." (See DPEIR at p. 5.6-13;Table 5.6.9.)

The problem is that the DPEIR never supports the underlying premise—that treatments will significantly reduce the severity and frequency of wildfires in *all* the relevant bio-regions covered by the Project. A detailed analysis of the available scientific evidence—and of the sources cited as support in the DPEIR—is presented in the numerous comments on the DPEIR submitted by the State's finest wildfire ecologists, and incorporated by reference in these comments. These comments demonstrate that the DPEIR has not provided substantial evidence supporting the key premise of the DPEIR as to all of the affected bioregions.

This absence is particularly severe as it relates to Southern California chaparral and other non-coniferous vegetation communities. As one noted fire ecologist has observed after reviewing the sources cited in the DPEIR,

> "There is some agreement that fuel treatments can be effective in some communities but the document ignores two decades of literature that indicate that fuel treatment in chaparral and other crown fire ecosystems are ineffectual in limiting fire size or spread under the high wind conditions that account for the largest acreage burned and greatest damage." (See letter from C.J. Fotheringham.)

Other scientists' comments are unanimous in their agreement that the underlying premise of the Project simply does not apply to chaparral and other non coniferous ecosystems. This consensus is summarized by biologist Dr. Wayne Spencer as follows:

> "The PEIR is fundamentally flawed, should not be certified, and needs to be completely redone using a much more scientifically valid approach to wildfire management. *All of the findings in the PEIR (e.g., findings of significance/non-significance) are based on one foundational assumption that is demonstrably false for most of the lands proposed for treatments*—specifically the assumption that vegetation treatments in wildland areas will reduce the size and severity of fires and thereby reduce risks to both human and natural communities. This assumption has been thoroughly debunked by the last 20 years or more of research on wildland fires and vegetation management in California (with the narrow exception that strategic treatments in some mixed coniferous or pine-dominated forests that evolved with frequent surface fires may be beneficial for restoring more natural fire regimes and reducing risks very large and severe fires). *In most California vegetation communities--especially chaparral, sage scrub, and grassland types and many non-pine forest type--the sorts of treatments proposed by the PEIR will not reduce fires risks, and are likely to do far more harm than good relative to meeting the PEIR's stated goals".* (Emphasis in original.)

This is not a situation where there is a "conflict among experts." Rather, there is a wholesale *absence* of credible science which undermines the core premise of not only the DPEIR's justification for the Project, but also the validity of the impacts analysis CEQA requires on biology, public safety, air quality, climate change, and other areas. Until substantial evidence is marshaled supporting the DPEIR's claims as to every vegetation community and bioregion covered by the Project, the DPEIR cannot be certified and used as a basis for the findings required by CEQA.

## III. The DPEIR Fails to Develop and Analyze a Reasonable Range of Alternatives.

Just as the Project is vaguely defined as to preclude the possibility of reasoned analysis of impacts, so are the three alternatives the DPEIR presents. Each alternative is merely a minor modification of the assumed relative percentages of different treatment methods. But since that *actual* combination of treatment methods on any given location for any of the alternatives is not specified, the distinction between the alternatives in the real world is merely hypothetical.

More fundamentally, all of the alternatives developed rely on vegetation clearing as the exclusive means to reduce fire risk. Other, more effective, methods such as reducing the number of structures in the Wildland Urban Interface (WUI), mandating fire safe buildings, selective clearing around structures, and other methods well within CALFIRE's statutory authority are not even considered. This is not the reasonable range of alternatives CEQA requires.

**IV. CALFIRE Cannot Tier Off the DPEIR Because It Fails to Address or Even Define Subsequent Vegetation Removal Projects.**

The DPEIR proposes that CALFIRE will tier off the DPEIR through the use of a yet-to-be formulated "checklist." The DPEIR states:

> "Projects conducted under the auspices of the VTP will be evaluated using an environmental checklist (Chapter 8) to determine whether the environmental effects of the projects were addressed in the PEIR. The environmental checklist includes the potential impacts and mitigation measures described in the PEIR. No additional CEQA documentation will be required if the subsequent project is within the scope of the program and if the environmental effects have been evaluated in the PEIR." (DPEIR at p. ES-13.)

As explained above, because the DPEIR employs a project description so vague as to preclude any reasoned analysis of impacts, the checklist approach cannot be used consistent with CEQA.

CEQA limits a lead agency's ability to tier off an initial programmatic EIR document to those impacts *specifically* addressed in the programmatic document. (See *Endangered Habitats League v. State Water Resources Control Board* (1997) 63 Cal. App. 4th 227, 242-243.) In particular, CALFIRE may not tier to the DPEIR on potential environmental impacts which (1) were not examined as significant effects on the environment in the prior EIR; or (2) are susceptible to substantial reduction or avoidance by the choice of specific revisions in the project, by the imposition of conditions, or other means. 14 Cal. Code Reg. § 15152(d). *See also* 14 Cal. Code Reg. § 15152(f)(3).

Here, because none of the impacts of an *actual* proposed clearance project were actually considered in the DPEIR, it has no utility as a programmatic document. All of the specific features of an actual VTP effort will be defined for the first time only upon the development of that project. As a consequence, full environmental review will be required at that time.

**Conclusion**

Thank you for considering our comments and please let me know if additional information would be helpful. Please retain EHL on all mailing, notification, and distribution lists for this project.

Yours truly,

Dan Silver
Executive Director

cc: Interested parties

# EXHIBIT 2

25 February, 2013

Board of Forestry and Fire Protection
ATTN: George Gentry, Executive Officer
PO Box 944246
Sacramento, CA 94244-2460
<VegetationTreatment@fire.ca.gov>

**RE: Draft Programmatic EIR for the Vegetation Treatment Program**

Dear Mr. Gentry:

I am fire ecologist with extensive professional experience and publications in the ecology of fire, fire behavior, and fire management issues (see attached *Curriculum Vitae* below).

I am submitting the following comments on the Draft Program EIR (D-PEIR) for the Board of Forestry's proposed statewide Vegetation Treatment Program (VTP), which would affect up to 38 million acres, or more than a third of the land area of the State of California.

I have reviewed the Draft Programmatic Environmental Impact Report (PEIR) presented by the California Board of Forestry in support for their Vegetation Treatment Program (VTP). To my understanding the document is a vehicle to streamline compliance with the California Environmental Quality Act (CEQA). This document also outlines the goals of, and provide justification for, the VTP. For a state with the size and diversity of California, this is a monumental task.

The document itself uses abundant citations, unfortunately many of these are not included in discussions to which they are pertinent, do not support the attributed statements and/or don't adequately reflect 'current scientific understanding' of all the ecosystems and fire regimes the document seeks to address [with some being untraceable (gray literature or improper citation)].

Specifically, the authors propose a program that covers all vegetation and fire regimes in California but base it on  a circumscribed body of literature that can only logically be applied to a very few specific ecosystems and fire regimes; primarily higher elevation/latitude coniferous forest with a historical frequent surface fire regime. In California these systems are primarily in the northern most counties and Sierra Nevada Mountains and account for less than half of the proposed treatment areas overall.  In some southern and central bioregions and counties treatments in non-surface fire regimes account for 70% or more of the proposed treatment area.

There is virtually no discussion of the efficacy of the proposed VTP in non-coniferous vegetation types even though they comprise the majority of the proposed treated area (table 2.2, 5.0.4). A document of this import requires a full and accurate review of current literature regarding all ecosystems, fire regimes and management efficacy in order fully weigh the potential cost versus benefits of the proposed projects. These omissions are particularly concerning when it comes to the southern regions of the state.  In some southern and central bioregions and counties treatments in crown fire regimes account for 70% or more of the proposed treatment area. In the past decade catastrophic, large fires have caused billions of dollars in suppression and damage losses as well as untold environmental losses. With small exception, these occurred in lower elevation shrublands under high wind conditions.

In southern California, large, wind driven crown fires are the historical norm and currently occur several times a decade. Unlike in coniferous forests, fire exclusion has been ineffectual, there is not an unnatural accumulation of fuels on the landscape at large, and in actuality fire frequency has increased and contributes to substantial type-conversion of natural shrublands to highly flammable non-native annual grasslands. These large wind-driven fires are the ones that burn the majority of the area and cause the greatest damage and are deserving of scarce planning resources. This document does not offer any substantial mitigation for this fire threat.

The document falls short of providing justification of the VTP for much of California and as such can not be reasonably used to assess the cost/benefit to the losses to natural resources. Further, the lack of specifics in regards to placement of of VTP projects on the landscape make it impossible to judge whether the document is sufficient to serve as a PEIR document to mitigate and balance resource loss.

For a state with the size and diversity of California, the production of a VTP and PEIR are a formidable task which may be beyond the ability of any single document. California, with it's variability in vegetation, associated fire regimes (crown/surface + historical frequency), urban associated resources and impacts, would potentially be better served with separate documents in order to meet all the stringent literature and analysis requirements of a PEIR and prevent unequal cost/benefit exchanges..

I have detailed specific concerns I have below, red font indicates direct quotation from the D-PEIR, black bold italic are my concerns, while indented text is quotations from sources cited in the D-PEIR.

I have also attached a copy of my current *Curriculum Vitae* at the end of the document.

Please feel free to contact me if you would like more information or clarification regarding my comments.

Sincerely,

CJ Fotheringham, PhD
Moreno Valley, CA
951-486-0138
<ca.fire.ecology@gmail.com>

P. 5.2-1

5.2 Effects of Program/Alternatives on Wildfire Severity and Extent

This section summarizes the impacts of implementing the Proposed Program and Alternatives on wildfire severity and wildfire extent. Wildfire severity is usually measured by the percent mortality of the resulting burned vegetation. Wildfire extent is usually measured as the number of acres burned by severity class. Wildfire frequency is the number of wildfires occurring in a bioregion in any year.

***This is not standard definition of 'wildfire extent' which is generally expressed as area burned and does not generally refer to severity but narratives of some fires may include further delineation of area burned by severity class.***

Implementing the Proposed Program or the Alternatives responds to several of the goals of the VTP including:

• Modify wildfire behavior to help reduce catastrophic losses to life and property.

• Reduce the severity and associated suppression costs of wildfires by altering the volume and continuity of wildland fuels.

***The goal of reducing suppression costs through wildland fuel modification is not realistic in reducing overall suppression costs in most of California as these are driven by large wind-driven fire events which are generally not mitigated by wildland fuel management. (as indicated in this D-PEIR, P. 5.2-6)***

• Reduce the risk of large, high severity fires by restoring a natural range of fire-adapted plant communities through periodic low intensity vegetation treatments.

***While presented broadly, this goal as laid out has limited applicability to much of California. It is not compatible with with shrub-dominated crown-fire ecosystem which have a natural low frequency, high severity fire-regime. Attempting frequent, low intensity fires is damaging and causes type-conversion to highly flammable non-native grasslands(Keeley et al., 2011 as cited[1] in the D-PEIR p. 6-59)***

## 5.2.1 Significance Criteria

Appendix G of the CEQA Guidelines contains only one-significance criteria relating to wildfire:

The Program and Alternatives would create a significant effect if treatments:

a) Expose people or structures to the risk of loss, injury or death involving wildfires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands.

5.2.2 Determination Threshold

The Program and Alternatives will have a significant adverse effect if treatments ultimately result in an:

a) Increase of 50% or more in the short ***(unclear what is meant by 'short')*** term size and severity of individual fires; or

b) Increase of 50% or more in the frequency of large-scale fires.

1 The citation is not included in the literature cited section but may refer to Jon E. Keeley, Juli G. Pausas, Philip W. Rundel, William J. Bond, Ross A. Bradstock, 2011 . Fire as an evolutionary pressure shaping plant traits, Trends in Plant Science, In Press, Corrected Proof, Available online 14 May 2011, ISSN 1360-1385, doi: 10.1016/j.tplants.2011.04.002

Fifty percent was chosen as the threshold because year-to-year variation is such that changes less than 50% are likely to be masked by the statistical variation of wildfire size and large-scale wildfire frequency both today and in the future. For instance, the yearly average acreage burned since 1950 is 230,00 acres plus or minus 195,250 acres, which is a coefficient of variation of 85%.

***It is unclear why any increase in fire frequency, severity and/or size would be an acceptable for a program which justifies large financial and ecological costs on the basis of reducing these occurrences.***

P. 5.2-2
There is general agreement within the scientific community that over a half- century of research shows reduced wildfire severity following fuel treatments (Finney, McHugh and Grenfell, 2005). Agee et al., (2000) found that wildfire behavior has been observed to decrease with fuel treatment. Simulations conducted by van Wagtendonk in 1996 found both pile burning and prescribed fire reduced fuel loads and subsequent wildfire behavior.

***The authors of the PEIR state that there is 'general agreement in the scientific community that half a century of research shows reduced fire severity following fuel treatment' but this is simply unsupported. There is some agreement that fuel treatments can be effective in some communities but the document ignores two decades of literature that indicate that fuel treatment in chaparral and other crown fire ecosystems are ineffectual in limiting fire size or spread under the high wind conditions that account for the largest acreage burned and greatest damage. There are other papers they cite later in this section that refute the contention "general agreement in the scientific community that half a century of research shows reduced fire severity following fuel treatment" eg, Keeley, 2002, Moritz, 1997, etc. cited on p.5.2-6.***

***The paper they cite to support the efficacy of fuel treatments (Finney et al., 2005) is very specific to coniferous forests in Arizona which have limited similarity to high frequency/low severity fire regimes in some California coniferous forests and none with other California plant community and fire regimes. The other paper they cite (Agee et al, 2000) is a discussion of shaded fuel breaks in higher elevation/latitude forest systems and not applicable to California as a whole. Van Wagtendonk, J. W. 1996. deals with the Sierra Neveda's modeling fire in coniferous forests under various conditions.***

P.5.2-2
However, most research to date [in California] on fuel treatments, particularly prescribed fire, has taken place in regimes of frequent, low-severity fires, such as ponderosa pine and mixed conifer forests (Omi and Martinson, 2002a) while not as much research has taken place in crown fire regimes (Keeley, 2002).

***The statement, while purportedly supported by Keeley, 2002, is misleading. While Keeley (2002) does allude to the need for more studies in crown-fire systems, he also indicates there are a number of valuable ones published:***

From Keeley 2002
**Abstract, P. 395**

> Differences in shrubland fire history suggest there may be a need for different fire management tactics between central coastal and southern California. Much less is known about shrubland fire history in the Sierra Nevada foothills and interior North

Coast Ranges, and thus it would be prudent to not transfer these ideas too broadly across the range of chaparral until we have a clearer understanding of the extent of regional variation in shrubland fire regimes.

**P. 400**

Construction of fuel breaks began in earnest in the 1930s and their effectiveness has been debated ever since (Clar 1969, Lee and Bonnicksen 1978, Biswell 1989, Agee and others 2000). Fuel breaks are of questionable value in preventing the spread of fire under severe fire weather conditions (Omi 1977, Dunn and Piirto 1987). However, these zones of reduced fuels provide safe access to fires ignited under more moderate weather conditions (Anonymous 1962, Davis 1965, Salazar and Gonza´lez-Caba´n 1987) and may contribute to reducing the size of fires ignited under such conditions, as inferred by Moritz (1997).

**P.403**

The lack of autumn foehn winds in the foothills of the Sierra Nevada, coupled with higher lightning fire incidence and fewer human-ignited fires (Keeley and Fotheringham in press) suggest that this region may also differ from the patterns observed in southern California. Considering the spatial variation in climate and human demography it is likely that over the range of shrubland habitats in California there is need for differing fire management approaches. Rather than a statewide strategy there is need for more localized management strategies that recognize differences in fire regime, population distribution, as well as infrastructure development, in particular the distribution of roads where most human ignited fires originate.

**Re: Sapsis quotation starting on p. 5.2-2:**

*In southern California, fuelbreaks, areas previously burned by wildfires, and areas that had been prescribe burned, all contributed to limiting the final size of the 1985 Wheeler Fire (Salazar and Gonzalez-Caban 1987). Walker (1995) reports that the 1995 Warner Fire and the 1993 Geujito Fire similarly lost intensity when they ran into recent prescribed burn areas.*

***Walker is anecdotal and untraceable, Salazar and Gonzalez-Caban 1987 is largely anecdotal and results are likely not broadly applicable.***

*However, recent wildfires burning under severe conditions in California have shown significantly reduced fire behavior when they burned into prescribed fire treated areas. Both the Pierce Fire in Sequoia National Park (Stephenson et al., 1991) and the A-Rock fire in Yosemite (Clark 1990) resulted in lower fire intensity and associated reduced fire size due to interaction with recently treated areas*

In Stephenson et al 1991:
For example in 1977, after two years of extreme drought in the southern Sierra Nevada, a prescribed fire in the Redwood Mountain Grove of Kings Canyon National Park burned hot enough in a 4-ha patch of particularly heavy fuel accumulation to kill all trees except large giant sequoias.

***and***

> Another example, perhaps of an extreme of fire behavior in sequoia groves, was the 1987 Pierce wildfire which burned with mixed to predominantly high intensity through a 20-ha section of Redwood Mountain Grove that had not burned for at least a century.

***The extreme in the above paper refers to drought and fuel, not wind. This is not the same as extreme when used in the context of wind-driven fires which the authors conflate throughout the D-PEIR.***

***Clark 1990 is an unpublished report but has to do with high elevation forests. What "severe" means in this report is unknown***.

PIER P. 5-2.3

Finney (2001) found that the greatest reduction in wildfire size and severity occurs when fuel treatment units limit wildfire spread in the heading direction of a wildfire since the heading portion of wildfires have the fastest spread rates and highest intensities. On the other hand, Finney (2001) also noted that treatments often remove some overstory trees, which can produce faster wind speeds in the understory and thereby elongate the fire spread and increase spread rates.

***This is a modeling paper that specifically deals with tree-dominant systems-specifically coniferous forests in northern Arizona, and does not apply to the many of the other ecosytems/fire regimes included in the VTP.***

Raymond and Peterson (2005) found that hardwood sprout regrowth after mechanical treatments resulted in higher mortality to mixed evergreen forests burned by wildfire than in untreated stands

***This is dealing with forests-specifically hardwoods and does not apply to the many other ecosytems/fire regime included in the VTP.***

Carey and Schumann (2003) reviewed 250 papers on the effectiveness of fuel treatments in modifying wildfire behavior.

***These are all dealing with forests, mostly coniferous***

***From Carey and Schumann, 2003:***

> This analysis focuses on ponderosa pine – a "fire adapted" forest type where periodic, low-intensity fires were the ecological norm in presettlement times. Nonetheless, studies in other forest types are reviewed if the research provides useful information on the fuel treatment/fire behavior relationship.

***The limitation to forested ecosystems is also apparent in their findings:***

> Findings:
> Although the assertion is frequently made that simply reducing tree density can reduce wildfire hazard, the scientific literature provides tenuous support for this hypothesis. The literature leaves little doubt, however, that fuel treatments can modify fire behavior. Thus, factors other than tree density, such as the distance from the ground to the base of

> the tree crown, surface vegetation and dead materials play a key role. Research has not yet fully developed the relationship among these factors in changing fire behavior.
> The specifics of how treatments are to be carried out and the relative effectiveness of alternative prescriptions in changing wildfire behavior are not supported by a significant consensus of scientific research at this point in time.
> Substantial evidence supports the effectiveness of prescribed fire, a treatment that addresses all of the factors mentioned above. Significantly, several empirical studies demonstrated the effectiveness of prescribed fire in altering wildfire behavior.
> By contrast, we found a limited number of papers on the effects of mechanical thinning alone on wildfire behavior. The most extensive research involved mathematical simulation of the impact of mechanical thinning on wildfire behavior. However, the results of this research are highly variable.
> A more limited number of studies addressed the effectiveness of a combination of thinning and burning in moderating wildfire behavior. The impacts varied, depending on the treatment of thinning slash prior to burning. Again, crown base height appeared as important a factor as tree density. The research community is still building a scientific basis for this combination of treatments.
> The proposal that commercial logging can reduce the incidence of canopy fire was untested in the scientific literature. Commercial logging focuses on large diameter trees and does not address crown base height – the branches, seedlings and saplings which contribute so significantly to the "ladder effect" in wildfire behavior.
> Much of the research on the effectiveness of fuel treatments uses dramatically different methodology, making a comparison of results difficult. To provide a basis for analysis, we structured our review of the literature into four general groupings: observations, case studies, simulation models and empirical studies. Empirical studies provide the strongest basis for evaluating treatments whereas personal observations are the least reliable.
> We found the fewest studies in the most reliable class – empirical research. We found the greatest number of studies in the least reliable class of research – reports of personal observation. Several other reviews of the literature confirm this finding, stating that the evidence of the efficacy of fuel treatment for reducing wildfire damage is largely anecdotal.
> The results of simulation studies are highly variable, in terms of such factors as fire spread, intensity and the occurrence of spotting and crowning.
> Scientists recognize that large scale prescribed burning and mechanical thinning are still experimental and may yet reveal unanticipated effects on biodiversity, wildlife populations and ecosystem function.

***Then there is this near the end of the paper:***

> The knowledge needed to carry out prescribed fire activities with any level of sophistication is severely limited because research has historically focused on fire suppression (Paysen et al. 1998). Other scientists acknowledged there is little objective data concerning effective combinations of prescribed fire and different silvicultural techniques (Harrington and Sackett 1990; van Wagtendonk 1996). Jim McIver, a research scientist undertaking a five year study of alternative fuel treatment strategies stated: "At this point, information needed to answer this question is anecdotal or completely absent" (Sonner 2002). Omi and Martinson (2002:3), in a comprehensive

> overview of the literature concluded that only a "spattering" of studies published since the 1950s report that fire severity was reduced in areas where fuels had been previously treated: "Very little work has been done that would fit into the scope of our research, i.e., wildfire severity variates measured and compared between untreated areas on non-commercial fuel reduction areas such that an hypothesis regarding treatment efficacy may be statistically tested."

Others have arrived at the same conclusion about the beneficial effects of prescribed fire on altering fuel structure and wildfire behavior and effects (Graham, McCaffrey, and Jain 2004). However, Graham et al., (2004) state that there is generally less predictability in post treatment stand structure following prescribed fire than with mechanical thinning treatments—regardless of the targeted condition and burning prescriptions, since prescribed fire is not as precise a tool for modifying stand structure and composition.

***Graham et al (2004) try to apply the pine model to everything but don't mention chaparral/shrublands specifically.***

While there are risks associated with use of prescribed fire because of the possibility of escapes that may cause unintended resource and economic damage, in practice, these types of problems are extremely rare relative to the large number of prescribed fires successfully conducted every year.

***They need to support this statement otherwise it is just speculation/opinion.***

***Review of treatment impacts beginning on P. 5.2-3 (Keeley, 2002 specifically address these re: chaparral and should discussed here, as well as other sections)***

• Mechanical

Used alone, mechanical thinning, especially emphasizing removal of smaller trees and shrubs, can be effective in reducing the vertical fuel continuity that fosters initiation of crown fires.

***If you remove smaller trees and shrubs from chaparral you have no vegetation left.***

Depending on how it is accomplished, mechanical thinning may add to surface fuels (Graham, McCaffrey and Jain, 2004). In addition, Raymond and Peterson (2005) found that mortality in Southern Oregon's Biscuit fire was more severe in mechanically thinned treatments compared to no treatment, in mixed evergreen forests.

***See comments regarding Graham et al above, re: Raymond and Peterson, 2005, conifer forests + conifer woodlands are ~21% of the treatable area in California, <4% in the South Coast region and ≤1% in 6 other regions***

P.5.2-4
Carey and Schumann (2003) found a limited number of papers on the effects of mechanical thinning on wildfire behavior. They report on one case study and one empirical study linking the effects of mechanical thinning to reduce wildfire behavior. In the case of the empirical study (Omi and Martinson, 2002b)

***Both the Carey and Schumann, 2003 and Omi and Martinson, 2002b papers explicitly deal with***

***coniferous systems and does not apply to the many other ecosytems/fire regime included in the VTP.***

On the other hand, Stephens et al., (2009) found that “Mechanical treatments without fire resulted in combined 1-, 10-, and 100-hour surface fuel loads that were significantly greater than [no treatment at all].

***Again, this is dealing with forests-specifically sequoia/conifer and does not apply to the many other ecosytems/fire regime included in the VTP.***

According to Evans et al., (2011), Safford et al., (2009) found that during the 2007 Angora Fire in the Lake Tahoe Basin, combined thinning and pile burning treatments reduced bole char height, crown scorching, torching, and mortality. Notably, the Lake Tahoe treatments were effective in changing fire behavior from an active crown fire to a surface fire (Safford et al., 2009).

***Again, this is dealing with forests-specifically mixed conifer and does not apply to the many other ecosytems/fire regime included in the VTP.***

P. 5.2-5
A preliminary report (Bostwick, Menakis and Sexton, 2011) describing the effectiveness of fuel treatments in the area of the Wallow Fire in eastern Arizona, shows that various fuel treatments (mostly mechanical) were able to slow crown fires approaching homes in the community of Alpine, and in some cases substantially reduced fire intensity and severity. North et al., 2009 describe a multi-age silvicultural system that includes ecological restoration which can lead to more fire resilient Sierra Nevada forests.

***Bostwick, Menakis and Sexton, 2011 is a very pretty pub info pamphlet with lots of great photos about eastern AZ dry coniferous forests and not a scientific study. North et al 2009 is a management treatise on Sierran mixed-conifer forests.***

• Hand Treatments
The effects of hand treatments on wildfire behavior are expected to be similar to mechanical treatments with prescribed fire, as most hand treatments are designed to thin understory trees and shrubs, reduce ladder fuels, and utilize hand pile and burn to reduce surface fuels.

***They need to support this statement otherwise it is just speculation/opinion. There is literature about this.***

• Herbivory
The effects of herbivory on reducing wildfire behavior have not been well studied. Grazing animals can reduce grass height and thus reduce grassland fire flame lengths and fire severity, however the effects are often short term. Goats have been used often to reduce shrubs and ladder fuels up to approximately five feet in height and thus can resemble hand treatments, though goats, sheep, etc., do not affect surface dead fuel loads. Goats are often used as a follow-up treatment, though they have been used in Tehama County to initially treat over 4,000 acres of dense shrublands. Overall, the practice of herbivory is expected to be similar to hand and mechanical treatments in terms of wildfire behavior.

***They need to support this statement otherwise it is just speculation/opinion. There is literature about this.***

• Herbicides

Herbicides are normally used in conjunction with other treatments, such as by browning/killing shrubs to help carry a prescribed fire through shrublands under weather and prescribed burn prescription conditions where burning might not be possible (e.g. during the winter). Herbicide application alone is not used to moderate wildfire behavior, except for limited treatments to control invasive grasses as practiced in sage ecosystems in the Modoc, Colorado Desert, and Mojave Bioregions.

***They need to support this statement otherwise it is just speculation/opinion. There is literature about this.***

• Effects of Treatments at the Landscape Scale

Rice et al., (1981) postulated that a very intensive fuel break system in Southern California chaparral stands could reduce average annual acreage burned by 12%. Finney, McHugh and Grenfell, (2005) and Keeley (2006) note that very large fires now burn under extreme weather conditions and tend to be oriented along a particular axis determined by the direction of episodic wind events such as Santa Ana winds. Finney's 2005 work analyzing the 2002 large Arizona fires suggests that [landscape] wildfire growth and severity under extreme weather conditions can be reduced by fuel treatments such as prescribed fire in forested ecosystems. In addition, Finney's 2001 paper documents, through simulation, that treating approximately 35% of the landscape can reduce wildfire extent and severity.

***Rice et al., (1981) 'postulated' but do not present any empirical support for this being the case. Their postulation was based on a monte carlo simulation that limits fire spread by stand age which, as indicated by other authors cited in this paragraph, is not the case.***

***In Finney, McHugh and Grenfell, (2005) the extreme weather conditions refer to drought while in Keeley (2006) they refer to high winds. In the former fuel reduction treatments can be effective while in the latter they are largely irrelevant as indicated by Keeley (below) and on P.5.2-6 of the D-PEIR (further below). Keeley doesn't say '...very large fires now burn under extreme...' he indicates this is likely the historic condition in southern California. Also Keeley does not actually discuss not discuss shape of fires in this paper.***

***From Keeley, 2006:***

> Under these severe fire weather conditions, fuel age is ineffective as a barrier to fire spread, which limits the value of pre-fire fuel manipulations (Keeley and Fotheringham 2001b, 2003; Keeley et al. 2004).

***and***

> The notion that a mosaic of age classes will act as a barrier to the spread of Santa Ana wind–driven fires is not supported (Dunn 1989, Keeley 2002b, Keeley and Fotheringham 2003). Illustrative of this are the massive wildfires that burned more than 300,000 ha in the last week of October 2003 (Halsey 2004). Within the perimeters of these large fires were substantial areas that had burned by either prescription burns or wildfires within the previous 10 years (Keeley et al. 2004). Fires either burned through or skipped over or around these younger age classes.

P. 5.2-6

On the other hand, Keeley in 2006 found that in chaparral ecosystems at least, the mosaic of treated vegetation did little to stop the spread of fire. In fact, Keeley notes that the Southern California fires which burned in 2003 burned in numerous locations where previous fires had occurred, in some cases within 3 years prior to the 2003 fire. Moritz determined that in the South Coast bioregion 10% of all wildfires generate 75% of the acreage burned in any one year, mostly due to their occurrence during extreme fire weather conditions (Moritz, 1997).

***They include minimal recent citations regarding fuel management in California shrubland ecosystems but the ones they include don't support the statements to which they are linked or take the sources points out of context. These citations (and potentially others that are applicable) should be in the section where they talk about fuel treatments efficacy. This is an example of a pattern within the D-PEIR that appears to be a token acknowledgement of the minimal efficacy of fuel treatments in California shrublands but even so these facts are not accounted for in the VTP. Indeed, it seems that the authors appear to try and nullify these by citing non-applicable studies such as Finney et. al, 2005 (above)***

Analytical Procedure

The South Coast Bioregion potentially has the most watersheds that could be treated and that burn at least once in ten years – 141 out of 155 watersheds.

***and***

In order to have a landscape effect, however, according to Finney, at least 35% of a watershed would need treatment in order to reduce the size and severity of wildfires during moderate fire weather conditions. The South Coast Bioregion could benefit the most from treatments which could result in a reduction in wildfire size and severity at the landscape scale since 26 of the 141 watersheds could potentially receive treatments covering 35% or more of the watershed in any ten year time period.

***It's not clear which Finney paper they are talking about but they all deal with coniferous forests (which is a minor proportion of proposed treatment areas in many treatment areas and <4% of treatable area in the South coast) Also do-able (which is what I think the mean) does not equal benefit. It is not clear that there is a benefit, Wohlgemuth found (in a paper they don't cite) that grassy slopes had a higher rate of post-fire sedimentation. Their map (fig 5.2.1) shows that south coast watershed already have the highest burn rate, so the contention that fuel treatments are needed to reduce severity due to fuel accumulation is not supported.***

***Post fire debris flows are also addressed in another paper cited in this section and should also be considered in the discussion.***

***In Keeley, 2002***

> The potential for small burns to reduce massive erosion and debris flows is high, however, there is little compelling evidence that lower fire intensity plays a crucial role in reducing postfire soil losses. In general, the relationship between prefire fuel treatments and postfire flooding and debris flows is complex and in need of more research (Spittler 1995).

***In Spittler, 1995***

> CALIFORNIA FIRES, FLOODS AND LANDSLIDES
> Presented at the Disaster Resistant California May 17, 2005
> Although it may see counterintuitive, the relative rate of hillslope-derived debris flow failures is often lower in burned watersheds than in areas that were affected by a severe fire. For example, Morton (1989) documents that soil slips (hillslope-derived debris flows) generated by winter rainstorms in 1969 were eight times more numerous on

unburned than on recently burned slopes in the San Timoteo Badlands of southern California

P. 5.2-8

***Table 5.2.1: Throughout the previous text in this section the D-PEIR the author's have advocated for fuel modification to mitigate fire severity. In this section they have attempted to present a case for treating watersheds to minimize post-fire debris flows by having smaller fires burn at a time. However, their table shows number of fires-this is apples and oranges. The ones with the least treatment have the most number of fires so are unlikely to have substantial fuel accumulation and are very likely to already be highly impacted and type converted. Essentially, these are 'self-treating' watersheds. In addition, there is generally an inverse correlation between number of fires and fire size which would indicate the low treatment watersheds have the smallest fires which leads to the inference that little or no treatment better reaches the stated goals of the VTP. It doesn't support their contention the south coast watersheds need treated because there is a fuel accumulation problem.***

***In addition, Table 5.2.1 lacks pertinent information needed for a reasonable understanding. Information is needed regarding watershed sizes (highly variable within and between regions), vegetation, fire size, reburn frequency (if one area is burning once a year and rest isn't burning at all it is very different than fires burning in staggered locations every year) etc. This table is confusing, at best, and does not support the stated VTP goals of reducing fire severity or contentions laid out in the text.***

P. 5.2-9

Also for this analysis, prescribed burns in surface fire regimes were assumed to change wildfire behavior post treatment from moderate to low based on using the USFS Forest Vegetation Simulator (FVS) and Forest Inventory Analysis (FIA) plots from the various bioregions. For crown fire regimes and regimes not inventoried by the FIA system, predicted flame lengths from Scott and Burgan (2005) were used which show changes in fire intensity due to potential treatments including changes in severity during extreme fire weather conditions. Overall, this analysis showed that for crown fire ecosystems, treatments will most often reduce wildfire severity from severe to moderate for extreme fire weather conditions and from severe to low to moderate in more moderate fire weather conditions, depending on the vegetation type assessed.

***Scott, J., H. and R. E. Burgan. 2005 present a model in which they fail to point out that when you set wind conditions to high in the models fuel breaks don't have any effect on spread. In the D-PEIR they continually conflate size, frequency, and severity in their justifications.***

***The Scott and Burgan paper (2005) is contradicted by other papers cited in the D-PEIR, a pertinent fact the authors of the document fail to point out or discuss in this section.***

5.2.4 Direct Effects Common to all Bioregions From Implementing the Program/Alternatives

The Proposed Program acreage and treatment effects between bioregions have previously been described in Tables 5.0.1, 5.0.4 and 5.0.5. The effect of treatments on reducing wildfire severity and extent are relatively similar between bioregions.

***They have not shown that the effects of treatments on reducing wildfire severity and extent are***

***similar between regions. They have not shown that fuel treatments will have any effect on severity and extent except possibly in coniferous forests, the amount of which varies dramatically between regions.***

***The authors appear to nullify the statement with the next statement:***

However, the consequences of implementing the Proposed Program can vary between bioregions due to the number of acres treated, the potential for wildfire to occur, the types of wildfires that do occur, and the vegetation in the bioregion.

P. 5.2-10

Table 5.2.2
***This table seems disingenuous as they conclude there are nothing but benefits with their treatments. This is not supported in their text or the literature they cite. Strangely, the title of the table is "Summary of Effects[1/] on Wildfire Severity and Frequency From Implementing the Proposed Program" but their foot note seems to indicate that they or referring to some amorphous 'resources at hand' It is not clear if this table is included to illustrate some intended point in the text or just to imply some sort of data analysis. They certainly aren't clarifying or adding information that could inform the reader.***

Consequences of Implementing the Program on Reducing Watershed-Level Wildfire Frequency
Implementing 216,910 acres of treatments annually (on average) across nearly 38,000,000 acres of the State of California available for treatment under this program treats about 5% of the state's available area in any ten-year period which is approximately 2% of the entire state. However, as noted above, not all treatments are equally effective at reducing the effects of wildfire, particularly in crown fire vegetation regimes. Based on Finney and Keeley's work, treating more than 35% of a watershed can potentially reduce wildfire size and severity in surface fire regimes during severe fire weather conditions. These benefits occur at the watershed or landscape level, that is: treatment of 350 acres of a 1,000-acre watershed potentially reduces wildfire size and severity on 1,000 acres, not just the 350 acres treated because, as Finney (2001) points out treatments can affect the head fire rate of spread and deflect fast spreading wildfire into a flanking fire condition.

***The top Finney is probably the one they cite down below in the paragraph which is specific to coniferous forests in Arizona. What Keeley 'work' they are talking about is unclear. To the best of my knowledge he has never done anything quantitative in regards to how much watershed needs to have fuel treatment. His 2002 paper, which is cited in other parts of the D-PEIR, does have some discussion on watersheds but it doesn't support anything they authors of the D-PEIR have stated, rather it largely contradicts it.***

***From Keeley, 2002***
***P.398***

> A primary resource value in this region is the shrubland ecosystem, comprising chaparral and coastal sage communities, which have long been touted for their watershed value (Kinney 1900, Clar 1959) and more recently as a repository of biodiversity (Davis and others

1994, Keeley and Swift 1995, Stephenson and Calcarone 1999). These ecosystems are resilient to a wide range of fire regimes, but there are two potential threats presented by the extreme conditions of total fire exclusion or very frequent repeat fires. These have been termed “senescence risk” (loss of fire-dependent species during long fire-free periods) and “immaturity risk” (loss of species when fire return intervals are shorter than the time required to reach reproductive maturity), respectively (Zedler 1995). Due to the resilience of these communities to century long fire-free intervals (Keeley 1992), and the high incidence of fire in the coastal ranges of central and southern California, senescence risk appears to be unimportant at this point in time. However, there is abundant evidence that high fire frequency is a very real threat to native shrublands, sometimes extirpating species sensitive to short fire return intervals (Zedler and others 1983, Haidinger and Keeley 1993, Keeley 1995).

***P. 402***

Watershed Considerations

One limitation to the focus on prefire buffer zone management is that it may not adequately address the impact of postfire flooding and debris flows that derive from fires in watersheds somewhat removed from the urban/wildland interface (Wells and Brown 1982). For these reasons fire managers will need to maintain their landscape scale perspective and consider strategically important watersheds that affect the urban environment. This is increasingly difficult as some critical watersheds have themselves been fragmented by urbanization, causing unforeseen problems in hydrology (Wells 1991).

Despite the millions of dollars spent on postfire manipulations, there is a lack of widespread agreement on their effectiveness. Compelling evidence has been presented that postfire grass seeding is often neither effective nor desirable (Conard and others 1995, Robichaud and others 2000), however, there are mechanical manipulations (e.g., hay bales) that provide a level of protection from flooding with minimal negative impacts on the biotic resources (Collins and Johnston 1995).

Prefire watershed management through prescription burning is predicated on the belief that postfire flooding and erosion are affected by fire intensity and fire size (Rogers 1982). Controlled burning is done under prescriptions that generate lower intensity and burns are planned for small portions of a watershed (e.g., Riggan and others 1994). The potential for small burns to reduce massive erosion and debris flows is high, however, there is little compelling evidence that lower fire intensity plays a crucial role in reducing postfire soil losses. In general, the relationship between prefire fuel treatments and postfire flooding and debris flows is complex and in need of more research (Spittler 1995).

The South Coast Bioregion benefits the most from the Program because 26 of the 163 watersheds in the bioregion might wind up with more than 35% of the watershed treated in a ten-year period. For the Sierra only two of the 254 watersheds might potentially have sufficient treatments to reduce the potential landscape size and severity of wildfire, while the Central Coast might successfully treat nine out of 90 watersheds, and the balance of the state could see 12 watersheds out of 202 watersheds with sufficient potential treatments to result in a reduction in the landscape extent of wildfire.

***They haven't shown that fuel treatments are needed, much less benefit, South coast watersheds. They've made statements to this effect but their support of it is tenuous at best and further weakened by their lack of including pertinent information from papers they've cited in other parts of the document.***

P. 5.2-11

Based on Table 5.2.1, about 86,500 acres in the South Coast, Central Coast, and Sierra Nevada Bioregions could be expected to experience reduced wildfire size and severity, particularly during moderate fire weather conditions, because 35% or more of the watersheds where the treatments occur also burn more than once every ten years. Another 336,700 acres in the rest of the bioregions could also exhibit reduced wildfire size and severity related to treatment and natural fire frequency.

***They have not offered any support to their contention that fuel treatments in shrublands will reduce fire size, only for coniferous systems. Coniferous forests are a minor part of the vegetation in the central and south coast bioregions.***

Because of the complexity of modeling wildfire occurrence and behavior at the bioregional level, let alone at the state level, it is difficult to predict whether implementation of the Program (or Alternatives) could reduce the frequency of large-scale wildfires. However, based on the analysis above, it appears that the size and severity of wildfires (but not the frequency of wildfires), particularly those burning in moderate fire weather conditions, could be reduced at the watershed level in the South Coast, Central Coast, and Sierra Bioregions and to a lesser extent in the balance of the bioregions, across both surface and crown fire regime adapted vegetation. The analysis also suggests that wildfire size could be reduced at the watershed scale during severe fire weather conditions for surface fire regime vegetation types across the entire state, but in crown fire regimes, wildfire size at the watershed scale would not be reduced.

***The metric used in Table 5.2.1 to justify fuel modification was frequency but in this paragraph they state that fuel treatments will not affect this trait. Further down in the paragraph they state that fuel treatments will not effect fire size in crown fire systems extreme weather. As the majority of the vegetation in the south coast region is shrublands with a crown fire regime (which predominantly burn under extreme weather and are always in the high severity class), this paragraph appears to***

***nullify previous statements in support of treatments in these areas.***

P.5.2-12

Since Program treatment would likely not greatly reduce the acreage burned by wildfire in most bioregions (except in the South Coast, Central Coast and Sierra), the additive total acreage burned in the state due to wildfire and prescribed fire could increase by 67% over current levels. That is, across the state the reduction in acreage burned by wildfire due to treatments covering more than 35% of a watershed is substantially less than the additional acreage treated by prescribed fire.

***They have not supported that treatments would reduce acreage burned in crown fire vegetation types, which is the majority fire type in the state overall. In point of fact they have stated that it is unlikely to reduce the fire size or frequency. Crown fire systems are always high fire severity by definition.***

Based on the methodology described above, Table 5.2.4 shows the likely consequences of implementing the Proposed Program in terms of the expected severity/extent of wildfires burning both treated and untreated lands, as well as the severity of both wildfires and prescribed fires. Treated acreage shown is less than the Program as herbivory and herbicide treatments are not expected to greatly affect wildfire behavior.

***This last statement begs the question of why do herbivory and herbicides treatments if they are not expected to effect fire behavior?***

Table 5.2.4

Comparison of Average Wildfire Acres Burned per Year to Total Acres Burned as a Result of Program Implementation

***There is no data to support this, it is just wishful thinking***

***Other areas of the document that are problematic.***

p.4.2-9

Depending on type and area, lands in the frequent fire regime are burning up to 100 times less frequently in the modern era (Martin and Sapsis, 1992; Skinner and Chang, 1996). Most of the brush and chaparral systems are probably operating close to their natural range of variation in fire frequency, with the notable exception of isolated areas of coastal sage scrub and light brush that appears to be burning more frequently, likely due to the invasion of annual grass species that fundamentally change fuel dynamics in the post-fire environment, making them highly flammable after fire (Keeley and Fotheringham, 2001).

***No Keeley and Fotheringham, 2001 don't say isolated areas, they say most of the southern California landscape is burning too frequently leading to increased grass invasion and increased fire.***

P.4.2-10

In the specific case of chaparral, while the frequency may not have changed significantly, and ecological stability appears not to be at risk (at least in terms of fire occurrence), there still exists the potential for extreme fire behavior, and such hazards do pose significant risks to people and property.

***Not according to the paper just cited -Keeley and Fotheringham, 2001. Frequency has increased dramatically despite increased suppression and fuels management. Increased frequency is putting these systems in risk of type-conversion to highly flammable non-native annual grasses and weeds.***

P4.2-13 to 4.2-14
Condition Class
Wildfire can cause serious and long-lasting damage to ecosystems. A fire regime condition class has been developed as a way to describe the degree of departure from the natural pre-settlement fire regime. These classes are assigned based on current vegetation type, structure, an understanding of its pre-settlement fire regime, current conditions, expected fire frequency, and potential fire behavior. For fire-adapted ecosystems, much of their ecological structure and processes are driven by fire, and disruption of fire regimes leads to changes in plant composition and structure, uncharacteristic fire behavior and other disturbance agents (pests), altered hydrologic processes and increased smoke production (Figure 4.2.9, Table 4.2.4).

Roughly 37 million acres are ecologically at risk from fire with 17 million acres of these at high risk (Table 4.2.5). Condition Class 2 lands (moderate risk) have missed one or more fire return intervals, resulting in moderate increases in fuel load and fire size, intensity, and severity. These areas pose a moderate public safety and ecological risk from severe fire, and need moderate levels of restoration treatment (e.g. mechanical fuel removal, prescribed fire).
For Class 3 lands (high risk), several fire return intervals have been missed, resulting in considerable accumulation of live and dead fuels. These lands, which range from pine forests in the Klamath/North Coast Bioregion to coastal sage scrub communities within the South Coast Bioregion, pose the greatest risk to public safety and are most in danger of ecological decline.

***This is simply unsupported in shrublands throughout much of the state. They are rated according to the provided figure as condition class 2 and 3 but fires occur much more frequently currently than occurred historically.***

4.2-15

4.2.6 Assets at Risk
Wildfire
Since 1970, California has experienced a doubling in acreage burned by wildfires, while the overall number of fires has increased only slightly (Martin and Sapsis, 1992). Wildfires can damage or destroy a wide-variety of assets. Several are described below.

***The paper they cite addresses a portion of northwest California and does not apply generally to the state as is implied in the paragraph.***

**CJ Fotheringham**
11642 Blue Lupin Lane
Moreno Valley, CA. 92557
ca.fire.ecology@gmail.com
951-486-0138

*Curriculum Vitae*

**Education**
Bachelor of Arts, Biology
Occidental College
12 May 1996

Master of Science, Biology
California State University, Los Angeles
12 June 1999

Doctor of Philosophy, Biology
University of California, Los Angeles
10 January 2010

**Positions**

**2008-current Research Ecologist**-GS-11, USGS-BRD Sequoia-Kings Canyon. Develop classification and assessment criteria for studies of role of urban fuels in large fire losses in southern California. Duties include study design, data collection, statistical analysis and testing, written report and preparation of papers for publication, communicating results through oral and A/V presentation to a wide variety of stake holders including fellow researchers local and state governing bodies, planning entities, fire and land management personnel, primary and secondary education, fire-watch and neighborhood councils. Supervisor: Jon Keeley (559) 565-3170 may be contacted.

**2004-2007 Independent consultant**. Focused, census and established protocol botanical surveys, ecological assessments, habitat monitoring, jurisdictional delineation, fuel and fire management planning. Written reports for technical and non-technical audience.Companies: Tom Dodson & Associates, 2150 North Arrowhead Avenue, San Bernardino, CA 92405 Supervisor: Shay Lawery (909) 882-3612 Shay@TDAenv.com, may be contacted.

**2002-2004 Research Associate II.** Post-fire recovery in Arizona and New Mexico Shrublands. National Science Foundation #0240353. P.I. Dr. Jon E. Keeley, University of California, Los Angeles. Duties included design, establish, survey and analyze data at 40 post-fire chaparral/grassland study sited in Arizona and New Mexico. Supervisor: Jon Keeley (559) 565-3170 may be contacted.

**1999-2003 Graduate student and Teaching assistant.** Various menial preparations for classes/labs assist and supervise of students. Supervisor: Philip Rundel (310) 825-4072 rundel@biology.ucla.edu, may be contacted.

**1999 Field Researcher-GS11**, USGS-BRD Sequoia-Kings Canyon.

Supervisor: Jon Keeley (559) 565-3170 may be contacted.

**1998** **Research Associate II.** The Effects of El Nino Rains on Desert Annual Plants. National Science Foundation #9810674. P.I. Dr. Philip Rundel University of California, Los Angeles.

**1997-1999 Adjunct Teaching Staff**, at California State University, Los Angeles. Instruction of lab sections for introductory biology classes Principles of Biology II Ecology, and Natural History of Plants.

**1996-1997 Research Assistant**. Ecology and distribution of two rare native California Plants, *Astragalus brauntonii* and *Pentachaeta lyonii*. California Fish and Game contract #FG5636R5. P.I. Dr. Jon Keeley, Occidental College

**1995-1996 Research Assistant.** Post-Fire Recovery of Coastal Sage and Chaparral following the wild-fires of 1993. Metropolitan Department of Water and Power, Environmental Research Division P.I. Dr. Jon Keeley, Occidental College.

**1993-1996 Work study research assistant and teaching assistant**. Research duties included development of biochemical assays, microscopy and staining techniques, experimental design, and evaluation of results. Teaching assistant duties include occasional lecturing, instruction in laboratory technique, including care and proper handling of materials and equipment, and explanation of theory.

**Professional Memberships**

Ecological Society of America since 1994.
ISOMED (The International Society of Mediterranean Ecologists) since 1994
Southern California Botanists since 1993
California Native Plant Society since 1993

**Publications**

2012 Fotheringham, C.J., J.E. Keeley, The role of urban fuels in structure losses during large fire events in southern California. International Journal of Wildland Fire. *In preparation.*

2012 Fotheringham, C.J., J.E. Keeley, P.W. Rundel. Diversity patterns of post-fire chaparral under a bimodal rainfall regime. Journal of Biodiversity, *In preparation.*

2012 Fotheringham, C.J., J.E. Keeley, P.W. Rundel. Post-fire recovery of chaparral under a bimodal rainfall regime. Journal of Arid Environments, *submitted.*

2012 Keeley, J.E., C.J. Fotheringham, and P.W. Rundel. Postfire chaparral regeneration under mediterranean and non-Mediterranean climates. Madroño. *In press*

2010 Keeley, J.E., H. Safford, C.J. Fotheringham, J. Franklin, and M. Moritz. The 2007 southern California wildfires: Lessons in complexity. Journal of Forestry 107:287-296.

Keeley, J.E., C.J. Fotheringham, and M. Baer-Keeley. 2006. Demographic patterns of postfire regeneration in mediterranean-climate shrublands of California. Ecological Monographs 76:235 255.

Keeley, J.E., C.D. Allen, J. Betancourt, G.W. Chong, C.J. Fotheringham, and H.D. Safford. 2006. A 21st century perspective on postfire seeding. Journal of Forestry 104(1):1-2.

Fotheringham, C. J.and Keeley, J.E. 2005. NO news is no new news- a response to Preston *et al.*. Seed Science Research 15:367-371.

Keeley, J.E., M. Baer-Keeley, and C.J. Fotheringham. 2005. Alien plant dynamics following fire in mediterranean-climate California shrublands. Ecological Applications 15:2109-2125

Keeley, J.E. and C.J. Fotheringham. 2006. Wildfire management on a human dominated landscape: California chaparral wildfires, pp. 69-75. In G. Wuerthner, Editor, Wildfire ---A Century of Failed Forest Policy. Island Press, Covelo, CA.

Keeley, J.E., C.J. Fotheringham, and M. Baer-Keeley. 2005. Determinants of postfire recovery and succession in mediterranean-climate shrublands of California. Ecological Applications 15:1515-1534

Keeley, J.E., C.J. Fotheringham, and M.Baer-Keeley. 2005. Factors affecting plant diversity during postfire recovery and succession of mediterranean-climate shrublands in California, USA. Diversity and Distributions. 11:525-537

Keeley, J.E. and C.J. Fotheringham. 2005. Plot shape effects on plant species diversity measurements. Journal of Vegetation Science 16:249-256.

Keeley, J.E. et C.J. Fotheringham. 2004. La prévention des risques et la lutte contre les incendies dans un paysage fortement marqué par la presence humaine: les incendies de chaparral californien. In Les Feux de Forests dans les Regions a Climat Mediterraneen, Domaine du Rayol, Le Royol-Canadel, République Française.

Keeley, J.E., C.J. Fotheringham, and M. A. Moritz. 2004. Lessons from the 2003 Wildfires in Southern California. Journal of Forestry 102(7):26-31.

Keeley, J.E. and C.J. Fotheringham. 2004. Lessons learned from the wildfires, pp. 112-122. In R.W. Halsey, Fire, chaparral and survival in southern California. Sunbelt Publications, El Cajon, California.

Keeley JE, Fotheringham CJ. 2003. Species-area relationships in Mediterranean-climate plant communities. Journal of Biogeography 30:1629-1657

Keeley, J.E., D. Lubin, and C.J. Fotheringham.2003. Fire and grazing impacts on plant diversity and invasives in the southern Sierra Nevada. Ecological Applications 13:1355-1374

Keeley, J.E. and C.J. Fotheringham. 2003. Historical fire regime in southern California. Fire Management Today 631:8-9 Keeley, J.E. and C.J. Fotheringham. 2002. Impact of past, present, and future fire regimes on North American Mediterranean shrublands, pp. 214-258. In T.T. Veblen, W.L.

Baker, G. Montenegro, and T.W. Swetnam (eds), Fire Regimes and Climatic Change in Temperate and Boreal Ecosystems of the Western Americans. Springer-Verlag, New York.

Keeley, J.E. and C.J. Fotheringham. 2001. History and Management of Crown-Fire Ecosystems: a Summary and Response. Conservation Biology 15 (6), 1561-1567

Keeley, J.E. and C.J. Fotheringham. 2001. The historical role of fire in California shrublands. Conservation Biology 15 (6), 1536-1548

Keeley, J.E. and C.J. Fotheringham. 2000. Role of fire in regeneration from seed, pp. 311-330. In M. Fenner (ed) Seeds: The Ecology of Regeneration in Plant Communities. 2nd Edition. CAB International, Oxon, UK.

Keeley, J.E., M.B. Keeley, and C.J. Fotheringham (eds). 2000. 2nd Interface Between Ecology and Land Development in California. U.S. Geological Survey, Open-File Report 00-62. 299 p.

Ne'eman, G., C.J. Fotheringham, and J.E. Keeley.1999. Patch to landscape patterns and the effect of burned canopies on post-fire recruitment in a serotinus conifer. Plant Ecology.135:235242

Keeley, J.E., C.J. Fotheringham, M. Morais. 1999 Re-examining fire suppression impacts on brushland fire regimes. Science. 284:1829-1832.

Fotheringham, C. J. and J. E. Keeley. 1998. Ecology and Distribution of Braunton's milkvetch (*Astragalus brauntonii*) and Lyon's Pentachaeta (*Pentachaeta lyonii*). Final Report for California Department of Fish and Game contract #FG5636R5.

Keeley, J.E., G. Ne'eman, and C.J. Fotheringham. 1999. Immaturity risk in a fire-dependent pine. Journal of Mediterranean Ecology. 1:41-47.

Keeley, J.E. and C.J. Fotheringham. 1998. Mechanisms of smoke-induced germination in a post-fire chaparral annual. Journal of Ecology, 86:27-36.

Keeley, J.E. and C.J. Fotheringham. 1998 Smoke-induced seed germination in Californian chaparral. Ecology. 79:2320-2336

Keeley, J.E. and C.J. Fotheringham. 1997 Trace Gas Emissions and Smoke-Induced Seed Germination. Science. 276:1248-51.

**Solicited Talks**

2010 Southern California Fire Scenario. Station Fire Recovery and Rehabilitation symposium, Los Angeles & San Gabriel Rivers Watershed Council.

2003 Challenges of Managing Fires along the Urban Wildland Interface-Lessons from the Santa Monica Mountains, Los Angeles, California. 3rd International Wildland Fire Conference, Sydney Australia

2002 Evolutionary aspects of seed germination strategies. CEA-CREST symposia, California State University, Los Angeles

2000 International Society of Mediterranean Ecologists, MEDECOS VIII. Germination in Desert Annual Plants

1997 Southern California Botanists. Smoke Induced Germination.

**Contributed Talks**

2012 3rd Human Dimensions of Wildland Fire Conference. Urban Fuels and Structure Loss

2011 MEDECOS XII International Conference. Urban Fuels and Structure Loss.

2003 Sweeney-Granite Mountains 25th anniversary symposium. Studies in community ecology at the Granite Mountain Reserve

1999 California Association for Fire Ecology. Reconstructing the natural fire regime in California shrublands.

1999 California Association for Fire Ecology. Debunking the myth of fire suppression impacts on brushland fire regimes.

1998. California Botanical Society 18th Graduate Student Meeting. Anatomical characteristics of smoke-stimulated Chaparral Seeds.

1997 MEDECOS VIII International Conference. Species Richness, Scale and Postfire Succession in California Chaparral.

1997 MEDECOS VIII International Conference. Role of Trace Gas Emissions and Seed Anatomy of Smoke-Induced Germination of Chaparral Fire-Endemics.

1997 Ecological Society of America. Role of Trace Gas Emissions in Smoke-Induced Germination of a Postfire Annual.

1997 Ecological Society of America. Anatomy and uptake characteristics of Smoke-Induced Seeds.

1997 California Association for Fire Ecology. Post-fire germination patterns in chaparral seed backs.

1997 California Association for Fire Ecology. Post-fire successional changes in species diversity patterns of chaparral.

1996 California Botanical Society 16th Graduate Student Meeting. Smoke stimulated Germination in Chaparral Seeds.

1994 Southern California Conference on Undergraduate Research. Post-Burn Area Regeneration.

1993 Southern California Conference on Undergraduate Research. Localization of Intracellular Carbonic Anhydrase in *Amblystegium riparium* and the relationship to the C13 value.

**Fellowships**

| | |
|---|---|
| 2003-2004 | University of California Dissertation Year Fellowship. $21,318 |
| 2002-2003 | University of California Regents Fellowship $6000 |
| 2002-2003 | Vavra Biology Fellowship $7732 |
| 1999-2002 | Science to Achieve Results (S.T.A.R.) Graduate Research Fellowship. $102,000. |
| 1999-2002 | National Science Foundation Graduate Research Fellowship. $76,500. Declined. |
| 1994 | Ford Fellowship for Undergraduate Research. Smoke stimulated Germination in California fire-endemics. $3000.00 |
| 1993 | Monsanto Corporation Fellowship for Undergraduate Research. Localization of carbonic anhydrase in Amblystegium riparium, an aquatic moss. $3000.00 |

**Grants**

| | |
|---|---|
| 1998 | Creating a computer database by correlating remote sensing imagery with data from an ongoing, ground-monitored study. Southwest Parks and Monuments.$4993.75 |
| 1994 | Post-fire environmental stimulation of germination in California chaparral. California Native Plant Society. $500.00 |
| 1994 | Effects of herbivory on post-fire recovery in chaparral and coastal sage scrub. Hardman Foundation, Inc. $750.00 |

**Professional Consultation Reports:**

2007 General biological assessment and jurisdictional delineation for Chicken Springs wash storm drain and street improvements between 2nd street and 4th street USGS – Yucaipa, Section 1, T2S, R2W, S.B.M.

2007 Mountain View Avenue Extension Botanical Report USGS –Redlands Quad, Unsectioned portion, T1S R3W

2007 Western Riverside County Multiple Species Habitat Conservation Plan Consistency Analysis for Industrial Condominiums/Facilities 7th Street and Johnson Avenue (S. G Street) Perris, CA (APN#S 310160050, 310160051, 310160052)

2007 Botanical Survey of Eagle Ridge Development Phases 4-7, Blue Jay, CA USGS – Harrison Mountain, T2N, R3W, Sections 20, S.B.M. Tract No. 15612 APN 0334-071-02, 0335011-35, 0335-011-35

2007 Western Riverside County Multiple Species Habitat Conservation Plan Constraint Analysis for Woodhouse Road off San Timoteo Canyon,USGS –El Casco T2S, R2W S27 APN #413180030)

2007 Soil Summary and Botanical survey of Wilson Road extension between Milliken Avenue to east of the Day Creek channel, Rancho Cucamonga, CA

2007 Soil Summary and Botanical survey of Wilson Road extension between Milliken Avenue to east of the Day Creek channel,Rancho Cucamonga, CA

2007 General Biological Assessment (USGS – Forest Falls, Section 32, T2S R1W) APN 0325021-01, -09, and -17

2007 Soil Summary and Botanical survey of of the Cajon Creek adjacent to Glen Helen Devore, CA

2006 Fire management plan, vegetation and fuel mapping for El Toro Marine base reserve. Nature Reserve of Orange County.

2006 Revision of Fire management plan and Fire mapping for Orange County NCCP/HCP. Nature Reserve of Orange County.

2006 2006 annual mitigation monitoring report for incidental take permit No. 2081-2002-018 06. Tom Dodson & Associates (San Bernardino, CA). 33 Pages

2006 Botanical, Narrow Endemic, and Criteria Area Plant Species Survey of the Indian Mesa Property. Tom Dodson & Associates (San Bernardino, CA). 31 Pages.

2006 Jackson Ranch, Yucaipa General Botanical, Heritage Tree and Oak Survey. Tom Dodson & Associates (San Bernardino, CA). 30 Pages.

2006 Botanical, Narrow Endemic, and Criteria Area Plant Species Survey of the Stoneridge Property. Tom Dodson & Associates (San Bernardino, CA).. 31 Pages

2006 General Biological Habitat and Assessment for Burrowing Owl (Speotyto cunicularia), and Jurisdictional Delineation for 25580 Jefferson avenue, Murrieta, CA. 92562. Tom Dodson & Associates (San Bernardino, CA). 22 Pages.

2006 BBARWA Drying Pond Botanical Survey. Tom Dodson & Associates (San Bernardino, CA). 13 Pages

2006 Greenspot S-curve Botanical Survey. Tom Dodson & Associates (San Bernardino, CA). 17 Pages.

2006 Botanical survey of parcel at end of Flicker road in Fawnskin, CA. Tom Dodson & Associates (San Bernardino, CA). 14 Pages

2006 Botanical Assessment of VVWRA Phases 1&2 Interceptor Upgrade Project. Tom Dodson & Associates (San Bernardino, CA). 41 Pages.

2006 Greenspot Bridge Botanical Survey. Tom Dodson & Associates (San Bernardino, CA). 17 Pages.

2006 Preliminary Observations of City of Laguna Beach Goat-mediated Fuel Modification Program and the Impacts to Aliso and Wood Canyons Wilderness Park and the NCCP Reserve. 24 Pages.

2005 A review of strategy pertaining to chaparral and fire in United States Forest Service Region 5 Land Management Plan. 12 December 2005 14 Pages.

2005 Grass Valley Creek Botanical Survey. 26 September 2005. 11 Pages.

2005 Survey For Rare Plant Species on Offered Parcel Involved in the Proposed Doble Land Exchange. Do It Right, Environmental (Lake Arrowhead, CA). 25 Pages.

2005 Survey For Rare Plant Species on Parcel Involved in the Proposed Doble Land Exchange. Do It Right, Environmental (Lake Arrowhead, CA). 29 Pages.

2005 Botanical Census and Protocol Survey of Cajon Pass from Keenbrook to Summit. Tom Dodson & Associates (San Bernardino, CA). 224 pages.

2005 Post-fire vegetation regrowth and sedimentation at Elliot Reserve. Do It Right, Environmental (Lake Arrowhead, CA).133 pages

2004 Survey for listed plant species on Parcels involved in the proposed Doble land exchange. Do It Right, Environmental (Lake Arrowhead, CA). 9 Pages.

# EXHIBIT 3

# Conservation Biology Institute

CONSERVATION BIOLOGY INSTITUTE

*A 501(c)3 tax-exempt organization*

815 Madison Avenue
San Diego, California 92116

Phone: (619)296-0164
Email: *wdspencer@consbio.org*

*www.consbio.org*

February 25, 2013

**Subject:** Comments on Draft Vegetation Treatment Program Environmental Impact Report (PEIR)

Dear Board of Forestry and Fire Protection:

The Conservation Biology Institute is a nonprofit research and planning institution that performs applied research and provides scientific guidance and review for conservation and land management plans. I am an ecologist and wildlife conservation biologist with over 30 years of ecological research experience in California and the west, including studies concerning the effects of fires and vegetation treatments on vegetation and wildlife, and on the habitat and population needs of numerous rare and endangered species. I also have extensive experience with CEQA and NEPA. I have attached my CV for reference.

**Overview**

The PEIR is fundamentally flawed in that it fails to support its conclusions in any meaningful way, and many of its conclusions are scientifically indefensible or simply wrong. *All of the findings in the PEIR (e.g., findings of significance/non-significance) are based on one foundational assumption that is demonstrably false or unsupported for most of the lands proposed for treatments*—specifically the assumption that vegetation treatments in wildland areas will reduce the size and severity of fires and thereby reduce risks to both human and natural communities. This assumption has been thoroughly debunked by the last 20 years or more of research on wildland fires and vegetation management in California (with the narrow exception that *strategic* treatments in *some* mixed coniferous or pine-dominated forests that evolved with frequent surface fires may be beneficial for restoring more natural fire regimes and reducing risks very large and severe fires). *In most California vegetation communities—especially chaparral, sage scrub, and grassland types and many non-pine forest types—the sorts of treatments proposed by the PEIR will not reduce fires risks, and are likely to do more harm than good relative to meeting the PEIR's stated goals.*

**Problems with the PEIR**

Most findings in the document depend on fundamental assertions that have been proven false by science—that the vegetation treatments outlined in the PEIR will effectively reduce the size and severity of wildfires in any and all regions and vegetation communities in California, and that treatments in wildland areas will reduce risks to homes or other human resources in developed areas. The PEIR ignores current scientific understanding of fire ecology in California's diverse natural communities, and uses a one-size-fits-all approach to fire management that is likely to do more harm than good when it comes to reducing fire risks to both human and natural communities. This flawed approach, which ignores the tremendous diversity of fire regimes and conditions across California—as well as a large literature presenting more effective and cost-effective solutions to reducing fire risks—is based on numerous poorly justified and outdated assumptions, an extremely vague description of the "Project" under CEQA, and simplistic, unjustified, unscientific analyses. The PEIR fails to meet CEQA requirements on a number of fundamental grounds:

<u>Insufficient Program/Project Descriptio</u>n. The description of the Project (or Program of projects) is so vague that the likely environmental impacts cannot be meaningfully analyzed. There is not even a map of the lands proposed for treatments. As a scientist, I cannot independently assess the likely impacts of the program based on the information provided, which is nothing more than unmapped guestimates of acreages that might be treated by different means in different regions, along with unsupported assumptions about how these actions might affect vegetation, wildlife, air, and other resources. The impact determinations that result from this approach are just simplistic speculations. In many cases, the PEIR's *opinions* about effects on resources are demonstrably wrong.

According to the PEIR, "a program-level EIR is prepared for an agency program or series of actions …considered under CEQA as one collectively large project with similar environmental effects." However, it is clear from any objective analysis that the proposed actions will certainly *not* have "similar environmental effects" throughout California's diverse ecoregions, which differ tremendously in fire terrain, fire weather, vegetation conditions, flora, fauna, species of concern, land management conditions, and numerous other factors. This diversity is in no way accounted for in the PEIR's simplistic assessment of environmental effects. Most notably, in relying on a few studies in dry coniferous forest types to represent all of California's bioregions, the PEIR completely ignores that most of the vegetation types proposed for treatments are natural crown-fire regimes (e.g., chaparral) in which fuels treatments are ineffective.

<u>Grossly Oversimplified Purpose and Need</u>. The description of the Purpose and Need for the Program—and indeed the entire approach used throughout the PEIR—is based on a biased, grossly oversimplified, unscientific, and provably incorrect theory that "fire exclusion" has universally increased fire risks across California and that we therefore need to "modify vegetation on wildlands to reduce the costs and losses associated with

wildfires and to enhance the condition of forests, rangelands, and watersheds." This simplistic, one-size-fits-all scenario has been disproved repeatedly by peer-reviewed fire science for many of the bioregions, vegetation communities, and resources at risk (e.g., Cary et al. 2009, Conard and Weise 1998, Keeley et al. 1999, 2009, Keeley and Zedler 2009, Owen-Price et al. 2012, Sugihara et al. 2006, Syphard et al. 2006, 2007, and other references too numerous to list). For example, the notions that (1) fire suppression has excluded fire from chaparral and sage scrub communities, leading to (2) an "unnatural" accumulation of fuels, and (3) that therefore treating these communities (with prescribed fire or other thinning/clearing treatments) will reduce fire risks, have all been thoroughly debunked by empirical science (Halsey 2008, Keeley et al. 1999, 2004, 2009, Conard and Weise 1998, Syphard et al. 2009, 2010, 2012, and many others). Most importantly, best available science is essentially unanimous that vegetation treatments *on wildlands* (i.e., more than about 100 feet from structures or other resources needing protection) will "reduce costs or losses associated with wildfires" or "enhance the condition" of ecological communities. This paradigm—which has scientific support in *some* coniferous forests that evolved with frequent, low-intensity, ground fires—simply does not apply in most bioregions and vegetation communities in California, where infrequent, severe, stand-replacing crown fires are the norm.

<u>No Evidence the Proposed Treatments Will Be Effective</u>. The PEIR provides no evidence, references, or research studies demonstrating the effectiveness of the proposed treatments in protecting homes or other structures. In fact, what little research is available to evaluate treatment effectiveness mostly concludes that the types of treatments proposed are *not effective* at protecting homes or other structures, unless strategically located immediately adjacent to the structures as defensible space for firefighters to use to advantage during a fire (e.g., Syphard et al. 2011a, 2011b, 2012). Treatments far from structures (e.g., more than about 100-120 feet away) do little good (e.g., Cohen 1999, 2000, Cohen and Stratton 2008).

<u>Inadequate Alternatives.</u> All alternatives presented in the PEIR are variations on the misguided assumption that clearing vegetation on wildlands will reduce fire risks to human or natural resources. The alternatives differ only in the different mixes of methods proposed to clear the vegetation (mechanical, herbicide, grazing, etc.). However, overwhelming scientific evidence shows that in almost all cases, vegetation treatments not directly in and immediately adjacent to the structures needing protection are not effective (Cohen 1999, 2000, Cohen and Stratton 2008).

An EIR must analyze a range of reasonable alternatives that could *feasibly attain the objectives of the project*. However, *none of the alternatives presented in the PEIR would achieve the stated objectives*. Reasonable alternatives that *would* meet the stated objectives would need to take a c*omprehensive approach to fire management that includes community and regional planning, reducing ignitability of structures, and using strategic fuel modifications within and directly around (e.g., within 100 feet of) the communities at risk.*

Substantial Factual Inaccuracies. The PEIR is so loaded with factual inaccuracies, outdated assumptions, distortions of science, and over simplifications that I cannot list them all here. Just a couple examples:

- The PEIR (Section 4.2) states that over-burned areas are rare in the South Coast Ecoregion and all are in coastal sage scrub. This is not true. Many chaparral areas have burned too frequently, relative to the natural range of variation, and are type-converting to weedy annual communities—and this trend is accelerating (Halsey 2011, Syphard et al. 2006, Keeley et al. 1999, 2011, Moritz et al. 2004). At the very least, the PEIR should consult Fire Return Interval Departure (FRID) maps (e.g., Safford and Schmidt 2008) rather than relying on nonscientific and incorrect opinions.
- Section 4.2.3 (and numerous other places in the PEIR) states that there are "excessive accumulations of flammable natural vegetation" in the WUI, without differentiating by bioregion or vegetation type. This statement is only true in limited portions of *some* forest communities, but is definitely not true in other areas, especially southern California shrublands. Much more problematic than natural vegetation is the accumulation of urban fuels (landscaping plants, wooden structures, etc.; Cohen 2000).

Attempts to Justify Statements with Inappropriate References and Failure to Cite More Appropriate and Contradictory References. CEQA guidelines require that an EIR should summarize points of disagreement among experts in a good faith effort at full disclosure. The PEIR fails to do this, instead citing mostly outdated, inappropriate, inaccurate sources with a clear bias towards justifying its predetermined approach to fire management and without citing numerous more recent, more scientifically valid, peer-reviewed studies that flatly contradict many PEIR assumptions and findings. This leads to numerous false statements and conclusions, including the foundational assumption that clearing wildland vegetation will reduce fire risks. Following are just a few *examples* of inappropriate uses of citations to support unsupportable conclusions:

- Section 4.2 has one of the most egregious examples of inappropriate citations to support biased assumptions. It cites a non-peer-reviewed report prepared by a San Diego County Wildland Task Force (2003) to support a proposal to conduct chaparral clearance projects in southern California. That Task Force report was actually withdrawn from the San Diego County website after an independent scientific review found that the report contained false and fabricated citations, misquoted research scientists, and presented a strongly biased and inaccurate assessment of fire science (San Diego Fire Recovery Network 2004). Scientists whose published research was cited in the Task Force report wrote the San Diego Board of Supervisors voicing their dismay with how their work had been distorted to support a biased and scientifically invalid approach to fire management (scientific review letters from C.J. Fotheringham, J. Keeley, F. Schoenberg, and R. Peng, 2004). *In some cases, the report said exactly the opposite of what the cited research found*. The independent science review of the Task Force report concluded that it was "woefully inadequate and biased in its treatment of the available scientific information, and flawed in many of its assumptions, its treatment of published data, and its recommendations concerning vegetation management as part of a comprehensive fire-risk reduction strategy" (San Diego Fire Recovery Network 2004). Citing this unpublished and repudiated Task Force report in the PEIR undermines the PEIR's credibility.

- Section 4.2 cites Bonnicksen (2003) to support a statement about adverse effects of severe wildfires on streams and forests. Bonnicksen (2003) is not a peer-reviewed or scientific reference, but rather testimony to a committee of Congress by a highly controversial timber industry lobbyist with a record of misrepresenting science as well as his credentials to speak about science (Rundel et al. 2006). Four highly respected scientists (P. Rundel, M. Allen, N. Christinsen, and J. Keeley) wrote an open letter to the media to counter an op-ed offensive by Tom Bonnicksen, who was distorting science, along with his qualifications, to push a political agenda (Rundel et al. 2006). In their words:

  > Dr. Bonnicksen's unusual theories of forest structure and stability… were never widely accepted… there is no serious scientific support for Dr. Bonnicksen's ideas of forest management…. Dr. Bonnicksen's views and misrepresentations of factual material, as well as his academic credentials, should be labeled for the political views they are and not presented as serious science. The opinions he presents are contradicted by all prevailing scientific data (Rundel et al. 2006).

- Section 4.2 cites Kaufmann and Catamount [nd] and Parsons and DeBenedetti, (1979) to support a statement that natural forest conditions in California were once open and park-like, with continuous ground cover. The first reference is a non-scientific article dealing with dry ponderosa pine forests in the southwestern US, as opposed to the more mesic, dense, mixed-coniferous forests most common in California. The second citation did *not* conclude that forests in California were open and park-like with continuous ground cover, but rather that mixed-conifer forests of Sequoia and Kings Canyon National Parks would have had "a mosaic of open and closed canopy conditions, as well as heavy to minimal ground fuels."

- Section 4.2.3 cites Finney (2005) as documenting that "treatments… can systematically realize extended attack benefits outside their actual boundaries…" The cited document, which applied to Ponderosa pine forest in Arizona, says no such thing, and in fact documented that the fire studied by Finney (2005) burned through and well beyond all fuel treatments. There are more relevant studies, conducted in California, that have showed little or no tactical benefits of fuels treatments or fuel breaks in wildland areas, especially in shrublands or under the extreme fire weather conditions that result in the greatest acreages and structural losses (e.g., Halsey 2008, Keeley et al. 2004, 2009, Syphard et al. 2012).

- The PEIR repeatedly cites UC Davis (1996) as supporting that fires are becoming larger and more severe throughout California. That document is specific to the

Sierra Nevada Ecoregion, and is way out of date concerning *current* trends. Trends in fire regimes vary greatly by region, and there are numerous more recent scientific publications evaluating these using best available science, which has advanced tremendously since 1996.

- In apparent attempt to justify treatments (e.g., canopy thinning) in marten (*Martes americana* [now *M. caurina]*) habitats, the PEIR states: "Reduction in canopy cover (short of complete removal) seems to have relatively little effect on mesocarnivores (K. Slauson, pers. comm.)." To the contrary, martens are sensitive to reductions in canopy cover and avoid openings. This biased assessment of the effects of thinning on martens is troubling, given the personal communication attribution to Keith Slauson, who strongly disagrees with the statement. In his words (K. Slauson, personal communication via email on January 28, 2013): "As you may have guessed this quote is taken completely out of context and I do not support it as the blanket statement it appears to be. I am not sure where this quote was taken, but it clearly was used in place of the numerous citations stating the opposite."

I could list many more inappropriate, outdated, or biased citations used by the PEIR to support non-scientific statements, but this should suffice.

<u>Insufficient and Faulty Assessment of Cumulative Impacts.</u> The PEIR fails to adequately assess cumulative impacts of the proposed treatments or the combination of treatments and wildfires on resources. Simply reporting average size of individual treatments or annual treatment acreage is not sufficient. The cumulative impact analysis must estimate acreages effected cumulatively over time, including how repeated treatments, in concert with wildfires and other disturbances, are likely to impact various resources, such as by type-converting natural habitats into weedy fields that do not support native plant and wildlife species.

<u>Lack of Analytical Rigor and Findings of Significance</u>. The PEIR appears to rely on a yet-to-be-produced "environmental checklist" for ensuring that environmental impacts will be avoided, minimized or mitigated and ensure that they are not significant. How can one evaluate whether impacts will actually be avoided, minimized, and mitigated when the checklist is not available? What little "analysis" is included in the PEIR lacks any transparency or analytical rigor. The findings use some vague estimates of acreages that may be impacted in different bioregions, some extremely broad descriptions of potential issues, and then some arm waving about how the impacts are likely to be less than significant. This "trust us" approach is a fatal flaw underlying all findings concerning environmental impacts in the PEIR.

<u>Extremely Cursory, Out-of-Date, and Inaccurate Assessment of Wildlife Status and Impacts.</u> Section 4.5.2 of the PEIR provides a biased, shallow, and outdated treatment of the status of wildlife resources in California, and Section 5.2.2 likewise provides a biased, shallow, and inaccurate assessment of likely impacts of the proposed treatment program on wildlife resources. Following are just a *few example*s from the sections

concerning "mesocarnivores" (martens and fishers), because I am considered an expert on these species*:*

- The PEIR cites Lyon et al. (1994) for current status of martens and fishers and makes the point that we know little about these species, despite the fact that there numerous more recent and applicable references that provide an especially rich understanding of the current status of habitat, populations, trends, and effects of fires and fuels treatments on these species, especially the fisher (e.g., Zielinski et al. 2013, Spencer et al. 2011, Scheller et al. 2011, and numerous others).
- The PEIR states: "In 2010 DFG announced that the Fisher (sic) was not a candidate for designation as threatened/endangered species." However, the PEIR fails to mention that fishers on the west coast, from California to British Columbia, are currently Candidates for federal listing under the ESA, with a final decision by the U.S. Fish and Wildlife Service needing to be made (under a court order) by 2014. Given that the isolated population of fishers in the Sierra Nevada is estimated at fewer than 300 adults and is experiencing elevated mortality rates due to human influences (Spencer et al. 2011) listing potential is high.
- It states: "The population status of the Humboldt marten (*Martes americana humboldtensis*) in northwestern California is uncertain (Lyon et al. 1994)." Actually, intensive and extensive surveys have been performed for the Humboldt marten in the nearly 20 years since this 1994 citation. Slauson et al. (2009) estimated the population based on occupancy surveys and concluded that the Humboldt marten population likely contains less than 100 individuals and is most likely declining. Listing potential is very high.
- The PEIR states: "Optimal habitats for marten are various … including…Jeffrey pine, and eastside pine." This is an inaccurate description of marten habitat. These forest types are generally too open and xeric to support breeding populations of marten.
- It states "Martens utilize small clearings…for foraging." This is misleading unless "small" is better defined. Martens avoid nearly all openings, rarely venturing more than a few meters away from overhead tree cover. This statement could be used to justify that fuel breaks or "small" clear cuts benefit marten, which is not true. Even ski runs in marten habitat are avoided (K Slauson pers. comm.).

Likewise, the evaluation of likely effects of the PEIR treatments on the Threatened California gnatcatcher is misleading:

- The PEIR states that the gnatcatcher avoids "dense, overgrown shrublands and so may benefit from treatments that create a better-proportioned mosaic of shrub mixed with open areas." It never defines the subjective phrases "dense, overgrown" or "better-proportioned" in speculating about how treatments might benefit gnatcatcher habitat, and it fails to acknowledge that the gnatcatcher's native habitat is *already severely disturbed* by overly frequent fires, fire breaks, human trampling, and other factors that have opened sage scrub up more than is normal or natural. Sage scrub in the South Coast Ecoregion is already type-converting to weedy conditions that cannot support gnatcatchers, and additional treatments would likely worsen this impact. Moreover, Atwood et al. (2002) demonstrated that most gnatcatcher pairs live in sage scrub stands greater than 20 years old, and that population persistence through bad winters is highest in the oldest stands.

**Conclusions**

This PEIR is fundamentally flawed, should not be certified, and needs to be completely redone using a much more scientifically valid approach to wildfire management. My comments represent only a partial sampling of the problems inherent in the proposed approach to reducing fire risks. I recommend that the program be rethought with input from experts in fire research, wildlife, and other appropriate topic areas.

Sincerely,

Dr. Wayne D. Spencer
Director of Conservation Assessment and Planning

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Dr. Spencer is a wildlife conservation biologist with over 30 years of professional experience in biological research and conservation planning. He specializes in the practical application of ecological and conservation science to resources management, design of nature reserves, and recovery of endangered species. He has conducted numerous field studies on rare and sensitive mammals, with particular focus on forest carnivores (e.g., martens and fishers) and endangered rodents (e.g., Pacific pocket mouse and Stephens' kangaroo rat). He is currently serving as Principle Investigator for California's Mammal Species of Special Concern project. Dr. Spencer also collaborates with other researchers and planners to develop and apply methods for identifying and conserving wildlife movement corridors and maintaining ecological connectivity in the face of climate change and habitat loss and fragmentation. He has provided scientific guidance for several large-scale habitat connectivity plans, including the South Coast Missing Linkages Project and the California Essential Habitat Connectivity Project. In the past, Dr. Spencer has prepared habitat conservation plans (HCPs), habitat management plans (HMPs), and natural community conservation plans (NCCPs) for numerous sensitive species in California, including the first NCCP plan ever permitted (Poway Subarea NCCP/HCP). Because he has both research and real-world conservation planning experience, Dr. Spencer is often asked to lead science advisory processes to provide guidance for regional conservation and recovery plans, such as the California Desert Renewable Energy Conservation Plan and the Sacramento-San Joaquin Bay Delta Conservation Plan.

## EDUCATION

Ph.D., Ecology and Evolutionary Biology, University of Arizona. 1992. Highest Honors.

M.S., Forestry and Resource Management/Wildlife Ecology. University of California, Berkeley. 1981. Honors.

B.S., Biology and Wildlife Management (double major). University of Wisconsin, Stevens Point. 1978. Highest Honors.

## RECENT AWARDS

2011 Special Recognition Award, Desert Tortoise Council
2011 Special Contributions Award, Desert Tortoise Preserve Committee
2008 Conservationist of the Year Award, Western Section of The Wildlife Society

## SELECT PROJECT EXPERIENCE

**Science Facilitator and Lead Advisor for Regional Conservation Plans — Numerous Agencies.** Served (or serving) as science facilitator and lead science advisor for a wide variety of large-scale HCPs and NCCPs throughout California, including the Desert Renewable Energy Conservation Plan, the Sacramento-San Joaquin Bay Delta Conservation Plan, the Altamont Pass Wind Resource Area Conservation Plan, and NCCP/HCP plans for the counties of Butte, Santa Clara, San Diego, Merced, Yuba, Sutter, and Yolo, and the city of Santa Cruz. These plans cover hundreds of listed and sensitive species in diverse habitats and ecological communities, usually under severe pressures from urban development, agricultural expansion, energy development, increasing water use, or other threats to biological integrity. The process includes selecting and leading groups of independent science advisors to reach consensus on scientific principles and solutions, reviewing extensive technical information, organizing questions and issues for advisors to address, compiling and editing inputs from the advisors, and usually serving as first author and editor of the resultant science advisory reports. The advisory reports serve as foundations for planning large ecological reserve systems and developing adaptive management and monitoring plans to sustain biological diversity, native habitats, and the species inhabiting them.

**Principle Investigator for California Mammal Species of Special Concern – California Department of Fish and Game.** Leading a Technical Advisory Committee and other contributors in a comprehensive update of the Mammal Species of Special Concern (MSSC) in California. The team has developed and is applying a systematic scoring procedure to rank mammal species, subspecies, or distinct population segments for their relative degree of conservation concern within California. They are compiling all available locality data and other pertinent information concerning the status and distribution of nominee taxa, and preparing species accounts for the final list of MSSC. The results will be used to update Department of Fish and Game's official list of sensitive taxa and will be published in book and web formats.

**Principle Investigator for California Essential Habitat Connectivity Project California Department of Transportation, California Department of Fish and Game, and Federal Highways Administration.** This project was a highly collaborative effort to identify and characterize areas important to maintaining a functional network of connected wildlands throughout the state of California. The project produced three primary products: (1) a statewide Essential Habitat Connectivity Map, (2) a database characterizing areas delineated on the map, and (3) guidance for mitigating the fragmenting effects of roads and for developing and implementing local and regional connectivity plans. The essential connectivity network consists of 850 relatively intact and well-conserved natural landscape blocks larger than 2,000 acres and 192 essential connectivity areas for maintaining wildlife movement and other ecological flows among them. The final report provides detailed guidance for considering ecological connectivity in transportation and land management planning, preparing finer-resolution regional and local connectivity plans and linkage designs, and siting and creating road-crossing improvements for wildlife to improve ecological connectivity and reduce vehicle-wildlife collisions. All products were produced using cutting-edge GIS modeling methods in a highly collaborative, transparent, and repeatable process that could be emulated by other states. The project received the 2011 Exemplary Ecosystem Initiative Award from the Federal Highways Administration.

**Lead Scientist for Pacific Fisher Baseline Assessment and Cumulative Effects Analysis in the Sierra Nevada, California – US Forest Service, Region 5.** Led a comprehensive compilation and analysis of data on the Pacific fisher (*Martes pennanti*)—which was found to be "warranted but precluded" for endangered species listing in 2004—to assess the species' historic, current, and future habitat and population status in the Sierra Nevada, and especially to assess the cumulative effects of wildfires, fuels management, timber harvest, and other threats to this isolated population. The project included extensive coordination with state, federal, and local agencies and stakeholder groups (e.g., conservation organizations and timber industry representatives), and facilitation of an independent science advisory body to ensure application of best available science. Cutting-edge spatial-analytical tools were used to forecast changes in fisher habitat and population size under various forest management and fire scenarios, and to forecast resulting effects on population viability. This involved coupling landscape-level models of fire and vegetation dynamics with fisher habitat suitability models and spatially explicit population dynamic models using GIS.

**Project Manager/Lead Biologist for Habitat Conservation Plans and Natural Community Conservation Plans – Numerous Agencies.** Managed the design, analysis documentation, public involvement, and permitting processes for a variety of regional HCP/NCCPs in California pursuant to the Endangered Species Act and the California NCCP Act, including the following:

- *Poway Subarea HCP/NCCP – City of Poway, California.* The first plan successfully permitted under the NCCP Act of 1991, this wildlife conservation plan was designed to sustain populations of 42 sensitive species in an interconnected habitat network within a 25,000 acre planning area.
- *Multiple Habitat Conservation Program (MHCP) – San Diego Association of Governments (SANDAG).* Managed design and documentation of this HCP/NCCP covering 7 incorporated cities and over 186 square miles in north San Diego County. Oversaw development and use of a comprehensive GIS database to design a biologically defensible plan that balances conservation and economic concerns. Included a public policy development and coordination component to ensure consensus between all pertinent organizations and agencies, as well as economic and financing analyses for plan implementation.
- *City of Carlsbad Habitat Management Plan (HMP).* Helped the City of Carlsbad complete a citywide HMP that also serves as a multiple species HCP/NCCP. Met with affected property owners and agencies to negotiate preserve areas within the 25,000-acre planning area; managed biological surveys, GIS analyses, and document preparation. The plan covered nearly 100 sensitive plant and animal

species, while preserving reasonable economic growth and private property rights throughout the city.

- *City of Oceanside HCP/NCCP.* Managed preparation of the City's subarea HCP/NCCP, which covered 27,000-acres. Tasks included managing field surveys, GIS database development and analyses, public outreach, and plan documentation.

**Framework Monitoring Plan for the Channel Island Fox – US Navy and The Nature Conservancy.** Served as project manager, science facilitator, and lead author on a project to review existing monitoring data and methods across all populations of the endangered Channel Island fox (*Urocyon littoralis*) and develop statistically robust monitoring methods to address population status, trends, and threats. Working closely with a panel of experts on fox biology, wildlife monitoring, and statistics, the team developed a statistically robust approach to monitoring population status and threats to the San Clemente Island fox (*U. l. clemente*) that met diverse operational and biological goals of the US Navy, which owns and operates San Clemente Island as a live-fire and special-operations training area. Based on this model, we developed a framework monitoring plan that could also be used on the other 5 islands supporting island fox populations (each island supports a unique subspecies and has different ownerships, management issues, and environmental conditions).

**Research on Effects of Fire Severity and Distance from Unburned Edge on Mammalian Community Post-fire Recovery — U.S. Forest Service, Joint Fire Science Program, Riverside Fire Lab.** Serving as Principle Investigator for a 4-year study of how mammal species and communities are recovering following the largest wildfire in California in over 100 years (the October 2003 Cedar Fire in San Diego County). Overseeing a crew of field biologists from the San Diego Natural History Museum sampling mammal communities and populations at numerous plots inside and outside the fire perimeter, at varying distances from the edge and in areas of differing fire intensity.

**Pacific Pocket Mouse Studies Program – Transportation Corridor Agencies, U.S. Fish and Wildlife Service, and California Department of Fish and Game.** Served as Principal Investigator for studies designed to further recovery of the critically endangered Pacific pocket mouse (*Perognathus longimembris pacificus*). Tasks included studying dispersal characteristics and other pertinent biological information on the species; performing detailed field studies of a surrogate subspecies to perfect field methods and design monitoring programs; determining the feasibility of a translocation or reintroduction program for the species, determining baseline measures of genetic diversity within and between extant (using live-captured specimens) and historic (using museum specimens) populations and developing genetic goals for the recovery program; and coordinating ongoing monitoring studies at extant population sites to maximize the value of the monitoring data for both scientific and preserve management goals.

**Stephens' Kangaroo Rat Studies at the Ramona Airport, San Diego County, California – KEA Environmental.** Verified a new population of the endangered

Stephens' kangaroo rat in the Santa Maria Valley, Ramona California, by trapping and reconnaissance surveys. Mapped the density and extent of this new, southern-most population, and performed GIS habitat modeling to predict other potential habitat throughout the Santa Maria Valley. Prepared a biological technical report and sections of the Biological Assessment for the Ramona Airport expansion project. Participated in a Section 7 consultation and prepared a Habitat Management Plan for the Stephens' kangaroo rat on the airport property. Prepared and oversaw implementation of a translocation program to salvage kangaroo rats prior to construction, house them in captivity, release them to release sites in improved habitat areas, and monitor success of the translocated population and the overall population in the area for several years.

**Basewide Survey for Pacific Pocket Mouse – U.S. Marine Corps Base Camp Pendleton.** Managed an intensive field survey to determine the distribution of the endangered Pacific pocket mouse on base. Developed detailed survey protocols in consultation with other mammalogists and the USFWS. Coordinated a team of 15 biologists performing reconnaissance and trapping surveys over all previously unsurveyed habitat for the species on base (over 6,000 acres). Managed development of a GIS database that summarizes all data for the species on base, including results of previous surveys. Analyzed habitat relationships of PPM using GIS and statistical models.

**Studies on the Community Ecology of the Chihuahuan Desert – National Science Foundation.** Studied the community ecology of desert rodents with Dr. James H. Brown, University of Arizona. Captured, identified, measured, and marked individuals of 15 species of rodents, including three species of kangaroo rats and three species of pocket mice, in over 20,000 trapnights in the Chihuahuan and Sonoran deserts. Trapped, marked, measured, and radio-tracked various species of kangaroo rats with Dr. Peter Waser, Purdue University, for a study of kangaroo rat behavior and ecology. Studied effects of foraging by javelina on native plant species. Performed microhabitat analyses and censuses and intensive foraging studies on wintering sparrow flocks while studying ecological interactions between desert rodents, birds, and ants in the Chihuahuan Desert (Thompson et al. 1991).

**Pine Marten Ecology Studies in the Pacific States – U.S. Forest Service.** Studied the ecology and behavior of pine martens in the Sierra Nevada and Cascade mountain ranges using trapping, radio-tracking, snow-tracking, smoked track-plate plots, and intensive habitat analyses (Spencer 1981; Spencer 1982; Spencer et al. 1983; Spencer and Zielinski 1983; Zielinski et al. 1983; Spencer 1987).

**Studies of Space-use Patterns, Behavior, and Brain Evolution in Heteromyid Rodents – National Science Foundation and National Institute of Health.** Researched space use patterns, memory, navigation, and spatial cognition in various species of kangaroo rats, pocket mice, and grasshopper mice (Spencer 1992). Collaborated with Dr. Lucia Jacobs on the evolution of spatial cognition and the hippocampus of the brain in kangaroo rats and pocket mice (Jacobs and Spencer 1991, 1994).

**Mount Baker Geothermal Energy Development Biological Resources Assessment – Seattle City Light and Power Company.** Led a team that studied the impacts of geothermal energy development on sensitive wildlife in old-growth forests on Mount Baker, Washington. Radio-tracked pine martens and performed trapping and other surveys for various rare carnivore species, including lynx, fisher, and wolverine. Coordinated with biologists studying northern spotted owls and mountain goats.

**Assessment of Impacts of Free-roaming House Cats on Native Wildlife Populations at Saguaro National Monument and Tucson Mountain Parks – National Park Service, Western Region.** Performed a study involving the impacts of free-roaming house cats on wildlife populations for the design of buffers around nature preserves in Arizona. Radio-tracked 14 free-roaming house cats and analyzed their movements, food habits, home ranges, and behaviors.

**Miscellaneous Endangered Species Surveys — numerous clients throughout California, Arizona, and New Mexico.** Coordinated and performed field surveys for the California gnatcatcher, coastal cactus wren, least Bell's vireo, southwestern willow flycatcher, desert tortoise, San Joaquin kit fox, and other rare and endangered species throughout the southwestern U.S. Coordinated and performed trapping surveys for the endangered Stephens' kangaroo rat, Pacific pocket mouse, Mojave River vole, and other rare small mammals in southern California.

**Kern River Pipeline Desert Tortoise Surveys and Construction Monitoring – Kern River Company.** Managed large crews of biologists doing field surveys and construction monitoring for the federally threatened desert tortoise throughout California, Nevada, Utah, and Arizona. Trained field biologists in techniques for surveying and monitoring tortoise populations. Educated construction personnel about mitigation requirements for protecting tortoises during construction of a natural gas pipeline across Utah, Nevada, and California. Relocated tortoises from the impact area under a memorandum of understanding with the USFWS.

## PROFESSIONAL REGISTRATIONS AND PERMITS

Society for Conservation Biology
Association for Fire Ecology
American Institute of Biological Sciences
The Wildlife Society
American Society of Mammalogists
Society of American Naturalists
Sigma Xi Honor Society

## TECHNICAL REVIEWER FOR:

*Biological Conservation*
*Journal of Mammalogy*
*Journal of Wildlife Management*
*Landscape Ecology*

*Ecology*
*Canadian Field-Naturalist*
*Animal Behavior*
*Great Basin Naturalist*
*Transactions, Western Section of the Wildlife Society*
National Geographic Society--Research Grants
US Fish and Wildlife Service—Miscellaneous listing and recovery proposals and plans

**PUBLICATIONS**

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**SELECT PRESENTATIONS**

California's Desert Renewable Energy Conservation Plan: A case study in use of independent science advice. Invited Keynote Address at annual conference of Northern California Conservation Planning Partners: Habitat Conservation Planning from Tahoe to the Bay. November 2012.

Planning for ecological connectivity from statewide to local scales. Invited Presentation, Caltrans Biologist Connectivity Training Workshop, Los Angeles, California. October 2011.

Potential effects of large-scale algal biofuels production on wildlife. Invited Presentation to National Academy of Sciences Committee on Sustainable Biofuels Production. August 2011.

Independent science advice for the California Desert Renewable Energy Conservation Plan: Background, Recommendations, and Future Directions. Invited Keynote Address at annual conference of the Desert Tortoise Council, Las Vegas, Nevada. February 2011.

Trends in independent science advice for NCCP/HCPs. Invited presentation at annual conference of the Western Section of The Wildlife Society, Riverside, California. February 2011.

Why mammals use home ranges: The value of spatial information. Invited Special Symposium Presentation, American Society of Mammalogists, Fairbanks, Alaska. June 2009.

Roles for science-based NGOs in wildlife management and conservation. Invited Plenary Talk at annual conference of the Western Section of The Wildlife Society, Redding, California. February 2008.

Managing landscape linkages to conserve desert wildlife during climate change. Invited presentation and panel discussion. The Climate & Deserts Workshop: Adaptive Management of Desert Ecosystems in a Changing Climate. Laughlin, NV, April 2008.

Improving science delivery for regional conservation plans: Lessons from science advisory processes in California. Invited presentation. Society for Conservation Biology, San Jose California, June 2006.

The science advisory process for regional NCCPs and HCPs. Invited presentation, Continuing Legal Education (CLE) workshop on regional conservation planning. San Francisco, California. December 2005.

Bioethical meanderings of a fur trapper to game biologist to ivory tower ecologist to bioslut to NGO conservation scientist convert. Invited talk at Special Session on Ethics in Wildlife Biology, Western Section of The Wildlife Society, February 2003.

Salvage translocation of endangered Stephens' kangaroo rats in a small, satellite population. Society for Conservation Biology, Duluth, Minnesota. 2003.

The role of consultants in conservation science delivery. Invited presentation at Regional Conservation Planning (NCCP/HCP) Workshop. Western Section of the Wildlife Society. Sacramento, California. 2001.

The science component of regional conservation plans. Invited presentation at Regional Conservation Planning (NCCP/HCP) Workshop. Western Section of the Wildlife Society. Sacramento, California. 2001.

Designing a translocation program to recover the critically endangered Pacific pocket mouse (*Perognathus longimembris pacificus*). American Society of Mammalogists. Missoula, Montana. 2001.

Status of mammals in near coastal habitats, with emphasis on the endangered Pacific pocket mouse. Invited Symposium Presentation. Planning for Biodiversity: Bringing Research and Management Together. Pamona, California. 2000.

U.S.-Mexican cooperation in the conservation of rare mammals: Workshop Introduction. International Theriological Congress IV. Acapulco, Mexico. 1997.

Does the extremely endangered pacific little pocket mouse exist in Baja, California, Mexico? International Theriological Congress IV. Acapulco, Mexico. 1997.

Linkage planning under severe constraints: gnatcatchers and the Oceanside stepping-stone hypothesis. Interface Between Ecology and Land Development in California. J.E. Keeley, ed. Southern Calif. Acad. Sci., Los Angeles. 1997.

Threatened and endangered species of California: a regional overview. CLE International Conference on the Endangered Species Act. San Diego, California. 1995.

Impacts of free-ranging house cats on wildlife at a suburban-desert interface. Society for Conservation Biology. Guadalajara, Mexico. 1994.

Resource dispersion, information, and space-use patterns of vertebrates. Animal Behavior Society. Binghamton, New York. 1990.

Statistical moments for analyses of two-dimensional distributions in ecology. Southwest Association of Biologists. Portal, Arizona. 1988.

Spatial learning and models of foraging movements. Southwestern Association of Biologists. Flagstaff, Arizona. 1987.

Multiple central-place foraging in small carnivores. American Society of Mammalogists. Albuquerque, New Mexico. 1987.

On cognitive maps and the optimal use of home range. Animal Behavior Society. Tucson, Arizona. 1986.

An evaluation of the harmonic mean measure for defining carnivore activity areas. Invited Paper: International Theriological Congress. Helsinki, Finland. 1982.

Selection of resting and foraging sites by *Martes americana*. International Theriological Congress. Helsinki, Finland. 1982.

Rest-site selection by pine martens at Sagehen Creek, California. Western Section of The Wildlife Society. Reno, Nevada. 1981.

# EXHIBIT 4

CONSERVATION BIOLOGY INSTITUTE

## *Conservation Biology Institute*

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February 25, 2013

George Gentry, Executive Officer
Board of Forestry and Fire Protection
<VegetationTreatment@fire.ca.gov>

**RE: Vegetation Treatment Program Environmental Impact Report (VTPEIR)**

Dear Mr. Gentry and Board of Forestry Members:

Thank you for the opportunity to comment on the Draft Vegetation Treatment Program Environmental Impact Report (VTPEIR). I am a research scientist specializing in fire science and ecology, biogeography, native plant ecology, and biodiversity in California. The Conservation Biology Institute is a nonprofit research institution that provides scientific guidance to jurisdictions, agencies, and other organizations in their efforts to conserve and manage lands for natural resources.

My primary intention was to review the VTPEIR and determine, based on the information provided in the document, whether the project has the potential to result in significant environmental impacts. Unfortunately, despite the > 1,300-page length of the document, I cannot make that assessment. The project description, including the list of landscape constraints and minimum management requirements, does not provide sufficient detail on the location, method, or timing of treatments to assess the potential for environmental impact. This lack of specifics applies to all alternatives presented. The alternatives reflect only slight modifications to the same plan and do not provide for a more comprehensive fire management approach that is consistent with current scientific literature or that reflects the complexity and diversity of the state. ***For these reasons, I recommend that the Board of Forestry retract the VTPEIR and instead engage diverse experts to draft a more effective, informative, and efficient approach.***

Given the vast land area of California and the complexity and diversity of fire regimes and vegetation types; population distribution; and species' habitat requirements, a statewide plan for vegetation management, at a minimum, would need to contain maps and project-level details of specific fuel modification projects. It is only possible to evaluate compliance with requirements of environmental law if a specific location, vegetation type, treatment method and timing, and past disturbance history are known. The statements in the minimum management requirements, e.g., that database searches will be conducted to identify biological information before treatments are conducted do not provide sufficient evidence that appropriate analysis or actions would follow.

One of the primary reasons it is impossible to evaluate the environmental impacts of the VTPEIR is that ***all regions and vegetation types in the state are treated in the document with the same assumptions and approach.*** Almost all of the literature and assumptions presented in the VTPEIR are derived from forested ecosystems and do not consider the most extensive vegetation type in the state, which is non-forested shrublands.

Surface fires in ponderosa pine and crown fires in chaparral have vastly different fire regimes and have been affected very differently by past fire management activities. The VTPEIR attributes the trend of increasing fire hazard to fuel accumulation resulting from fire exclusion policies, but this has not been true for shrublands in the southern part of the state, which on the contrary, have experienced unprecedented high fire frequencies that well exceed historical conditions (Keeley et al. 1999, Syphard et al. 2007). ***These differences in fire regimes and management require very different approaches for effective future fire management, and they also mean that potential environmental impacts of treatments are very different (Keeley et al. 2009).*** The plan described in the VTPEIR proposes using a uniform treatment approach across the state and provides no provision to account for these differences.

In southern CA, there has been no accumulation of fuel beyond the historic range of variability. In fact, due to excessive burning in the region, ***the most significant ongoing change in fuel is the conversion of native shrublands to exotic grasses that facilitate fire and expand under high levels of burning (Keeley et al. 2011)***. The problem of excessive wildfire, and in turn prescribed burning, in southern California is therefore important because: 1) it can lead to significant environmental impacts through elimination of native shrublands, and thus, habitat for T&E species, 2) it can facilitate the expansion of flashy herbaceous fuels that actually increase fire hazard, and 3) it is ineffective in reducing the extent of subsequent fires under severe weather (Syphard et al. 2006, Price et al. 2012).

Unlike some forested regions, where treatments and ecological resources may be mutually beneficial, fuel treatments in chaparral invariably result in significant environmental impacts, including exotic species expansion, erosion and watershed issues, and fragmentation of important habitat (Keeley et al. 2009). In forests, mechanical fuel treatments typically remove only surface fuels, but fuel management in chaparral usually involves complete removal of vegetation. Thus, ***although no maps or project-specific details are provided in the VTPEIR to perform a scientific assessment, it is nevertheless highly likely that fuel management will have significant negative environmental impact in southern California shrublands***. This is particularly important because southern California is recognized as a biodiversity hotspot, and there are many threatened and endangered (T&E) species in the region. San Diego County is home more T&E species than any comparable area in the mainland US.

Considering the likelihood for significant environmental impacts of fuel treatments in the state's nonforested lands, an honest proposal should acknowledge that it may be necessary to sacrifice resources for the benefit of fire safety under conditions of extreme fire risk. Nevertheless, if resources are to be sacrificed, than the hope is that the treatment would in fact improve the safety of communities. Unfortunately, ***because the overwhelming majority of homes burn down under severe weather conditions in southern CA (Syphard et al. 2012), and because fuel***

***treatments rarely stop fires under these conditions (Syphard et al. 2009, 2010), the entire premise of using vegetation management as the primary fire management approach should be called into question.*** This is not to say there is no role for vegetation management. However, research shows that fuel breaks in southern CA are most effective when used to support active fire management; thus, firefighters need to have access to the treatment, and the treatment should be located near the value at risk (Syphard et al. 2011a,b).

Recent research also shows that a number of alternatives may be significantly more effective at reducing risk to lives and structures than fuel management, particularly in the southern part of the state. These include fire-safe building construction, modification of urban fuels immediately adjacent to structures, and land use planning (e.g., Cohen 2000, Winter et al. 2009, and Syphard et al. 2012). ***In addition to the importance of structure arrangement and location, we found that a significant predictor of homes burned by fires is high historic fire frequency – where fuel is youngest.*** This underscores the importance of maps and location and that some areas are much more fire-prone than others.

This also underscores the importance of a comprehensive fire management approach, developed in collaboration with land managers, conservation organizations, and reputable scientists - and in coordination with other stakeholders involved with decision-making that affects fire risk, such as land use planners. I urge you to develop a plan that accounts for the spatial and temporal complexity in the state; provides maps and adequate detail on the timing and method of treatment; and prioritizes vegetation management in the wildland-urban interface, or close to communities at risk.

Again, thank you for providing me an opportunity to comment. Please provide acknowledgment of receipt.

Sincerely,

Alexandra D. Syphard, Ph.D.

**References Cited**


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Keeley J.E., Aplet G.H., Christensen N.L., Conard S.G., Johnson E.A., Omi P.N., Peterson D.L., Swetnam T.W. 2009. Ecological foundations for fire management in North American forest and shrubland ecosystems. General Technical Report, USDA Forest Service, Pacific Northwest Research Station.

Keeley JE, Franklin J, D'Antonio C. 2011. Fire and invasive plants on California landscapes. In Springer: The Landscape Ecology of Fire.

Price, O.F., Bradstock, R.A., Keeley, J.E., and Syphard, A.D. In press (2012) Antecedent fire area has no effect on wildfire area in coastal southern California. Journal of Environmental Management.

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Syphard, A.D., Keeley, J.E., and Brennan, T.J. 2011b. Factors affecting fuel break effectiveness in the control of large fires in the Los Padres National Forest, California. International Journal of Wildland Fire 20: 764-775.

Syphard, A.D., Keeley, J.E., Bar Massada, A., Brennan, T.J., and Radeloff, V.C. (2012). Housing location and pattern increase fire risk. PLoS ONE 7: e33954. doi:10.1371/journal.pone.0033954.

Winter G., McCaffrey S., Vogt C.A. (2009). The role of community policies in defensible space compliance. Forest Policy and Economic 11:570-578.

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**EDUCATION**

2005 – Ph.D., San Diego State University and University of California, Santa Barbara, Geography.

1998 – MES, Virginia Commonwealth University, Environmental Studies.

1994 – MPH, Medical College of Virginia, Public Health.

1992 – BA, University of Mary Washington, English/communications.

**AWARDS**

2002-2005 –NASA Earth System Science Fellowship

2002 – "Ecosystem Management in Cultural Landscapes" training in Europe, funded by FIPSE.

2002 – McFarland Scholarship, San Diego State University

**PROFESSIONAL EXPERIENCE**

2011-current – Adjunct Professor, Geography, San Diego State University, CA.

2007-current – Research Scientist, Conservation Biology Institute, La Mesa, CA.

2007-2008 – Postdoctoral Fellow, Biology, San Diego State University, CA.

2005-2007 – Postdoctoral Fellow, Forest & Wildlife Ecology, University of Wisconsin, Madison, WI.

1998-1999 – GIS Analyst/Environmental Planner, Vanasse Hangen Brustlin, Williamsburg, VA.

1995-1998 – Publications writer, Alliance for the Chesapeake Bay, Richmond, VA.

**SELECT RESEARCH EXPERIENCE**

2011-2012 – Decision support for climate change adaptation and fire management strategies for at-risk species in southern California. California Landscape Conservation Cooperative.

2011-2015 – Collaborative Research: Do microenvironments govern macroecology? National Science Foundation.

2009-2013 – Understanding and improving fire management for Marine Corps Base Camp Pendleton. Department of Defense.

2008-2013 – Urban growth and fire risk modeling. USGS Western Ecological Research Center.

2008-2012 – Quantitative Assessment of the effect of fuel manipulation projects on fire behavior and urban loss. USGS Western Ecological Research Center.

2008-2011 – The persistence of biodiversity in southern California under future land-use change scenarios. National Science Foundation.

**PEER-REVIEWED PUBLICATIONS**

Syphard, A.D., Bar Massada, A., Butsic, V., and Keeley, J.E. In review (2013). Land use planning and wildfire: development policies influence future probability of housing loss.

Syphard, A.D., Regan, H.M., Franklin, J., Swab, R.M., and Bonebrake, T.C. In press (2013) Does functional type vulnerability to multiple threats depend on spatial context in Mediterranean-climate ecosystems? Diversity and Distributions.

Beltran, B.J., Franklin, J., Syphard, A.D., Regan, H.M., Flint, L.E., Flint, A.L., In review (2012) Effects of climate change and urban development on the distribution and conservation of vegetation in a Mediterranean type ecosystem.

Bonebrake, T.C., Syphard, A.D., Regan, H.M., Franklin, J., Anderson, K.E., Mizerek, T., Winchell, C. In review (2012) Integrative Evaluation of Diverse Conservation Strategies for a Rare Shrub Species Facing Multiple Threats.

Serra-Diaz, P., Franklin, J., Ninyerola, M., Davis, F.D., Syphard, A.D., Regan, H.M., Ikegami, M. In review (2012) Species-specific exposure to climate change in time and space: from climate velocity to bioclimatic-velocity.

Franklin, J., Davis, F.W., Ikegami, M., Syphard, A.D., Flint, L.E., Flint, A.L., Hannah, L. In press (2012) Modeling plant species distributions under future climates: how fine-scale do climate projections need to be? Global Change Biology.

Conlisk, E., Syphard, A.D., Franklin, J., Flint, L., Flint, A., and Regan, H.M. 2013. Uncertainty in assessing the impacts of global change with spatially dynamic population models. Global Change Biology18: 858-869.

Bar-Massada, A., Syphard, A.D., Stewart, S.I., and Radeloff, V.C. In press (2012). Wildfire ignition modeling: a comparative study in the Huron National Forest, Michigan, USA. International Journal of Wildland Fire.

Price, O.F., Bradstock, R.A., Keeley, J.E., and Syphard, A.D. In press (2012) Antecedent fire area has no effect on wildfire area in coastal southern California. Journal of Environmental Management.

Syphard, A.D., Keeley, J.E., Bar Massada, A., Brennan, T.J., and Radeloff, V.C. (2012). Housing location and pattern increase fire risk. PLoS ONE 7: e33954. doi:10.1371/journal.pone.0033954.

Conlisk, E., Lawson, D., Syphard, A.D., Franklin, J., Flint, A., Flint, L., and Regan, H.M. (2012). The roles of dispersal, fecundity, and predation on the population viability of an

oak species (Quercus engelmannii) under global change. PLoS ONE 7(5): e36391. doi:10.1371/journal.pone.0036391.

Keeley, J.E., Syphard, A.D., and Fotheringham, C.J. In press (2012). The 2003 and 2007 wildfires in southern California. In: Natural Disasters and Adaptation to Climate Change. Cambridge University Press.

Regan, H.M. Syphard, A.D., Franklin, J., Swab, R. Markovchick, L. Flint, A., Flint, L., and Zedler, P. 2012. Evaluation of assisted colonization strategies under climate change for a rare, fire-dependent plant. Global Change Biology 18: 936-947.

Scheller, R.M., Spencer, W.D., Rustigian, H., Syphard, A.D., Ward, B.W., and Strittholt, J.R. 2011. Using stochastic simulation to evaluate competing risks of wildfires and fuels management on an isolated forest carnivore. Landscape Ecology 26: 1491-1504.

Syphard, A.D., Clarke, K.C., Franklin, J., Regan, H., and McGinnis, M. 2011. Forecasts of habitat loss and fragmentation due to urban growth are sensitive to source of input data. Journal of Environmental Management 92: 1882-1893.

Syphard, A.D., Keeley, J.E., and Brennan, T.J. 2011. Comparing the role of fuel breaks across southern California national forests. Forest Ecology and Management 26: 2038-2048.

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Bar Massada, A., Syphard, A.D., Radeloff, V.C., Hawbaker, T.J., and Stewart, S.I. 2011. Effects of ignition models on the spatial patterns of simulated fires. Environmental Modelling & Software 26: 583-592.

Miller, C., Abatzoglou, J., Brown, T., and Syphard, A.D. 2011. Wilderness fire management in a changing environment. In: The Landscape Ecology of Fire. Edited by Don McKenzie, Carol Miller, Don Falk, and Lara-Karena Kellogg. Pp. 269-294.

Sturtevant, B.R., Scheller, R.M., Miranda, B.R., Shinneman, D., and Syphard, A.D. 2010. Simulating dynamic and mixed-severity fire regimes: A process-based fire extension for LANDIS-II. Ecological Modelling 220: 3380-3393.

Syphard, A.D., and Franklin, J. 2010. Species' traits affect the performance of species' distribution models for plants in southern California. Journal of Vegetation Science 21: 177-189.

Syphard, A.D., and Franklin, J. 2009. Differences in spatial predictions among species distribution modeling methods vary with species traits and environmental predictors. Ecography 32: 907-918.

Syphard, A.D., Radeloff, V.C., Hawbaker, T.J., and Stewart, S.I. 2009. Conservation threats due to human-caused increases in fire frequency in Mediterranean climate ecosystems. Conservation Biology 23: 758-769.

Syphard, A.D., Stewart, S.I., McKeefry, J., Hammer, R., Fried, J., Holcomb, S., and Radeloff, V.C. 2009. Assessing housing growth when census boundaries change. International Journal of Geographic Information Science 23: 859-876.

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Akcakaya, R., Franklin, J., Syphard, A. D., and Stephenson, J. 2005. Viability of the sage sparrow under altered fire regimes: integrated landscape and metapopulation modeling. Ecological Applications 15: 521-531.

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**FIRST-AUTHOR PRESENTATIONS AND INVITED LECTURES**

Land use planning to reduce housing loss to wildfire in southern California. Association for Fire Ecology, Portland OR, 2012.

Analysis of geographic influence on reducing wildfire risks and ecological impacts. San Diego partners for Biodiversity meeting, San Diego, CA, 2011.

Land use planning to reduce wildfire risk in southern California. MEDECOS Conference XII. Los Angeles, CA. 2011.

A modeling framework for assessing adaptation strategies for plants threatened by climate, land use, and altered fire regimes in Mediterranean-type ecosystems. 7th European Conference on Ecological Modelling – Riva del Garda, Italy. 2011.

Evaluating the relative impact of climate change and other threats to the persistence of rare plant species in southern California. Invited lecture, U.S. Fish and Wildlife Service, U.S. Geological Survey and California Department of Fish & Game, Bridging the Gap climate change communications workshop, Sacramento, CA. 2010.

Does translocation of a rare fire-dependent plant mitigate the effects of climate change? Invited lecture, Tecate cypress symposium, Rancho Jamul Ecological Preserve, CA. 2010.

Humans alter the spatial pattern of fire in Mediterranean ecosystems. Invited lecture, Department of Geography, San Diego State University

The role of pre-fire fuel management on reducing impacts of large fires in the Los Padres National Forest, California. 4th International Fire Congress – Savannah, GA. 2009.

Modeling interactions among humans, fire, and vegetation in California. Invited lecture, Department of Biology, San Diego State University. 2008.

Humans alter the spatial pattern of fire in Mediterranean ecosystems. Pacific Coast Fire Conference: Changing Fire Regimes, Goals and Ecosystems. California Association of Fire Ecology – San Diego, CA. 2008.

Southern Sierra Nevada Fisher Baseline Assessment and Prediction of Future Habitat Conditions Under Changing Fire Regimes. Association for Fire Ecology Regional Conference 2008 – Tucson, AZ. 2008.

Interactions among humans, fire, and vegetation on southern California landscapes. Invited lecture, Department of Botany, University of California, Riverside. 2007.

Modeling and mapping human influence on California fire regimes. Invited lecture, University of Wisconsin-Madison, Chaos and Complex Systems Seminar. 2007.

Using global satellite data to predict human influence on fire in Mediterranean ecosystems. 4th International Wildland Fire Conference – Seville, Spain. 2007.

Humans and fire in California: predicting influences and simulating impacts. Invited lecture, Department of Geology & Geography, University of West Virginia. 2006.

Predicting spatial patterns of fire in a southern California landscape. Third International Fire Ecology & Management Congress – San Diego, CA. 2006.

Effects of human activities on California fire regimes. International Association for Landscape Ecology Annual Meeting – San Diego, CA. 2006.

Simulating the combined effects of urban growth and high fire frequency on native shrublands in southern California. Association of American Geographers Annual Meeting – Chicago, IL. 2006.

Simulating the effects of frequent fire on the distribution of dominant plant functional types in southern California shrublands. Society for Conservation Biology Annual Meeting – Brasilia, Brazil. 2005.

Simulating alternate scenarios of habitat fragmentation in California native shrublands using a cellular automaton urban growth model. Ecological Society of America Annual meeting - Portland OR. 2004.

Modeling alternate scenarios of urban growth on habitat fragmentation in southern California. The 19th Annual Symposium International Association Landscape Ecology- Las Vegas, NV. 2004.

Modeling long-term effects of altered fire regimes and urbanization on vegetation succession. International Association for Landscape Ecology World Congress - Darwin, Australia. 2003.

Simulation modeling of the long-term effects of altered fire regimes on vegetation succession in the Peninsular Ranges of San Diego County. Fire Conference: Managing Fire and Fuels in the Remaining Wildlands and Open Spaces of the Southwestern United States - San Diego, CA. 2003.

## PEER REVIEWS AND OTHER CONTRIBUTIONS

Peer Reviewer:

- Amnio
- Applied Vegetation Science
- Conservation Letters
- Diversity and Distributions
- Ecography
- Ecology
- Ecological Applications
- Ecological Modelling
- Ecoscience
- Ecosphere
- Ecosystems
- Environmental Modelling & Software
- Environmental Monitoring and Assessment
- Forest Ecology & Management
- Forest Science
- Global Change Biology
- International Journal of Wildland Fire
- Journal of Environmental Management
- Journal of Vegetation Science
- Landscape and Urban Planning
- Landscape Ecology
- Maryland Sea Grant
- Nature Climate Change

- Plant Ecology
- 2008 Climate change impacts assessment
- Science of the Total Environment

Professional Activities:

- Taught course on population biology in Spanish at ECOSUR, Chiapas MX 2012
- Faculty reader for Prescott, AZ masters program.
- Guest Editor ESA Ecological Applications Dec 2011
- Member of NCEAS working group, Global climate change and adaptation of conservation priorities, Santa Barbara, CA.
- Member of Vegetation/Fuels Fire Committee for the San Diego County Forest Area Safety Taskforce (FAST).
- Member of expert review panel of vegetation models for LANDFIRE project.

# EXHIBIT 5

# United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Carlsbad Fish and Wildlife Office
6010 Hidden Valley Road, Suite 101
Carlsbad, California 92011

In Reply Refer To:
FWS-CFWO-13B0120-13TA0174

FEB 25 2013

George Gentry
Executive Officer
California Department of Fire and Forest Protection
VegetationTreatment@fire.ca.gov

Subject: California Department of Fire and Forestry Protection Statewide Draft Vegetation Treatment Program Environmental Impact Report

Dear Mr. Gentry:

The Carlsbad Fish and Wildlife Office of the U.S. Fish and Wildlife Service (Service) has reviewed the above referenced Draft Vegetation Treatment Program Environmental Impact Report (VTPEIR). The Draft VTPEIR is a programmatic environmental impact report that is intended to streamline compliance with the California Environmental Quality Act (CEQA) for vegetation treatment projects across the state of California. The proposed program is intended to lower the risk of catastrophic wildfires by reducing fuels on nonfederal lands and federal Direct Protection Area lands (i.e., federal lands where the California Department of Fire and Forestry Protection is primarily responsible for directing the fire suppression response). Other goals include the control of unwanted vegetation, improvement of rangeland for livestock grazing, improvement of fish and wildlife habitat, enhancement and protection of riparian areas and wetlands, and improvement of water quality in priority watersheds. The VTPEIR does not identify specific project activities but acts as a tool to streamline the CEQA process as projects are identified. The proposed program is expected to treat five times as many acres as the status quo (from 470,000 acres/decade to 2.16 million acres/decade).

The primary concern and mandate of the Service is the protection of public fish and wildlife resources and their habitats. The Service has legal responsibility for the welfare of migratory birds, anadromous fish, and endangered animals and plants occurring in the United States. The Service is responsible for administering the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 *et seq.*), the Bald and Golden Eagle Protection Act (BGEPA) (16 U.S.C. 668-668c), and the Migratory Bird Treaty Act (MBTA) (16 U.S.C. 703 *et seq.*). Our comments are based on the information provided in the Draft VTPEIR, the Service's knowledge of sensitive and declining vegetation communities in southern California, and our participation in regional conservation planning efforts.

Based on the generic nature of much of the analysis and mitigation measures in the Draft VTPEIR, we find it difficult to offer specific recommendations regarding conservation measures or species survey needs for the projects that may occur under this program. However, early coordination and consultation with our office as projects are proposed is strongly recommended so that enough time is allowed for coordination between our agencies and to ensure compliance with the ESA, BPGEPA, and MBTA is addressed prior to project implementation. In addition, we have the following comments on the Draft VTPEIR specific to the jurisdiction of the Carlsbad Fish and Wildlife Office:

1. The Draft VTPEIR indicates that databases such as the California Natural Diversity Database and BIOS will be checked for potential species locations for specific projects. Please note that the California Natural Diversity Database and the BIOS database information may be incomplete regarding the locations or potential locations of federally listed, proposed, and candidate species. Coordination with our office will be important for identifying the more recent information on species occurrence and important habitat types as projects are identified.

2. We are concerned regarding the potential impacts of the proposed program on existing and draft Natural Community Conservation Plan/Habitat Conservation Plans and their associated conservation lands throughout southern California. These plans often rely on key habitat linkages and core reserves. These planning areas include large portions of southern California and conducting additional early and project-specific coordination will be important for these areas, in particular. In addition, thousands of acres have been conserved in southern California through section 6 of the ESA (Cooperative Endangered Species Conservation Fund) to support federally listed species. It is also important that these areas are managed and protected for these species. Thus, early coordination with the Service and the California Department of Fish and Wildlife on proposed activities within or near these areas is imperative.

3. While your analysis on page 5.5-64 indicates that type conversion of habitat is a potential threat to the federally threatened coastal California gnatcatcher (*Polioptila californica californica*), your table on page 5.5-65 indicates that impacts due to prescribed fire is negligible. Please clarify whether the impact is described as negligible because Mitigation Measure 5.5.2-3 would prevent prescribed burning in coastal California gnatcatcher habitat or if there is some other reason. We agree that type conversion of coastal California gnatcatcher habitat due to frequent fires is a threat. Thus, if you are proposing prescribed burning in coastal California gnatcatcher habitat, the table should reflect this concern.

4. Your analysis of the effects of the program to species within the South Coast Bioregion on pages 5.5-63 to 5.5-66 only includes seven species and no reptiles, amphibians, or fish. The analysis should be expanded for this bioregion to include a more representative suite of species. In addition, we recommend including in your analysis some species that may have small ranges and low numbers of individuals such as the federally endangered mountain yellow-legged frog (*Rana muscosa*) and Laguna Mountains skipper (*Pyrgus ruralis lagunae*).

5. On page 5.5-2 you indicate that most species have evolved with fire and are able to recover from them. However, some populations are now isolated due to urbanization, and impacts due to fire could result in the extirpation or loss of these species with limited or no potential for recovery. Your analysis should reflect this concern and provide measures to address it.

6. On page 5.5-4 you indicate that impacts to aquatic organisms due to the proposed herbivory program are not likely due to the use of Mitigation Measure 5.7-3. However, Mitigation Measure 5.7-3 does not indicate that impacts will be avoided to aquatic species; rather, it describes some potential measures that may be implemented. We recommend developing clear measures indicating that impacts to federally listed aquatic species due to the herbivory program will be avoided.

7. The analysis on page 5.5-67 recognizes the potential for the herbivory program to result in the transmission of disease to bighorn sheep but only indicates that it would result in moderately adverse impacts. Based on the potential for disease transmission to bighorn sheep, in particular the federally endangered Peninsular bighorn sheep (*Ovis canadensis nelsoni*), and for serious impacts (USFWS 2011[1]), this impact should be described as a substantially adverse impact. We recommend avoiding grazing where it could impact the Peninsular bighorn sheep.

8. Herbivory could enhance nonnative species by impacting the cryptogamic crust (a thin organic crust composed of cyanobacteria, lichens, mosses, and fungi of the soil). The cryptogamic crust helps inhibit the spread of nonnative plants. Grazing by sheep and goats, in particular, in habitat of the federally endangered Quino checkerspot butterfly (*Euphydryas editha quino*) can result in extirpation of this species from the grazed areas (USFWS 2003[2]). We recommend avoiding grazing within habitat of this species, in particular.

9. The conclusion that the proposed herbivory program will not have impacts on any habitat types seems overly broad. Grazing can help promote nonnative plants, which can displace and compete with native plants, with subsequent impacts to wildlife. Grazing can result in declines in riparian, oak woodland, grassland and meadow habitats (Stephenson and Calcarone 1999 ). Your analysis should include more discussion regarding the potential impacts of grazing to the habitat types within the South Coast Bioregion.

10. It is unclear whether the mitigation measures on pages 5.7-17 and 5.7-18 will adequately protect aquatic organisms. Please provide a discussion in your analysis regarding how these measures were developed, if they have been used in the past, and any data collection that has occurred after use of these measures.

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[1] USFWS (U.S. Fish and Wildlife Service). 2011. Peninsular bighorn sheep (*Ovis canadensis nelsoni*) 5-Year Review: Summary and Evaluation. 95 pp.

[2] USFWS (U.S. Fish and Wildlife Service). 2003. Recovery Plan for the Quino checkerspot butterfly (*Euphydryas editha quino*). Portland, Oregon. x + 179 pp.

11. Mitigation Measure 5.5.2-7 on page 5.5-70 indicates that mechanical vegetation removal and prescribed fire will not be used in riparian areas that border aquatic areas with special status amphibians. We recommend amending this measure to include special status fish species. Furthermore, it is not clear that this measure will adequately protect aquatic species from indirect effects such as sedimentation. Additional coordination with our office will be important, especially for projects in the vicinity of federally listed amphibians and fish. Your mitigation measures should make the need for this coordination clear.

12. For the mitigation measures on pages 5.5-109 to 5.5-111, we recommend including coordination with our agency in addition to the California Department of Fish and Wildlife.

13. To clarify the description of take under the ESA on page 5.5-112, limited protection of listed plants from take is provided to the extent that this law prohibits the removal of federally listed endangered plants or the malicious damage of such plants on areas under Federal jurisdiction, or the destruction of listed plants on non-Federal areas in violation of State law or regulation. In addition, it is illegal to remove and reduce to possession federally listed threatened plants from areas under Federal jurisdiction or import or export, sell or offer for sale, deliver, receive, carry transport, or ship in interstate commerce federally endangered and threatened plants.

The Service supports efforts to lower the risk of catastrophic wildfires and to prevent the loss of human life and natural resources. These efforts must be conducted in an environmentally sensitive and prudent manner and include measures to protect significant fish and wildlife resources. It is unclear in the Draft VTPEIR how such protective measures will be identified and implemented, and this is of great concern given the significant increase in acreage addressed by the proposed program. Thus, we recommend that our concerns are addressed in the Final Environmental Impact Report.

If you have any questions or concerns regarding this letter, please call Jesse Bennett of this office at 760-431-9440, extension 305.

Sincerely,

Jonathan Snyder (Acting)

for Karen A. Goebel
Assistant Field Supervisor

# EXHIBIT 6

United States Department of the Interior

NATIONAL PARK SERVICE
Santa Monica Mountains National Recreation Area
401 West Hillcrest Drive
Thousand Oaks, California 91360-4207

February 25, 2013

Mr. George Gentry, Executive Officer
Board of Forestry and Fire Protection
P. O. Box 944246
Sacramento, CA 94244-2460

Re: Draft Programmatic Environmental Impact Report for the Vegetation Treatment Program

Dear Mr. Gentry and Board of Forestry Members:

Thank you for the opportunity to provide comments on the Draft Programmatic Environmental Impact Report (PEIR) for the Vegetation Treatment Program (VTP). I work as a Fire GIS Specialist and fire scientist for the National Park Service in southern California. I support fire program planning and operations for the Santa Monica Mountains National Recreations Area, Channel Islands National Park, and Cabrillo National Monument. I'll make a few general comments at the top of this letter. A more detailed discussion follows, mainly addressing the technical basis of fire regime characterization, fire hazard assessment, efficacy and likely effects of proposed fuel treatments presented in Section 4.2, and the GIS-based spatial modeling presented in Appendix A.

In general, I find that the various sections of the document are reasonably well organized, approximately following the format of an EIR. The various sections of the EIR appear at first glance to offer a broad historic, statistical, regulatory, land use, and geographic context to the topics. But upon closer inspection I find that the proposed program is based on a number of unjustified assumptions, that it employs problematic methods, and is riddled with errors on important topics. The report ignores a large body of best available science, and in very many instances cites inappropriate, irrelevant, or debunked references. Moreover, although the PEIR is over 1300 pages long, it contains absolutely no meaningful information about the program's proposed project level planning and does not include any detailed information on the checklist that it proposes to use for assessing project impacts in lieu of legally mandated environmental compliance procedures. The closest this report gets to a project level environmental analysis is a carefully documented process of combining a lot of coarse spatial data that Cal Fire has previously stated to be unreliable into variously unreliable, extremely coarse, over-generalized, and not very informative indices plotted statewide on a series of tiny, blurry maps at an effective scale of 1:25 million. For all these reasons and more, the document is legally inadequate for its intended purpose as an Environmental Impact Report.

If implemented, the proposed program would cause significant, irreversible, and unmitigable environmental impacts to natural resources in the Santa Monica Mountains National Recreation Area on a large scale, while producing few if any of the fire safety benefits stated as goals of the program. As such, it would represent a very poor use of public funds.

I strongly recommend that Cal Fire withdraw the current proposal and produce a new one based on best available science that is more clearly focused on the stated program goals, and makes a considerably greater effort to meet the legal standards of a programmatic EIR and other legal requirements of CA's environmental compliance process.

Respectfully submitted,

Robert S. Taylor Jr., PhD

Fire GIS Specialist/ Biogeographer
Mediterranean Coast Network

Attachment:
Detailed comments, citations, and CV.

National Park Service

**Specific comments regarding: Section 4.2 Wildfire Trends**

**Discussions of wildfire history are overly broad, frequently incorrect, presented with little or no documentation of data sources and methods of analysis.**
The overview of California fire regimes makes broad, overly-generalized assertions about the pre-European fire history that makes no attempt to discuss how fires regimes might vary because of California's topographic, climatic, and geological diversity. No references are cited to support the quantitative assertions made about California's pre-European fire regime. The coarse-scale, statewide maps of generalized fire regime types are intended to be the scientific basis of the entire program. But they are little more than pretty cartoons, presented with no information about how they were derived or what they mean. Moreover they are presented at an effective scale of about 1:25 million, and are represented as poor quality jpg images so blurry that most of the information content of the original maps. The URLs in the citations for the 2003 CalFire FRAP fire regime analyses no longer work. I am familiar with the methods of that 2003 GIS work 2003 and know that they are based on many questionable assumptions about pre-European fire history and expected fire behavior in various vegetation types, especially in southern CA shrublands.

References to Figure 4.2.1 provide murky interpretations of the map by making vague and misleading use of sweeping terms (…"the vast majority of which were…") to describe quantitative data that is not presented in the report. There are also awkward and misleading references to fire severity with undefined, non-scientific terms ("non lethal class" fires, "partially lethal severity fire regimes").

From pre-European times, the report moves on to discuss post-1950 fire history, jumping without mention over a several hundred year period of Spanish, Mexican, and American land tenure with lots of important and relevant land use and fire history. The narrative resumes with a misleading and factually incorrect label: "The suppression era" is used to refer to a time period when Cal Fire's own fire history database documents that coastal southern California experienced wave upon wave of unstoppable, human-caused, weather-driven wildfires that collectively burned most shrublands rather more frequently than presumed during the pre-European period.

**Assumptions about historic and modern fire regime of dry Ponderosa pine forests and fire effects in same are inappropriately extrapolated to shrubland systems to reach incorrect conclusions that form the basis of a misguided fuel treatment program, while good science is ignored.**
The report then takes up a relentlessly slanted discussion asserting uncritically that a model of fire effects demonstrated in some dry Ponderosa pine forests (mostly in the southern Rocky Mountains) applies to most or all CA wildlands. The model is well known: Dry Ponderosa pine forests, once open and park-like due to a regime of frequent, low intensity surface fires, were converted by a century of successful but misguided fire suppression to unnaturally densely stocked stands of young conifers that promote fires with unnaturally extreme fire behavior and unnaturally severe fire effects. There is persuasive evidence that more or less comparable conditions do exist in many areas of mid-elevation montane California conifer forests. But they are not nearly so widespread as Cal Fire assumes in this report. Several analyses of modern fire history data, stand structure, and fire behavior have demonstrated clearly that this model does not apply to southern CA shrublands, nor to shrublands in some other areas of the state (Mensing et al, 1999; Moritz, 2003; Moritz et al, 2004; Keeley et al 2009). The report ignores these peer-reviewed scientific publications, and cites as sole support for this ambitious statewide program a single opinion letter to a Congressional hering by an unqualified author with documented professional conflicts of interest whose credibility has been openly questioned by his peers in the scientific community (Rundel et al, 2006).

The standard solution proposed for such forests is mechanical thinning, followed by pile burning (or otherwise removing harvested biomass safely), and finally by prescribed fires that (in theory) are low intensity surface fires, like the presumed prehistoric condition. This is pretty much what Cal Fire proposes to do across the state. But they make no credible scientific case for doing this anywhere, least of all on the millions of acres outside of the overstocked forests where fire suppression actually succeeded in creating an unnatural stand structure that arguably increases fire hazards. And they ignore recent science suggesting that their assumptions may even be wrong in those forest types (Odion et al, 2008, Odion et al 2009). This report does not demonstrate any real scientific basis for the entire fuel treatment program.

**Fire ecology of southern CA shrublands is misrepresented and/or ignored in attempt to justify applying questionable forestry methods to shrublands. Overly broad conclusions in support of misguided program are drawn from false statements.**
The report briefly notes that south coast chaparral is mostly within its natural range of variation for historic fire return interval, and that some areas are burned too frequently. Then it moves immediately to the preferred narrative: an over-generalized discussion of how fire suppression created an unnaturally overgrown vegetation condition just about everywhere. To downplay or discount the actual history of frequent wildfires in coastal southern CA in favor of the "under-burned, overgrown" narrative, the report suggests that over-burned areas are rare and only found in coastal sage scrub (CSS). This is not accurate. In fact, many areas of chaparral are also over-burned and some of the CSS is former chaparral that has been damaged by too much fire. Fire suppression has never succeeded in southern CA shrublands because almost all the acres burn in extreme wind-driven fire weather producing fire intensity that defies direct attack. And there are more and more fire starts, because people and human infrastructure (not lightning) starts all the fires in southern CA shrublands. In the Santa Monica Mountains (and substantial portions of Orange and San Diego Counties as well), most of our chaparral is at risk of type conversion from fire intervals that today are often shorter than the native shrubs can handle. A host of exotic annual grasses and other weeds is invading native shrublands, abetted by wildfires and the disturbances caused by fuel modification projects and fire suppression activities (Keeley and Fotheringham, 2005). And climate change forecasts suggest that it will probably get worse. All of this is ignored by Cal Fire in their rush to conclude that what our embattled shrublands need to be restored to its natural condition is more fire and more industrial-scale mechanical vegetation mastication.
**Condition Class calculation methods are both murky and unscientific, and lead to false conclusions about shrubland management needs.**
Various attractively colored but barely legible 1:25 million scale state level maps are presented as evidence supporting the proposed program. Condition Class, as calculated by Cal Fire for southern CA shrublands, is upside down and backwards. The methods are not described in this document, but reference to other reports seems to show that the Condition Class is based on the incorrect assumption that all vegetation types are burning less frequently today than we think they did historically, due to many years of successful fire suppression. In many dry conifer forests this assumption may be more or less true. But in modern historic times, large areas of shrublands in the south coast region are actually burning more frequently than we think they did historically. Fire suppression in this region has never been achieved because people and their infrastructure start so many fires and almost all the acres burn during unstoppable fires in extreme fire weather, which occurs annually. Much of the south coast's shublands are assigned to condition class 2 or 3, apparently based on their deviation on the short side of historic fire return intervals (or possibly because someone at Cal Fire made a qualitative adjustment of the classes based on unstated information regarding invasive exotic plants- based on their descriptions of methods in various publications it's not really possible to tell). But then Cal Fire lumps these over-burned shrublands in with the presumably under-burned lands from elsewhere in the state and treats them all them all accordingly. So over-burned south coast shrublands at risk of ecological damage from too much fire (many of which are currently recovering from damage caused by recent fires) are defined as high priority treatment areas that urgently need more fire (Rx burning) or fuel reduction treatments in order to reverse the invasion of exotic annual plants and restore them to a more natural condition. And that is simply nonsensical.

**More false statements cited in support of the program, while good science to the contrary is ignored.**
Section 4.2.3 opens with a dark warning based on a falsehood: *"The potential economic impact of failing to reduce excessive accumulations of flammable natural vegetation in the Wildland/Urban Interface (WUI) is substantial."* There might be an excessive accumulation of natural vegetation in some forest types, but there is now plenty of evidence that the extensive shrublands of the south coast region suffer from no such problem. In fact, a few pages earlier the report notes that large areas of southern CA shrublands have burned in the last decade, so presumably all those areas have just been treated (need it or not) and thus should not need any more attention for some time to come. It is true, however, that an excessive accumulation of **urban fuels** (both horticultural landscaping and highly flammable structures) in the WUI is a very widespread problem in CA both south and north (Cohen and Saveland, 1997; Cohen, 1999, 2000; Cohen and Stratton 2008). However the proposed program does little to address urban fuels.

**Little/ no evidence presented that fuel treatments actually are effective in aiding fire suppression, reducing fire size significantly, or protecting property.**
The Fire Trends section of this document (section 4.2) opens with a sweeping and mostly false statement that, *"There is strong scientific agreement that the use of fuel treatments help to reduce the impact and damage from wildfires..."* and then admits that , *"...there is a lack of quantifying data to directly relate treatment methods to a reduction in damage and costs relative to WUI."*
In fact a number of respected scientists have recently published evidence that fuel treatments are generally ineffective at stopping the fires that cause most of the property damage (Price, et al, 2012). But this report does not cite them.

Section 4.2.3 attempts to justify the efficacy of fuel treatments, but offers only very weak claims backed up by a couple of oddly inappropriate references. For example the report states:

*"…Individual (fuel) treatments within these larger fire areas can systematically realize extended attack benefits outside their actual boundaries if the collection and pattern of treatment areas has been developed using landscape level strategies…" (Finney, 2005).*

It is quite a stretch to attribute this statement to that publication. In the cited study of fire in an AZ dry Ponderosa pine forest, Mark Finney did notice fire spread to slow going through and around the lee side of a fuel treatment. He also documented that fuel treatments <3years old, when observed on satellite imagery, produced significantly lower dNBR (normalized burn ratio) values than adjacent untreated areas. Actual reductions in tree mortality were not directly measured or estimated. There was no evidence that the treatments created any useful tactical advantage for fire suppression, and the fire burned through and well beyond the fuel treatments in all cases.

In other papers (not cited here) Mark Finney has used Farsite to model fire spread through simulated level fuelbeds of discontinuous but evenly arrayed fuel breaks of a range of sizes. He found that if you treat substantial fractions of the whole landscape (at least 20%) and convert it to a fuel type with low rate of spread, and arrange it so the fire has to constantly flank and back around the treatment units, then significant reductions in average fire rate of spread may occur. It's still up to firefighters to go there and use this for tactical advantage to actually stop the fire.

**More reasons why the proposed vegetation treatment program will not make proeple safer from fire in southern CA shrublands.**
In the real world of southern CA wildlands, treating shrub fuel types usually type converts them sooner or later to grass fuel types that burn with a greater (not slower) rate of spread, because continuous canopies of tall stature shrubs are converted to fields of annual grasses and subshrubs full of flashy fine fuels. Treated areas often need to be treated annually once the grasses get established and if this cannot be done for any reason then more or less continuous beds of hazardous fine fuels quickly accumulate. Because surface wind speed is no longer reduced by a canopy of sheltering shrubs, treated shrub stands also tend to see greater midflame windspeeds than untreated stands. When a wildfire's rate of spread increases like this, reductions in fuel loading achieved by fuel treatment may be offset by higher rates of fuel consumption, resulting in little net change of fire intensity and flame length. In wind-driven fires, grass fuel models tend to exceed shrub fuel models in fire intensity and rate of spread. Moreover, these faster moving fires respond very quickly to changes in wind direction, creating greater potential for entrapments and burn-overs to occur. The overall affect can be to create more hazardous conditions for firefighters than unmodified fuels would present. More firefighters have died working in grasslands than in any other fuel type. Creating more of these fuel types may actually increase fire danger for residents and firefighters alike.

**Comments: Appendix A, Spatial Modeling of Landscape Potential for the VTP**
An extensive series of GIS analyses conducted for the entire state with coarse data derived from various small scale (generalized and spatially imprecise) map products appear to be the only real spatial environmental analysis conducted for this project. Although the analysis was an impressive feat of GIS data manipulation, here are many very serious, deal-breaking problems with the spatial and thematic quality of the data, and with the analysis. The data flow is carefully documented, but many methods are not described in great detail.

**Spatial data is of poor quality, and Cal Fire refuses to stand by it.**
Many of the data products used as input are familiar to GIS professionals because they have been available for years on Cal Fire's FRAP GIS data website. You won't find it in the current report, but all of Cal Fire's input data sets that are publicly available come with a legal disclaimer in the metadata warning of various spatial and thematic limitations of the data and stating that Cal Fire cannot vouch for the data's accuracy or be legally responsible for anything that anyone does with it. The following disclaimer from Cal Fire's Fire Regime and Condition Class dataset is typical:

> **The State of California and the Department of Forestry and Fire Protection make no representations or warranties regarding the accuracy of data or maps. The user will not seek to hold the State or the Department liable under any circumstances for any damages with respect to any claim by the user or any third party on account of or arising from the use of data or maps.**

**Data with coarse, state-level spatial and limited thematic thematic accuracy is used for analysis at inappropriate scales.**Almost all the input datasets are unsuitable for use in project level analyses, because of their limited spatial and thematic accuracy. Important data (like, archaeological resource data) are simply omitted from the analysis if they are not conveniently available. Individual data products are standardized across whole watersheds, often converted to crude ordinal data with subjectively determined cutoffs, and summed in a variety of creative (mostly logical) ways with a variety of more or less murky assumptions to produce other derived data products (like Condition Class, Fuel Ranking, WUI). Many data products consist of crude ordinal data (vaguely defined scales of 1 to 5, or 1 to 3 = "low, medium and high") which are then combined in variously described sometimes rather dubious linear combinations to produce even more derived data products (like wildfire hazard rating, values at risk rating, environmental services rating). These crude ordinal datasets are then combined again to produce even murkier derived ordinal datasets (relative risk rating, VTP benefit potential). The whole process is like an ambitious house of cards built several layers tall from very flimsy cards. There is no sensitivity analysis of the models. There was no attempt to estimate the magnitude of any errors and no attempt to account for the way errors compound when datasets are aggregated over and over again with other datasets of unknown (but presumably limited) accuracy.

**Wildfire hazard rating fails validation check.**
In a recent comparison of Cal Fire's Wildfire Hazard rating to actual patterns of structure loss in southern CA wildfires, Keeley et al found that Cal Fire's wildfire hazard rating had no statistically significant predictive power at all.

**Complete lack of project level maps, analysis, and data makes document legally inadequate as EIR.**
The complete lack of project level maps, or even data suitable for use in making project level maps makes this document legally inadequate for its intended purpose as an Environmental Impact Report.

**A more general discussion: Cumulative impacts, the efficacy of defensible space, strategic fuel treatment's 000 batting average, and a proposed call to action for Cal Fire.**
An analysis I recently performed in support of a revision of SAMO's Fire Management Plan shows that the closer we do defensible space clearance to our neighbor's houses, the lower is the proportion of high quality native vegetation impacted. I don't have data to support it, but it's a fair guess there are similar spatial patterns in sensitive species impacts. And that's very convenient because, for purely operational and tactical reasons, clearing fuel 'from the house out' is exactly what our County Firefighters tell folks to do to improve home fire safety. This is entirely consistent with findings and recommendations from Jack Cohen's (USFS, Missoula Fire Lab) work on structure ignition, and NIST's investigations of structure loss in the 2003 Cedar Fire. When creating defensible space, the most valuable place to treat hazardous fuels is right by your house. Every foot further away from a structure has less influence on fire safety than the ones that are closer. And there is little value in clearing beyond 100ft except on steep slopes and in other hazardous places.

As for strategic fuel mod projects (ones placed at a distance from resources they're supposed to protect), it's often hard to demonstrate their efficacy. The Fire Trends section of this document (section 4.2) opens with a sweeping and mostly false statement that:
*"There is strong scientific agreement that the use of fuel treatments help to reduce the impact and damage from wildfires..."*

The report then admits that :
*"...there is a lack of quantifying data to directly relate treatment methods to a reduction in damage and costs relative to WUI."*

Scientists would agree that there are now many examples of dry conifer forest thinning that succeeded in keeping future fires on the surface and killing fewer trees. But recent work by Owen Price and colleagues at the University of Wollongong (NSW, Australia) shows that fuel treatment performed in southern CA to date provides no real benefit at all in reducing number of acres burned. Price was only able to demonstrate that fuel treatment works at all in parts of Australia where over half of the entire landscape was treated. Recent work by Jon Keeley (USGS) and colleagues in southern CA is also documenting how little effect our large fuel mod programs really have had on annual acres burned. There are many anecdotal accounts of fuel breaks that did reduce the intensity fires burning across them. But despite many fire seasons of urgently seeking for success stories to support fire agencies' desired narrative (and avoiding public discussion of the countless ‘lack of success’ stories), there are no particularly persuasive examples of a strategic fuel treatment that actually conveyed tactical advantage to firefighters thereby making the difference in allowing them to stop a fire in fire weather.

With no real examples of success to study, there is little to guide us in planning new strategic fuel mod projects that will actually help stop future fires. But all admit that fuel breaks can only work in moderate weather on smaller fires, And those don’t cause a lot of damage even if we do nothing. The fires that cause almost all the property damage and burn almost all of the acres are the big ones occurring in extreme fire weather- the ones that spot right over or blow right through most fuel treatments. FLAMMAP's new minimum travel time module was designed to help systematize the process of identifying likely fire corridors on a landscape, but it still generally requires some conjecture and a little imaginative storytelling to decide how a proposed strategic fuel break will protect communities in the area from future wildfires. By contrast, defensible space fuel treatments (ones placed right next to the structures they 're supposed to protect), if they are well implemented, should help protect those structures from wildfire no matter which way the wind is blowing or where the fire starts.

**This then is the win-win strategy for Cal Fire's Veg Treatment Program:**
The fuel treatment program that turns scarce and hard-earned tax dollars into the most real and demonstrable wildfire safety for Californians. The one that will minimize environmental impacts, and maximize tactical advantages for local firefighters. The one that is supported by current Federal fire science research and also by generations of field experience of the LA and Ventura County Fire Departments (and others?). Cal Fire should focus clearance planning and work on creating and maintaining 100' of good defensible space around each of the approximately 350,000 houses in CA's wildland urban interface. The program should be set up to also use the publicly funded fuel clearance work to leverage homeowners into performing their own privately funded home improvement projects to harden them against ember ignitions. When this large job is done, Cal Fire should go through them all again to make sure they are being maintained well, and to do selective thinning along evacuation routes. Then they should come back to the houses in hazardous terrain and discuss selective thinning in the 100-200' zone. Then they should go through them all one more time to make sure they are being maintained well and to help with other high priority tasks identified by local Community Wildfire Protection Planning groups. When all that important work is done, then and only then it might be appropriate to begin planning strategic fuel treatments.

**Summary statement: Serious environmental impacts and high costs for little demonstrable gain in fire safety for residents and neighbors of southern CA National Parks**
The Santa Monica Mountains National Recreation Area (SAMO) would be seriously affected by the proposed vegetation treatment plan if it were implemented as currently described. About 50% of the land within the SAMO boundary is private and would fall within the scope of the proposed project. If Cal Fire were able to mechanically treat large areas of chaparral and coastal sage scrub in the Santa Monica Mountains, they would cause serious impacts to wildlife habitat, possibly destabilize steep slopes, create ideal conditions for

establishment and spread of a host of noxious exotic plant species (like *Euphorbia terracina*, to name just one example). Listed threatened and endangered plants like *Pentachaeta lyonii*, and *Astragalus brauntonii* would be at risk of unmitigable impacts. Cal Fire would be operating without any oversight from the National Park Service, and without any coordination with our own fuel modification program. Migratory birds would be impacted by the work and there would be very limited opportunities to avoid impacts by manipulating the timing of treatments. Various shrub fuel types would be converted to fine, flashy fuel types that would increase fire hazards for both residents and fire suppression personnel. And the vegetation treatments would not be effective at all in creating useful tactical advantages for fire suppression during the Santa Ana wind-driven fires that burn more than 90% of all acres that burn here. The public might be lulled into a false sense of safety by the projects in such a way that would actually deter them from the important work of making their homes resistant to ignition by embers. Scarce tax dollars consumed by the program would be diverted from other potentially more effective ways of making the mountains more fire safe (for example, fire prevention programs, neighborhood defensible space programs, improvements to evacuation routes, roadside barriers to keep car fires out of wildlands, making power lines in Santa Ana wind corridors more fire safe).

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## Education

| | | |
|---|---|---|
| Ph.D. | 2004 | Geography, University of California, Santa Barbara |
| M.A. | 1990 | Land Resources, Institute for Environmental Studies, University of Wisconsin-Madison |
| B.A. | 1985 | Biology; University of California, Berkeley |

## Employment

| | |
|---|---|
| 2002-present | Biogeographer/ Fire GIS Specialist, Coast Mediterranean Network, National Park Service |
| 1997-2002 | Graduate Student Researcher, Biogeography Lab, Geography Department, U.C.S.B. |
| 1995-1997 | Teaching assistant, Geography Department UCSB |
| 1990-1995 | Restoration Ecologist, Ogden Environmental and Energy Services, San Diego, CA |

## Selected Publications

A. D. Syphard , V. C. Radeloff, N. S. Keuler , **R. S. Taylor** , T. J. Hawbaker, S. I. Stewart and M. K. Clayton (2008) Predicting spatial patterns of fire on a southern California landscape. *International Journal of Wildland Fire* **17**: 602-613.

Dennison, P.E., M.A. Moritz & **R.S. Taylor** (2008) Evaluating predictive models of critical live fuel moisture in the Santa Monica Mountains, California. *International Journal of Wildland Fire* **17**:18-27.

Witter and **R.S. Taylor** (2008) Preserving the future: A case study in fire management and conservation from the Santa Monica Mountains. In Halsey, R.W. 2008. Fire, chaparral, and survival in southern California. Sunbelt Publications, San Diego, CA.

M. Witter, **R.S. Taylor** & S. Davis (2007) Vegetation response to wildfire and fire history in the Santa Monica Mountains, California. Flora and Ecology of the Santa Monica Mountains. Edited by D.A. Knapp. 2007. Southern California Botanists, Fullerton, CA.

**Taylor, R.S.** (2005) A new look at coastal sage scrub: what 70 year old VTM plot data tells us about southern California shrublands. Proceedings, Planning for Biodiversity: Bringing Research and Management Together, February 29-March 2, 2000, Pomona, CA.

**Taylor, R. S.** (2004). A Natural History of Coastal Sage Scrub in Southern California: Regional Floristic Patterns and Relations to Physical Geography, How It Changes Over Time, and How Well Reserves Represent Its Biodiversity. Geography Department. Santa Barbara, University of California, Santa Barbara.

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# EXHIBIT 7

**State of California**
**Department of Fish and Wildlife**

# M e m o r a n d u m

**Date:** February 25, 2013

**To:** Mr. George Gentry
Executive Officer
State Board of Forestry and Fire Protection

**From:** Sandra Morey
Deputy Director
Ecosystem Conservation Division

**Subject:** **Draft Programmatic Environmental Impact Report for California Board of Forestry and Fire Protection's (BOF) Vegetation Treatment Program**

Thank you for the opportunity to comment on the Draft Programmatic Environmental Impact Report for California Board of Forestry and Fire Protection's (BOF) Vegetation Treatment Program, October 30, 2012 Draft.

The California Department of Fish and Wildlife (CDFW) has jurisdiction over the conservation, protection, and management of fish, wildlife, and habitat necessary for biologically sustainable populations of those species (Fish & G. Code, § 1802). CDFW also has regulatory authority under the California Endangered Species Act (CESA), Native Plant Protection Act, the Natural Community Conservation Planning Act, and other provisions of Fish and Game Code that afford protection to California's fish and wildlife resources.

The proposed Vegetation Treatment Program's (VTP) emphasis is to lower the risk of catastrophic wildfires on non-federal land by reducing hazardous fuels. Other goals include controlling unwanted vegetation including invasive species, improving rangeland for livestock grazing, and improving fish and wildlife habitat. This proposed VTP appears to support site-specific projects that would affect existing habitat in forest and rangelands using prescribed fire, mechanical clearing, herbicides, and other treatments. This plan considers that up to one third of the state (38 million acres) is available for treatment.

CDFW offers the following general comments and recommendations for the above referenced draft Programmatic Environmental Impact Report (PEIR). We provide additional and more detailed comments in the attachment to this letter (Attachment A).

Shrublands and Desert Shrub-type Habitats: The Final PEIR for the VTP should more thoroughly address the extensive acreage of native shrublands and desert shrub-type habitats within California and their vulnerability to potential vegetation treatment impacts. The document should also include a broader ecological perspective in managing episodic stream ecosystems in dryland environments.

Consistency with Existing Plans: The Final PEIR for the VTP should reference and be consistent with existing applicable plans such as the State Wildlife Action Plan, various Cooperative Fire Protection Agreement and Operation Plans, and Natural Community Conservation Plans (NCCP).

Vegetation Analysis, Mapping, and Standardization: CDFW has worked closely with local, state, and federal agency partners to develop the Second Edition of *A Manual of California Vegetation* to provide a standardized, floristic-based systematic classification and description of vegetation in California (Sawyer et. al, 2009). The method of vegetation classification used in this manual represents the vegetation classification standards for large-scale vegetation maps recently adopted by the State of California. These state standards meet the National Vegetation Classification System standards followed by federal agencies. Use of this vegetation classification system will help better determine the extent of common, rare, and unique habitats in need of protection and allow for a more comprehensive planning effort.

Subsequent Environmental Review: CDFW is concerned that forthcoming projects may propose to query the California Natural Diversity Database (CNDDB) or the Biogeographic Information and Observation System (BIOS) in lieu of on-the-ground general biological surveys. Although these databases provide useful information for determining which species are potentially present on a site, they are not an appropriate substitute for project level general biological surveys. It is not clear what criteria would determine the need for surveys.

Projects conducted under the final PEIR within habitat occupied by species listed as threatened, endangered, or candidate for listing under CESA would require further consultation with CDFW to determine if a permit would be required prior to project initiation due to the potential for the incidental take of a listed species (Fish & G. Code, § 2080 et seq.).

Seasonal Impacts: While wildlife and plant species impacts are explicitly outlined in Chapter 5, the environmental checklist does not address seasonality, nor does it outline avoidance or mitigation strategies to protect wildlife or plants during their most vulnerable life stages (Checklist 5.5- 14, 5.5- 19, 5.5- 20, 5.5- 22).

Invasive Species Management: CDFW believes removing invasive species and retaining native species should be a goal for every VTP project, not on a case-by-case basis. VTP projects should include field analysis and effective strategies to prevent invasive species from expanding into project treatment areas. Post-treatment follow-up monitoring at years 1, 5 and 10, should also be considered to address changed conditions stemming from the project and include mitigation to actually effectively control and remove noxious and problematic weeds.

Coordination with CDFW: The draft PEIR outlines coordination and CDFW's ongoing involvement with the VTP in order to achieve the VTP's goals. Although the discussion of coordination in the draft PEIR likely has its roots in the 1994 *Interim*

*Joint CDFW/Board Policy on Pre, During, and Post Fire Activities and Wildlife Habitat* (Joint Policy), the draft PEIR makes no mention of the Joint Policy. The Joint Policy outlines a process to facilitate needed coordination to achieve common goals and

objectives but limits its implementation to “the extent feasible” given funds and staffing.

Finally, due to the large scale and scope of the draft PEIR crossing into multiple CDFW Regions, please include each CDFW regional office in future communications so they can be involved as the draft PEIR progresses through the CEQA and subsequent permitting processes.

If you have any questions please contact Helen Birss, Habitat Conservation Planning Branch Chief, at 916-653-9834 or Helen.Birss@wildlife.ca.gov.

Attachment

ec: Dept. of Fish and Wildlife
Helen Birss, Tina Bartlett, Jeb Bjerke, Kimberly Nicol, Scott Wilson, Curt Babcock, Cathie Vouchilas, Ryan Mathis, Paul Schlitt, Ed Pert, Neil Manji, Sonke Mastrup, Dr. Jeffrey R. Single, Jeff Drongeson,

## Attachment A

## California Department of Fish and Wildlife Detailed Comments on California Board of Forestry and Fire Protection Vegetation Treatment Program Draft Programmatic Environmental Impact Report

**Prescribed Fire:** Draft Programmatic Environmental Impact Report (PEIR) Section 5.5.3.4 describes a proposed Vegetation Treatment Program (VTP) that would "reintroduce fire into (natural) communities where fire has been excluded through past suppression or control efforts." This proposal may not be applicable to the coastal southern California bioregion, and particularly, the shrub-dominated chaparral and coastal scrub habitats.

There is substantial evidence that the frequency of fires continues to increase in coastal southern California (USDI NPS, 2004; Keeley et al. 1999). Fire management of California's shrublands has been heavily influenced by policies designed for coniferous forests; however, fire suppression has not effectively excluded fire from chaparral and coastal sage scrub landscapes and catastrophic wildfires are not the result of unnatural fuel accumulations (Keeley, 2002). There is also considerable evidence that high fire frequency is a very real threat to native shrublands in southern California, sometimes leading to loss of species when fire return intervals are shorter than the time required to reach reproductive maturity (Keeley, 2002). Both common and rare plant species and the habitats they provide are vulnerable to adverse impacts where fire regimes are altered.

The VTP could increase treatments across the landscape, potentially clearing habitat and replacing older vegetation stands. Expansion of invasive herbaceous species poses an additional threat to shrub-dominated communities subjected to frequent fires. Vegetation clearing projects, and burning to increase forage for livestock, often results in type conversion to low diversity annual grasslands. The draft PEIR acknowledges these threats to some degree.

CDFW is concerned that the VTP may further contribute to substantial adverse cumulative affects across the landscape through altering natural fire regimes, applying cool season prescribed burning to vegetation adapted to infrequent, dry season hot fires, and by clearing intact habitat areas that may expose them to weed invasion.

**Environmental Setting/Bioregion Overview:** Sections 4.1 and 4.5 provide a general discussion focused primarily on forest and rangelands within the state. There is some discussion of hardwoods and woodlands in this section. The VTP would benefit from more extensive coverage on the importance, and extensive acreage of, shrublands and desert shrub-type habitats within California and their vulnerability to potential vegetation treatment impacts.

The bioregional summaries in Section 4.1 provide maps of general vegetation; however, they are at a scale that is not useful to the reviewer. The VTP would benefit from additional information and a summary of the environmental setting for each bioregion. Section 4.5 provides additional but limited information for each bioregion, however there is little or no discussion of the bioregional setting specific to the south coast bioregion and the presence of over 2.9 million acres of shrublands, much of which is on private lands and therefore potentially subject to the VTP.

Section 4.5.3 addresses the environmental setting relative to plant species of concern (generally) and vegetation, but more information would be useful to determine and evaluate the environmental impacts from the VTP. Knowledge of the regional environmental setting is critical for assessing environmental impacts, and special emphasis should be given to environmental resources that are rare or unique to that region and that could be affected by the VTP (Guidelines, § 15125, subd. (c)). CDFW recommends that the VTP be organized into manageable bioregions, and each bioregion should be analyzed at the programmatic level.

**Consistency with NCCP/HCP Planning Efforts:** A plan of this magnitude, extending through diverse and biologically rich habitats, merits a more thorough discussion regarding the potential impacts the VTP (including alternatives) could have on achieving the objectives contemplated in existing and draft Natural Community Conservation Plan/Habitat Conservation Plans (NCCP/HCP) throughout the State. The success of these plans relies on maintaining core biological resource areas and habitat linkages that are essential to the long-term biological viability of associated flora and fauna. The VTP could lead to impacts and loss of biologically sensitive lands and resources within those portions of the state with NCCPs/HCPs. CDFW recommends providing a discussion in the final PEIR to identify the VTP's potential effects (including connected actions and alternatives) on conservation strategies that are outlined within existing or draft NCCP/HCPs.

Federal and state permits for endangered/threatened species have been issued to local jurisdictions based on plan conservation levels and the configuration of conserved habitats. If those conservation levels and the locations of conserved lands are significantly altered by the VTP, then permits for the NCCP plans may have to be modified (to the detriment of conserved resources) or comprehensively re-evaluated. This could potentially affect a much broader area than just the footprint of the vegetation treatments, as these jurisdictions rely upon the permits to address take of listed species throughout their jurisdictional areas. The environmental checklist (Chapter 8) for the VTP should include an evaluation of potentially affected regional NCCPs/HCPs. A thorough analysis of the regulatory impacts of the VTP area should be included in the final PEIR.

CDFW encourages the Board of Forestry and Fire Protection (BOF) to incorporate the goals, objectives, and preserve design criteria associated with affected NCCP/HCPs into the final PEIR. CDFW recommends that alternatives that minimize adverse impacts to native vegetation communities and associated species should be evaluated and considered. This could partially be accomplished by adherence to the conservation objectives identified within approved and draft NCCP/HCPs and then applying the principal conservation strategies outlined within those plans.

**Region-Specific Conservation Actions:** Section 1.2 of the draft PEIR provides an introductory overview of resource management actions that have changed the structural characteristics of California forests. The discussion highlights concerns with coniferous forests and other hardwood forest/ woodland management. However, no comparable discussion was included that specifically addresses shrubland or scrub communities and management within Southern California. California's Wildlife Action Plan cites, "*Wildfire is a natural and important ecological process in the South Coast. Widespread forest management practices, as well as increase in human-caused wildfires, have altered fire regimes, in some causes causing dramatic changes in regional habitats*." Furthermore, the Wildlife Action Plan states, "*The cause and ecological consequence of wildfires differ among the region's ecological communities*." This important topic should be included within the introductory portion of the final PEIR and given equal attention throughout other sections of the final PEIR.

**Regulatory Compliance**: The PEIR should provide a more thorough analysis of the regulatory requirements of the VTP. Examples include compliance with the following:

1) Fish and Game Code section 1600 et seq. that is required for any substantial alteration of any river, stream or lake, including those that are episodic (e.g., ephemeral streams, desert washes) as well as perennial (flow year round). Note the bed, channel, or bank includes the floodplain and riparian vegetation when present.
2) The lead agency obligation to determine the direct and indirect effects of a project (CEQA Guidelines, § 15064 subds. (d)(1) & (2)), and to obtain the necessary expertise to inform those determinations, using substantive data, expert input, and site-specific analysis.
3) California Department of Pesticide Regulation (CDPR) with respect to buffer zones.

**California Endangered Species Act (CESA)**: Section 4.5 cites, "*The California Endangered Species Act was enacted in 1984…*" Please correct this reference to identify the California Endangered Species Act was enacted in 1970 (Stats. 1970, ch. 1510, § 3). The current basic structure added to the California Fish and Game Code in 1984, replacing the original Act from 1970 (stats. 1984, ch. 1162, §§ 5 & 6: stats. 1984, ch. 1240, §§ 1 & 2.).

**VTP Actions on State Responsibility Areas:** CDFW's South Coast Region (Region 5) has a Cooperative Fire Protection Agreement and Operation Plan (dated, June 1, 2012) with CAL FIRE. This agreement describes a cooperative fire protection plan between the two agencies for CDFW lands within San Diego County (covering Wildlife Areas, Ecological Reserves, and Undesignated Lands). The Operating Plan includes key special management considerations that should be referenced within Section 2.3 (Minimum Management Requirements) of the draft PEIR. With respect to similar operating plans for CDFW lands within CDFW Regions 1 through 4 and 6, a similar acknowledgement of the key management elements for each applicable plan should be provided in the final PEIR. Furthermore, we suggest that the special management considerations identified within all affected operating plans be carried forward into the commitment language under section 7.2 *Mitigation Monitoring Responsibility and Reporting Requirements*.

**Management Actions Common to all VTP Alternatives**: CDFW encourages continuing coordination on wildlife-related issues; including the BOF considering the *California Wildlife: Conservation Challenges, California's Wildlife Action Plan* within the planning framework of the final PEIR. This tool evaluates stressors on wildlife and provides measures to ensure diverse and abundant wildlife populations in the future. The adaptive management guidance provided in the *Wildlife Action Plan* cites the importance of continuing collaborative efforts between federal, state, and local agencies, along with nongovernmental conservation organizations to effectively protect and manage sensitive species and important wildlife habitat.

**Vegetation Classification, Fire Characteristics, and Mapping**: The vegetation classification and mapping used in the draft PEIR should be updated using the Second Edition of *A Manual of California Vegetation.* California Fish and Game Code was revised in 2007 to include Section 1940, which instructs CDFW to adopt vegetation mapping standards for the state (Fish & G. Code, § 1940 subd. (a); "The Department of Fish and Game shall undertake the development of a vegetation mapping standard for the state"). CDFW has worked closely with our local, state, and federal agency partners to develop the Second Edition of *A Manual of California Vegetation* to provide a standardized, floristic-based systematic classification and description of vegetation in the State of California (Sawyer et. al, 2009). The method of vegetation classification used in this manual represents the vegetation classification standards for large-scale vegetation maps recently adopted by the State of California. These state standards meet the National Vegetation Classification System standards followed by federal agencies. Use of this vegetation classification system will help better determine the extent of common, rare, and unique habitats in need of protection and allow for a more comprehensive planning effort.

The draft PEIR should reference and utilize the 1995 *Manual of California Vegetation* (Sawyer and Keeler-Wolf, 1995), and provide current information from the 2009 Second Edition of the Manual. The Second Edition contains a wealth of specific information on the fire characteristics of numerous alliances and associations- it includes both life history traits for the principal species which make up a given alliance, and specific fire characteristics of that alliance, where known. The Second Edition includes extensive scientific literature citations, including references pertinent to fire ecology.

CDFW recommends that alliance-based mapping be utilized at the project and regional level for all proposed vegetation treatment projects. A qualified botanist will be needed for each project to characterize affected vegetation, assess potential impacts, and modify treatments as appropriate. Site-specific floristic evaluations, consistent with the manual, are also needed for subsequent environmental review at the project level. Regional tracking of individual projects is also essential to ensure cumulative impacts are adequately addressed.

**Subsequent Environmental Review**: The draft PEIR section 5.5.2 and 5.5.3 provide a broad analysis of the potential direct impacts to vegetation and wildlife resources that could result from the proposed VTP. The draft PEIR provides a very limited analysis of the potential for indirect impacts to specific special status species. CDFW believes that the approach described in the draft PEIR (page 5.5-12: Approach to Bioregional Analyses) may be appropriate at program level analysis; however, subsequent project-level analysis will be necessary to determine the potential for both direct and indirect impacts to special status flora and fauna. The draft PEIR partially recognizes the need for subsequent project specific analysis in Section 2.2 (Landscape Available to be Treated: #5) and Section 2.3 (Minimum Management Requirements (MMR): #5) of the draft PEIR.

CDFW is concerned that forthcoming projects may be proposing to use database searches (CNDDB, BIOS) in lieu of on the ground general biological surveys. Although MMR #5 does state that surveys may be required, it is not clear what criteria would determine the need for surveys. Although these databases provide useful information for determining which species are potentially present on a site and which species-specific surveys should be performed, they are not an appropriate substitute for project level general biological surveys. The final PEIR should provide clear guidance for individual VTP projects including the necessity for subsequent environmental review and site-specific biological surveys. This includes ensuring plant surveys will be floristic (i.e., Protocol for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities, DFG, November 24, 2009).

MMR#5 describes a process through which the wildlife agencies are notified during the project-scoping phase and asked for comments and recommendations. This condition should be modified to indicate that the lead agency for a Project shall modify the project design and/or incorporate mitigations recommended by the wildlife agencies stemming from those comments and consultations. This measure largely emphasizes species-based analysis, and we recommend it also include vegetation, habitat, watershed, and soils that could potentially be impacted by project activities.  Project applicants could be private landowners or other parties who are typically not qualified to determine direct and indirect project effects to biological resources. It is the obligation of the lead agency under the CEQA to determine the direct and indirect effects of a project and to obtain the necessary expertise to inform those determinations, using substantive data, expert input, and site-specific analysis.

**Typical Treatments to Meet VTP Goals**: Section, 1.7, 2.5, and 5.5.4.4 discuss wildland fire and suppression including the use of fuel breaks. Excerpted from *Comparing the role of fuel breaks across southern California national forests*, Syphard, A.D. et al, 2011:

> “[T]his study strongly supports the notion of constructing fuel breaks along the wildland-urban interface where firefighters will have better access to the fuel breaks, and where the fuel breaks will provide an immediate line of defense adjacent to homes that are at risk. The case studies from all four national forests demonstrate that fuel breaks will not stop fires without firefighter presence.

> Therefore, constructing fuel breaks in remote, backcountry locations will do little to save homes during a wildfire because most firefighters will be needed to protect the wildland-urban interface, and fires will not be stopped by those fuel breaks that are located farther away. Finally, because access to fuel breaks was consistently improved when vegetation structure was favorable, this study suggests that maintaining fuel breaks in strategic locations may be just as important as constructing new fuel breaks."

CDFW discourages the creation of new fire breaks or fuel modifications zones in remote areas as these fire breaks serve as conduits for the introduction of non-native and invasive plant species into areas that currently may not have weed problems. Additionally, these fire breaks provide vehicular and human access into areas that may have been inaccessible to humans prior to the fire break, thus creating secondary impacts such as renegade trails, trash, illegal collecting of wildlife (amphibians, reptiles, raptors, etc.), poaching, and degradation of areas that were previously pristine wilderness. The resource cost of placing any fire break should be evaluated in the context of the net benefits for communities (natural or anthropogenic) and the accessibility of the fire break to firefighter personnel. In some instances a strategically placed fire break could help protect highly sensitive species, such as cactus stands supporting cactus wrens, or critical locations of some plant populations in as much as they are meaningful and serviceable. The development of individual fire management plans should be evaluated within the context of the applicable NCCP reserve system.

Section 4.16 (Hazardous Material and Other Concerns) states "*VTP practices may involve the application of fire retardants to control fire*." Section 2.5 (Detailed Description of Treatments) should discuss whether fire retardants are being considered as a preemptive VTP treatment measure for wildland-urban interface areas. CDFW is aware of residential property owners in San Diego County who have requested applying a Phos-Chek fire retardant to vegetation along property perimeters (i.e., prior to start of fire season). The primary constituents of these products are ammonium salts, consequently the retardant acts similar to a chemical fertilizer. The ammonia and phosphorus are the constituents of greatest concern in terms for potential ecotoxicity to aquatic organisms. These products are effective for a season-long duration; however, they will wash-off in the rain. The retardant may also cause foliage to wither and turn brown. In those instances where CDFW has been notified of such applications, we have cautioned against their application. We have also emphasized that a minimum of a 200-foot setback be factored in for application near any drainage areas (including ephemeral) and cautioned their application where fine fuels (e.g., annual grasses) occur. The final PEIR should include supplemental discussion on whether this issue was raised during project scoping and whether they were considered to be evaluated as part of the VTP.

**Vegetation Treatments for Rangeland Improvements:** In the south coast bioregion, the hazardous fuels targeted by the proposed VTP constitute native habitats that are often shrub-dominated and support a diverse array of both common and uncommon species of plants and animals. The draft PEIR generally treats these shrub-dominated plant communities as "rangelands," even though they provide low levels of suitable forage for cattle. Due to its low value for cattle forage, chaparral and coastal scrub areas have been identified as being most useful for conserving watersheds and as deer forage (Sampson and Jespersen, 1963).

Shrublands have historically been viewed as a general impediment to livestock movement and as crowding out grasses and forbs favored by grazing livestock, particularly cattle (Sampson and Jespersen, 1963). The replacement of shrublands with grasslands, resulting in type conversion, has occurred extensively throughout California for several hundred years, and is frequently the end result of vegetation management treatments to “improve” rangelands. Diverse shrublands have been intentionally and unintentionally converted through repeated episodes of burning and livestock grazing, and are often replaced by lower diversity grasslands typically dominated by non-native Mediterranean grasses and forbs. Introduction of livestock onto recently burned shrublands further exacerbates habitat fragmentation, impairs shrubland recovery, and reduces watershed integrity, increasing runoff and exacerbating downstream flooding. Cumulatively, past type conversion of shrublands to annual, herbaceous vegetation has affected extensive areas in the south coast bioregion, and projects proposed under the VTP could further contribute to type conversion and associated loss of biodiversity through continuing these historic practices.

The VTP does not provide a grazing-free recovery period for rangeland improvements in shrub-dominated habitats and woodlands. The adverse impacts of livestock grazing on recovering treatment areas should be evaluated in the final PEIR. The first several years following wildfires or prescribed fire treatments are critical to the successful recovery of short-lived native herbaceous and perennial vegetation. Chaparral and coastal scrub vegetation supports a unique post-fire herbaceous flora, typically over a 1-3 year period following fire (Westman, 1979). Some of these species are pyrophytic endemics, and persist only as seed bank in between infrequent fire events. Obligate seeding shrubs must reproduce via seed from the seed bank. Absent a recovery period, they may fail to become established and ultimately be eliminated from treated stands. Livestock grazing during the recovery period can also damage species with basal reshoots. CDFW recommends that a minimum 3-year recovery period with no livestock grazing be provided for any project where shrublands and woodlands are treated in areas accessible to livestock. Extended recovery periods may be necessary if post-treatment monitoring suggests additional recovery time is needed or if substantial drought conditions occur during the recovery period.

**Increased Fire Frequency:** Fire regimes in the south coast bioregion are currently driven by human caused ignitions and many habitat areas are at risk of experiencing frequent fires leading to the potential for vegetative type conversion and subsequent loss of biodiversity. Conditions favorable for prescription burning often result in out-of-season burning when conditions are moister, cooler and fuel moisture levels are higher. Since chaparral and coastal scrub are adapted to a regime of infrequent, relatively intense, dry season fires, imposition of low intensity cool season fires through prescribed burning can produce undesirable ecological effects and damage vegetation.

Abundant evidence exists that high fire frequency is a very real threat to native shrublands, sometimes extirpating species sensitive to short fire return intervals (Keeler-Wolf, 1995; Keeley, 2002; USDI NPS, 2004). The fire return intervals in the Santa Monica Mountains, for instance, which have been carefully analyzed, threaten the persistence of shrublands that have dominated this area (NPS, 1994); vegetation type conversion in mixed chaparral in the Santa Monica Mountains has been documented after a series of fires (Fabritius and Davis, 2000 *In* USDI NPS, 2004). CDFW recommends that treatments proposed under the VTP be limited to areas adjacent to the wildland-urban interface, in order to minimize the amount of landscape exposed to unnaturally high fire frequencies.

With regard to shrublands in the south coast bioregion, (including chaparral, coastal scrub and maritime chaparral), CDFW recommends the VTP be modified to ensure that moderate to old aged stands are conserved across the landscape, and protected from mechanical treatments or prescribed fires. Any active treatment should be consistent with the fire history, frequency and conditions for which the key species comprising these habitats are adapted.

**Invasive Species Expansion in Project Treatments:** The draft PEIR analyzed the potential for adverse impacts stemming from a variety of proposed vegetation treatments. The invasive species discussion in the draft PEIR generally recognizes that invasive weeds are capable of spreading into areas treated with prescribed broadcast fire, controlled burns, fuel break construction, and maintenance, mechanical and herbicide clearing. Section 5.5.4.4 states that although the Proposed Program creates the indirect effect of encouraging the spread of invasive species, much of the potential impact is "*balanced by the VTP projects designed to reduce or eradicate invasive species*." While there are certainly benefits to undertaking effective vegetation treatments specifically designed to control invasive weeds, a control project in one location does not offset or mitigate for weed expansion stemming from implementing a project in another geographic location. The VTP offers no specific mitigation aimed at identifying, controlling, reducing or eliminating non-native invasive species likely to expand following habitat clearing projects. There is therefore potential for serious adverse impacts at most, if not all, potential treatment locations.

**Data and Assumptions/ Approach to Statewide Analysis:** The statewide analysis discussion (sec. 5.5.2.3.1) states, *"Effects of fuel reduction on wildlife depend on the specific ecological requirements of individual species and thus are difficult to generalize, especially in a treatment area as large and complex as that considered here."* CDFW encourages that a further comprehensive project-by-project analysis be conducted by each lead agency carrying out projects under the VTP. It is important that each analysis include further bioregion-specific wildlife resource inventory information, define specific impacts to those resources, and propose avoidance and mitigation measures to be implemented for all subsequent projects carried out under the VTP. In order to maximize CDFW's ability to provide lead agencies further protective measures for wildlife resources, early consultation with CDFW should be conducted through the CEQA process for each forthcoming project

**Bioregion-Specific Effects of Implementing the Program Alternatives:** The species accounts section for prescribed burns (sec. 5.5.2.6), states "*Species such as California tiger salamander...are expected to benefit indirectly from treatment, which will help maintain grasslands by preventing encroachment of woody vegetation*." Please provide supplemental discussion, including any supporting science, for that conclusion.

Desert tortoise (*Gopherus agassizii*), least Bell's vireo (*Vireo bellii busillus*), burrowing owl (*Athene cunicularia*), Swainson's hawk (*Buteo swainsoni*), and tri-colored blackbird (*Agelaius tricolor*) should be included within the Mojave bioregion specific effects analysis section. Specific to the South Coast Bioregion, least Bell's vireo, southwestern willow flycatcher **(***Empidonax traillii extimus),* golden eagle (*Aquila chrysaetos canadensis*), Cooper's hawk (*Accipiter cooperii*), white-tailed kite (*Elanus leucurus*), quino checkerspot butterfly (*Euphydryas editha quino*),western spadefoot (*Spea hammondii*), arroyo toad (*Bufo californicus*), Western pond turtle (*Emys marmorata*), flat-tailed horned lizard (*Phrynosoma mcalli*), and American badger (*Taxidea taxus*) should be discussed in the effects analysis section (sec. 5.5.2.6).

Mitigation measures are lacking in the draft PEIR for special status species described within the Mojave and South Coast Bioregion. Occurrences of special status species can be quite localized and may consist of metapopulations that are important to species persistence within a specific bioregion. The direct and cumulative loss of these populations or portions of these populations may be significant. Consulting the CNDDB and BIOS may not provide full coverage of species presence for the purposes of impact assessment, avoidance, and mitigation analysis. Mortality (take) of special status species including species listed under CESA may result from implementation of the VTP. Take may result from direct incineration of species of low mobility and/or during the breeding season, crushing of shallow burrows by equipment, and other indirect disturbances performed during important life stages of wildlife within the work zones. Projects conducted under the final PEIR within habitat occupied by species listed as threatened or endangered under CESA may require an Incidental Take Permit (ITP) prior to project initiation. Impacts to CESA-listed species and other special status species should be considered on a project-by-project basis in consultation with CDFW. CDFW recommends avoiding habitat occupied by special status species during project activities.

The environmental impact analysis for vegetation (sec. 5.5.3.5) contains a series of bioregional tables which, in the case of the south coast bioregion, lists seven special status (rare) plants and one natural community described as having the most element occurrences in the bioregion (Table 5.5.3.20). The assumption presented is that the species and habitats in these tables are presumably the most likely to be adversely affected by the proposed VTP at the programmatic level. We recommend including a discussion of the information in these tables in the PEIR.

Table 5.5.3.20 appears to contain erroneous information. The table lists the state and federally endangered slender-horned spineflower (*Dodecahema leptoceras*) (an endangered genus) and is shown as having 913 element occurrences. A 2011 CNDDB query showed only 35 element occurrences, including presumably extirpated occurrences. The table indicates that Southern Sycamore Alder Riparian Woodland has 1103 element occurrences, when the 2011 CNDDB indicates there are 230. Please provide further explanation to occurrences reported and revise final PEIR accordingly.

**Program Monitoring:** Chapter 7.0 describes a program-level monitoring effort emphasizing baseline inventory, implementation, effectiveness, and validation monitoring. CDFW agrees that this type of monitoring is important for evaluating the success of the overall statewide program. However, the PEIR does not address the need to monitor the results of individual project treatments and the recovery of treated vegetation stands. Furthermore, it states that CAL FIRE will, each year, field review a "sample" of burned projects to assess the results of treatments and wildfire effects. The proportion of projects that would be sampled is not identified. CDFW recommends that all site-specific projects receive post-treatment field evaluations to determine that project objectives have been met. It is also critical that site specific monitoring occur in order to document habitat and vegetation recovery, and identify invasive species issues that need follow up control. We recommend treatment areas be monitored at year 1, 5 and 10, following treatment.

**VTP Mitigation Measures**: In section 5.5.2.1, Fish and Game code 3505.5 is incorrectly identified. Fish and Game Code sections 3503 (nests and eggs) and 3503.5 (birds of prey, nest, eggs) should be inserted as a correction.

Section 5.5.2 and 5.5.2.1 recognize the need to comply with the Migratory Bird Treaty Act (MBTA) and Fish and Game Code section 3503.5 (corrected), however, no specific mitigation measures were provided to ensure compliance with these state or federal wildlife protection laws. CDFW recommends that the Mitigation Monitoring and Reporting conditions be amended to include provisions for avoiding project work during avian breeding seasons to avoid the take of birds or eggs, and provisions for how work might proceed, if necessary, during the breeding season with the use of a qualified biologist to conduct appropriate surveys, document findings, recommend adequate buffers, and use biological monitors, in consultation with CDFW.

Mitigation Measure 5.5.3-1 directs that treatment prescriptions mimic natural fire regimes, but this measure would apply only to "fire adapted special status plants." This measure should be modified to ensure that all vegetation stands where treatments are proposed will be managed consistent with natural fire regimes and utilize the best available species-specific and habitat-specific scientific information. This measure indicates that a mosaic of "old" and "young" stands would be created with "diverse habitat structures." There is little or no discussion of what constitutes "old" stands with regard to southern California shrublands. This measure should be modified to address intermediate aged stands as well, which provide habitat components essential for a variety of wildlife species.

Mitigation Measure 5.5.3-2 directs that cool season prescribed fire timing and ignition techniques be used in desert shrub habitats with well-established stands of invasive grasses (e.g., cheat grass), in order to prevent type conversion. This measure and associated discussion pertaining to this subject need further development, as it is not clear if the purpose of cool season burning is to control the invasive grasses. In addition, there is insufficient information provided as to the effectiveness of such cool season burns in protecting native desert shrubs and native herbs.

Mitigation Measure 5.5.3-3 states, "*Mechanical treatment shall be avoided to the greatest extent possible in special status plant communities with a state rank of 3.2 or lower. If mechanical treatment cannot be avoided, impacts will be mitigated on an acre-for acre- basis by enhancing or restoring the same community type elsewhere in the region*." This ratio could be appropriate for addressing temporary impacts; however it may not be adequate depending on the specific type of community or importance to the local landscape. A discussion should be included of mitigation for impacts to occupied and unoccupied suitable habitat for listed species.

Mitigation Measure 5.5.3-4 states, "*A 50' exclusion zone shall be established around vernal pools*". A 50-foot setback may be suitable in some cases (e.g., individual road ruts pools); however, actual buffer widths should be based site-specific factors, such as pool flora/fauna and associated vernal pool complex/watershed characteristics. CDFW recommends the final PEIR provide the criteria by which the buffer width will be determined. The mitigation measure should be modified to require consultation with CDFW and the U.S. Fish and Wildlife Service with respect to determining appropriate setbacks.

Mitigation Measure 5.5.3-5 indicates that a qualified biologist or CDFW be consulted during project development when treatments are proposed in maritime chaparral (identified as a rare natural community prescribed for special treatment in the draft PEIR). This measure should be modified to address all rare natural communities and declining common vegetation types supporting key species adapted to infrequent dry season fires. Any proposed treatments should be evaluated based on current science and specific characteristics of the local and regional project area and include follow up monitoring. We recommend using a regional interdisciplinary team approach to ensure adequate review and planning. Adoption of appropriate treatment alternatives, including no treatment, is warranted where alliances and associates are rare, declining, or particularly vulnerable to adverse effects from vegetation treatments.

Mitigation Measure 5.5.4-3 states "*Prior to implementing any project which could create conditions favorable to invasive species, CAL FIRE/applicant shall contact the county Agriculture Department and any local groups concerned with noxious weed control, to ascertain the location and extent of known populations of non-native invasive species, which could provide a seed source in the project area*." This measure offers no mitigation actions or commitments for avoiding or compensating for an activity. CDFW recommends that all VTP projects include on the ground assessments for existing invasive species, and include analysis and effective strategies for preventing them from expanding into project treatment areas. Post-treatment follow-up monitoring at years 1, 5 and 10, should also be considered to address changed conditions stemming from the project and include mitigation to effectively control and remove noxious and problematic weeds. The VTP should include a funded weed management program and trained staff to implement the program at the regional project level. Where invasive species like

Mediterranean annual grasses and forbs are present near proposed treatments, prescribed fires in intact habitats adjoining areas supporting these species should be minimized.

***Water Resources and Water Quality*** Section 4.7. Impacts associated with changes in water quality properties may be as important as increased sediment yields. For example, phosphorus loads are thought to increase after prescribed wildfires just below wildfire levels. Nitrate-N concentrations peak slightly higher with a wildfire, but within a few months appear to return to normal levels. Prescribed burns lengthen the duration of nitrate-N leaching from the soil, thereby contributing more overall pollution to the watershed (Meixner, 2004). An important management consideration should be to evaluate fire effects on chaparral ecosystem processes, such as identifying variables in terms of short and long-term recovery (associated nitrate cycles) and implications of fire suppression, prescription, and management on catchment nutrient export (Meixner et al. 2003).

The list of principal rivers in the program area by region (Table 4.7.2) should be amended to include the Tijuana River. The Tijuana River watershed is divided by the U.S. and Mexico international border and is probably the most impaired watershed in San Diego County (CRWQCB 1994). The CRWQCB identifies sedimentation as a priority pollutant and should be included within Table 4.7.4 of the final PEIR.

Table 4.7.6 identified no lakes, bays, and estuaries impaired by sediment within Regional Water Quality Control Board Region 9. According to California's 2010 State Water Resources Control Board Clean Water Act Section 303(d) List/305(b) Report, 5 waterbodies within those waterbody categories are impaired by sediment. Additionally, Table 4.7.5 and 4.7.6 provides a citation to a 2010 State Water Resource Control Board reference source; however, we were unable to locate that citation for Chapter 4 – Literature Cited. Revisions should be provided where needed to address the aforementioned items.

**Landscape Available to be Treated**: DEIR Section 2.2; page 2-5; number 1 states:

> *A watercourse and lake protection zone (WLPZ) will be established on each side of all Class I and II watercourses (see Glossary for definitions) that is equal to the widths specified in the CA Forest Practice Rules, which vary between 75-150 feet on each side of Class I watercourses and from 50-100 feet on each side of Class II watercourses. WLPZs are measured by slope distance from the high water mark of the watercourse. Vegetation significant to maintenance of watercourse shade will not be disturbed within Class I and II watercourses. Vegetation within and adjacent to Class III watercourses will be retained, as feasible, to protect water quality.*

Use of the Forest Practice Rules' stream definitions limits protection from heavy earth-moving equipment to watercourses where fish and non-fish but fully aquatic species are present, and implicitly allows heavy equipment operation in all other watercourses. While such an approach may by appropriate in perennial streams in temperate region environs, it is entirely unsuited to the intermittent and ephemeral streams that comprise the majority of the streams in the drier parts of the state and that dominate the landscape in Modoc, Southern San Joaquin Valley, Mojave, and Colorado Desert bioregions. Fully aquatic species are typically absent from these dryland streams but the streams nevertheless are critical to the survival of terrestrial plant and animal species. This comment is also pertinent to Chapter 3 – Alternatives; section 3.6 subsections A and C.

CDFW recommends that the Class I through III definitions and their reliance on the presence of fully aquatic species be abandoned in this application.

> Section 2.2 number 2: *Heavy earth-moving equipment will not operate within the WLPZ of any Class I or II watercourse without a California Department of Fish and Game (DFG) Streambed Alteration Agreement, as indicated above except at existing or designated crossings*

The above statement implies that CDFW Streambed Alteration Agreements are required for heavy equipment work in Class I and Class II streams but no such permit and/or consultation with CDFW is required for similar work in Class III streams where aquatic life is absent. The FPRs definition for Class III streams is absent from the Glossary. Fish and Game Code section 1600 et seq. applies to ephemeral streams. DFW recommends that the VTP indicate that alterations and activities in ephemeral/Class III streams regardless of the presence or absence of aquatic species may require notification to the DFW and acquisition of a Streambed Alteration Agreement.

This comment is also pertinent to section 4.5 Biological Resources, subsection 4.5.1 Aquatics and subsection 4.5.1.2 Overview of Aquatic Habitat Conditions; pages 4.5-23 through 4.5-26 where "headwater streams" are defined as Class II and Class III streams.

**Biological Resources and Riparian Function:** The term "riparian" is used throughout the VTP in close association with iconic woody riparian/wetland plant species like cottonwood and willow *(draft PEIR section 4.5, pg. 4.5-20 and 4.5.1.2, pg. 4.5-24).*

While the presence of riparian vegetation can be an appropriate indicator in temperate perennial and intermittent stream ecosystems, it is not generally a meaningful indicator of dryland episodic stream environments where stream-associated upland species tend to dominate.

CDFW recommends that the term "riparian" be defined and added to the VTP Glossary and that its usage be clarified throughout the document. To reflect the most current usage of the term and its pertinence in the VTP's statewide application, CDFW recommends the definition developed by the National Research Council (as noted above) and currently used in practice by CDFW and the SWRCB (NRC 2002)

*[A]reas adjacent to perennial, intermittent, and ephemeral streams or lakes, and estuarine-marine shorelines that are transitional between terrestrial and aquatic ecosystems and that are distinguished by gradients in biophysical conditions, ecological processes, and biota; an area through which surface and subsurface hydrology connect waterbodies with their adjacent uplands. Riparian areas include those portions of terrestrial ecosystems that significantly influence exchanges of energy and matter with aquatic ecosystems (i.e., a zone of influence) (NRC 2002)*.

**Aquatics/Aquatic Habitat Conditions**: Headwater streams are typically defined by the scientific community as first or second order streams, relatively higher in a watershed than the larger and higher order streams they flow to. However, first order streams also occur much lower and in greater density in dryland watersheds of the state. As used in the examples below and as linked with the FPRs Class II and Class II terminology, it is unclear whether the VTP has included first order dryland streams in their analysis or what protection they would receive. Moreover, the VTP application describes species use typical of temperate region intermittent and perennial headwater stream ecosystems. Species use of dryland first order – or headwater – or Class II and Class III streams is typically quite different, oftentimes with the use of these episodic water sources by terrestrial species from many miles away.

This comment is also pertinent to section 4.5 Biological Resources, subsection 4.5.1 Aquatics and subsection 4.5.1.2 Overview of Aquatic Habitat Conditions; pages 4.5-23 through 4.5-26 where "headwater streams" are defined as Class II and Class III streams and also to Chapter 6, section 6.4.11k Cumulative Effects Potential – Criterion 1K, pages 6-82 through -83, disturbance as an influence on Headwater Streams Ecosystem Structure and Function.

CDFW recommends that the Final PEIR for the VTP indicate that alterations and activities in ephemeral/Class III streams regardless of the presence or absence of aquatic species may require notification to the CDFW and acquisition of a Streambed Alteration Agreement. CDFW also recommends that the term "headwater stream" be defined and added to the Glossary.

**Watershed Condition and Geomorphology**: Section 4.7.3 of the draft PEIR states:

*Geomorphology is not an environmental resource like biology or cultural resources. Potential effects on fluvial geomorphic processes are not direct environmental impacts, but geomorphic effects have the potential to lead to other environmental effects through further changes in channel conditions. Changes in vegetative cover associated with VTP projects and the increase or decrease in the amount of high severity fires can in turn influence the delivery of sediment and large woody debris to stream channels; these in turn modify the geomorphic characteristics of a stream. Changes in geomorphology can affect both sediment transport and, through aggrading channel beds, can increase the frequency or severity of flooding.*

This is not correct. Alterations of basic fluvial geomorphic processes do indeed result in direct and potentially detrimental environmental impacts. For example: alterations to sand transport that directly supplies dune habitat utilized by sensitive species such as the fringe toed lizards; changes in sediment supply that result in the loss of spawning gravels that provide life stage-critical spawning habitat to salmonids; changes in bank erosion and loss of nesting habitat for bank swallows.

CDFW recommends that the first sentence of this section be altered accordingly: *~~Geomorphology is not an environmental resource like biology or cultural resources.~~ ~~Potential~~ ~~Effects~~ Effects on fluvial geomorphic processes can result in ~~are not~~ direct and indirect detrimental environmental impacts, ~~but geomorphic effects have the potential to lead to other environmental effects~~ through ~~further~~ alterations in the geomorphic processes responsible for creating and maintaining the physical habitat that sustains the stream ecosystem ~~changes in channel conditions~~.*

The Section 4.7.3 of the draft PEIR further states:

> *Fluvial geomorphology is the study of sediment transport by flowing water and its effect on the size and shape of stream channels.*

Sediment transport is only one of many processes that comprise the science of fluvial geomorphology. While it is correct that the morphology of many fluvial systems – and particularly fully alluvial channels – is largely a function of flow regime and sediment load, it is not the only factor or the dominate factor controlling channel morphology.

CDFW recommends that this sentence be altered accordingly: *Fluvial geomorphology is the study of the processes that operate in river systems and the landforms a river creates or has created ~~sediment transport by flowing water and its effect on the size and shape of stream channels~~.*

**Potential Effects on Water Quality:** The statement below explicitly limits protection of overstory trees to those that occur along fish-bearing perennial streams, reflects the north coast, temperate region perennial stream ecosystem orientation of the FPRs.

> *For the Proposed Program and Alternatives 2, 3 and 4 there is no requirement to retain overstory trees along Class III streams; however, these are seasonal streams that do not flow during the summer months, and thus are not subject to increased solar radiation on the stream surface when these streams are flowing (draft PEIR section 5.7.4, pgs. 5.7-12 & 13).*

CDFW recommends that the statement be edited to also address riparian resources associated with the episodic stream ecosystems that dominate the dryland environs of the state.

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# EXHIBIT 8

9222 Lake Canyon Road
Santee, CA 92071

February 21, 2013

Board of Forestry and Fire Protection
Attn: George Gentry
Executive Officer
VegetationTreatment@fire.ca.gov
Sacramento, CA 94244-2460

Via Electronic Mail

**Re: Draft Program EIR for the Vegetation Treatment Program (VTP)**

Dear Mr. Gentry and Board Members,

The California Board of Forestry and Fire Protection proposes a program for potential "treatment" of 38,000,000 acres over an unspecified period (likely to be 2.16 million acres in any decade). (ES iv) As a former USDA-Forest Service Wildland Firefighter and experienced Natural Resource Geographer, please consider my expert comments upon the VTPEIR.

## Exceedingly Narrow Alternatives

CEQA requires "a range of reasonable and feasible alternatives to the project". However, all three "alternative" projects offered consist of slight variations in landscape level "Treatments." An Alternative must be assessed that provides something other than a landscape level treatment to reach important project goals. Alternatives that would invest primarily in retrofit and better design of the wildland-urban interface or reducing anthropogenic ignitions and exacerbations of climate change should be considered as potentially superior.

"*The need for the Program is based on the fact that the wildlands of California are naturally fire prone. Past land and fire management practices have had the effect of increasing the intensity, rate of spread, as well as the annual acreage burned on these lands (BOF, 1996)*." (ES ii)

The second sentence of the statement above is controversial when applied to diverse landscapes. For example, Keeley and Zedler conclude:

"*Thus, the idea that fire suppression has altered fuel structure in ways that make this landscape more vulnerable to large fires is demonstrably false for southern California*."

The VTPEIR fails to adequately explore scientific data[1] related to the impacts of fire

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[1] Jon E. Keeley and Paul H Zedler. "Large, high-intensity fire events in southern California shrublands: debunking the fine-grain age patch model", Ecological

management practices upon diverse biomes. Thus, an unsupported assumption that "*fire management practices have had the effect of increasing the intensity, rate of spread, as well as the annual acreage burned"* has provided seriously questionable rational driving the program/project. In fact, the fire behavior recognized is more likely attributed to climate change coupled with increased human caused ignitions exacerbated by exceedingly poor land use planning. Analysis and recognition of this undisclosed view might result in very different alternatives for consideration, goals and judgment of the need for the VTP.

There is a large amount of scientific research from Jon Keeley and others that suggests that Program Goals 3, 4, 6, 7, & 8, (ES iii) are improbable to be achieved by broad landscape level "treatments", especially in shrub and chaparral ecosystems.[2] The research should be reviewed and the PEIR modified accordingly. Without doing so, the VTP can be accurately characterized as panic reaction to an era of increasingly severe wildland fires.

The first sentence of the Executive Summary (ES) rightly acknowledges climate change impacts, suggesting climate change "*may already be*" responsible for increased acreage burned and further notes that differing climate models predict differing vegetative changes. (ES iii) Importantly, the ES concludes, "Precipitation will either increase or decrease, depending upon the scenario modeled." This prediction of opposites has extremely different impacts/outcomes upon vegetation, wildlife and ecosystems. This statement in the ES reveals that we do not and cannot know what we are doing when proposing a program level treatment of such vast and diverse landscapes that are under assault by rapid changes - the causes of which our international political and economic systems have been incapable of controlling.

Regardless, if any Alternative other than the No Project Alternative is implemented and "the cumulative impacts of the larger program" are to be disclosed, assessed, avoided and mitigated adequately in compliance with CEQA, then detailed answers to questions included in this comment letter are essential.

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Applications, 19(1), 2009, p. 90, attached.

[2] Jon E. Keeley, et al., "Ecological Foundations for Fire Management in North American Forest and Shrubland Ecosystems", United States Department of Agriculture Forest Service, Pacific Northwest Research Station, General Technical Report PNW-GTR-779, March 2009, attached.
Alexandra D. Syphard, et al., "Predicting spatial patterns of fire on a southern California landscape", International Journal of Wildland Fire 2008, 17, 602–613, attached.
Alexandra D. Syphard, et al., "Conservation Threats Due to Human-Caused Increases in Fire Frequency in Mediterranean-Climate Ecosystems", Conservation Biology, Volume 23, No. 3, 2009, attached.

**Environmental Checklist**

Chapter 8 is devoted to the use of an environmental checklist and there are at least 28 references to an "Environmental Checklist" in the Draft PEIR including the following excerpts.

"*The environmental checklist includes the potential impacts and mitigation measures described in the PEIR. No additional CEQA documentation will be required if the subsequent project is within the scope of the program and if the environmental effects have been evaluated in the PEIR*." 2-28

"*In CEQA terms, the VTP environmental checklist is essentially an "Initial Study". If the checklist reveals no significant adverse impacts resulting from the VTP project, then the proposed project is both within the scope of the VTPEIR and in compliance with CEQA*." 8-1

"*If the project, as finally proposed after including results of consultation with trustee and responsible agencies, could create environmental impacts that have not been addressed in the VTPEIR or that cannot be mitigated or avoided using measures from this "checklist", CEQA requires the Lead Agency to do a supplemental environmental analysis and public review. The Checklist will contain four sections for most resource areas that could be affected by VTP projects: Chapter Heading, Conditions, Procedure, and Other*." 8-1

"*The checklist shall be completed by the lead agency for all VTP projects. The completed checklist will indicate whether the proposed project is in compliance with the Minimum Landscape Constraints, Management Requirements, and other requirements noted in the PEIR, thereby indicating whether the environmental effects of the proposed project are consistent with the analysis in the EIR.* ***The Board will adopt a checklist as recommended by section 15168 (c)(4) at the time a determination is made on the Final EIR****."* 8-1

**Where and specifically what is to be in the "Environmental Checklist"?**
The use of the "Environmental Checklist" is a key function of the VTP in its attempt to meet the requirements of CEQA for a vast program with potentially known and unknown significant adverse environmental impacts. The public and decision makers should have the opportunity to evaluate how complete, useful and how feasible it is for the "Environmental Checklist" to satisfy all the requirements of CEQA for the final VTPEIR and subsequent projects. Thus, reviewers must be able to evaluate the feasibility for the "checklist" to essentially substitute for the current requirement of a more rigorous environmental analysis at the project level. The apparent absence of the "Environmental Checklist" from the DPEIR is a fatal flaw in the Draft VTPEIR. The VTPEIR will be legally inadequate without including a checklist designed for diverse habitats and ecosystems and under each climatic change modeled (i.e., "increased or decreased precipitation" by season, elevation, watershed and region considering the implications of these changes). What will be included within the "Environmental Checklist" under these different potential circumstances?

**Substantial Evidence Lacking**

Upon what basis will it be determined that the environmental effects of a subsequent project have been evaluated within the PEIR? The Draft VTPEIR lacks substantial evidence to indicate that the broad determinations of the PEIR will be adequate to address the diversity and complexity of the program area or time period to which the VTPEIR suggests it would be applied.

For example, it is my personal observation as a former Wildland-Firefighter and Natural Resource Geographer that disturbance of certain natural habitats will increase the overall landscapes vulnerability to wildfire due to invasions of non-native species and greater access by human activities. What evidence demonstrates that the VTP can avoid or mitigate the invasion and spread of highly flammable, non-native weeds and grasses expected to be the result of widespread disturbance proposed by the VTP? The physical and economic requirements to adequately mitigate the increased ignitability of certain VTP disturbed areas have not been adequately evaluated. What are the specific actions and costs associated with mitigating these significant adverse impacts of the VTP to a level of insignificance? Consider that potential treatments provide potential for significant increases in the length of the fire season at different elevations throughout the state.

What quantity of greenhouse gases will be produced directly by the treatments proposed? What quantity of GHGs will not be able to be removed from the atmosphere due to the modification or destruction of acres treated? How will these quantities of GHGs impact climate change and what evidence indicates that the impacts will be significant or insignificant?

What are the impacts of the VTP to species? Explain why the potential impacts are considered significant or insignificant? What species on the “State and Federally Listed, Threatened, and Rare Plants of California” list (Exhibit 1), on the “Special Vascular Plants, Bryophytes, And Lichens List” (Exhibit 2), on the “Special Animals (898 taxa) January 2011” list (Exhibit 3) and on the “State & Federally Listed Endangered & Threatened Animals of California” list (Exhibit 4) will be impacted by the VTP? Where and in what quantities will these species be impacted and by which treatment activities? What are the consequences of these impacts to these species and their ecosystems? What evidence indicates that the impacts will be significant or insignificant? What are the specific actions and costs associated with mitigating the significant adverse impacts of the VTP upon these species to a level of insignificance?

What are the impacts of the VTP to “covered species” lists within Habitat Conservation Plans (HCPs) being adopted and implemented under the state Natural Communities Conservation Program (NCCP)? HCPs have contractual obligations that would be significantly adversely impacted by modifying management with an introduction of fire clearance “treatments” that were expected to be applied outside of multiple species preserves.

What and how many species in San Diego's MSCP would be adversely impacted by the VTP that should result in their removal from its "covered species" list?

How many HCPs in California are being impacted by the VTP and what is the status of these HCPs (please differentiate between negotiations, draft plans and those adopted under implementation contracts). How many have subarea plans that have failed to be adopted and how will adding "treatment" obligations impact the ability to adopt and implement these subarea plans? Santee's un-adopted subarea plan within the MSCP is an example.

**Significant Impacts and Mitigation**

Because the Draft VTPEIR fails to do a comprehensive review of scientific research related to the proposed VTP and because the EIR is so ambiguous in regard to where, when, why and how "Treatment" projects will be implemented, its determination discussion of significant and insignificant impacts is a meaningless exercise. It should be revisited after more specifically defining the Program and considering a range of real alternatives.

Thank you for considering these comments,

Van K. Collinsworth, M.A.
Natural Resource Geographer & former
Wildland Firefighter, USDA-Forest Service[3]

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[3] Van K. Collinsworth obtained a Master's degree with Geographic emphasis in 1986 from Humboldt State University, a Bachelor's in Geography in 1982 and teaching credential in 1983, HSU. Natural Resource and Geographic studies include: Biology, Botany, Zoology, Ecology, Geology, Soil Science, Hydrology, Range Management, Environmental Impact Report Writing, Natural Resource Economics, Economic Geography, Physical Geography, Urban Geography, Mountain Geography, Cartography, Air Photo Interpretation, Resource Planning & Environmental Design, Environmental Policy, Conservation Geography, Environmental Engineering. Completion of various fire behavior and suppression courses with the US Forest Service. Related professional experience includes resource interpretation, land management and fire suppression assignments with the USDA-Forest Service between 1980 and 1992. Founded Preserve Wild Santee in 1994. Voluntarily analyzed numerous CEQA and NEPA documents submitting comments that helped to improve development projects within the San Diego County. Monitored compliance with mitigation requirements, ordinances and plans. Provided a region-wide source of environmental education. In 2003, participated in the founding and on-going educational activities of the San Diego Fire Recovery Network. Produced "Preventing Firestorm Disaster" PowerPoint utilized as the basis of educational exhibits in public buildings.

Attachments:
Exhibit 1: “State and Federally Listed, Threatened, and Rare Plants of California”

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Specific fire suppression experience that is relevant to comments submitted in this letter includes: Participation in the planning and execution of sage land and pine forest control burns. Drove and operated fire engines. Engine assignments included everything from small initial response to engine strike teams dispatched to large wildland fires throughout the western United States. Large fire response was also often as a member of a hand crew actively building fireline, backfiring and burning out. I was also transported on initial attack by helicopter and worked with helicopters on water drops, or when equipped with a helitorch. Guided from the ground safe landings and take-offs at high altitudes. Knew and utilized the Incident Command System. Performed as Incident Commander on initial attack and transitioned to other roles as warranted including assisting Operations and Air Operations Officers. Sized-up fires upon initial attack and ordered other resources from dispatch necessary to suppress fires. Briefed superior officers/ICS Teams to the location of all incident resources upon transition.
The fire example most similar to the Cedar and Witch Fires was the 133,000-acre Wheeler Fire on the Los Padres National Forest. I performed as a Squad Supervisor on a twenty-person crew that doused structure ignitions fueled by “Sundowner” Santa Ana winds throughout the night of our initial 24-hour shift. The total nine-shift campaign included extensive line building in steep chaparral topography that included backfiring operations where I used a drip-torch in coordination with a helitorch above to successfully ignite fires that ran into and contained the main fire. I voluntarily used this experience to assist structure protection when the Cedar Fire burned to Santee’s wildland/urban interface in 2003.
Total professional fire assignments ranged diversely from coastal to alpine environments that included natural and human ignitions under various climatic conditions within diverse plant communities. The most difficult and dangerous assignments were usually attempts to protect structures found within wildlands. On my initial fire (the “Swall Fire” in 1981) we experienced a 180 degree reversal in wind direction that forced us to immediately abandon flanking line construction to defend homes on the down-slope fire head of a steep sage scrub and pine forest mountain. As the most experienced members of our crew completed backfiring ignitions at the closest structure, I was instructed to initiate the crew’s decent down the escape route and into the safety zone. The wind and heat from the fire became so intense that it blew the hardhats off of some of the firefighters as we ran down the escape route. While this particular home was saved, other homes on the slope were destroyed. A fire engine was destroyed and others were damaged on the same slope. Fortunately, there were no casualties and after the fire head blew by us we returned to protecting structures throughout the night. The loss of structures on this fire was my first experience with members of the public blaming government firefighters for the loss of homes. The reality is that the homes placed within the unfavorable circumstances of topography, weather and fuel exceeded our ability to save more structures that day. This dangerous situation on the wildland/urban interface continues to multiply with predictably disastrous results throughout the western United States.

Exhibit 2: “Special Vascular Plants, Bryophytes, And Lichens List”
Exhibit 3: “Special Animals (898 taxa) January 2011”
Exhibit 4: “State & Federally Listed Endangered & Threatened Animals of California”
Exhibit 5: Wildland Fire Research Examples Binder

State of California
The Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Biogeographic Data Branch
**California Natural Diversity Database**

STATE AND FEDERALLY LISTED
ENDANGERED, THREATENED, AND RARE PLANTS OF CALIFORNIA

**January 2013**

Designations and Subtotals for each Designation:

| | Designations: | Subtotals: |
|---|---|---|
| SE | State-listed endangered | 134 |
| ST | State-listed threatened | 22 |
| SR | State-listed rare | 64 |
| SC | State candidate for listing | 0 |
| FE | Federally listed endangered | 139 |
| FT | Federally listed threatened | 47 |
| FPE | Federally proposed endangered | 0 |
| FPT | Federally proposed threatened | 0 |
| | Both State and Federally listed | 125 |

State listing is pursuant to §1904 (Native Plant Protection Act of 1977) and §2074.2 and §2075.5 (California Endangered Species Act of 1984) of the Fish and Game Code, relating to listing of Endangered, Threatened and Rare species of plants and animals. Federal listing is pursuant with the Federal Endangered Species Act of 1973, as amended. For information regarding plant conservation, contact the Habitat Conservation Planning Branch, 1416 Ninth Street, Sacramento, CA 95814, phone (916) 653-9767, or the nearest Department of Fish and Wildlife office. For information on this list, contact CNDDB's Information Services at (916) 324-3812. Scientific and common names for State-listed plants are listed in Title 14, §670.2. Scientific or common names in parentheses are the most scientifically accepted nomenclature but have yet to be officially adopted into the California Code of Regulations, Title 14, Division 1, §670.2.

| **State Designated Plants** | **Classification** | | | |
|---|---|---|---|---|
| | **State** | **List Date** | **Federal** | **List Date** |
| *Acanthomintha duttonii*<br>San Mateo thorn-mint | SE | Jul 1979 | FE | Sep 18,1985 |
| *Acanthomintha ilicifolia*<br>San Diego thorn-mint | SE | Jan 1982 | FT | Oct 13,1998 |
| *Agrostis blasdalei* var. *marinensis* (=*Agrostis blasdalei*)<br>Marin bent grass | | Delisted April 2008. | | |
| *Allium munzii*<br>Munz's onion | ST | Jan 1990 | FE | Oct 13,1998 |
| *Allium yosemitense*<br>Yosemite onion | SR | Jul 1982 | | |

| **State Designated Plants** | Classification | | | |
|---|---|---|---|---|
| | **State** | **List Date** | **Federal** | **List Date** |
| *Alopecurus aequalis* var. *sonomensis*<br>Sonoma alopecurus | | | FE | Oct 22,1997 |
| *Ambrosia pumila*<br>San Diego ambrosia | | | FE | July 2, 2002 |
| *Amsinckia grandiflora*<br>large-flowered fiddleneck | SE | Apr 1982 | FE | May 08,1985 |
| *Arabis hoffmannii*<br>Hoffmann's rock cress | | | FE | Jul 31,1997 |
| *Arabis macdonaldiana*<br>McDonald's rock cress | SE | Jul 1979 | FE | Sep 28,1978 |
| *Arctostaphylos bakeri* (=*A. b.* ssp. *bakeri* and *A. b.* ssp. *sublaevis*)<br>Baker's manzanita | SR | Sep 1979 | | |
| *Arctostaphylos confertiflora*<br>Santa Rosa Island manzanita | | | FE | Jul 31,1997 |
| *Arctostaphylos densiflora*<br>Vine Hill manzanita | SE | Aug 1981 | | |
| *Arctostaphylos edmundsii* var. *parvifolia*<br>Hanging Gardens manzanita | | Delisted April 2008 | | |
| *Arctostaphylos glandulosa* ssp. *crassifolia*<br>Del Mar manzanita | | | FE | Oct 07,1996 |
| *Arctostaphylos hookeri* ssp. *hearstiorum*<br>Hearst's manzanita | SE | Sep 1979 | | |
| *Arctostaphylos hookeri* ssp. *ravenii*<br>Presidio manzanita | SE | Nov 1978 | FE | Oct 26,1979 |
| *Arctostaphylos imbricata*<br>San Bruno Mountain manzanita | SE | Sep 1979 | | |
| *Arctostaphylos morroensis*<br>Morro manzanita | | | FT | Dec 15,1994 |
| *Arctostaphylos myrtifolia*<br>Ione manzanita | | | FT | May 26,1999 |
| *Arctostaphylos pacifica*<br>Pacific manzanita | SE | Sep 1979 | | |
| *Arctostaphylos pallida*<br>pallid manzanita | SE | Nov 1979 | FT | Apr 22,1998 |
| *Arenaria paludicola*<br>marsh sandwort | SE | Feb 1990 | FE | Aug 03,1993 |
| *Arenaria ursina*<br>Big Bear Valley sandwort | | | FT | Sep 14,1998 |
| *Astragalus agnicidus*<br>Humboldt milk-vetch | SE | Apr 1982 | | |
| *Astragalus albens*<br>Cushenbury milk-vetch | | | FE | Aug 24,1994 |

| **State Designated Plants** | **Classification** | | | |
|---|---|---|---|---|
| | **State** | **List Date** | **Federal** | **List Date** |
| *Astragalus brauntonii*<br>Braunton's milk-vetch | | | FE | Jan 29,1997 |
| *Astragalus claranus* (= *A. clarianus*)<br>Clara Hunt's milk-vetch | ST | Jan 1990 | FE | Oct 22,1997 |
| *Astragalus jaegerianus*<br>Lane Mountain milk-vetch | | | FE | Oct 06,1998 |
| *Astragalus johannis-howellii*<br>Long Valley milk-vetch | SR | Jul 1982 | | |
| *Astragalus lentiginosus* var. *coachellae*<br>Coachella Valley milk-vetch | | | FE | Oct 06,1998 |
| *Astragalus lentiginosus* var. *piscinensis*<br>Fish Slough milk-vetch | | | FT | Oct 06,1998 |
| *Astragalus lentiginosus* var. *sesquimetralis*<br>Sodaville milk-vetch | SE | Sep 1979 | | |
| *Astragalus magdalenae* var. *peirsonii*<br>Peirson's milk-vetch | SE | Nov 1979 | FT | Oct 06,1998 |
| *Astragalus monoensis* (= *A. monoensis* var. *monoensis*)<br>Mono milk-vetch | SR | Jul 1982 | | |
| *Astragalus pycnostachyus* var. *lanosissimus*<br>Ventura Marsh milk-vetch | SE | Apr 2000 | FE | May 21,2001 |
| *Astragalus tener* var. *titi*<br>coastal dunes milk-vetch | SE | Feb 1982 | FE | Aug 12,1998 |
| *Astragalus traskiae*<br>Trask's milk-vetch | SR | Nov 1979 | | |
| *Astragalus tricarinatus*<br>triple-ribbed milk-vetch | | | FE | Oct 06,1998 |
| *Atriplex coronata* var. *notatior*<br>San Jacinto Valley crownscale | | | FE | Oct 13,1998 |
| *Atriplex tularensis*<br>Bakersfield smallscale | SE | Jan 1987 | | |
| *Baccharis vanessae*<br>Encinitas baccharis | SE | Jan 1987 | FT | Oct 07,1996 |
| *Bensoniella oregona*<br>bensoniella | SR | Jul 1982 | | |
| *Berberis nevinii*<br>Nevin's barberry | SE | Jan 1987 | FE | Oct 13,1998 |
| *Berberis pinnata* ssp. *insularis*<br>island barberry | SE | Nov 1979 | FE | Jul 31,1997 |
| *Blennosperma bakeri*<br>Sonoma sunshine | SE | Feb 1992 | FE | Dec 02,1991 |
| *Blennosperma nanum* var. *robustum*<br>Point Reyes blennosperma | SR | Nov 1978 | | |
| *Bloomeria humilis*<br>dwarf goldenstar | SR | Nov 1978 | | |
| *Brodiaea coronaria* ssp. *rosea*<br>Indian Valley brodiaea | SE | Sep 1979 | | |

**State Designated Plants** **Classification**

| | State | List Date | Federal | List Date |
|---|---|---|---|---|
| *Brodiaea filifolia*<br>thread-leaved brodiaea | SE | Jan 1982 | FT | Oct 13,1998 |
| *Brodiaea insignis*<br>Kaweah brodiaea | SE | Nov 1979 | | |
| *Brodiaea pallida*<br>Chinese Camp brodiaea | SE | Nov 1978 | FT | Sep 14,1998 |
| *Calamagrostis foliosa*<br>leafy reed grass | SR | Nov 1979 | | |
| *Calochortus dunnii*<br>Dunn's mariposa lily | SR | Nov 1979 | | |
| *Calochortus persistens*<br>Siskiyou mariposa lily | SR | Jul 1982 | | |
| *Calochortus tiburonensis*<br>Tiburon mariposa lily | ST | May 1987 | FT | Feb 03,1995 |
| *Calyptridium pulchellum*<br>Mariposa pussypaws | | | FT | Sep 14,1998 |
| *Calystegia stebbinsii*<br>Stebbins's morning-glory | SE | Aug 1981 | FE | Oct 18,1996 |
| *Camissonia benitensis*<br>San Benito evening-primrose | | | FT | Feb 12,1985 |
| *Carex albida*<br>white sedge | SE | Nov 1979 | FE | Oct 22,1997 |
| *Carex tompkinsii*<br>Tompkins's sedge | SR | Nov 1979 | | |
| *Carpenteria californica*<br>tree-anemone | ST | Jan 1990 | | |
| *Castilleja affinis* ssp. *neglecta*<br>Tiburon Indian paintbrush | ST | Jan 1990 | FE | Feb 03, 1995 |
| *Castilleja campestris* ssp. *succulenta*<br>succulent owl's-clover | SE | Sep 1979 | FT | Mar 26,1997 |
| *Castilleja cinerea*<br>ash-gray Indian paintbrush | | | FT | Sep 14,1998 |
| *Castilleja gleasonii*<br>Mt. Gleason Indian paintbrush | SR | Jul 1982 | | |
| *Castilleja grisea*<br>San Clemente Island Indian paintbrush | SE | Apr 1982 | FE | Aug 11,1977 |

**State Designated Plants** **Classification**

| | State | List Date | Federal | List Date |
|---|---|---|---|---|
| *Castilleja mollis*<br>soft-leaved Indian paintbrush | | | FE | Jul 31,1997 |
| *Castilleja uliginosa*<br>Pitkin Marsh Indian paintbrush | SE | Nov 1978 | | |
| *Caulanthus californicus*<br>California jewel-flower | SE | Jan 1987 | FE | Jul 19,1990 |
| *Caulanthus stenocarpus*<br>slender-pod jewel-flower | | Delisted April 2008 | | |
| *Ceanothus ferrisae*<br>coyote ceanothus | | | FE | Feb 03,1995 |
| *Ceanothus hearstiorum*<br>Hearst's ceanothus | SR | Aug 1981 | | |
| *Ceanothus maritimus*<br>maritime ceanothus | SR | Nov 1978 | | |
| *Ceanothus masonii*<br>Mason's ceanothus | SR | Nov 1978 | | |
| *Ceanothus ophiochilus*<br>Vail Lake ceanothus | SE | Jan 1994 | FT | Oct 13,1998 |
| *Ceanothus roderickii*<br>Pine Hill ceanothus | SR | Jul 1982 | FE | Oct 18,1996 |
| *Cercocarpus traskiae*<br>Catalina Island mountain-mahogany | SE | Apr 1982 | FE | Aug 08,1997 |
| *Chamaesyce hooveri*<br>Hoover's spurge | | | FT | Mar 26,1997 |
| *Chlorogalum purpureum* var. *purpureum*[1]<br>purple amole | | | FT | Mar 20,2000 |
| *Chlorogalum purpureum* var. *reductum*[2]<br>Camatta Canyon amole | SR | Nov 1978 | FT | Mar 20,2000 |
| *Chorizanthe howellii*<br>Howell's spineflower | ST | Jan 1987 | FE | Jun 22,1992 |
| *Chorizanthe orcuttiana*<br>Orcutt's spineflower | SE | Nov 1979 | FE | Oct 07,1996 |

[1] The U.S. Fish & Wildlife Service listed the entire species, *Chlorogalum purpureum*.

[2] The U.S. Fish & Wildlife Service listed the entire species, *Chlorogalum purpureum*.

| **State Designated Plants** | **Classification** | | | |
|---|---|---|---|---|
| | **State** | **List Date** | **Federal** | **List Date** |
| *Chorizanthe parryi* var. *fernandina*<br>San Fernando Valley spineflower | SE | Aug 2001 | | |
| *Chorizanthe pungens* var. *hartwegiana*<br>Ben Lomond spineflower | | | FE | Feb 04,1994 |
| *Chorizanthe pungens* var. *pungens*<br>Monterey spineflower | | | FT | Feb 04,1994 |
| *Chorizanthe robusta* (includes vars. *hartwegii* and *robusta*)<br>robust spineflower | | | FE | Feb 04,1994 |
| *Chorizanthe valida*<br>Sonoma spineflower | SE | Jan 1990 | FE | Jun 22,1992 |
| *Cirsium ciliolatum*<br>Ashland thistle | SE | Sep 1982 | | |
| *Cirsium fontinale* var. *fontinale*<br>fountain thistle | SE | Jul 1979 | FE | Feb 03,1995 |
| *Cirsium fontinale* var. *obispoense*<br>Chorro Creek bog thistle | SE | Jun 1993 | FE | Dec 15,1994 |
| *Cirsium hydrophilum* var. *hydrophilum*<br>Suisun thistle | | | FE | Nov 20,1997 |
| *Cirsium loncholepis*<br>La Graciosa thistle | ST | Feb 1990 | FE | Mar 20,2000 |
| *Cirsium rhothophilum*<br>surf thistle | ST | Feb 1990 | | |
| *Clarkia franciscana*<br>Presidio clarkia | SE | Nov 1978 | FE | Feb 03,1995 |
| *Clarkia imbricata*<br>Vine Hill clarkia | SE | Nov 1978 | FE | Oct 22,1997 |
| *Clarkia lingulata*<br>Merced clarkia | SE | Jan 1989 | | |
| *Clarkia speciosa* ssp. *immaculata*<br>Pismo clarkia | SR | Nov 1978 | FE | Dec 15,1994 |
| *Clarkia springvillensis*<br>Springville clarkia | SE | Sep 1979 | FT | Sep 14,1998 |
| *Cordylanthus maritimus* ssp. *maritimus*<br>salt marsh bird's-beak | SE | Jul 1979 | FE | Sep 28,1978 |
| *Cordylanthus mollis* ssp. *mollis*<br>soft bird's-beak | SR | Jul 1979 | FE | Nov 20,1997 |
| *Cordylanthus nidularius*<br>Mt. Diablo bird's-beak | SR | Nov 1978 | | |
| *Cordylanthus palmatus*<br>palmate-bracted bird's-beak | SE | May 1984 | FE | Jul 01, 1986 |
| *Cordylanthus rigidus* ssp. *littoralis*<br>seaside bird's-beak | SE | Jan 1982 | | |

| **State Designated Plants** | **Classification** | | | |
|---|---|---|---|---|
| | **State** | **List Date** | **Federal** | **List Date** |
| *Cordylanthus tenuis* ssp. *capillaris*<br>Pennell's bird's-beak | SR | Nov 1978 | FE | Feb 03,1995 |
| *Croton wigginsii*<br>Wiggins' croton | SR | Jan 1982 | | |
| *Cryptantha roosiorum*<br>bristlecone cryptantha | SR | Jul 1982 | | |
| *Cupressus abramsiana* (= Callitropsis abramsiana)<br>Santa Cruz cypress | SE | Nov 1979 | FE | Jan 08,1987 |
| *Cupressus goveniana* ssp. *goveniana* (=*Callitropsis goveniana)*<br>Gowen cypress | | | FT | Aug 12,1998 |
| *Dedeckera eurekensis*<br>July gold | SR | Nov 1978 | | |
| *Deinandra arida* (=*Hemizonia arida*)<br>Red Rock tarplant | SR | Jul 1982 | | |
| *Deinandra conjugens* (=*Hemizonia conjugens*)<br>Otay tarplant | SE | Nov 1979 | FT | Oct 13,1998 |
| *Deinandra increscens* ssp. *villosa*(=*Hemizonia increscens* ssp. *villosa*)<br>Gaviota tarplant | SE | Jan 1990 | FE | Mar 20,2000 |
| *Deinandra minthornii* (= *Hemizonia minthornii*)<br>Santa Susana tarplant | SR | Nov 1978 | | |
| *Deinandra mohavensis* (= *Hemizonia mohavensis*)<br>Mojave tarplant | SE | Aug 1981 | | |
| *Delphinium bakeri*<br>Baker's larkspur | SE | April 2007 | FE | Jan 26,2000 |
| *Delphinium hesperium* ssp. *cuyamacae*<br>Cuyamaca larkspur | SR | Jul 1982 | | |
| *Delphinium luteum*<br>yellow larkspur | SR | Sep 1979 | FE | Jan 26,2000 |
| *Delphinium variegatum* ssp. *kinkiense*<br>San Clemente Island larkspur | SE | Sep 1979 | FE | Aug 11,1977 |
| *Dichanthelium lanuginosum* var. *thermale*<br>Geysers dichanthelium | SE | Sep 1978 | | |
| *Dieteria asteroides* var. *lagunensis*<br>Mount Laguna aster (= *Machaeranthera asteroides* var. *lagunensis*) | SR | Sep 1979 | | |
| *Dithyrea maritima*<br>beach spectaclepod | ST | Feb 1990 | | |
| *Dodecahema leptoceras*<br>slender-horned spineflower | SE | Jan 1982 | FE | Sep 28,1987 |
| *Downingia concolor* var. *brevior*<br>Cuyamaca Lake downingia | SE | Feb 1982 | | |

| **State Designated Plants** | **Classification** | | | |
|---|---|---|---|---|
| | **State** | **List Date** | **Federal** | **List Date** |
| *Dudleya abramsii* ssp. *parva* (=*D. parva*)<br>Conejo dudleya | | | FT | Jan 29,1997 |
| *Dudleya brevifolia* (=*D. blochmaniae* ssp. *brevifolia*)<br>short-leaved dudleya | SE | Jan 1982 | | |
| *Dudleya cymosa* ssp. *agourensis* [3]<br>Santa Monica Mtns. dudleya | | | FT | Jan 29, 1997 |
| *Dudleya cymosa* ssp. *marcescens*<br>marcescent dudleya | SR | Nov 1978 | FT | Jan 29,1997 |
| *Dudleya cymosa* ssp. *ovatifolia*<br>Santa Monica Mountains dudleya | | | FT | Jan 29,1997 |
| *Dudleya nesiotica*<br>Santa Cruz Island dudleya | SR | Nov 1979 | FT | Jul 31,1997 |
| *Dudleya setchellii*<br>Santa Clara Valley dudleya | | | FE | Feb 03,1995 |
| *Dudleya stolonifera*<br>Laguna Beach dudleya | ST | Jan 1987 | FT | Oct 13,1998 |
| *Dudleya traskiae*<br>Santa Barbara Island dudleya | SE | Nov 1979 | FE | Apr 26,1978 |
| *Dudleya verityi*<br>Verity's dudleya | | | FT | Jan 29,1997 |
| *Enceliopsis nudicaulis* var. *corrugata*<br>Ash Meadows daisy | | | FT | May 20,1985 |
| *Eremalche kernensis*<br>Kern mallow | | | FE | Jul 19,1990 |
| *Eriastrum densifolium* ssp. *sanctorum*<br>Santa Ana River woollystar | SE | Jan 1987 | FE | Sep 28,1987 |
| *Eriastrum hooveri*<br>Hoover's woolly-star | | | Delisted | Oct 7,2003 |
| *Eriastrum tracyi*<br>Tracy's eriastrum | SR | Jul 1982 | | |
| *Erigeron parishii*<br>Parish's daisy | | | FT | Aug 24,1994 |
| *Eriodictyon altissimum*<br>Indian Knob mountainbalm | SE | Jul 1979 | FE | Dec 15,1994 |
| *Eriodictyon capitatum*<br>Lompoc yerba santa | SR | Sep 1979 | FE | Mar 20,2000 |

[3] The U.S. Fish & Wildlife Service has listed the more encompassing *Dudleya cymosa* ssp. *ovatifolia* from which ssp. *agourensis* was split.

| **State Designated Plants** | **Classification** | | | |
|---|---|---|---|---|
| | **State** | **List Date** | **Federal** | **List Date** |
| *Eriogonum alpinum*<br>Trinity buckwheat | SE | Jul 1979 | | |
| *Eriogonum apricum* var. *apricum*[4]<br>Ione buckwheat | SE | Aug 1981 | FE | May 26,1999 |
| *Eriogonum apricum* var. *prostratum*[5]<br>Irish Hill buckwheat | SE | Jan 1987 | FE | May 26,1999 |
| *Eriogonum butterworthianum*<br>Butterworth's buckwheat | SR | Nov 1979 | | |
| *Eriogonum crocatum*<br>Conejo buckwheat | SR | Sep 1979 | | |
| *Eriogonum giganteum* var. *compactum*<br>Santa Barbara Island buckwheat | SR | Nov 1979 | | |
| *Eriogonum grande* ssp. *timorum* (= Eriogonum grande var. timorum)<br>San Nicolas Island buckwheat | SE | Nov 1979 | | |
| *Eriogonum kelloggii*<br>Kellogg's buckwheat | SE | Apr 1982 | | |
| *Eriogonum kennedyi* var. *austromontanum*<br>southern mountain buckwheat | | | FT | Sep 14,1978 |
| *Eriogonum ovalifolium* var. *vineum*<br>Cushenbury buckwheat | | | FE | Aug 24,1994 |
| *Eriogonum thornei* (= *E. ericifolium* var. *thornei*)<br>Thorne's buckwheat | SE | Nov 1979 | | |
| *Eriogonum twisselmannii*<br>Twisselmann's buckwheat | SR | Jul 1982 | | |
| *Eriophyllum congdonii*<br>Congdon's woolly sunflower | SR | Jul 1982 | | |
| *Eriophyllum latilobum*<br>San Mateo woolly sunflower | SE | Jun 1992 | FE | Feb 03,1995 |
| *Eryngium aristulatum* var. *parishii*<br>San Diego button-celery | SE | Jul 1979 | FE | Aug 03,1993 |
| *Eryngium constancei*<br>Loch Lomond button-celery | SE | Jan 1987 | FE | Dec 23,1986 |
| *Eryngium racemosum*<br>Delta button-celery | SE | Aug 1981 | | |
| *Erysimum capitatum* var. *angustatum*<br>Contra Costa wallflower | SE | Nov 1978 | FE | Apr 26,1978 |

[4] The U.S. Fish & Wildlife Service has listed *Eriogonum apricum* as the species, which includes both rare varieties.

[5] The U.S. Fish & Wildlife Service has listed *Eriogonum apricum* as the species, which includes both rare varieties.

**State Designated Plants** **Classification**

| | State | List Date | Federal | List Date |
|---|---|---|---|---|
| *Erysimum menziesii*[6]<br>Menzies' wallflower | SE | Sep 1984 | FE | Jun 22,1992 |
| *Erysimum teretifolium*<br>Santa Cruz wallflower | SE | Aug 1981 | FE | Feb 04,1994 |
| *Fremontodendron decumbens*<br>Pine Hill flannelbush | SR | Jul 1979 | FE | Oct 18,1996 |
| *Fremontodendron mexicanum*<br>Mexican flannelbush | SR | Jul 1982 | FE | Oct 13,1998 |
| *Fritillaria gentneri*<br>Gentner's fritillary | | | FE | Dec 10,1999 |
| *Fritillaria roderickii*<br>Roderick's fritillary | SE | Nov 1979 | | |
| *Fritillaria striata*<br>striped adobe-lily | ST | Jan 1987 | | |
| *Galium angustifolium* ssp. *borregoense*<br>Borrego bedstraw | SR | Sep 1979 | | |
| *Galium buxifolium*<br>box bedstraw | SR | Nov 1979 | FE | Jul 31,1997 |
| *Galium californicum* ssp. *sierrae*<br>El Dorado bedstraw | SR | Nov 1979 | FE | Oct 18,1996 |
| *Galium catalinense* ssp. *acrispum*<br>San Clemente Island bedstraw | SE | Apr 1982 | | |
| *Gilia tenuiflora ssp. arenaria*<br>sand gilia | ST | Jan 1987 | FE | Jun 22,1992 |
| *Gilia tenuiflora ssp. hoffmannii*<br>Hoffmann's slender-flowered gilia | | | FE | Jul 31,1997 |
| *Gratiola heterosepala*<br>Boggs Lake hedge-hyssop | SE | Nov 1978 | | |
| *Grindelia fraxino-pratensis*<br>Ash Meadows gumplant | | | FT | May 20,1985 |
| *Hazardia orcuttii*<br>Orcutt's hazardia | ST | Aug 2002 | | |
| *Helianthemum greenei*<br>island rush-rose | | | FT | Jul 31,1997 |
| *Helianthus niveus* ssp. *tephrodes*<br>Algodones Dunes sunflower | SE | Nov 1979 | | |
| *Hesperolinon congestum*<br>Marin western flax | ST | Jun 1992 | FT | Feb 03,1995 |

[6] The U.S. Fish & Wildlife Service separately listed all as endangered, *E. menziesii* ssp. *eurekense*, *E. menziesii* ssp. *menziesii*, and *E. menziesii* ssp. *yadonii*.

**State Designated Plants** **Classification**

| | State | List Date | Federal | List Date |
|---|---|---|---|---|
| *Hesperolinon didymocarpum*<br>Lake County western flax | SE | Aug 1981 | | |
| *Holmgrenanthe petrophila* (= *Maurandya petrophila*)<br>rock lady | SR | Jul 1982 | | |
| *Holocarpha macradenia*<br>Santa Cruz tarplant | SE | Sep 1979 | FT | Mar 20,2000 |
| *Howellia aquatilis*<br>water howellia | | | FT | Jul 14,1994 |
| *Ivesia callida*<br>Tahquitz ivesia | SR | Jul 1982 | | |
| *Lasthenia burkei*<br>Burke's goldfields | SE | Sep 1979 | FE | Dec 02,1991 |
| *Lasthenia conjugens*<br>Contra Costa goldfields | | | FE | Jun 18,1997 |
| *Layia carnosa*<br>beach layia | SE | Jan 1990 | FE | Jun 22,1992 |
| *Lembertia congdonii* (=*Monolopia congdonii*)<br>San Joaquin woollythreads | | | FE | Jul 19,1990 |
| *Lesquerella kingii* ssp. *bernardina*<br>San Bernardino Mountains bladderpod | | | FE | Aug 24,1994 |
| *Lessingia germanorum*<br>San Francisco lessingia | SE | Jan 1990 | FE | Jun 19,1997 |
| *Lewisia congdonii*<br>Congdon's lewisia | SR | Jul 1982 | | |
| *Lilaeopsis masonii*<br>Mason's lilaeopsis | SR | Nov 1979 | | |
| *Lilium occidentale*<br>western lily | SE | Jan 1982 | FE | Aug 17,1994 |
| *Lilium pardalinum* ssp. *pitkinense*<br>Pitkin Marsh lily | SE | Nov 1978 | FE | Oct 22,1997 |
| *Limnanthes bakeri*<br>Baker's meadowfoam | SR | Nov 1978 | | |
| *Limnanthes douglasii* var. *sulphurea* (=*Limnanthes douglasii ssp. sulphurea)*<br>Point Reyes meadowfoam | SE | Apr 1982 | | |
| *Limnanthes floccosa* ssp. *californica*<br>Butte County meadowfoam | SE | Feb 1982 | FE | Jun 08,1992 |
| *Limnanthes gracilis* var. *parishii* (=*Limnanthes gracilis ssp. parishii)*<br>Parish’s meadowfoam | SE | Jul 1979 | | |
| *Limnanthes vinculans*<br>Sebastopol meadowfoam | SE | Nov 1979 | FE | Dec 02,1991 |

**State Designated Plants** **Classification**

| | State | List Date | Federal | List Date |
|---|---|---|---|---|
| *Lithophragma maximum*<br>San Clemente Island woodland star | SE | Feb 1982 | FE | Aug 08,1997 |
| *Lotus argophyllus* var. *adsurgens*<br>San Clemente Island bird's-foot trefoil | SE | Nov 1979 | | |
| *Lotus argophyllus* var. *niveus*<br>Santa Cruz Island bird's-foot trefoil | SE | Aug 1981 | | |
| *Lotus dendroideus* var. *traskiae*<br>San Clemente Island lotus | SE | Apr 1982 | FE | Aug 11,1977 |
| *Lupinus citrinus* var. *deflexus*<br>Mariposa lupine | ST | Jan 1990 | | |
| *Lupinus milo-bakeri*<br>Milo Baker's lupine | ST | Jan 1987 | | |
| *Lupinus nipomensis*<br>Nipomo Mesa lupine | SE | Jan 1987 | FE | Mar 20,2000 |
| *Lupinus padre-crowleyi*<br>Father Crowley's lupine | SR | Aug 1981 | | |
| *Lupinus tidestromii* var. *tidestromii* (=*L. tidestromii*)<br>Tidestrom's lupine | SE | Jan 1987 | FE | Jun 22,1992 |
| *Machaeranthera lagunensis*<br>(see *Dieteria asteroides* var. *lagunensis*) | | | | |
| *Mahonia sonnei* (= *Berberis sonnei*)<br>Truckee barberry | | Delisted April 2008 | Delisted | Oct 1,2003 |
| *Malacothamnus clementinus*<br>San Clemente Island bush mallow | SE | Feb 1982 | FE | Aug 11,1977 |
| *Malacothamnus fasciculatus* var. *nesioticus*<br>Santa Cruz Island bush mallow | SE | Nov 1979 | FE | Jul 31,1997 |
| *Malacothrix indecora*<br>Santa Cruz Island malacothrix | | | FE | Jul 31,1997 |
| *Malacothrix squalida*<br>island malacothrix | | | FE | Jul 31,1997 |
| *Monardella linoides* ssp. *viminea* (=*M. viminea*)<br>willowy monardella | SE | Nov 1979 | FE | Oct 13,1998 |
| *Nasturtium gambellii* (= *Rorippa gambellii*)<br>Gambel's water cress | ST | Feb 1990 | FE | Aug 03,1993 |
| *Navarretia fossalis*<br>spreading navarretia | | | FT | Oct 13,1998 |
| *Navarretia leucocephala* ssp. *pauciflora*<br>few-flowered navarretia | ST | Jan 1990 | FE | Jun 18,1997 |

| **State Designated Plants** | **Classification** | | | |
|---|---|---|---|---|
| | **State** | **List Date** | **Federal** | **List Date** |
| *Navarretia leucocephala* ssp. *plieantha*<br>many-flowered navarretia | SE | Nov 1979 | FE | Jun 18,1997 |
| *Nemacladus twisselmannii*<br>Twisselmann's nemacladus | SR | Jul 1982 | | |
| *Neostapfia colusana*<br>Colusa grass | SE | Nov 1979 | FT | Mar 26,1997 |
| *Nitrophila mohavensis*<br>Amargosa nitrophila | SE | Nov 1979 | FE | May 20,1985 |
| *Nolina interrata*<br>Dehesa nolina | SE | Nov 1979 | | |
| *Oenothera californica* ssp. *eurekensis*<br>Eureka Dunes evening-primrose | SR | Nov 1978 | FE | Apr 26,1978 |
| *Oenothera deltoides* ssp. *howellii*<br>Antioch Dunes evening-primrose | SE | Nov 1978 | FE | Apr 26,1978 |
| *Opuntia basilaris* var. *treleasei*<br>Bakersfield cactus | SE | Jan 1990 | FE | Jul 19,1990 |
| *Orcuttia californica*<br>California Orcutt grass | SE | Sep 1979 | FE | Aug 03,1993 |
| *Orcuttia inaequalis*<br>San Joaquin Valley Orcutt grass | SE | Sep 1979 | FT | Mar 26,1997 |
| *Orcuttia pilosa*<br>hairy Orcutt grass | SE | Sep 1979 | FE | Mar 26,1997 |
| *Orcuttia tenuis*<br>slender Orcutt grass | SE | Sep 1979 | FT | Mar 26,1997 |
| *Orcuttia viscida*<br>Sacramento Orcutt grass | SE | Jul 1979 | FE | Mar 26,1997 |
| *Ornithostaphylos oppositifolia*<br>Baja California birdbush | SE | Apr 2001 | | |
| *Oxytheca parishii* var. *goodmaniana* (=*Acanthoscyphus parishii var. goodmaniana*<br>Cushenbury oxytheca | | | FE | Aug 24,1994 |
| *Packera ganderi* (= *Senecio ganderi*)<br>Gander’s ragwort | SR | Jul 1982 | | |
| *Packera layneae* (= *Senecio layneae*)<br>Layne's ragwort | SR | Nov 1979 | FT | Oct 18,1996 |
| *Parvisedum leiocarpum* (=*Sedella leiocarpa*)<br>Lake County stonecrop | SE | Jan 1990 | FE | Jun 18,1997 |
| *Pedicularis dudleyi*<br>Dudley's lousewort | SR | Sep 1979 | | |
| *Pentachaeta bellidiflora*<br>white-rayed pentachaeta | SE | Jun 1992 | FE | Feb 03,1995 |
| *Pentachaeta lyonii*<br>Lyon's pentachaeta | SE | Jan 1990 | FE | Jan 29,1997 |
| *Phacelia insularis* ssp. *insularis*<br>northern Channel Islands phacelia | | | FE | Jul 31,1997 |

**State Designated Plants** | **Classification**

| | **State** | **List Date** | **Federal** | **List Date** |
|---|---|---|---|---|
| *Phlox hirsuta*<br>Yreka phlox | SE | Jan 1987 | FE | Feb 3,2000 |
| *Piperia yadonii*<br>Yadon's rein orchid | | | FE | Aug 12,1998 |
| *Plagiobothrys diffusus*<br>San Francisco popcorn-flower | SE | Sep 1979 | | |
| *Plagiobothrys strictus*<br>Calistoga popcorn-flower | ST | Jan 1990 | FE | Oct 22,1997 |
| *Pleuropogon hooverianus*<br>North Coast semaphore grass | ST | Dec 2002 | | |
| *Poa atropurpurea*<br>San Bernardino blue grass | | | FE | Sep 14,1998 |
| *Poa napensis*<br>Napa blue grass | SE | Jul 1979 | FE | Oct 22,1997 |
| *Pogogyne abramsii*<br>San Diego mesa mint | SE | Jul 1979 | FE | Sep 28,1978 |
| *Pogogyne clareana*<br>Santa Lucia mint | SE | Nov 1979 | | |
| *Pogogyne nudiuscula*<br>Otay Mesa mint | SE | Jan 1987 | FE | Aug 03,1993 |
| *Polygonum hickmanii*<br>Scott's Valley polygonum | SE | May 2005 | FE | Apr 8,2003 |
| *Potentilla hickmanii*<br>Hickman's cinquefoil | SE | Sep 1979 | FE | Aug 12,1998 |
| *Pseudobahia bahiifolia*<br>Hartweg's golden sunburst | SE | Aug 1981 | FE | Feb 06,1997 |
| *Pseudobahia peirsonii*<br>San Joaquin adobe sunburst | SE | Jan 1987 | FT | Feb 06,1997 |
| *Rorippa subumbellata*<br>Tahoe yellow cress | SE | Apr 1982 | | |
| *Rosa minutifolia*<br>small-leaved rose | SE | Oct 1989 | | |
| *Sanicula maritima*<br>adobe sanicle | SR | Aug 1981 | | |
| *Sanicula saxatilis*<br>rock sanicle | SR | Jul 1982 | | |
| *Sedella leiocarpa* (= *Parvisedum leiocarpum*)<br>Lake County stonecrop | SE | Jan 1990 | FE | Jun 18,1997 |
| *Senecio ganderi*<br>(see *Packera ganderi*) | | | | |
| *Senecio layneae* (=*Packera layneae*) | | | | |
| *Sibara filifolia*<br>Santa Cruz Island rock cress | | | FE | Aug 08,1997 |
| *Sidalcea covillei*<br>Owens Valley checkerbloom | SE | Jul 1979 | | |

**State Designated Plants** **Classification**

| | State | List Date | Federal | List Date |
|---|---|---|---|---|
| *Sidalcea hickmanii* ssp. *anomala*<br>Cuesta Pass checkerbloom | SR | Nov 1979 | | |
| *Sidalcea hickmanii* ssp. *parishii*<br>Parish's checkerbloom | SR | Nov 1979 | Removed as FC, 2006 Fed. Register | |
| *Sidalcea keckii*<br>Keck's checker-mallow | | | FE | Feb 16,2000 |
| *Sidalcea oregana* ssp. *valida*<br>Kenwood Marsh checkerbloom | SE | Jan 1982 | FE | Oct 22,1997 |
| *Sidalcea pedata*<br>bird-foot checkerbloom | SE | Jan 1982 | FE | Aug 31,1984 |
| *Sidalcea stipularis*<br>Scadden Flat checkerbloom | SE | Jan 1982 | | |
| *Silene campanulata* ssp. *campanulata*<br>Red Mountain catchfly | SE | Apr 1982 | | |
| *Streptanthus albidus* ssp. *albidus*<br>Metcalf Canyon jewel-flower | | | FE | Feb 03,1995 |
| *Streptanthus niger*<br>Tiburon jewel-flower | SE | Feb 1990 | FE | Feb 03,1995 |
| *Suaeda californica*<br>California seablite | | | FE | Dec 15,1994 |
| *Swallenia alexandrae*<br>Eureka Valley dune grass | SR | Aug 1981 | FE | Apr 26,1978 |
| *Taraxacum californicum*<br>California dandelion | | | FE | Sep 14,1998 |
| *Thelypodium stenopetalum*<br>slender-petaled thelypodium | SE | Feb 1982 | FE | Aug 31,1984 |
| *Thermopsis macrophylla* var. *angina* (=*T. macrophylla*)<br>Santa Ynez false lupine | SR | Aug 1981 | | |
| *Thlaspi californicum*<br>Kneeland Prairie penny-cress | | | FE | Feb 9,2000 |
| *Thysanocarpus conchuliferus*<br>Santa Cruz Island fringepod | | | FE | Jul 31,1997 |
| *Trichostema austromontanum* ssp. *compactum*<br>Hidden Lake bluecurls | | | FT | Sep 14,1998 |
| *Trifolium amoenum*<br>showy Indian clover | | | FE | Oct 22,1997 |
| *Trifolium polyodon*<br>Pacific Grove clover | SR | Sep 1979 | | |
| *Trifolium trichocalyx*<br>Monterey clover | SE | Nov 1979 | FE | Aug 12,1998 |
| *Tuctoria greenei*<br>Greene's tuctoria | SR | Sep 1979 | FE | Mar 26,1997 |
| *Tuctoria mucronata*<br>Crampton's tuctoria | SE | Jul 1979 | FE | Sep 28,1978 |
| *Verbena californica*<br>California vervain | ST | Aug 1994 | FT | Sep 14,1998 |

| **State Designated Plants** | **Classification** | | | |
| --- | --- | --- | --- | --- |
| | **State** | **List Date** | **Federal** | **List Date** |
| *Verbesina dissita*<br>Big-leaved crownbeard | ST | Jan 1990 | FT | Oct 07,1996 |

***California Department of Fish and Wildlife***
***Natural Diversity Database***

# *SPECIAL VASCULAR PLANTS, BRYOPHYTES, AND LICHENS LIST*

***January 2013***

Citation: California Department of Fish and Wildlife, Natural Diversity Database. January 2013. Special Vascular Plants, Bryophytes, and Lichens List. Quarterly publication. 73 pp.

## SPECIAL PLANTS

Last updated November 1, 2012

"Special Plants" is a broad term used to refer to all the plant taxa inventoried by the Department of Fish and Wildlife's California Natural Diversity Database (CNDDB), regardless of their legal or protection status. Special Plants include vascular plants and high priority bryophytes (mosses, liverworts, and hornworts). A few lichens are also tracked. Special Plant taxa are species, subspecies, or varieties that fall into one or more of the following categories:

- Officially listed by California or the Federal Government as Endangered, Threatened, or Rare;
- A candidate for state or federal listing as Endangered, Threatened, or Rare;
- Taxa which meet the criteria for listing, even if not currently included on any list, as described in Section 15380 of the California Environmental Quality Act (CEQA) Guidelines; these taxa may indicate "None" under listing status, but note that all CNPS List 1 and 2 and some List 3 and 4 (now known as California Rare Plant Ranks[1] 1A, 1B, 2, 3 and 4) plants may fall under Section 15380 of CEQA.
- A Bureau of Land Management, U.S. Fish and Wildlife Service, or U.S. Forest Service Sensitive Species;
- Taxa listed in the California Native Plant Society's *Inventory of Rare and Endangered Plants of California*;
- Taxa that are biologically rare, very restricted in distribution, or declining throughout their range but not currently threatened with extirpation;
- Population(s) in California that may be peripheral to the major portion of a taxon's range but are threatened with extirpation in California; and
- Taxa closely associated with a habitat that is declining in California at a significant rate (e.g. wetlands, riparian, vernal pools, old growth forests, desert aquatic systems, native grasslands, valley shrubland habitats, etc.).
- Taxa which meet the criteria for listing, even if not currently included on any list, as described in Section 15380 of the California Environmental Quality Act (CEQA) Guidelines; these taxa may indicate "None" under listing status, but note that all CNPS List 1 and 2 and some List 3 and 4 (now known as California Rare Plant Ranks[2] 1A, 1B, 2, 3 and 4) plants may fall under Section 15380 of CEQA.
- A Bureau of Land Management, U.S. Fish and Wildlife Service, or U.S. Forest Service Sensitive Species;
- Taxa listed in the California Native Plant Society's *Inventory of Rare and Endangered Plants of California*;
- Taxa that are biologically rare, very restricted in distribution, or declining throughout their range but not currently threatened with extirpation;
- Population(s) in California that may be peripheral to the major portion of a taxon's range but are threatened with extirpation in California; and
- Taxa closely associated with a habitat that is declining in California at a significant rate (e.g. wetlands, riparian, vernal pools, old growth forests, desert aquatic systems, native grasslands, valley shrubland habitats, etc.).

**This list contains taxa that are actively inventoried by the CNDDB (Note: Taxa mapped in the GIS have a "yes" in the right column of the list) as well as an almost equal number of taxa (mostly RPR 3 and 4) which we track but for which we only currently have quad and county level geographic information.** For the latter taxa, we maintain site and other information in manual files along with internet access to the quad and county level information via our "***CNDDB Quick Viewer***." These plants will be mapped as time permits or when we have enough information to determine that they fulfill our rarity and/or endangerment criteria. For more copies of this list or other CNDDB information, call (916) 324-3812 or email Kristine Donat, Information Services, at kristina.donat@wildlife.ca.gov.

**California Heritage (CNDDB) Element Ranking**
**For Plants**
Last updated November, 2012

All Heritage Programs, such as the California Natural Diversity Database (CNDDB) use the same ranking methodology, originally developed by The Nature Conservancy and now maintained and recently revised by Natureserve. It includes a **Global rank** (G rank), describing the rank for a given taxon over its entire distribution and a **State rank** (S rank), describing the rank for the taxon over its state distribution. For subspecies and varieties, there is also a "T" rank describing the global rank for the subspecies. The second page of this document details the criteria used to assign element ranks, from G1 to G5 for the Global rank and from S1 to S5 for the State rank. Procedurally, state programs such as the CNDDB develop the State ranks and the Global ranks are developed collaboratively among state's/provinces containing the species, and checked for consistency and logical errors by Natureserve at the national level.

The first step to ranking is based on *rarity*, and involves counting total occurrences, counting the number of "good" (highly ranked) occurrences and counting individuals for a given plant. An occurrence for a plant is defined as any population or group of nearby populations located more than 0.25 miles from any other population. If sufficient information is available, element occurrences can be ranked A-D, depending on apparent degree of viability and habitat condition. Usually the two biggest factors are population size and habitat quality. However, there is more to ranking than just counting element occurrences and individuals. Some of the other considerations include:

- Rarity factors can include range extent, area of occupancy, population size, number of occurrences and number of good occurrences (ranked A or B). Environmental specificity can modify the rarity factors.
- Trends: Both long-term and short-term trends are factored in, if known. Trends receive higher weight than in the past
- Threats are factored in and receive higher weight than in the past.
- Intrinsic vulnerability is factored in if threats are Unknown or Null.

Detailed information on the newest element ranking methodology can be found here:
http://www.natureserve.org/publications/ConsStatusAssess_StatusFactors.pdf

With the above considerations in mind, refer below for the numerical definitions for G1-5 and S1-5. An element's ranking status may be adjusted up or down depending upon the considerations above.

# ELEMENT RANKING

## GLOBAL RANKING

The *global rank* (G-rank) is a reflection of the overall status of an element throughout its global range. **Both Global and State ranks represent a letter+number score that reflects a combination of Rarity, Threat and Trend factors, with weighting being heavier on Rarity than the other two.**

## SPECIES OR NATURAL COMMUNITY LEVEL

**G1** = **Critically Imperiled**—At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
**G2** = **Imperiled**—At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.
**G3** = **Vulnerable**—At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.
**G4** = **Apparently Secure**—Uncommon but not rare; some cause for long-term concern due to declines or other factors.
**G5** = **Secure**—Common; widespread and abundant.

## SUBSPECIES LEVEL

Subspecies receive a **T-rank** attached to the G-rank. With the subspecies, the G-rank reflects the condition of the entire species, whereas the T-rank reflects the global situation of just the subspecies or variety. For example: *Chorizanthe robusta* var. *hartwegii*. This plant is ranked G2T1. The G-rank refers to the whole species range i.e., *Chorizanthe robusta*. The T-rank refers only to the global condition of var. *hartwegii*.

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## STATE RANKING

The *state rank* (S-rank) is assigned much the same way as the global rank, but state ranks refer to the imperilment status only within California's state boundaries.

**S1** = **Critically Imperiled**—Critically imperiled in the state because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province.
**S2** = **Imperiled**—Imperiled in the state because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province.
**S3** = **Vulnerable**—Vulnerable in the state due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.
**S4** = **Apparently Secure**—Uncommon but not rare; some cause for long-term concern due to declines or other factors.
**S5** = **Secure**—Common, widespread, and abundant in the state.

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**Notes:**

| | | | | |
|---|---|---|---|---|
| 1. | Other considerations used when ranking a species or natural community include the pattern of distribution of the element on the landscape, fragmentation of the population/stands, and historical extent as compared to its modern range. It is important to take a **bird's eye or aerial view** when ranking sensitive elements rather than simply counting element occurrences. | | 3. | Other symbols:<br><br>GH All sites are **historical**; the element has not been seen for at least 20 years, but suitable habitat still exists (SH = All California sites are historical).<br><br>GX All sites are **extirpated**; this element is extinct in the wild (SX = All California sites are extirpated).<br><br>GXC Extinct in the wild; exists in cultivation.<br><br>G1Q The element is very rare, but there are **taxonomic questions** associated with it.<br><br>T Rank applies to a subspecies or variety. |
| 2. | Uncertainty about the rank of an element is expressed in two major ways:<br><br>By expressing the ranks as a **range** of values: e.g., S2S3 means the rank is somewhere between S2 and S3.<br><br>By adding a ? to the rank: e.g., S2? This represents more certainty than S2S3, but less certainty than S2. | | | |

## SPECIAL LICHENS

Last updated March 23, 2007

There are a few lichens in California for which we have adequate information to place them on the list of Special taxa. They appear after the bryophytes at the beginning of the list. We are not including lichens for which little is known, even if they are only known from a few sites in California because the level of information is not developed enough. As information on individual taxa becomes better developed, more lichens may be added. Lichen statuses are developed in coordination with the California Lichen Society (CALS) and relevant experts.

Note that lichens are not plants, but a symbiotic relationship between a fungus and either green algae or cyanobacteria (aka bluegreen algae).

## The California Rare Plant Ranks[3]

1A. Presumed extinct in California
1B. Rare or Endangered in California and elsewhere
2. Rare or Endangered in California, more common elsewhere
3. Plants for which we need more information - Review list
4. Plants of limited distribution - Watch list

**1A: Plants Presumed Extinct in California**
**Includes Rare Plant Rank 1A**

The plants of List 1A are presumed extinct because they have not been seen or collected in the wild in California for many years. Although most of them are restricted to California, a few are found in other states as well. In many cases, repeated attempts have been made to rediscover these plants by visiting known historical locations. Even after such diligent searching, we are constrained against saying that they are extinct, since for most of them rediscovery remains a distinct possibility. Note that care should be taken to distinguish between "extinct" and "extirpated." A plant is extirpated if it has been locally eliminated, but it may be doing well elsewhere in its range.

**1B: Plants Rare, Threatened, or Endangered in California and Elsewhere**
**Includes Rare Plant Ranks 1B.1, 1B.2, 1B.3**

The plants of List 1B are rare throughout their range. All but a few are endemic to California. All of them are judged to be vulnerable under present circumstances or to have a high potential for becoming so because of their limited or vulnerable habitat, their low numbers of individuals per population (even though they may be wide ranging), or their limited number of populations. Most of the plants of List 1B have declined significantly over the last century.

**2: Plants Rare, Threatened, or Endangered in California, but More Common Elsewhere**
**Includes Rare Plant Ranks 2.1, 2.2, 2.3**

Except for being common beyond the boundaries of California, the plants of List 2 would have appeared on List 1B. From the federal perspective, plants common in other states or countries are not eligible for consideration under the provisions of the Endangered Species Act. Until 1979, a similar policy was followed in California. However, after the passage of the Native Plant Protection Act, plants were considered for protection without regard to their distribution outside the state.

**3: Plants About Which We Need More Information - A Review list**
**Includes Rare Plant Rank 3, 3.1, 3.2, 3.3**

The plants that comprise List 3 are united by one common theme--we lack the necessary information to assign them to one of the other lists or to reject them. Nearly all of the plants remaining on List 3 are taxonomically problematic.

**4: Plants of Limited Distribution - A Watch list**
**Includes Rare Plant Rank 4.1, 4.2, 4.3**

The plants in this category are of limited distribution or infrequent throughout a broader area in California, and their vulnerability or susceptibility to threat appears low at this time. While we cannot call these plants "rare" from a statewide perspective, they are uncommon enough that their status should be monitored regularly. Should the degree of endangerment or rarity of a List 4 plant change, we will transfer it to a more appropriate list or deleted from consideration.

**Threat ranks**:

The CRPR's use a decimal-style threat rank. This extension replaces the E (Endangerment) value from the R-E-D Code. Rare Plant Ranks therefore read like this: 1B.1, 1B.2, etc.

**New Threat Code extensions and their meanings:**
**.1** - Seriously endangered in California

**.2** – Fairly endangered in California

**.3** – Not very endangered in California

Note that all List 1A (presumed extinct in California) and some List 3 (need more information- a review list) plants lacking any threat information receive no threat code extension.

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3 In March, 2010, CDFW changed the name of "CNPS List" or "CNPS Ranks" to "California Rare Plant Rank" (or CRPR). This was done to reduce confusion over the fact that CNPS and DFG jointly manage the Rare Plant Status Review groups (300+ botanical experts from government, academia, NGOs and the private sector) and that the rank assignments are the product of a collaborative effort and not solely a CNPS assignment. The old name gave the false impression that CNPS solely assigned the ranks and had excessive influence on the regulatory process. We did this in consultation and agreement with the CNPS Executive Director and the CNPS Board of Directors. Nothing about the actual process of rare plant review or rank assignment has changed and the same committee of experts from many organizations in addition to DFG and CNPS still review each change and ultimately assign the ranks.

# Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities

State of California
CALIFORNIA NATURAL RESOURCES AGENCY
Department of Fish and Game
November 24, 2009[4]

## INTRODUCTION AND PURPOSE

The conservation of special status native plants and their habitats, as well as natural communities, is integral to maintaining biological diversity. The purpose of these protocols is to facilitate a consistent and systematic approach to the survey and assessment of special status native plants and natural communities so that reliable information is produced and the potential of locating a special status plant species or natural community is maximized. They may also help those who prepare and review environmental documents determine when a botanical survey is needed, how field surveys may be conducted, what information to include in a survey report, and what qualifications to consider for surveyors. The protocols may help avoid delays caused when inadequate biological information is provided during the environmental review process; assist lead, trustee and responsible reviewing agencies to make an informed decision regarding the direct, indirect, and cumulative effects of a proposed development, activity, or action on special status native plants and natural communities; meet California Environmental Quality Act (CEQA)[5] requirements for adequate disclosure of potential impacts; and conserve public trust resources.

## DEPARTMENT OF FISH AND GAME TRUSTEE AND RESPONSIBLE AGENCY MISSION

The mission of the Department of Fish and Game (DFG) is to manage California's diverse wildlife and native plant resources, and the habitats upon which they depend, for their ecological values and for their use and enjoyment by the public. DFG has jurisdiction over the conservation, protection, and management of wildlife, native plants, and habitat necessary to maintain biologically sustainable populations (Fish and Game Code §1802). DFG, as trustee agency under CEQA §15386, provides expertise in reviewing and commenting on environmental documents and makes protocols regarding potential negative impacts to those resources held in trust for the people of California.

Certain species are in danger of extinction because their habitats have been severely reduced in acreage, are threatened with destruction or adverse modification, or because of a combination of these and other factors. The California Endangered Species Act (CESA) provides additional protections for such species, including take prohibitions (Fish and Game Code §2050 *et seq.*). As a responsible agency, DFG has the authority to issue permits for the take of species listed under CESA if the take is incidental to an otherwise lawful activity; DFG has determined that the impacts of the take have been minimized and fully mitigated; and, the take would not jeopardize the continued existence of the species (Fish and Game Code §2081). Surveys are one of the preliminary steps to detect a listed or special status plant species or natural community that may be impacted significantly by a project.

## DEFINITIONS

Botanical surveys provide information used to determine the potential environmental effects of proposed projects on all special status plants and natural communities as required by law (i.e., CEQA, CESA, and Federal Endangered Species Act (ESA)). Some key terms in this document appear in **bold font** for assistance in use of the document.

For the purposes of this document, **special status plants** include all plant species that meet one or more of the following criteria[6]:

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4 This document replaces the DFG document entitled "Guidelines for Assessing the Effects of Proposed Projects on Rare, Threatened and Endangered Plants and Natural Communities."

5 http://ceres.ca.gov/ceqa/

6 Adapted from the East Alameda County Conservation Strategy available at http://www.fws.gov/sacramento/EACCS/Documents/080228_Species_Evaluation_EACCS.pdf

- Listed or proposed for listing as threatened or endangered under ESA or candidates for possible future listing as threatened or endangered under the ESA (50 CFR §17.12).

- Listed[7] or candidates for listing by the State of California as threatened or endangered under CESA (Fish and Game Code §2050 *et seq.*). A species, subspecies, or variety of plant is **endangered** when the prospects of its survival and reproduction in the wild are in immediate jeopardy from one or more causes, including loss of habitat, change in habitat, over-exploitation, predation, competition, disease, or other factors (Fish and Game Code §2062). A plant is **threatened** when it is likely to become endangered in the foreseeable future in the absence of special protection and management measures (Fish and Game Code §2067).

- Listed as rare under the California Native Plant Protection Act (Fish and Game Code §1900 *et seq*.). A plant is **rare** when, although not presently threatened with extinction, the species, subspecies, or variety is found in such small numbers throughout its range that it may be endangered if its environment worsens (Fish and Game Code §1901).

- Meet the definition of rare or endangered under CEQA §15380(b) and (d). Species that may meet the definition of rare or endangered include the following:

    - Species considered by the California Native Plant Society (CNPS) to be "rare, threatened or endangered in California" (Lists 1A, 1B and 2);

    - Species that may warrant consideration on the basis of local significance or recent biological information[8];

    - Some species included on the California Natural Diversity Database's (CNDDB) *Special Plants, Bryophytes, and Lichens List* (California Department of Fish and Game 2008)[9].

- Considered a **locally significant species,** that is, a species that is not rare from a statewide perspective but is rare or uncommon in a local context such as within a county or region (CEQA §15125 (c)) or is so designated in local or regional plans, policies, or ordinances (CEQA Guidelines, Appendix G). Examples include a species at the outer limits of its known range or a species occurring on an uncommon soil type.

**Special status natural communities** are communities that are of limited distribution statewide or within a county or region and are often vulnerable to environmental effects of projects. These communities may or may not contain special status species or their habitat. The most current version of the Department's *List of California Terrestrial Natural Communities*[10] indicates which natural communities are of special status given the current state of the California classification.

Most types of wetlands and riparian communities are considered special status natural communities due to their limited distribution in California. These natural communities often contain special status plants such as those described above. These protocols may be used in conjunction with protocols formulated by other agencies, for example, those developed by the U.S. Army Corps of Engineers to delineate jurisdictional wetlands[11] or by the U.S. Fish and Wildlife Service to survey for the presence of special status plants[12].

## BOTANICAL SURVEYS

[7] Refer to current online published lists available at: http://www.dfg.ca.gov/biogeodata.

[8] In general, CNPS List 3 plants (plants about which more information is needed) and List 4 plants (plants of limited distribution) may not warrant consideration under CEQA §15380. These plants may be included on special status plant lists such as those developed by counties where they would be addressed under CEQA §15380. List 3 plants may be analyzed under CEQA §15380 if sufficient information is available to assess potential impacts to such plants. Factors such as regional rarity vs. statewide rarity should be considered in determining whether cumulative impacts to a List 4 plant are significant even if individual project impacts are not. List 3 and 4 plants are also included in the California Natural Diversity Database's (CNDDB) *Special Plants, Bryophytes, and Lichens List.* [Refer to the current online published list available at: http://www.dfg.ca.gov/biogeodata.] Data on Lists 3 and 4 plants should be submitted to CNDDB. Such data aids in determining or revising priority ranking.

[9] Refer to current online published lists available at: http://www.dfg.ca.gov/biogeodata.

[10] http://www.dfg.ca.gov/biogeodata/vegcamp/pdfs/natcomlist.pdf. The rare natural communities are asterisked on this list.

[11] http://www.wetlands.com/regs/tlpge02e.htm

[12] U.S. Fish and Wildlife Service Survey Guidelines available at http://www.fws.gov/sacramento/es/protocol.htm

Conduct botanical surveys prior to the commencement of any activities that may modify vegetation, such as clearing, mowing, or ground-breaking activities. It is appropriate to conduct a botanical field survey when:

- Natural (or naturalized) vegetation occurs on the site, and it is unknown if special status plant species or natural communities occur on the site, and the project has the potential for direct or indirect effects on vegetation; or
- Special status plants or natural communities have historically been identified on the project site; or
- Special status plants or natural communities occur on sites with similar physical and biological properties as the project site.

**SURVEY OBJECTIVES**

Conduct field surveys in a manner which maximizes the likelihood of locating special status plant species or special status natural communities that may be present. Surveys should be **floristic in nature**, meaning that every plant taxon that occurs on site is identified to the taxonomic level necessary to determine rarity and listing status. "Focused surveys" that are limited to habitats known to support special status species or are restricted to lists of likely potential species are not considered floristic in nature and are not adequate to identify all plant taxa on site to the level necessary to determine rarity and listing status. Include a list of plants and natural communities detected on the site for each botanical survey conducted. More than one field visit may be necessary to adequately capture the floristic diversity of a site. An indication of the prevalence (estimated total numbers, percent cover, density, etc.) of the species and communities on the site is also useful to assess the significance of a particular population.

**SURVEY PREPARATION**

Before field surveys are conducted, compile relevant botanical information in the general project area to provide a regional context for the investigators. Consult the CNDDB[13] and BIOS[14] for known occurrences of special status plants and natural communities in the project area prior to field surveys. Generally, identify vegetation and habitat types potentially occurring in the project area based on biological and physical properties of the site and surrounding ecoregion[15], unless a larger assessment area is appropriate. Then, develop a list of special status plants with the potential to occur within these vegetation types. This list can serve as a tool for the investigators and facilitate the use of reference sites; however, special status plants on site might not be limited to those on the list. Field surveys and subsequent reporting should be comprehensive and floristic in nature and not restricted to or focused only on this list. Include in the survey report the list of potential special status species and natural communities, and the list of references used to compile the background botanical information for the site.

**SURVEY EXTENT**

Surveys should be comprehensive over the entire site, including areas that will be directly or indirectly impacted by the project. Adjoining properties should also be surveyed where direct or indirect project effects, such as those from fuel modification or herbicide application, could potentially extend offsite. Pre-project surveys restricted to known CNDDB rare plant locations may not identify all special status plants and communities present and do not provide a sufficient level of information to determine potential impacts.

**FIELD SURVEY METHOD**

Conduct surveys using **systematic field techniques** in all habitats of the site to ensure thorough coverage of potential impact areas. The level of effort required per given area and habitat is dependent upon the vegetation and its overall diversity and structural complexity, which determines the distance at which plants can be identified. Conduct surveys by walking over the entire site to ensure thorough coverage, noting all plant taxa observed. The level of effort should be sufficient to provide comprehensive reporting. For example, one person-hour per eight acres per survey date is needed for a comprehensive field survey in grassland with medium diversity and moderate terrain[16], with additional time allocated for species identification.

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13 Available at http://www.dfg.ca.gov/biogeodata/cnddb

14 http://www.bios.dfg.ca.gov/

15 Ecological Subregions of California, available at http://www.fs.fed.us/r5/projects/ecoregions/toc.htm

16 Adapted from U.S. Fish and Wildlife Service kit fox survey guidelines available at www.fws.gov/sacramento/es/documents/kitfox_no_protocol.pdf

**TIMING AND NUMBER OF VISITS**

Conduct surveys in the field at the time of year when species are both evident and identifiable. Usually this is during flowering or fruiting. Space visits throughout the growing season to accurately determine what plants exist on site. Many times this may involve multiple visits to the same site (e.g. in early, mid, and late-season for flowering plants) to capture the floristic diversity at a level necessary to determine if special status plants are present[17]. The timing and number of visits are determined by geographic location, the natural communities present, and the weather patterns of the year(s) in which the surveys are conducted.

**REFERENCE SITES**

When special status plants are known to occur in the type(s) of habitat present in the project area, observe reference sites (nearby accessible occurrences of the plants) to determine whether those species are identifiable at the time of the survey and to obtain a visual image of the target species, associated habitat, and associated natural community.

**USE OF EXISTING SURVEYS**

For some sites, floristic inventories or special status plant surveys may already exist. Additional surveys may be necessary for the following reasons:

- Surveys are not current[18]; or
- Surveys were conducted in natural systems that commonly experience year to year fluctuations such as periods of drought or flooding (e.g. vernal pool habitats or riverine systems); or
- Surveys are not comprehensive in nature; or fire history, land use, physical conditions of the site, or climatic conditions have changed since the last survey was conducted[19]; or
- Surveys were conducted in natural systems where special status plants may not be observed if an annual above ground phase is not visible (e.g. flowers from a bulb); or
- Changes in vegetation or species distribution may have occurred since the last survey was conducted, due to habitat alteration, fluctuations in species abundance and/or seed bank dynamics.

**NEGATIVE SURVEYS**

Adverse conditions may prevent investigators from determining the presence of, or accurately identifying, some species in potential habitat of target species. Disease, drought, predation, or herbivory may preclude the presence or identification of target species in any given year. Discuss such conditions in the report.

The failure to locate a known special status plant occurrence during one field season does not constitute evidence that this plant occurrence no longer exists at this location, particularly if adverse conditions are present. For example, surveys over a number of years may be necessary if the species is an annual plant having a persistent, long-lived seed bank and is known not to germinate every year. Visits to the site in more than one year increase the likelihood of detection of a special status plant especially if conditions change. To further substantiate negative findings for a known occurrence, a visit to a nearby reference site may ensure that the timing of the survey was appropriate.

## REPORTING AND DATA COLLECTION

Adequate information about special status plants and natural communities present in a project area will enable reviewing agencies and the public to effectively assess potential impacts to special status plants or natural communities[20] and will guide

[17] U.S. Fish and Wildlife Service Survey Guidelines available at http://www.fws.gov/sacramento/es/protocol.htm

[18] Habitats, such as grasslands or desert plant communities that have annual and short-lived perennial plants as major floristic components may require yearly surveys to accurately document baseline conditions for purposes of impact assessment. In forested areas, however, surveys at intervals of five years may adequately represent current conditions. For forested areas, refer to “Guidelines for Conservation of Sensitive Plant Resources Within the Timber Harvest Review Process and During Timber Harvesting Operations”, available at https://r1.dfg.ca.gov/portal/Portals/12/THPBotanicalGuidelinesJuly2005.pdf

[19] U.S. Fish and Wildlife Service Survey Guidelines available at http://www.fws.gov/ventura/speciesinfo/protocols_guidelines/docs/botanicalinventories.pdf

[20] Refer to current online published lists available at: http://www.dfg.ca.gov/biogeodata. For Timber Harvest Plans (THPs) please refer to the “Guidelines for Conservation of Sensitive Plant Resources Within the Timber Harvest Review Process and During Timber Harvesting Operations”, available at https://r1.dfg.ca.gov/portal/Portals/12/THPBotanicalGuidelinesJuly2005.pdf

the development of minimization and mitigation measures. The next section describes necessary information to assess impacts. For comprehensive, systematic surveys where no special status species or natural communities were found, reporting and data collection responsibilities for investigators remain as described below, excluding specific occurrence information.

**SPECIAL STATUS PLANT OR NATURAL COMMUNITY OBSERVATIONS**

Record the following information for locations of each special status plant or natural community detected during a field survey of a project site.

- A detailed map (1:24,000 or larger) showing locations and boundaries of each special status species occurrence or natural community found as related to the proposed project. Mark occurrences and boundaries as accurately as possible. Locations documented by use of global positioning system (GPS) coordinates must include the datum[21] in which they were collected;
- The site-specific characteristics of occurrences, such as associated species, habitat and microhabitat, structure of vegetation, topographic features, soil type, texture, and soil parent material. If the species is associated with a wetland, provide a description of the direction of flow and integrity of surface or subsurface hydrology and adjacent off-site hydrological influences as appropriate;
- The number of individuals in each special status plant population as counted (if population is small) or estimated (if population is large);
- If applicable, information about the percentage of individuals in each life stage such as seedlings vs. reproductive individuals;
- The number of individuals of the species per unit area, identifying areas of relatively high, medium and low density of the species over the project site; and
- Digital images of the target species and representative habitats to support information and descriptions.

**FIELD SURVEY FORMS**

When a special status plant or natural community is located, complete and submit to the CNDDB a California Native Species (or Community) Field Survey Form[22] or equivalent written report, accompanied by a copy of the relevant portion of a 7.5 minute topographic map with the occurrence mapped. Present locations documented by use of GPS coordinates in map and digital form. Data submitted in digital form must include the datum[23] in which it was collected. If a potentially undescribed special status natural community is found on the site, document it with a Rapid Assessment or Relevé form[24] and submit it with the CNDDB form.

**VOUCHER COLLECTION**

Voucher specimens provide verifiable documentation of species presence and identification as well as a public record of conditions. This information is vital to all conservation efforts. Collection of voucher specimens should be conducted in a manner that is consistent with conservation ethics, and is in accordance with applicable state and federal permit requirements (e.g. incidental take permit, scientific collection permit). Voucher collections of special status species (or suspected special status species) should be made only when such actions would not jeopardize the continued existence of the population or species.

Deposit voucher specimens with an indexed regional herbarium[25] no later than 60 days after the collections have been made. Digital imagery can be used to supplement plant identification and document habitat. Record all relevant permittee names and permit numbers on specimen labels. A collecting permit is required prior to the collection of State-listed plant species[26].

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21 NAD83, NAD27 or WGS84

22 http://www.dfg.ca.gov/biogeodata

23 NAD83, NAD27 or WGS84

24 http://www.dfg.ca.gov/biogeodata/vegcamp/veg_publications_protocols.asp

25 For a complete list of indexed herbaria, see: Holmgren, P., N. Holmgren and L. Barnett. 1990. Index Herbariorum, Part 1: Herbaria of the World. New York Botanic Garden, Bronx, New York. 693 pp. Or: http://www.nybg.org/bsci/ih/ih.html

26 Refer to current online published lists available at: http://www.dfg.ca.gov/biogeodata.

## BOTANICAL SURVEY REPORTS

Include reports of botanical field surveys containing the following information with project environmental documents:

- **Project and site description**
  - A description of the proposed project;
  - A detailed map of the project location and study area that identifies topographic and landscape features and includes a north arrow and bar scale; and,
  - A written description of the biological setting, including vegetation[27] and structure of the vegetation; geological and hydrological characteristics; and land use or management history.

- **Detailed description of survey methodology and results**
  - Dates of field surveys (indicating which areas were surveyed on which dates), name of field investigator(s), and total person-hours spent on field surveys;
  - A discussion of how the timing of the surveys affects the comprehensiveness of the survey;
  - A list of potential special status species or natural communities;
  - A description of the area surveyed relative to the project area;
  - References cited, persons contacted, and herbaria visited;
  - Description of reference site(s), if visited, and phenological development of special status plant(s);
  - A list of all taxa occurring on the project site. Identify plants to the taxonomic level necessary to determine whether or not they are a special status species;
  - Any use of existing surveys and a discussion of applicability to this project;
  - A discussion of the potential for a false negative survey;
  - Provide detailed data and maps for all special plants detected. Information specified above under the headings "Special Status Plant or Natural Community Observations," and "Field Survey Forms," should be provided for locations of each special status plant detected;
  - Copies of all California Native Species Field Survey Forms or Natural Community Field Survey Forms should be sent to the CNDDB and included in the environmental document as an Appendix. It is not necessary to submit entire environmental documents to the CNDDB; and,
  - The location of voucher specimens, if collected.

- **Assessment of potential impacts**
  - A discussion of the significance of special status plant populations in the project area considering nearby populations and total species distribution;
  - A discussion of the significance of special status natural communities in the project area considering nearby occurrences and natural community distribution;
  - A discussion of direct, indirect, and cumulative impacts to the plants and natural communities;
  - A discussion of threats, including those from invasive species, to the plants and natural communities;
  - A discussion of the degree of impact, if any, of the proposed project on unoccupied, potential habitat of the species;
  - A discussion of the immediacy of potential impacts; and,
  - Recommended measures to avoid, minimize, or mitigate impacts.

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27 A vegetation map that uses the National Vegetation Classification System (http://biology.usgs.gov/npsveg/nvcs.html), for example *A Manual of California Vegetation*, and highlights any special status natural communities. If another vegetation classification system is used, the report should reference the system, provide the reason for its use, and provide a crosswalk to the National Vegetation Classification System.

## QUALIFICATIONS

Botanical consultants should possess the following qualifications:

- Knowledge of plant taxonomy and natural community ecology;
- Familiarity with the plants of the area, including special status species;
- Familiarity with natural communities of the area, including special status natural communities;
- Experience conducting floristic field surveys or experience with floristic surveys conducted under the direction of an experienced surveyor;
- Familiarity with the appropriate state and federal statutes related to plants and plant collecting; and,
- Experience with analyzing impacts of development on native plant species and natural communities.

## SUGGESTED REFERENCES


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# Special Vascular Plants, Bryophytes, and Lichens List

## California Department of Fish and Game

### Natural Diversity Database

## Bryophytes

| Scientific Name | Common Name | Element Code | Federal Listing Status | State Listing Status | Heritage Rank | Rare Plant Rank | Records in CNDDB ? |
|---|---|---|---|---|---|---|---|
| *Anomobryum julaceum* | slender silver moss | NBMUS80010 | None | None | G4G5/S2 | 2.2 | Yes |
| *Bruchia bolanderi* | Bolander's bruchia | NBMUS13010 | None | None | G3/S3? | 2.2 | Yes |
| *Campylopodiella stenocarpa* | flagella-like atractylocarpus | NBMUS84010 | None | None | G5/S1? | 2.2 | Yes |
| *Dacryophyllum falcifolium* | tear drop moss | NBMUS8Z010 | None | None | G1/S1 | 1B.3 | Yes |
| *Didymodon norrisii* | Norris' beard moss | NBMUS2C0H0 | None | None | G3G4/S3S4 | 2.2 | Yes |
| *Discelium nudum* | naked flag moss | NBMUS2E010 | None | None | G3G4/S1 | 2.2 | Yes |
| *Entosthodon kochii* | Koch's cord moss | NBMUS2P050 | None | None | G1/S1 | 1B.3 | Yes |
| *Fissidens aphelotaxifolius* | brook pocket moss | NBMUS2W290 | None | None | G3G4/S1 | 2.2 | Yes |
| *Fissidens pauperculus* | minute pocket moss | NBMUS2W0U0 | None | None | G3?/S1 | 1B.2 | Yes |
| *Geothallus tuberosus* | Campbell's liverwort | NBHEP1C010 | None | None | G1/S1 | 1B.1 | Yes |
| *Helodium blandowii* | Blandow's bog moss | NBMUS3C010 | None | None | G5/S1 | 2.3 | Yes |
| *Meesia triquetra* | three-ranked hump moss | NBMUS4L020 | None | None | G5/S4 | 4.2 | Yes |
| *Meesia uliginosa* | broad-nerved hump moss | NBMUS4L030 | None | None | G4/S2 | 2.2 | Yes |
| *Mielichhoferia elongata* | elongate copper moss | NBMUS4Q022 | None | None | G4?/S2 | 2.2 | Yes |
| *Mielichhoferia mielichhoferiana* | Mielichhofer's copper moss | NBMUS4Q020 | None | None | G2G3/S1 | 2.3 | Yes |
| *Mielichhoferia tehamensis* | Lassen Peak copper moss | NBMUS4Q030 | None | None | G2/S2 | 1B.3 | Yes |
| *Myurella julacea* | small mousetail moss | NBMUS4U010 | None | None | G5/S1S2 | 2.3 | Yes |
| *Orthotrichum kellmanii* | Kellman's bristle moss | NBMUS56190 | None | None | G2/S2 | 1B.2 | Yes |
| *Orthotrichum shevockii* | Shevock's bristle moss | NBMUS56150 | None | None | G2/S2 | 1B.3 | Yes |
| *Orthotrichum spjutii* | Spjut's bristle moss | NBMUS56160 | None | None | G1/S1 | 1B.3 | Yes |
| *Pohlia tundrae* | tundra thread moss | NBMUS5S1B0 | None | None | G2G3/S2S3 | 2.3 | Yes |
| *Pterygoneurum californicum* | California chalk moss | NBMUS65020 | None | None | GH/SH | 1B.1 | Yes |
| *Ptilidium californicum* | Pacific fuzzwort | NBHEP2U010 | None | None | G3G4/S3? | 4.3 | Yes |
| *Riella americana* | American riella | NBHEP31020 | None | None | G2?/S1? | 2.2 | Yes |
| *Schizymenium shevockii* | Shevock's copper moss | NBMUSA1010 | None | None | G1/S1 | 1B.2 | Yes |
| *Scopelophila cataractae* | tongue-leaf copper moss | NBMUS6U010 | None | None | G3/S1.2 | 2.2 | Yes |
| *Sphaerocarpos drewei* | bottle liverwort | NBHEP35030 | None | None | G1/S1 | 1B.1 | Yes |
| *Tortella alpicola* | alpine crisp moss | NBMUS7K100 | None | None | G4G5/S1 | 2.3 | Yes |
| *Tortula californica* | California screw moss | NBMUS7L090 | None | None | G2?/S2 | 1B.2 | Yes |
| *Trichodon cylindricus* | cylindrical trichodon | NBMUS7N020 | None | None | G4G5/S2 | 2.2 | Yes |
| *Triquetrella californica* | coastal triquetrella | NBMUS7S010 | None | None | G1/S1 | 1B.2 | Yes |

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### Lichens

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|---|---|---|---|---|---|---|---|
| *Cladonia firma* | firm cup lichen | NLT0008460 | None | None | G4/S1 | | Yes |
| *Graphis saxorum* | Baja rock lichen | NLTES29470 | None | None | G1G3/S1S3 | | Yes |
| *Mobergia calculiformis* | light gray lichen | NLT0018660 | None | None | G1/S1 | | Yes |
| *Peltigera hydrothyria* | aquatic felt lichen | NLLEC83010 | None | None | G4/S3.2 | | Yes |
| *Solorina spongiosa* | Solorina spongiosa | NLT0028030 | None | None | G4G5/S1.2 | | Yes |
| *Sulcaria isidiifera* | splitting yarn lichen | NLTEST0020 | None | None | G1/S1.1 | | Yes |
| *Texosporium sancti-jacobi* | woven-spored lichen | NLTEST7980 | None | None | G3/S1.1 | | Yes |
| *Thamnolia vermicularis* | thamnolia lichen | NLTES43860 | None | None | G3G5/S1.1 | | Yes |
| *Usnea longissima* | long-beard lichen | NLLEC5P420 | None | None | G4/S4.2 | | Yes |

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|---|---|---|---|---|---|---|---|
| *Abies amabilis* | Pacific silver fir | PGPIN01010 | None | None | G5/S3 | 2.3 | Yes |
| *Abies bracteata* | bristlecone fir | PGPIN01030 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Abies lasiocarpa var. lasiocarpa* | subalpine fir | PGPIN01072 | None | None | G5T5/S3 | 2.3 | Yes |
| *Abronia alpina* | Ramshaw Meadows abronia | PDNYC01020 | Candidate | None | G2/S2 | 1B.1 | Yes |
| *Abronia maritima* | red sand-verbena | PDNYC010E0 | None | None | G4?/S3? | 4.2 | No |
| *Abronia nana var. covillei* | Coville's dwarf abronia | PDNYC010H1 | None | None | G4T3/S3.2 | 4.2 | No |
| *Abronia umbellata var. breviflora* | pink sand-verbena | PDNYC010N2 | None | None | G4G5T2/S2.1 | 1B.1 | Yes |
| *Abronia villosa var. aurita* | chaparral sand-verbena | PDNYC010P1 | None | None | G5T3T4/S2 | 1B.1 | Yes |
| *Abutilon parvulum* | dwarf abutilon | PDMAL020F0 | None | None | G5/S2 | 2.3 | Yes |
| *Acanthomintha duttonii* | San Mateo thorn-mint | PDLAM01040 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Acanthomintha ilicifolia* | San Diego thorn-mint | PDLAM01010 | Threatened | Endangered | G2/S2 | 1B.1 | Yes |
| *Acanthomintha lanceolata* | Santa Clara thorn-mint | PDLAM01020 | None | None | G3/S3.2 | 4.2 | No |
| *Acanthomintha obovata ssp. cordata* | heart-leaved thorn-mint | PDLAM01033 | None | None | G3?T3?/S3.2? | 4.2 | No |
| *Acanthomintha obovata ssp. obovata* | San Benito thorn-mint | PDLAM01032 | None | None | G3?T3?/S3.2? | 4.2 | No |
| *Acanthoscyphus parishii var. abramsii* | Abrams' oxytheca | PDPGN0J041 | None | None | G4?T2/S2.2 | 1B.2 | Yes |
| *Acanthoscyphus parishii var. cienegensis* | Cienega Seca oxytheca | PDPGN0J042 | None | None | G4?T2/S2 | 1B.3 | Yes |
| *Acanthoscyphus parishii var. goodmaniana* | Cushenbury oxytheca | PDPGN0J043 | Endangered | None | G4?T1/S1 | 1B.1 | Yes |
| *Acanthoscyphus parishii var. parishii* | Parish's oxytheca | PDPGN0J044 | None | None | G4?T3/S3.2 | 4.2 | No |
| *Acleisanthes longiflora* | angel trumpets | PDNYC02040 | None | None | G5/S1 | 2.3 | Yes |
| *Acleisanthes nevadensis* | desert wing-fruit | PDNYC0F040 | None | None | G5/S1 | 2.3 | Yes |
| *Acmispon argophyllus var. adsurgens* | San Clemente Island bird's-foot trefoil | PDFAB2A041 | None | Endangered | G5T1/S1 | 1B.1 | Yes |
| *Acmispon argophyllus var. niveus* | Santa Cruz Island bird's-foot trefoil | PDFAB2A048 | None | Endangered | G5T3/S3 | 4.2 | Yes |
| *Acmispon argyraeus var. multicaulis* | scrub lotus | PDFAB2A052 | None | None | G4?T2/S2 | 1B.3 | Yes |
| *Acmispon argyraeus var. notitius* | Providence Mountains lotus | PDFAB2A053 | None | None | G4?T2/S2 | 1B.3 | Yes |
| *Acmispon dendroideus var. dendroideus* | island broom | PDFAB2A1G1 | None | None | G4T3/S3.2 | 4.2 | No |
| *Acmispon dendroideus var. traskiae* | San Clemente Island lotus | PDFAB2A1G2 | Endangered | Endangered | G4T2/S2 | 1B.1 | Yes |
| *Acmispon dendroideus var. veatchii* | San Miguel Island deerweed | PDFAB2A1G3 | None | None | G4T3/S3.3 | 4.3 | No |
| *Acmispon haydonii* | pygmy lotus | PDFAB2A0H0 | None | None | G3/S2.3? | 1B.3 | Yes |
| *Acmispon rubriflorus* | red-flowered bird's-foot-trefoil | PDFAB2A150 | None | None | G1/S1 | 1B.1 | Yes |

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|---|---|---|---|---|---|---|---|
| *Adolphia californica* | California adolphia | PDRHA01010 | None | None | G3G4/S2 | 2.1 | Yes |
| *Agave shawii var. shawii* | Shaw's agave | PMAGA010P1 | None | None | G2G3T2T3/S1 | 2.1 | Yes |
| *Agave utahensis var. eborispina* | ivory-spined agave | PMAGA010S1 | None | None | G4T3Q/S2 | 1B.3 | Yes |
| *Agave utahensis var. nevadensis* | Clark Mountain agave | PMAGA010S3 | None | None | G4T3Q/S3.2 | 4.2 | No |
| *Ageratina herbacea* | desert ageratina | PDASTBX0J0 | None | None | G5/S2 | 2.3 | Yes |
| *Ageratina shastensis* | Shasta ageratina | PDASTBX0R0 | None | None | G2/S2 | 1B.2 | Yes |
| *Agrostis blasdalei* | Blasdale's bent grass | PMPOA04060 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Agrostis hendersonii* | Henderson's bent grass | PMPOA040K0 | None | None | G1Q/S1 | 3.2 | Yes |
| *Agrostis hooveri* | Hoover's bent grass | PMPOA040M0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Agrostis humilis* | mountain bent grass | PMPOA040P0 | None | None | G4/S2 | 2.3 | Yes |
| *Agrostis lacuna-vernalis* | vernal pool bent grass | PMPOA041N0 | None | None | G1/S1 | 1B.1 | Yes |
| *Aliciella ripleyi* | Ripley's aliciella | PDPLM041E0 | None | None | G3/S2 | 2.3 | Yes |
| *Aliciella triodon* | coyote gilia | PDPLM041T0 | None | None | G5/S2 | 2.2 | Yes |
| *Alisma gramineum* | grass alisma | PMALI01010 | None | None | G5/S1S2 | 2.2 | Yes |
| *Allium abramsii* | Abrams' onion | PMLIL02360 | None | None | G2G3/S2S3 | 1B.2 | Yes |
| *Allium atrorubens var. atrorubens* | Great Basin onion | PMLIL02061 | None | None | G4T4/S2 | 2.3 | Yes |
| *Allium atrorubens var. cristatum* | Inyo onion | PMLIL02063 | None | None | G4T3?/S3.3 | 4.3 | No |
| *Allium fimbriatum var. purdyi* | Purdy's onion | PMLIL020Y7 | None | None | G4G5T3/S3.3? | 4.3 | No |
| *Allium hickmanii* | Hickman's onion | PMLIL02140 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Allium hoffmanii* | Beegum onion | PMLIL02150 | None | None | G3/S3.3 | 4.3 | No |
| *Allium howellii var. clokeyi* | Mt. Pinos onion | PMLIL02161 | None | None | G4T2/S2.3 | 1B.3 | Yes |
| *Allium jepsonii* | Jepson's onion | PMLIL022V0 | None | None | G1/S1 | 1B.2 | Yes |
| *Allium marvinii* | Yucaipa onion | PMLIL02330 | None | None | G1/S1.1 | 1B.1 | Yes |
| *Allium munzii* | Munz's onion | PMLIL022Z0 | Endangered | Threatened | G1/S1 | 1B.1 | Yes |
| *Allium nevadense* | Nevada onion | PMLIL021J0 | None | None | G4/S2 | 2.3 | Yes |
| *Allium parishii* | Parish's onion | PMLIL021N0 | None | None | G3/S3.3? | 4.3 | No |
| *Allium peninsulare var. franciscanum* | Franciscan onion | PMLIL021R1 | None | None | G5T2/S2.2 | 1B.2 | Yes |
| *Allium punctum* | dotted onion | PMLIL021Y0 | None | None | G3?/S1 | 2.2 | Yes |
| *Allium sanbornii var. congdonii* | Congdon's onion | PMLIL02211 | None | None | G3T3/S3.3 | 4.3 | No |
| *Allium sanbornii var. sanbornii* | Sanborn's onion | PMLIL02212 | None | None | G3T3/S3.2 | 4.2 | No |
| *Allium sharsmithiae* | Sharsmith's onion | PMLIL02310 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Allium shevockii* | Spanish Needle onion | PMLIL022M0 | None | None | G2/S2 | 1B.3 | Yes |
| *Allium siskiyouense* | Siskiyou onion | PMLIL02280 | None | None | G4/S3.3? | 4.3 | No |
| *Allium tribracteatum* | three-bracted onion | PMLIL022D0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Allium tuolumnense* | Rawhide Hill onion | PMLIL022W0 | None | None | G2/S2 | 1B.2 | Yes |
| *Allium yosemitense* | Yosemite onion | PMLIL022L0 | None | Rare | G2/S2.3 | 1B.3 | Yes |

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|---|---|---|---|---|---|---|---|
| *Alopecurus aequalis var. sonomensis* | Sonoma alopecurus | PMPOA07012 | Endangered | None | G5T1Q/S1 | 1B.1 | Yes |
| *Aloysia wrightii* | Wright's beebrush | PDVER02040 | None | None | G5/S3.3 | 4.3 | No |
| *Amaranthus watsonii* | Watson's amaranth | PDAMA04170 | None | None | G4G5/S3.3 | 4.3 | No |
| *Ambrosia chenopodiifolia* | San Diego bur-sage | PDAST0C080 | None | None | G3?/S2.1 | 2.1 | Yes |
| *Ambrosia monogyra* | singlewhorl burrobrush | PDAST50010 | None | None | G5/S2.2 | 2.2 | Yes |
| *Ambrosia pumila* | San Diego ambrosia | PDAST0C0M0 | Endangered | None | G1/S1 | 1B.1 | Yes |
| *Ammoselinum giganteum* | desert sand-parsley | PDAPI05020 | None | None | G2G3/SH | 2.3 | Yes |
| *Amorpha californica var. napensis* | Napa false indigo | PDFAB08012 | None | None | G4T2/S2.2 | 1B.2 | Yes |
| *Amsinckia douglasiana* | Douglas' fiddleneck | PDBOR01010 | None | None | G3/S3.2 | 4.2 | No |
| *Amsinckia furcata* | forked fiddleneck | PDBOR010D1 | None | None | G3/S3.2 | 4.2 | No |
| *Amsinckia grandiflora* | large-flowered fiddleneck | PDBOR01050 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Amsinckia lunaris* | bent-flowered fiddleneck | PDBOR01070 | None | None | G2?/S2? | 1B.2 | Yes |
| *Ancistrocarphus keilii* | Santa Ynez groundstar | PDASTD5020 | None | None | G1/S1 | 1B.1 | Yes |
| *Androsace elongata ssp. acuta* | California androsace | PDPRI02031 | None | None | G5? T3T4/S3.2? | 4.2 | No |
| *Androsace filiformis* | slender-stemmed androsace | PDPRI02040 | None | None | G4/S1? | 2.3 | Yes |
| *Androsace occidentalis* | western androsace | PDPRI02050 | None | None | G5/S2 | 2.3 | Yes |
| *Androstephium breviflorum* | small-flowered androstephium | PMLIL06010 | None | None | G5/S2S3 | 2.2 | Yes |
| *Angelica callii* | Call's angelica | PDAPI07060 | None | None | G3/S3.3? | 4.3 | No |
| *Angelica kingii* | King's angelica | PDAPI070D0 | None | None | G4/S3.2 | 4.2 | No |
| *Angelica lucida* | sea-watch | PDAPI070G0 | None | None | G5/S2S3 | 4.2 | No |
| *Anisocarpus scabridus* | scabrid alpine tarplant | PDASTDU020 | None | None | G2G3/S2S3 | 1B.3 | Yes |
| *Antennaria flagellaris* | stoloniferous pussy-toes | PDAST0H0W0 | None | None | G5?/S3.2 | 4.2 | Yes |
| *Antennaria lanata* | woolly pussy-toes | PDAST0H0B0 | None | None | G5/S1 | 2.2 | Yes |
| *Antennaria marginata* | white-margined everlasting | PDAST0H1G0 | None | None | G4G5/S1 | 2.3 | Yes |
| *Antennaria pulchella* | beautiful pussy-toes | PDAST0H1H0 | None | None | G3/S3.3 | 4.3 | No |
| *Antennaria suffrutescens* | evergreen everlasting | PDAST0H0S0 | None | None | G4/S3.3? | 4.3 | No |
| *Antirrhinum ovatum* | oval-leaved snapdragon | PDSCR2K010 | None | None | G3/S3.2 | 4.2 | Yes |
| *Antirrhinum subcordatum* | dimorphic snapdragon | PDSCR2S070 | None | None | G3/S3.3 | 4.3 | Yes |
| *Antirrhinum virga* | twig-like snapdragon | PDSCR2S090 | None | None | G3/S3.3? | 4.3 | No |
| *Aphanisma blitoides* | aphanisma | PDCHE02010 | None | None | G3G4/S3 | 1B.2 | Yes |
| *Arabis aculeolata* | Waldo rockcress | PDBRA06010 | None | None | G4/S2 | 2.2 | Yes |
| *Arabis blepharophylla* | coast rockcress | PDBRA06040 | None | None | G3/S3.3? | 4.3 | No |
| *Arabis mcdonaldiana* | Mcdonald's rockcress | PDBRA06150 | Endangered | Endangered | G2/S2 | 1B.1 | Yes |
| *Arabis modesta* | modest rockcress | PDBRA06180 | None | None | G3/S3.3? | 4.3 | No |
| *Arabis oregana* | Oregon rockcress | PDBRA061A0 | None | None | G3G4Q/S3.3? | 4.3 | No |
| *Arabis repanda var. greenei* | Greene's rockcress | PDBRA061Q1 | None | None | G5T2T3/S2S3 | 4.3 | No |
| *Arabis rigidissima var. demota* | Galena Creek rockcress | PDBRA061R1 | None | None | G3T3/S1 | 1B.2 | Yes |

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| *Arabis rigidissima var. rigidissima* | Trinity Mountains rockcress | PDBRA061R2 | None | None | G3T2/S2 | 1B.3 | Yes |
| *Arctomecon merriamii* | white bear poppy | PDPAP02030 | None | None | G3/S2.2 | 2.2 | Yes |
| *Arctostaphylos andersonii* | Anderson's manzanita | PDERI04030 | None | None | G2/S2? | 1B.2 | Yes |
| *Arctostaphylos auriculata* | Mt. Diablo manzanita | PDERI04040 | None | None | G2/S2 | 1B.3 | Yes |
| *Arctostaphylos bakeri ssp. bakeri* | Baker's manzanita | PDERI04221 | None | Rare | G2T2/S2 | 1B.1 | Yes |
| *Arctostaphylos bakeri ssp. sublaevis* | The Cedars manzanita | PDERI04222 | None | Rare | G2T2/S2 | 1B.2 | Yes |
| *Arctostaphylos canescens ssp. sonomensis* | Sonoma canescent manzanita | PDERI04066 | None | None | G3G4T2/S2.1 | 1B.2 | Yes |
| *Arctostaphylos catalinae* | Santa Catalina Island manzanita | PDERI04070 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Arctostaphylos confertiflora* | Santa Rosa Island manzanita | PDERI040A0 | Endangered | None | G1/S1 | 1B.2 | Yes |
| *Arctostaphylos crustacea ssp. eastwoodiana* | Eastwood's brittle-leaf manzanita | PDERI041H4 | None | None | G4T2?/S2? | 1B.1 | Yes |
| *Arctostaphylos crustacea ssp. insulicola* | island manzanita | PDERI041H5 | None | None | G4T3/S3.2 | 4.2 | No |
| *Arctostaphylos crustacea ssp. subcordata* | Santa Cruz Island manzanita | PDERI041H7 | None | None | G4T3/S3.2 | 4.2 | No |
| *Arctostaphylos cruzensis* | Arroyo de la Cruz manzanita | PDERI040B0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Arctostaphylos densiflora* | Vine Hill manzanita | PDERI040C0 | None | Endangered | G1/S1 | 1B.1 | Yes |
| *Arctostaphylos edmundsii* | Little Sur manzanita | PDERI04260 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Arctostaphylos franciscana* | Franciscan manzanita | PDERI040J3 | None | None | G1/S1 | 1B.1 | Yes |
| *Arctostaphylos gabilanensis* | Gabilan Mountains manzanita | PDERI042X0 | None | None | G1/S1 | 1B.2 | Yes |
| *Arctostaphylos glandulosa ssp. crassifolia* | Del Mar manzanita | PDERI040E8 | Endangered | None | G5T2/S2 | 1B.1 | Yes |
| *Arctostaphylos glandulosa ssp. gabrielensis* | San Gabriel manzanita | PDERI042P0 | None | None | G5T2/S2 | 1B.2 | Yes |
| *Arctostaphylos glutinosa* | Schreiber's manzanita | PDERI040G0 | None | None | G2/S2.1 | 1B.2 | Yes |
| *Arctostaphylos hispidula* | Howell's manzanita | PDERI04230 | None | None | G3/S3.2 | 4.2 | No |
| *Arctostaphylos hookeri ssp. hearstiorum* | Hearst's manzanita | PDERI040J4 | None | Endangered | G3T2/S2 | 1B.2 | Yes |
| *Arctostaphylos hookeri ssp. hookeri* | Hooker's manzanita | PDERI040J1 | None | None | G3T2?/S2? | 1B.2 | Yes |
| *Arctostaphylos hooveri* | Hoover's manzanita | PDERI040K0 | None | None | G3/S3.3? | 4.3 | No |
| *Arctostaphylos imbricata* | San Bruno Mountain manzanita | PDERI040L0 | None | Endangered | G1/S1 | 1B.1 | Yes |
| *Arctostaphylos klamathensis* | Klamath manzanita | PDERI041R0 | None | None | G2/S2 | 1B.2 | Yes |
| *Arctostaphylos luciana* | Santa Lucia manzanita | PDERI040N0 | None | None | G2/S2.2 | 1B.2 | Yes |

# Special Vascular Plants, Bryophytes, and Lichens List

## California Department of Fish and Game

### Natural Diversity Database

| Scientific Name | Common Name | Element Code | Federal Listing Status | State Listing Status | Heritage Rank | Rare Plant Rank | Records in CNDDB ? |
|---|---|---|---|---|---|---|---|
| *Arctostaphylos malloryi* | Mallory's manzanita | PDERI042V0 | None | None | G3/S3.3? | 4.3 | No |
| *Arctostaphylos manzanita ssp. elegans* | Konocti manzanita | PDERI04271 | None | None | G5T2/S2.3 | 1B.3 | Yes |
| *Arctostaphylos manzanita ssp. laevigata* | Contra Costa manzanita | PDERI04273 | None | None | G5T2/S2 | 1B.2 | Yes |
| *Arctostaphylos mewukka ssp. truei* | True's manzanita | PDERI040Q2 | None | None | G4?T3/S3.2 | 4.2 | No |
| *Arctostaphylos montana ssp. montana* | Mt. Tamalpais manzanita | PDERI040J5 | None | None | G3T2/S2.2 | 1B.3 | Yes |
| *Arctostaphylos montana ssp. ravenii* | Presidio manzanita | PDERI040J2 | Endangered | Endangered | G3T1/S1 | 1B.1 | Yes |
| *Arctostaphylos montaraensis* | Montara manzanita | PDERI042W0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Arctostaphylos montereyensis* | Toro manzanita | PDERI040R0 | None | None | G2/S2.1 | 1B.2 | Yes |
| *Arctostaphylos morroensis* | Morro manzanita | PDERI040S0 | Threatened | None | G2/S2 | 1B.1 | Yes |
| *Arctostaphylos myrtifolia* | Ione manzanita | PDERI04240 | Threatened | None | G2/S2 | 1B.2 | Yes |
| *Arctostaphylos nissenana* | Nissenan manzanita | PDERI040V0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Arctostaphylos nortensis* | Del Norte manzanita | PDERI04092 | None | None | G3?/S3? | 4.3 | No |
| *Arctostaphylos nummularia ssp. mendocinoensis* | pygmy manzanita | PDERI04280 | None | None | G3?T1/S1 | 1B.2 | Yes |
| *Arctostaphylos obispoensis* | Bishop manzanita | PDERI040X0 | None | None | G3?/S3? | 4.3 | No |
| *Arctostaphylos ohloneana* | Ohlone manzanita | PDERI042Y0 | None | None | G1/S1 | 1B.1 | Yes |
| *Arctostaphylos osoensis* | Oso manzanita | PDERI042S0 | None | None | G1/S1 | 1B.2 | Yes |
| *Arctostaphylos otayensis* | Otay manzanita | PDERI040Y0 | None | None | G2/S2.1 | 1B.2 | Yes |
| *Arctostaphylos pacifica* | Pacific manzanita | PDERI040Z0 | None | Endangered | G1/S1 | 1B.2 | Yes |
| *Arctostaphylos pajaroensis* | Pajaro manzanita | PDERI04100 | None | None | G2/S2.1 | 1B.1 | Yes |
| *Arctostaphylos pallida* | pallid manzanita | PDERI04110 | Threatened | Endangered | G1/S1 | 1B.1 | Yes |
| *Arctostaphylos parryana ssp. tumescens* | interior manzanita | PDERI042A1 | None | None | G4T3/S3 | 4.3 | No |
| *Arctostaphylos pechoensis* | Pecho manzanita | PDERI04140 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Arctostaphylos pilosula* | Santa Margarita manzanita | PDERI04160 | None | None | G3/S3 | 1B.2 | Yes |
| *Arctostaphylos pumila* | sandmat manzanita | PDERI04180 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Arctostaphylos purissima* | La Purisima manzanita | PDERI041A0 | None | None | G2?/S2? | 1B.1 | Yes |
| *Arctostaphylos rainbowensis* | Rainbow manzanita | PDERI042T0 | None | None | G2/S2.1 | 1B.1 | Yes |
| *Arctostaphylos refugioensis* | Refugio manzanita | PDERI041B0 | None | None | G2/S2? | 1B.2 | Yes |
| *Arctostaphylos regismontana* | Kings Mountain manzanita | PDERI041C0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Arctostaphylos rudis* | sand mesa manzanita | PDERI041E0 | None | None | G2/S2.2 | 1B.2 | Yes |

# Special Vascular Plants, Bryophytes, and Lichens List

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|---|---|---|---|---|---|---|---|
| *Arctostaphylos silvicola* | Bonny Doon manzanita | PDERI041F0 | None | None | G2/S2.1 | 1B.2 | Yes |
| *Arctostaphylos stanfordiana ssp. decumbens* | Rincon Ridge manzanita | PDERI041G4 | None | None | G3T1/S1 | 1B.1 | Yes |
| *Arctostaphylos stanfordiana ssp. raichei* | Raiche's manzanita | PDERI041G2 | None | None | G3T2?/S2? | 1B.1 | Yes |
| *Arctostaphylos tomentosa ssp. daciticola* | dacite manzanita | PDERI041HD | None | None | G4T1/S1 | 1B.1 | Yes |
| *Arctostaphylos virgata* | Marin manzanita | PDERI041K0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Arctostaphylos viridissima* | white-haired manzanita | PDERI041L0 | None | None | G3/S3 | 4.2 | No |
| *Arenaria lanuginosa var. saxosa* | rock sandwort | PDCAR040E4 | None | None | G5T5/S2 | 2.3 | Yes |
| *Arenaria paludicola* | marsh sandwort | PDCAR040L0 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Argyrochosma limitanea ssp. limitanea* | southwestern false cloak-fern | PPADI0N051 | None | None | G4G5T3T4/S1 | 2.3 | Yes |
| *Aristocapsa insignis* | Indian Valley spineflower | PDPGN0U010 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Arnica cernua* | serpentine arnica | PDAST0Q040 | None | None | G5/S3.3 | 4.3 | No |
| *Arnica fulgens* | hillside arnica | PDAST0Q090 | None | None | G5/S2.2 | 2.2 | Yes |
| *Arnica spathulata* | Klamath arnica | PDAST0Q0M0 | None | None | G3?/S3.3 | 4.3 | No |
| *Arnica venosa* | Shasta County arnica | PDAST0Q0Q0 | None | None | G3/S3.2 | 4.2 | No |
| *Arnica viscosa* | Mt. Shasta arnica | PDAST0Q0R0 | None | None | G4/S3.3 | 4.3 | No |
| *Artemisia nesiotica* | island sagebrush | PDAST0S120 | None | None | G3/S3.3 | 4.3 | No |
| *Artemisia palmeri* | San Diego sagewort | PDAST0S160 | None | None | G3/S3.2 | 4.2 | Yes |
| *Artemisia tripartita ssp. tripartita* | threetip sagebrush | PDAST0S1S2 | None | None | G5T3T5/S2 | 2.3 | Yes |
| *Asarum marmoratum* | marbled wild-ginger | PDARI02070 | None | None | G3G4/S2 | 2.3 | Yes |
| *Asclepias asperula ssp. asperula* | antelope-horns | PDASC02051 | None | None | G5T5/S3.3 | 4.3 | No |
| *Asclepias nyctaginifolia* | Mojave milkweed | PDASC02190 | None | None | G4G5/S2 | 2.1 | Yes |
| *Asclepias solanoana* | serpentine milkweed | PDASC021R0 | None | None | G3/S3.2 | 4.2 | No |
| *Aspidotis carlotta-halliae* | Carlotta Hall's lace fern | PPADI07020 | None | None | G3/S3.2 | 4.2 | No |
| *Asplenium septentrionale* | northern spleenwort | PPASP021F0 | None | None | G4G5/S2.3 | 2.3 | Yes |
| *Asplenium trichomanes ssp. trichomanes* | maidenhair spleenwort | PPASP021K2 | None | None | G5T5/S1 | 2.3 | Yes |
| *Asplenium vespertinum* | western spleenwort | PPASP021P0 | None | None | G3?/S3.2 | 4.2 | No |
| *Asplenium viride* | green spleenwort | PPASP02250 | None | None | G4/S1 | 2.3 | Yes |
| *Astragalus agnicidus* | Humboldt milk-vetch | PDFAB0F080 | None | Endangered | G3/S3 | 1B.1 | Yes |
| *Astragalus agrestis* | field milk-vetch | PDFAB0F090 | None | None | G5/S2? | 2.2 | Yes |
| *Astragalus albens* | Cushenbury milk-vetch | PDFAB0F0A0 | Endangered | None | G1/S1 | 1B.1 | Yes |
| *Astragalus allochrous var. playanus* | playa milk-vetch | PDFAB0F0C1 | None | None | G4T3?/S1 | 2.2 | Yes |
| *Astragalus anxius* | Ash Valley milk-vetch | PDFAB0FBD0 | None | None | G1/S1 | 1B.3 | Yes |
| *Astragalus argophyllus var. argophyllus* | silver-leaved milk-vetch | PDFAB0F0S1 | None | None | G5T4/S1 | 2.2 | Yes |

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|---|---|---|---|---|---|---|---|
| *Astragalus atratus var. mensanus* | Darwin Mesa milk-vetch | PDFAB0F0Z3 | None | None | G4G5T1/S1 | 1B.1 | Yes |
| *Astragalus bernardinus* | San Bernardino milk-vetch | PDFAB0F190 | None | None | G2G3/S2S3 | 1B.2 | Yes |
| *Astragalus bicristatus* | crested milk-vetch | PDFAB0F1A0 | None | None | G3/S3.3 | 4.3 | No |
| *Astragalus brauntonii* | Braunton's milk-vetch | PDFAB0F1G0 | Endangered | None | G2/S2 | 1B.1 | Yes |
| *Astragalus breweri* | Brewer's milk-vetch | PDFAB0F1J0 | None | None | G3/S3.2 | 4.2 | No |
| *Astragalus cimae var. cimae* | Cima milk-vetch | PDFAB0F231 | None | None | G2T2/S2 | 1B.2 | Yes |
| *Astragalus cimae var. sufflatus* | inflated Cima milk-vetch | PDFAB0F232 | None | None | G2T2/S2.3 | 1B.3 | Yes |
| *Astragalus claranus* | Clara Hunt's milk-vetch | PDFAB0F240 | Endangered | Threatened | G1/S1 | 1B.1 | Yes |
| *Astragalus clevelandii* | Cleveland's milk-vetch | PDFAB0F250 | None | None | G3/S3.3? | 4.3 | No |
| *Astragalus crotalariae* | Salton milk-vetch | PDFAB0F2K0 | None | None | G4G5/S3.3 | 4.3 | No |
| *Astragalus deanei* | Dean's milk-vetch | PDFAB0F2R0 | None | None | G2/S2.1 | 1B.1 | Yes |
| *Astragalus didymocarpus var. milesianus* | Miles' milk-vetch | PDFAB0F2X3 | None | None | G5T2/S2.2 | 1B.2 | Yes |
| *Astragalus douglasii var. perstrictus* | Jacumba milk-vetch | PDFAB0F303 | None | None | G5T2/S2.2 | 1B.2 | Yes |
| *Astragalus ertterae* | Walker Pass milk-vetch | PDFAB0FB30 | None | None | G2/S2 | 1B.3 | Yes |
| *Astragalus funereus* | black milk-vetch | PDFAB0F3K0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Astragalus geyeri var. geyeri* | Geyer's milk-vetch | PDFAB0F3M1 | None | None | G4T4/S2 | 2.2 | Yes |
| *Astragalus gilmanii* | Gilman's milk-vetch | PDFAB0F3R0 | None | None | G2/S2 | 1B.2 | Yes |
| *Astragalus hornii var. hornii* | Horn's milk-vetch | PDFAB0F421 | None | None | G4G5T2T3/S1 | 1B.1 | Yes |
| *Astragalus insularis var. harwoodii* | Harwood's milk-vetch | PDFAB0F491 | None | None | G5T3/S2 | 2.2 | Yes |
| *Astragalus inversus* | Susanville milk-vetch | PDFAB0F4A0 | None | None | G3/S3.3 | 4.3 | No |
| *Astragalus inyoensis* | Inyo milk-vetch | PDFAB0F4B0 | None | None | G3/S3.2 | 4.2 | No |
| *Astragalus iodanthus var. diaphanoides* | snake milk-vetch | PDFAB0F4C3 | None | None | G4T4/S3.3 | 4.3 | No |
| *Astragalus jaegerianus* | Lane Mountain milk-vetch | PDFAB0F4F0 | Endangered | None | G1/S1 | 1B.1 | Yes |
| *Astragalus johannis-howellii* | Long Valley milk-vetch | PDFAB0F4H0 | None | Rare | G2/S2.2 | 1B.2 | Yes |
| *Astragalus kentrophyta var. danaus* | Sweetwater Mountains milk-vetch | PDFAB0F4J2 | None | None | G5T3/S3 | 4.3 | No |
| *Astragalus kentrophyta var. elatus* | spiny-leaved milk-vetch | PDFAB0F4J4 | None | None | G5T4/S2 | 2.2 | Yes |
| *Astragalus kentrophyta var. ungulatus* | spiny milk-vetch | PDFAB0F4JB | None | None | G5T3T4/S1 | 2.2 | Yes |
| *Astragalus lemmonii* | Lemmon's milk-vetch | PDFAB0F4N0 | None | None | G2/S2 | 1B.2 | Yes |
| *Astragalus lentiformis* | lens-pod milk-vetch | PDFAB0F4P0 | None | None | G2/S2 | 1B.2 | Yes |
| *Astragalus lentiginosus var. antonius* | San Antonio milk-vetch | PDFAB0FB92 | None | None | G5T2/S2 | 1B.3 | Yes |
| *Astragalus lentiginosus var. borreganus* | Borrego milk-vetch | PDFAB0FB95 | None | None | G5T4T5/S3.3 | 4.3 | No |

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|---|---|---|---|---|---|---|---|
| *Astragalus lentiginosus var. coachellae* | Coachella Valley milk-vetch | PDFAB0FB97 | Endangered | None | G5T2/S2 | 1B.2 | Yes |
| *Astragalus lentiginosus var. kernensis* | Kern Plateau milk-vetch | PDFAB0FB98 | None | None | G5T2T3/S2S3 | 1B.2 | Yes |
| *Astragalus lentiginosus var. micans* | shining milk-vetch | PDFAB0FB9C | None | None | G5T2Q/S2 | 1B.2 | Yes |
| *Astragalus lentiginosus var. piscinensis* | Fish Slough milk-vetch | PDFAB0FB9E | Threatened | None | G5T1/S1 | 1B.1 | Yes |
| *Astragalus lentiginosus var. sesquimetralis* | Sodaville milk-vetch | PDFAB0FB9K | None | Endangered | G5T1/S1 | 1B.1 | Yes |
| *Astragalus lentiginosus var. sierrae* | Big Bear Valley milk-vetch | PDFAB0FB9L | None | None | G5T2/S2 | 1B.2 | Yes |
| *Astragalus leucolobus* | Big Bear Valley woollypod | PDFAB0F4T0 | None | None | G2/S2 | 1B.2 | Yes |
| *Astragalus macrodon* | Salinas milk-vetch | PDFAB0F520 | None | None | G3/S3.3 | 4.3 | No |
| *Astragalus magdalenae var. peirsonii* | Peirson's milk-vetch | PDFAB0F532 | Threatened | Endangered | G3G4T2/S2 | 1B.2 | Yes |
| *Astragalus miguelensis* | San Miguel Island milk-vetch | PDFAB0F5C0 | None | None | G3/S3.3? | 4.3 | No |
| *Astragalus mohavensis var. hemigyrus* | curved-pod milk-vetch | PDFAB0F5J1 | None | None | G3G4T2T3/S1 | 1B.1 | Yes |
| *Astragalus monoensis* | Mono milk-vetch | PDFAB0F5N0 | None | Rare | G2/S2.2 | 1B.2 | Yes |
| *Astragalus nevinii* | San Clemente Island milk-vetch | PDFAB0F5X0 | None | None | G3/S3 | 1B.2 | Yes |
| *Astragalus nutans* | Providence Mountains milk-vetch | PDFAB0F620 | None | None | G3/S3.3 | 4.3 | No |
| *Astragalus nuttallii var. nuttallii* | ocean bluff milk-vetch | PDFAB0F641 | None | None | G3T3/S3.2 | 4.2 | No |
| *Astragalus nyensis* | Nye milk-vetch | PDFAB0F660 | None | None | G3/S1 | 1B.1 | Yes |
| *Astragalus oocarpus* | San Diego milk-vetch | PDFAB0F6B0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Astragalus oophorus var. lavinii* | Lavin's milk-vetch | PDFAB0F6C4 | None | None | G4T2/S1 | 1B.2 | Yes |
| *Astragalus oophorus var. oophorus* | egg milk-vetch | PDFAB0F6C6 | None | None | G4T3T4/S3.3 | 4.3 | No |
| *Astragalus pachypus var. jaegeri* | Jaeger's milk-vetch | PDFAB0F6G1 | None | None | G4T1/S1 | 1B.1 | Yes |
| *Astragalus pauperculus* | depauperate milk-vetch | PDFAB0F6N0 | None | None | G3/S3.3 | 4.3 | No |
| *Astragalus platytropis* | broad-keeled milk-vetch | PDFAB0F6X0 | None | None | G5/S2 | 2.2 | Yes |
| *Astragalus preussii var. laxiflorus* | Lancaster milk-vetch | PDFAB0F721 | None | None | G4T2/S1 | 1B.1 | Yes |
| *Astragalus preussii var. preussii* | Preuss' milk-vetch | PDFAB0F722 | None | None | G4T4/S1 | 2.3 | Yes |
| *Astragalus pseudiodanthus* | Tonopah milk-vetch | PDFAB0F750 | None | None | G2Q/S2.2 | 1B.2 | Yes |
| *Astragalus pulsiferae var. coronensis* | Modoc Plateau milk-vetch | PDFAB0F784 | None | None | G4T3/S3.2 | 4.2 | No |
| *Astragalus pulsiferae var. pulsiferae* | Pulsifer's milk-vetch | PDFAB0F783 | None | None | G4T2/S2.2 | 1B.2 | Yes |

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|---|---|---|---|---|---|---|---|
| *Astragalus pulsiferae var. suksdorfii* | Suksdorf's milk-vetch | PDFAB0F782 | None | None | G4T2/S2.2 | 1B.2 | Yes |
| *Astragalus pycnostachyus var. lanosissimus* | Ventura Marsh milk-vetch | PDFAB0F7B1 | Endangered | Endangered | G2T1/S1 | 1B.1 | Yes |
| *Astragalus pycnostachyus var. pycnostachyus* | coastal marsh milk-vetch | PDFAB0F7B2 | None | None | G2T2/S2.2 | 1B.2 | Yes |
| *Astragalus rattanii var. jepsonianus* | Jepson's milk-vetch | PDFAB0F7E1 | None | None | G4T3/S3 | 1B.2 | Yes |
| *Astragalus rattanii var. rattanii* | Rattan's milk-vetch | PDFAB0F7E2 | None | None | G4T3/S3.3 | 4.3 | No |
| *Astragalus ravenii* | Raven's milk-vetch | PDFAB0F7F0 | None | None | G2Q/S2 | 1B.3 | Yes |
| *Astragalus sabulonum* | gravel milk-vetch | PDFAB0F7R0 | None | None | G5/S2 | 2.2 | Yes |
| *Astragalus serenoi var. shockleyi* | Shockley's milk-vetch | PDFAB0F802 | None | None | G4T3/S2 | 2.2 | Yes |
| *Astragalus shevockii* | Shevock's milk-vetch | PDFAB0F850 | None | None | G2/S2.2 | 1B.3 | Yes |
| *Astragalus subvestitus* | Kern County milk-vetch | PDFAB0F8M0 | None | None | G3/S3.3 | 4.3 | No |
| *Astragalus tener var. ferrisiae* | Ferris' milk-vetch | PDFAB0F8R3 | None | None | G1T1/S1 | 1B.1 | Yes |
| *Astragalus tener var. tener* | alkali milk-vetch | PDFAB0F8R1 | None | None | G2T2/S2 | 1B.2 | Yes |
| *Astragalus tener var. titi* | coastal dunes milk-vetch | PDFAB0F8R2 | Endangered | Endangered | G1T1/S1 | 1B.1 | Yes |
| *Astragalus tidestromii* | Tidestrom's milk-vetch | PDFAB0F8X0 | None | None | G4G5/S2 | 2.2 | Yes |
| *Astragalus traskiae* | Trask's milk-vetch | PDFAB0F910 | None | Rare | G3/S3 | 1B.2 | Yes |
| *Astragalus tricarinatus* | triple-ribbed milk-vetch | PDFAB0F920 | Endangered | None | G1/S1 | 1B.2 | Yes |
| *Astragalus umbraticus* | Bald Mountain milk-vetch | PDFAB0F990 | None | None | G4/S2.3 | 2.3 | Yes |
| *Astragalus webberi* | Webber's milk-vetch | PDFAB0F9J0 | None | None | G1/S1 | 1B.2 | Yes |
| *Astragalus whitneyi var. lenophyllus* | woolly-leaved milk-vetch | PDFAB0F9L6 | None | None | G5T3/S3.3 | 4.3 | No |
| *Astrolepis cochisensis ssp. cochisensis* | scaly cloak fern | PPADI0P013 | None | None | G5?T4/S2.3 | 2.3 | Yes |
| *Atriplex argentea var. hillmanii* | Hillman's silverscale | PDCHE04055 | None | None | G5T3?/S2.2 | 2.2 | Yes |
| *Atriplex argentea var. longitrichoma* | Pahrump orache | PDCHE04056 | None | None | G5T2/S2 | 1B.1 | Yes |
| *Atriplex cordulata var. cordulata* | heartscale | PDCHE040B0 | None | None | G3T2/S2.2? | 1B.2 | Yes |
| *Atriplex cordulata var. erecticaulis* | Earlimart orache | PDCHE042V0 | None | None | G3T2/S2.2 | 1B.2 | Yes |
| *Atriplex coronata var. coronata* | crownscale | PDCHE040C3 | None | None | G4T3/S3.2 | 4.2 | No |
| *Atriplex coronata var. notatior* | San Jacinto Valley crownscale | PDCHE040C2 | Endangered | None | G4T1/S1 | 1B.1 | Yes |
| *Atriplex coronata var. vallicola* | Lost Hills crownscale | PDCHE04250 | None | None | G4T2/S2 | 1B.2 | Yes |
| *Atriplex coulteri* | Coulter's saltbush | PDCHE040E0 | None | None | G2/S2 | 1B.2 | Yes |
| *Atriplex depressa* | brittlescale | PDCHE042L0 | None | None | G2Q/S2.2 | 1B.2 | Yes |

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|---|---|---|---|---|---|---|---|
| *Atriplex gardneri var. falcata* | falcate saltbush | PDCHE040J0 | None | None | G4Q/S2.2 | 2.2 | Yes |
| *Atriplex joaquinana* | San Joaquin spearscale | PDCHE041F3 | None | None | G2/S2 | 1B.2 | Yes |
| *Atriplex minuscula* | lesser saltscale | PDCHE042M0 | None | None | G2/S2 | 1B.1 | Yes |
| *Atriplex pacifica* | south coast saltscale | PDCHE041C0 | None | None | G3G4/S2 | 1B.2 | Yes |
| *Atriplex parishii* | Parish's brittlescale | PDCHE041D0 | None | None | G1G2/S1 | 1B.1 | Yes |
| *Atriplex persistens* | vernal pool smallscale | PDCHE042P0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Atriplex pusilla* | smooth saltbush | PDCHE041P0 | None | None | G5/S1 | 2 | Yes |
| *Atriplex serenana var. davidsonii* | Davidson's saltscale | PDCHE041T1 | None | None | G5T2?/S2? | 1B.2 | Yes |
| *Atriplex subtilis* | subtle orache | PDCHE042T0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Atriplex tularensis* | Bakersfield smallscale | PDCHE04240 | None | Endangered | GX/SX | 1A | Yes |
| *Ayenia compacta* | California ayenia | PDSTE01020 | None | None | G4/S3? | 2.3 | Yes |
| *Azolla microphylla* | Mexican mosquito fern | PPAZO01030 | None | None | G5/S3.2? | 4.2 | No |
| *Baccharis malibuensis* | Malibu baccharis | PDAST0W0W0 | None | None | G1/S1 | 1B.1 | Yes |
| *Baccharis plummerae ssp. glabrata* | San Simeon baccharis | PDAST0W0D1 | None | None | G3T2/S2 | 1B.2 | Yes |
| *Baccharis plummerae ssp. plummerae* | Plummer's baccharis | PDAST0W0D2 | None | None | G3T3/S3.2 | 4.3 | No |
| *Baccharis vanessae* | Encinitas baccharis | PDAST0W0P0 | Threatened | Endangered | G1/S1 | 1B.1 | Yes |
| *Balsamorhiza lanata* | woolly balsamroot | PDAST11047 | None | None | G3/S3 | 1B.2 | Yes |
| *Balsamorhiza macrolepis* | big-scale balsamroot | PDAST11061 | None | None | G2/S2 | 1B.2 | Yes |
| *Balsamorhiza sericea* | silky balsamroot | PDAST110C0 | None | None | G4Q/S2.3 | 1B.3 | Yes |
| *Balsamorhiza serrata* | serrated balsamroot | PDAST110A0 | None | None | G5/S2 | 2.3 | Yes |
| *Benitoa occidentalis* | western lessingia | PDAST15010 | None | None | G3/S3.3 | 4.3 | No |
| *Bensoniella oregona* | bensoniella | PDSAX02010 | None | Rare | G3/S2.2 | 1B.1 | Yes |
| *Berberis fremontii* | Fremont barberry | PDBER06060 | None | None | G5/S2? | 3 | Yes |
| *Berberis harrisoniana* | Kofa barberry | PDBER02030 | None | None | G1/S1 | 1B.2 | Yes |
| *Berberis nevinii* | Nevin's barberry | PDBER060A0 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Berberis pinnata ssp. insularis* | island barberry | PDBER060B2 | Endangered | Endangered | G5T1/S1 | 1B.2 | Yes |
| *Bergerocactus emoryi* | golden-spined cereus | PDCAC11010 | None | None | G2G3/S2.1 | 2.2 | Yes |
| *Betula glandulosa* | dwarf resin birch | PDBET02030 | None | None | G5/S2 | 2.2 | Yes |
| *Blennosperma bakeri* | Sonoma sunshine | PDAST1A010 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Blennosperma nanum var. robustum* | Point Reyes blennosperma | PDAST1A022 | None | Rare | G4T2/S2 | 1B.2 | Yes |
| *Blepharidachne kingii* | King's eyelash grass | PMPOA0X020 | None | None | G4/S2 | 2.3 | Yes |
| *Blepharizonia plumosa* | big tarplant | PDAST1C011 | None | None | G1/S1 | 1B.1 | Yes |
| *Bloomeria clevelandii* | San Diego goldenstar | PMLIL1H010 | None | None | G2/S2 | 1B.1 | Yes |
| *Bloomeria humilis* | dwarf goldenstar | PMLIL0B020 | None | Rare | G1/S1 | 1B.2 | Yes |
| *Boechera bodiensis* | Bodie Hills rockcress | PDBRA06240 | None | None | G2/S2 | 1B.3 | Yes |
| *Boechera cobrensis* | Masonic rockcress | PDBRA06080 | None | None | G5/S1S2 | 2.3 | Yes |
| *Boechera constancei* | Constance's rockcress | PDBRA06090 | None | None | G2/S2 | 1B.1 | Yes |
| *Boechera dispar* | pinyon rockcress | PDBRA060F0 | None | None | G3/S2.3 | 2.3 | Yes |

# Special Vascular Plants, Bryophytes, and Lichens List

## California Department of Fish and Game

### Natural Diversity Database

| Scientific Name | Common Name | Element Code | Federal Listing Status | State Listing Status | Heritage Rank | Rare Plant Rank | Records in CNDDB ? |
|---|---|---|---|---|---|---|---|
| *Boechera evadens* | hidden rockcress | PDBRA40030 | None | None | G1G2/S1S2 | 1B.3 | Yes |
| *Boechera hirshbergiae* | Hirshberg's rockcress | PDBRA064D0 | None | None | G1/S1 | 1B.2 | Yes |
| *Boechera hoffmannii* | Hoffmann's rockcress | PDBRA060V0 | Endangered | None | G2?/S2? | 1B.1 | Yes |
| *Boechera johnstonii* | Johnston's rockcress | PDBRA060Y0 | None | None | G1/S1 | 1B.2 | Yes |
| *Boechera koehleri* | Koehler's rockcress | PDBRA060Z0 | None | None | G3/S2 | 1B.3 | Yes |
| *Boechera lincolnensis* | Lincoln rockcress | PDBRA061M3 | None | None | G4?/S2 | 2.3 | Yes |
| *Boechera microphylla* | small-leaved rockcress | PDBRA06162 | None | None | G5T4Q/S3.3 | 3 | No |
| *Boechera parishii* | Parish's rockcress | PDBRA061C0 | None | None | G2/S2.1 | 1B.2 | Yes |
| *Boechera peirsonii* | San Bernardino rockcress | PDBRA06053 | None | None | G1/S1 | 1B.2 | Yes |
| *Boechera pendulina* | rabbit-ear rockcress | PDBRA061E0 | None | None | G5/S1 | 2.3 | Yes |
| *Boechera pinzliae* | Pinzl's rockcress | PDBRA06270 | None | None | G2/S1 | 1B.3 | Yes |
| *Boechera pygmaea* | Tulare County rockcress | PDBRA061N0 | None | None | G3/S3 | 4.3 | No |
| *Boechera rollei* | Rolle's rockcress | PDBRA064H0 | None | None | G1/S1 | 1B.1 | Yes |
| *Boechera rubicundula* | Mount Day rockcress | PDBRA40100 | None | None | G1/S1 | 1B.1 | Yes |
| *Boechera serpenticola* | serpentine rockcress | PDBRA40110 | None | None | G1/S1 | 1B.2 | Yes |
| *Boechera shevockii* | Shevock's rockcress | PDBRA40120 | None | None | G1/S1 | 1B.1 | Yes |
| *Boechera shockleyi* | Shockley's rockcress | PDBRA061V0 | None | None | G3/S2 | 2.2 | Yes |
| *Boechera tiehmii* | Tiehm's rockcress | PDBRA06280 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Boechera tularensis* | Tulare rockcress | PDBRA40130 | None | None | G2/S2 | 1B.3 | Yes |
| *Boechera ultraalsa* | Snow Mountain rockcress | PDBRA40140 | None | None | G1/S1 | 1B.1 | Yes |
| *Boechera yorkii* | Last Chance rockcress | PDBRA40010 | None | None | G1/S1 | 1B.3 | Yes |
| *Bolandra californica* | Sierra bolandra | PDSAX03010 | None | None | G3/S3.3 | 4.3 | No |
| *Botrychium ascendens* | upswept moonwort | PPOPH010S0 | None | None | G2G3/S2 | 2.3 | Yes |
| *Botrychium crenulatum* | scalloped moonwort | PPOPH010L0 | None | None | G3/S2.2 | 2.2 | Yes |
| *Botrychium lineare* | slender moonwort | PPOPH01120 | None | None | G2?/S1 | 1B.3 | Yes |
| *Botrychium lunaria* | common moonwort | PPOPH01080 | None | None | G5/S2? | 2.3 | Yes |
| *Botrychium minganense* | mingan moonwort | PPOPH010R0 | None | None | G4/S2 | 2.2 | Yes |
| *Botrychium montanum* | western goblin | PPOPH010K0 | None | None | G3/S2 | 2.1 | Yes |
| *Botrychium paradoxum* | paradox moonwort | PPOPH010J0 | None | None | G3G4/S1 | 2.1 | Yes |
| *Botrychium pedunculosum* | stalked moonwort | PPOPH010T0 | None | None | G2G3/S1 | 2.1 | Yes |
| *Botrychium pinnatum* | northwestern moonwort | PPOPH010V0 | None | None | G4?/S2 | 2.3 | Yes |
| *Botrychium pumicola* | pumice moonwort | PPOPH010D0 | None | None | G3/S1? | 2.2 | Yes |
| *Botrychium tunux* | moosewort | PPOPH01240 | None | None | G3?/S1 | 2.1 | Yes |
| *Botrychium yaaxudakeit* | giant moonwort | PPOPH01180 | None | None | G3G4/S1 | 2.1 | Yes |
| *Botrypus virginianus* | rattlesnake fern | PPOPH010H0 | None | None | G5/S2 | 2.2 | Yes |
| *Bouteloua eriopoda* | black grama | PMPOA10080 | None | None | G5/S3.2 | 4.2 | No |
| *Bouteloua trifida* | three-awned grama | PMPOA100L0 | None | None | G4G5/S2? | 2.3 | Yes |
| *Brasenia schreberi* | watershield | PDCAB01010 | None | None | G5/S2 | 2.3 | Yes |
| *Brodiaea filifolia* | thread-leaved brodiaea | PMLIL0C050 | Threatened | Endangered | G1/S1 | 1B.1 | Yes |
| *Brodiaea insignis* | Kaweah brodiaea | PMLIL0C060 | None | Endangered | G1/S1 | 1B.2 | Yes |

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|---|---|---|---|---|---|---|---|
| *Brodiaea kinkiensis* | San Clemente Island brodiaea | PMLIL0C080 | None | None | G2/S2 | 1B.2 | Yes |
| *Brodiaea leptandra* | narrow-anthered brodiaea | PMLIL0C022 | None | None | G2G3/S2S3.2 | 1B.2 | Yes |
| *Brodiaea matsonii* | Sulphur Creek brodiaea | PMLIL0C0H0 | None | None | G1/S1 | 1B.1 | Yes |
| *Brodiaea orcuttii* | Orcutt's brodiaea | PMLIL0C0B0 | None | None | G1/S1 | 1B.1 | Yes |
| *Brodiaea pallida* | Chinese Camp brodiaea | PMLIL0C0C0 | Threatened | Endangered | G1/S1 | 1B.1 | Yes |
| *Brodiaea rosea* | Indian Valley brodiaea | PMLIL0C032 | None | Endangered | G1/S1 | 1B.1 | Yes |
| *Brodiaea santarosae* | Santa Rosa Basalt brodiaea | PMLIL0C0G0 | None | None | G1Q/S1.3 | 3 | No |
| *Brodiaea sierrae* | Sierra foothills brodiaea | PMLIL0C0J0 | None | None | G3/S3 | 4.3 | No |
| *Bulbostylis capillaris* | thread-leaved beakseed | PMCYP02020 | None | None | G5/S3.2 | 4.2 | No |
| *Bursera microphylla* | little-leaf elephant tree | PDBUR01020 | None | None | G4/S2 | 2.3 | Yes |
| *Buxbaumia viridis* | buxbaumia moss | NBMUS1B040 | None | None | G4G5/S2 | 2.2 | Yes |
| *Calamagrostis bolanderi* | Bolander's reed grass | PMPOA17010 | None | None | G3/S3.2 | 4.2 | No |
| *Calamagrostis crassiglumis* | Thurber's reed grass | PMPOA17070 | None | None | G3Q/S2? | 2.1 | Yes |
| *Calamagrostis foliosa* | leafy reed grass | PMPOA170C0 | None | Rare | G3/S3.2 | 4.2 | Yes |
| *Calamagrostis ophitidis* | serpentine reed grass | PMPOA170V0 | None | None | G3/S3.3 | 4.3 | No |
| *Calandrinia breweri* | Brewer's calandrinia | PDPOR01020 | None | None | G4/S3.2? | 4.2 | No |
| *California macrophylla* | round-leaved filaree | PDGER01070 | None | None | G2/S2 | 1B.1 | Yes |
| *Calliandra eriophylla* | pink fairy-duster | PDFAB0N040 | None | None | G5/S2S3 | 2.3 | Yes |
| *Callitropsis nootkatensis* | Alaska cedar | PGCUP03020 | None | None | G4/S3.3 | 4.3 | No |
| *Calochortus catalinae* | Catalina mariposa-lily | PMLIL0D080 | None | None | G3/S3.2 | 4.2 | No |
| *Calochortus clavatus var. avius* | Pleasant Valley mariposa-lily | PMLIL0D095 | None | None | G4T2/S2 | 1B.2 | Yes |
| *Calochortus clavatus var. clavatus* | club-haired mariposa-lily | PMLIL0D091 | None | None | G4T3/S3 | 4.3 | No |
| *Calochortus clavatus var. gracilis* | slender mariposa-lily | PMLIL0D096 | None | None | G4T2/S2 | 1B.2 | Yes |
| *Calochortus clavatus var. recurvifolius* | Arroyo de la Cruz mariposa-lily | PMLIL0D098 | None | None | G4T1/S1 | 1B.2 | Yes |
| *Calochortus dunnii* | Dunn's mariposa-lily | PMLIL0D0C0 | None | Rare | G2/S2.1 | 1B.2 | Yes |
| *Calochortus excavatus* | Inyo County star-tulip | PMLIL0D0F0 | None | None | G2/S2 | 1B.1 | Yes |
| *Calochortus fimbriatus* | late-flowered mariposa-lily | PMLIL0D1J2 | None | None | G3G4/S2.2 | 1B.2 | Yes |
| *Calochortus greenei* | Greene's mariposa-lily | PMLIL0D0H0 | None | None | G3/S3 | 1B.2 | Yes |
| *Calochortus longebarbatus var. longebarbatus* | long-haired star-tulip | PMLIL0D0R1 | None | None | G4T3/S3 | 1B.2 | Yes |
| *Calochortus monanthus* | single-flowered mariposa-lily | PMLIL0D0W0 | None | None | GH/SH | 1A | Yes |
| *Calochortus obispoensis* | San Luis mariposa-lily | PMLIL0D110 | None | None | G2/S2.1 | 1B.2 | Yes |
| *Calochortus palmeri var. munzii* | San Jacinto mariposa-lily | PMLIL0D121 | None | None | G2T1/S1 | 1B.2 | Yes |
| *Calochortus palmeri var. palmeri* | Palmer's mariposa-lily | PMLIL0D122 | None | None | G2T2/S2.1 | 1B.2 | Yes |

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|---|---|---|---|---|---|---|---|
| *Calochortus panamintensis* | Panamint mariposa-lily | PMLIL0D130 | None | None | G3/S3.2 | 4.2 | No |
| *Calochortus persistens* | Siskiyou mariposa-lily | PMLIL0D140 | Candidate | Rare | G2/S2.2 | 1B.2 | Yes |
| *Calochortus plummerae* | Plummer's mariposa-lily | PMLIL0D150 | None | None | G4/S4 | 4.2 | Yes |
| *Calochortus pulchellus* | Mt. Diablo fairy-lantern | PMLIL0D160 | None | None | G2/S2 | 1B.2 | Yes |
| *Calochortus raichei* | The Cedars fairy-lantern | PMLIL0D1L0 | None | None | G2/S2 | 1B.2 | Yes |
| *Calochortus simulans* | La Panza mariposa-lily | PMLIL0D170 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Calochortus striatus* | alkali mariposa-lily | PMLIL0D190 | None | None | G2/S2 | 1B.2 | Yes |
| *Calochortus syntrophus* | Callahan's mariposa-lily | PMLIL0D1S0 | None | None | G1/S1 | 1B.1 | Yes |
| *Calochortus tiburonensis* | Tiburon mariposa-lily | PMLIL0D1C0 | Threatened | Threatened | G1/S1 | 1B.1 | Yes |
| *Calochortus umbellatus* | Oakland star-tulip | PMLIL0D1E0 | None | None | G3/S3.2 | 4.2 | No |
| *Calochortus uniflorus* | large-flowered mariposa lily | PMLIL0D1F0 | None | None | G4/S3 | 4.2 | No |
| *Calochortus weedii var. intermedius* | intermediate mariposa-lily | PMLIL0D1J1 | None | None | G3G4T2/S2.2 | 1B.2 | Yes |
| *Calochortus westonii* | Shirley Meadows star-tulip | PMLIL0D1M0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Calycadenia hooveri* | Hoover's calycadenia | PDAST1P040 | None | None | G2/S2.2 | 1B.3 | Yes |
| *Calycadenia micrantha* | small-flowered calycadenia | PDAST1P0C0 | None | None | G2G3/S2S3.2 | 1B.2 | Yes |
| *Calycadenia oppositifolia* | Butte County calycadenia | PDAST1P070 | None | None | G3/S3.2 | 4.2 | No |
| *Calycadenia villosa* | dwarf calycadenia | PDAST1P0B0 | None | None | G2/S2.1 | 1B.1 | Yes |
| *Calyptridium arizonicum* | Arizona pussypaws | PDPOR09051 | None | None | G2G3/S1 | 2.1 | Yes |
| *Calyptridium parryi var. hesseae* | Santa Cruz Mountains pussypaws | PDPOR09052 | None | None | G3G4T2/S2 | 1B.1 | Yes |
| *Calyptridium pulchellum* | Mariposa pussypaws | PDPOR09060 | Threatened | None | G1/S1 | 1B.1 | Yes |
| *Calyptridium pygmaeum* | pygmy pussypaws | PDPOR09070 | None | None | G2/S2 | 1B.2 | Yes |
| *Calyptridium quadripetalum* | four-petaled pussypaws | PDPOR09080 | None | None | G3/S3.3 | 4.3 | No |
| *Calystegia atriplicifolia ssp. buttensis* | Butte County morning-glory | PDCON04012 | None | None | G5T3/S3 | 4.2 | Yes |
| *Calystegia collina ssp. oxyphylla* | Mt. Saint Helena morning-glory | PDCON04032 | None | None | G4T3/S3.2 | 4.2 | Yes |
| *Calystegia collina ssp. tridactylosa* | coast range bindweed | PDCON04036 | None | None | G4T1/S1 | 1B.2 | Yes |
| *Calystegia collina ssp. venusta* | South Coast Range morning-glory | PDCON04034 | None | None | G4T3/S3.2 | 4.3 | No |
| *Calystegia macrostegia ssp. amplissima* | island morning-glory | PDCON04081 | None | None | G4G5T3/S3.3 | 4.3 | No |
| *Calystegia malacophylla var. berryi* | Berry's morning-glory | PDCON040K2 | None | None | G4G5T3? Q/S3? | 3.3 | Yes |
| *Calystegia peirsonii* | Peirson's morning-glory | PDCON040A0 | None | None | G3/S3.2 | 4.2 | Yes |
| *Calystegia purpurata ssp. saxicola* | coastal bluff morning-glory | PDCON040D2 | None | None | G4T2/S2.2 | 1B.2 | Yes |
| *Calystegia sepium ssp. binghamiae* | Santa Barbara morning-glory | PDCON040E6 | None | None | G5T1/S1 | 1B.1 | Yes |

# Special Vascular Plants, Bryophytes, and Lichens List

## California Department of Fish and Game

### Natural Diversity Database

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|---|---|---|---|---|---|---|---|
| *Calystegia stebbinsii* | Stebbins' morning-glory | PDCON040H0 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Calystegia subacaulis ssp. episcopalis* | Cambria morning-glory | PDCON040J1 | None | None | G3T3/S3 | 4.2 | Yes |
| *Camissonia benitensis* | San Benito evening-primrose | PDONA03030 | Threatened | None | G2/S2 | 1B.1 | Yes |
| *Camissonia integrifolia* | Kern River evening-primrose | PDONA030T0 | None | None | G2/S2 | 1B.3 | Yes |
| *Camissonia kernensis ssp. kernensis* | Kern County evening-primrose | PDONA030V2 | None | None | G4T3/S3.3 | 4.3 | No |
| *Camissonia sierrae ssp. alticola* | Mono Hot Springs evening-primrose | PDONA031H1 | None | None | G3T2/S2.2 | 1B.2 | Yes |
| *Camissonia sierrae ssp. sierrae* | Yosemite evening-primrose | PDONA031H2 | None | None | G3T3/S3.3 | 4.3 | No |
| *Camissonia tanacetifolia ssp. quadriperforata* | Sierra Valley evening-primrose | PDONA031M1 | None | None | G5T3/S3 | 4.3 | No |
| *Camissoniopsis guadalupensis ssp. clementina* | San Clemente Island evening-primrose | PDONA030M1 | None | None | G3T3/S3 | 1B.2 | Yes |
| *Camissoniopsis hardhamiae* | Hardham's evening-primrose | PDONA030N0 | None | None | G1Q/S1 | 1B.2 | Yes |
| *Camissoniopsis lewisii* | Lewis' evening-primrose | PDONA030X0 | None | None | G2G3/S1S3 | 3 | No |
| *Campanula californica* | swamp harebell | PDCAM02060 | None | None | G3/S3 | 1B.2 | Yes |
| *Campanula exigua* | chaparral harebell | PDCAM020A0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Campanula scabrella* | rough harebell | PDCAM020U0 | None | None | G4/S3.3 | 4.3 | No |
| *Campanula sharsmithiae* | Sharsmith's harebell | PDCAM02100 | None | None | G1/S1 | 1B.2 | Yes |
| *Campanula shetleri* | Castle Crags harebell | PDCAM020W0 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Campanula wilkinsiana* | Wilkin's harebell | PDCAM020Z0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Canbya candida* | white pygmy-poppy | PDPAP05020 | None | None | G3/S3.2 | 4.2 | Yes |
| *Cardamine angulata* | seaside bittercress | PDBRA0K010 | None | None | G5/S1 | 2.1 | Yes |
| *Cardamine bellidifolia var. pachyphylla* | fleshy toothwort | PDBRA0K022 | None | None | G5T3/S3 | 4.3 | No |
| *Cardamine nuttallii var. gemmata* | yellow-tubered toothwort | PDBRA0K0R3 | None | None | G5T3Q/S2 | 3.3 | Yes |
| *Cardamine pachystigma var. dissectifolia* | dissected-leaved toothwort | PDBRA0K1B1 | None | None | G3G5T3Q/S3 | 3 | No |
| *Carex albida* | white sedge | PMCYP030D0 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Carex arcta* | northern clustered sedge | PMCYP030X0 | None | None | G5/S1S2 | 2.2 | Yes |
| *Carex atherodes* | wheat sedge | PMCYP03160 | None | None | G5/S1 | 2.2 | Yes |
| *Carex buxbaumii* | Buxbaum's sedge | PMCYP032B0 | None | None | G5/S3.2 | 4.2 | No |
| *Carex californica* | California sedge | PMCYP032D0 | None | None | G5/S2? | 2.3 | Yes |
| *Carex comosa* | bristly sedge | PMCYP032Y0 | None | None | G5/S2 | 2.1 | Yes |
| *Carex congdonii* | Congdon's sedge | PMCYP03320 | None | None | G3/S3.3 | 4.3 | No |
| *Carex davyi* | Davy's sedge | PMCYP033H0 | None | None | G2/S2 | 1B.3 | Yes |
| *Carex duriuscula* | spikerush sedge | PMCYP03450 | None | None | G5/S2? | 2.3 | Yes |
| *Carex geyeri* | Geyer's sedge | PMCYP03540 | None | None | G5/S3.2 | 4.2 | No |
| *Carex halliana* | Oregon sedge | PMCYP035M0 | None | None | G4G5/S2 | 2.3 | Yes |

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|---|---|---|---|---|---|---|---|
| *Carex hystericina* | porcupine sedge | PMCYP036D0 | None | None | G5/S1 | 2.1 | Yes |
| *Carex idahoa* | Idaho sedge | PMCYP036E0 | None | None | G2G3/S1 | 2.3 | Yes |
| *Carex incurviformis* | Mount Dana sedge | PMCYP036G0 | None | None | G3/S3.3 | 4.3 | No |
| *Carex klamathensis* | Klamath sedge | PMCYP03L70 | None | None | G2/S2 | 1B.2 | Yes |
| *Carex lasiocarpa* | woolly-fruited sedge | PMCYP03720 | None | None | G5/S2 | 2.3 | Yes |
| *Carex lenticularis var. limnophila* | lagoon sedge | PMCYP037A7 | None | None | G5T5/S1S2.2 | 2.2 | Yes |
| *Carex leptalea* | bristle-stalked sedge | PMCYP037E0 | None | None | G5/S2? | 2.2 | Yes |
| *Carex limosa* | mud sedge | PMCYP037K0 | None | None | G5/S3 | 2.2 | Yes |
| *Carex livida* | livid sedge | PMCYP037L0 | None | None | G5/SH | 1A | Yes |
| *Carex lyngbyei* | Lyngbye's sedge | PMCYP037Y0 | None | None | G5/S2.2 | 2.2 | Yes |
| *Carex obispoensis* | San Luis Obispo sedge | PMCYP039J0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Carex occidentalis* | western sedge | PMCYP039M0 | None | None | G4/S2S3 | 2.3 | Yes |
| *Carex petasata* | Liddon's sedge | PMCYP03AE0 | None | None | G5/S1S2 | 2.3 | Yes |
| *Carex praticola* | northern meadow sedge | PMCYP03B20 | None | None | G5/S2S3 | 2.2 | Yes |
| *Carex saliniformis* | deceiving sedge | PMCYP03BY0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Carex scabriuscula* | Cascade sedge | PMCYP03C40 | None | None | G3G4/S3.3? | 4.3 | No |
| *Carex scirpoidea ssp. pseudoscirpoidea* | western single-spiked sedge | PMCYP03C85 | None | None | G5T5/S2 | 2.2 | Yes |
| *Carex scoparia var. scoparia* | pointed broom sedge | PMCYP03C91 | None | None | G5T5/S2S3 | 2.2 | Yes |
| *Carex serpenticola* | serpentine sedge | PMCYP03KM0 | None | None | G4/S2.3 | 2.3 | Yes |
| *Carex sheldonii* | Sheldon's sedge | PMCYP03CE0 | None | None | G4/S3 | 2.2 | Yes |
| *Carex stevenii* | Steven's sedge | PMCYP039D4 | None | None | G4?/S1 | 2.2 | Yes |
| *Carex tahoensis* | Tahoe sedge | PMCYP03DG0 | None | None | G5/S3 | 4.3 | No |
| *Carex tiogana* | Tioga Pass sedge | PMCYP03GP0 | None | None | G1/S1 | 1B.3 | Yes |
| *Carex tompkinsii* | Tompkins' sedge | PMCYP03DR0 | None | Rare | G3/S3.3 | 4.3 | Yes |
| *Carex vallicola* | western valley sedge | PMCYP03EA0 | None | None | G5/S2.3 | 2.3 | Yes |
| *Carex viridula ssp. viridula* | green yellow sedge | PMCYP03EM5 | None | None | G5T5/S2 | 2.3 | Yes |
| *Carlowrightia arizonica* | Arizona carlowrightia | PDACA07010 | None | None | G4G5/S2 | 2.2 | Yes |
| *Carlquistia muirii* | Muir's tarplant | PDASTDU010 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Carnegiea gigantea* | saguaro | PDCAC12010 | None | None | G5/S1 | 2.2 | Yes |
| *Carpenteria californica* | tree-anemone | PDHDR04010 | None | Threatened | G1/S1? | 1B.2 | Yes |
| *Cascadia nuttallii* | Nuttall's saxifrage | PDSAX0U160 | None | None | G4?/S1 | 2.1 | Yes |
| *Castela emoryi* | Emory's crucifixion-thorn | PDSIM03030 | None | None | G4/S2S3 | 2.3 | Yes |
| *Castilleja affinis ssp. litoralis* | Oregon coast paintbrush | PDSCR0D012 | None | None | G4G5T4/S2.2 | 2.2 | Yes |
| *Castilleja affinis ssp. neglecta* | Tiburon paintbrush | PDSCR0D013 | Endangered | Threatened | G4G5T1/S1 | 1B.2 | Yes |
| *Castilleja ambigua var. ambigua* | johnny-nip | PDSCR0D401 | None | None | G4T3T4/S3 | 4.2 | No |
| *Castilleja ambigua var. humboldtiensis* | Humboldt Bay owl's-clover | PDSCR0D402 | None | None | G4T2/S2.2 | 1B.2 | Yes |

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|---|---|---|---|---|---|---|---|
| *Castilleja ambigua var. insalutata* | pink Johnny-nip | PDSCR0D403 | None | None | G4T1/S1 | 1B.1 | Yes |
| *Castilleja brevilobata* | short-lobed paintbrush | PDSCR0D181 | None | None | G3/S3.2 | 4.2 | No |
| *Castilleja campestris ssp. succulenta* | succulent owl's-clover | PDSCR0D3Z1 | Threatened | Endangered | G4?T3/S3 | 1B.2 | Yes |
| *Castilleja cinerea* | ash-gray paintbrush | PDSCR0D0H0 | Threatened | None | G2/S2 | 1B.2 | Yes |
| *Castilleja densiflora ssp. obispoensis* | San Luis Obispo owl's-clover | PDSCR0D453 | None | None | G5T2/S2.2 | 1B.2 | Yes |
| *Castilleja gleasoni* | Mt. Gleason paintbrush | PDSCR0D140 | None | Rare | G2Q/S2.2 | 1B.2 | Yes |
| *Castilleja grisea* | San Clemente Island paintbrush | PDSCR0D160 | Endangered | Endangered | G3/S3 | 1B.2 | Yes |
| *Castilleja hololeuca* | island white-felted paintbrush | PDSCR0D1L1 | None | None | G3/S3 | 1B.2 | Yes |
| *Castilleja lasiorhyncha* | San Bernardino Mountains owl's-clover | PDSCR0D410 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Castilleja latifolia* | Monterey Coast paintbrush | PDSCR0D1P0 | None | None | G3/S3.3 | 4.3 | No |
| *Castilleja leschkeana* | Point Reyes paintbrush | PDSCR0D1R0 | None | None | GH/SH | 1A | Yes |
| *Castilleja mendocinensis* | Mendocino Coast paintbrush | PDSCR0D3N0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Castilleja miniata ssp. elata* | Siskiyou paintbrush | PDSCR0D213 | None | None | G5T3/S2.2 | 2.2 | Yes |
| *Castilleja mollis* | soft-leaved paintbrush | PDSCR0D230 | Endangered | None | G1/S1 | 1B.1 | Yes |
| *Castilleja montigena* | Heckard's paintbrush | PDSCR0D3G0 | None | None | G3/S3.3 | 4.3 | No |
| *Castilleja plagiotoma* | Mojave paintbrush | PDSCR0D2J0 | None | None | G3/S3.3 | 4.3 | No |
| *Castilleja rubicundula ssp. rubicundula* | pink creamsacs | PDSCR0D482 | None | None | G5T2/S2 | 1B.2 | Yes |
| *Castilleja schizotricha* | split-hair paintbrush | PDSCR0D2Y0 | None | None | G3/S3.3 | 4.3 | No |
| *Castilleja uliginosa* | Pitkin Marsh paintbrush | PDSCR0D380 | None | Endangered | GXQ/SX | 1A | Yes |
| *Caulanthus amplexicaulis var. barbarae* | Santa Barbara jewel-flower | PDBRA0M012 | None | None | G4T1/S1 | 1B.1 | Yes |
| *Caulanthus californicus* | California jewel-flower | PDBRA31010 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Caulanthus lemmonii* | Lemmon's jewel-flower | PDBRA0M0E0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Caulanthus major var. nevadensis* | slender jewel-flower | PDBRA0M0F1 | None | None | G4T3?/S3 | 4.3 | No |
| *Caulanthus simulans* | Payson's jewel-flower | PDBRA0M0H0 | None | None | G3/S3.2 | 4.2 | Yes |
| *Ceanothus confusus* | Rincon Ridge ceanothus | PDRHA04220 | None | None | G2/S2.2 | 1B.1 | Yes |
| *Ceanothus cuneatus var. fascicularis* | Lompoc ceanothus | PDRHA04066 | None | None | G5T3/S3.2 | 4.2 | No |
| *Ceanothus cyaneus* | Lakeside ceanothus | PDRHA04070 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Ceanothus divergens* | Calistoga ceanothus | PDRHA04240 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Ceanothus ferrisiae* | Coyote ceanothus | PDRHA041N0 | Endangered | None | G2/S2 | 1B.1 | Yes |
| *Ceanothus foliosus var. vineatus* | Vine Hill ceanothus | PDRHA040D6 | None | None | G3T1/S1? | 1B.1 | Yes |
| *Ceanothus fresnensis* | Fresno ceanothus | PDRHA040E0 | None | None | G3/S3.3 | 4.3 | No |
| *Ceanothus gloriosus var. exaltatus* | glory brush | PDRHA040F4 | None | None | G3G4T3/S3.3 | 4.3 | No |

# Special Vascular Plants, Bryophytes, and Lichens List

## California Department of Fish and Game

### Natural Diversity Database

| Scientific Name | Common Name | Element Code | Federal Listing Status | State Listing Status | Heritage Rank | Rare Plant Rank | Records in CNDDB ? |
|---|---|---|---|---|---|---|---|
| *Ceanothus gloriosus var. gloriosus* | Point Reyes ceanothus | PDRHA040F5 | None | None | G3G4T3/S3.3 | 4.3 | No |
| *Ceanothus gloriosus var. porrectus* | Mt. Vision ceanothus | PDRHA040F7 | None | None | G3G4T2/S2.2 | 1B.3 | Yes |
| *Ceanothus hearstiorum* | Hearst's ceanothus | PDRHA040J0 | None | Rare | G1/S1 | 1B.2 | Yes |
| *Ceanothus maritimus* | maritime ceanothus | PDRHA040T0 | None | Rare | G2/S2.2 | 1B.2 | Yes |
| *Ceanothus masonii* | Mason's ceanothus | PDRHA04200 | None | Rare | G1/S1 | 1B.2 | Yes |
| *Ceanothus megacarpus var. insularis* | island ceanothus | PDRHA040W1 | None | None | G5T3/S3.3 | 4.3 | No |
| *Ceanothus ophiochilus* | Vail Lake ceanothus | PDRHA041M0 | Threatened | Endangered | G1/S1 | 1B.1 | Yes |
| *Ceanothus otayensis* | Otay Mountain ceanothus | PDRHA04430 | None | None | G1/S1 | 1B.2 | Yes |
| *Ceanothus pinetorum* | Kern ceanothus | PDRHA04130 | None | None | G3/S3.3 | 4.3 | No |
| *Ceanothus purpureus* | holly-leaved ceanothus | PDRHA04160 | None | None | G2/S2 | 1B.2 | Yes |
| *Ceanothus rigidus* | Monterey ceanothus | PDRHA04067 | None | None | G3/S3.2 | 4.2 | No |
| *Ceanothus roderickii* | Pine Hill ceanothus | PDRHA04190 | Endangered | Rare | G1/S1 | 1B.2 | Yes |
| *Ceanothus sonomensis* | Sonoma ceanothus | PDRHA04420 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Ceanothus verrucosus* | wart-stemmed ceanothus | PDRHA041J0 | None | None | G3/S2.2 | 2.2 | Yes |
| *Centromadia parryi ssp. australis* | southern tarplant | PDAST4R0P4 | None | None | G4T2/S2 | 1B.1 | Yes |
| *Centromadia parryi ssp. congdonii* | Congdon's tarplant | PDAST4R0P1 | None | None | G4T2/S2 | 1B.2 | Yes |
| *Centromadia parryi ssp. parryi* | pappose tarplant | PDAST4R0P2 | None | None | G4T1/S1 | 1B.2 | Yes |
| *Centromadia parryi ssp. rudis* | Parry's rough tarplant | PDAST4R0P3 | None | None | G4T3/S3.2 | 4.2 | No |
| *Centromadia pungens ssp. laevis* | smooth tarplant | PDAST4R0R4 | None | None | G3G4T2/S2 | 1B.1 | Yes |
| *Cercocarpus betuloides var. blancheae* | island mountain-mahogany | PDROS08022 | None | None | G5T3/S3.3 | 4.3 | No |
| *Cercocarpus traskiae* | Catalina Island mountain-mahogany | PDROS08030 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Chaenactis carphoclinia var. peirsonii* | Peirson's pincushion | PDAST20042 | None | None | G5T2/S2 | 1B.3 | Yes |
| *Chaenactis douglasii var. alpina* | alpine dusty maidens | PDAST20065 | None | None | G5T5/S2.3? | 2.3 | Yes |
| *Chaenactis glabriuscula var. orcuttiana* | Orcutt's pincushion | PDAST20095 | None | None | G5T1/S1 | 1B.1 | Yes |
| *Chaenactis parishii* | Parish's chaenactis | PDAST200D0 | None | None | G3/S2.3 | 1B.3 | Yes |
| *Chaenactis suffrutescens* | Shasta chaenactis | PDAST200H0 | None | None | G3/S3 | 1B.3 | Yes |
| *Chaetadelpha wheeleri* | Wheeler's dune-broom | PDAST21010 | None | None | G4/S2 | 2.2 | Yes |
| *Chamaebatia australis* | southern mountain misery | PDROS0A010 | None | None | G4/S3.2 | 4.2 | No |
| *Chamaesyce abramsiana* | Abrams' spurge | PDEUP0D010 | None | None | G4/S2S3 | 2.2 | Yes |
| *Chamaesyce arizonica* | Arizona spurge | PDEUP0D060 | None | None | G5/S2 | 2.3 | Yes |
| *Chamaesyce hooveri* | Hoover's spurge | PDEUP0D150 | Threatened | None | G2/S2 | 1B.2 | Yes |

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|---|---|---|---|---|---|---|---|
| *Chamaesyce ocellata ssp. rattanii* | Stony Creek spurge | PDEUP0D1P1 | None | None | G4T1T2/S1S2 | 1B.2 | Yes |
| *Chamaesyce parryi* | Parry's spurge | PDEUP0D1T0 | None | None | G5/S1 | 2.3 | Yes |
| *Chamaesyce platysperma* | flat-seeded spurge | PDEUP0D1X0 | None | None | G3/S1 | 1B.2 | Yes |
| *Chamaesyce revoluta* | revolute spurge | PDEUP0D230 | None | None | G5/S3.3 | 4.3 | No |
| *Chamaesyce vallis-mortae* | Death Valley sandmat | PDEUP0D2G0 | None | None | G3/S3.2 | 4.2 | No |
| *Cheilanthes wootonii* | Wooton's lace fern | PPADI090S0 | None | None | G5/S1 | 2.3 | Yes |
| *Chenopodium littoreum* | coastal goosefoot | PDCHE091Z0 | None | None | G2/S2 | 1B.2 | Yes |
| *Chenopodium simplex* | large-seeded goosefoot | PDCHE091P0 | None | None | G5/S3.3 | 4.3 | No |
| *Chlorogalum grandiflorum* | Red Hills soaproot | PMLIL0G020 | None | None | G3/S3 | 1B.2 | Yes |
| *Chlorogalum pomeridianum var. minus* | dwarf soaproot | PMLIL0G042 | None | None | G5T2/S2 | 1B.2 | Yes |
| *Chlorogalum purpureum var. purpureum* | Santa Lucia purple amole | PMLIL0G051 | Threatened | None | G2T2/S2 | 1B.1 | Yes |
| *Chlorogalum purpureum var. reductum* | Camatta Canyon amole | PMLIL0G052 | Threatened | Rare | G2T1/S1 | 1B.1 | Yes |
| *Chloropyron maritimum ssp. maritimum* | salt marsh bird's-beak | PDSCR0J0C2 | Endangered | Endangered | G4?T1/S1 | 1B.2 | Yes |
| *Chloropyron maritimum ssp. palustre* | Point Reyes bird's-beak | PDSCR0J0C3 | None | None | G4?T2/S2.2 | 1B.2 | Yes |
| *Chloropyron molle ssp. hispidum* | hispid bird's-beak | PDSCR0J0D1 | None | None | G2T2/S2.1 | 1B.1 | Yes |
| *Chloropyron molle ssp. molle* | soft bird's-beak | PDSCR0J0D2 | Endangered | Rare | G2T1/S1 | 1B.2 | Yes |
| *Chloropyron palmatum* | palmate-bracted bird's-beak | PDSCR0J0J0 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Chloropyron tecopense* | Tecopa bird's-beak | PDSCR0J0Q0 | None | None | G2/S1 | 1B.2 | Yes |
| *Chorizanthe biloba var. immemora* | Hernandez spineflower | PDPGN04025 | None | None | G3T1?/S1? | 1B.2 | Yes |
| *Chorizanthe blakleyi* | Blakley's spineflower | PDPGN04030 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Chorizanthe breweri* | Brewer's spineflower | PDPGN04050 | None | None | G2/S2.2 | 1B.3 | Yes |
| *Chorizanthe cuspidata var. cuspidata* | San Francisco Bay spineflower | PDPGN04081 | None | None | G2T2/S2.2 | 1B.2 | Yes |
| *Chorizanthe cuspidata var. villosa* | woolly-headed spineflower | PDPGN04082 | None | None | G2T1/S1 | 1B.2 | Yes |
| *Chorizanthe douglasii* | Douglas' spineflower | PDPGN040A0 | None | None | G3/S3.3 | 4.3 | No |
| *Chorizanthe howellii* | Howell's spineflower | PDPGN040C0 | Endangered | Threatened | G1/S1 | 1B.2 | Yes |
| *Chorizanthe leptotheca* | Peninsular spineflower | PDPGN040D0 | None | None | G4/S3.2 | 4.2 | No |
| *Chorizanthe orcuttiana* | Orcutt's spineflower | PDPGN040G0 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Chorizanthe palmeri* | Palmer's spineflower | PDPGN040H0 | None | None | G3?/S3.2? | 4.2 | No |
| *Chorizanthe parryi var. fernandina* | San Fernando Valley spineflower | PDPGN040J1 | Candidate | Endangered | G2T1/S1 | 1B.1 | Yes |
| *Chorizanthe parryi var. parryi* | Parry's spineflower | PDPGN040J2 | None | None | G2T2/S2 | 1B.1 | Yes |

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|---|---|---|---|---|---|---|---|
| *Chorizanthe polygonoides var. longispina* | long-spined spineflower | PDPGN040K1 | None | None | G5T3/S3 | 1B.2 | Yes |
| *Chorizanthe pungens var. hartwegiana* | Ben Lomond spineflower | PDPGN040M1 | Endangered | None | G2T1/S1 | 1B.1 | Yes |
| *Chorizanthe pungens var. pungens* | Monterey spineflower | PDPGN040M2 | Threatened | None | G2T2/S2 | 1B.2 | Yes |
| *Chorizanthe rectispina* | straight-awned spineflower | PDPGN040N0 | None | None | G1/S1 | 1B.3 | Yes |
| *Chorizanthe robusta var. hartwegii* | Scotts Valley spineflower | PDPGN040Q1 | Endangered | None | G2T1/S1 | 1B.1 | Yes |
| *Chorizanthe robusta var. robusta* | robust spineflower | PDPGN040Q2 | Endangered | None | G2T1/S1 | 1B.1 | Yes |
| *Chorizanthe spinosa* | Mojave spineflower | PDPGN040R0 | None | None | G3/S3.2 | 4.2 | No |
| *Chorizanthe valida* | Sonoma spineflower | PDPGN040V0 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Chorizanthe ventricosa* | potbellied spineflower | PDPGN040W0 | None | None | G3/S3.3 | 4.3 | No |
| *Chorizanthe wheeleri* | Wheeler's spineflower | PDPGN040Y0 | None | None | G3/S3.3 | 4.3 | No |
| *Chorizanthe xanti var. leucotheca* | white-bracted spineflower | PDPGN040Z1 | None | None | G4T2/S2 | 1B.2 | Yes |
| *Chrysothamnus greenei* | Greene's rabbitbrush | PDAST2C030 | None | None | G5/S3? | 2.3 | Yes |
| *Chylismia arenaria* | sand evening-primrose | PDONA03020 | None | None | G4?/S2 | 2.2 | Yes |
| *Chylismia claviformis ssp. cruciformis* | cruciform evening-primrose | PDONA030D4 | None | None | G5T4/S2S3 | 2.3 | Yes |
| *Cicuta maculata var. bolanderi* | Bolander's water-hemlock | PDAPI0M051 | None | None | G5T3T4/S2 | 2.1 | Yes |
| *Cinna bolanderi* | Bolander's woodreed | PMPOA1H040 | None | None | G2/S2 | 1B.2 | Yes |
| *Cirsium andrewsii* | Franciscan thistle | PDAST2E050 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Cirsium arizonicum var. tenuisectum* | desert mountain thistle | PDAST2E083 | None | None | G5T2/S2 | 1B.2 | Yes |
| *Cirsium ciliolatum* | Ashland thistle | PDAST2E0P0 | None | Endangered | G3/S1 | 2.1 | Yes |
| *Cirsium crassicaule* | slough thistle | PDAST2E0U0 | None | None | G2/S2.2 | 1B.1 | Yes |
| *Cirsium fontinale var. campylon* | Mt. Hamilton fountain thistle | PDAST2E163 | None | None | G2T2/S2 | 1B.2 | Yes |
| *Cirsium fontinale var. fontinale* | fountain thistle | PDAST2E161 | Endangered | Endangered | G2T2/S1 | 1B.1 | Yes |
| *Cirsium fontinale var. obispoense* | Chorro Creek bog thistle | PDAST2E162 | Endangered | Endangered | G2T2/S2 | 1B.2 | Yes |
| *Cirsium hydrophilum var. hydrophilum* | Suisun thistle | PDAST2E1G1 | Endangered | None | G2T1/S1 | 1B.1 | Yes |
| *Cirsium hydrophilum var. vaseyi* | Mt. Tamalpais thistle | PDAST2E1G2 | None | None | G2T2/S2 | 1B.2 | Yes |
| *Cirsium occidentale var. compactum* | compact cobwebby thistle | PDAST2E1Z1 | None | None | G3G4T2/S2.1 | 1B.2 | Yes |
| *Cirsium occidentale var. lucianum* | Cuesta Ridge thistle | PDAST2E1Z6 | None | None | G3G4T2/S2 | 1B.2 | Yes |
| *Cirsium praeteriens* | lost thistle | PDAST2E2B0 | None | None | GX/SX | 1A | Yes |
| *Cirsium rhothophilum* | surf thistle | PDAST2E2J0 | None | Threatened | G1/S1 | 1B.2 | Yes |

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|---|---|---|---|---|---|---|---|
| *Cirsium scariosum var. loncholepis* | La Graciosa thistle | PDAST2E1N0 | Endangered | Threatened | G5T1/S1 | 1B.1 | Yes |
| *Cistanthe maritima* | seaside cistanthe | PDPOR09020 | None | None | G3G4/S3.2 | 4.2 | No |
| *Cladium californicum* | California saw-grass | PMCYP04010 | None | None | G4/S2.2 | 2.2 | Yes |
| *Clarkia amoena ssp. whitneyi* | Whitney's farewell-to-spring | PDONA05025 | None | None | G5T2/S2.1 | 1B.1 | Yes |
| *Clarkia australis* | Small's southern clarkia | PDONA05040 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Clarkia biloba ssp. australis* | Mariposa clarkia | PDONA05051 | None | None | G4G5T2/S2.2 | 1B.2 | Yes |
| *Clarkia biloba ssp. brandegeeae* | Brandegee's clarkia | PDONA05053 | None | None | G4G5T4/S4 | 4.2 | Yes |
| *Clarkia borealis ssp. arida* | Shasta clarkia | PDONA05061 | None | None | G3T2/S2 | 1B.1 | Yes |
| *Clarkia borealis ssp. borealis* | northern clarkia | PDONA05062 | None | None | G3T2/S2.3 | 1B.3 | Yes |
| *Clarkia breweri* | Brewer's clarkia | PDONA05080 | None | None | G3/S3.2 | 4.2 | No |
| *Clarkia concinna ssp. automixa* | Santa Clara red ribbons | PDONA050A1 | None | None | G5?T3/S3.3 | 4.3 | Yes |
| *Clarkia concinna ssp. raichei* | Raiche's red ribbons | PDONA050A2 | None | None | G5?T1/S1 | 1B.1 | Yes |
| *Clarkia delicata* | delicate clarkia | PDONA050D0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Clarkia exilis* | slender clarkia | PDONA050G0 | None | None | G3/S3.3 | 4.3 | No |
| *Clarkia franciscana* | Presidio clarkia | PDONA050H0 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Clarkia gracilis ssp. albicaulis* | white-stemmed clarkia | PDONA050J1 | None | None | G5T2/S2.2? | 1B.2 | Yes |
| *Clarkia gracilis ssp. tracyi* | Tracy's clarkia | PDONA050J4 | None | None | G5T3/S3.2 | 4.2 | No |
| *Clarkia imbricata* | Vine Hill clarkia | PDONA050K0 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Clarkia jolonensis* | Jolon clarkia | PDONA050L0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Clarkia lewisii* | Lewis' clarkia | PDONA050N0 | None | None | G3/S3.3 | 4.3 | No |
| *Clarkia lingulata* | Merced clarkia | PDONA050P0 | None | Endangered | G1/S1 | 1B.1 | Yes |
| *Clarkia mildrediae ssp. lutescens* | golden-anthered clarkia | PDONA050Q1 | None | None | G3T3/S3.2 | 4.2 | No |
| *Clarkia mildrediae ssp. mildrediae* | Mildred's clarkia | PDONA050Q2 | None | None | G3T3/S3 | 1B.3 | Yes |
| *Clarkia mosquinii* | Mosquin's clarkia | PDONA050S0 | None | None | G2/S2 | 1B.1 | Yes |
| *Clarkia rostrata* | beaked clarkia | PDONA050Y0 | None | None | G2/S2 | 1B.3 | Yes |
| *Clarkia speciosa ssp. immaculata* | Pismo clarkia | PDONA05111 | Endangered | Rare | G4T1/S1 | 1B.1 | Yes |
| *Clarkia springvillensis* | Springville clarkia | PDONA05120 | Threatened | Endangered | G2/S2 | 1B.2 | Yes |
| *Clarkia tembloriensis ssp. calientensis* | Vasek's clarkia | PDONA05141 | None | None | G3T1/S1 | 1B.1 | Yes |
| *Clarkia virgata* | Sierra clarkia | PDONA05160 | None | None | G3/S3.3 | 4.3 | No |
| *Clarkia xantiana ssp. parviflora* | Kern Canyon clarkia | PDONA05181 | None | None | G4T3/S3 | 4.2 | Yes |
| *Claytonia lanceolata var. peirsonii* | Peirson's spring beauty | PDPOR03097 | None | None | G5T1Q/S1 | 3.1 | Yes |
| *Claytonia megarhiza* | fell-fields claytonia | PDPOR030A0 | None | None | G4G5/S2S3 | 2.3 | Yes |

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|---|---|---|---|---|---|---|---|
| *Claytonia palustris* | marsh claytonia | PDPOR030S0 | None | None | G3/S3.3 | 4.3 | No |
| *Claytonia parviflora ssp. grandiflora* | streambank spring beauty | PDPOR030D1 | None | None | G5T3/S3.2 | 4.2 | No |
| *Claytonia umbellata* | Great Basin claytonia | PDPOR030P0 | None | None | G5?/S2 | 2.3 | Yes |
| *Cleomella brevipes* | short-pedicelled cleomella | PDCPP04020 | None | None | G3G4/S3.2 | 4.2 | No |
| *Cleomella hillmanii var. hillmanii* | Hillman's cleomella | PDCPP04030 | None | None | G4G5T4T5/S2 | 2.2 | Yes |
| *Clinopodium chandleri* | San Miguel savory | PDLAM08030 | None | None | G2/S2 | 1B.2 | Yes |
| *Clinopodium mimuloides* | monkey-flower savory | PDLAM1T040 | None | None | G3/S3.2 | 4.2 | No |
| *Cochlearia officinalis var. arctica* | arctic spoonwort | PDBRA0S032 | None | None | G5T3T4/S2 | 2.3 | Yes |
| *Collinsia antonina* | San Antonio collinsia | PDSCR0H010 | None | None | G1/S1 | 1B.2 | Yes |
| *Collinsia corymbosa* | round-headed Chinese-houses | PDSCR0H060 | None | None | G1/S1 | 1B.2 | Yes |
| *Collinsia multicolor* | San Francisco collinsia | PDSCR0H0B0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Collomia diversifolia* | serpentine collomia | PDPLM02020 | None | None | G3/S3.3 | 4.3 | No |
| *Collomia larsenii* | talus collomia | PDPLM02014 | None | None | G4/S2 | 2.2 | Yes |
| *Collomia rawsoniana* | Rawson's flaming trumpet | PDPLM02080 | None | None | G2/S2 | 1B.2 | Yes |
| *Collomia tenella* | slender collomia | PDPLM02090 | None | None | G4?/S1 | 2.2 | Yes |
| *Collomia tracyi* | Tracy's collomia | PDPLM020B0 | None | None | G3/S3.3 | 4.3 | No |
| *Colubrina californica* | Las Animas colubrina | PDRHA05030 | None | None | G4/S2S3.3 | 2.3 | Yes |
| *Comarostaphylis diversifolia ssp. diversifolia* | summer holly | PDERI0B011 | None | None | G3T2/S2 | 1B.2 | Yes |
| *Condalia globosa var. pubescens* | spiny abrojo | PDRHA06031 | None | None | G5T3T4/S3.2 | 4.2 | No |
| *Constancea nevinii* | Nevin's woolly sunflower | PDAST3N090 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Convolvulus simulans* | small-flowered morning-glory | PDCON05060 | None | None | G3/S3.2 | 4.2 | No |
| *Coptis laciniata* | Oregon goldthread | PDRAN0A020 | None | None | G4G5/S3 | 2.2 | Yes |
| *Corallorhiza trifida* | northern coralroot | PMORC0M050 | None | None | G5/S1 | 2.1 | Yes |
| *Cordylanthus capitatus* | Yakima bird's-beak | PDSCR0J030 | None | None | G4/S2.2 | 2.2 | Yes |
| *Cordylanthus eremicus ssp. eremicus* | desert bird's-beak | PDSCR0J042 | None | None | G3?T3?/S3? | 4.3 | No |
| *Cordylanthus eremicus ssp. kernensis* | Kern Plateau bird's-beak | PDSCR0J043 | None | None | G3?T2/S2.3 | 1B.3 | Yes |
| *Cordylanthus nidularius* | Mt. Diablo bird's-beak | PDSCR0J0F0 | None | Rare | G1/S1 | 1B.1 | Yes |
| *Cordylanthus parviflorus* | small-flowered bird's-beak | PDSCR0J0K0 | None | None | G4G5/S1S2 | 2.3 | Yes |
| *Cordylanthus rigidus ssp. brevibracteatus* | short-bracted bird's-beak | PDSCR0J0P3 | None | None | G5T3/S3.3 | 4.3 | No |
| *Cordylanthus rigidus ssp. littoralis* | seaside bird's-beak | PDSCR0J0P2 | None | Endangered | G5T2/S2 | 1B.1 | Yes |
| *Cordylanthus tenuis ssp. barbatus* | Fresno County bird's-beak | PDSCR0J0S4 | None | None | G4G5T3/S3.3? | 4.3 | No |

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|---|---|---|---|---|---|---|---|
| *Cordylanthus tenuis ssp. brunneus* | serpentine bird's-beak | PDSCR0J0S1 | None | None | G4G5T3/S3.3 | 4.3 | No |
| *Cordylanthus tenuis ssp. capillaris* | Pennell's bird's-beak | PDSCR0J0S2 | Endangered | Rare | G4G5T1/S1 | 1B.2 | Yes |
| *Cordylanthus tenuis ssp. pallescens* | pallid bird's-beak | PDSCR0J0S3 | None | None | G4G5T1/S1 | 1B.2 | Yes |
| *Corethrogyne filaginifolia var. incana* | San Diego sand aster | PDAST2M025 | None | None | G4T1/S1 | 1B.1 | Yes |
| *Corethrogyne filaginifolia var. linifolia* | Del Mar Mesa sand aster | PDAST2M027 | None | None | G4T1/S1 | 1B.1 | Yes |
| *Corethrogyne leucophylla* | branching beach aster | PDAST2M030 | None | None | G3Q/S3.2 | 3.2 | No |
| *Corispermum americanum var. americanum* | American bugseed | PDCHE0A091 | None | None | G5?T5?/S1 | 2.2 | Yes |
| *Cornus canadensis* | bunchberry | PDCOR01040 | None | None | G5/S2 | 2.2 | No |
| *Coryphantha alversonii* | Alverson's foxtail cactus | PDCAC0X060 | None | None | G3/S3.2 | 4.3 | Yes |
| *Coryphantha chlorantha* | desert pincushion | PDCAC040J0 | None | None | G2G3/S2 | 2.1 | Yes |
| *Coryphantha vivipara var. rosea* | viviparous foxtail cactus | PDCAC0X0G8 | None | None | G5T3/S2.2 | 2.2 | Yes |
| *Crataegus castlegarensis* | Calstlegar hawthorne | PDROS0H9E0 | None | None | G5/S1S3 | 3 | No |
| *Crepis runcinata ssp. hallii* | Hall's meadow hawksbeard | PDAST2R0KB | None | None | G5T3?/S1S2 | 2.1 | Yes |
| *Crossosoma californicum* | Catalina crossosoma | PDCRO02020 | None | None | G2/S2 | 1B.2 | Yes |
| *Croton wigginsii* | Wiggins' croton | PDEUP0H140 | None | Rare | G2G3/S2 | 2.2 | Yes |
| *Cryptantha celosioides* | cocks-comb cat's-eye | PDBOR0A0F0 | None | None | G5/S1 | 2.3 | Yes |
| *Cryptantha circumscissa var. rosulata* | rosette cushion cryptantha | PDBOR0A0G3 | None | None | G5T2/S2 | 1B.2 | Yes |
| *Cryptantha clokeyi* | Clokey's cryptantha | PDBOR0A3M0 | None | None | G2/S2 | 1B.2 | Yes |
| *Cryptantha costata* | ribbed cryptantha | PDBOR0A0M0 | None | None | G4G5/S3.3 | 4.3 | No |
| *Cryptantha crinita* | silky cryptantha | PDBOR0A0Q0 | None | None | G2/S2 | 1B.2 | Yes |
| *Cryptantha crymophila* | subalpine cryptantha | PDBOR0A0R0 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Cryptantha dissita* | serpentine cryptantha | PDBOR0A0H2 | None | None | G2/S2 | 1B.2 | Yes |
| *Cryptantha excavata* | deep-scarred cryptantha | PDBOR0A0W0 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Cryptantha fendleri* | sand dune cryptantha | PDBOR0A0X0 | None | None | G5/S1 | 2.2 | Yes |
| *Cryptantha ganderi* | Gander's cryptantha | PDBOR0A120 | None | None | G1G2/S1 | 1B.1 | Yes |
| *Cryptantha glomeriflora* | clustered-flower cryptantha | PDBOR0A130 | None | None | G3Q/S3.3 | 4.3 | No |
| *Cryptantha holoptera* | winged cryptantha | PDBOR0A180 | None | None | G3G4/S3? | 4.3 | No |
| *Cryptantha hooveri* | Hoover's cryptantha | PDBOR0A190 | None | None | GH/SH | 1A | Yes |
| *Cryptantha incana* | Tulare cryptantha | PDBOR0A1D0 | None | None | G1/S1 | 1B.3 | Yes |
| *Cryptantha mariposae* | Mariposa cryptantha | PDBOR0A1Q0 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Cryptantha rattanii* | Rattan's cryptantha | PDBOR0A2H0 | None | None | G3/S3.3 | 4.3 | No |
| *Cryptantha roosiorum* | bristlecone cryptantha | PDBOR0A2L0 | None | Rare | G2/S2 | 1B.2 | Yes |
| *Cryptantha schoolcraftii* | Schoolcraft's cryptantha | PDBOR0A3H0 | None | None | G3/S1 | 2.2 | Yes |
| *Cryptantha scoparia* | gray cryptantha | PDBOR0A2Q0 | None | None | G4?/S3.3 | 4.3 | No |
| *Cryptantha traskiae* | Trask's cryptantha | PDBOR0A370 | None | None | G2/S2 | 1B.1 | Yes |

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|---|---|---|---|---|---|---|---|
| *Cryptantha tumulosa* | New York Mountains cryptantha | PDBOR0A380 | None | None | G4?/S3.3 | 4.3 | No |
| *Cuniculotinus gramineus* | Panamint rock-goldenrod | PDAST2C0H0 | None | None | G4?/S2.3 | 2.3 | Yes |
| *Cuscuta californica var. apiculata* | pointed dodder | PDCUS01071 | None | None | G5T3?/S2S3 | 3 | No |
| *Cuscuta jepsonii* | Jepson's dodder | PDCUS011T0 | None | None | GH/SH | 1B.2 | Yes |
| *Cuscuta obtusiflora var. glandulosa* | Peruvian dodder | PDCUS01111 | None | None | G5T4T5/SH | 2.2 | Yes |
| *Cuscuta pacifica var. papillata* | Mendocino dodder | PDCUS011A2 | None | None | G5T1/S1 | 1B.2 | Yes |
| *Cusickiella quadricostata* | Bodie Hills cusickiella | PDBRA2V010 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Cylindropuntia californica var. californica* | snake cholla | PDCAC0D2Y1 | None | None | G3T2/S1 | 1B.1 | Yes |
| *Cylindropuntia fosbergii* | pink cholla | PDCAC0D2U0 | None | None | G2/S2 | 1B.3 | Yes |
| *Cylindropuntia munzii* | Munz's cholla | PDCAC0D0V0 | None | None | G3/S1 | 1B.3 | Yes |
| *Cylindropuntia wolfii* | Wolf's cholla | PDCAC0D2R0 | None | None | G4?/S3.3 | 4.3 | No |
| *Cymopterus deserticola* | desert cymopterus | PDAPI0U090 | None | None | G2/S2 | 1B.2 | Yes |
| *Cymopterus gilmanii* | Gilman's cymopterus | PDAPI0U0C0 | None | None | G3?/S2.2 | 2.3 | Yes |
| *Cymopterus globosus* | globose cymopterus | PDAPI0U0E0 | None | None | G3G4/S1S2.2 | 2.2 | Yes |
| *Cymopterus multinervatus* | purple-nerve cymopterus | PDAPI0U0Q0 | None | None | G5?/S2 | 2.2 | Yes |
| *Cymopterus ripleyi var. saniculoides* | sanicle cymopterus | PDAPI0U0X1 | None | None | G3G4T3Q/S1 | 1B.2 | Yes |
| *Cypripedium californicum* | California lady's-slipper | PMORC0Q040 | None | None | G3/S3.2 | 4.2 | No |
| *Cypripedium fasciculatum* | clustered lady's-slipper | PMORC0Q060 | None | None | G4/S3.2 | 4.2 | No |
| *Cypripedium montanum* | mountain lady's-slipper | PMORC0Q080 | None | None | G4/S4.2 | 4.2 | No |
| *Cypripedium parviflorum var. makasin* | northern yellow lady's slipper | PMORC0Q093 | None | None | G5T4Q/S1 | 3.1 | No |
| *Dalea ornata* | ornate dalea | PDFAB1A150 | None | None | G4G5/S2 | 2.1 | Yes |
| *Darlingtonia californica* | California pitcherplant | PDSAR01010 | None | None | G3G4/S3.2 | 4.2 | No |
| *Dedeckera eurekensis* | July gold | PDPGN06010 | None | Rare | G2/S2.2 | 1B.3 | Yes |
| *Deinandra arida* | Red Rock tarplant | PDAST4R010 | None | Rare | G1/S1 | 1B.2 | Yes |
| *Deinandra bacigalupii* | Livermore tarplant | PDAST4R0V0 | None | None | G1/S1 | 1B.2 | Yes |
| *Deinandra clementina* | island tarplant | PDAST4R040 | None | None | G3/S3.3 | 4.3 | No |
| *Deinandra conjugens* | Otay tarplant | PDAST4R070 | Threatened | Endangered | G1/S1 | 1B.1 | Yes |
| *Deinandra floribunda* | Tecate tarplant | PDAST4R0B0 | None | None | G3/S2.2 | 1B.2 | Yes |
| *Deinandra halliana* | Hall's tarplant | PDAST4R0C0 | None | None | G2/S2 | 1B.1 | Yes |
| *Deinandra increscens ssp. villosa* | Gaviota tarplant | PDAST4R0U3 | Endangered | Endangered | G4G5T2/S2 | 1B.1 | Yes |
| *Deinandra minthornii* | Santa Susana tarplant | PDAST4R0J0 | None | Rare | G2/S2.2 | 1B.2 | Yes |
| *Deinandra mohavensis* | Mojave tarplant | PDAST4R0K0 | None | Endangered | G2G3/S2S3 | 1B.3 | Yes |
| *Deinandra paniculata* | paniculate tarplant | PDAST4R0N0 | None | None | G3G4/S3.2 | 4.2 | No |
| *Delphinium bakeri* | Baker's larkspur | PDRAN0B050 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Delphinium californicum ssp. interius* | Hospital Canyon larkspur | PDRAN0B0A2 | None | None | G3T2?/S2? | 1B.2 | Yes |

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|---|---|---|---|---|---|---|---|
| *Delphinium gypsophilum ssp. gypsophilum* | gypsum-loving larkspur | PDRAN0B0S1 | None | None | G4T3/S3.2 | 4.2 | No |
| *Delphinium gypsophilum ssp. parviflorum* | small-flowered gypsum-loving larkspur | PDRAN0B0S2 | None | None | G4T3?Q/S3? | 3.2 | No |
| *Delphinium hansenii ssp. ewanianum* | Ewan's larkspur | PDRAN0B0T2 | None | None | G4T3/S3.2 | 4.2 | No |
| *Delphinium hesperium ssp. cuyamacae* | Cuyamaca larkspur | PDRAN0B0U1 | None | Rare | G4T2/S2.1 | 1B.2 | Yes |
| *Delphinium hutchinsoniae* | Hutchinson's larkspur | PDRAN0B0V0 | None | None | G2/S2.1 | 1B.2 | Yes |
| *Delphinium inopinum* | unexpected larkspur | PDRAN0B0W0 | None | None | G3/S3.3 | 4.3 | Yes |
| *Delphinium luteum* | golden larkspur | PDRAN0B0Z0 | Endangered | Rare | G1/S1 | 1B.1 | Yes |
| *Delphinium parishii ssp. subglobosum* | Colorado Desert larkspur | PDRAN0B1A3 | None | None | G4T3/S3.2 | 4.3 | No |
| *Delphinium parryi ssp. blochmaniae* | dune larkspur | PDRAN0B1B1 | None | None | G4T2/S2.2 | 1B.2 | Yes |
| *Delphinium parryi ssp. eastwoodiae* | Eastwood's larkspur | PDRAN0B1B2 | None | None | G4T2/S2 | 1B.2 | Yes |
| *Delphinium parryi ssp. purpureum* | Mt. Pinos larkspur | PDRAN0B1B5 | None | None | G4T3/S3.3 | 4.3 | No |
| *Delphinium purpusii* | rose-flowered larkspur | PDRAN0B1G0 | None | None | G2/S2 | 1B.3 | Yes |
| *Delphinium recurvatum* | recurved larkspur | PDRAN0B1J0 | None | None | G3/S3 | 1B.2 | Yes |
| *Delphinium scaposum* | bare-stem larkspur | PDRAN0B1M0 | None | None | G5/S1 | 2.3 | Yes |
| *Delphinium stachydeum* | spiked larkspur | PDRAN0B1Q0 | None | None | G5/S2.3 | 2.3 | Yes |
| *Delphinium uliginosum* | swamp larkspur | PDRAN0B1V0 | None | None | G3/S3.2 | 4.2 | No |
| *Delphinium umbraculorum* | umbrella larkspur | PDRAN0B1W0 | None | None | G2G3/S2S3.3 | 1B.3 | Yes |
| *Delphinium variegatum ssp. kinkiense* | San Clemente Island larkspur | PDRAN0B1X3 | Endangered | Endangered | G4T2/S2 | 1B.1 | Yes |
| *Delphinium variegatum ssp. thornei* | Thorne's royal larkspur | PDRAN0B1X2 | None | None | G4T2/S2 | 1B.1 | Yes |
| *Dendromecon harfordii var. harfordii* | north island bush-poppy | PDPAP08020 | None | None | G3Q/S3.2 | 4.2 | No |
| *Dendromecon harfordii var. rhamnoides* | south island bush-poppy | PDPAP08012 | None | None | G4T1/S1 | 1B.1 | Yes |
| *Dicentra formosa ssp. oregana* | Oregon bleeding heart | PDFUM04052 | None | None | G5T4/S3.2 | 4.2 | No |
| *Dicentra nevadensis* | Tulare County bleeding heart | PDFUM04060 | None | None | G3/S3.3 | 4.3 | No |
| *Dichondra occidentalis* | western dichondra | PDCON08060 | None | None | G4?/S3.2 | 4.2 | No |
| *Dicranostegia orcuttiana* | Orcutt's bird's-beak | PDSCR0J0G0 | None | None | G2?/S1 | 2.1 | Yes |
| *Dieteria asteroides var. lagunensis* | Mount Laguna aster | PDAST64131 | None | Rare | G5T2T3Q/S1 | 2.1 | Yes |
| *Dieteria canescens var. ziegleri* | Ziegler's aster | PDAST640B2 | None | None | G5T1/S1 | 1B.2 | Yes |
| *Digitaria californica var. californica* | Arizona cottontop | PMPOA27051 | None | None | G5T5?/S2 | 2.3 | Yes |
| *Dimeresia howellii* | doublet | PDAST2Z010 | None | None | G4?/S2.3 | 2.3 | Yes |

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|---|---|---|---|---|---|---|---|
| *Dirca occidentalis* | western leatherwood | PDTHY03010 | None | None | G2G3/S2S3 | 1B.2 | Yes |
| *Dissanthelium californicum* | California dissanthelium | PMPOA29010 | None | None | G1/S1 | 1B.2 | Yes |
| *Ditaxis claryana* | glandular ditaxis | PDEUP080L0 | None | None | G4G5/S1 | 2.2 | Yes |
| *Ditaxis serrata var. californica* | California ditaxis | PDEUP08050 | None | None | G5T2T3/S2 | 3.2 | Yes |
| *Dithyrea maritima* | beach spectaclepod | PDBRA10020 | None | Threatened | G2/S2.1 | 1B.1 | Yes |
| *Dodecahema leptoceras* | slender-horned spineflower | PDPGN0V010 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Dodecatheon pulchellum* | beautiful shootingstar | PDPRI030D0 | None | None | G5/S2S3.2 | 4.2 | No |
| *Downingia concolor var. brevior* | Cuyamaca Lake downingia | PDCAM06041 | None | Endangered | G4T1/S1 | 1B.1 | Yes |
| *Downingia laeta* | Great Basin downingia | PDCAM06080 | None | None | G5/S2.2 | 2.2 | Yes |
| *Downingia pusilla* | dwarf downingia | PDCAM060C0 | None | None | G2/S2 | 2.2 | Yes |
| *Draba asterophora var. asterophora* | Tahoe draba | PDBRA110D1 | None | None | G2T2/S2 | 1B.2 | Yes |
| *Draba asterophora var. macrocarpa* | Cup Lake draba | PDBRA110D2 | None | None | G2T1/S1 | 1B.1 | Yes |
| *Draba aureola* | golden alpine draba | PDBRA110F0 | None | None | G4/S2 | 1B.3 | Yes |
| *Draba californica* | California draba | PDBRA11380 | None | None | G3/S3.2 | 4.2 | No |
| *Draba cana* | canescent draba | PDBRA110M0 | None | None | G5/S2 | 2.3 | Yes |
| *Draba carnosula* | Mt. Eddy draba | PDBRA112T0 | None | None | G2/S2.2 | 1B.3 | Yes |
| *Draba cruciata* | Mineral King draba | PDBRA110U0 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Draba howellii* | Howell's draba | PDBRA11150 | None | None | G4/S3.3 | 4.3 | No |
| *Draba incrassata* | Sweetwater Mountains draba | PDBRA113G0 | None | None | G3/S3 | 1B.3 | Yes |
| *Draba lonchocarpa* | spear-fruited draba | PDBRA111F0 | None | None | G5/S1 | 2.3 | Yes |
| *Draba monoensis* | White Mountains draba | PDBRA113B0 | None | None | G2/S2 | 1B.2 | Yes |
| *Draba praealta* | tall draba | PDBRA11210 | None | None | G5/S2.3 | 2.3 | Yes |
| *Draba pterosperma* | winged-seed draba | PDBRA11230 | None | None | G3/S3.3 | 4.3 | No |
| *Draba saxosa* | Southern California rock draba | PDBRA110Q2 | None | None | G2G3/S2S3 | 1B.3 | Yes |
| *Draba sharsmithii* | Mt. Whitney draba | PDBRA113F0 | None | None | G2/S2 | 1B.3 | Yes |
| *Draba sierrae* | Sierra draba | PDBRA112A0 | None | None | G3/S3 | 1B.3 | Yes |
| *Draba subumbellata* | mound draba | PDBRA11370 | None | None | G3/S3.3 | 4.3 | No |
| *Drosera anglica* | English sundew | PDDRO02010 | None | None | G5/S2S3 | 2.3 | Yes |
| *Drymocallis cuneifolia var. cuneifolia* | wedgeleaf woodbeauty | PDROS2D011 | None | None | G1T1/S1 | 1B.1 | Yes |
| *Drymocallis cuneifolia var. ewanii* | Ewan's cinquefoil | PDROS1B0S3 | None | None | G1T1/S1 | 1B.3 | Yes |
| *Dryopteris filix-mas* | male fern | PPDRY0A0B0 | None | None | G5/S2 | 2.3 | Yes |
| *Dudleya abramsii ssp. affinis* | San Bernardino Mountains dudleya | PDCRA04013 | None | None | G3T2/S2.2 | 1B.2 | Yes |
| *Dudleya abramsii ssp. bettinae* | Betty's dudleya | PDCRA04011 | None | None | G3T1/S1 | 1B.2 | Yes |

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|---|---|---|---|---|---|---|---|
| *Dudleya abramsii ssp. calcicola* | limestone dudleya | PDCRA040Y0 | None | None | G3T3/S3.3 | 4.3 | No |
| *Dudleya abramsii ssp. murina* | mouse-gray dudleya | PDCRA04012 | None | None | G3T2/S2.3 | 1B.3 | Yes |
| *Dudleya abramsii ssp. setchellii* | Santa Clara Valley dudleya | PDCRA040Z0 | Endangered | None | G3T2/S2 | 1B.1 | Yes |
| *Dudleya alainae* | banner dudleya | PDCRA040X0 | None | None | G1?Q/S1? | 3.2 | No |
| *Dudleya attenuata ssp. orcuttii* | Orcutt's dudleya | PDCRA04031 | None | None | G4T2/S1 | 2.1 | Yes |
| *Dudleya blochmaniae ssp. blochmaniae* | Blochman's dudleya | PDCRA04051 | None | None | G2T2/S2.1 | 1B.1 | Yes |
| *Dudleya blochmaniae ssp. insularis* | Santa Rosa Island dudleya | PDCRA04052 | None | None | G2T1/S1 | 1B.1 | Yes |
| *Dudleya brevifolia* | short-leaved dudleya | PDCRA04053 | None | Endangered | G2T1/S1 | 1B.1 | Yes |
| *Dudleya candelabrum* | candleholder dudleya | PDCRA04080 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Dudleya cymosa ssp. agourensis* | Agoura Hills dudleya | PDCRA040A7 | Threatened | None | G5T1/S2 | 1B.2 | Yes |
| *Dudleya cymosa ssp. costatifolia* | Pierpoint Springs dudleya | PDCRA040A2 | None | None | G5T2/S2.1 | 1B.2 | Yes |
| *Dudleya cymosa ssp. crebrifolia* | San Gabriel River dudleya | PDCRA040A8 | None | None | G5T1/S1 | 1B.2 | Yes |
| *Dudleya cymosa ssp. marcescens* | marcescent dudleya | PDCRA040A3 | Threatened | Rare | G5T2/S2 | 1B.2 | Yes |
| *Dudleya cymosa ssp. ovatifolia* | Santa Monica dudleya | PDCRA040A5 | Threatened | None | G5T1/S1 | 1B.2 | Yes |
| *Dudleya densiflora* | San Gabriel Mountains dudleya | PDCRA040B0 | None | None | G2/S2 | 1B.1 | Yes |
| *Dudleya gnoma* | munchkin dudleya | PDCRA040W0 | None | None | G1/S1 | 1B.1 | Yes |
| *Dudleya greenei* | Greene's dudleya | PDCRA040E0 | None | None | G3/S3.2 | 4.2 | No |
| *Dudleya multicaulis* | many-stemmed dudleya | PDCRA040H0 | None | None | G2/S2 | 1B.2 | Yes |
| *Dudleya nesiotica* | Santa Cruz Island dudleya | PDCRA040J0 | Threatened | Rare | G1/S1 | 1B.1 | Yes |
| *Dudleya parva* | Conejo dudleya | PDCRA04016 | Threatened | None | G2/S2 | 1B.2 | Yes |
| *Dudleya saxosa ssp. saxosa* | Panamint dudleya | PDCRA040N2 | None | None | G4T3/S3 | 1B.3 | Yes |
| *Dudleya stolonifera* | Laguna Beach dudleya | PDCRA040P0 | Threatened | Threatened | G1/S1 | 1B.1 | Yes |
| *Dudleya traskiae* | Santa Barbara Island dudleya | PDCRA040Q0 | Endangered | Endangered | G1/S1 | 1B.2 | Yes |
| *Dudleya variegata* | variegated dudleya | PDCRA040R0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Dudleya verityi* | Verity's dudleya | PDCRA040U0 | Threatened | None | G1/S1 | 1B.2 | Yes |
| *Dudleya virens ssp. hassei* | Catalina Island dudleya | PDCRA040S1 | None | None | G2T2?/S2? | 1B.2 | Yes |
| *Dudleya virens ssp. insularis* | island green dudleya | PDCRA040S2 | None | None | G2T2/S2.2 | 1B.2 | Yes |
| *Dudleya virens ssp. virens* | bright green dudleya | PDCRA040S3 | None | None | G2T1/S1 | 1B.2 | Yes |
| *Dudleya viscida* | sticky dudleya | PDCRA040T0 | None | None | G2/S2.2 | 1B.2 | Yes |

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|---|---|---|---|---|---|---|---|
| *Echinocereus engelmannii var. howei* | Howe's hedgehog cactus | PDCAC06035 | None | None | G5T1/S1 | 1B.1 | Yes |
| *Eleocharis parvula* | small spikerush | PMCYP091G0 | None | None | G5/S3.3 | 4.3 | No |
| *Eleocharis torticulmis* | California twisted spikerush | PMCYP092E0 | None | None | G1/S1 | 1B.3 | Yes |
| *Elymus californicus* | California bottle-brush grass | PMPOA2H0W0 | None | None | G3/S3.3 | 4.3 | No |
| *Elymus salina* | Salina Pass wild-rye | PMPOA6P010 | None | None | G5/S2 | 2.3 | Yes |
| *Elymus scribneri* | Scribner's wheat grass | PMPOA2H170 | None | None | G5/S2? | 2.3 | Yes |
| *Empetrum nigrum* | black crowberry | PDEMP03020 | None | None | G5/S2? | 2.2 | Yes |
| *Enceliopsis covillei* | Panamint daisy | PDAST3G020 | None | None | G2?/S2? | 1B.2 | Yes |
| *Enceliopsis nudicaulis var. corrugata* | Ash Meadows daisy | PDAST3G031 | Threatened | None | G5T2/S1 | 3.3 | Yes |
| *Enceliopsis nudicaulis var. nudicaulis* | naked-stemmed daisy | PDAST3G032 | None | None | G5T5/S3.3 | 4.3 | No |
| *Enneapogon desvauxii* | nine-awned pappus grass | PMPOA2J010 | None | None | G5/S2 | 2.2 | Yes |
| *Ephedra torreyana* | Torrey's Mormon-tea | PGEPH01080 | None | None | G5?/S1 | 2.1 | Yes |
| *Epilobium howellii* | subalpine fireweed | PDONA06180 | None | None | G4/S4 | 4.3 | Yes |
| *Epilobium luteum* | yellow willowherb | PDONA060H0 | None | None | G5/S2? | 2.3 | Yes |
| *Epilobium nivium* | Snow Mountain willowherb | PDONA060M0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Epilobium oreganum* | Oregon fireweed | PDONA060P0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Epilobium palustre* | marsh willowherb | PDONA060R0 | None | None | G5/S2 | 2.3 | Yes |
| *Epilobium rigidum* | Siskiyou Mountains willowherb | PDONA060V0 | None | None | G3G4/S3.3 | 4.3 | No |
| *Epilobium septentrionale* | Humboldt County fuchsia | PDONA06110 | None | None | G3/S3.3 | 4.3 | No |
| *Epilobium siskiyouense* | Siskiyou fireweed | PDONA06100 | None | None | G3/S2.2 | 1B.3 | Yes |
| *Equisetum palustre* | marsh horsetail | PPEQU01050 | None | None | G5/S1S2 | 3 | No |
| *Eremalche kernensis* | Kern mallow | PDMAL0C031 | Endangered | None | G3?T2Q/S2 | 1B.1 | Yes |
| *Eremogone cliftonii* | Clifton's eremogone | PDCAR17010 | None | None | G2/S2 | 1B.3 | Yes |
| *Eremogone congesta var. charlestonensis* | Charleston sandwort | PDCAR0405B | None | None | G5T2?/S1 | 1B.3 | Yes |
| *Eremogone ursina* | Big Bear Valley sandwort | PDCAR040R0 | Threatened | None | G1/S1 | 1B.2 | Yes |
| *Eremothera boothii ssp. alyssoides* | Pine Creek evening-primrose | PDONA03051 | None | None | G5T4/S3.3 | 4.3 | No |
| *Eremothera boothii ssp. boothii* | Booth's evening-primrose | PDONA03052 | None | None | G5T4/S2 | 2.3 | Yes |
| *Eremothera boothii ssp. intermedia* | Booth's hairy evening-primrose | PDONA03056 | None | None | G5T3T4/S2.3 | 2.3 | Yes |
| *Eremothera minor* | Nelson's evening-primrose | PDONA03110 | None | None | G4/S2.3 | 2.3 | Yes |
| *Eriastrum brandegeeae* | Brandegee's eriastrum | PDPLM03020 | None | None | G1Q/S1 | 1B.1 | Yes |
| *Eriastrum densifolium ssp. sanctorum* | Santa Ana River woollystar | PDPLM03035 | Endangered | Endangered | G4T1/S1 | 1B.1 | Yes |
| *Eriastrum harwoodii* | Harwood's eriastrum | PDPLM030B1 | None | None | G3/S3 | 1B.2 | Yes |
| *Eriastrum hooveri* | Hoover's eriastrum | PDPLM03070 | Delisted | None | G3/S3.2 | 4.2 | Yes |

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|---|---|---|---|---|---|---|---|
| *Eriastrum luteum* | yellow-flowered eriastrum | PDPLM03080 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Eriastrum sparsiflorum* | few-flowered eriastrum | PDPLM030B0 | None | None | G3G4/S3? | 4.3 | No |
| *Eriastrum tracyi* | Tracy's eriastrum | PDPLM030C0 | None | Rare | G3Q/S3 | 3.2 | Yes |
| *Eriastrum virgatum* | virgate eriastrum | PDPLM030D0 | None | None | G3/S3.3 | 4.3 | No |
| *Ericameria albida* | white-flowered rabbitbrush | PDAST2C010 | None | None | G4/S3.2 | 4.2 | No |
| *Ericameria cuneata var. macrocephala* | Laguna Mountains goldenbush | PDAST3L062 | None | None | G5T2/S2.3 | 1B.3 | Yes |
| *Ericameria fasciculata* | Eastwood's goldenbush | PDAST3L080 | None | None | G2/S2.1 | 1B.1 | Yes |
| *Ericameria gilmanii* | Gilman's goldenbush | PDAST3L0P0 | None | None | G1/S1 | 1B.3 | Yes |
| *Ericameria nana* | dwarf goldenbush | PDAST3L0B0 | None | None | G5/S3.3 | 4.3 | No |
| *Ericameria ophitidis* | serpentine goldenbush | PDAST3L0S0 | None | None | G3/S3.3 | 4.3 | No |
| *Ericameria palmeri var. palmeri* | Palmer's goldenbush | PDAST3L0C1 | None | None | G4T2T3/S1 | 1B.1 | Yes |
| *Erigeron aequifolius* | Hall's daisy | PDAST3M030 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Erigeron biolettii* | streamside daisy | PDAST3M5H0 | None | None | G3?/S3? | 3 | No |
| *Erigeron blochmaniae* | Blochman's leafy daisy | PDAST3M5J0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Erigeron bloomeri var. nudatus* | Waldo daisy | PDAST3M0M2 | None | None | G5T4/S2? | 2.3 | Yes |
| *Erigeron breweri var. jacinteus* | San Jacinto Mountains daisy | PDAST3M0P3 | None | None | G5T3/S3.3 | 4.3 | No |
| *Erigeron calvus* | bald daisy | PDAST3M5N0 | None | None | G1Q/S1 | 1B.1 | Yes |
| *Erigeron cervinus* | Siskiyou daisy | PDAST3M0U0 | None | None | G3/S3.3 | 4.3 | No |
| *Erigeron compactus* | compact daisy | PDAST3M5Z0 | None | None | G2G3/S2.3 | 2.3 | Yes |
| *Erigeron eatonii var. nevadincola* | Nevada daisy | PDAST3M2U0 | None | None | G5T4/S2.3 | 2.3 | Yes |
| *Erigeron elegantulus* | volcanic daisy | PDAST3M190 | None | None | G4G5/S3.3 | 4.3 | No |
| *Erigeron greenei* | Greene's narrow-leaved daisy | PDAST3M5G0 | None | None | G2/S2 | 1B.2 | Yes |
| *Erigeron inornatus var. calidipetris* | hot rock daisy | PDAST3M1Z1 | None | None | G5T3/S3.3 | 4.3 | No |
| *Erigeron inornatus var. keilii* | keil's daisy | PDAST3M1Z2 | None | None | G5T1/S1 | 1B.3 | Yes |
| *Erigeron lassenianus var. deficiens* | Plumas rayless daisy | PDAST3M262 | None | None | G3G4T2T3/S2S3 | 1B.3 | Yes |
| *Erigeron maniopotamicus* | Mad River fleabane daisy | PDASTE1050 | None | None | G1/S1 | 1B.2 | Yes |
| *Erigeron mariposanus* | Mariposa daisy | PDAST3M5L0 | None | None | GH/SH | 1A | Yes |
| *Erigeron miser* | starved daisy | PDAST3M2K0 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Erigeron multiceps* | Kern River daisy | PDAST3M2N0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Erigeron nivalis* | snow fleabane daisy | PDASTE1060 | None | None | G4G5/S2S3 | 2.3 | Yes |
| *Erigeron oxyphyllus* | wand-like fleabane daisy | PDAST3M2Z0 | None | None | G2G4/S2 | 2.3 | Yes |
| *Erigeron parishii* | Parish's daisy | PDAST3M310 | Threatened | None | G2/S2 | 1B.1 | Yes |
| *Erigeron petrophilus var. sierrensis* | northern Sierra daisy | PDAST3M351 | None | None | G4T3/S3.3 | 4.3 | No |

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| *Erigeron petrophilus var. viscidulus* | Klamath rock daisy | PDAST3M352 | None | None | G4T3/S3.3 | 4.3 | No |
| *Erigeron robustior* | robust daisy | PDAST3M134 | None | None | G3/S3.3 | 4.3 | No |
| *Erigeron sanctarum* | saint's daisy | PDAST3M3R0 | None | None | G3/S3.2 | 4.2 | No |
| *Erigeron serpentinus* | serpentine daisy | PDAST3M5M0 | None | None | G2/S2 | 1B.3 | Yes |
| *Erigeron supplex* | supple daisy | PDAST3M3Z0 | None | None | G2/S2 | 1B.2 | Yes |
| *Erigeron uncialis var. uncialis* | limestone daisy | PDAST3M452 | None | None | G3G4T2/S2.2 | 1B.2 | Yes |
| *Erigeron utahensis* | Utah daisy | PDAST3M480 | None | None | G4/S2 | 2.3 | Yes |
| *Eriodictyon altissimum* | Indian Knob mountainbalm | PDHYD04010 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Eriodictyon angustifolium* | narrow-leaved yerba santa | PDHYD04020 | None | None | G5/S2? | 2.3 | Yes |
| *Eriodictyon capitatum* | Lompoc yerba santa | PDHYD04040 | Endangered | Rare | G2/S2 | 1B.2 | Yes |
| *Eriogonum alexanderae* | Alexander's buckwheat | PDPGN084C5 | None | None | G2G3/S1 | 1B.1 | Yes |
| *Eriogonum alpinum* | Trinity buckwheat | PDPGN08060 | None | Endangered | G3/S3 | 1B.2 | Yes |
| *Eriogonum apricum var. apricum* | Ione buckwheat | PDPGN080F1 | Endangered | Endangered | G2T1/S1 | 1B.1 | Yes |
| *Eriogonum apricum var. prostratum* | Irish Hill buckwheat | PDPGN080F2 | Endangered | Endangered | G2T1/S1 | 1B.1 | Yes |
| *Eriogonum argillosum* | clay buckwheat | PDPGN080J0 | None | None | G3/S3.3 | 4.3 | No |
| *Eriogonum baileyi var. praebens* | Bailey's woolly buckwheat | PDPGN080M2 | None | None | G5T4/S3.3 | 4.3 | No |
| *Eriogonum bifurcatum* | forked buckwheat | PDPGN080R0 | None | None | G3/S3 | 1B.2 | Yes |
| *Eriogonum breedlovei var. breedlovei* | Breedlove's buckwheat | PDPGN080V1 | None | None | G3T2/S2 | 1B.2 | Yes |
| *Eriogonum breedlovei var. shevockii* | The Needles buckwheat | PDPGN080V2 | None | None | G3T3/S3.3 | 4.3 | Yes |
| *Eriogonum butterworthianum* | Butterworth's buckwheat | PDPGN080X0 | None | Rare | G2/S2 | 1B.3 | Yes |
| *Eriogonum callistum* | Tehachapi buckwheat | PDPGN08790 | None | None | G1/S1 | 1B.1 | Yes |
| *Eriogonum cedrorum* | The Cedars buckwheat | PDPGN087A0 | None | None | G1/S1 | 1B.3 | Yes |
| *Eriogonum collinum* | hill buckwheat | PDPGN08160 | None | None | G4/S3.3 | 4.3 | No |
| *Eriogonum congdonii* | Congdon's buckwheat | PDPGN081A0 | None | None | G3/S3.3 | 4.3 | No |
| *Eriogonum contiguum* | Ash Meadows buckwheat | PDPGN081B0 | None | None | G2/S2 | 2.3 | Yes |
| *Eriogonum crocatum* | conejo buckwheat | PDPGN081G0 | None | Rare | G2/S2.1 | 1B.2 | Yes |
| *Eriogonum diclinum* | Jaynes Canyon buckwheat | PDPGN081S0 | None | None | G3/S2S3 | 1B.3 | Yes |
| *Eriogonum eastwoodianum* | Eastwood's buckwheat | PDPGN081V0 | None | None | G1G2/S1S2.3 | 1B.3 | Yes |
| *Eriogonum elegans* | elegant wild buckwheat | PDPGN081Y0 | None | None | G3/S3 | 4.3 | No |
| *Eriogonum eremicola* | Wildrose Canyon buckwheat | PDPGN08210 | None | None | G1/S1 | 1B.3 | Yes |
| *Eriogonum evanidum* | vanishing wild buckwheat | PDPGN08780 | None | None | G1/S1 | 1B.1 | Yes |

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| *Eriogonum giganteum var. compactum* | Santa Barbara Island buckwheat | PDPGN082A1 | None | Rare | G2T2/S2.2 | 1B.3 | Yes |
| *Eriogonum giganteum var. formosum* | San Clemente Island buckwheat | PDPGN082A2 | None | None | G2T2/S2.2 | 1B.2 | Yes |
| *Eriogonum giganteum var. giganteum* | Santa Catalina Island buckwheat | PDPGN082A3 | None | None | G2T2/S2.2 | 4.3 | No |
| *Eriogonum gilmanii* | Gilman's buckwheat | PDPGN082B0 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Eriogonum gossypinum* | cottony buckwheat | PDPGN082E0 | None | None | G3/S3.2 | 4.2 | No |
| *Eriogonum grande var. grande* | island buckwheat | PDPGN082J1 | None | None | G3T3/S3.2 | 4.2 | No |
| *Eriogonum grande var. rubescens* | red-flowered buckwheat | PDPGN082J2 | None | None | G3T2/S2.2 | 1B.2 | Yes |
| *Eriogonum grande var. timorum* | San Nicolas Island buckwheat | PDPGN082J3 | None | Endangered | G3T1/S1 | 1B.1 | Yes |
| *Eriogonum heermannii var. floccosum* | Clark Mountain buckwheat | PDPGN082P3 | None | None | G5T3/S3.3 | 4.3 | No |
| *Eriogonum heermannii var. occidentale* | western Heermann's buckwheat | PDPGN082P6 | None | None | G5T3/S3.2 | 4.2 | No |
| *Eriogonum heracleoides var. heracleoides* | parsnip-flowered buckwheat | PDPGN082R2 | None | None | G5T5/S3.3 | 4.3 | No |
| *Eriogonum hirtellum* | Klamath Mountain buckwheat | PDPGN082T0 | None | None | G3/S3 | 1B.3 | Yes |
| *Eriogonum hoffmannii var. hoffmannii* | Hoffmann's buckwheat | PDPGN082V1 | None | None | G3T2/S2.3 | 1B.3 | Yes |
| *Eriogonum hoffmannii var. robustius* | robust Hoffmann's buckwheat | PDPGN082V2 | None | None | G3T2/S2.3 | 1B.3 | Yes |
| *Eriogonum intrafractum* | jointed buckwheat | PDPGN08360 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Eriogonum kelloggii* | Kellogg's buckwheat | PDPGN083A0 | Candidate | Endangered | G2/S2 | 1B.2 | Yes |
| *Eriogonum kennedyi var. alpigenum* | southern alpine buckwheat | PDPGN083B1 | None | None | G4T2/S2.3 | 1B.3 | Yes |
| *Eriogonum kennedyi var. austromontanum* | southern mountain buckwheat | PDPGN083B2 | Threatened | None | G4T2/S2 | 1B.2 | Yes |
| *Eriogonum kennedyi var. pinicola* | Kern buckwheat | PDPGN083B4 | None | None | G4T1/S1 | 1B.1 | Yes |
| *Eriogonum libertini* | Dubakella Mountain buckwheat | PDPGN083M0 | None | None | G3/S3.2 | 4.2 | No |
| *Eriogonum luteolum var. caninum* | Tiburon buckwheat | PDPGN083S1 | None | None | G5T2/S2 | 1B.2 | Yes |
| *Eriogonum luteolum var. saltuarium* | Jack's wild buckwheat | PDPGN083S4 | None | None | G5T1/S1 | 1B.2 | Yes |
| *Eriogonum mensicola* | Pinyon Mesa buckwheat | PDPGN084H1 | None | None | G2G3/S2 | 1B.3 | Yes |
| *Eriogonum microthecum var. alpinum* | northern limestone buckwheat | PDPGN083WA | None | None | G5T3/S3.3 | 4.3 | No |
| *Eriogonum microthecum var. johnstonii* | Johnston's buckwheat | PDPGN083W5 | None | None | G5T2/S2 | 1B.3 | Yes |
| *Eriogonum microthecum var. lacus-ursi* | Bear Lake buckwheat | PDPGN083WF | None | None | G5T1/S1 | 1B.1 | Yes |
| *Eriogonum microthecum var. lapidicola* | Inyo Mountains buckwheat | PDPGN083W6 | None | None | G5T3T4/S3.3 | 4.3 | No |

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|---|---|---|---|---|---|---|---|
| *Eriogonum microthecum var. panamintense* | Panamint Mountains buckwheat | PDPGN083W9 | None | None | G5T2/S2.3 | 1B.3 | Yes |
| *Eriogonum microthecum var. schoolcraftii* | Schoolcraft's wild buckwheat | PDPGN083WG | None | None | G5T2/S2.2 | 1B.2 | Yes |
| *Eriogonum nervulosum* | Snow Mountain buckwheat | PDPGN08440 | None | None | G2/S2 | 1B.2 | Yes |
| *Eriogonum nortonii* | Pinnacles buckwheat | PDPGN08470 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Eriogonum nudum var. decurrens* | Ben Lomond buckwheat | PDPGN08492 | None | None | G5T2/S2.1 | 1B.1 | Yes |
| *Eriogonum nudum var. indictum* | protruding buckwheat | PDPGN08494 | None | None | G5T3/S3.2 | 4.2 | No |
| *Eriogonum nudum var. murinum* | mouse buckwheat | PDPGN08495 | None | None | G5T2/S2.2 | 1B.2 | Yes |
| *Eriogonum nudum var. paralinum* | Del Norte buckwheat | PDPGN08498 | None | None | G5T2T4/S2? | 2.2 | Yes |
| *Eriogonum nudum var. psychicola* | Antioch Dunes buckwheat | PDPGN0849Q | None | None | G5T1/S1 | 1B.1 | Yes |
| *Eriogonum nudum var. regirivum* | Kings River buckwheat | PDPGN0849F | None | None | G5T2/S2 | 1B.2 | Yes |
| *Eriogonum nutans var. nutans* | Dugway wild buckwheat | PDPGN084B2 | None | None | G5T3T4/S2.3 | 2.3 | Yes |
| *Eriogonum ochrocephalum var. ochrocephalum* | ochre-flowered buckwheat | PDPGN084C6 | None | None | G5T4/S1 | 2.2 | Yes |
| *Eriogonum ovalifolium var. depressum* | depressed wild buckwheat | PDPGN084FF | None | None | G5T4T5/S1 | 2.1 | Yes |
| *Eriogonum ovalifolium var. eximium* | brown-margined buckwheat | PDPGN084FD | None | None | G5T3/S3.2 | 4.3 | No |
| *Eriogonum ovalifolium var. monarchense* | Monarch buckwheat | PDPGN084FJ | None | None | G5T1/S1 | 1B.3 | Yes |
| *Eriogonum ovalifolium var. vineum* | Cushenbury buckwheat | PDPGN084F8 | Endangered | None | G5T1/S1 | 1B.1 | Yes |
| *Eriogonum pendulum* | Waldo wild buckwheat | PDPGN084Q0 | None | None | G4/S2.2 | 2.2 | Yes |
| *Eriogonum polypodum* | Tulare County buckwheat | PDPGN084U0 | None | None | G3/S3.3 | 4.3 | No |
| *Eriogonum prattenianum var. avium* | Kettle Dome buckwheat | PDPGN084V1 | None | None | G4T3/S3.2 | 4.2 | No |
| *Eriogonum prociduum* | prostrate buckwheat | PDPGN084W0 | None | None | G3/S2.2 | 1B.2 | Yes |
| *Eriogonum pyrolifolium var. pyrolifolium* | pyrola-leaved buckwheat | PDPGN084Z2 | None | None | G4T4/S3 | 2.3 | Yes |
| *Eriogonum shockleyi var. shockleyi* | Shockley's buckwheat | PDPGN085E0 | None | None | G5/S3.3 | 4.3 | No |
| *Eriogonum siskiyouense* | Siskiyou buckwheat | PDPGN085F0 | None | None | G3/S3.3 | 4.3 | No |
| *Eriogonum spectabile* | Barron's buckwheat | PDPGN08750 | None | None | G1/S1 | 1B.2 | Yes |
| *Eriogonum spergulinum var. pratense* | mountain meadow wild buckwheat | PDPGN085J1 | None | None | G4T3/S3 | 4.3 | No |
| *Eriogonum strictum var. greenei* | Greene's buckwheat | PDPGN085L3 | None | None | G5T3Q/S3.3 | 4.3 | No |
| *Eriogonum temblorense* | Temblor buckwheat | PDPGN085P0 | None | None | G2/S2.2 | 1B.2 | Yes |

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|---|---|---|---|---|---|---|---|
| *Eriogonum ternatum* | ternate buckwheat | PDPGN085R0 | None | None | G4/S3.3 | 4.3 | No |
| *Eriogonum thornei* | Thorne's buckwheat | PDPGN08233 | None | Endangered | G1/S1 | 1B.2 | Yes |
| *Eriogonum tripodum* | tripod buckwheat | PDPGN085Y0 | None | None | G3/S3.2 | 4.2 | No |
| *Eriogonum truncatum* | Mt. Diablo buckwheat | PDPGN085Z0 | None | None | G2/S2 | 1B.1 | Yes |
| *Eriogonum twisselmannii* | Twisselmann's buckwheat | PDPGN08610 | None | Rare | G2/S2.2 | 1B.2 | Yes |
| *Eriogonum umbellatum var. ahartii* | Ahart's buckwheat | PDPGN086UY | None | None | G5T2/S2 | 1B.2 | Yes |
| *Eriogonum umbellatum var. bahiiforme* | bay buckwheat | PDPGN086UB | None | None | G5T3/S3.2 | 4.2 | No |
| *Eriogonum umbellatum var. glaberrimum* | Warner Mountains buckwheat | PDPGN086U2 | None | None | G5T2?/S2 | 1B.3 | Yes |
| *Eriogonum umbellatum var. humistratum* | Mt. Eddy buckwheat | PDPGN086U4 | None | None | G5T3/S3.3 | 4.3 | No |
| *Eriogonum umbellatum var. juniporinum* | juniper sulphur-flowered buckwheat | PDPGN086U6 | None | None | G5T3?/S1S2 | 2.3 | Yes |
| *Eriogonum umbellatum var. lautum* | Scott Valley buckwheat | PDPGN086UX | None | None | G5T1/S1 | 1B.1 | Yes |
| *Eriogonum umbellatum var. minus* | alpine sulphur-flowered buckwheat | PDPGN086U7 | None | None | G5T3/S3.3 | 4.3 | No |
| *Eriogonum umbellatum var. torreyanum* | Donner Pass buckwheat | PDPGN086U9 | None | None | G5T2/S2.2 | 1B.2 | Yes |
| *Eriogonum ursinum var. erubescens* | blushing wild buckwheat | PDPGN08632 | None | None | G3G4T2/S2.3 | 1B.3 | Yes |
| *Eriogonum vestitum* | Idria buckwheat | PDPGN08640 | None | None | G3Q/S3.3 | 4.3 | No |
| *Eriogonum wrightii var. olanchense* | Olancha Peak buckwheat | PDPGN086D3 | None | None | G5T2/S2 | 1B.3 | Yes |
| *Erioneuron pilosum* | hairy erioneuron | PMPOA2S020 | None | None | G5/S2S3 | 2.3 | Yes |
| *Eriophorum gracile* | slender cottongrass | PMCYP0A080 | None | None | G5/S3.3 | 4.3 | No |
| *Eriophyllum confertiflorum var. tanacetiflorum* | tansy-flowered woolly sunflower | PDAST3N0D0 | None | None | G3Q/S3.3 | 4.3 | No |
| *Eriophyllum congdonii* | Congdon's woolly sunflower | PDAST3N030 | None | Rare | G2/S2.2 | 1B.2 | Yes |
| *Eriophyllum jepsonii* | Jepson's woolly sunflower | PDAST3N040 | None | None | G3/S3 | 4.3 | No |
| *Eriophyllum lanatum var. hallii* | Fort Tejon woolly sunflower | PDAST3N058 | None | None | G5T1/S1 | 1B.1 | Yes |
| *Eriophyllum lanatum var. obovatum* | southern Sierra woolly sunflower | PDAST3N05D | None | None | G5T3/S3.3 | 4.3 | No |
| *Eriophyllum latilobum* | San Mateo woolly sunflower | PDAST3N060 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Eriophyllum mohavense* | Barstow woolly sunflower | PDAST3N070 | None | None | G2/S2 | 1B.2 | Yes |
| *Eriophyllum nubigenum* | Yosemite woolly sunflower | PDAST3N0A0 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Eryngium aristulatum var. hooveri* | Hoover's button-celery | PDAPI0Z043 | None | None | G5T2/S2.1 | 1B.1 | Yes |

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|---|---|---|---|---|---|---|---|
| *Eryngium aristulatum var. parishii* | San Diego button-celery | PDAPI0Z042 | Endangered | Endangered | G5T1/S1 | 1B.1 | Yes |
| *Eryngium constancei* | Loch Lomond button-celery | PDAPI0Z0W0 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Eryngium pendletonense* | Pendleton button-celery | PDAPI0Z120 | None | None | G1/S1 | 1B.1 | Yes |
| *Eryngium pinnatisectum* | Tuolumne button-celery | PDAPI0Z0P0 | None | None | G2/S2 | 1B.2 | Yes |
| *Eryngium racemosum* | Delta button-celery | PDAPI0Z0S0 | None | Endangered | G1Q/S1 | 1B.1 | Yes |
| *Eryngium spinosepalum* | spiny-sepaled button-celery | PDAPI0Z0Y0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Erysimum ammophilum* | sand-loving wallflower | PDBRA16010 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Erysimum capitatum var. angustatum* | Contra Costa wallflower | PDBRA16052 | Endangered | Endangered | G5T1/S1 | 1B.1 | Yes |
| *Erysimum capitatum var. lompocense* | San Luis Obispo wallflower | PDBRA16057 | None | None | G5T3/S3.2 | 4.2 | No |
| *Erysimum concinnum* | bluff wallflower | PDBRA160E3 | None | None | G3/S3 | 1B.2 | No |
| *Erysimum franciscanum* | San Francisco wallflower | PDBRA160A0 | None | None | G3/S3.2 | 4.2 | No |
| *Erysimum insulare* | island wallflower | PDBRA160D1 | None | None | G3/S2.3 | 1B.3 | Yes |
| *Erysimum menziesii* | Menzies' wallflower | PDBRA160R0 | Endangered | Endangered | G2/S2 | 1B.1 | No |
| *Erysimum menziesii ssp. eurekense* | Humboldt Bay wallflower | PDBRA160E2 | Endangered | Endangered | G3?T1/S1 | 1B.1 | Yes |
| *Erysimum menziesii ssp. menziesii* | Menzies' wallflower | PDBRA160E1 | Endangered | Endangered | G3?T1/S1 | 1B.1 | Yes |
| *Erysimum menziesii ssp. yadonii* | Yadon's wallflower | PDBRA160E4 | Endangered | Endangered | G3?T1/S1 | 1B.1 | Yes |
| *Erysimum suffrutescens* | suffrutescent wallflower | PDBRA160D2 | None | None | G3/S3.2 | 4.2 | No |
| *Erysimum teretifolium* | Santa Cruz wallflower | PDBRA160N0 | Endangered | Endangered | G2/S2 | 1B.1 | Yes |
| *Erythronium citrinum var. citrinum* | lemon-colored fawn lily | PMLIL0U041 | None | None | G4T4/S3.3 | 4.3 | No |
| *Erythronium citrinum var. roderickii* | Scott Mountains fawn lily | PMLIL0U042 | None | None | G4T3/S3 | 1B.3 | Yes |
| *Erythronium helenae* | St. Helena fawn lily | PMLIL0U060 | None | None | G3/S3.2 | 4.2 | No |
| *Erythronium hendersonii* | Henderson's fawn lily | PMLIL0U070 | None | None | G4/S2 | 2.3 | Yes |
| *Erythronium howellii* | Howell's fawn lily | PMLIL0U080 | None | None | G3G4/S2.3 | 1B.3 | Yes |
| *Erythronium klamathense* | Klamath fawn lily | PMLIL0U090 | None | None | G4/S2 | 2.2 | Yes |
| *Erythronium oregonum* | giant fawn lily | PMLIL0U0C0 | None | None | G5/S2.2 | 2.2 | Yes |
| *Erythronium pluriflorum* | Shuteye Peak fawn lily | PMLIL0U0Q0 | None | None | G2/S2 | 1B.3 | Yes |
| *Erythronium pusaterii* | Kaweah fawn lily | PMLIL0U0R0 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Erythronium revolutum* | coast fawn lily | PMLIL0U0F0 | None | None | G4/S2S3 | 2.2 | Yes |
| *Erythronium taylorii* | Pilot Ridge fawn lily | PMLIL0U0S0 | None | None | G1/S1 | 1B.2 | Yes |
| *Erythronium tuolumnense* | Tuolumne fawn lily | PMLIL0U0H0 | None | None | G2/S2 | 1B.2 | Yes |
| *Eschscholzia hypecoides* | San Benito poppy | PDPAP0A060 | None | None | G3/S3.3 | 4.3 | No |
| *Eschscholzia lemmonii ssp. kernensis* | Tejon poppy | PDPAP0A071 | None | None | G5T2/S2 | 1B.1 | Yes |
| *Eschscholzia minutiflora ssp. twisselmannii* | Red Rock poppy | PDPAP0A093 | None | None | G5T2/S2.2 | 1B.2 | Yes |
| *Eschscholzia procera* | Kernville poppy | PDPAP0A0B0 | None | None | G1G2Q/S1S2 | 3 | No |

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|---|---|---|---|---|---|---|---|
| *Eschscholzia ramosa* | island poppy | PDPAP0A0C0 | None | None | G3/S3.3 | 4.3 | No |
| *Eschscholzia rhombipetala* | diamond-petaled California poppy | PDPAP0A0D0 | None | None | G1/S1 | 1B.1 | Yes |
| *Eucephalus vialis* | wayside aster | PDASTEC0A0 | None | None | G3/S1 | 1B.2 | Yes |
| *Eucnide rupestris* | annual rock-nettle | PDLOA02020 | None | None | G3/S1 | 2.2 | Yes |
| *Euphorbia exstipulata var. exstipulata* | Clark Mountain spurge | PDEUP0Q0P1 | None | None | G5T5?/S2 | 2.1 | Yes |
| *Euphorbia misera* | cliff spurge | PDEUP0Q1B0 | None | None | G5/S1 | 2.2 | Yes |
| *Euphrosyne acerosa* | copperwort | PDAST58010 | None | None | G5/S3.2 | 4.2 | No |
| *Euphrosyne nevadensis* | Nevada wormwood | PDAST580D0 | None | None | G3?/S3.3 | 4.3 | No |
| *Eurybia merita* | subalpine aster | PDASTEB030 | None | None | G5/S1 | 2.3 | Yes |
| *Fendlerella utahensis* | yerba desierto | PDHDR08010 | None | None | G5/S3.3 | 4.3 | No |
| *Ferocactus viridescens* | San Diego barrel cactus | PDCAC08060 | None | None | G4/S2 | 2.1 | Yes |
| *Festuca minutiflora* | small-flowered fescue | PMPOA2V1M0 | None | None | G5/S2 | 2.3 | Yes |
| *Fimbristylis thermalis* | hot springs fimbristylis | PMCYP0B0N0 | None | None | G4/S2.2 | 2.2 | Yes |
| *Frangula purshiana ssp. ultramafica* | Caribou coffeeberry | PDRHA0H061 | None | None | G4T2/S2 | 1B.2 | Yes |
| *Frankenia palmeri* | Palmer's frankenia | PDFRA01040 | None | None | G3G4/S1 | 2.1 | Yes |
| *Frasera neglecta* | pine green-gentian | PDGEN05080 | None | None | G3/S3.3 | 4.3 | No |
| *Frasera umpquaensis* | Umpqua green-gentian | PDGEN050F0 | None | None | G3Q/S2.2 | 2.2 | Yes |
| *Fraxinus parryi* | chaparral ash | PDOLE040K0 | None | None | G3?/S1 | 2.2 | Yes |
| *Fremontodendron decumbens* | Pine Hill flannelbush | PDSTE03030 | Endangered | Rare | G1/S1 | 1B.2 | Yes |
| *Fremontodendron mexicanum* | Mexican flannelbush | PDSTE03020 | Endangered | Rare | G1/S1 | 1B.1 | Yes |
| *Fritillaria agrestis* | stinkbells | PMLIL0V010 | None | None | G3/S3.2 | 4.2 | Yes |
| *Fritillaria biflora var. ineziana* | Hillsborough chocolate lily | PMLIL0V031 | None | None | G1QT1Q/S1 | 1B.1 | Yes |
| *Fritillaria brandegeei* | Greenhorn fritillary | PMLIL0V040 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Fritillaria eastwoodiae* | Butte County fritillary | PMLIL0V060 | None | None | G3Q/S3 | 3.2 | Yes |
| *Fritillaria falcata* | talus fritillary | PMLIL0V070 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Fritillaria gentneri* | Gentner's fritillary | PMLIL0V080 | Endangered | None | G1/S1 | 1B.1 | Yes |
| *Fritillaria glauca* | Siskiyou fritillaria | PMLIL0V090 | None | None | G3G4/S3 | 4.2 | No |
| *Fritillaria lanceolata var. tristulis* | Marin checker lily | PMLIL0V0P1 | None | None | G5T2/S2 | 1B.1 | Yes |
| *Fritillaria liliacea* | fragrant fritillary | PMLIL0V0C0 | None | None | G2/S2 | 1B.2 | Yes |
| *Fritillaria ojaiensis* | Ojai fritillary | PMLIL0V0N0 | None | None | G2/S2 | 1B.2 | Yes |
| *Fritillaria pinetorum* | pine fritillary | PMLIL0V0E0 | None | None | G4/S3.3 | 4.3 | No |
| *Fritillaria pluriflora* | adobe-lily | PMLIL0V0F0 | None | None | G3/S3 | 1B.2 | Yes |
| *Fritillaria purdyi* | Purdy's fritillary | PMLIL0V0H0 | None | None | G3/S3.2 | 4.3 | No |
| *Fritillaria roderickii* | Roderick's fritillary | PMLIL0V0M0 | None | Endangered | G1Q/S1 | 1B.1 | Yes |
| *Fritillaria striata* | striped adobe-lily | PMLIL0V0K0 | None | Threatened | G2/S2 | 1B.1 | Yes |
| *Fritillaria viridea* | San Benito fritillary | PMLIL0V0L0 | None | None | G2/S2 | 1B.2 | Yes |
| *Funastrum utahense* | Utah vine milkweed | PDASC050M0 | None | None | G4/S3.2 | 4.2 | No |

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|---|---|---|---|---|---|---|---|
| *Galium andrewsii ssp. gatense* | serpentine phlox-leaf bedstraw | PDRUB0N032 | None | None | G5T3/S3.2 | 4.2 | No |
| *Galium angustifolium ssp. borregoense* | Borrego bedstraw | PDRUB0N042 | None | Rare | G5T2/S2.3 | 1B.3 | Yes |
| *Galium angustifolium ssp. gabrielense* | San Antonio Canyon bedstraw | PDRUB0N044 | None | None | G5T3/S3.3 | 4.3 | No |
| *Galium angustifolium ssp. gracillimum* | slender bedstraw | PDRUB0N04B | None | None | G5T3/S3.2 | 4.2 | No |
| *Galium angustifolium ssp. jacinticum* | San Jacinto Mountains bedstraw | PDRUB0N04C | None | None | G5T2T3/S2S3 | 1B.3 | Yes |
| *Galium angustifolium ssp. onycense* | Onyx Peak bedstraw | PDRUB0N048 | None | None | G5T2/S2.3 | 1B.3 | Yes |
| *Galium buxifolium* | box bedstraw | PDRUB0N0D0 | Endangered | Rare | G1/S1 | 1B.2 | Yes |
| *Galium californicum ssp. luciense* | Cone Peak bedstraw | PDRUB0N0E3 | None | None | G5T2/S2.3 | 1B.3 | Yes |
| *Galium californicum ssp. miguelense* | San Miguel Island bedstraw | PDRUB0N0E5 | None | None | G5T3/S3.2 | 4.2 | No |
| *Galium californicum ssp. primum* | Alvin Meadow bedstraw | PDRUB0N0E6 | None | None | G5T1Q/S1 | 1B.2 | Yes |
| *Galium californicum ssp. sierrae* | El Dorado bedstraw | PDRUB0N0E7 | Endangered | Rare | G5T1/S1 | 1B.2 | Yes |
| *Galium catalinense ssp. acrispum* | San Clemente Island bedstraw | PDRUB0N0F1 | None | Endangered | G4T2/S2 | 1B.2 | Yes |
| *Galium catalinense ssp. catalinense* | Santa Catalina Island bedstraw | PDRUB0N0F2 | None | None | G4T2T3/S2S3.2 | 1B.2 | Yes |
| *Galium clementis* | Santa Lucia bedstraw | PDRUB0N0H0 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Galium cliftonsmithii* | Santa Barbara bedstraw | PDRUB0N0J0 | None | None | G3/S3.3 | 4.3 | No |
| *Galium glabrescens ssp. modocense* | Modoc bedstraw | PDRUB0N0T2 | None | None | G4T3/S3 | 1B.2 | Yes |
| *Galium grande* | San Gabriel bedstraw | PDRUB0N0V0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Galium hardhamiae* | Hardham's bedstraw | PDRUB0N0Y0 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Galium hilendiae ssp. carneum* | Panamint Mountains bedstraw | PDRUB0N0Z1 | None | None | G4T2/S2.3 | 1B.3 | Yes |
| *Galium hilendiae ssp. kingstonense* | Kingston Mountains bedstraw | PDRUB0N0Z3 | None | None | G4T2/S2 | 1B.3 | Yes |
| *Galium hypotrichium ssp. tomentellum* | Telescope Peak bedstraw | PDRUB0N126 | None | None | G5T1/S1 | 1B.3 | Yes |
| *Galium jepsonii* | Jepson's bedstraw | PDRUB0N130 | None | None | G3/S3.3 | 4.3 | No |
| *Galium johnstonii* | Johnston's bedstraw | PDRUB0N140 | None | None | G3/S3.3 | 4.3 | No |
| *Galium munzii* | Munz's bedstraw | PDRUB0N1G0 | None | None | G4G5/S3.3 | 4.3 | No |
| *Galium nuttallii ssp. insulare* | Nuttall's island bedstraw | PDRUB0N1K1 | None | None | G5?T3/S3.3 | 4.3 | No |
| *Galium oreganum* | Oregon bedstraw | PDRUB0N1N0 | None | None | G4/S2S3 | 3 | No |
| *Galium proliferum* | desert bedstraw | PDRUB0N1V0 | None | None | G5/S2 | 2.2 | Yes |
| *Galium serpenticum ssp. scotticum* | Scott Mountain bedstraw | PDRUB0N1Y6 | None | None | G4G5T2/S2.2 | 1B.2 | Yes |
| *Galium serpenticum ssp. warnerense* | Warner Mountains bedstraw | PDRUB0N1Y8 | None | None | G4G5T2/S2 | 1B.2 | Yes |

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|---|---|---|---|---|---|---|---|
| *Galium wrightii* | Wright's bedstraw | PDRUB0N2F0 | None | None | G3G4/S2 | 2.3 | Yes |
| *Gambelia speciosa* | showy island snapdragon | PDSCR2H010 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Gentiana affinis var. parvidentata* | small-toothed prairie gentian | PDGEN06013 | None | None | G5T3?Q/SNR | 3 | No |
| *Gentiana fremontii* | Fremont's gentian | PDGEN060Y0 | None | None | G4/S2.3 | 2.3 | Yes |
| *Gentiana plurisetosa* | Klamath gentian | PDGEN060V0 | None | None | G2G3/S2S3.3 | 1B.3 | Yes |
| *Gentiana prostrata* | pygmy gentian | PDGEN060M0 | None | None | G4G5/S2.3 | 2.3 | Yes |
| *Gentiana setigera* | Mendocino gentian | PDGEN060S0 | None | None | G2/S1 | 1B.2 | Yes |
| *Geraea viscida* | sticky geraea | PDAST42020 | None | None | G3/S2.3? | 2.3 | Yes |
| *Geum aleppicum* | Aleppo avens | PDROS0S010 | None | None | G5/S2.2? | 2.2 | Yes |
| *Gilia capitata ssp. chamissonis* | blue coast gilia | PDPLM040B3 | None | None | G5T2/S2.1 | 1B.1 | Yes |
| *Gilia capitata ssp. pacifica* | Pacific gilia | PDPLM040B6 | None | None | G5T3T4/S2.2? | 1B.2 | Yes |
| *Gilia capitata ssp. tomentosa* | woolly-headed gilia | PDPLM040B9 | None | None | G5T2/S2 | 1B.1 | Yes |
| *Gilia interior* | inland gilia | PDPLM040Q0 | None | None | G3/S3.3 | 4.3 | No |
| *Gilia latiflora ssp. cuyamensis* | Cuyama gilia | PDPLM040T2 | None | None | G5?T3/S3.3 | 4.3 | No |
| *Gilia leptantha ssp. leptantha* | San Bernardino gilia | PDPLM040W1 | None | None | G4T2/S2.3 | 1B.3 | Yes |
| *Gilia leptantha ssp. pinetorum* | pine gilia | PDPLM040W2 | None | None | G4T3/S3.3 | 4.3 | No |
| *Gilia mexicana* | El Paso gilia | PDPLM04110 | None | None | G4/S1 | 2.3 | Yes |
| *Gilia millefoliata* | dark-eyed gilia | PDPLM04130 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Gilia nevinii* | Nevin's gilia | PDPLM04160 | None | None | G3/S3.2 | 4.3 | No |
| *Gilia tenuiflora ssp. amplifaucalis* | trumpet-throated gilia | PDPLM041P4 | None | None | G3G4T3/S3.3 | 4.3 | No |
| *Gilia tenuiflora ssp. arenaria* | sand gilia | PDPLM041P2 | Endangered | Threatened | G3G4T2/S2 | 1B.2 | Yes |
| *Gilia tenuiflora ssp. hoffmannii* | Hoffmann's slender-flowered gilia | PDPLM041P3 | Endangered | None | G3G4T1/S1 | 1B.1 | Yes |
| *Gilia yorkii* | Monarch gilia | PDPLM04230 | None | None | G1/S1 | 1B.2 | Yes |
| *Gilmania luteola* | golden-carpet gilmania | PDPGN0A010 | None | None | G2/S2 | 1B.3 | Yes |
| *Githopsis diffusa ssp. filicaulis* | Mission Canyon bluecup | PDCAM07023 | None | None | G5T2T3/S1 | 3.1 | Yes |
| *Githopsis pulchella ssp. serpentinicola* | serpentine bluecup | PDCAM07053 | None | None | G4T3/S3.3 | 4.3 | No |
| *Githopsis tenella* | delicate bluecup | PDCAM07070 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Glehnia littoralis ssp. leiocarpa* | American glehnia | PDAPI13011 | None | None | G5T5/S3.2 | 4.2 | No |
| *Glossopetalon pungens* | pungent glossopetalon | PDCRO04020 | None | None | G2G3/S1 | 1B.2 | Yes |
| *Glyceria grandis* | American manna grass | PMPOA2Y080 | None | None | G5/S2 | 2.3 | Yes |
| *Goodmania luteola* | golden goodmania | PDPGN0B010 | None | None | G3/S3.2 | 4.2 | No |
| *Gratiola heterosepala* | Boggs Lake hedge-hyssop | PDSCR0R060 | None | Endangered | G2/S2 | 1B.2 | Yes |

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|---|---|---|---|---|---|---|---|
| *Grindelia fraxinipratensis* | Ash Meadows gumplant | PDAST47080 | Threatened | None | G2/S1 | 1B.2 | Yes |
| *Grindelia hallii* | San Diego gumplant | PDAST470D4 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Grindelia hirsutula var. maritima* | San Francisco gumplant | PDAST470D3 | None | None | G5T1Q/S1 | 3.2 | Yes |
| *Grusonia parishii* | Parish's club-cholla | PDCAC0D2H0 | None | None | G3G4/S2? | 2.2 | Yes |
| *Grusonia pulchella* | beautiful cholla | PDCAC0D120 | None | None | G4/S2S3 | 2.2 | Yes |
| *Hackelia amethystina* | amethyst stickseed | PDBOR0G010 | None | None | G3/S3.3 | 4.3 | No |
| *Hackelia brevicula* | Poison Canyon stickseed | PDBOR0G040 | None | None | G2/S2.3 | 3.3 | Yes |
| *Hackelia cusickii* | Cusick's stickseed | PDBOR0G090 | None | None | G5?/S3.3 | 4.3 | No |
| *Hackelia sharsmithii* | Sharsmith's stickseed | PDBOR0G0Q0 | None | None | G2G3/S2S3 | 2.3 | Yes |
| *Harmonia doris-nilesiae* | Niles' harmonia | PDAST650L0 | None | None | G2/S2.1 | 1B.1 | Yes |
| *Harmonia guggolziorum* | Guggolz's harmonia | PDAST650M0 | None | None | G1/S1 | 1B.1 | Yes |
| *Harmonia hallii* | Hall's harmonia | PDAST650A0 | None | None | G2/S2? | 1B.2 | Yes |
| *Harmonia nutans* | nodding harmonia | PDAST650D0 | None | None | G3/S3.3 | 4.3 | No |
| *Harmonia stebbinsii* | Stebbins' harmonia | PDAST650K0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Harpagonella palmeri* | Palmer's grapplinghook | PDBOR0H010 | None | None | G4/S3.2 | 4.2 | Yes |
| *Hazardia cana* | San Clemente Island hazardia | PDAST4H020 | None | None | G2/S2 | 1B.2 | Yes |
| *Hazardia detonsa* | northern islands hazardia | PDAST4H030 | None | None | G3/S3.3 | 4.3 | No |
| *Hazardia orcuttii* | Orcutt's hazardia | PDAST4H070 | Candidate | Threatened | G1/S1 | 1B.1 | Yes |
| *Hecastocleis shockleyi* | prickle-leaf | PDAST4J010 | None | None | G4/S3S4 | 3 | No |
| *Hedeoma drummondii* | Drummond's false pennyroyal | PDLAM0M060 | None | None | G5/S1 | 2.2 | Yes |
| *Hedeoma nana ssp. californica* | California mock pennyroyal | PDLAM0M0S1 | None | None | G5T4/S3.3 | 4.3 | No |
| *Helianthella castanea* | Diablo helianthella | PDAST4M020 | None | None | G2/S2 | 1B.2 | Yes |
| *Helianthemum greenei* | island rush-rose | PDCIS02090 | Threatened | None | G2/S2 | 1B.2 | Yes |
| *Helianthemum suffrutescens* | Bisbee Peak rush-rose | PDCIS020F0 | None | None | G2Q/S2.2 | 3.2 | Yes |
| *Helianthus exilis* | serpentine sunflower | PDAST4N1J0 | None | None | G3Q/S3.2 | 4.2 | No |
| *Helianthus inexpectatus* | Newhall sunflower | PDAST4N250 | None | None | G1/S1 | 1B.1 | Yes |
| *Helianthus niveus ssp. tephrodes* | Algodones Dunes sunflower | PDAST4N0Z2 | None | Endangered | G4T2/S2 | 1B.2 | Yes |
| *Helianthus nuttallii ssp. parishii* | Los Angeles sunflower | PDAST4N102 | None | None | G5TH/SH | 1A | Yes |
| *Hemieva ranunculifolia* | buttercup-leaf suksdorfia | PDSAX0W010 | None | None | G5/S2 | 2 | Yes |
| *Hemizonia congesta ssp. calyculata* | Mendocino tarplant | PDAST4R063 | None | None | G5T3/S3.3 | 4.3 | No |
| *Hemizonia congesta ssp. congesta* | white seaside tarplant | PDAST4R065 | None | None | G5T2T3/S2S3 | 1B.2 | Yes |
| *Hemizonia congesta ssp. tracyi* | Tracy's tarplant | PDAST4R067 | None | None | G5T3/S3.3 | 4.3 | No |
| *Herissantia crispa* | curly herissantia | PDMAL0F010 | None | None | G5/S2 | 2.3 | Yes |
| *Hesperevax caulescens* | hogwallow starfish | PDASTE5020 | None | None | G3/S3.2 | 4.2 | No |

# Special Vascular Plants, Bryophytes, and Lichens List

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### Natural Diversity Database

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|---|---|---|---|---|---|---|---|
| *Hesperevax sparsiflora var. brevifolia* | short-leaved evax | PDASTE5011 | None | None | G4T2T3/S2S3 | 1B.2 | Yes |
| *Hesperidanthus jaegeri* | Jaeger's hesperidanthus | PDBRA0N010 | None | None | G2/S2 | 1B.2 | Yes |
| *Hesperocyparis abramsiana var. abramsiana* | Santa Cruz cypress | PGCUP04081 | Endangered | Endangered | G1T1/S1 | 1B.2 | Yes |
| *Hesperocyparis abramsiana var. butanoensis* | Butano Ridge cypress | PGCUP04082 | Endangered | Endangered | G1T1/S1 | 1B.2 | Yes |
| *Hesperocyparis bakeri* | Baker cypress | PGCUP04020 | None | None | G3/S3.2 | 4.2 | No |
| *Hesperocyparis forbesii* | Tecate cypress | PGCUP040C0 | None | None | G2/S2 | 1B.1 | Yes |
| *Hesperocyparis goveniana* | Gowen cypress | PGCUP04031 | Threatened | None | G1/S1 | 1B.2 | Yes |
| *Hesperocyparis macrocarpa* | Monterey cypress | PGCUP04060 | None | None | G1/S1 | 1B.2 | Yes |
| *Hesperocyparis nevadensis* | Piute cypress | PGCUP04012 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Hesperocyparis pygmaea* | pygmy cypress | PGCUP04032 | None | None | G2/S2 | 1B.2 | Yes |
| *Hesperocyparis stephensonii* | Cuyamaca cypress | PGCUP040B0 | None | None | G1/S1 | 1B.1 | Yes |
| *Hesperolinon adenophyllum* | glandular western flax | PDLIN01010 | None | None | G2/S2.3 | 1B.2 | Yes |
| *Hesperolinon bicarpellatum* | two-carpellate western flax | PDLIN01020 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Hesperolinon breweri* | Brewer's western flax | PDLIN01030 | None | None | G2/S2 | 1B.2 | Yes |
| *Hesperolinon congestum* | Marin western flax | PDLIN01060 | Threatened | Threatened | G2/S2 | 1B.1 | Yes |
| *Hesperolinon didymocarpum* | Lake County western flax | PDLIN01070 | None | Endangered | G1/S1 | 1B.2 | Yes |
| *Hesperolinon drymarioides* | drymaria-like western flax | PDLIN01090 | None | None | G2/S2 | 1B.2 | Yes |
| *Hesperolinon sharsmithiae* | Sharsmith's western flax | PDLIN010E0 | None | None | G2Q/S2 | 1B.2 | No |
| *Hesperolinon tehamense* | Tehama County western flax | PDLIN010C0 | None | None | G3/S3 | 1B.3 | Yes |
| *Heterotheca monarchensis* | Monarch golden-aster | PDAST4V0U0 | None | None | G1/S2 | 1B.3 | Yes |
| *Heterotheca sessiliflora ssp. sessiliflora* | beach goldenaster | PDAST4V0K2 | None | None | G4T2T3/S2.1? | 1B.1 | Yes |
| *Heterotheca shevockii* | Shevock's golden-aster | PDAST4V0T0 | None | None | G2/S2 | 1B.3 | Yes |
| *Heuchera abramsii* | Abrams' alumroot | PDSAX0E010 | None | None | G3/S3.3 | 4.3 | No |
| *Heuchera brevistaminea* | Laguna Mountains alumroot | PDSAX0E050 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Heuchera caespitosa* | urn-flowered alumroot | PDSAX0E0C0 | None | None | G3/S3.3 | 4.3 | No |
| *Heuchera hirsutissima* | shaggy-haired alumroot | PDSAX0E0J0 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Heuchera maxima* | island alumroot | PDSAX0E0M0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Heuchera parishii* | Parish's alumroot | PDSAX0E0S0 | None | None | G3/S3 | 1B.3 | Yes |
| *Heuchera rubescens var. versicolor* | San Diego County alumroot | PDSAX0E106 | None | None | G5T4/S2 | 2.3 | Yes |

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|---|---|---|---|---|---|---|---|
| *Hibiscus lasiocarpos var. occidentalis* | woolly rose-mallow | PDMAL0H0R3 | None | None | G4/S2.2 | 1B.2 | Yes |
| *Hierochloe odorata* | nodding vanilla-grass | PMPOA35040 | None | None | G5/S2 | 2.3 | Yes |
| *Hoita strobilina* | Loma Prieta hoita | PDFAB5Z030 | None | None | G2/S2 | 1B.1 | Yes |
| *Holmgrenanthe petrophila* | rock lady | PDSCR2J010 | None | Rare | G1/S1 | 1B.2 | Yes |
| *Holocarpha macradenia* | Santa Cruz tarplant | PDAST4X020 | Threatened | Endangered | G1/S1 | 1B.1 | Yes |
| *Holocarpha virgata ssp. elongata* | curving tarplant | PDAST4X041 | None | None | G5T3/S3.2 | 4.2 | No |
| *Hordeum intercedens* | vernal barley | PMPOA380E0 | None | None | G3G4/S3S4 | 3.2 | No |
| *Horkelia bolanderi* | Bolander's horkelia | PDROS0W010 | None | None | G1/S1 | 1B.2 | Yes |
| *Horkelia congesta ssp. nemorosa* | Josephine horkelia | PDROS0W032 | None | None | G4T4?/S1 | 2.1 | Yes |
| *Horkelia cuneata var. puberula* | mesa horkelia | PDROS0W045 | None | None | G4T2/S2.1 | 1B.1 | Yes |
| *Horkelia cuneata var. sericea* | Kellogg's horkelia | PDROS0W043 | None | None | G4T2/S2? | 1B.1 | Yes |
| *Horkelia daucifolia var. indicta* | Jepson's horkelia | PDROS0W053 | None | None | G4T1/S1 | 1B.1 | Yes |
| *Horkelia hendersonii* | Henderson's horkelia | PDROS0W090 | None | None | G1/S1 | 1B.1 | Yes |
| *Horkelia hispidula* | White Mountains horkelia | PDROS0W0A0 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Horkelia marinensis* | Point Reyes horkelia | PDROS0W0B0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Horkelia parryi* | Parry's horkelia | PDROS0W0C0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Horkelia sericata* | Howell's horkelia | PDROS0W0D0 | None | None | G3G4/S3.3 | 4.3 | No |
| *Horkelia tenuiloba* | thin-lobed horkelia | PDROS0W0E0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Horkelia truncata* | Ramona horkelia | PDROS0W0G0 | None | None | G3/S2.3 | 1B.3 | Yes |
| *Horkelia tularensis* | Kern Plateau horkelia | PDROS0W0H0 | None | None | G2/S2 | 1B.3 | Yes |
| *Horkelia wilderae* | Barton Flats horkelia | PDROS0W0J0 | None | None | G2/S2 | 1B.1 | Yes |
| *Horkelia yadonii* | Santa Lucia horkelia | PDROS0W0K0 | None | None | G3/S3.2 | 4.2 | No |
| *Horsfordia alata* | pink velvet-mallow | PDMAL0J010 | None | None | G4/S3.3 | 4.3 | No |
| *Horsfordia newberryi* | Newberry's velvet-mallow | PDMAL0J020 | None | None | G4/S3.3 | 4.3 | No |
| *Hosackia crassifolia var. otayensis* | Otay Mountain lotus | PDFAB2A092 | None | None | G5T1/S1 | 1B.1 | Yes |
| *Hosackia oblongifolia var. cuprea* | copper-flowered bird's-foot trefoil | PDFAB2A0W1 | None | None | G5T2/S2.3 | 1B.3 | Yes |
| *Hosackia yollabolliensis* | Yolla Bolly Mtns. bird's-foot trefoil | PDFAB2A1F0 | None | None | G3/S3.3 | 4.3 | No |
| *Howellanthus dalesianus* | Scott Mountain howellanthus | PDHYD0C140 | None | None | G3/S3.3 | 4.3 | Yes |
| *Howellia aquatilis* | water howellia | PDCAM0A010 | Threatened | None | G3/S2 | 2.2 | Yes |
| *Hulsea brevifolia* | short-leaved hulsea | PDAST4Z020 | None | None | G3/S3 | 1B.2 | Yes |
| *Hulsea californica* | San Diego hulsea | PDAST4Z030 | None | None | G2/S2.1 | 1B.3 | Yes |
| *Hulsea mexicana* | Mexican hulsea | PDAST4Z050 | None | None | G3G4/S1 | 2.3 | Yes |
| *Hulsea nana* | little hulsea | PDAST4Z060 | None | None | G4/S2.3 | 2.3 | Yes |

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|---|---|---|---|---|---|---|---|
| *Hulsea vestita ssp. callicarpha* | beautiful hulsea | PDAST4Z074 | None | None | G5T3/S3.2 | 4.2 | No |
| *Hulsea vestita ssp. gabrielensis* | San Gabriel Mountains hulsea | PDAST4Z075 | None | None | G5T3/S3.3 | 4.3 | No |
| *Hulsea vestita ssp. inyoensis* | Inyo hulsea | PDAST4Z073 | None | None | G5T2T3/S1S2 | 2.2 | Yes |
| *Hulsea vestita ssp. parryi* | Parry's hulsea | PDAST4Z076 | None | None | G5T3/S3.3 | 4.3 | No |
| *Hulsea vestita ssp. pygmaea* | pygmy hulsea | PDAST4Z077 | None | None | G5T2/S2.3 | 1B.3 | Yes |
| *Hymenopappus filifolius var. eriopodus* | hairy-podded fine-leaf hymenopappus | PDAST51032 | None | None | G5T3/S1 | 2.3 | Yes |
| *Hymenopappus filifolius var. nanus* | little cutleaf | PDAST5103H | None | None | G5T4/S2S3 | 2.3 | Yes |
| *Hymenothrix wrightii* | Wright's hymenothrix | PDAST52030 | None | None | G5/S3.3 | 4.3 | No |
| *Hymenoxys lemmonii* | alkali hymenoxys | PDAST530C0 | None | None | G3?/S2 | 2.2 | Yes |
| *Hymenoxys odorata* | bitter hymenoxys | PDAST530E0 | None | None | G5/S2 | 2 | Yes |
| *Iliamna bakeri* | Baker's globe mallow | PDMAL0K010 | None | None | G4/S3.2 | 4.2 | Yes |
| *Iliamna latibracteata* | California globe mallow | PDMAL0K040 | None | None | G3/S2.2 | 1B.2 | Yes |
| *Imperata brevifolia* | California satintail | PMPOA3D020 | None | None | G2/S2.1 | 2.1 | Yes |
| *Ipomopsis effusa* | Baja California ipomopsis | PDPLM060U0 | None | None | G3?/S1 | 2.1 | Yes |
| *Ipomopsis tenuifolia* | slender-leaved ipomopsis | PDPLM060J0 | None | None | G3G4/S2 | 2.3 | Yes |
| *Iris bracteata* | Siskiyou iris | PMIRI09020 | None | None | G4G5/S3.3? | 3.3 | No |
| *Iris hartwegii ssp. columbiana* | Tuolumne iris | PMIRI090D2 | None | None | G4T2/S2.2 | 1B.2 | Yes |
| *Iris innominata* | Del Norte County iris | PMIRI090F0 | None | None | G4G5/S3.3 | 4.3 | No |
| *Iris longipetala* | coast iris | PMIRI092E0 | None | None | G3/S3.2 | 4.2 | No |
| *Iris munzii* | Munz's iris | PMIRI090M0 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Iris tenax ssp. klamathensis* | Orleans iris | PMIRI090Z2 | None | None | G4G5T3/S3.3 | 4.3 | No |
| *Isocoma arguta* | Carquinez goldenbush | PDAST57050 | None | None | G1/S1 | 1B.1 | Yes |
| *Isocoma menziesii var. decumbens* | decumbent goldenbush | PDAST57091 | None | None | G3G5T2T3/S2.2 | 1B.2 | Yes |
| *Isocoma menziesii var. diabolica* | Satan's goldenbush | PDAST57092 | None | None | G3G5T3/S3.2 | 4.2 | No |
| *Iva hayesiana* | San Diego marsh-elder | PDAST580A0 | None | None | G3?/S2.2? | 2.2 | Yes |
| *Ivesia aperta var. aperta* | Sierra Valley ivesia | PDROS0X011 | None | None | G2T2/S2.2 | 1B.2 | Yes |
| *Ivesia aperta var. canina* | Dog Valley ivesia | PDROS0X012 | None | None | G2T1/S1 | 1B.1 | Yes |
| *Ivesia argyrocoma var. argyrocoma* | silver-haired ivesia | PDROS0X020 | None | None | G2T2/S2.2 | 1B.2 | Yes |
| *Ivesia arizonica var. arizonica* | yellow ivesia | PDROS0X0R1 | None | None | G3G4T3/S1 | 2.3 | Yes |
| *Ivesia baileyi var. baileyi* | Bailey's ivesia | PDROS0X031 | None | None | G5T4/S2 | 2.3 | Yes |
| *Ivesia baileyi var. beneolens* | Owyhee ivesia | PDROS0X032 | None | None | G5T5/S1 | 2.3 | Yes |
| *Ivesia callida* | Tahquitz ivesia | PDROS0X040 | None | Rare | G1/S1 | 1B.3 | Yes |

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|---|---|---|---|---|---|---|---|
| *Ivesia campestris* | field ivesia | PDROS0X050 | None | None | G3/S3 | 1B.2 | Yes |
| *Ivesia jaegeri* | Jaeger's ivesia | PDROS0X080 | None | None | G2G3/S1 | 1B.3 | Yes |
| *Ivesia kingii var. kingii* | alkali ivesia | PDROS0X092 | None | None | G4T3Q/S2 | 2.2 | Yes |
| *Ivesia longibracteata* | Castle Crags ivesia | PDROS0X0U0 | None | None | G1/S1 | 1B.3 | Yes |
| *Ivesia paniculata* | Ash Creek ivesia | PDROS0X0S0 | None | None | G2/S2 | 1B.2 | Yes |
| *Ivesia patellifera* | Kingston Mountains ivesia | PDROS0X0Z0 | None | None | G1/S1.3 | 1B.3 | Yes |
| *Ivesia pickeringii* | Pickering's ivesia | PDROS0X0D0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Ivesia sericoleuca* | Plumas ivesia | PDROS0X0K0 | None | None | G2G3/S2S3 | 1B.2 | Yes |
| *Ivesia unguiculata* | Yosemite ivesia | PDROS0X0N0 | None | None | G3/S3.2 | 4.2 | Yes |
| *Ivesia webberi* | Webber's ivesia | PDROS0X0Q0 | Candidate | None | G2/S2.1 | 1B.1 | Yes |
| *Jamesia americana var. rosea* | rosy-petalled cliffbush | PDHDR02019 | None | None | G5T3/S3.3 | 4.3 | No |
| *Jensia yosemitana* | Yosemite tarplant | PDAST650J0 | None | None | G2G3/S2S3 | 3.2 | No |
| *Jepsonia heterandra* | foothill jepsonia | PDSAX0J010 | None | None | G3/S3.3 | 4.3 | No |
| *Jepsonia malvifolia* | island jepsonia | PDSAX0J020 | None | None | G3/S3.3 | 4.2 | No |
| *Johanneshowellia puberula* | downy buckwheat | PDPGN084X0 | None | None | G3?/S1 | 2.3 | Yes |
| *Juglans californica* | southern California black walnut | PDJUG02020 | None | None | G3/S3.2 | 4.2 | No |
| *Juglans hindsii* | Northern California black walnut | PDJUG02040 | None | None | G1/S1 | 1B.1 | Yes |
| *Juncus acutus ssp. leopoldii* | southwestern spiny rush | PMJUN01051 | None | None | G5T5/S3.2 | 4.2 | No |
| *Juncus cooperi* | Cooper's rush | PMJUN010T0 | None | None | G4/S3.3 | 4.3 | No |
| *Juncus digitatus* | finger rush | PMJUN013E0 | None | None | G1/S1 | 1B.1 | Yes |
| *Juncus dudleyi* | Dudley's rush | PMJUN01390 | None | None | G5/S2.3? | 2.3 | Yes |
| *Juncus duranii* | Duran's rush | PMJUN013T0 | None | None | G3/S3.3 | 4.3 | No |
| *Juncus hemiendytus var. abjectus* | Center Basin rush | PMJUN011F1 | None | None | G5T4/S3.3 | 4.3 | No |
| *Juncus interior* | inland rush | PMJUN011J0 | None | None | G4/S1 | 2.2 | Yes |
| *Juncus leiospermus var. ahartii* | Ahart's dwarf rush | PMJUN011L1 | None | None | G2T1/S1 | 1B.2 | Yes |
| *Juncus leiospermus var. leiospermus* | Red Bluff dwarf rush | PMJUN011L2 | None | None | G2T2/S2.2 | 1B.1 | Yes |
| *Juncus luciensis* | Santa Lucia dwarf rush | PMJUN013J0 | None | None | G2G3/S2S3 | 1B.2 | Yes |
| *Juncus nevadensis var. inventus* | Sierra rush | PMJUN011Z5 | None | None | G5T3T4/S1 | 2.2 | Yes |
| *Juncus nodosus* | knotted rush | PMJUN01210 | None | None | G5/S2.3 | 2.3 | Yes |
| *Juncus regelii* | Regel's rush | PMJUN012D0 | None | None | G4?/S1 | 2.3 | Yes |
| *Juncus supiniformis* | hair-leaved rush | PMJUN012R0 | None | None | G5/S2.2? | 2.2 | Yes |
| *Kobresia myosuroides* | seep kobresia | PMCYP0F010 | None | None | G5/S1 | 2.3 | Yes |
| *Koeberlinia spinosa ssp. tenuispina* | slender-spined all-thorn | PDCPP05012 | None | None | G4T4/S2.2 | 2.2 | Yes |
| *Kopsiopsis hookeri* | small groundcone | PDORO01010 | None | None | G5/S1S2 | 2.3 | Yes |
| *Ladeania lanceolata* | lance-leaved scurf-pea | PDFAB5M030 | None | None | G5/S2.3 | 2.3 | Yes |

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|---|---|---|---|---|---|---|---|
| *Lagophylla dichotoma* | forked hare-leaf | PDAST5J020 | None | None | G1/S1 | 1B.1 | Yes |
| *Lasthenia burkei* | Burke's goldfields | PDAST5L010 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Lasthenia californica ssp. bakeri* | Baker's goldfields | PDAST5L0C4 | None | None | G3TH/SH | 1B.2 | Yes |
| *Lasthenia californica ssp. macrantha* | perennial goldfields | PDAST5L0C5 | None | None | G3T2/S2.2 | 1B.2 | Yes |
| *Lasthenia conjugens* | Contra Costa goldfields | PDAST5L040 | Endangered | None | G1/S1 | 1B.1 | Yes |
| *Lasthenia ferrisiae* | Ferris' goldfields | PDAST5L070 | None | None | G3/S3.2 | 4.2 | No |
| *Lasthenia glabrata ssp. coulteri* | Coulter's goldfields | PDAST5L0A1 | None | None | G4T3/S2.1 | 1B.1 | Yes |
| *Lasthenia leptalea* | Salinas Valley goldfields | PDAST5L0B0 | None | None | G3/S3.3 | 4.3 | No |
| *Lathyrus biflorus* | two-flowered pea | PDFAB25180 | None | None | G1/S1 | 1B.1 | Yes |
| *Lathyrus delnorticus* | Del Norte pea | PDFAB25070 | None | None | G4/S3.3 | 4.3 | No |
| *Lathyrus glandulosus* | sticky pea | PDFAB251A0 | None | None | G3/S3.3 | 4.3 | No |
| *Lathyrus hitchcockianus* | Bullfrog Mountain pea | PDFAB250A0 | None | None | G2/S1 | 1B.3 | Yes |
| *Lathyrus japonicus* | seaside pea | PDFAB250C0 | None | None | G5/S2 | 2.1 | Yes |
| *Lathyrus jepsonii var. jepsonii* | Delta tule pea | PDFAB250D2 | None | None | G5T2/S2.2 | 1B.2 | Yes |
| *Lathyrus palustris* | marsh pea | PDFAB250P0 | None | None | G5/S2S3 | 2.2 | Yes |
| *Lathyrus rigidus* | rigid pea | PDFAB250W0 | None | None | G5/S1 | 2.2 | Yes |
| *Lathyrus splendens* | pride-of-California | PDFAB250Z0 | None | None | G3G4/S3.3 | 4.3 | No |
| *Lathyrus sulphureus var. argillaceus* | dubious pea | PDFAB25101 | None | None | G1G2/S1S2 | 3 | Yes |
| *Lavatera assurgentiflora ssp. assurgentiflora* | island mallow | PDMAL0N021 | None | None | G2T2/S2.1 | 1B.1 | Yes |
| *Lavatera assurgentiflora ssp. glabra* | southern island mallow | PDMAL0N022 | None | None | G2T2/S2.1 | 1B.1 | Yes |
| *Layia carnosa* | beach layia | PDAST5N010 | Endangered | Endangered | G2/S2 | 1B.1 | Yes |
| *Layia discoidea* | rayless layia | PDAST5N030 | None | None | G2/S2.2 | 1B.1 | Yes |
| *Layia heterotricha* | pale-yellow layia | PDAST5N070 | None | None | G2/S2 | 1B.1 | Yes |
| *Layia jonesii* | Jones' layia | PDAST5N090 | None | None | G1/S1 | 1B.2 | Yes |
| *Layia leucopappa* | Comanche Point layia | PDAST5N0A0 | None | None | G1/S1 | 1B.1 | Yes |
| *Layia munzii* | Munz's tidy-tips | PDAST5N0B0 | None | None | G1/S1 | 1B.2 | Yes |
| *Layia septentrionalis* | Colusa layia | PDAST5N0F0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Legenere limosa* | legenere | PDCAM0C010 | None | None | G2/S2.2 | 1B.1 | Yes |
| *Lepechinia cardiophylla* | heart-leaved pitcher sage | PDLAM0V020 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Lepechinia fragrans* | fragrant pitcher sage | PDLAM0V030 | None | None | G3/S3.2 | 4.2 | No |
| *Lepechinia ganderi* | Gander's pitcher sage | PDLAM0V040 | None | None | G2/S2.2 | 1B.3 | Yes |
| *Lepechinia rossii* | Ross' pitcher sage | PDLAM0V060 | None | None | G1/S1 | 1B.2 | Yes |
| *Lepidium flavum var. felipense* | Borrego Valley pepper-grass | PDBRA1M0B1 | None | None | G5T1/S1 | 1B.2 | Yes |
| *Lepidium jaredii ssp. album* | Panoche pepper-grass | PDBRA1M0G2 | None | None | G2T2/S2 | 1B.2 | Yes |
| *Lepidium jaredii ssp. jaredii* | Jared's pepper-grass | PDBRA1M0G1 | None | None | G2T1T2/S1S2 | 1B.2 | Yes |

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|---|---|---|---|---|---|---|---|
| *Lepidium latipes var. heckardii* | Heckard's pepper-grass | PDBRA1M0K1 | None | None | G4T2/S2 | 1B.2 | Yes |
| *Lepidium virginicum var. robinsonii* | Robinson's pepper-grass | PDBRA1M114 | None | None | G5T3/S3 | 1B.2 | Yes |
| *Leptodactylon californicum ssp. tomentosum* | fuzzy prickly-phlox | PDPLM08021 | None | None | G5T3/S3.2 | 4.2 | No |
| *Leptosiphon acicularis* | bristly leptosiphon | PDPLM09010 | None | None | G3/S3.2 | 4.2 | No |
| *Leptosiphon ambiguus* | serpentine leptosiphon | PDPLM09020 | None | None | G3/S3.2 | 4.2 | No |
| *Leptosiphon croceus* | coast yellow leptosiphon | PDPLM09170 | None | None | G1/S1 | 1B.1 | Yes |
| *Leptosiphon floribundus ssp. hallii* | Santa Rosa Mountains leptosiphon | PDPLM090J3 | None | None | G4T1/S1 | 1B.3 | Yes |
| *Leptosiphon grandiflorus* | large-flowered leptosiphon | PDPLM090K0 | None | None | G3/S3.2 | 4.2 | No |
| *Leptosiphon jepsonii* | Jepson's leptosiphon | PDPLM09140 | None | None | G2/S2 | 1B.2 | Yes |
| *Leptosiphon latisectus* | broad-lobed leptosiphon | PDPLM09150 | None | None | G3/S3.3 | 4.3 | No |
| *Leptosiphon nuttallii ssp. howellii* | Mt. Tedoc leptosiphon | PDPLM090V4 | None | None | G5T2/S2 | 1B.3 | Yes |
| *Leptosiphon oblanceolatus* | Sierra Nevada leptosiphon | PDPLM090W0 | None | None | G3/S3.3 | 4.3 | No |
| *Leptosiphon pygmaeus ssp. pygmaeus* | pygmy leptosiphon | PDPLM09102 | None | None | G4T1/S1 | 1B.2 | Yes |
| *Leptosiphon rattanii* | Rattan's leptosiphon | PDPLM09110 | None | None | G3/S3.3 | 4.3 | No |
| *Leptosiphon rosaceus* | rose leptosiphon | PDPLM09180 | None | None | G1/S1 | 1B.1 | Yes |
| *Leptosiphon serrulatus* | Madera leptosiphon | PDPLM09130 | None | None | G1?/S1? | 1B.2 | Yes |
| *Leptosyne hamiltonii* | Mt. Hamilton coreopsis | PDAST2L0C0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Leptosyne maritima* | sea dahlia | PDAST2L0L0 | None | None | G3/S2.2 | 2.2 | Yes |
| *Lessingia arachnoidea* | Crystal Springs lessingia | PDAST5S0C0 | None | None | G1/S1 | 1B.2 | Yes |
| *Lessingia germanorum* | San Francisco lessingia | PDAST5S010 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Lessingia glandulifera var. tomentosa* | Warner Springs lessingia | PDAST5S022 | None | None | G4?T2/S2.3 | 1B.3 | Yes |
| *Lessingia hololeuca* | woolly-headed lessingia | PDAST5S030 | None | None | G3/S3 | 3 | No |
| *Lessingia micradenia var. glabrata* | smooth lessingia | PDAST5S062 | None | None | G2T2/S2 | 1B.2 | Yes |
| *Lessingia micradenia var. micradenia* | Tamalpais lessingia | PDAST5S063 | None | None | G2T1T2/S1S2 | 1B.2 | Yes |
| *Lessingia tenuis* | spring lessingia | PDAST5S0B0 | None | None | G3/S3.3 | 4.3 | No |
| *Lewisia brachycalyx* | short-sepaled lewisia | PDPOR04010 | None | None | G4G5/S2 | 2.2 | Yes |
| *Lewisia cantelovii* | Cantelow's lewisia | PDPOR04020 | None | None | G3/S3 | 1B.2 | Yes |
| *Lewisia congdonii* | Congdon's lewisia | PDPOR04040 | None | Rare | G2/S2 | 1B.3 | Yes |
| *Lewisia cotyledon var. heckneri* | Heckner's lewisia | PDPOR04052 | None | None | G4T2/S2.2 | 1B.2 | Yes |
| *Lewisia cotyledon var. howellii* | Howell's lewisia | PDPOR04053 | None | None | G4T4Q/S3? | 3.2 | No |
| *Lewisia disepala* | Yosemite lewisia | PDPOR04060 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Lewisia kelloggii ssp. hutchisonii* | Hutchison's lewisia | PDPOR04071 | None | None | G4T2T3/S2S3 | 3.3 | No |

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|---|---|---|---|---|---|---|---|
| *Lewisia longipetala* | long-petaled lewisia | PDPOR040K0 | None | None | G2/S2.2 | 1B.3 | Yes |
| *Lewisia oppositifolia* | opposite-leaved lewisia | PDPOR040B0 | None | None | G4/S2.2 | 2.2 | Yes |
| *Lewisia serrata* | saw-toothed lewisia | PDPOR040E0 | None | None | G2/S2.2 | 1B.1 | Yes |
| *Lewisia stebbinsii* | Stebbins' lewisia | PDPOR040G0 | None | None | G2/S2 | 1B.2 | Yes |
| *Lilaeopsis masonii* | Mason's lilaeopsis | PDAPI19030 | None | Rare | G2/S2 | 1B.1 | Yes |
| *Lilium bolanderi* | Bolander's lily | PMLIL1A010 | None | None | G4/S3.2 | 4.2 | No |
| *Lilium humboldtii ssp. humboldtii* | Humboldt lily | PMLIL1A071 | None | None | G4T3/S3.2 | 4.2 | No |
| *Lilium humboldtii ssp. ocellatum* | ocellated humboldt lily | PMLIL1A072 | None | None | G4T3/S3.2 | 4.2 | No |
| *Lilium kelloggii* | Kellogg's lily | PMLIL1A0A0 | None | None | G3/S3.3 | 4.3 | No |
| *Lilium maritimum* | coast lily | PMLIL1A0C0 | None | None | G2/S2 | 1B.1 | Yes |
| *Lilium occidentale* | western lily | PMLIL1A0G0 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Lilium pardalinum ssp. pitkinense* | Pitkin Marsh lily | PMLIL1A0H3 | Endangered | Endangered | G5T1/S1 | 1B.1 | Yes |
| *Lilium pardalinum ssp. vollmeri* | Vollmer's lily | PMLIL1A0H2 | None | None | G5T4/S3.3 | 4.3 | No |
| *Lilium pardalinum ssp. wigginsii* | Wiggins' lily | PMLIL1A0S0 | None | None | G5T4?/S3.3 | 4.3 | No |
| *Lilium parryi* | lemon lily | PMLIL1A0J0 | None | None | G3/S2 | 1B.2 | Yes |
| *Lilium rubescens* | redwood lily | PMLIL1A0N0 | None | None | G3/S3.2 | 4.2 | No |
| *Lilium washingtonianum ssp. purpurascens* | purple-flowered Washington lily | PMLIL1A0R2 | None | None | G4T4/S3.3 | 4.3 | No |
| *Limnanthes alba ssp. parishii* | Parish's meadowfoam | PDLIM02052 | None | Endangered | G3T2T3/S2S3 | 1B.2 | Yes |
| *Limnanthes bakeri* | Baker's meadowfoam | PDLIM02020 | None | Rare | G1/S1 | 1B.1 | Yes |
| *Limnanthes douglasii ssp. sulphurea* | Point Reyes meadowfoam | PDLIM02038 | None | Endangered | G4T2/S2 | 1B.2 | Yes |
| *Limnanthes floccosa ssp. bellingeriana* | Bellinger's meadowfoam | PDLIM02041 | None | None | G4T2/S1 | 1B.2 | Yes |
| *Limnanthes floccosa ssp. californica* | Butte County meadowfoam | PDLIM02042 | Endangered | Endangered | G4T1/S1 | 1B.1 | Yes |
| *Limnanthes floccosa ssp. floccosa* | woolly meadowfoam | PDLIM02043 | None | None | G4T4/S3.2 | 4.2 | Yes |
| *Limnanthes vinculans* | Sebastopol meadowfoam | PDLIM02090 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Limosella australis* | Delta mudwort | PDSCR10050 | None | None | G4G5/S2 | 2.1 | Yes |
| *Linanthus bellus* | desert beauty | PDPLM09070 | None | None | G2G3/S2.3? | 2.3 | Yes |
| *Linanthus concinnus* | San Gabriel linanthus | PDPLM090D0 | None | None | G3/S3 | 1B.2 | Yes |
| *Linanthus jaegeri* | San Jacinto linanthus | PDPLM08030 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Linanthus killipii* | Baldwin Lake linanthus | PDPLM090N0 | None | None | G2/S2 | 1B.2 | Yes |
| *Linanthus maculatus* | Little San Bernardino Mtns. linanthus | PDPLM041Y0 | None | None | G2/S2 | 1B.2 | Yes |
| *Linanthus orcuttii* | Orcutt's linanthus | PDPLM090X0 | None | None | G4/S2 | 1B.3 | Yes |
| *Linum puberulum* | plains flax | PDLIN020P0 | None | None | G5/S2 | 2.3 | Yes |
| *Listera cordata* | heart-leaved twayblade | PMORC1N060 | None | None | G5/S3.2 | 4.2 | No |

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|---|---|---|---|---|---|---|---|
| *Lithophragma maximum* | San Clemente Island woodland star | PDSAX0M070 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Lithospermum incisum* | plains stoneseed | PDBOR0L070 | None | None | G5/S1 | 2.3 | Yes |
| *Loeflingia squarrosa var. artemisiarum* | sagebrush loeflingia | PDCAR0E011 | None | None | G5T2T3/S2.2 | 2.2 | Yes |
| *Loeseliastrum depressum* | depressed standing-cypress | PDPLM06040 | None | None | G5/S3? | 4.3 | No |
| *Lomatium canbyi* | Canby's lomatium | PDAPI1B060 | None | None | G4/S3? | 4.3 | No |
| *Lomatium congdonii* | Congdon's lomatium | PDAPI1B0B0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Lomatium engelmannii* | Engelmann's lomatium | PDAPI1B0K0 | None | None | G3/S3.3 | 4.3 | No |
| *Lomatium foeniculaceum ssp. inyoense* | Inyo lomatium | PDAPI1B0M4 | None | None | G5T3/S3.3 | 4.3 | No |
| *Lomatium foeniculaceum var. macdougalii* | Macdougal's lomatium | PDAPI1B0M5 | None | None | G5T4T5/S2.2 | 2.2 | Yes |
| *Lomatium grayi* | Gray's lomatium | PDAPI1B0Q0 | None | None | G5/S1S2 | 2.3 | Yes |
| *Lomatium hendersonii* | Henderson's lomatium | PDAPI1B0T0 | None | None | G5?/S2.3 | 2.3 | Yes |
| *Lomatium hooveri* | Hoover's lomatium | PDAPI1B2K0 | None | None | G3/S3.3 | 4.3 | No |
| *Lomatium howellii* | Howell's lomatium | PDAPI1B0U0 | None | None | G4G5/S3.3 | 4.3 | No |
| *Lomatium insulare* | San Nicolas Island lomatium | PDAPI1B0W0 | None | None | G2G3/S2S3 | 1B.2 | Yes |
| *Lomatium martindalei* | Coast Range lomatium | PDAPI1B140 | None | None | G5/S2.3 | 2.3 | Yes |
| *Lomatium observatorium* | Mt. Hamilton lomatium | PDAPI1B2J0 | None | None | G1/S1? | 1B.2 | Yes |
| *Lomatium parvifolium* | small-leaved lomatium | PDAPI1B1F0 | None | None | G3/S3 | 4.2 | No |
| *Lomatium peckianum* | Peck's lomatium | PDAPI1B1G0 | None | None | G4/S1 | 2.2 | Yes |
| *Lomatium ravenii* | Raven's lomatium | PDAPI1B1L0 | None | None | G4/S3 | 2.3 | Yes |
| *Lomatium repostum* | Napa lomatium | PDAPI1B1M0 | None | None | G3/S3.3 | 4.3 | No |
| *Lomatium rigidum* | stiff lomatium | PDAPI1B1N0 | None | None | G3/S3.3 | 4.3 | No |
| *Lomatium roseanum* | adobe lomatium | PDAPI1B2G0 | None | None | G2G3/S2 | 1B.2 | Yes |
| *Lomatium shevockii* | Owens Peak lomatium | PDAPI1B2C0 | None | None | G2/S2 | 1B.3 | Yes |
| *Lomatium stebbinsii* | Stebbins' lomatium | PDAPI1B1V0 | None | None | G2/S2 | 1B.1 | Yes |
| *Lomatium tracyi* | Tracy's lomatium | PDAPI1B1Y0 | None | None | G3/S3.3 | 4.3 | No |
| *Lonicera subspicata var. subspicata* | Santa Barbara honeysuckle | PDCPR030R3 | None | None | G5T2/S2 | 1B.2 | Yes |
| *Lotus formosissimus* | harlequin lotus | PDFAB2A0D0 | None | None | G4/S3.2 | 4.2 | No |
| *Lotus nuttallianus* | Nuttall's lotus | PDFAB2A0V0 | None | None | G1/S1 | 1B.1 | Yes |
| *Lupinus albifrons var. abramsii* | Abrams' lupine | PDFAB2B010 | None | None | G1Q/S1? | 3.2 | No |
| *Lupinus antoninus* | Anthony Peak lupine | PDFAB2B0C0 | None | None | G2/S2 | 1B.3 | Yes |
| *Lupinus arboreus var. eximius* | San Mateo tree lupine | PDFAB2B570 | None | None | G2Q/S2.2 | 3.2 | No |
| *Lupinus cervinus* | Santa Lucia lupine | PDFAB2B0X0 | None | None | G3/S3.3 | 4.3 | No |
| *Lupinus citrinus var. citrinus* | orange lupine | PDFAB2B103 | None | None | G2T2/S2.2 | 1B.2 | Yes |
| *Lupinus citrinus var. deflexus* | Mariposa lupine | PDFAB2B102 | None | Threatened | G2T1/S1 | 1B.2 | Yes |
| *Lupinus constancei* | The Lassics lupine | PDFAB2B490 | None | None | G1/S1 | 1B.2 | Yes |

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|---|---|---|---|---|---|---|---|
| *Lupinus croceus var. pilosellus* | saffron-flowered lupine | PDFAB2B162 | None | None | G3T3/S3.3 | 4.3 | No |
| *Lupinus dalesiae* | Quincy lupine | PDFAB2B1A0 | None | None | G3/S3.2 | 4.2 | Yes |
| *Lupinus duranii* | Mono Lake lupine | PDFAB2B1E0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Lupinus elatus* | silky lupine | PDFAB2B1F0 | None | None | G3/S3.3 | 4.3 | No |
| *Lupinus elmeri* | South Fork Mtn. lupine | PDFAB2B1G0 | None | None | G2/S2 | 1B.2 | Yes |
| *Lupinus excubitus var. johnstonii* | interior bush lupine | PDFAB2B1J4 | None | None | G4T3/S3.3 | 4.3 | No |
| *Lupinus excubitus var. medius* | Mountain Springs bush lupine | PDFAB2B1J5 | None | None | G4T2T3/S2 | 1B.3 | Yes |
| *Lupinus gracilentus* | slender lupine | PDFAB2B1R0 | None | None | G2/S2 | 1B.3 | Yes |
| *Lupinus guadalupensis* | Guadalupe Island lupine | PDFAB2B1T0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Lupinus holmgrenianus* | Holmgren's lupine | PDFAB2B1Y0 | None | None | G2G3/S2.3 | 2.3 | Yes |
| *Lupinus lapidicola* | Heller's Mt. Eddy lupine | PDFAB2B280 | None | None | G3/S3.3 | 4.3 | No |
| *Lupinus latifolius var. barbatus* | bearded lupine | PDFAB2B29H | None | None | G5T1T2/S1 | 1B.2 | Yes |
| *Lupinus lepidus var. culbertsonii* | Hockett Meadows lupine | PDFAB2B171 | None | None | G3?T2/S2 | 1B.3 | Yes |
| *Lupinus lepidus var. utahensis* | stemless lupine | PDFAB2B0V2 | None | None | G5T5?/S3.3 | 4.3 | No |
| *Lupinus ludovicianus* | San Luis Obispo County lupine | PDFAB2B2G0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Lupinus magnificus var. glarecola* | Coso Mountains lupine | PDFAB2B2K1 | None | None | G3T3Q/S3.3 | 4.3 | No |
| *Lupinus magnificus var. hesperius* | Mcgee Meadows lupine | PDFAB2B2K2 | None | None | G3T2Q/S2.3 | 1B.3 | Yes |
| *Lupinus magnificus var. magnificus* | Panamint Mountains lupine | PDFAB2B2K3 | None | None | G3T2Q/S2 | 1B.2 | Yes |
| *Lupinus milo-bakeri* | Milo Baker's lupine | PDFAB2B4E0 | None | Threatened | G1Q/S1 | 1B.1 | Yes |
| *Lupinus nevadensis* | Nevada lupine | PDFAB2B500 | None | None | G3G4/S3.3 | 4.3 | No |
| *Lupinus nipomensis* | Nipomo Mesa lupine | PDFAB2B550 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Lupinus padre-crowleyi* | Father Crowley's lupine | PDFAB2B2Z0 | None | Rare | G2/S2 | 1B.2 | Yes |
| *Lupinus peirsonii* | Peirson's lupine | PDFAB2B330 | None | None | G2/S2 | 1B.3 | Yes |
| *Lupinus pusillus var. intermontanus* | intermontane lupine | PDFAB2B3B1 | None | None | G5T5?/S2.2 | 2.3 | Yes |
| *Lupinus sericatus* | Cobb Mountain lupine | PDFAB2B3J0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Lupinus spectabilis* | shaggyhair lupine | PDFAB2B3P0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Lupinus tidestromii* | Tidestrom's lupine | PDFAB2B3Y0 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Lupinus tracyi* | Tracy's lupine | PDFAB2B3Z0 | None | None | G4/S3.3 | 4.3 | No |
| *Lupinus uncialis* | lilliput lupine | PDFAB2B410 | None | None | G4/S2.2 | 2.2 | Yes |
| *Lycium brevipes var. hassei* | Santa Catalina Island desert-thorn | PDSOL0G0N0 | None | None | G1Q/S1 | 1B.1 | Yes |
| *Lycium californicum* | California box-thorn | PDSOL0G050 | None | None | G4/S3.2 | 4.2 | No |
| *Lycium parishii* | Parish's desert-thorn | PDSOL0G0D0 | None | None | G3?/S2S3 | 2.3 | Yes |
| *Lycium verrucosum* | San Nicolas Island desert-thorn | PDSOL0G0M0 | None | None | GXQ/SX | 1A | Yes |

# Special Vascular Plants, Bryophytes, and Lichens List

## California Department of Fish and Game

### Natural Diversity Database

| Scientific Name | Common Name | Element Code | Federal Listing Status | State Listing Status | Heritage Rank | Rare Plant Rank | Records in CNDDB ? |
|---|---|---|---|---|---|---|---|
| *Lycopodiella inundata* | inundated bog-clubmoss | PPLYC03060 | None | None | G5/S1? | 2.2 | Yes |
| *Lycopodium clavatum* | running-pine | PPLYC01080 | None | None | G5/S4.1 | 4.1 | Yes |
| *Lycopus uniflorus* | northern bugleweed | PDLAM0X080 | None | None | G5/S3.3 | 4.3 | No |
| *Lyonothamnus floribundus ssp. aspleniifolius* | Santa Cruz Island ironwood | PDROS12011 | None | None | G2T2/S2.2 | 1B.2 | Yes |
| *Lyonothamnus floribundus ssp. floribundus* | Santa Catalina Island ironwood | PDROS12012 | None | None | G2T2/S2 | 1B.2 | Yes |
| *Lyrocarpa coulteri* | Palmer's lyrepod | PDBRA1R010 | None | None | G4/S3.3 | 4.3 | No |
| *Lysimachia thyrsiflora* | tufted loosestrife | PDPRI070S0 | None | None | G5/S1 | 2.3 | Yes |
| *Madia radiata* | showy golden madia | PDAST650E0 | None | None | G2/S2 | 1B.1 | Yes |
| *Malacothamnus abbottii* | Abbott's bush-mallow | PDMAL0Q010 | None | None | G1/S1 | 1B.1 | Yes |
| *Malacothamnus aboriginum* | Indian Valley bush-mallow | PDMAL0Q020 | None | None | G2/S2 | 1B.2 | Yes |
| *Malacothamnus arcuatus* | arcuate bush-mallow | PDMAL0Q0E0 | None | None | G2Q/S2.2 | 1B.2 | Yes |
| *Malacothamnus clementinus* | San Clemente Island bush-mallow | PDMAL0Q030 | Endangered | Endangered | G2/S2 | 1B.1 | Yes |
| *Malacothamnus davidsonii* | Davidson's bush-mallow | PDMAL0Q040 | None | None | G2/S2 | 1B.2 | Yes |
| *Malacothamnus fasciculatus var. nesioticus* | Santa Cruz Island bush-mallow | PDMAL0Q061 | Endangered | Endangered | G4T1/S1 | 1B.1 | Yes |
| *Malacothamnus gracilis* | slender bush-mallow | PDMAL0Q0J0 | None | None | G3Q/S3.3 | 4.3 | No |
| *Malacothamnus hallii* | Hall's bush-mallow | PDMAL0Q0F0 | None | None | G2Q/S2 | 1B.2 | Yes |
| *Malacothamnus helleri* | Heller's bush-mallow | PDMAL0Q0G0 | None | None | G3Q/S3.3 | 4.3 | No |
| *Malacothamnus jonesii* | Jones' bush-mallow | PDMAL0Q090 | None | None | G3/S3.3 | 4.3 | No |
| *Malacothamnus mendocinensis* | Mendocino bush-mallow | PDMAL0Q0D0 | None | None | GXQ/SX | 1A | Yes |
| *Malacothamnus niveus* | San Luis Obispo County bush-mallow | PDMAL0Q0H0 | None | None | G3Q/S3.3 | 4.3 | No |
| *Malacothamnus palmeri var. involucratus* | Carmel Valley bush-mallow | PDMAL0Q0B1 | None | None | G3T2Q/S2.2 | 1B.2 | Yes |
| *Malacothamnus palmeri var. lucianus* | Arroyo Seco bush-mallow | PDMAL0Q0B2 | None | None | G3T1Q/S1 | 1B.2 | Yes |
| *Malacothamnus palmeri var. palmeri* | Santa Lucia bush-mallow | PDMAL0Q0B5 | None | None | G3T2Q/S2.2 | 1B.2 | Yes |
| *Malacothamnus parishii* | Parish's bush-mallow | PDMAL0Q0C0 | None | None | GHQ/SH | 1A | Yes |
| *Malacothrix foliosa ssp. crispifolia* | wavy-leaved malacothrix | PDAST66066 | None | None | G4T1/S1 | 1B.2 | Yes |
| *Malacothrix foliosa ssp. foliosa* | leafy malacothrix | PDAST66064 | None | None | G4T3/S3.2 | 4.2 | No |
| *Malacothrix foliosa ssp. philbrickii* | Philbrick's malacothrix | PDAST66065 | None | None | G4T2/S2.2 | 1B.2 | Yes |
| *Malacothrix foliosa ssp. polycephala* | many-headed malacothrix | PDAST66067 | None | None | G4T3/S3.2 | 4.2 | No |
| *Malacothrix incana* | dunedelion | PDAST66070 | None | None | G3/S3.3 | 4.3 | No |

# Special Vascular Plants, Bryophytes, and Lichens List

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|---|---|---|---|---|---|---|---|
| *Malacothrix indecora* | Santa Cruz Island malacothrix | PDAST660J0 | Endangered | None | G2/S2 | 1B.1 | Yes |
| *Malacothrix junakii* | Junak's malcothrix | PDAST660Q0 | None | None | G1/S1 | 1B.1 | Yes |
| *Malacothrix phaeocarpa* | dusky-fruited malacothrix | PDAST66090 | None | None | G3/S3.3 | 4.3 | No |
| *Malacothrix saxatilis var. arachnoidea* | Carmel Valley malacothrix | PDAST660C2 | None | None | G5T2/S2.2 | 1B.2 | Yes |
| *Malacothrix saxatilis var. saxatilis* | cliff malacothrix | PDAST660C5 | None | None | G5T3/S3.2 | 4.2 | No |
| *Malacothrix similis* | Mexican malacothrix | PDAST660D0 | None | None | G2G3/SH | 1A | Yes |
| *Malacothrix squalida* | island malacothrix | PDAST660K0 | Endangered | None | G1/S1 | 1B.1 | Yes |
| *Malaxis monophyllos var. brachypoda* | white bog adder's-mouth | PMORC1R010 | None | None | G4?T4/S1 | 2.1 | Yes |
| *Malperia tenuis* | brown turbans | PDAST67010 | None | None | G4?/S2 | 2.3 | Yes |
| *Mammillaria grahamii var. grahamii* | Graham fishhook cactus | PDCAC0A021 | None | None | G4T4/S2 | 2.2 | Yes |
| *Marina orcuttii var. orcuttii* | California marina | PDFAB2F031 | None | None | G2G3T1T2/S2? | 1B.3 | Yes |
| *Matelea parvifolia* | spear-leaf matelea | PDASC0A0J0 | None | None | G5?/S2.2 | 2.3 | Yes |
| *Maurandella antirrhiniflora* | violet twining snapdragon | PDSCR2M011 | None | None | G4G5/S2 | 2.3 | Yes |
| *Meconella oregana* | Oregon meconella | PDPAP0G030 | None | None | G2G3/S1 | 1B.1 | Yes |
| *Melica spectabilis* | purple onion grass | PMPOA3X0G0 | None | None | G5/S3.3 | 4.3 | No |
| *Menodora scabra* | rough menodora | PDOLE09040 | None | None | G5/S2.3 | 2.3 | Yes |
| *Menodora spinescens var. mohavensis* | Mojave menodora | PDOLE09061 | None | None | G4T2T3/S2S3 | 1B.2 | Yes |
| *Mentzelia eremophila* | solitary blazing star | PDLOA030G0 | None | None | G3/S3.2 | 4.2 | No |
| *Mentzelia hirsutissima* | hairy stickleaf | PDLOA030K0 | None | None | G3?/S2S3 | 2.3 | Yes |
| *Mentzelia inyoensis* | Inyo blazing star | PDLOA032Z0 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Mentzelia monoensis* | Mono Craters blazing star | PDLOA032B0 | None | None | G3/S3 | 4.3 | No |
| *Mentzelia polita* | polished blazing star | PDLOA031D0 | None | None | G2/S2 | 1B.2 | Yes |
| *Mentzelia pterosperma* | wing-seed blazing star | PDLOA031E0 | None | None | G4/S2 | 2.2 | Yes |
| *Mentzelia puberula* | Darlington's blazing star | PDLOA031F0 | None | None | G4/S2 | 2.2 | Yes |
| *Mentzelia torreyi* | Torrey's blazing star | PDLOA031S0 | None | None | G4/S2.2 | 2.2 | Yes |
| *Mentzelia tricuspis* | spiny-hair blazing star | PDLOA031T0 | None | None | G4/S2 | 2.1 | Yes |
| *Mentzelia tridentata* | creamy blazing star | PDLOA031U0 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Mertensia bella* | Oregon lungwort | PDBOR0N040 | None | None | G4/S2S3 | 2.2 | Yes |
| *Mertensia cusickii* | Toiyabe bluebells | PDBOR0N0M0 | None | None | G4?/S2.2? | 2.2 | Yes |
| *Mertensia longiflora* | long bluebells | PDBOR0N0D0 | None | None | G4G5/S1 | 2.2 | Yes |
| *Mertensia oblongifolia var. amoena* | beautiful sagebrush bluebells | PDBOR0N0G1 | None | None | G5T5/S2.2 | 2.2 | Yes |
| *Mertensia oblongifolia var. oblongifolia* | sagebrush bluebells | PDBOR0N0G2 | None | None | G5T2/S2.2? | 2.2 | Yes |
| *Micranthes howellii* | Howell's saxifrage | PDSAX0U0T0 | None | None | G4/S3.3 | 4.3 | No |
| *Micromonolepis pusilla* | dwarf monolepis | PDCHE0F020 | None | None | G5/S2.3 | 2.3 | Yes |
| *Micropus amphibolus* | Mt. Diablo cottonweed | PDAST6D030 | None | None | G3/S3.2? | 3.2 | No |

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|---|---|---|---|---|---|---|---|
| *Microseris borealis* | northern microseris | PDAST6E030 | None | None | G4?/S1 | 2.1 | Yes |
| *Microseris douglasii ssp. platycarpha* | small-flowered microseris | PDAST6E062 | None | None | G4T3/S3.2 | 4.2 | No |
| *Microseris laciniata ssp. detlingii* | Detling's silverpuffs | PDAST6E0A1 | None | None | G4T3/S1 | 2.2 | Yes |
| *Microseris paludosa* | marsh microseris | PDAST6E0D0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Microseris sylvatica* | sylvan microseris | PDAST6E0E0 | None | None | G3/S3.2 | 4.2 | No |
| *Mimulus acutidens* | Kings River monkeyflower | PDSCR1B010 | None | None | G2?Q/S2? | 3 | No |
| *Mimulus aurantiacus var. aridus* | low bush monkeyflower | PDSCR22040 | None | None | G5T3T4/S3.3 | 4.3 | No |
| *Mimulus brandegeei* | Santa Cruz Island monkeyflower | PDSCR1B0K0 | None | None | GXQ/SX | 1A | Yes |
| *Mimulus clevelandii* | Cleveland's bush monkeyflower | PDSCR22010 | None | None | G3G4/S3.2 | 4.2 | No |
| *Mimulus cusickii* | Cusick's monkeyflower | PDSCR1B0V0 | None | None | G4G5/S2 | 2.3 | Yes |
| *Mimulus diffusus* | Palomar monkeyflower | PDSCR1B0Z0 | None | None | G4Q/S3.3 | 4.3 | No |
| *Mimulus evanescens* | ephemeral monkeyflower | PDSCR1B370 | None | None | G3/S2 | 1B.2 | Yes |
| *Mimulus exiguus* | San Bernardino Mountains monkeyflower | PDSCR1B140 | None | None | G2/S2 | 1B.2 | Yes |
| *Mimulus filicaulis* | slender-stemmed monkeyflower | PDSCR1B150 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Mimulus flemingii* | island bush monkeyflower | PDSCR1B320 | None | None | G3Q/S3.3 | 4.3 | No |
| *Mimulus fremontii var. vandenbergensis* | Vandenberg monkeyflower | PDSCR1B381 | Candidate | None | G3G5T1/S1 | 1B.1 | Yes |
| *Mimulus glabratus ssp. utahensis* | Utah monkeyflower | PDSCR1B1A6 | None | None | G5T5?/S1 | 2.1 | Yes |
| *Mimulus glaucescens* | shield-bracted monkeyflower | PDSCR1B1B0 | None | None | G3/S3.3 | 4.3 | No |
| *Mimulus gracilipes* | slender-stalked monkeyflower | PDSCR1B1C0 | None | None | G2G3/S2S3 | 1B.2 | Yes |
| *Mimulus grayi* | Gray's monkeyflower | PDSCR1B1D0 | None | None | G3/S3.3 | 4.3 | No |
| *Mimulus inconspicuus* | small-flowered monkeyflower | PDSCR1B1F0 | None | None | G3/S3.3 | 4.3 | No |
| *Mimulus johnstonii* | Johnston's monkeyflower | PDSCR1B1H0 | None | None | G3/S3.3 | 4.3 | No |
| *Mimulus laciniatus* | cut-leaved monkeyflower | PDSCR1B1L0 | None | None | G3/S3.3 | 4.3 | No |
| *Mimulus microphyllus* | small-leaved monkeyflower | PDSCR1B300 | None | None | G3Q/S3.3 | 4.3 | No |
| *Mimulus mohavensis* | Mojave monkeyflower | PDSCR1B1V0 | None | None | G2/S2 | 1B.2 | Yes |
| *Mimulus norrisii* | Kaweah monkeyflower | PDSCR1B2Y0 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Mimulus nudatus* | bare monkeyflower | PDSCR1B200 | None | None | G3/S3.3 | 4.3 | No |
| *Mimulus parryi* | Parry's monkeyflower | PDSCR1B230 | None | None | G3G4/S2.3 | 2.3 | Yes |
| *Mimulus pictus* | calico monkeyflower | PDSCR1B240 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Mimulus pulchellus* | yellow-lip pansy monkeyflower | PDSCR1B280 | None | None | G2G3/S2S3 | 1B.2 | Yes |

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|---|---|---|---|---|---|---|---|
| *Mimulus purpureus* | little purple monkeyflower | PDSCR1B2B0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Mimulus pygmaeus* | Egg Lake monkeyflower | PDSCR1B2C0 | None | None | G4/S3.2 | 4.2 | Yes |
| *Mimulus rattanii ssp. decurtatus* | Santa Cruz County monkeyflower | PDSCR1B2D2 | None | None | G4T3/S3.2 | 4.2 | No |
| *Mimulus rupicola* | Death Valley monkeyflower | PDSCR1B2H0 | None | None | G3/S3.3 | 4.3 | No |
| *Mimulus shevockii* | Kelso Creek monkeyflower | PDSCR1B2Z0 | None | None | G2/S2 | 1B.2 | Yes |
| *Mimulus subsecundus* | one-sided monkeyflower | PDSCR1B2K0 | None | None | G3/S3.3 | 4.3 | No |
| *Mimulus traskiae* | Santa Catalina Island monkeyflower | PDSCR1B2P0 | None | None | GX/SX | 1A | Yes |
| *Mimulus whipplei* | Whipple's monkeyflower | PDSCR1B2U0 | None | None | GXQ/SX | 1A | Yes |
| *Minuartia decumbens* | The lassics sandwort | PDCAR0G0Y0 | None | None | G1/S1 | 1B.2 | Yes |
| *Minuartia howellii* | Howell's sandwort | PDCAR0G0F0 | None | None | G4/S2 | 1B.3 | Yes |
| *Minuartia obtusiloba* | alpine sandwort | PDCAR0G0N0 | None | None | G5/S3.3 | 4.3 | No |
| *Minuartia rosei* | peanut sandwort | PDCAR0G0R0 | None | None | G3/S3.2 | 4.2 | No |
| *Minuartia stolonifera* | Scott Mountain sandwort | PDCAR0G110 | None | None | G2/S2 | 1B.3 | Yes |
| *Minuartia stricta* | bog sandwort | PDCAR0G0U0 | None | None | G5/S2 | 2.3 | Yes |
| *Mirabilis coccinea* | red four o'clock | PDNYC0A090 | None | None | G5/S2 | 2.3 | Yes |
| *Mirabilis greenei* | Greene's four o'clock | PDNYC0A0N0 | None | None | G3/S3.2 | 4.2 | No |
| *Mirabilis tenuiloba* | slender-lobed four o'clock | PDNYC0A150 | None | None | G4/S3.3 | 4.3 | No |
| *Mitellastra caulescens* | leafy-stemmed mitrewort | PDSAX0N020 | None | None | G5/S4.2 | 4.2 | Yes |
| *Monarda pectinata* | plains bee balm | PDLAM170A0 | None | None | G5/S1 | 2.3 | Yes |
| *Monardella antonina ssp. antonina* | San Antonio Hills monardella | PDLAM18011 | None | None | G4T3Q/S3? | 3 | No |
| *Monardella antonina ssp. benitensis* | San Benito monardella | PDLAM18012 | None | None | G4T3/S3.3 | 4.3 | No |
| *Monardella australis ssp. cinerea* | gray monardella | PDLAM18060 | None | None | G4T3/S3.3 | 4.3 | No |
| *Monardella australis ssp. jokerstii* | Jokerst's monardella | PDLAM18112 | None | None | G4T1/S1 | 1B.1 | Yes |
| *Monardella beneolens* | sweet-smelling monardella | PDLAM180U0 | None | None | G1/S1 | 1B.3 | Yes |
| *Monardella boydii* | Boyd's monardella | PDLAM18120 | None | None | G2Q/S2 | 1B.2 | Yes |
| *Monardella candicans* | Sierra monardella | PDLAM18050 | None | None | G3/S3.3 | 4.3 | No |
| *Monardella eremicola* | Clark Mountain monardella | PDLAM18130 | None | None | G2G3Q/S2S3 | 1B.3 | Yes |
| *Monardella follettii* | Follett's monardella | PDLAM180W0 | None | None | G2/S2 | 1B.2 | Yes |
| *Monardella frutescens* | San Luis Obispo monardella | PDLAM180X0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Monardella hypoleuca ssp. hypoleuca* | white-veined monardella | PDLAM180A3 | None | None | G4T2T3/S2S3 | 1B.3 | No |
| *Monardella hypoleuca ssp. intermedia* | intermediate monardella | PDLAM180A4 | None | None | G4T2T3/S2S3 | 1B.3 | No |

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|---|---|---|---|---|---|---|---|
| *Monardella hypoleuca ssp. lanata* | felt-leaved monardella | PDLAM180A2 | None | None | G4T2/S2.2 | 1B.2 | Yes |
| *Monardella leucocephala* | Merced monardella | PDLAM180C0 | None | None | GH/SH | 1A | Yes |
| *Monardella linoides ssp. oblonga* | Tehachapi monardella | PDLAM180D2 | None | None | G5T2/S2.2 | 1B.3 | Yes |
| *Monardella macrantha ssp. hallii* | Hall's monardella | PDLAM180E1 | None | None | G5T3/S3 | 1B.3 | Yes |
| *Monardella nana ssp. leptosiphon* | San Felipe monardella | PDLAM180F2 | None | None | G4G5T2Q/S2 | 1B.2 | Yes |
| *Monardella palmeri* | Palmer's monardella | PDLAM180H0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Monardella pringlei* | Pringle's monardella | PDLAM180J0 | None | None | GX/SX | 1A | Yes |
| *Monardella robisonii* | Robison's monardella | PDLAM180K0 | None | None | G3/S3 | 1B.3 | Yes |
| *Monardella saxicola* | rock monardella | PDLAM180Q1 | None | None | G3/S3.2 | 4.2 | No |
| *Monardella stebbinsii* | Stebbins' monardella | PDLAM180L0 | None | None | G2/S2 | 1B.2 | Yes |
| *Monardella stoneana* | Jennifer's monardella | PDLAM180Y0 | None | None | G1/S1.2 | 1B.2 | Yes |
| *Monardella undulata* | curly-leaved monardella | PDLAM180N0 | None | None | G3/S3.2 | 4.2 | No |
| *Monardella undulata ssp. arguelloensis* | Point Arguello monardella | PDLAM18151 | None | None | G3T1/S1 | 1B.1 | Yes |
| *Monardella undulata ssp. crispa* | crisp monardella | PDLAM18070 | None | None | G3T2/S2.2 | 1B.2 | Yes |
| *Monardella venosa* | veiny monardella | PDLAM18082 | None | None | G1/S1 | 1B.1 | Yes |
| *Monardella viminea* | willowy monardella | PDLAM180D4 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Monardella viridis ssp. viridis* | green monardella | PDLAM180Q2 | None | None | G3T3/S3.3 | 4.3 | No |
| *Moneses uniflora* | woodnymph | PDPYR02010 | None | None | G5/S3.3 | 4.3 | No |
| *Monolopia congdonii* | San Joaquin woollythreads | PDASTA8010 | Endangered | None | G3/S3 | 1B.2 | Yes |
| *Monolopia gracilens* | woodland woollythreads | PDAST6G010 | None | None | G2G3/S2S3 | 1B.2 | Yes |
| *Monotropa uniflora* | ghost-pipe | PDMON03030 | None | None | G5/S2S3 | 2.2 | Yes |
| *Montia howellii* | Howell's montia | PDPOR05070 | None | None | G3G4/S3 | 2.2 | Yes |
| *Mortonia utahensis* | Utah mortonia | PDCEL09030 | None | None | G4G5/S3 | 4.3 | No |
| *Mucronea californica* | California spineflower | PDPGN0F010 | None | None | G3/S3 | 4.2 | No |
| *Muhlenbergia alopecuroides* | wolftail | PMPOA3W020 | None | None | G5/S1? | 2.2 | Yes |
| *Muhlenbergia appressa* | appressed muhly | PMPOA48020 | None | None | G4/S3 | 2.2 | Yes |
| *Muhlenbergia arsenei* | tough muhly | PMPOA48060 | None | None | G5/S1S2 | 2.3 | Yes |
| *Muhlenbergia californica* | California muhly | PMPOA480A0 | None | None | G3/S3.3 | 4.3 | Yes |
| *Muhlenbergia fragilis* | delicate muhly | PMPOA480Q0 | None | None | G5?/S1 | 2.3 | Yes |
| *Muhlenbergia jonesii* | Jones' muhly | PMPOA480X0 | None | None | G3/S3.3 | 4.3 | No |
| *Muhlenbergia pauciflora* | few-flowered muhly | PMPOA48170 | None | None | G5/S2 | 2.3 | Yes |
| *Muilla coronata* | crowned muilla | PMLIL1H020 | None | None | G3/S3.2? | 4.2 | No |
| *Munroa squarrosa* | false buffalo-grass | PMPOA49010 | None | None | G5/S1S2 | 2.2 | Yes |
| *Munzothamnus blairii* | Blair's munzothamnus | PDAST8U0K0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Myosurus minimus ssp. apus* | little mousetail | PDRAN0H031 | None | None | G5T2Q/S2.2 | 3.1 | Yes |

# Special Vascular Plants, Bryophytes, and Lichens List

## California Department of Fish and Game

### Natural Diversity Database

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|---|---|---|---|---|---|---|---|
| *Myrica hartwegii* | Sierra sweet bay | PDMCC02050 | None | None | G3G4/S3S4 | 4.3 | No |
| *Nama dichotomum var. dichotomum* | forked purple mat | PDHYD0A061 | None | None | G4T4?/S1 | 2.3 | Yes |
| *Nama stenocarpum* | mud nama | PDHYD0A0H0 | None | None | G4G5/S1S2 | 2.2 | Yes |
| *Nasturtium gambelii* | Gambel's water cress | PDBRA270V0 | Endangered | Threatened | G1/S1 | 1B.1 | Yes |
| *Navarretia cotulifolia* | cotula navarretia | PDPLM0C040 | None | None | G3/S3.2 | 4.2 | No |
| *Navarretia eriocephala* | hoary navarretia | PDPLM0C060 | None | None | G3/S3.3 | 4.3 | No |
| *Navarretia fossalis* | spreading navarretia | PDPLM0C080 | Threatened | None | G1/S1 | 1B.1 | Yes |
| *Navarretia gowenii* | Lime Ridge navarretia | PDPLM0C120 | None | None | G1/S1 | 1B.1 | Yes |
| *Navarretia heterandra* | Tehama navarretia | PDPLM0C0A0 | None | None | G3/S3.3 | 4.3 | No |
| *Navarretia jepsonii* | Jepson's navarretia | PDPLM0C0D0 | None | None | G3/S3.3 | 4.3 | No |
| *Navarretia leucocephala ssp. bakeri* | Baker's navarretia | PDPLM0C0E1 | None | None | G4T2/S2 | 1B.1 | Yes |
| *Navarretia leucocephala ssp. pauciflora* | few-flowered navarretia | PDPLM0C0E4 | Endangered | Threatened | G4T1/S1 | 1B.1 | Yes |
| *Navarretia leucocephala ssp. plieantha* | many-flowered navarretia | PDPLM0C0E5 | Endangered | Endangered | G4T1/S1 | 1B.2 | Yes |
| *Navarretia myersii ssp. deminuta* | small pincushion navarretia | PDPLM0C0X2 | None | None | G1T1/S1 | 1B.1 | Yes |
| *Navarretia myersii ssp. myersii* | pincushion navarretia | PDPLM0C0X1 | None | None | G1T1/S1 | 1B.1 | Yes |
| *Navarretia nigelliformis ssp. nigelliformis* | adobe navarretia | PDPLM0C0J1 | None | None | G4T3/S3.2 | 4.2 | No |
| *Navarretia nigelliformis ssp. radians* | shining navarretia | PDPLM0C0J2 | None | None | G4T2/S2 | 1B.2 | Yes |
| *Navarretia ojaiensis* | Ojai navarretia | PDPLM0C130 | None | None | G1/S1 | 1B.1 | Yes |
| *Navarretia peninsularis* | Baja navarretia | PDPLM0C0L0 | None | None | G3?/S2 | 1B.2 | Yes |
| *Navarretia prolifera ssp. lutea* | yellow bur navarretia | PDPLM0C0N1 | None | None | G4T3/S3.3 | 4.3 | No |
| *Navarretia prostrata* | prostrate vernal pool navarretia | PDPLM0C0Q0 | None | None | G2/S2 | 1B.1 | Yes |
| *Navarretia rosulata* | Marin County navarretia | PDPLM0C0Z0 | None | None | G2?/S2? | 1B.2 | Yes |
| *Navarretia setiloba* | Piute Mountains navarretia | PDPLM0C0S0 | None | None | G2/S2 | 1B.1 | Yes |
| *Navarretia sinistra ssp. pinnatisecta* | pinnate-leaved navarretia | PDPLM04211 | None | None | G4G5T3/S3.3 | 4.3 | No |
| *Navarretia subuligera* | awl-leaved navarretia | PDPLM0C0U0 | None | None | G4/S3.3 | 4.3 | No |
| *Nemacaulis denudata var. denudata* | coast woolly-heads | PDPGN0G011 | None | None | G3G4T3?/S2.2 | 1B.2 | Yes |
| *Nemacaulis denudata var. gracilis* | slender cottonheads | PDPGN0G012 | None | None | G3G4T3?/S2 | 2.2 | Yes |
| *Nemacladus calcaratus* | Chimney Creek nemacladus | PDCAM0F0E0 | None | None | G1/S1 | 1B.2 | Yes |
| *Nemacladus gracilis* | graceful nemacladus | PDCAM0F030 | None | None | G3/S3.3 | 4.3 | No |
| *Nemacladus secundiflorus var. robbinsii* | Robbins' nemacladus | PDCAM0F0B2 | None | None | G3T2T3/S2S3 | 1B.2 | Yes |

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|---|---|---|---|---|---|---|---|
| *Nemacladus secundiflorus var. secundiflorus* | large-flowered nemacladus | PDCAM0F0B1 | None | None | G3T3?/S3? | 4.3 | No |
| *Nemacladus twisselmannii* | Twisselmann's nemacladus | PDCAM0F0D0 | None | Rare | G1/S1 | 1B.2 | Yes |
| *Nemophila breviflora* | Great Basin nemophila | PDHYD0B020 | None | None | G5/S2.3 | 2.3 | Yes |
| *Nemophila parviflora var. quercifolia* | oak-leaved nemophila | PDHYD0B073 | None | None | G5T3/S3.3 | 4.3 | No |
| *Neostapfia colusana* | Colusa grass | PMPOA4C010 | Threatened | Endangered | G2/S2 | 1B.1 | Yes |
| *Neviusia cliftonii* | Shasta snow-wreath | PDROS14020 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Nitrophila mohavensis* | Amargosa nitrophila | PDCHE0G010 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Noccaea fendleri ssp. californica* | Kneeland Prairie pennycress | PDBRA2P041 | Endangered | None | G?T1/S1 | 1B.1 | Yes |
| *Nolina cismontana* | chaparral nolina | PMAGA080E0 | None | None | G2/S2 | 1B.2 | Yes |
| *Nolina interrata* | Dehesa nolina | PMAGA08070 | None | Endangered | G2/S2 | 1B.1 | Yes |
| *Oenothera caespitosa ssp. crinita* | caespitose evening-primrose | PDONA0C063 | None | None | G5T4T5/S3.3 | 4.2 | No |
| *Oenothera californica ssp. eurekensis* | Eureka Dunes evening-primrose | PDONA0C071 | Endangered | Rare | G4?T2/S2 | 1B.2 | Yes |
| *Oenothera cavernae* | cave evening-primrose | PDONA0C090 | None | None | G2G3/S1 | 2.1 | Yes |
| *Oenothera deltoides ssp. howellii* | Antioch Dunes evening-primrose | PDONA0C0B4 | Endangered | Endangered | G5T1/S1 | 1B.1 | Yes |
| *Oenothera longissima* | long-stem evening-primrose | PDONA0C0T0 | None | None | G4/S1 | 2.2 | Yes |
| *Oenothera wolfii* | Wolf's evening-primrose | PDONA0C1K0 | None | None | G1/S1 | 1B.1 | Yes |
| *Ophioglossum californicum* | California adder's-tongue | PPOPH020G0 | None | None | G4/S3.2 | 4.2 | No |
| *Ophioglossum pusillum* | northern adder's-tongue | PPOPH020F0 | None | None | G5/S1 | 2.2 | Yes |
| *Opuntia basilaris var. brachyclada* | short-joint beavertail | PDCAC0D053 | None | None | G5T3/S3 | 1B.2 | Yes |
| *Opuntia basilaris var. treleasei* | Bakersfield cactus | PDCAC0D055 | Endangered | Endangered | G5T1/S1 | 1B.1 | Yes |
| *Opuntia fragilis* | brittle prickly-pear | PDCAC0D0H0 | None | None | G4G5/SH | 2.1 | Yes |
| *Opuntia wigginsii* | Wiggins' cholla | PDCAC0D1P0 | None | None | G3?Q/S1? | 3.3 | Yes |
| *Opuntia xcurvispina* | curved-spine beavertail | PDCAC0D270 | None | None | G3G4Q/S1 | 2.2 | Yes |
| *Orcuttia californica* | California Orcutt grass | PMPOA4G010 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Orcuttia inaequalis* | San Joaquin Valley Orcutt grass | PMPOA4G060 | Threatened | Endangered | G1/S1 | 1B.1 | Yes |
| *Orcuttia pilosa* | hairy Orcutt grass | PMPOA4G040 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Orcuttia tenuis* | slender Orcutt grass | PMPOA4G050 | Threatened | Endangered | G2/S2 | 1B.1 | Yes |
| *Orcuttia viscida* | Sacramento Orcutt grass | PMPOA4G070 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Oreonana purpurascens* | purple mountain-parsley | PDAPI1G020 | None | None | G2/S2 | 1B.2 | Yes |
| *Oreonana vestita* | woolly mountain-parsley | PDAPI1G030 | None | None | G3/S3 | 1B.3 | Yes |
| *Oreostemma elatum* | tall alpine-aster | PDASTEA020 | None | None | G2Q/S2.2 | 1B.2 | Yes |
| *Ornithostaphylos oppositifolia* | Baja California birdbush | PDERI0W010 | None | Endangered | G4/S1 | 2.1 | Yes |

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|---|---|---|---|---|---|---|---|
| *Orobanche ludoviciana var. arenosa* | Suksdorf's broom-rape | PDORO04071 | None | None | G5T5/S2 | 2.3 | Yes |
| *Orobanche parishii ssp. brachyloba* | short-lobed broomrape | PDORO040A2 | None | None | G4?T3/S3.2 | 4.2 | Yes |
| *Orobanche valida ssp. howellii* | Howell's broomrape | PDORO040G1 | None | None | G3T3/S3.3 | 4.3 | No |
| *Orobanche valida ssp. valida* | Rock Creek broomrape | PDORO040G2 | None | None | G3T2/S2 | 1B.2 | Yes |
| *Orthocarpus cuspidatus ssp. cuspidatus* | Siskiyou Mountains orthocarpus | PDSCR1H081 | None | None | G5T3T4/S3.3 | 4.3 | No |
| *Orthocarpus pachystachyus* | Shasta orthocarpus | PDSCR1H0L0 | None | None | G1/S1 | 1B.1 | Yes |
| *Oryctes nevadensis* | Nevada oryctes | PDSOL0Q010 | None | None | G2G3/S2 | 2.1 | Yes |
| *Osmorhiza depauperata* | blunt-fruited sweet-cicely | PDAPI1K050 | None | None | G5/S1 | 2.3 | Yes |
| *Oxalis suksdorfii* | Suksdorf's wood-sorrel | PDOXA010U0 | None | None | G4/S3.3 | 4.3 | No |
| *Oxytheca watsonii* | Watson's oxytheca | PDPGN0J070 | None | None | G3?/S1 | 2.2 | Yes |
| *Oxytropis deflexa var. sericea* | blue pendent-pod oxytrope | PDFAB2X053 | None | None | G5T5/S1 | 2.1 | Yes |
| *Oxytropis oreophila var. oreophila* | rock-loving oxytrope | PDFAB2X0H3 | None | None | G5T4/S2.3 | 2.3 | Yes |
| *Oxytropis parryi* | Parry's oxytrope | PDFAB2X0J0 | None | None | G5/S3.3 | 4.3 | No |
| *Packera bernardina* | San Bernardino ragwort | PDAST8H0E0 | None | None | G2/S2 | 1B.2 | Yes |
| *Packera bolanderi var. bolanderi* | seacoast ragwort | PDAST8H0H1 | None | None | G4T4/S3 | 2.2 | Yes |
| *Packera eurycephala var. lewisrosei* | Lewis Rose's ragwort | PDAST8H182 | None | None | G4T2/S2.2 | 1B.2 | Yes |
| *Packera ganderi* | Gander's ragwort | PDAST8H1F0 | None | Rare | G2/S2.2 | 1B.2 | Yes |
| *Packera hesperia* | western ragwort | PDAST8H1L0 | None | None | G3/S1 | 2.2 | Yes |
| *Packera indecora* | rayless mountain ragwort | PDAST8H1R0 | None | None | G5/S1 | 2.2 | Yes |
| *Packera ionophylla* | Tehachapi ragwort | PDAST8H1T0 | None | None | G3/S3.3 | 4.3 | No |
| *Packera layneae* | Layne's ragwort | PDAST8H1V0 | Threatened | Rare | G2/S2 | 1B.2 | Yes |
| *Packera macounii* | Siskiyou Mountains ragwort | PDAST8H1Z0 | None | None | G5/S3.3 | 4.3 | No |
| *Palafoxia arida var. gigantea* | giant spanish-needle | PDAST6T012 | None | None | G5T3/S2 | 1B.3 | Yes |
| *Panicum acuminatum var. thermale* | Geysers panicum | PMPOA24028 | None | Endangered | G5T2Q/S2 | 1B.2 | Yes |
| *Parkinsonia microphylla* | little-leaved palo verde | PDFAB2Z030 | None | None | G5/S3.3 | 4.3 | No |
| *Parnassia cirrata var. cirrata* | San Bernardino grass-of-Parnassus | PDSAX0P030 | None | None | G5T2/S2.3 | 1B.3 | Yes |
| *Parnassia cirrata var. intermedia* | Cascade grass-of-Parnassus | PDSAX0P044 | None | None | G5T2T3/S2 | 2.2 | Yes |
| *Parnassia parviflora* | small-flowered grass-of-Parnassus | PDSAX0P0A0 | None | None | G4/S1 | 2.2 | Yes |
| *Paronychia ahartii* | Ahart's paronychia | PDCAR0L0V0 | None | None | G2/S2 | 1B.1 | Yes |
| *Pedicularis bracteosa var. flavida* | yellowish lousewort | PDSCR1K044 | None | None | G5T4/S3.3 | 4.3 | No |
| *Pedicularis centranthera* | Great Basin lousewort | PDSCR1K070 | None | None | G4/S2 | 2.3 | Yes |

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|---|---|---|---|---|---|---|---|
| *Pedicularis contorta* | curved-beak lousewort | PDSCR1K090 | None | None | G5/S3.3 | 4.3 | No |
| *Pedicularis crenulata* | scalloped-leaved lousewort | PDSCR1K0A0 | None | None | G4/S1 | 2.2 | Yes |
| *Pedicularis dudleyi* | Dudley's lousewort | PDSCR1K0D0 | None | Rare | G2/S2.2 | 1B.2 | Yes |
| *Pedicularis howellii* | Howell's lousewort | PDSCR1K0J0 | None | None | G4/S3.3 | 4.3 | No |
| *Pediomelum castoreum* | Beaver Dam breadroot | PDFAB5L050 | None | None | G3/S2 | 1B.2 | Yes |
| *Pellaea truncata* | spiny cliff-brake | PPADI0H0C0 | None | None | G5/S2 | 2.3 | Yes |
| *Penstemon albomarginatus* | white-margined beardtongue | PDSCR1L070 | None | None | G2/S1 | 1B.1 | Yes |
| *Penstemon barnebyi* | Barneby's beardtongue | PDSCR1L0Q0 | None | None | G3G4/S1 | 2.1 | Yes |
| *Penstemon bicolor ssp. roseus* | rosy two-toned beardtongue | PDSCR1L0S2 | None | None | G3T3Q/S1 | 1B.1 | Yes |
| *Penstemon calcareus* | limestone beardtongue | PDSCR1L100 | None | None | G2G3/S2S3 | 1B.3 | Yes |
| *Penstemon californicus* | California beardtongue | PDSCR1L110 | None | None | G3?/S2 | 1B.2 | Yes |
| *Penstemon cinereus* | gray beardtongue | PDSCR1L7F0 | None | None | G4/S3.3 | 4.3 | No |
| *Penstemon cinicola* | ashy-gray beardtongue | PDSCR1L1B0 | None | None | G4/S3.3 | 4.3 | No |
| *Penstemon clevelandii var. connatus* | San Jacinto beardtongue | PDSCR1L1D2 | None | None | G5T4/S3.3 | 4.3 | No |
| *Penstemon filiformis* | thread-leaved beardtongue | PDSCR1L2A0 | None | None | G3/S3 | 1B.3 | Yes |
| *Penstemon fruticiformis var. amargosae* | Amargosa beardtongue | PDSCR1L2F2 | None | None | G4T3/S2.3 | 1B.3 | Yes |
| *Penstemon heterodoxus var. shastensis* | Shasta beardtongue | PDSCR1L5Q0 | None | None | G5T3/S3.3 | 4.3 | No |
| *Penstemon janishiae* | Janish's beardtongue | PDSCR1L3A0 | None | None | G4/S1 | 2.2 | Yes |
| *Penstemon newberryi var. sonomensis* | Sonoma beardtongue | PDSCR1L483 | None | None | G4T1/S2 | 1B.3 | Yes |
| *Penstemon pahutensis* | Pahute beardtongue | PDSCR1L4H0 | None | None | G3/S1 | 2.3 | Yes |
| *Penstemon papillatus* | Inyo beardtongue | PDSCR1L4L0 | None | None | G3/S3.3 | 4.3 | No |
| *Penstemon personatus* | closed-throated beardtongue | PDSCR1L4Y0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Penstemon pseudospectabilis ssp. pseudospectabilis* | desert beardtongue | PDSCR1L562 | None | None | G4G5T3T5/S3 | 2.2 | Yes |
| *Penstemon rattanii var. kleei* | Santa Cruz Mountains beardtongue | PDSCR1L5B1 | None | None | G4T2/S2.2 | 1B.2 | Yes |
| *Penstemon scapoides* | pinyon beardtongue | PDSCR1L5J0 | None | None | G3/S3.3 | 4.3 | No |
| *Penstemon stephensii* | Stephens' beardtongue | PDSCR1L5W0 | None | None | G2/S2 | 1B.3 | Yes |
| *Penstemon sudans* | Susanville beardtongue | PDSCR1L620 | None | None | G3/S3 | 1B.3 | Yes |
| *Penstemon thompsoniae* | Thompson's beardtongue | PDSCR1L670 | None | None | G4/S1 | 2.3 | Yes |
| *Penstemon thurberi* | Thurber's beardtongue | PDSCR1L680 | None | None | G5/S3.2? | 4.2 | No |
| *Penstemon tracyi* | Tracy's beardtongue | PDSCR1L6A0 | None | None | G1/S1 | 1B.3 | Yes |
| *Penstemon utahensis* | Utah beardtongue | PDSCR1L6G0 | None | None | G4/S2 | 2.3 | Yes |
| *Pentachaeta aurea ssp. allenii* | Allen's pentachaeta | PDAST6X021 | None | None | G4T2/S2 | 1B.1 | Yes |

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|---|---|---|---|---|---|---|---|
| *Pentachaeta aurea ssp. aurea* | golden-rayed pentachaeta | PDAST6X022 | None | None | G4T3/S3 | 4.2 | No |
| *Pentachaeta bellidiflora* | white-rayed pentachaeta | PDAST6X030 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Pentachaeta exilis ssp. aeolica* | San Benito pentachaeta | PDAST6X041 | None | None | G5T1/S1 | 1B.2 | Yes |
| *Pentachaeta fragilis* | fragile pentachaeta | PDAST6X050 | None | None | G3/S3.3 | 4.3 | No |
| *Pentachaeta lyonii* | Lyon's pentachaeta | PDAST6X060 | Endangered | Endangered | G2/S2 | 1B.1 | Yes |
| *Perideridia bacigalupii* | Bacigalupi's yampah | PDAPI1N020 | None | None | G3/S3 | 4.2 | No |
| *Perideridia gairdneri ssp. gairdneri* | California Gairdner's yampah | PDAPI1N062 | None | None | G5T3/S3.2 | 4.2 | No |
| *Perideridia leptocarpa* | narrow-seeded yampah | PDAPI1N0A0 | None | None | G3Q/S3.3 | 4.3 | No |
| *Perideridia parishii ssp. parishii* | Parish's yampah | PDAPI1N0C2 | None | None | G4T3T4/S2.2? | 2.2 | Yes |
| *Perideridia pringlei* | adobe yampah | PDAPI1N0D0 | None | None | G3/S3.3 | 4.3 | No |
| *Perityle inyoensis* | Inyo rock daisy | PDAST700F0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Perityle villosa* | Hanaupah rock daisy | PDAST700V0 | None | None | G2/S2 | 1B.3 | Yes |
| *Petalonyx thurberi ssp. gilmanii* | Death Valley sandpaper-plant | PDLOA04041 | None | None | G5T2/S2.3 | 1B.3 | Yes |
| *Peteria thompsoniae* | spine-noded milk vetch | PDFAB32020 | None | None | G4/S1 | 2.3 | Yes |
| *Petradoria pumila ssp. pumila* | rock goldenrod | PDAST72022 | None | None | G5T4/S3.3 | 4.3 | No |
| *Petrophytum caespitosum ssp. acuminatum* | marble rockmat | PDROS18010 | None | None | G5T2/S2 | 1B.3 | Yes |
| *Phacelia amabilis* | Saline Valley phacelia | PDHYD0C040 | None | None | GHQ/SH | 3.3 | Yes |
| *Phacelia anelsonii* | Aven Nelson's phacelia | PDHYD0C060 | None | None | G2G3/S2.3? | 2.3 | Yes |
| *Phacelia argentea* | sand dune phacelia | PDHYD0C070 | None | None | G2/S1 | 1B.1 | Yes |
| *Phacelia barnebyana* | Barneby's phacelia | PDHYD0C0C0 | None | None | G3?/S2.3 | 2.3 | Yes |
| *Phacelia ciliata var. opaca* | Merced phacelia | PDHYD0C0S2 | None | None | G5TH/SH | 1B.2 | Yes |
| *Phacelia coerulea* | sky-blue phacelia | PDHYD0C0U0 | None | None | G5/S2 | 2.3 | Yes |
| *Phacelia cookei* | Cooke's phacelia | PDHYD0C0Y0 | None | None | G1/S1 | 1B.1 | Yes |
| *Phacelia exilis* | Transverse Range phacelia | PDHYD0C4Y0 | None | None | G3Q/S3.3 | 4.3 | No |
| *Phacelia floribunda* | many-flowered phacelia | PDHYD0C1G0 | None | None | G2/S1 | 1B.2 | Yes |
| *Phacelia greenei* | Scott Valley phacelia | PDHYD0C1V0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Phacelia gymnoclada* | naked-stemmed phacelia | PDHYD0C1X0 | None | None | G4/S2.3 | 2.3 | Yes |
| *Phacelia hubbyi* | Hubby's phacelia | PDHYD0C0R4 | None | None | G3/S3.2 | 4.2 | No |
| *Phacelia insularis var. continentis* | North Coast phacelia | PDHYD0C2B1 | None | None | G2T1/S1 | 1B.2 | Yes |
| *Phacelia insularis var. insularis* | northern Channel Islands phacelia | PDHYD0C2B2 | Endangered | None | G2TH/SH | 1B.2 | Yes |
| *Phacelia inundata* | playa phacelia | PDHYD0C2E0 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Phacelia inyoensis* | Inyo phacelia | PDHYD0C2F0 | None | None | G2/S2 | 1B.2 | Yes |
| *Phacelia keckii* | Santiago Peak phacelia | PDHYD0C4G1 | None | None | G2/S2 | 1B.3 | Yes |
| *Phacelia leonis* | Siskiyou phacelia | PDHYD0C2N0 | None | None | G2/S2.2 | 1B.3 | Yes |

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|---|---|---|---|---|---|---|---|
| *Phacelia mohavensis* | Mojave phacelia | PDHYD0C310 | None | None | G3Q/S3.3 | 4.3 | No |
| *Phacelia monoensis* | Mono County phacelia | PDHYD0C4V0 | None | None | G3/S2.1 | 1B.1 | Yes |
| *Phacelia mustelina* | Death Valley round-leaved phacelia | PDHYD0C330 | None | None | G2/S2 | 1B.3 | Yes |
| *Phacelia nashiana* | Charlotte's phacelia | PDHYD0C350 | None | None | G3/S3 | 1B.2 | Yes |
| *Phacelia novenmillensis* | Nine Mile Canyon phacelia | PDHYD0C3A0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Phacelia orogenes* | Sierra phacelia | PDHYD0C3C0 | None | None | G3/S3.3 | 4.3 | No |
| *Phacelia parishii* | Parish's phacelia | PDHYD0C3G0 | None | None | G2G3/S1 | 1B.1 | Yes |
| *Phacelia peirsoniana* | Peirson's phacelia | PDHYD0C3N0 | None | None | G3G4/S3.3 | 4.3 | No |
| *Phacelia perityloides var. jaegeri* | Jaeger's phacelia | PDHYD0C1M0 | None | None | G4T2/S1 | 1B.3 | Yes |
| *Phacelia phacelioides* | Mt. Diablo phacelia | PDHYD0C3Q0 | None | None | G1/S1 | 1B.2 | Yes |
| *Phacelia pulchella var. gooddingii* | Goodding's phacelia | PDHYD0C3V1 | None | None | G5T2T3/S2 | 2.3 | Yes |
| *Phacelia ramosissima var. austrolitoralis* | south coast branching phacelia | PDHYD0C416 | None | None | G5?T3/S3.2 | 3.2 | No |
| *Phacelia sericea var. ciliosa* | blue alpine phacelia | PDHYD0C4A1 | None | None | G5T5/S2 | 2.3 | Yes |
| *Phacelia stebbinsii* | Stebbins' phacelia | PDHYD0C4D0 | None | None | G3/S3 | 1B.2 | Yes |
| *Phacelia stellaris* | Brand's star phacelia | PDHYD0C510 | Candidate | None | G2?/S1 | 1B.1 | Yes |
| *Phaseolus filiformis* | slender-stem bean | PDFAB330P0 | None | None | G5/S1 | 2.1 | Yes |
| *Phlox dispersa* | High Sierra phlox | PDPLM0D0M0 | None | None | G3/S3.3 | 4.3 | No |
| *Phlox dolichantha* | Big Bear Valley phlox | PDPLM0D0P0 | None | None | G2/S2 | 1B.2 | Yes |
| *Phlox hirsuta* | Yreka phlox | PDPLM0D100 | Endangered | Endangered | G1/S1 | 1B.2 | Yes |
| *Phlox muscoides* | squarestem phlox | PDPLM0D115 | None | None | G5?/S2S3 | 2.3 | Yes |
| *Pholisma sonorae* | sand food | PDLNN02020 | None | None | G2/S2 | 1B.2 | Yes |
| *Pholistoma auritum var. arizonicum* | Arizona pholistoma | PDHYD0D011 | None | None | G5T2T3/S2 | 2.3 | Yes |
| *Physalis lobata* | lobed ground-cherry | PDSOL0T010 | None | None | G5/S2 | 2.3 | Yes |
| *Physaria chambersii* | Chambers' physaria | PDBRA22050 | None | None | G4/S1S2 | 2.3 | Yes |
| *Physaria kingii ssp. bernardina* | San Bernardino Mountains bladderpod | PDBRA1N0W1 | Endangered | None | G5T1/S1 | 1B.1 | Yes |
| *Physaria ludoviciana* | silver bladderpod | PDBRA1N110 | None | None | G5/S1 | 2.2 | Yes |
| *Physocarpus alternans* | Nevada ninebark | PDROS19010 | None | None | G4/S2.3 | 2.3 | Yes |
| *Picea engelmannii* | Engelmann spruce | PGPIN03030 | None | None | G5/S2.2 | 2.2 | Yes |
| *Pickeringia montana var. tomentosa* | woolly chaparral-pea | PDFAB34012 | None | None | G5T2T4/S2S4.3 | 4.3 | No |
| *Pilostyles thurberi* | Thurber's pilostyles | PDRAF01010 | None | None | G5/S3.3 | 4.3 | Yes |
| *Pinguicula macroceras* | horned butterwort | PDLNT01040 | None | None | G5/S2S3 | 2.2 | Yes |
| *Pinus contorta ssp. bolanderi* | Bolander's beach pine | PGPIN04081 | None | None | G5T2/S2 | 1B.2 | Yes |
| *Pinus edulis* | two-needle pinyon pine | PGPIN040C0 | None | None | G5Q/S2 | 3.3 | No |
| *Pinus longaeva* | bristlecone pine | PGPIN04180 | None | None | G4/S3.3 | 4.3 | No |
| *Pinus radiata* | Monterey pine | PGPIN040V0 | None | None | G1/S1 | 1B.1 | Yes |

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|---|---|---|---|---|---|---|---|
| *Pinus torreyana ssp. insularis* | Santa Rosa Island torrey pine | PGPIN04151 | None | None | G1T1/S1 | 1B.2 | Yes |
| *Pinus torreyana ssp. torreyana* | torrey pine | PGPIN04152 | None | None | G1T1/S1 | 1B.2 | Yes |
| *Piperia candida* | white-flowered rein orchid | PMORC1X050 | None | None | G3?/S2 | 1B.2 | Yes |
| *Piperia colemanii* | Coleman's rein orchid | PMORC1X080 | None | None | G3/S3.3 | 4.3 | No |
| *Piperia cooperi* | chaparral rein orchid | PMORC1X090 | None | None | G4/S3.2 | 4.2 | No |
| *Piperia elegans ssp. decurtata* | Point Reyes rein orchid | PMORC1X011 | None | None | G4T1/S1 | 1B.1 | Yes |
| *Piperia leptopetala* | narrow-petaled rein orchid | PMORC1X100 | None | None | G3/S3.3 | 4.3 | No |
| *Piperia michaelii* | Michael's rein orchid | PMORC1X110 | None | None | G3/S3.2 | 4.2 | No |
| *Piperia yadonii* | Yadon's rein orchid | PMORC1X070 | Endangered | None | G2/S2 | 1B.1 | Yes |
| *Pityopus californica* | California pinefoot | PDMON05010 | None | None | G4G5/S3.2 | 4.2 | No |
| *Plagiobothrys chorisianus var. chorisianus* | Choris' popcornflower | PDBOR0V061 | None | None | G3T2Q/S2.2 | 1B.2 | Yes |
| *Plagiobothrys chorisianus var. hickmanii* | Hickman's popcornflower | PDBOR0V062 | None | None | G3T3Q/S3.2 | 4.2 | No |
| *Plagiobothrys diffusus* | San Francisco popcornflower | PDBOR0V080 | None | Endangered | G1Q/S1 | 1B.1 | Yes |
| *Plagiobothrys glaber* | hairless popcornflower | PDBOR0V0B0 | None | None | GH/SH | 1A | Yes |
| *Plagiobothrys glyptocarpus var. modestus* | Cedar Crest popcornflower | PDBOR0V0C2 | None | None | G3THQ/SH | 3 | No |
| *Plagiobothrys hystriculus* | bearded popcornflower | PDBOR0V0H0 | None | None | G1G2/S1S2 | 1B.1 | Yes |
| *Plagiobothrys lithocaryus* | Mayacamas popcornflower | PDBOR0V0P0 | None | None | GH/SH | 1A | Yes |
| *Plagiobothrys mollis var. vestitus* | Petaluma popcornflower | PDBOR0V0Q2 | None | None | G4?TX/SX | 1A | Yes |
| *Plagiobothrys nitens* | shiny-nutlet popcornflower | PDBOR0V1B0 | None | None | GNR/S1 | 2.1 | Yes |
| *Plagiobothrys parishii* | Parish's popcornflower | PDBOR0V0U0 | None | None | G1/S1 | 1B.1 | Yes |
| *Plagiobothrys salsus* | desert popcornflower | PDBOR0V0X0 | None | None | G2G3/S1 | 2.2 | Yes |
| *Plagiobothrys strictus* | Calistoga popcornflower | PDBOR0V120 | Endangered | Threatened | G1/S1 | 1B.1 | Yes |
| *Plagiobothrys torreyi var. perplexans* | chaparral popcornflower | PDBOR0V153 | None | None | G4T3/S3 | 4.3 | No |
| *Plagiobothrys torreyi var. torreyi* | Yosemite popcornflower | PDBOR0V152 | None | None | G4T2Q/S2.2 | 1B.2 | Yes |
| *Plagiobothrys uncinatus* | hooked popcornflower | PDBOR0V170 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Plagiobothrys verrucosus* | warty popcorn-flower | PDBOR0V1D0 | None | None | G4?/S1 | 2.1 | Yes |
| *Platanthera stricta* | slender bog-orchid | PMORC1Y0P0 | None | None | G5/S3.2? | 4.2 | No |
| *Platanthera yosemitensis* | Yosemite bog orchid | PMORC1Y1B0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Platystemon californicus var. ciliatus* | Santa Barbara Island cream cups | PDPAP0J022 | None | None | G5T1Q/S1 | 1B.2 | Yes |

| Scientific Name | Common Name | Element Code | Federal Listing Status | State Listing Status | Heritage Rank | Rare Plant Rank | Records in CNDDB ? |
|---|---|---|---|---|---|---|---|
| *Pleuropogon californicus var. davyi* | Davy's semaphore grass | PMPOA7Y012 | None | None | G5T3/S3.3 | 4.3 | No |
| *Pleuropogon hooverianus* | North Coast semaphore grass | PMPOA4Y070 | None | Threatened | G2/S2 | 1B.1 | Yes |
| *Pleuropogon refractus* | nodding semaphore grass | PMPOA4Y080 | None | None | G4/S3.2? | 4.2 | No |
| *Poa abbreviata ssp. marshii* | Marsh's blue grass | PMPOA4Z013 | None | None | G5T2/S1 | 2.3 | Yes |
| *Poa abbreviata ssp. pattersonii* | Patterson's blue grass | PMPOA4Z015 | None | None | G5T5/S1 | 2.3 | Yes |
| *Poa atropurpurea* | San Bernardino blue grass | PMPOA4Z0A0 | Endangered | None | G2/S2 | 1B.2 | Yes |
| *Poa diaboli* | Diablo Canyon blue grass | PMPOA4Z390 | None | None | G2/S2 | 1B.2 | Yes |
| *Poa lettermanii* | Letterman's blue grass | PMPOA4Z1H0 | None | None | G4/S3 | 2.3 | Yes |
| *Poa napensis* | Napa blue grass | PMPOA4Z1R0 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Poa piperi* | Piper's blue grass | PMPOA4Z200 | None | None | G4/S3.3 | 4.3 | No |
| *Poa rhizomata* | timber blue grass | PMPOA4Z250 | None | None | G3G4/S3.3 | 4.3 | No |
| *Poa sierrae* | Sierra blue grass | PMPOA4Z310 | None | None | G2G3/S2S3 | 1B.3 | Yes |
| *Podistera nevadensis* | Sierra podistera | PDAPI1T030 | None | None | G3/S3.3 | 4.3 | No |
| *Pogogyne abramsii* | San Diego mesa mint | PDLAM1K010 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Pogogyne clareana* | Santa Lucia mint | PDLAM1K020 | None | Endangered | G2/S2 | 1B.2 | Yes |
| *Pogogyne floribunda* | profuse-flowered pogogyne | PDLAM1K070 | None | None | G4/S4 | 4.2 | Yes |
| *Pogogyne nudiuscula* | Otay Mesa mint | PDLAM1K040 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Polemonium carneum* | Oregon polemonium | PDPLM0E050 | None | None | G4/S1 | 2.2 | Yes |
| *Polemonium chartaceum* | Mason's sky pilot | PDPLM0E060 | None | None | G2/S2 | 1B.3 | Yes |
| *Poliomintha incana* | frosted mint | PDLAM1L020 | None | None | G5/SH | 1A | Yes |
| *Polyctenium fremontii var. fremontii* | Fremont's combleaf | PDBRA23012 | None | None | G4T4/S3.3 | 4.3 | No |
| *Polyctenium williamsiae* | Williams' combleaf | PDBRA23030 | None | None | G2Q/S1 | 1B.2 | Yes |
| *Polygala acanthoclada* | thorny milkwort | PDPGL02020 | None | None | G4/S1 | 2.3 | Yes |
| *Polygala cornuta var. fishiae* | Fish's milkwort | PDPGL020B2 | None | None | G5T4/S3.3 | 4.3 | No |
| *Polygala heterorhyncha* | notch-beaked milkwort | PDPGL02270 | None | None | G3/S2 | 2.3 | Yes |
| *Polygala intermontana* | intermountain milkwort | PDPGL021U0 | None | None | G3?/S2.3 | 2.3 | Yes |
| *Polygala subspinosa* | spiny milkwort | PDPGL021Q0 | None | None | G4?/S3 | 2.2 | Yes |
| *Polygonum bidwelliae* | Bidwell's knotweed | PDPGN0L0C0 | None | None | G3/S3.3 | 4.3 | No |
| *Polygonum hickmanii* | Scotts Valley polygonum | PDPGN0L310 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Polygonum marinense* | Marin knotweed | PDPGN0L1C0 | None | None | G1Q/S1.1 | 3.1 | Yes |
| *Polygonum polygaloides ssp. esotericum* | Modoc County knotweed | PDPGN0L1Y2 | None | None | G4G5T2/S2.1 | 1B.1 | Yes |
| *Polystichum kruckebergii* | Kruckeberg's sword fern | PPDRY0R0C0 | None | None | G4/S3.3 | 4.3 | No |
| *Polystichum lonchitis* | northern holly fern | PPDRY0R0F0 | None | None | G5/S2? | 3 | No |
| *Populus angustifolia* | narrow-leaved cottonwood | PDSAL01020 | None | None | G5/S2S3 | 2.2 | Yes |

# Special Vascular Plants, Bryophytes, and Lichens List

## California Department of Fish and Game

### Natural Diversity Database

| Scientific Name | Common Name | Element Code | Federal Listing Status | State Listing Status | Heritage Rank | Rare Plant Rank | Records in CNDDB ? |
|---|---|---|---|---|---|---|---|
| *Portulaca halimoides* | desert portulaca | PDPOR06040 | None | None | G5/S3 | 4.2 | No |
| *Potamogeton epihydrus* | Nuttall's ribbon-leaved pondweed | PMPOT03081 | None | None | G5/S2.2? | 2.2 | Yes |
| *Potamogeton foliosus ssp. fibrillosus* | fibrous pondweed | PMPOT030B1 | None | None | G5T2T4/S1S2 | 2.3 | Yes |
| *Potamogeton praelongus* | white-stemmed pondweed | PMPOT030V0 | None | None | G5/S1S2 | 2.3 | Yes |
| *Potamogeton robbinsii* | Robbins' pondweed | PMPOT030Z0 | None | None | G5/S2.3? | 2.3 | Yes |
| *Potamogeton zosteriformis* | eel-grass pondweed | PMPOT03160 | None | None | G5/S2.2? | 2.2 | Yes |
| *Potentilla basaltica* | Black Rock potentilla | PDROS1B270 | Candidate | None | G1/S1 | 1B.3 | Yes |
| *Potentilla concinna* | early cinquefoil | PDROS1B0F0 | None | None | G5?/S1 | 2.3 | Yes |
| *Potentilla cristae* | crested potentilla | PDROS1B2F0 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Potentilla hickmanii* | Hickman's cinquefoil | PDROS1B0U0 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Potentilla morefieldii* | Morefield's cinquefoil | PDROS1B2R0 | None | None | G2/S2 | 1B.3 | Yes |
| *Potentilla multijuga* | Ballona cinquefoil | PDROS1B120 | None | None | GX/SX | 1A | Yes |
| *Potentilla newberryi* | Newberry's cinquefoil | PDROS1B130 | None | None | G3G4/S2.3? | 2.3 | Yes |
| *Potentilla pulcherrima* | beautiful cinquefoil | PDROS1B2P0 | None | None | G5/S1 | 2.2 | Yes |
| *Potentilla rimicola* | cliff cinquefoil | PDROS1B2G0 | None | None | G2G4/S1 | 2.3 | Yes |
| *Potentilla uliginosa* | Cunningham Marsh cinquefoil | PDROS1B4A0 | None | None | GH/SH | 1A | Yes |
| *Proboscidea althaeifolia* | desert unicorn-plant | PDPED06010 | None | None | G5/S3.3 | 4.3 | No |
| *Prosartes parvifolia* | Siskiyou bells | PMLIL0R014 | None | None | G2?/S2 | 1B.2 | Yes |
| *Prunus eremophila* | Mojave Desert plum | PDROS1C1Q0 | None | None | G1/S1 | 1B.2 | Yes |
| *Prunus fasciculata var. punctata* | sand almond | PDROS1C0E2 | None | None | G5T3/S3.3 | 4.3 | No |
| *Pseudobahia bahiifolia* | Hartweg's golden sunburst | PDAST7P010 | Endangered | Endangered | G2/S2 | 1B.1 | Yes |
| *Pseudobahia peirsonii* | San Joaquin adobe sunburst | PDAST7P030 | Threatened | Endangered | G1/S1 | 1B.1 | Yes |
| *Pseudognaphalium leucocephalum* | white rabbit-tobacco | PDAST440C0 | None | None | G4/S2S3.2 | 2.2 | Yes |
| *Pseudorontium cyathiferum* | Deep Canyon snapdragon | PDSCR2R010 | None | None | G4?/S1 | 2.3 | Yes |
| *Pseudostellaria sierrae* | Sierra starwort | PDCAR13020 | None | None | G3G4/S3S4 | 4.2 | No |
| *Psilocarphus brevissimus var. multiflorus* | Delta woolly-marbles | PDAST7R012 | None | None | G4T3/S3 | 4.2 | No |
| *Psilocarphus elatior* | tall woolly-marbles | PDAST7R020 | None | None | G4Q/S3.3 | 4.3 | No |
| *Psorothamnus arborescens var. arborescens* | Mojave indigo-bush | PDFAB3C011 | None | None | G5T3/S3.3 | 4.3 | No |
| *Psorothamnus fremontii var. attenuatus* | narrow-leaved psorothamnus | PDFAB3C031 | None | None | G5T3?/S2.3 | 2.3 | Yes |
| *Puccinellia howellii* | Howell's alkali grass | PMPOA531A0 | None | None | G1/S1 | 1B.1 | Yes |
| *Puccinellia parishii* | Parish's alkali grass | PMPOA530T0 | None | None | G2G3/S1 | 1B.1 | Yes |
| *Puccinellia pumila* | dwarf alkali grass | PMPOA531B0 | None | None | G4?/SH | 2.2 | Yes |

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|---|---|---|---|---|---|---|---|
| *Pyrola chlorantha* | green-flowered wintergreen | PDPYR04030 | None | None | G5/SH | 1A | Yes |
| *Pyrrocoma lucida* | sticky pyrrocoma | PDASTDT0E0 | None | None | G3/S3 | 1B.2 | Yes |
| *Pyrrocoma racemosa var. congesta* | Del Norte pyrrocoma | PDASTDT0F4 | None | None | G5T4/S2.3 | 2.3 | Yes |
| *Pyrrocoma racemosa var. pinetorum* | pine pyrrocoma | PDASTDT0F2 | None | None | G5T3/S3.2 | 4.2 | No |
| *Pyrrocoma uniflora var. gossypina* | Bear Valley pyrrocoma | PDASTDT0K1 | None | None | G5T1/S1 | 1B.2 | Yes |
| *Quercus cedrosensis* | Cedros Island oak | PDFAG05650 | None | None | G2?/S1 | 2.2 | Yes |
| *Quercus dumosa* | Nuttall's scrub oak | PDFAG050D0 | None | None | G2/S2 | 1B.1 | Yes |
| *Quercus durata var. gabrielensis* | San Gabriel oak | PDFAG050G2 | None | None | G4T3/S3.2 | 4.2 | No |
| *Quercus engelmannii* | Engelmann oak | PDFAG050K0 | None | None | G3/S3.2 | 4.2 | No |
| *Quercus pacifica* | island scrub oak | PDFAG05620 | None | None | G3/S3.2 | 4.2 | No |
| *Quercus parvula var. parvula* | Santa Cruz Island oak | PDFAG051Q1 | None | None | G4T3/S3.2 | 4.2 | No |
| *Quercus parvula var. tamalpaisensis* | Tamalpais oak | PDFAG051Q3 | None | None | G4T2/S2 | 1B.3 | Yes |
| *Quercus tomentella* | island oak | PDFAG05250 | None | None | G3/S3.2 | 4.2 | No |
| *Quercus turbinella* | shrub live oak | PDFAG05270 | None | None | G5/S3.3 | 4.3 | No |
| *Raillardella pringlei* | showy raillardella | PDAST7X030 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Ranunculus hydrocharoides* | frog's-bit buttercup | PDRAN0L190 | None | None | G4G5/S1 | 2.1 | Yes |
| *Ranunculus lobbii* | Lobb's aquatic buttercup | PDRAN0L1J0 | None | None | G4/S3.2 | 4.2 | No |
| *Ranunculus macounii* | Macoun's buttercup | PDRAN0L1M0 | None | None | G5/S2.2 | 2.2 | Yes |
| *Rhamnus alnifolia* | alder buckthorn | PDRHA0C010 | None | None | G5/S2.2 | 2.2 | Yes |
| *Rhamnus pirifolia* | island redberry | PDRHA0C0A0 | None | None | G3/S3.2 | 4.2 | No |
| *Rhus trilobata var. simplicifolia* | single-leaved skunkbrush | PDANA080B5 | None | None | G5T3T5/S2 | 2.3 | Yes |
| *Rhynchospora alba* | white beaked-rush | PMCYP0N010 | None | None | G5/S2 | 2.2 | Yes |
| *Rhynchospora californica* | California beaked-rush | PMCYP0N060 | None | None | G1/S1 | 1B.1 | Yes |
| *Rhynchospora capitellata* | brownish beaked-rush | PMCYP0N080 | None | None | G5/S2S3 | 2.2 | Yes |
| *Rhynchospora globularis* | round-headed beaked-rush | PMCYP0N0W0 | None | None | G5/S1 | 2.1 | Yes |
| *Ribes amarum var. hoffmannii* | Hoffmann's bitter gooseberry | PDGRO02012 | None | None | G4? T2T3/S2S3 | 3 | No |
| *Ribes canthariforme* | Moreno currant | PDGRO02070 | None | None | G1/S1.3 | 1B.3 | Yes |
| *Ribes divaricatum var. parishii* | Parish's gooseberry | PDGRO020F3 | None | None | G4TH/SH | 1A | Yes |
| *Ribes hudsonianum var. petiolare* | western black currant | PDGRO020N2 | None | None | G5T3T5/S2.3? | 2.3 | Yes |
| *Ribes laxiflorum* | trailing black currant | PDGRO020V0 | None | None | G5/S3.3 | 4.3 | No |
| *Ribes marshallii* | Marshall's gooseberry | PDGRO020Z0 | None | None | G4/S3.3 | 4.3 | No |
| *Ribes menziesii var. ixoderme* | aromatic canyon gooseberry | PDGRO02104 | None | None | G4T2/S2.2 | 1B.2 | Yes |

| Scientific Name | Common Name | Element Code | Federal Listing Status | State Listing Status | Heritage Rank | Rare Plant Rank | Records in CNDDB ? |
|---|---|---|---|---|---|---|---|
| *Ribes roezlii var. amictum* | hoary gooseberry | PDGRO021B1 | None | None | G3G4T3/S3.3 | 4.3 | No |
| *Ribes sericeum* | Santa Lucia gooseberry | PDGRO021F0 | None | None | G3/S3.3 | 4.3 | No |
| *Ribes thacherianum* | Santa Cruz Island gooseberry | PDGRO02109 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Ribes tularense* | Sequoia gooseberry | PDGRO021L0 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Ribes viburnifolium* | Santa Catalina Island currant | PDGRO021P0 | None | None | G2/S2 | 1B.2 | Yes |
| *Ribes victoris* | Victor's gooseberry | PDGRO021Q0 | None | None | G3/S3.3 | 4.3 | No |
| *Robinia neomexicana* | New Mexico locust | PDFAB3G070 | None | None | G4/S1.3 | 2.3 | Yes |
| *Romanzoffia tracyi* | Tracy's romanzoffia | PDHYD0E030 | None | None | G4/S1.3 | 2.3 | Yes |
| *Romneya coulteri* | Coulter's matilija poppy | PDPAP0L010 | None | None | G3/S3.2 | 4.2 | No |
| *Rorippa columbiae* | Columbia yellow cress | PDBRA27060 | None | None | G3/S1.1 | 1B.2 | Yes |
| *Rorippa subumbellata* | Tahoe yellow cress | PDBRA270M0 | Candidate | Endangered | G1/S1 | 1B.1 | Yes |
| *Rosa gymnocarpa var. serpentina* | Gasquet rose | PDROS1J1V1 | None | None | G5T2/S2 | 1B.3 | Yes |
| *Rosa minutifolia* | small-leaved rose | PDROS1J1B0 | None | Endangered | G3/SXC | 2.1 | Yes |
| *Rosa pinetorum* | pine rose | PDROS1J0W0 | None | None | G2Q/S2.2 | 1B.2 | Yes |
| *Rubus glaucifolius var. ganderi* | Cuyamaca raspberry | PDROS1K2N1 | None | None | G5T1/S1.1 | 1B.3 | Yes |
| *Rubus nivalis* | snow dwarf bramble | PDROS1K4S0 | None | None | G4?/S1.3? | 2.3 | Yes |
| *Rumex venosus* | winged dock | PDPGN0P1K0 | None | None | G5?/S2.3 | 2.3 | Yes |
| *Rupertia hallii* | Hall's rupertia | PDFAB62010 | None | None | G3/S3 | 1B.2 | Yes |
| *Rupertia rigida* | Parish's rupertia | PDFAB62030 | None | None | G3/S3.3 | 4.3 | No |
| *Sagittaria sanfordii* | Sanford's arrowhead | PMALI040Q0 | None | None | G3/S3 | 1B.2 | Yes |
| *Salix bebbiana* | Bebb's willow | PDSAL020E0 | None | None | G5/S2.3? | 2.3 | Yes |
| *Salix brachycarpa var. brachycarpa* | short-fruited willow | PDSAL020H5 | None | None | G5T5/S1.3? | 2.3 | Yes |
| *Salix delnortensis* | Del Norte willow | PDSAL023F0 | None | None | G4/S3.3 | 4.3 | No |
| *Salix nivalis* | snow willow | PDSAL024K0 | None | None | G5/S1.3 | 2.3 | Yes |
| *Saltugilia caruifolia* | caraway-leaved woodland-gilia | PDPLM040C0 | None | None | G4?/S3.3 | 4.3 | No |
| *Saltugilia latimeri* | Latimer's woodland-gilia | PDPLM0H010 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Salvia brandegeei* | Brandegee's sage | PDLAM1S080 | None | None | G2/S1S2 | 1B.2 | Yes |
| *Salvia dorrii var. incana* | fleshy sage | PDLAM1S0G8 | None | None | G5T5/S1S2 | 3 | No |
| *Salvia eremostachya* | desert sage | PDLAM1S0K0 | None | None | G4G5/S3.3 | 4.3 | No |
| *Salvia funerea* | Death Valley sage | PDLAM1S0M0 | None | None | G3/S3.3 | 4.3 | No |
| *Salvia greatae* | Orocopia sage | PDLAM1S0P0 | None | None | G2/S2 | 1B.3 | Yes |
| *Salvia munzii* | Munz's sage | PDLAM1S140 | None | None | G3/S2.2 | 2.2 | Yes |
| *Sanguisorba officinalis* | great burnet | PDROS1L060 | None | None | G5?/S2.2 | 2.2 | Yes |
| *Sanicula hoffmannii* | Hoffmann's sanicle | PDAPI1Z090 | None | None | G3/S3.3 | 4.3 | No |
| *Sanicula maritima* | adobe sanicle | PDAPI1Z0D0 | None | Rare | G2/S2.2 | 1B.1 | Yes |
| *Sanicula peckiana* | Peck's sanicle | PDAPI1Z0E0 | None | None | G4/S3.3 | 4.3 | No |
| *Sanicula saxatilis* | rock sanicle | PDAPI1Z0H0 | None | Rare | G2/S2 | 1B.2 | Yes |

# Special Vascular Plants, Bryophytes, and Lichens List

## California Department of Fish and Game

### Natural Diversity Database

| Scientific Name | Common Name | Element Code | Federal Listing Status | State Listing Status | Heritage Rank | Rare Plant Rank | Records in CNDDB ? |
|---|---|---|---|---|---|---|---|
| *Sanicula tracyi* | Tracy's sanicle | PDAPI1Z0K0 | None | None | G3/S3.2 | 4.2 | Yes |
| *Sanvitalia abertii* | Abert's sanvitalia | PDAST89010 | None | None | G5/S1S2 | 2.2 | Yes |
| *Sarcobatus baileyi* | Bailey's greasewood | PDCHE0L020 | None | None | G4/S1 | 2.3 | Yes |
| *Saussurea americana* | American saw-wort | PDAST8B020 | None | None | G5/S1.2? | 2.2 | Yes |
| *Saxifraga cespitosa* | tufted saxifrage | PDSAX0U0C0 | None | None | G5/S1.3 | 2.3 | Yes |
| *Saxifraga rufidula* | red-wool saxifrage | PDSAX0U1H0 | None | None | G5?/S1.3 | 2.3 | Yes |
| *Scheuchzeria palustris* | American scheuchzeria | PMSCH02011 | None | None | G5/S1.1 | 2.1 | Yes |
| *Schkuhria multiflora var. multiflora* | many-flowered schkuhria | PDAST8C021 | None | None | G5T5/S1S2 | 2.3 | Yes |
| *Schoenoplectus heterochaetus* | slender bulrush | PMCYP0Q0T0 | None | None | G5/S1.3 | 2.3 | Yes |
| *Schoenoplectus subterminalis* | water bulrush | PMCYP0Q1G0 | None | None | G4G5/S2S3 | 2.3 | Yes |
| *Schoenus nigricans* | black bog-rush | PMCYP0P010 | None | None | G4/S2.2 | 2.2 | Yes |
| *Scirpus pendulus* | pendulous bulrush | PMCYP0Q160 | None | None | G5/S1.2 | 2.2 | Yes |
| *Sclerocactus johnsonii* | Johnson's bee-hive cactus | PDCAC0J0H0 | None | None | G3G4/S2.2 | 2.2 | Yes |
| *Sclerocactus polyancistrus* | Mojave fish-hook cactus | PDCAC0J050 | None | None | G4/S3.2 | 4.2 | No |
| *Scleropogon brevifolius* | burro grass | PMPOA5G010 | None | None | G5/S1.3 | 2.3 | Yes |
| *Scrophularia atrata* | black-flowered figwort | PDSCR1S010 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Scrophularia villosa* | Santa Catalina figwort | PDSCR1S0D0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Scutellaria bolanderi ssp. austromontana* | southern mountains skullcap | PDLAM1U0A1 | None | None | G4T2/S2 | 1B.2 | Yes |
| *Scutellaria galericulata* | marsh skullcap | PDLAM1U0J0 | None | None | G5/S2 | 2.2 | Yes |
| *Scutellaria holmgreniorum* | Holmgren's skullcap | PDLAM1U1C0 | None | None | G3Q/S3.3 | 4.3 | Yes |
| *Scutellaria lateriflora* | side-flowering skullcap | PDLAM1U0Q0 | None | None | G5/S1 | 2.2 | Yes |
| *Sedella leiocarpa* | Lake County stonecrop | PDCRA0F020 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Sedum albomarginatum* | Feather River stonecrop | PDCRA0A030 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Sedum divergens* | Cascade stonecrop | PDCRA0A0B0 | None | None | G5?/S1.3 | 2.3 | Yes |
| *Sedum laxum ssp. eastwoodiae* | Red Mountain stonecrop | PDCRA0A0L1 | Candidate | None | G5T1/S1.2 | 1B.2 | Yes |
| *Sedum laxum ssp. flavidum* | pale yellow stonecrop | PDCRA0A0L2 | None | None | G5T3Q/S3.3 | 4.3 | Yes |
| *Sedum laxum ssp. heckneri* | Heckner's stonecrop | PDCRA0A0L3 | None | None | G5T3Q/S3.3 | 4.3 | No |
| *Sedum niveum* | Davidson's stonecrop | PDCRA0A0R0 | None | None | G3/S3.2 | 4.2 | No |
| *Sedum oblanceolatum* | Applegate stonecrop | PDCRA0A0T0 | None | None | G3/S1.2 | 1B.1 | Yes |
| *Sedum obtusatum ssp. paradisum* | Canyon Creek stonecrop | PDCRA0A0U3 | None | None | G4G5T1/S1.3 | 1B.3 | Yes |
| *Sedum pinetorum* | Pine City sedum | PDCRA0A0Z0 | None | None | G?/SH | 3 | No |
| *Selaginella asprella* | bluish spike-moss | PPSEL01060 | None | None | G4G5/S3.3 | 4.3 | No |
| *Selaginella cinerascens* | ashy spike-moss | PPSEL01090 | None | None | G3G4/S3S4 | 4.1 | No |
| *Selaginella eremophila* | desert spike-moss | PPSEL010G0 | None | None | G4/S2.2? | 2.2 | Yes |
| *Selaginella leucobryoides* | Mojave spike-moss | PPSEL010P0 | None | None | G3/S3.2 | 4.3 | No |

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|---|---|---|---|---|---|---|---|
| *Selaginella scopulorum* | Rocky Mountain spike-moss | PPSEL010C2 | None | None | G4G5/S2S3 | 3 | No |
| *Senecio aphanactis* | chaparral ragwort | PDAST8H060 | None | None | G3?/S1.2 | 2.2 | Yes |
| *Senecio astephanus* | San Gabriel ragwort | PDAST8H090 | None | None | G3/S3 | 4 | No |
| *Senecio blochmaniae* | Blochman's ragwort | PDAST8H0G0 | None | None | G3/S3.2 | 4.2 | No |
| *Senecio clevelandii var. clevelandii* | Cleveland's ragwort | PDAST8H0R1 | None | None | G4?T3Q/S3.3 | 4.3 | No |
| *Senecio clevelandii var. heterophyllus* | Red Hills ragwort | PDAST8H0R2 | None | None | G4?T2Q/S2? | 1B.2 | Yes |
| *Senecio hydrophiloides* | sweet marsh ragwort | PDAST8H400 | None | None | G4G5/S2S3 | 4.2 | No |
| *Senecio pattersonensis* | Mount Patterson senecio | PDAST8H2C0 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Senna covesii* | Cove's cassia | PDFAB491X0 | None | None | G5?/S2 | 2.2 | Yes |
| *Shepherdia canadensis* | Canadian buffalo-berry | PDELG03020 | None | None | G5/S1.2 | 2.1 | Yes |
| *Sibara deserti* | desert winged-rockcress | PDBRA2A010 | None | None | G3/S3.3 | 4.3 | No |
| *Sibara filifolia* | Santa Cruz Island winged-rockcress | PDBRA2A020 | Endangered | None | G1/S1 | 1B.1 | Yes |
| *Sibaropsis hammittii* | Hammitt's clay-cress | PDBRA32010 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Sidalcea calycosa ssp. rhizomata* | Point Reyes checkerbloom | PDMAL11012 | None | None | G5T2/S2.2 | 1B.2 | Yes |
| *Sidalcea celata* | Redding checkerbloom | PDMAL110FG | None | None | G2G3/S2S3 | 3 | No |
| *Sidalcea covillei* | Owens Valley checkerbloom | PDMAL11040 | None | Endangered | G3/S3 | 1B.1 | Yes |
| *Sidalcea elegans* | Del Norte checkerbloom | PDMAL110F5 | None | None | G4?/S2? | 3.3 | No |
| *Sidalcea gigantea* | giant checkerbloom | PDMAL110T0 | None | None | G3/S3 | 4.3 | No |
| *Sidalcea hickmanii ssp. anomala* | Cuesta Pass checkerbloom | PDMAL110A1 | None | Rare | G3T1/S1 | 1B.2 | Yes |
| *Sidalcea hickmanii ssp. hickmanii* | Hickman's checkerbloom | PDMAL110A2 | None | None | G3T2/S2.3 | 1B.3 | Yes |
| *Sidalcea hickmanii ssp. napensis* | Napa checkerbloom | PDMAL110A6 | None | None | G1/S1 | 1B.1 | Yes |
| *Sidalcea hickmanii ssp. parishii* | Parish's checkerbloom | PDMAL110A3 | None | Rare | G3T1/S1.2 | 1B.2 | Yes |
| *Sidalcea hickmanii ssp. pillsburiensis* | Lake Pillsbury checkerbloom | PDMAL110A5 | None | None | G3T1/S1 | 1B.2 | Yes |
| *Sidalcea hickmanii ssp. viridis* | Marin checkerbloom | PDMAL110A4 | None | None | G3T2/S2.2? | 1B.3 | Yes |
| *Sidalcea keckii* | Keck's checkerbloom | PDMAL110D0 | Endangered | None | G1/S1 | 1B.1 | Yes |
| *Sidalcea malachroides* | maple-leaved checkerbloom | PDMAL110E0 | None | None | G3G4/S3S4.2 | 4.2 | Yes |
| *Sidalcea malviflora ssp. dolosa* | Bear Valley checkerbloom | PDMAL110FH | None | None | G5T2T3/S2S3 | 1B.2 | Yes |
| *Sidalcea malviflora ssp. patula* | Siskiyou checkerbloom | PDMAL110F9 | None | None | G5T2/S2 | 1B.2 | Yes |
| *Sidalcea malviflora ssp. purpurea* | purple-stemmed checkerbloom | PDMAL110FL | None | None | G5T2/S2.2 | 1B.2 | Yes |
| *Sidalcea multifida* | cut-leaf checkerbloom | PDMAL110G0 | None | None | G3/S2 | 2.3 | Yes |
| *Sidalcea neomexicana* | Salt Spring checkerbloom | PDMAL110J0 | None | None | G4?/S2S3 | 2.2 | Yes |

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|---|---|---|---|---|---|---|---|
| *Sidalcea oregana ssp. eximia* | coast sidalcea | PDMAL110K9 | None | None | G5T1/S1 | 1B.2 | Yes |
| *Sidalcea oregana ssp. hydrophila* | marsh checkerbloom | PDMAL110K2 | None | None | G5T2?/S2? | 1B.2 | Yes |
| *Sidalcea oregana ssp. valida* | Kenwood Marsh checkerbloom | PDMAL110K5 | Endangered | Endangered | G5T1/S1 | 1B.1 | Yes |
| *Sidalcea pedata* | bird-foot checkerbloom | PDMAL110L0 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Sidalcea robusta* | Butte County checkerbloom | PDMAL110P0 | None | None | G2/S2 | 1B.2 | Yes |
| *Sidalcea stipularis* | Scadden Flat checkerbloom | PDMAL110R0 | None | Endangered | G1/S1 | 1B.1 | Yes |
| *Sidotheca caryophylloides* | chickweed oxytheca | PDPGN0J010 | None | None | G3/S3.3 | 4.3 | No |
| *Sidotheca emarginata* | white-margined oxytheca | PDPGN0J030 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Silene aperta* | Tulare campion | PDCAR0U050 | None | None | G3/S3.3 | 4.3 | No |
| *Silene campanulata ssp. campanulata* | Red Mountain catchfly | PDCAR0U0A2 | None | Endangered | G5T3Q/S3 | 4.2 | Yes |
| *Silene marmorensis* | Marble Mountain campion | PDCAR0U0Z0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Silene occidentalis ssp. longistipitata* | long-stiped campion | PDCAR0U161 | None | None | G4T2Q/S2 | 1B.2 | Yes |
| *Silene occidentalis ssp. occidentalis* | Western campion | PDCAR0U162 | None | None | G4T3/S3 | 4.3 | No |
| *Silene oregana* | Oregon campion | PDCAR0U170 | None | None | G5/S2.3 | 2.3 | Yes |
| *Silene salmonacea* | Klamath Mountain catchfly | PDCAR0U2D0 | None | None | G1G2/S1S2.2 | 1B.2 | Yes |
| *Silene serpentinicola* | serpentine catchfly | PDCAR0U2B0 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Silene suksdorfii* | Cascade alpine campion | PDCAR0U1W0 | None | None | G4/S2.3 | 2.3 | Yes |
| *Silene verecunda ssp. verecunda* | San Francisco campion | PDCAR0U213 | None | None | G5T2/S2.2 | 1B.2 | Yes |
| *Sisyrinchium funereum* | Death Valley blue-eyed grass | PMIRI0D0L0 | None | None | G2G3/S2.3 | 1B.3 | Yes |
| *Sisyrinchium hitchcockii* | Hitchcock's blue-eyed grass | PMIRI0D0S0 | None | None | G2/S1.1 | 1B.1 | Yes |
| *Sisyrinchium longipes* | timberland blue-eyed grass | PMIRI0D0Y0 | None | None | G3/S1.2 | 2.2 | Yes |
| *Smelowskia ovalis* | Lassen Peak smelowskia | PDBRA2D040 | None | None | G1/S1.2 | 1B.2 | Yes |
| *Smilax jamesii* | English Peak greenbrier | PMSMI010D0 | None | None | G2/S2 | 1B.3 | Yes |
| *Solanum clokeyi* | island nightshade | PDSOL0Z450 | None | None | G3/S3.2 | 4.2 | No |
| *Solanum wallacei* | Wallace's nightshade | PDSOL0Z280 | None | None | G2Q/S2.1 | 1B.1 | Yes |
| *Solidago gigantea* | giant goldenrod | PDAST8P0Q0 | None | None | G5/S1.2? | 2.2 | Yes |
| *Solidago guiradonis* | Guirado's goldenrod | PDAST8P0T0 | None | None | G3/S3.2 | 4.2 | No |
| *Sparganium natans* | small bur-reed | PMSPA01090 | None | None | G5/S3.3 | 4.3 | No |
| *Spartina gracilis* | alkali cord grass | PMPOA5S060 | None | None | G5/S3.2 | 4.2 | No |
| *Spergularia canadensis var. occidentalis* | western sand-spurrey | PDCAR0W032 | None | None | G5T4?/S1.1 | 2.1 | Yes |
| *Spermolepis echinata* | bristly scaleseed | PDAPI23020 | None | None | G5/S1.3 | 2.3 | Yes |

# Special Vascular Plants, Bryophytes, and Lichens List

## California Department of Fish and Game

### Natural Diversity Database

| Scientific Name | Common Name | Element Code | Federal Listing Status | State Listing Status | Heritage Rank | Rare Plant Rank | Records in CNDDB ? |
|---|---|---|---|---|---|---|---|
| *Sphaeralcea grossulariifolia* | currant-leaved desert mallow | PDMAL14090 | None | None | G4G5/S2S3 | 2.3 | Yes |
| *Sphaeralcea munroana* | Munro's desert mallow | PDMAL140F0 | None | None | G4/S1.2 | 2.2 | Yes |
| *Sphaeralcea rusbyi var. eremicola* | Rusby's desert-mallow | PDMAL140L1 | None | None | G4T2/S2 | 1B.2 | Yes |
| *Sphaeromeria potentilloides var. nitrophila* | alkali tansy-sage | PDAST8S061 | None | None | G5T4/S2.2 | 2.2 | Yes |
| *Sphenopholis obtusata* | prairie wedge grass | PMPOA5T030 | None | None | G5/S2.2 | 2.2 | Yes |
| *Stachys pilosa* | hairy marsh hedge-nettle | PDLAM1X1A0 | None | None | G5/S2.3 | 2.3 | Yes |
| *Stanleya viridiflora* | green-flowered prince's plume | PDBRA2E060 | None | None | G4/S1S2 | 2.3 | Yes |
| *Stebbinsoseris decipiens* | Santa Cruz microseris | PDAST6E050 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Stellaria littoralis* | beach starwort | PDCAR0X0L0 | None | None | G3G4/S3S4.2 | 4.2 | No |
| *Stellaria longifolia* | long-leaved starwort | PDCAR0X0M0 | None | None | G5/S1.2 | 2.2 | Yes |
| *Stellaria obtusa* | obtuse starwort | PDCAR0X0U0 | None | None | G5/S3.3 | 4.3 | Yes |
| *Stemodia durantifolia* | purple stemodia | PDSCR1U010 | None | None | G5/S2.1? | 2.1 | Yes |
| *Stenotus lanuginosus var. lanuginosus* | woolly stenotus | PDASTCX012 | None | None | G5T3/S3 | 2.2 | Yes |
| *Stipa arida* | Mormon needle grass | PMPOA5X010 | None | None | G5/S2? | 2.3 | Yes |
| *Stipa diegoensis* | San Diego County needle grass | PMPOA5X0B0 | None | None | G3/S3.2 | 4.2 | No |
| *Stipa divaricata* | small-flowered rice grass | PMPOA4J070 | None | None | G5/S2S3 | 2.3 | Yes |
| *Stipa exigua* | little ricegrass | PMPOA4J040 | None | None | G5/S1.3 | 2.3 | Yes |
| *Stipa lemmonii var. pubescens* | pubescent needle grass | PMPOA5X0F2 | None | None | G5T1T2Q/S1.2 ? | 3.2 | No |
| *Streptanthus albidus ssp. albidus* | Metcalf Canyon jewel-flower | PDBRA2G011 | Endangered | None | G2T1/S1 | 1B.1 | Yes |
| *Streptanthus albidus ssp. peramoenus* | most beautiful jewel-flower | PDBRA2G012 | None | None | G2T2/S2.2 | 1B.2 | Yes |
| *Streptanthus barbiger* | bearded jewel-flower | PDBRA2G040 | None | None | G3/S3.2 | 4.2 | No |
| *Streptanthus batrachopus* | Tamalpais jewel-flower | PDBRA2G050 | None | None | G1/S1.2 | 1B.3 | Yes |
| *Streptanthus bernardinus* | Laguna Mountains jewel-flower | PDBRA2G060 | None | None | G3/S3 | 4.3 | Yes |
| *Streptanthus brachiatus ssp. brachiatus* | Socrates Mine jewel-flower | PDBRA2G072 | None | None | G2T1/S1.2 | 1B.2 | Yes |
| *Streptanthus brachiatus ssp. hoffmanii* | Freed's jewel-flower | PDBRA2G071 | None | None | G2T1/S1.2 | 1B.2 | Yes |
| *Streptanthus callistus* | Mt. Hamilton jewel-flower | PDBRA2G0A0 | None | None | G1/S1 | 1B.3 | Yes |
| *Streptanthus campestris* | southern jewel-flower | PDBRA2G0B0 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Streptanthus cordatus var. piutensis* | Piute Mountains jewel-flower | PDBRA2G0D2 | None | None | G5T1/S1.2 | 1B.2 | Yes |
| *Streptanthus drepanoides* | sickle-fruit jewel-flower | PDBRA2G200 | None | None | G3/S3.3 | 4.3 | No |
| *Streptanthus farnsworthianus* | Farnsworth's jewel-flower | PDBRA2G0G0 | None | None | G3/S3.3 | 4.3 | No |

| Scientific Name | Common Name | Element Code | Federal Listing Status | State Listing Status | Heritage Rank | Rare Plant Rank | Records in CNDDB ? |
|---|---|---|---|---|---|---|---|
| *Streptanthus fenestratus* | Tehipite Valley jewel-flower | PDBRA2G0H0 | None | None | G2/S2 | 1B.3 | Yes |
| *Streptanthus glandulosus ssp. hoffmanii* | Hoffman's bristly jewel-flower | PDBRA2G0J4 | None | None | G4TH/SH | 1B.3 | Yes |
| *Streptanthus glandulosus ssp. niger* | Tiburon jewel-flower | PDBRA2G0T0 | Endangered | Endangered | G4T1/S1 | 1B.1 | Yes |
| *Streptanthus glandulosus ssp. pulchellus* | Mount Tamalpais bristly jewel-flower | PDBRA2G0J2 | None | None | G4T1/S1.2 | 1B.2 | Yes |
| *Streptanthus gracilis* | alpine jewel-flower | PDBRA2G0K0 | None | None | G3/S3 | 1B.3 | Yes |
| *Streptanthus hesperidis* | green jewel-flower | PDBRA2G510 | None | None | G2/S2 | 1B.2 | Yes |
| *Streptanthus hispidus* | Mt. Diablo jewel-flower | PDBRA2G0M0 | None | None | G1/S1.2 | 1B.3 | Yes |
| *Streptanthus howellii* | Howell's jewel-flower | PDBRA2G0N0 | None | None | G2/S1.2 | 1B.2 | Yes |
| *Streptanthus insignis ssp. lyonii* | Arburua Ranch jewel-flower | PDBRA2G0Q1 | None | None | G3G4T1/S1.2 | 1B.2 | Yes |
| *Streptanthus longisiliqus* | long-fruit jewel-flower | PDBRA2G400 | None | None | G3/S3.3 | 4.3 | No |
| *Streptanthus morrisonii* | Morrison's jewel-flower | PDBRA2G0S0 | None | None | G2/S2 | | Yes |
| *Streptanthus morrisonii ssp. elatus* | Three Peaks jewel-flower | PDBRA2G0S1 | None | None | G2T2/S2.2 | 1B.2 | No |
| *Streptanthus morrisonii ssp. hirtiflorus* | Dorr's Cabin jewel-flower | PDBRA2G0S2 | None | None | G2T1/S1.2 | 1B.2 | No |
| *Streptanthus morrisonii ssp. kruckebergii* | Kruckeberg's jewel-flower | PDBRA2G0S4 | None | None | G2T1/S1.2 | 1B.2 | No |
| *Streptanthus morrisonii ssp. morrisonii* | Morrison's jewel-flower | PDBRA2G0S3 | None | None | G2T2/S2.2 | 1B.2 | No |
| *Streptanthus oblanceolatus* | Trinity River jewel-flower | PDBRA2G500 | None | None | G1/S1 | 1B.2 | Yes |
| *Streptanthus oliganthus* | Masonic Mountain jewel-flower | PDBRA2G0V0 | None | None | G3/S2.2 | 1B.2 | Yes |
| *Streptanthus vernalis* | early jewel-flower | PDBRA2G120 | None | None | G1/S1 | 1B.2 | Yes |
| *Stuckenia filiformis* | slender-leaved pondweed | PMPOT03090 | None | None | G5/S1S2 | 2.2 | Yes |
| *Stylocline citroleum* | oil neststraw | PDAST8Y070 | None | None | G2/S2 | 1B.1 | Yes |
| *Stylocline masonii* | Mason's neststraw | PDAST8Y080 | None | None | G1/S1.1 | 1B.1 | Yes |
| *Stylocline sonorensis* | mesquite neststraw | PDAST8Y060 | None | None | G3G5/SX | 1A | Yes |
| *Suaeda californica* | California seablite | PDCHE0P020 | Endangered | None | G1/S1 | 1B.1 | Yes |
| *Suaeda esteroa* | estuary seablite | PDCHE0P0D0 | None | None | G3/S2 | 1B.2 | Yes |
| *Suaeda occidentalis* | western seablite | PDCHE0P080 | None | None | G5/S2.3 | 2.3 | Yes |
| *Suaeda taxifolia* | woolly seablite | PDCHE0P0L0 | None | None | G3?/S2S3 | 4.2 | No |
| *Subularia aquatica ssp. americana* | American water-awlwort | PDBRA2H012 | None | None | G5T5/S4.3 | 4.3 | No |
| *Swallenia alexandrae* | Eureka Valley dune grass | PMPOA5Y010 | Endangered | Rare | G2/S2 | 1B.2 | Yes |
| *Swertia albomarginata* | desert green-gentian | PDGEN05020 | None | None | G5/S3.3 | 4.3 | No |
| *Symphyotrichum defoliatum* | San Bernardino aster | PDASTE80C0 | None | None | G2/S2 | 1B.2 | Yes |
| *Symphyotrichum greatae* | Greata's aster | PDASTE80U0 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Symphyotrichum lentum* | Suisun Marsh aster | PDASTE8470 | None | None | G2/S2 | 1B.2 | Yes |

# Special Vascular Plants, Bryophytes, and Lichens List

## California Department of Fish and Game

### Natural Diversity Database

| Scientific Name | Common Name | Element Code | Federal Listing Status | State Listing Status | Heritage Rank | Rare Plant Rank | Records in CNDDB ? |
|---|---|---|---|---|---|---|---|
| *Synthyris missurica ssp. missurica* | kitten-tails | PDSCR1W042 | None | None | G4T4/S2.3 | 2.3 | Yes |
| *Syntrichopappus lemmonii* | Lemmon's syntrichopappus | PDAST90020 | None | None | G3/S3.3 | 4.3 | No |
| *Systenotheca vortriedei* | Vortriede's spineflower | PDPGN0W010 | None | None | G3/S3.3 | 4.3 | No |
| *Taraxacum californicum* | California dandelion | PDAST93050 | Endangered | None | G2/S2 | 1B.1 | Yes |
| *Taraxacum ceratophorum* | horned dandelion | PDAST930Y1 | None | None | G5/S1.1 | 2.1 | Yes |
| *Tauschia glauca* | glaucous tauschia | PDAPI27020 | None | None | G4/S3.3 | 4.3 | No |
| *Tauschia howellii* | Howell's tauschia | PDAPI27050 | None | None | G2/S2 | 1B.3 | Yes |
| *Tetracoccus dioicus* | Parry's tetracoccus | PDEUP1C010 | None | None | G3/S2.2 | 1B.2 | Yes |
| *Tetracoccus hallii* | Hall's tetracoccus | PDEUP1C021 | None | None | G4/S3.3 | 4.3 | No |
| *Tetracoccus ilicifolius* | holly-leaved tetracoccus | PDEUP1C030 | None | None | G1/S1.3 | 1B.3 | Yes |
| *Tetradymia argyraea* | striped horsebrush | PDAST95010 | None | None | G4?/S3.3 | 4.3 | No |
| *Tetradymia tetrameres* | dune horsebrush | PDAST950A0 | None | None | G4/S1.2 | 2.2 | Yes |
| *Teucrium cubense ssp. depressum* | dwarf germander | PDLAM20032 | None | None | G4G5T3T4/S2 | 2.2 | Yes |
| *Teucrium glandulosum* | desert germander | PDLAM20040 | None | None | G4/S1.3 | 2.3 | Yes |
| *Thalictrum alpinum* | arctic meadow-rue | PDRAN0M010 | None | None | G5/S3.3 | 4.3 | No |
| *Thelypodium brachycarpum* | short-podded thelypodium | PDBRA2N010 | None | None | G3/S3.2 | 4.2 | No |
| *Thelypodium howellii ssp. howellii* | Howell's thelypodium | PDBRA2N051 | None | None | G2T2/S2 | 1B.2 | Yes |
| *Thelypodium integrifolium ssp. complanatum* | foxtail thelypodium | PDBRA2N062 | None | None | G5T5/S2.2 | 2.2 | Yes |
| *Thelypodium milleflorum* | many-flowered thelypodium | PDBRA2N0A0 | None | None | G5/S2S3 | 2.2 | Yes |
| *Thelypodium stenopetalum* | slender-petaled thelypodium | PDBRA2N0F0 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Thelypteris puberula var. sonorensis* | Sonoran maiden fern | PPTHE05192 | None | None | G5T3/S2.2? | 2.2 | Yes |
| *Thermopsis californica var. argentata* | silvery false lupine | PDFAB3Z011 | None | None | G3T3/S3.3 | 4.3 | No |
| *Thermopsis californica var. semota* | velvety false lupine | PDFAB3Z013 | None | None | G3T2/S2.1 | 1B.2 | Yes |
| *Thermopsis gracilis* | slender false lupine | PDFAB3Z0C0 | None | None | G3G4/S3.3 | 4.3 | No |
| *Thermopsis macrophylla* | Santa Ynez false lupine | PDFAB3Z0E0 | None | Rare | G1/S1.3 | 1B.3 | Yes |
| *Thermopsis robusta* | robust false lupine | PDFAB3Z0D0 | None | None | G2Q/S2.2 | 1B.2 | Yes |
| *Thysanocarpus conchuliferus* | Santa Cruz Island fringepod | PDBRA2Q060 | Endangered | None | G1/S1 | 1B.2 | Yes |
| *Thysanocarpus rigidus* | rigid fringepod | PDBRA2Q070 | None | None | G1G2/S1S2 | 1B.2 | Yes |
| *Tiarella trifoliata var. trifoliata* | trifoliate laceflower | PDSAX10031 | None | None | G5T5/S2S3 | 3 | No |
| *Tiquilia canescens var. pulchella* | Chocolate Mountains tiquilia | PDBOR0Y012 | None | None | G5T3T4/S3? | 3.2 | No |
| *Tonestus eximius* | Tahoe tonestus | PDASTE0030 | None | None | G3/S3.3 | 4.3 | No |

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|---|---|---|---|---|---|---|---|
| *Tonestus lyallii* | Lyall's tonestus | PDASTE0050 | None | None | G5/S1.3? | 2.3 | Yes |
| *Tonestus peirsonii* | Peirson's tonestus | PDASTE0070 | None | None | G3/S3.3 | 4.3 | No |
| *Townsendia condensata* | cushion townsendia | PDAST9C040 | None | None | G4/S1.3 | 2.3 | Yes |
| *Townsendia leptotes* | slender townsendia | PDAST9C0F0 | None | None | G4/S2.3 | 2.3 | Yes |
| *Toxicoscordion fontanum* | marsh zigadenus | PMLIL28050 | None | None | G3/S3.2 | 4.2 | No |
| *Tracyina rostrata* | beaked tracyina | PDAST9D010 | None | None | G1G2/S1S2.2 | 1B.2 | Yes |
| *Tragia ramosa* | desert tragia | PDEUP1D090 | None | None | G5/S3.3 | 4.3 | No |
| *Transberingia bursifolia ssp. virgata* | virgate halimolobos | PDBRA1A040 | None | None | G4T?/S1.3? | 2.3 | Yes |
| *Trichocoronis wrightii var. wrightii* | Wright's trichocoronis | PDAST9F031 | None | None | G4T3/S1.1 | 2.1 | Yes |
| *Trichophorum pumilum* | little bulrush | PMCYP0Q250 | None | None | G5/S1.2 | 2.2 | Yes |
| *Trichostema austromontanum ssp. compactum* | Hidden Lake bluecurls | PDLAM22022 | Threatened | None | G3G4T1/S1 | 1B.1 | Yes |
| *Trichostema micranthum* | small-flowered bluecurls | PDLAM22080 | None | None | G4/S3.3 | 4.3 | No |
| *Trichostema ovatum* | San Joaquin bluecurls | PDLAM220A0 | None | None | G3/S3.2 | 4.2 | No |
| *Trichostema rubisepalum* | Hernandez bluecurls | PDLAM220C0 | None | None | G3/S3.3 | 4.3 | No |
| *Trichostema ruygtii* | Napa bluecurls | PDLAM220H0 | None | None | G2/S2 | 1B.2 | Yes |
| *Trientalis europaea* | arctic starflower | PDPRI0A030 | None | None | G5/S1 | 2.2 | Yes |
| *Trifolium amoenum* | showy rancheria clover | PDFAB40040 | Endangered | None | G1/S1 | 1B.1 | Yes |
| *Trifolium andersonii ssp. andersonii* | Anderson's clover | PDFAB40055 | None | None | G4T3/S3.3 | 4.3 | No |
| *Trifolium bolanderi* | Bolander's clover | PDFAB400G0 | None | None | G2G3/S2S3 | 1B.2 | Yes |
| *Trifolium buckwestiorum* | Santa Cruz clover | PDFAB402W0 | None | None | G1/S1.1 | 1B.1 | Yes |
| *Trifolium dedeckerae* | Dedecker's clover | PDFAB400Q0 | None | None | G2/S2.3 | 1B.3 | Yes |
| *Trifolium gymnocarpon ssp. plummerae* | Plummer's clover | PDFAB40112 | None | None | G5T4/S2.3 | 2.3 | Yes |
| *Trifolium howellii* | Howell's clover | PDFAB40140 | None | None | G4/S3.3 | 4.3 | No |
| *Trifolium hydrophilum* | saline clover | PDFAB400R5 | None | None | G2/S2 | 1B.2 | Yes |
| *Trifolium jokerstii* | Butte County golden clover | PDFAB40310 | None | None | G1/S1.2 | 1B.2 | Yes |
| *Trifolium lemmonii* | Lemmon's clover | PDFAB401C0 | None | None | G4?/S3.2 | 4.2 | No |
| *Trifolium palmeri* | southern island clover | PDFAB40102 | None | None | G3/S3.2 | 4.2 | No |
| *Trifolium polyodon* | Pacific Grove clover | PDFAB402H0 | None | Rare | G1Q/S1.1 | 1B.1 | Yes |
| *Trifolium siskiyouense* | Siskiyou clover | PDFAB402S0 | None | None | G3G4Q/S2.2 | 3.2 | No |
| *Trifolium trichocalyx* | Monterey clover | PDFAB402J0 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Triglochin palustris* | marsh arrow-grass | PMJCG02040 | None | None | G5/S2.3 | 2.3 | Yes |
| *Trillium ovatum ssp. oettingeri* | Salmon Mountains wakerobin | PMLIL200M1 | None | None | G5T3/S3.2 | 4.2 | No |
| *Triphysaria floribunda* | San Francisco owl's-clover | PDSCR2T010 | None | None | G2/S2.2 | 1B.2 | Yes |
| *Tripterocalyx crux-maltae* | Kellogg's sand-verbena | PDNYC0G020 | None | None | G4/S1.2 | 2.2 | Yes |
| *Tripterocalyx micranthus* | small-flowered sand-verbena | PDNYC0G030 | None | None | G5/S1.3 | 2.3 | Yes |

# Special Vascular Plants, Bryophytes, and Lichens List

## California Department of Fish and Game

### Natural Diversity Database

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|---|---|---|---|---|---|---|---|
| *Triteleia clementina* | San Clemente Island triteleia | PMLIL21020 | None | None | G1/S1.2 | 1B.2 | Yes |
| *Triteleia crocea var. crocea* | yellow triteleia | PMLIL21031 | None | None | G4T4/S3.3 | 4.3 | No |
| *Triteleia crocea var. modesta* | Trinity Mountains triteleia | PMLIL21032 | None | None | G4T3/S3.3 | 4.3 | No |
| *Triteleia grandiflora* | Howell's triteleia | PMLIL21060 | None | None | G3G4/S1.1 | 2.1 | Yes |
| *Triteleia hendersonii* | Henderson's triteleia | PMLIL21070 | None | None | G4/S1.2 | 2.2 | Yes |
| *Triteleia ixioides ssp. cookii* | Cook's triteleia | PMLIL210A2 | None | None | G5T2/S2.3 | 1B.3 | Yes |
| *Triteleia lugens* | dark-mouthed triteleia | PMLIL210D0 | None | None | G3/S3.3 | 4.3 | No |
| *Tropidocarpum californicum* | Kings gold | PDBRA33010 | None | None | G1/S1.1 | 1B.1 | Yes |
| *Tropidocarpum capparideum* | caper-fruited tropidocarpum | PDBRA2R010 | None | None | G1/S1.1 | 1B.1 | Yes |
| *Tuctoria greenei* | Greene's tuctoria | PMPOA6N010 | Endangered | Rare | G1/S1 | 1B.1 | Yes |
| *Tuctoria mucronata* | Crampton's tuctoria or Solano grass | PMPOA6N020 | Endangered | Endangered | G1/S1 | 1B.1 | Yes |
| *Utricularia intermedia* | flat-leaved bladderwort | PDLNT020A0 | None | None | G5/S2.2 | 2.2 | Yes |
| *Utricularia minor* | lesser bladderwort | PDLNT020D0 | None | None | G5/S3.2 | 4.2 | No |
| *Utricularia ochroleuca* | cream-flowered bladderwort | PDLNT020E0 | None | None | G4?/S1.2 | 2.2 | Yes |
| *Vaccinium coccineum* | Siskiyou Mountains huckleberry | PDERI181N0 | None | None | G3G4/S3? | 3.3 | No |
| *Vaccinium scoparium* | little-leaved huckleberry | PDERI180Y0 | None | None | G5/S2.2? | 2.2 | Yes |
| *Vahlodea atropurpurea* | mountain hair grass | PMPOA6M010 | None | None | G5/S3.3 | 4.3 | No |
| *Valeriana occidentalis* | western valerian | PDVAL03080 | None | None | G5/S1.3 | 2.3 | Yes |
| *Vancouveria chrysantha* | Siskiyou inside-out-flower | PDBER09010 | None | None | G4/S3.3 | 4.3 | No |
| *Veratrum fimbriatum* | fringed false-hellebore | PMLIL25030 | None | None | G3/S3.3 | 4.3 | No |
| *Veratrum insolitum* | Siskiyou false-hellebore | PMLIL25040 | None | None | G3/S3.3 | 4.3 | No |
| *Verbena californica* | Red Hills vervain | PDVER0N050 | Threatened | Threatened | G2/S2 | 1B.1 | Yes |
| *Verbesina dissita* | big-leaved crownbeard | PDAST9R050 | Threatened | Threatened | G2G3/S1 | 1B.1 | Yes |
| *Veronica copelandii* | Copeland's speedwell | PDSCR200B0 | None | None | G3/S3.3 | 4.3 | No |
| *Veronica cusickii* | Cusick's speedwell | PDSCR200C0 | None | None | G5/S3.3 | 4.3 | No |
| *Viburnum edule* | squashberry | PDCPR07070 | None | None | G5/S1 | 2.1 | Yes |
| *Viburnum ellipticum* | oval-leaved viburnum | PDCPR07080 | None | None | G5/S2.3 | 2.3 | Yes |
| *Viguiera laciniata* | San Diego County viguiera | PDAST9T060 | None | None | G4/S3.2 | 4.2 | No |
| *Viguiera purisimae* | La Purisima viguiera | PDAST9T0S0 | None | None | G4?/S1.3 | 2.3 | Yes |
| *Viola howellii* | Howell's violet | PDVIO040U0 | None | None | G4/S1 | 2.2 | Yes |
| *Viola langsdorffii* | Langsdorf's violet | PDVIO04100 | None | None | G4/S1.1 | 2.1 | Yes |
| *Viola palustris* | alpine marsh violet | PDVIO041G0 | None | None | G5/S1S2 | 2.2 | Yes |
| *Viola pinetorum var. grisea* | grey-leaved violet | PDVIO04431 | None | None | G4G5T2T3/S2S3 | 1B.3 | Yes |

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|---|---|---|---|---|---|---|---|
| *Viola primulifolia ssp. occidentalis* | western white bog violet | PDVIO040Y2 | None | None | G5T2/S2.2 | 1B.2 | Yes |
| *Viola purpurea ssp. aurea* | golden violet | PDVIO04420 | None | None | G5T2T3/S2S3 | 2.2 | Yes |
| *Viola tomentosa* | felt-leaved violet | PDVIO04280 | None | None | G3/S3.2 | 4.2 | Yes |
| *Wislizenia refracta ssp. palmeri* | Palmer's jackass clover | PDCPP09015 | None | None | G5T2T4/S2? | 2.2 | Yes |
| *Wislizenia refracta ssp. refracta* | jackass-clover | PDCPP09013 | None | None | G5T5?/S1.2? | 2.2 | Yes |
| *Wolffia brasiliensis* | Brazilian watermeal | PMLEM03020 | None | None | G5/S1.3 | 2.3 | Yes |
| *Woodsia plummerae* | Plummer's woodsia | PPDRY0U0A0 | None | None | G5/S1.3? | 2.3 | Yes |
| *Wyethia elata* | Hall's wyethia | PDAST9X050 | None | None | G3/S3.3 | 4.3 | No |
| *Wyethia longicaulis* | Humboldt County wyethia | PDAST9X0A0 | None | None | G3/S3.3 | 4.3 | No |
| *Wyethia reticulata* | El Dorado County mule ears | PDAST9X0D0 | None | None | G2/S2 | 1B.2 | Yes |
| *Xanthisma gracile* | annual bristleweed | PDAST640E0 | None | None | G5/S3.3 | 4.3 | No |
| *Xanthisma junceum* | rush-like bristleweed | PDAST641A0 | None | None | G5/S3.3 | 4.3 | No |
| *Xylorhiza cognata* | Mecca-aster | PDASTA1010 | None | None | G2/S2 | 1B.2 | Yes |
| *Xylorhiza orcuttii* | Orcutt's woody-aster | PDASTA1040 | None | None | G2G3/S2 | 1B.2 | Yes |

State of California
The Natural Resources Agency
DEPARTMENT OF FISH AND GAME
Biogeographic Data Branch
California Natural Diversity Database

**SPECIAL ANIMALS (898 taxa)**
January 2011

The California Natural Diversity Database (CNDDB) is a continually refined and updated, computerized inventory of location information on the most rare animals, plants, and natural communities in California. The blueprint used to set up the CNDDB was developed by The Nature Conservancy (TNC) in the early 1970's. The California program was started in 1979. TNC has helped to set up similar programs in all 50 states and a number of foreign countries. Collectively these programs are known as the Natural Heritage Network. The "Heritage Methodology" used by all of these programs sets the standards for the information we gather and the procedures we use. In 1999 TNC and the Natural Heritage Network jointly established an independent organization, the Association for Biodiversity Information (ABI), to achieve their mutual goal of using the wealth of biodiversity information in the Heritage Network to support conservation efforts. In November 2001 ABI changed its name to NatureServe. More information the Natural Heritage Network is available on the NatureServe web site: **http://www.natureserve.org**.

"Special Animals" is a general term that refers to all of the taxa the CNDDB is interested in tracking, regardless of their legal or protection status. This list is also referred to as the list of "species at risk" or "special status species". The Department of Fish and Game considers the taxa on this list to be those of greatest conservation need. The species on this list in 2005 were used in the development of California's Wildlife Action Plan (available at: **http://www.dfg.ca.gov/wildlife/WAP** )

The species on this list generally fall into one or more of the following categories:

- Officially listed or proposed for listing under the State and/or Federal Endangered Species Acts.
- State or Federal candidate for possible listing.
- Taxa which meet the criteria for listing, even if not currently included on any list, as described in Section 15380 of the California Environmental Quality Act Guidelines. (More information on CEQA is available at **http://ceres.ca.gov/topic/env_law/ceqa/guidelines/**
- Taxa considered by the Department to be a Species of Special Concern (SSC)
- Taxa that are biologically rare, very restricted in distribution, declining throughout their range, or have a critical, vulnerable stage in their life cycle that warrants monitoring. There may be taxa that fall into this category but are not included on this list because their status has not been called to our attention.
- Populations in California that may be on the periphery of a taxon's range, but are threatened with extirpation in California.

- Taxa closely associated with a habitat that is declining in California at an alarming rate (e.g., wetlands, riparian, old growth forests, desert aquatic systems, native grasslands, vernal pools, etc.)
- Taxa designated as a special status, sensitive, or declining species by other state or federal agencies, or non-governmental organization (NGO).

Taxa marked with a "+" to the left of the scientific name are those for which there is location information in the CNDDB Geographic Information System (GIS), as of the date of this list.

Taxa with a "Yes" in the "Notes" column have more information in an end note at the back of the list.

Additional information on the CNDDB is available on the Department of Fish and Game web site at: **http://www.dfg.ca.gov/biogeodata/cnddb** .
Additional information on other Department resource management programs is available at: **http://www.dfg.ca.gov/about/resource-mgmt.html .** The Species Conservation & Recovery Program page at: **http://www.dfg.ca.gov/wildlife/nongame** is a particularly rich source of information including such topics as "Survey Standards and Guidelines", "Threats to Wildlife", "Habitats", and "Plant and Animal Pictures".

**What is an Element Occurrence?**

An element Occurrence (EO) is a location where the element (species) has been documented to occur. **An EO is not a population**, but it may indicate that a population is present in that area; and a single population may be represented by more than one EO. An EO is based upon the source documents available to us at the time it was mapped. Both the mapped feature and the text portion of EO's are updated as new information becomes available.

**Element Occurrence (EO) Definition:**

The EO definition refers to the types of information we map. For most animal taxa, the CNDDB is interested in information that indicates the presence of a resident population. For many birds, however, the CNDDB tracks only nesting locations, (those species are so indicated on the list). Detailed information about avian detections is available at: **http://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=25731** . For other taxa where we track only a certain part of their range or life history, the area or life stage is indicated on the list.

**Mapping Conventions:**

Our information is mapped as precisely as possible, based upon the source materials used to map the element occurrence (EO). More vague location information is mapped with the larger circular features and more precise location information is mapped with 80m radius circles or polygon features. Generally, observations/collections within ¼ mile, within continuous habitat, are combined into a single element occurrence (EO). However, there are exceptions such as nest trees for Swainson's hawk, where each known nest tree is mapped.

**Taxonomic References and Sources of Additional Information:**

We follow the most current published taxonomy.

For butterflies we followed the taxonomy used by NatureServe:
**http://www.natureserve.org/explorer/**

For fish we used:


Moyle, P. B. 2002. Inland Fishes of California. University of California Press.

Nelson, J.S., E.J. Crossman, H. Espinosa-Perea, L.T. Findley, C.R. Gilbert, R. N. Lea, and J. D. Williams. 2004. Common and scientific names of fishes from the United States, Canada, and Mexico. American Fisheries Society, Special Publication 29, Bethesda, Maryland. 386 pp.

Jelks, H.L., S.J. Walsh, N.M. Burkhead, S.Contreras-Balderas, E. Díaz-Pardo, D.A. Hendrickson, J. Lyons, N.E. Mandrak, F. McCormick, J.S. Nelson, S.P. Platania, B.A. Porter, C.B. Renaud, J. J. Schmitter-Soto, E.B. Taylor, and M.L. Warren, Jr. 2008. Conservation status of imperiled North American freshwater and diadromous fishes. Fisheries 33(8):372-407. Available at: http://www.fisheries.org/afs/docs/fisheries/fisheries_3308.pdf


For reptiles and amphibians, most changes are explained and referenced on the Center for North American Herpetology web site: **http://www.cnah.org**. In addition, we made taxonomic changes based on the following papers:


Collins, Joseph T. and Travis W. Taggart. 2009. Standard Common & Current Scientific Names for North American Amphibians, Turtles, Reptiles, and Corcodilians. Sixth Edition. Publication of the Center for North American Herpetology, Lawrence. iv + 44 pp. Available at: http://www.cnah.org/index.asp

Feldman, C. R. & J. F. Parham. 2002. Molecular phylogenetics of emydine turtles: Taxonomic revision and the evolution of shell kinesis. Molecular Phylogenetics and Evolution 22(3): 388-398. Available at: http://www.cnah.org/cnah_pdf.asp

Frost, Grant, Faivovich, Bain, Haas, Haddad, De Sá, Channing, Wilkinson, Donnellan, Raxworthy, Campbell, Blotto, Moler, Drewes, Nussbaum, Lynch, Green & Wheeler. 2006. The Amphibian Tree of Life. Bulletin of the American Museum of Natural History 297: 1-370. Available at: http://digitallibrary.amnh.org/dspace/bitstream/2246/5781/1/B297.pdf

Frost, Darrel, Joseph Mendelson,III, and Jennifer Pramuk. 2009 Further Notes on the Nomenclature of Middle American Toads (Bufonidae). Copeia 2009, No. 2, 418. Available at: http://www.cnah.org/cnah_pdf.asp

Goebel, A. M., T. A. Ranker, P. S. Corn, & R. G. Olmstead. 2009. Mitochondrial DNA evolution in the *Anaxyrus boreas* species group. Molecular Phylogenetics and Evolution 50(2009) 209-225. Available at: http://www.cnah.org/cnah_pdf.asp

Hollingsworth, B. D. 1998. The systematics of chuckwallas (SAUROMALUS) with a phylogenetic analysis of other iguanid lizards. Herpetological Monographs (12):38-191.

Holman, J.A. & U. Fritz. 2001. A new emydine species from the Medial Miocene (Barstovian) of Nebraska, USA with a new generic arrangement for the species of *Clemmys* sensu McDowell (1964) (Reptilia: Testudines: Emydidae). Zoologische Abhandlungen Staatliches Museum fur Tiekunde Dresden 51(19)321-344. Available at: http://www.cnah.org/cnah_pdf.asp

Leache, Adam, D, Michelle S. Koo, Carol L. Spencer, Theodore J. Papenfuss, Robert N. Fisher & Jimmy A. McGuire. 2009. Quantifying Ecological, Morphological, and Genetic Variation to Delimit Species in the Coast Horned Lizard Species Complex (*Phrynosoma*). PNAS. 106(30):12418-12423. Available at: http://www.pnas.org/content/106/30/12418.full

Mead, Louise S., David R. Clayton, Richard S. Nauman, Deanna H. Olsen, & Michael E. Pfrender. 2005. Newly discovered populations of salamanders from Siskiyou County, California, represent a species distinct from Plethodon stormi. Herpetologica 61(2): 158-77. Available at: http://www.cnah.org/cnah_pdf.asp

Reeder, T., C. J Cole & H. C. Dessauer. 2002. Phylogenetic Relationships of Whiptail Lizards of the Genus Cnemidophorus (Squamata: Teiidae): A Test of monophyly, reevaluation of karyotypic evolution, and review of hybrid origins. American Museum Novitates No. 3365. 61pp. Available at: http://www.cnah.org/cnah_pdf.asp

Shaffer, H. Bradley, G. M. Fellers, S. Randal Voss, J. C. Oliver & Gregory B. Pauly. 2004. Species boundaries, phylogeography and conservation genetics of the red-legged frog (*Rana aurora/draytonii*) complex. Molecular Ecology (2004) 13, 2667-2677. Available at: http://www.cnah.org/cnah_pdf.asp

Spinks, Phillip Q. & H. Bradley Shaffer. 2005. Range-wide molecular analysis of the western pond turtle (Emys marmorata): cryptic variation, isolation by distance, and their conservation implications. Molecular Ecology (2005) 14, 2047-2064. Available at: http://www2.eve.ucdavis.edu/shafferlab/pubs/SpinksMolEcol2005.pdf

Spinks, Phillip Q. & H. Bradley Shaffer. 2009. Conflicting mitochondrial and muclear phylogenies for the widely disjunct Emys (Testudines: Emydidae) species comples, and what they tell us about biogeography and hybridization. Systematic Biology. 58(1):pp 1-20. Available at: http://www.eve.ucdavis.edu/shafferlab/pubs/SpinksSysBio2009.pdf

Stephens, Patrick R. and John J. Wiens. 2003, Ecological Diversification and Phylogeny of Emydid Turtles. Biological Journal of the Linnean Society 79: 577-610. Available at: http://www.cnah.org/cnah_pdf.asp

Vredenburg, V.T., R. Bingham, R. Knapp, J.A.T. Morgan, C. Moritz & D. Wake. 2007. Concordant molecular and phenotypic data delineate new taxonomy and conservation priorities for the endangered mountain yellow-legged frog. Journal of Zoology 271 (2007) 361-374. Available at: http://www.cnah.org/cnah_pdf.asp

For birds we made taxonomic changes based on the following papers:

American Ornithologists' Union (AOU). 1998. Check-list of North American birds. Seventh edition. American Ornithologists' Union, Washington, D.C. 829 pp. Available at: http://www.aou.org/checklist/north/index.php

Banks, R. C. , R. T. Chesser, C.Cicero, J. L. Dunn, A. W. Kratter, I. J. Lovette, P. C. Rasmussen, J. V. Remsen Jr., J. D. Rising, D. F. Stotz, & K. Winker. 2008. Forty-ninth Supplement to the American Ornithologists' Union *Check-list of North American Birds.* The Auk 125(3):758-768. Available at: http://www.aou.org/checklist/north/print.php

Barrowclough, Geroge F., Jeff G. Groth, Lisa A. Mertz and R. J. Gutierrez. 2004. Phylogeographic structure, gene flow and species status in blue grouse (*Dendragapus obscurus*). Molecular Ecology (2004) 13, 1911-1922. Available at: http://fwcb.cfans.umn.edu/research/owls/lit%20folder/barrowclough%20et%20al.%202004.pdf

Bridge, E. S., A. W. Jones, and A. J. Baker. 2005. A Phylogenetic Framework for the Terns (Sternini) Inferred from mtDNA sequences: Implications for Taxonomy and Plumage Evolution. Molecular Phylogenetis and Evolution 35:459-469. Available at: http://www.cmnh.org/site/Files/Ornithology/MPETerns.pdf

Chesser, R. Terry, Richard C. Banks, F. Keith Barker, Carla Cicero, Jon L. Dunn, Andrew W. Kratter, Irby J. Lovette, Pamela C. Rasmussen, J. V. Remsen, James D. Rising, Douglas F. Stotz, Kevin Winker. 2010. Fifty-first supplement to the American Ornithologists' Union Check-List of North American Birds. Auk 127(3):726-744. Available at: http://www.aou.org/checklist/north/suppl/51.php

Patten, M. A. 2001. The roles of habitat and signaling in speciation: Evidence from a contact zone of two song sparrow (Melospiza melodia) subspecies. Ph.D. dissertation, Univ. Calif., Riverside.

For mammals we made taxonomic changes based on the following papers:

Baker, R. J., L. C. Bradley, R. D. Bradley, J. W. Dragoo, M. D. Engstrom, R. Hoffman, C. A. Jones, F. Reid, D. W. Rice, & C. Jones. 2003. Revised Checklist of North American Mammals North of Mexico, 2003. Museum of Texas Tech University Occasional Papers 229:1-23. Available at: http://www.nsrl.ttu.edu/publications/opapers/ops/op229.pdf
Bean, C. 2003. An Assessment of the Endangerment Status of the Santa Cruz Kangaroo Rat. MS Thesis, San Jose State University.

Best, T. L., R. K. Chesser, D. A. McCullough, & G. D. Baumgardner. 1996. Genic and Morphometric Variation in Kangaroo Rats, Genus *Dipodomys*, from Coastal California. Journal of Mammalogy 77(3):785-800. Available at: http://htmlscript.auburn.edu/academic/science_math/cosam/departments/biology/faculty/webpages/best/PDFs/1996BestEtAl.pdf

Hafner, David J. & Andrew T. Smith. 2010. Revision of the subspecies of the American pika, *Ochotona princeps* (Lagomorpha: Ochotonidae). Journal of Mammalogy 91(2):401-417.

Helgen, K.M., F.R. Cole, L.E. Helgen & D.E. Wilson. 2009. Generic Revision in the Holarctic Ground Squirrel Genus *Spermophilus*. Journal of Mammalogy 90(2):270-305. Available at: http://www.mammalogy.org/pubjom/OpenAccess/Helgen_etal_2009.pdf

Jones, C. A. & C. N. Baxter. 2004. *Thomomys bottae*. Mammalian Species 742:1-14. Available at: http://www.science.smith.edu/departments/Biology/VHAYSSEN/msi/pdf/742_Thomomys_bottae.pdf

Matocq, M. D. 2002. Morphological and Molecular Analysis of a Contact Zone in the *Neotoma fuscipes* complex. Journal of Mammalogy 83(3):866-883. Available at: http://www.cabnr.unr.edu/matocq/Matocqjm02%20copy.pdf

Patton, J. L. & M. A. Smith. 1990. The Evolutionary Dynamics of the Pocket Gopher *Thomomys bottae*, with Emphasis on California Populations. University of California Publications in Zoology 123:1-161.

Wehausen, John D., Bleich, Vernon C., and Ramey Rob R. II. 2005. Correct Nomenclature for Sierra Nevada Bighorn Sheep. Calif Fish and Game 91(3):216-218. Available at: http://www.wmrs.edu/people/bios/john%20wehausen/bighorn%20nomenclature.pdf

**CNDDB CONSERVATION STATUS RANKS:**

The CNDDB ranking codes are part of the "Heritage Methodology". It is a shorthand formula that provides information about the status of a taxon, both throughout its entire range and within California. We use the best information available to assign these ranks and they are changed and refined as new information becomes available. More detailed information about the conservation status ranking system can be found at: **http://www.natureserve.org/publications/ConsStatusAssess_StatusFactors.pdf**

**CALIFORNIA ENDANGERED SPECIES ACT (CESA) LISTING CODES:** The listing status of each species is current as of the date of this list. The most current changes in listing status will be found in the list of "Endangered and Threatened Animals of California", which the CNDDB updates and issues quarterly (January, April, July, & October).

| | |
|---|---|
| SE | State-listed as Endangered |
| ST | State-listed as Threatened |
| SCE | State candidate for listing as Endangered |
| SCT | State candidate for listing as Threatened |
| SCD | State candidate for delisting |

**FEDERAL ENDANGERED SPECIES ACT (ESA) LISTING CODES:** The listing status is current as of the date of this list. The most current changes in listing status will be found in the list of "Endangered and Threatened Animals of California", which the CNDDB updates and issues quarterly (January, April, July, & October). Federal listing actions contained in the Federal Register are also available at: **http://www.regulations.gov/search/Regs/home.html#home.**

| | |
|---|---|
| FE | Federally listed as Endangered |
| FT | Federally listed as Threatened |
| FPE | Federally proposed for listing as Endangered |
| FPT | Federally proposed for listing as Threatened |
| FPD | Federally proposed for delisting |
| FC | Federal candidate species (former Category 1 candidates) |

Section 4(c)(2)(A) of the Act requires that we conduct a review of listed species at least once every five years. Five year reviews for the Pacific Southwest Region are available at: **http://www.fws.gov/cno/es/five_year_review_lists.html**

**OTHER STATUS CODES:**

**IUCN - The World Conservation Union**, through its Species Survival Commission (SSC) assess, on a global scale, the conservation status of species, subspecies, varieties and even selected subpopulations in order to highlight taxa threatened with extinction, and therefore promote their conservation. The SSC is firmly committed to providing the world with the most objective, scientifically-based information on the current status of globally threatened biodiversity. The taxa assessed for the IUCN Red List have been evaluated using the IUCN Red List Categories and Criteria **http://www.iucnredlist.org/technical-documents/categories-and-criteria** . Detailed information on the IUCN and the Red List is available at: **http://www.redlist.org/.**

**American Bird Conservancy: United States WatchList of Birds of Conservation Concern:** The United States *WatchList* is a joint project between the American Bird Conservancy and the National Audubon Society. It reflects a comprehensive analysis of all the bird species in the United States. It reveals those in greatest need of immediate conservation attention to survive a convergence of environmental challenges, including habitat loss, invasive species, and global warming. The list builds on the species assessments conducted for many years by Partners in Flight (PIF) for land birds. It uses those same PIF standards but it is expanded to cover all bird species, not just land birds. The list is based on the latest available research and assessments from the bird conservation community, along with data from the Christmas Bird Count and Breeding Bird Survey. More information is available at: **http://www.abcbirds.org/abcprograms/science/watchlist/index.html**

**AFS:** Designations for freshwater and diadromous species were taken from the paper: Jelks, H.L., S.J. Walsh, N.M. Burkhead, S.Contreras-Balderas, E. Díaz-Pardo, D.A. Hendrickson, J. Lyons, N.E. Mandrak, F. McCormick, J.S. Nelson, S.P. Platania, B.A. Porter, C.B. Renaud, J. J. Schmitter-Soto, E.B. Taylor, and M.L. Warren, Jr. 2008. Conservation status of imperiled North American freshwater and diadromous fishes. Fisheries 33(8):372-407. Available at: **http://www.fisheries.org/afs/docs/fisheries/fisheries_3308.pdf** . Designations for marine and estuarine species were taken from the paper: Musick, J.T. et al. 2000. "Marine, Estuarine, and Diadromous Fish Stocks at Risk of Extinction in North America (Exclusive of Pacific Salmonids). Fisheries 25(11):6-30. Available at: **http://www.flmnh.ufl.edu/fish/sharks/sawfish/Reprint1390.pdf**

**Audubon: WatchList:** The Audubon WatchList has been incorporated into the **American Bird Conservancy United States WatchList of Birds of Conservation Concern** and no longer has a separate designation.

**BLM: Sensitive:** Bureau of Land Management. BLM Manual §6840 defines sensitive species as"…those species that are (1) under status review by the FWS/NMFS; or (2) whose numbers are declining so rapidly that Federal listing may become necessary, or (3) with typically small and widely dispersed populations; or (4) those inhabiting ecological refugia or other specialized or unique habitats." Existing California-BLM policy concerning the designation of sensitive species identifies two conditions that must be met before a species may be considered as BLM sensitive: (1) a significant population of the species must occur on BLM-administered lands, and (2) the potential must exist for improvement of the species' condition through BLM management. The "Sensitive Species" designation is not meant to include federally listed species, proposed species, candidate species or State-listed species. It is BLM policy to provide sensitive species with the same level of protection that is given federal candidate species. The list is available at: **http://www.blm.gov/ca/pdfs/pa_pdfs/biology_pdfs/SensitiveAnimals.pdf**

**CDF: Sensitive:** California Department of Forestry and Fire Protection. The Board of Forestry classifies as "sensitive species" those species that warrant special protection during timber operations. The list of "sensitive species" is given in §895.1 (Definitions) of the California Forest Practice Rules. The 2010 Forest Practice Rules are available at: **http://www.fire.ca.gov/resource_mgt/downloads/2010_FP_Rulebook_w-Diagrams_wo-TechRule_No1.pdf**

**<u>DFG: SSC</u>:** California Species of Special Concern. It is the goal and responsibility of the Department of Fish and Game to maintain viable populations of all native species. To this end, the Department has designated certain vertebrate species as "Species of Special Concern" because declining population levels, limited ranges, and/or continuing threats have made them vulnerable to extinction. The goal of designating species as "Species of Special Concern" is to halt or reverse their decline by calling attention to their plight and addressing the issues of concern early enough to secure their long term viability. Not all "Species of Special Concern" have declined equally; some species may be just starting to decline, while others may have already reached the point where they meet the criteria for listing as a "Threatened" or "Endangered" species under the State and/or Federal Endangered Species Acts. More information is available at:
**http://www.nrm.dfg.ca.gov/fileHandler.ashx?DocumentID=3778**

The 1995 report for fish, the 1994 report for amphibians and reptiles and the 1986 & 1998 reports for mammals are available on-line.

Fish: **http://www.dfg.ca.gov/wildlife/nongame/publications/docs/fish_ssc.pdf**
Amphibians & Reptiles:
**http://www.dfg.ca.gov/wildlife/nongame/publications/docs/herp_ssc.pdf**

Mammals:
**http://www.dfg.ca.gov/wildlife/nongame/publications/bm_research/docs/86_27.pdf**
**http://www.dfg.ca.gov/wildlife/nongame/ssc/1998mssc.html**

Updates of all three reports are in preparation. Information on the Amphibian and Reptile Species of Special Concern report is available at: **http://arssc.ucdavis.edu** . Information on the mammal report is available at:
**http://www.dfg.ca.gov/wildlife/nongame/ssc/mammals.html** and
**http://www.dfg.ca.gov/wildlife/nongame/ssc/docs/mammal/MSSCProjectTimeline.pdf**

A new *California Bird Species of Special Concern* report was completed in 2008. More information is available at: **http://www.dfg.ca.gov/wildlife/species/ssc/birds.html .** A new category of **"Taxa to Watch"** was created in the new *California Bird Species of Special Concern* report. The birds on this **Watch List** are 1) not on the current Special Concern list but were on previous lists and they have not been state listed under CESA; 2) were previously state or federally listed and now are on neither list; or 3) are on the list of "Fully Protected" species. More information and brief accounts for each species is available in the report.

**<u>DFG: Fully Protected</u>:** The classification of Fully Protected was the State's initial effort to identify and provide additional protection to those animals that were rare or faced possible extinction. Lists were created for fish, amphibians and reptiles, birds and mammals. Most of the species on these lists have subsequently been listed under the state and/or federal endangered species acts; white-tailed kite, golden eagle, trumpeter swan, northern elephant seal and ring-tailed cat are the exceptions. The white-tailed kite and the golden eagle are tracked in the CNDDB; the trumpeter swan, northern elephant seal and ring-tailed cat are not.

The Fish and Game Code sections dealing with Fully Protected species state that these species "....may not be taken or possessed at any time and no provision of this code or any other law shall be construed to authorize the issuance of permits or licenses to take any fully protected" species, although take may be authorized for necessary scientific research. This language arguably makes the "Fully Protected" designation the strongest and most restrictive regarding the "take" of these species. In 2003 the code sections dealing with fully protected species were amended to allow the Department to authorize take resulting from recovery activities for state-listed species.

More information on Fully Protected species and the take provisions can be found in the Fish and Game Code, (birds at §3511, mammals at §4700, reptiles and amphibians at §5050, and fish at §5515). Additional information on Fully Protected fish can be found in the California Code of Regulations, Title 14, Division 1, Subdivision 1, Chapter 2, Article 4, §5.93. The category of Protected Amphibians and Reptiles in Title 14 has been repealed. The Fish and Game Code is available online at: **http://www.leginfo.ca.gov/cgi-bin/calawquery?codesection=fgc&codebody=&hits=20** . Title 14 of the California Code of Regulations is available at: **http://ccr.oal.ca.gov/linkedslice/default.asp?SP=CCR-1000&Action=Welcome**

**FS: Sensitive:** USDA Forest Service defines sensitive species as those plant and animal species identified by a regional forester that are not listed or proposed for listing under the federal Endangered Species Act for which population viability is a concern, as evidenced by significant current or predicted downward trends in population numbers or density, or significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution. Regional Foresters shall identify sensitive species occurring within the region. California is the Pacific Southwest Region (Region 5).The list of sensitive animals for Region 5 is undergoing revision. The anticipated completion date was spring 2009, however it still has not been updated in spring 2010. The sensitive designation on this list is based on the previous list. More information is available at:
**http://www.fs.fed.us/r5/projects/sensitive-species/**

**FWS: BCC:** Fish and Wildlife Service: Birds of Conservation Concern: The goal of the *Birds of Conservation Concern 2008* report is to accurately identify the migratory and nonmigratory bird species (beyond those already designated as Federally threatened or endangered) that represent our highest conservation priorities and draw attention to species in need of conservation action. We hope that by focusing attention on these highest priority species, this report will promote greater study and protection of the habitats and ecological communities upon which these species depend, thereby ensuring the future of healthy avian populations and communities. This report is available at:
**http://library.fws.gov/Bird_Publications/BCC2008.pdf**

**Marine Mammal Commission: Marine Mammal Species of Special Concern:** Section 202 of the Marine Mammal Protection Act directs the Marine Mammal Commission, in consultation with its Committee of Scientific Advisors, to make recommendations to the Department of Commerce, the Department of the Interior, and other federal agencies on research and management actions needed to conserve species of marine mammals. To meet this charge, the Commission devotes special attention to particular species and populations that are vulnerable to various types of human-related activities, impacts, and contaminants. Such species may include marine mammals listed as endangered or threatened under the Endangered Species Act or as depleted under the Marine Mammal Protection Act. In addition, the Commission often directs special attention to other species or populations of marine mammals not so listed whenever special conservation challenges arise that may affect them. More information on the Marine Mammal Protection Act and the Species of Special Concern list is available at: **http://www.mmc.gov/species**

**National Oceanic and Atmospheric Administration (NOAA):** The Office of Protected Resources (OPR) is a headquarters program office of NOAA's National Marine Fisheries Service (NOAA Fisheries Service, or NMFS), under the U.S. Department of Commerce, with responsibility for protecting marine mammals and endangered marine life.

NOAA's Office of Protected Resources works to conserve, protect, and recover species under the Endangered Species Act (ESA) and the Marine Mammal Protection Act (MMPA) in conjunction with our Regional offices, Science Centers, and various partners. The category **Species of Concern** was established by the National Marine Fisheries Service (NMFS) effective 15 April 2004. **Species of Concern** are those species about which NOAA's National Marine Fisheries Service (NMFS) has some concerns regarding status and threats, but for which insufficient information is available to indicate a need to list the species under the Endangered Species Act (ESA). We wish to draw proactive attention and conservation action to these species. "Species of concern" status does not carry any procedural or substantive protections under the ESA. More information is available at:
**http://www.nmfs.noaa.gov/pr/species/concern**

**WBWG: High Priority:** The Western Bat Working Group is comprised of agencies, organizations and individuals interested in bat research, management and conservation from the 13 western states and provinces. The goals are (1) to facilitate communication among interested parties and reduce risks of species decline or extinction; (2) to provide a mechanism by which current information on bat ecology, distribution and research techniques can be readily accessed; and (3) to develop a forum to discuss conservation strategies, provide technical assistance and encourage education programs. Species designated as "High Priority" are imperiled or are at high risk of imperilment based on available information on distribution, status, ecology and known threats. More information is available at: **http://www.wbwg.org**.

**Xerces Society: Red list:** The Xerces Society is an international non-profit organization dedicated to protecting biological diversity through invertebrate conservation. The Society advocates for invertebrates and their habitats by working with scientists, land managers, educators, and citizens on conservation and education projects. Their core programs focus on endangered species, native pollinators, and watershed health. More information on the Red list is available at: **http://www.xerces.org/**

## Table of status code abbreviations

| Organization | Abbreviation |
|---|---|
| | |
| American Bird Conservancy - U. S. WatchList of Birds of Conservation Concern | ABC_WLBCC |
| American Fisheries Society - Endangered | AFS_EN |
| American Fisheries Society - Threatened | AFS_TH |
| American Fisheries Society - Vulnerable | AFS_VU |
| Bureau of Land Management - Sensitive | BLM_S |
| Calif Dept of Forestry & Fire Protection - Sensitive | CDF_S |
| Calif Dept of Fish & Game - Fully Protected | DFG_FP |
| Calif Dept of Fish & Game - Species of Special Concern | DFG_SSC |
| Calif Dept of Fish & Game - Watch List | DFG_WL |
| IUCN - Conservation Dependent | IUCN_CD |
| IUCN - Critically Endangered | IUCN_CR |
| IUCN - Data Deficient | IUCN_DD |
| IUCN - Endangered | IUCN_EN |
| IUCN - Least Concern | IUCN_LC |
| IUCN - Near Threatened | IUCN_NT |
| IUCN - Vulnerable | IUCN_VU |
| Marine Mammal Commission - Species of Special Concern | MMC_SSC |
| National Marine Fisheries Service - Species of Concern | NMFS_SC |
| U. S. Forest Service - Sensitive | USFS_S |
| U. S. Fish & Wildlife Service Birds of Conservation Concern | USFWS_BCC |
| Western Bat Working Group - High Priority | WBWG_H |
| Western Bat Working Group - Low-Medium Priority | WBWG_LM |
| Western Bat Working Group - Medium Priority | WBWG_M |
| Western Bat Working Group - Medium-High Priority | WBWG_MH |
| Xerces Society - Critically Imperiled | XERCES_CI |
| Xerces Society - Data Deficient | XERCES_DD |
| Xerces Society - Imperiled | XERCES_IM |
| Xerces Society - Vulnerable | XERCES_VU |

## Invertebrates

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **PELECYPODA (clams and mussels)** | | | | | | |
| +*Anodonta californiensis*<br>California floater | | G3Q S2? | None | None | USFS:S | |
| *Anodonta oregonensis*<br>Oregon floater | | G5Q S2? | None | None | | |
| +*Gonidea angulata*<br>western ridged mussel | | G3 S1S2 | None | None | | |
| +*Margaritifera falcata*<br>western pearlshell | | G4 S2S3? | None | None | | |
| *Pisidium ultramontanum*<br>fingernail clam | | G1 S1 | None | None | USFS:S | |
| **GASTROPODA (Snails, slugs and abalone)** | | | | | | |
| *Algamorda newcombiana*<br>Newcomb's littorine snail | | G1G2 S1S2 | None | None | | |
| +*Ammonitella yatesii*<br>tight coin (=Yates' snail) | | G1 S1 | None | None | IUCN:VU | |
| +*Ancotrema voyanum*<br>hooded lancetooth | | G1G2 S1S2 | None | None | BLM:S | |
| +*Assiminea infima*<br>Badwater snail | | G1 S1 | None | None | IUCN:VU | |
| +*Binneya notabilis*<br>Santa Barbara shelled slug | | G1 S1 | None | None | IUCN:DD | |
| +*Colligyrus convexus*<br>canary duskysnail | | G1G2 S1S2 | None | None | | |
| +*Eremarionta immaculata*<br>white desertsnail | | G1 S1 | None | None | IUCN:VU | |
| *Eremarionta millepalmarum*<br>Thousand Palms desertsnail | | G1 S1 | None | None | IUCN:VU | |
| +*Eremarionta morongoana*<br>Morongo (=Colorado) desertsnail | | G1G3 S1 | None | None | IUCN:NT | |
| +*Eremarionta rowelli bakerensis*<br>Baker's desertsnail | | G1T1 S1 | None | None | IUCN:DD | |
| +*Eremarionta rowelli mccoiana*<br>California Mccoy snail | | G1T1 S1 | None | None | IUCN:DD | |
| +*Fluminicola seminalis*<br>nugget pebblesnail | | G2 S1S2 | None | None | USFS:S | |
| +*Fontelicella sp.*<br>Deep Springs fontelicella | | G1 S1 | None | None | | |
| *Glyptostoma gabrielense*<br>San Gabriel chestnut | | G2 S2 | None | None | | |
| *Haliotis corrugata*<br>pink abalone | | G3? S2? | None | None | NMFS:SC | |
| +*Haliotis cracherodii*<br>black abalone | | G3G4 S3 | Endangered | None | IUCN:CR | |
| *Haliotis fulgens*<br>green abalone | | G3G4 S3 | None | None | NMFS:SC | |
| *Haliotis kamtschatkana*<br>pinto abalone | | G3G4 S1S3 | None | None | IUCN:EN<br>NMFS:SC | |
| *Haliotis sorenseni*<br>white abalone | | G1 S1 | Endangered | None | | |
| +*Haplotrema catalinense*<br>Santa Catalina lancetooth | | G1 S1 | None | None | | |
| +*Haplotrema duranti*<br>Durant's snail | | G2G3 S2S3 | None | None | | |
| +*Helisoma newberryi*<br>Great Basin rams-horn | | G1Q S1 | None | None | USFS:S | |
| +*Helminthoglypta allynsmithi*<br>Merced Canyon shoulderband | | G1 S1 | None | None | IUCN:VU | |
| +*Helminthoglypta arrosa monticola*<br>mountain shoulderband | | G2G3T1 S1 | None | None | | |

## Invertebrates

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **GASTROPODA (Snails, slugs and abalone)** | | | | | | |
| +*Helminthoglypta arrosa pomoensis*<br>Pomo bronze shoulderband | | G2G3T1 S1 | None | None | IUCN:DD | |
| +*Helminthoglypta ayresiana sanctaecrucis*<br>Ayer's snail | | G1G2T1T2 S1S2 | None | None | | |
| +*Helminthoglypta callistoderma*<br>Kern shoulderband | | G1 S1 | None | None | IUCN:EN | |
| +*Helminthoglypta coelata*<br>mesa shoulderband | | G1 S1 | None | None | IUCN:VU | |
| +*Helminthoglypta concolor*<br>whitefir shoulderband | | G1G3 S1S3 | None | None | | |
| *Helminthoglypta fontiphila*<br>Soledad shoulderband | | G1 S1 | None | None | | |
| +*Helminthoglypta hertleini*<br>Oregon shoulderband | | G1 S1 | None | None | BLM:S | |
| +*Helminthoglypta milleri*<br>peak shoulderband | | G1 S1 | None | None | | |
| +*Helminthoglypta mohaveana*<br>Victorville shoulderband | | G1 S1 | None | None | IUCN:NT | |
| +*Helminthoglypta nickliniana awania*<br>Peninsula coast range shoulderband | | G1T1 S1 | None | None | IUCN:DD | |
| +*Helminthoglypta nickliniana bridgesi*<br>Bridges' coast range shoulderband | | G2T1 S1 | None | None | IUCN:DD | |
| +*Helminthoglypta sequoicola consors*<br>redwood shoulderband | | G1G2T1 S1 | None | None | IUCN:DD | |
| +*Helminthoglypta stiversiana williamsi*<br>Williams' bronze shoulderband | | G2G3T1 S1 | None | None | IUCN:DD | |
| +*Helminthoglypta talmadgei*<br>Trinity shoulderband | | G1G3 S1S3 | None | None | BLM:S | |
| +*Helminthoglypta taylori*<br>westfork shoulderband | | G1 S1 | None | None | | |
| *Helminthoglypta traskii pacoimensis*<br>Pacoima shoulderband | | G1T1 S1 | None | None | | |
| +*Helminthoglypta traskii traskii*<br>Trask shoulderband | | G1G2T1 S1 | None | None | | |
| *Helminthoglypta uvasana*<br>Grapevine shoulderband | | G1 S1 | None | None | | |
| *Helminthoglypta vasquezi*<br>Vasquez shoulderband | | G1 S1 | None | None | | |
| +*Helminthoglypta walkeriana*<br>Morro shoulderband (=banded dune) snail | | G1 S1 | Endangered | None | IUCN:CR | |
| *Herpeteros angelus*<br>Soledad desertsnail | | G1 S1 | None | None | | |
| +*Hesperarion plumbeus*<br>leaden slug | | G1G3 S1S3 | None | None | | |
| +*Ipnobius robustus*<br>robust tryonia | | G1G2 S1 | None | None | | |
| +*Juga acutifilosa*<br>topaz juga | | G2 S2 | None | None | USFS:S | |
| +*Juga chacei*<br>Chace juga | | G1 S1 | None | None | | |
| +*Juga occata*<br>scalloped juga | | G1 S1 | None | None | USFS:S | |
| +*Juga orickensis*<br>redwood juga | | G2 S1S2 | None | None | | |
| *Lanx alta*<br>highcap lanx | | G2 S1S2 | None | None | | |
| *Lanx klamathensis*<br>scale lanx | | G1 S1 | None | None | | |

## Invertebrates

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **GASTROPODA (Snails, slugs and abalone)** | | | | | | |
| +*Lanx patelloides*<br>kneecap lanx | | G2 S2 | None | None | | |
| +*Megomphix californicus*<br>Natural Bridge megomphix | | G1G2 S1S2 | None | None | | |
| +*Micrarionta facta*<br>Santa Barbara islandsnail | | G1G2 S1S2 | None | None | IUCN:VU | |
| +*Micrarionta feralis*<br>San Nicolas islandsnail | | G1 S1 | None | None | IUCN:CR | |
| +*Micrarionta gabbi*<br>San Clemente islandsnail | | G1 S1 | None | None | IUCN:VU | |
| +*Micrarionta opuntia*<br>pricklypear islandsnail | | G1 S1 | None | None | IUCN:VU | |
| +*Monadenia callipeplus*<br>downy sideband | | G1G2 S1S2 | None | None | | |
| +*Monadenia chaceana*<br>Siskiyou shoulderband | | G2 S2 | None | None | BLM:S | |
| +*Monadenia churchi*<br>Klamath sideband | | G2 S2 | None | None | | |
| +*Monadenia circumcarinata*<br>keeled sideband | | G1 S1 | None | None | BLM:S<br>IUCN:VU | |
| +*Monadenia cristulata*<br>crested sideband | | G1G2 S1S2 | None | None | | |
| +*Monadenia fidelis leonina*<br>A terrestrial snail | | G4G5T1T2 S1S2 | None | None | | |
| +*Monadenia fidelis pronotis*<br>rocky coast Pacific sideband | | G4G5T1 S1 | None | None | | |
| +*Monadenia infumata ochromphalus*<br>yellow-based sideband | | G2T1 S1 | None | None | | |
| +*Monadenia infumata setosa*<br>Trinity bristle snail | | G2T2 S2 | None | Threatened | IUCN:VU | |
| *Monadenia marmarotis*<br>marble sideband | | G1 S1 | None | None | | |
| +*Monadenia mormonum buttoni*<br>Button's Sierra sideband | | G1G2T1 S1 | None | None | | |
| +*Monadenia mormonum hirsuta*<br>hirsute Sierra sideband | | G1G2T1 S1 | None | None | BLM:S | |
| +*Monadenia troglodytes troglodytes*<br>Shasta sideband | | G1G2T1T2 S1S2 | None | None | IUCN:DD<br>USFS:S | |
| *Monadenia troglodytes wintu*<br>Wintu sideband | | G1G2T1T2 S1S2 | None | None | IUCN:DD<br>USFS:S | |
| +*Monadenia tuolumneana*<br>Tuolumne sideband | | G1 S1 | None | None | BLM:S | |
| +*Monadenia yosemitensis*<br>Yosemite Mariposa sideband | | G1 S1 | None | None | | |
| +*Noyo intersessa*<br>Ten Mile shoulderband | | G2 S2 | None | None | | |
| +*Pomatiopsis binneyi*<br>robust walker | | G1 S1 | None | None | | |
| *Pomatiopsis californica*<br>Pacific walker | | G1 S1 | None | None | | |
| *Pomatiopsis chacei*<br>marsh walker | | G1 S1 | None | None | | |
| +*Pristiloma shepardae*<br>Shepard's snail | | G1 S1 | None | None | | |
| +*Pristinicola hemphilli*<br>pristine pyrg | | G3 S1 | None | None | | |
| *Prophysaon coeruleum*<br>Blue-gray taildropper slug | (May be a species complex.) | G3G4 S1S2 | None | None | USFS:S | |

## Invertebrates

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **GASTROPODA (Snails, slugs and abalone)** | | | | | | |
| +*Punctum hannai*<br>Trinity Spot | | G1 S1S3 | None | None | | |
| +*Pyrgulopsis aardahli*<br>Benton Valley (=Aahrdahl's) springsnail | | G1 S1 | None | None | | |
| +*Pyrgulopsis archimedis*<br>Archimedes pyrg | | G1 S1 | None | None | | |
| +*Pyrgulopsis cinerana*<br>Ash Valley pyrg | | G1G2 S1S2 | None | None | | |
| +*Pyrgulopsis diablensis*<br>Diablo Range pyrg | | G1 S1 | None | None | | |
| +*Pyrgulopsis eremica*<br>Smoke Creek pyrg | | G2 S2 | None | None | | |
| +*Pyrgulopsis falciglans*<br>Likely pyrg | | G1G2 S1 | None | None | | |
| +*Pyrgulopsis gibba*<br>Surprise Valley pyrg | | G3 S2? | None | None | | |
| +*Pyrgulopsis greggi*<br>Kern River pyrg | | G1 S1 | None | None | | |
| +*Pyrgulopsis lasseni*<br>Willow Creek pyrg | | G1G2 S1S2 | None | None | | |
| +*Pyrgulopsis longae*<br>Long Valley pyrg | | G1 S1 | None | None | | |
| +*Pyrgulopsis owensensis*<br>Owens Valley springsnail | | G1G2 S1S2 | None | None | USFS:S | |
| +*Pyrgulopsis perturbata*<br>Fish Slough springsnail | | G1G2 S1S2 | None | None | | |
| +*Pyrgulopsis rupinicola*<br>Sucker Springs pyrg | | G1G2 S1 | None | None | | |
| +*Pyrgulopsis taylori*<br>San Luis Obispo pyrg | | G1 S1 | None | None | | |
| *Pyrgulopsis ventricosa*<br>Clear Lake pyrg | | G1 S1 | None | None | | |
| +*Pyrgulopsis wongi*<br>Wong's springsnail | | G2 S1S2 | None | None | USFS:S | |
| +*Radiocentrum avalonense*<br>Catalina mountainsnail | | G1 S1 | None | None | IUCN:CR | |
| +*Rothelix warnerfontis*<br>Warner Springs shoulderband | | G1 S1 | None | None | | |
| +*Sterkia clementina*<br>San Clemente Island blunt-top snail | | G1 S1 | None | None | IUCN:NT | |
| +*Trilobopsis roperi*<br>Shasta chaparral | | G1 S1 | None | None | USFS:S | |
| *Trilobopsis tehamana*<br>Tehama chaparral | | G1 S1 | None | None | BLM:S<br>USFS:S | |
| +*Tryonia imitator*<br>mimic tryonia (=California brackishwater snail) | | G2G3 S2S3 | None | None | IUCN:DD | |
| +*Tryonia margae*<br>Grapevine Springs elongate tryonia | | G1 S1 | None | None | | |
| +*Tryonia rowlandsi*<br>Grapevine Springs squat tryonia | | G1 S1 | None | None | | |
| +*Vespericola karokorum*<br>Karok hesperian | | G2G3 S2S3 | None | None | IUCN:DD | |
| +*Vespericola marinensis*<br>Marin hesperian | | G2G3 S2S3 | None | None | | |
| +*Vespericola pressleyi*<br>Big Bar hesperian | | G1 S1 | None | None | BLM:S<br>USFS:S | |

## Invertebrates

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **GASTROPODA (Snails, slugs and abalone)** | | | | | | |
| *Vespericola scotti*<br>Benson Gulch hesperian | (Known only from the type locality, Benson Gulch, Trinity Co.) | G1 S1 | None | None | | |
| +*Vespericola shasta*<br>Shasta hesperian | | G1 S1 | None | None | USFS:S | |
| +*Vespericola sierranus*<br>Siskiyou hesperian | | G2 S1S2 | None | None | | |
| +*Xerarionta intercisa*<br>horseshoe snail | | G1 S1 | None | None | IUCN:VU | |
| +*Xerarionta redimita*<br>wreathed cactussnail | | G1 S1 | None | None | IUCN:VU | |
| *Xerarionta tryoni*<br>Bicolor cactussnail | | G1 S1 | None | None | IUCN:VU | |
| **ARACHNIDA (Spiders and relatives)** | | | | | | |
| +*Aphrastochthonius grubbsi*<br>Grubbs' Cave pseudoscorpion | | G1G2 S1S2 | None | None | | |
| *Aphrastochthonius similis*<br>Carlow's Cave pseudoscorpion | | G1G2 S1S2 | None | None | | |
| *Archeolarca aalbui*<br>Aalbu's Cave pseudoscorpion | | G1G2 S1S2 | None | None | | |
| +*Banksula californica*<br>Alabaster Cave harvestman | | GH SH | None | None | | |
| +*Banksula galilei*<br>Galile's cave harvestman | | G1 S1 | None | None | | |
| +*Banksula grubbsi*<br>Grubbs' cave harvestman | | G1 S1 | None | None | | |
| +*Banksula incredula*<br>incredible harvestman | | G1 S1 | None | None | | |
| +*Banksula martinorum*<br>Martins' cave harvestman | | G1 S1 | None | None | | |
| +*Banksula melones*<br>Melones Cave harvestman | | G2G3 S2S3 | None | None | IUCN:VU | |
| +*Banksula rudolphi*<br>Rudolph's cave harvestman | | G1 S1 | None | None | | |
| +*Banksula tuolumne*<br>Tuolumne cave harvestman | | G1 S1 | None | None | | |
| +*Banksula tutankhamen*<br>King Tut Cave harvestman | | G1 S1 | None | None | | |
| +*Calicina arida*<br>San Benito harvestman | | G1 S1 | None | None | | |
| +*Calicina breva*<br>Stanislaus harvestman | | G1 S1 | None | None | | |
| +*Calicina cloughensis*<br>Clough Cave harvestman | | G1 S1 | None | None | | |
| +*Calicina conifera*<br>Crane Flat harvestman | | G1 S1 | None | None | | |
| +*Calicina diminua*<br>Marin blind harvestman | | G1 S1 | None | None | | |
| +*Calicina dimorphica*<br>Watts Valley harvestman | | G1 S1 | None | None | | |
| +*Calicina macula*<br>marbled harvestman | | G1 S1 | None | None | | |
| +*Calicina mesaensis*<br>Table Mountain harvestman | | G1 S1 | None | None | | |
| +*Calicina minor*<br>Edgewood blind harvestman | | G1 S1 | None | None | | |
| +*Calicina piedra*<br>Piedra harvestman | | G1 S1 | None | None | | |

## Invertebrates

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **ARACHNIDA (Spiders and relatives)** | | | | | | |
| +*Calileptoneta briggsi*<br>Briggs' leptonetid spider | | G1 S1 | None | None | | |
| +*Calileptoneta oasa*<br>Andreas Canyon leptonetid spider | | G1 S1 | None | None | | |
| +*Calileptoneta ubicki*<br>Ubick's leptonetid spider | | G1 S1 | None | None | | |
| +*Calileptoneta wapiti*<br>Mendocino leptonetid spider | | G1 S1 | None | None | | |
| +*Fissilicreagris imperialis*<br>Empire Cave pseudoscorpion | | G1 S1 | None | None | IUCN:VU | |
| +*Hubbardia idria*<br>Idria short-tailed whipscorpion | | G1 S1 | None | None | | |
| +*Hubbardia secoensis*<br>Arroyo Seco short-tailed whipscorpion | | G1 S1 | None | None | | |
| +*Hubbardia shoshonensis*<br>Shoshone Cave whip-scorpion | | G1 S1 | None | None | BLM:S | |
| +*Larca laceyi*<br>Lacey's Cave pseudoscorpion | | G1G2 S1 | None | None | | |
| +*Meta dolloff*<br>Dolloff Cave spider | | G1 S1 | None | None | IUCN:VU | |
| +*Microcina edgewoodensis*<br>Edgewood Park micro-blind harvestman | | G1 S1 | None | None | | |
| +*Microcina homi*<br>Hom's micro-blind harvestman | | G1 S1 | None | None | | |
| +*Microcina jungi*<br>Jung's micro-blind harvestman | | G1 S1 | None | None | | |
| +*Microcina leei*<br>Lee's micro-blind harvestman | | G1 S1 | None | None | | |
| +*Microcina lumi*<br>Lum's micro-blind harvestman | | G1 S1 | None | None | | |
| +*Microcina tiburona*<br>Tiburon micro-blind harvestman | | G1 S1 | None | None | | |
| +*Neochthonius imperialis*<br>Empire Cave pseudoscorpion | | G1 S1 | None | None | | |
| *Pauroctonus maritimus*<br>Monterey dunes scorpion | | GNR SNR | None | None | | |
| +*Pseudogarypus orpheus*<br>Music Hall Cave pseudoscorpion | | G1G2 S1 | None | None | | |
| +*Socalchemmis gertschi*<br>Gertsch's socalchemmis spider | | G1 S1 | None | None | | |
| +*Socalchemmis icenoglei*<br>Icenogle's socalchemmis spider | | G1 S1 | None | None | | |
| +*Socalchemmis monterey*<br>Monterey socalchemmis spider | | G1 S1 | None | None | | |
| +*Talanites moodyae*<br>Moody's gnaphosid spider | | G1G2 S1S2 | None | None | | |
| +*Talanites ubicki*<br>Ubick's gnaphosid spider | | G1 S1 | None | None | | |
| *Telema sp.*<br>Santa Cruz telemid spider | | G1G2 S1S2 | None | None | | |
| *Texella deserticola*<br>Whitewater Canyon harvestman | | G1 S1 | None | None | | |
| +*Texella kokoweef*<br>Kokoweef Crystal Cave harvestman | | G1 S1 | None | None | | |
| +*Texella shoshone*<br>Shoshone Cave harvestman | | G1 S1 | None | None | | |

## Invertebrates

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **CRUSTACEA, Order Anostraca (fairy shrimp)** | | | | | | |
| +*Artemia monica*<br>Mono brine shrimp | | G1 S1 | None | None | IUCN:CD | |
| +*Branchinecta campestris*<br>pocket pouch fairy shrimp | | G4 S1 | None | None | | |
| +*Branchinecta conservatio*<br>Conservancy fairy shrimp | | G1 S1 | Endangered | None | IUCN:EN | |
| +*Branchinecta longiantenna*<br>longhorn fairy shrimp | | G1 S1 | Endangered | None | IUCN:EN | |
| +*Branchinecta lynchi*<br>vernal pool fairy shrimp | | G3 S2S3 | Threatened | None | IUCN:VU | |
| +*Branchinecta mesovallensis*<br>midvalley fairy shrimp | | G2 S2 | None | None | | |
| +*Branchinecta sandiegonensis*<br>San Diego fairy shrimp | | G1 S1 | Endangered | None | IUCN:EN | |
| +*Linderiella occidentalis*<br>California linderiella | | G3 S2S3 | None | None | IUCN:NT | |
| +*Linderiella santarosae*<br>Santa Rosa Plateau fairy shrimp | | G1G2 S1 | None | None | | |
| +*Streptocephalus woottoni*<br>Riverside fairy shrimp | | G1 S1 | Endangered | None | IUCN:EN | |
| **CRUSTACEA, Order Notostraca (tadpole shrimp)** | | | | | | |
| +*Lepidurus packardi*<br>vernal pool tadpole shrimp | | G3 S2S3 | Endangered | None | IUCN:EN | |
| **CRUSTACEA, Order Anomopoda (water fleas)** | | | | | | |
| +*Dumontia oregonensis*<br>hairy water flea | | G1G3 S1 | None | None | | |
| **CRUSTACEA, Order Isopoda (isopods)** | | | | | | |
| +*Bowmanasellus sequoiae*<br>Sequoia cave isopod | | G1 S1 | None | None | | |
| +*Caecidotea tomalensis*<br>Tomales isopod | | G2 S2 | None | None | | |
| +*Calasellus californicus*<br>An isopod | | G2 S2 | None | None | | |
| +*Calasellus longus*<br>An isopod | | G1 S1 | None | None | | |
| **CRUSTACEA, Order Amphipoda (amphipods)** | | | | | | |
| *Hyalella muerta*<br>Texas Spring amphipod | | G1 S1 | None | None | | |
| *Hyalella sandra*<br>Death Valley amphipod | | G1 S1 | None | None | | |
| *Stygobromus cherylae*<br>Barr's amphipod | | G1 S1 | None | None | | |
| *Stygobromus cowani*<br>Cowan's amphipod | | G1 S1 | None | None | | |
| *Stygobromus gallawayae*<br>Gallaway's amphipod | | G1 S1 | None | None | | |
| +*Stygobromus gradyi*<br>Grady's Cave amphipod | | G1 S1 | None | None | IUCN:VU | |
| *Stygobromus grahami*<br>Graham's Cave Amphipod | | G2 S2 | None | None | | |
| +*Stygobromus harai*<br>Hara's Cave amphipod | | G1G2 S1S2 | None | None | IUCN:VU | |
| *Stygobromus hyporheicus*<br>Hypoheic amphipod | | G1 S1 | None | None | | |
| *Stygobromus imperialis*<br>Empire Cave amphipod | | G1 S1 | None | None | | |
| *Stygobromus lacicolus*<br>Lake Tahoe amphipod | | G1 S1 | None | None | | |

## Invertebrates

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **CRUSTACEA, Order Amphipoda (amphipods)** | | | | | | |
| +*Stygobromus mackenziei*<br>Mackenzie's Cave amphipod | | G1 S1 | None | None | IUCN:VU | |
| *Stygobromus myersae*<br>Myer's amphipod | | G1G2? S1S2? | None | None | | |
| *Stygobromus mysticus*<br>Secret Cave amphipod | | G1 S1 | None | None | | |
| *Stygobromus rudolphi*<br>Rudolph's amphipod | | G1 S1 | None | None | | |
| *Stygobromus sheldoni*<br>Sheldon's amphipod | | G1 S1 | None | None | | |
| *Stygobromus sierrensis*<br>Sierra amphipod | | G1 S1 | None | None | | |
| *Stygobromus tahoensis*<br>Lake Tahoe stygobromid | | G1 S1 | None | None | | |
| *Stygobromus trinus*<br>Trinity County Amphipod | | G1 S1 | None | None | | |
| +*Stygobromus wengerorum*<br>Wengerors' Cave amphipod | | G1 S1 | None | None | IUCN:VU | |
| **CRUSTACEA, Order Decapoda (crayfish & shrimp)** | | | | | | |
| +*Pacifastacus fortis*<br>Shasta crayfish | | G1 S1 | Endangered | Endangered | IUCN:CR | |
| *Pacifastacus leniusculus klamathensis*<br>Klamath crayfish | | G5T5 S3 | None | None | | |
| +*Syncaris pacifica*<br>California freshwater shrimp | | G1 S1 | Endangered | Endangered | IUCN:EN | |
| **INSECTA, Order Odonata (dragonflies & damselflies)** | | | | | | |
| +*Ischnura gemina*<br>San Francisco forktail damselfly | | G2 S2 | None | None | IUCN:VU | |
| **INSECTA, Order Plecoptera (stoneflies)** | | | | | | |
| +*Capnia lacustra*<br>Lake Tahoe benthic stonefly | | G1 S1 | None | None | | |
| +*Cosumnoperla hypocrena*<br>Cosumnes spring stonefly | | G1 S1 | None | None | | |
| +*Megaleuctra sierra*<br>Shirttail Creek stonefly | | G2Q S1? | None | None | | |
| **INSECTA, Order Orthoptera (grasshoppers, katydids, and crickets)** | | | | | | |
| +*Aglaothorax longipennis*<br>Santa Monica shieldback katydid | | G1G2 S1S2 | None | None | IUCN:CR | |
| +*Ammopelmatus kelsoensis*<br>Kelso jerusalem cricket | | G1 S1 | None | None | IUCN:VU | |
| +*Ammopelmatus muwu*<br>Point Conception jerusalem cricket | | G1 S1 | None | None | IUCN:VU | |
| +*Idiostatus kathleenae*<br>Pinnacles shieldback katydid | | G1G2 S1S2 | None | None | | |
| +*Idiostatus middlekauffi*<br>Middlekauff's shieldback katydid | | G1G2 S1 | None | None | IUCN:CR | |
| *Macrobaenetes algodonensis*<br>Algodones sand treader cricket | | G1G2 S1S2 | None | None | | |
| +*Macrobaenetes kelsoensis*<br>Kelso giant sand treader cricket | | G1 S1 | None | None | IUCN:VU | |
| +*Macrobaenetes valgum*<br>Coachella giant sand treader cricket | | G1G2 S1S2 | None | None | IUCN:VU | |
| *Pristoceuthophilus sp.*<br>Samwell Cave cricket | | G1G3 S1S3 | None | None | IUCN:VU | |
| +*Psychomastax deserticola*<br>desert monkey grasshopper | | G1G2 S1S2 | None | None | IUCN:VU | |
| +*Stenopelmatus cahuilaensis*<br>Coachella Valley jerusalem cricket | | G1G2 S1S2 | None | None | IUCN:VU | |

## Invertebrates

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **INSECTA, Order Orthoptera (grasshoppers, katydids, and crickets)** | | | | | | |
| +*Tetrix sierrana*<br>Sierra pygmy grasshopper | | G1G2 S1S2 | None | None | IUCN:VU | |
| +*Trimerotropis infantilis*<br>Zayante band-winged grasshopper | | G1 S1 | Endangered | None | IUCN:EN | |
| +*Trimerotropis occidentiloides*<br>Santa Monica grasshopper | | G1G2 S1S2 | None | None | IUCN:EN | |
| +*Trimerotropis occulens*<br>Lompoc grasshopper | | GH SH | None | None | IUCN:EN | |
| **INSECTA, Order Heteroptera (true bugs)** | | | | | | |
| +*Ambrysus funebris*<br>Nevares Spring naucorid bug | | G1 S1 | Candidate | None | | |
| +*Belostoma saratogae*<br>Saratoga Springs belostoman bug | | G1 S1 | None | None | | |
| +*Oravelia pege*<br>Dry Creek cliff strider bug | | G1 S1 | None | None | | |
| +*Pelocoris shoshone*<br>Amargosa naucorid bug | | G1G3 S1S2 | None | None | | |
| +*Saldula usingeri*<br>Wilbur Springs shorebug | | G1 S1 | None | None | | |
| **INSECTA, Order Neuroptera (lacewings)** | | | | | | |
| +*Oliarces clara*<br>cheeseweed owlfly (cheeseweed moth lacewing) | | G1G3 S1S3 | None | None | | |
| **INSECTA, Order Coleoptera (beetles)** | | | | | | |
| +*Aegialia concinna*<br>Ciervo aegilian scarab beetle | | G1 S1 | None | None | BLM:S<br>IUCN:VU | |
| +*Agabus rumppi*<br>Death Valley agabus diving beetle | | G1G3 S1 | None | None | | |
| *Agrilus harenus*<br>Narenus jewel beetle | | G1G2 S1S2 | None | None | | |
| +*Anomala carlsoni*<br>Carlson's dune beetle | | G2 S2 | None | None | | |
| +*Anomala hardyorum*<br>Hardy's dune beetle | | G2 S2 | None | None | | |
| +*Anthicus antiochensis*<br>Antioch Dunes anthicid beetle | | G1 S1 | None | None | | |
| +*Anthicus sacramento*<br>Sacramento anthicid beetle | | G1 S1 | None | None | IUCN:EN | |
| +*Atractelmis wawona*<br>Wawona riffle beetle | | G1G3 S1S2 | None | None | | |
| +*Chaetarthria leechi*<br>Leech's chaetarthrian water scavenger beetle | | G1? S1? | None | None | | |
| +*Cicindela gabbii*<br>western tidal-flat tiger beetle | | G4 S1 | None | None | | |
| +*Cicindela hirticollis abrupta*<br>Sacramento Valley tiger beetle | | G5TH SH | None | None | | |
| +*Cicindela hirticollis gravida*<br>sandy beach tiger beetle | | G5T2 S1 | None | None | | |
| +*Cicindela latesignata latesignata*<br>western beach tiger beetle | | G4T1T2 S1 | None | None | | |
| +*Cicindela ohlone*<br>Ohlone tiger beetle | | G1 S1 | Endangered | None | | |
| +*Cicindela senilis frosti*<br>senile tiger beetle | | G4T1 S1 | None | None | | |
| +*Cicindela tranquebarica ssp.*<br>San Joaquin tiger beetle | | G5T1 S1 | None | None | | |
| +*Cicindela tranquebarica viridissima*<br>greenest tiger beetle | | G5T1 S1 | None | None | | |

## Invertebrates

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **INSECTA, Order Coleoptera (beetles)** | | | | | | |
| +*Coelus globosus*<br>globose dune beetle | | G1 S1 | None | None | IUCN:VU | |
| +*Coelus gracilis*<br>San Joaquin dune beetle | | G1 S1 | None | None | BLM:S<br>IUCN:VU | |
| *Coenonycha clementina*<br>San Clemente Island coenonycha beetle | | G1? S1? | None | None | | |
| *Cyclocephala wandae*<br>Wandae dune beetle | | G1G2 S1S2 | None | None | | |
| *Deltaspis ivae*<br>marsh-elder long-horned beetle | | G1 S1 | None | None | | |
| +*Desmocerus californicus dimorphus*<br>valley elderberry longhorn beetle | | G3T2 S2 | Threatened | None | | |
| +*Dinacoma caseyi*<br>Casey's June beetle | | G1 S1 | Proposed Endangered | None | | |
| +*Dubiraphia brunnescens*<br>brownish dubiraphian riffle beetle | | G1G3 S1S3 | None | None | | |
| +*Dubiraphia giulianii*<br>Giuliani's dubiraphian riffle beetle | | G1G3 S1S3 | None | None | | |
| +*Elaphrus viridis*<br>Delta green ground beetle | | G1 S1 | Threatened | None | IUCN:CR | |
| +*Glaresis arenata*<br>Kelso Dunes scarab glaresis beetle | | G1G3 S1S3 | None | None | | |
| +*Hydrochara rickseckeri*<br>Ricksecker's water scavenger beetle | | G1G2 S1S2 | None | None | | |
| +*Hydroporus hirsutus*<br>wooly hydroporus diving beetle | | G1G3 S1S3 | None | None | | |
| +*Hydroporus leechi*<br>Leech's skyline diving beetle | | G1? S1? | None | None | | |
| +*Hydroporus simplex*<br>simple hydroporus diving beetle | | G1? S1? | None | None | | |
| +*Hygrotus curvipes*<br>curved-foot hygrotus diving beetle | | G1 S1 | None | None | | |
| +*Hygrotus fontinalis*<br>travertine band-thigh diving beetle | | G1 S1 | None | None | | |
| *Juniperella mirabilis*<br>juniper metallic wood-boring beetle | | G1 S1 | None | None | | |
| +*Lepismadora algodones*<br>Algodones sand jewel beetle | | G1 S1 | None | None | | |
| +*Lichnanthe albipilosa*<br>white sand bear scarab beetle | | G1 S1 | None | None | | |
| +*Lichnanthe ursina*<br>bumblebee scarab beetle | | G2 S2 | None | None | | |
| +*Lytta hoppingi*<br>Hopping's blister beetle | | G1G2 S1S2 | None | None | | |
| *Lytta insperata*<br>Mojave Desert blister beetle | | G1G2 S1S2 | None | None | | |
| +*Lytta moesta*<br>moestan blister beetle | | G2 S2 | None | None | | |
| +*Lytta molesta*<br>molestan blister beetle | | G2 S2 | None | None | | |
| +*Lytta morrisoni*<br>Morrison's blister beetle | | G1G2 S1S2 | None | None | | |
| +*Microcylloepus formicoideus*<br>Furnace Creek riffle beetle | | G1 S1 | None | None | | |
| +*Miloderes nelsoni*<br>Nelson's miloderes weevil | | G1G3 S1S3 | None | None | | |
| +*Nebria darlingtoni*<br>South Forks ground beetle | | G1 S1 | None | None | | |

## Invertebrates

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **INSECTA, Order Coleoptera (beetles)** | | | | | | |
| +*Nebria gebleri siskiyouensis*<br>Siskiyou ground beetle | | G4G5T4 S1S3 | None | None | | |
| +*Nebria sahlbergii triad*<br>Tinity Alps ground beetle | | G1G3T1T3 S1S3 | None | None | | |
| *Ochthebius crassalus*<br>wing shoulder minute moss beetle | | G1G3 S1S3 | None | None | | |
| +*Ochthebius recticulus*<br>Wilbur Springs minute moss beetle | | G1 S1 | None | None | | |
| +*Onychobaris langei*<br>Lange's El Segundo Dune weevil | | G1 S1 | None | None | | |
| +*Optioservus canus*<br>Pinnacles optioservus riffle beetle | | G1 S1 | None | None | | |
| *Paleoxenus dohrni*<br>Dohrn's elegant eucnemid beetle | | G3? S3? | None | None | | |
| +*Polyphylla anteronivea*<br>Saline Valley snow-front June beetle | | G1 S1 | None | None | | |
| +*Polyphylla barbata*<br>Mount Hermon (=barbate) June beetle | | G1 S1 | Endangered | None | | |
| +*Polyphylla erratica*<br>Death Valley June beetle | | G1 S1 | None | None | | |
| +*Polyphylla nubila*<br>Atascadero June beetle | | G1 S1 | None | None | | |
| *Prasinalia imperialis*<br>Algodones white wax jewel beetle | | G1G2 S1S2 | None | None | | |
| +*Pseudocotalpa andrewsi*<br>Andrew's dune scarab beetle | | G2G3 S2S3 | None | None | | |
| *Scaphinotus behrensi*<br>Behrens' snail-eating beetle | | G2G4 S2S4 | None | None | | |
| +*Trachykele hartmani*<br>serpentine cypress wood-boring beetle | | G1 S1 | None | None | | |
| *Trichinorhipis knulli*<br>A metallic wood-boring beetle | | G1 S1 | None | None | | |
| +*Trigonoscuta brunnotesselata*<br>brown tassel trigonoscuta weevil | | G1G2 S1S2 | None | None | | |
| +*Trigonoscuta dorothea dorothea*<br>Dorothy's El Segundo Dune weevil | | G1T1 S1 | None | None | | |
| *Trigonoscuta rothi algodones*<br>Algodones dune weevil | | G1G2 S1S2 | None | None | | |
| *Trigonoscuta rothi imperialis*<br>Imperial dune weevil | | G1G2 S1S2 | None | None | | |
| *Trigonoscuta rothi punctata*<br>Punctate dune weevil | | G1G2 S1S2 | None | None | | |
| *Trigonoscuta rothi rothi*<br>Roth's dune weevil | | G1G2 S1S2 | None | None | | |
| +*Trigonoscuta sp.*<br>Doyen's trigonoscuta dune weevil | | G1 S1 | None | None | | Yes |
| +*Trigonoscuta stantoni*<br>Santa Cruz Island shore weevil | | G1? S1? | None | None | | |
| +*Vandykea tuberculata*<br>serpentine cypress long-horned beetle | | G1 S1 | None | None | | |
| **INSECTA, Order Mecoptera (scorpionflies)** | | | | | | |
| +*Orobittacus obscurus*<br>gold rush hanging scorpionfly | | G1 S1 | None | None | | |
| **INSECTA, Order Diptera (flies)** | | | | | | |
| +*Ablautus schlingeri*<br>Oso Flaco robber fly | | G1 S1 | None | None | | |

## Invertebrates

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **INSECTA, Order Diptera (flies)** | | | | | | |
| *Apiocera warneri*<br>Glamis sand fly | | G1G2 S1S2 | None | None | | |
| +*Brennania belkini*<br>Belkin's dune tabanid fly | | G1G2 S1S2 | None | None | IUCN:VU | |
| +*Efferia antiochi*<br>Antioch efferian robberfly | | G1G3 S1S3 | None | None | | |
| *Efferia macroxipha*<br>Glamis robberfly | | G1G2 S1S2 | None | None | | |
| +*Metapogon hurdi*<br>Hurd's metapogon robberfly | | G1G3 S1S3 | None | None | | |
| +*Paracoenia calida*<br>Wilber Springs shore fly | | G1 S1 | None | None | | |
| +*Rhaphiomidas terminatus abdominalis*<br>Delhi Sands flower-loving fly | | G1T1 S1 | Endangered | None | | |
| +*Rhaphiomidas terminatus terminatus*<br>El Segundo flower-loving fly | | G1T1 S1 | None | None | | |
| *Rhaphiomidas trochilus*<br>Valley mydas fly | | G1 S1 | None | None | | |
| **INSECTA, Order Lepidoptera (butterflies & moths)** | | | | | | |
| +*Adela oplerella*<br>Opler's longhorn moth | | G2G3 S2S3 | None | None | | |
| +*Apodemia mormo langei*<br>Lange's metalmark butterfly | | G5T1 S1 | Endangered | None | XERCES:CI | |
| +*Areniscythris brachypteris*<br>Oso Flaco flightless moth | | G1 S1 | None | None | | |
| *Callophrys comstocki*<br>desert green hairstreak | | G2G3 S1S2 | None | None | XERCES:IM | |
| +*Callophrys mossii bayensis*<br>San Bruno elfin butterfly | | G4T1 S1 | Endangered | None | XERCES:CI | |
| +*Callophrys mossii hidakupa*<br>San Gabriel Mountains elfin butterfly | | G4T1T2 S1S2 | None | None | | |
| +*Callophrys mossii marinensis*<br>Marin elfin butterfly | | G4T1 S1 | None | None | | |
| +*Callophrys thornei*<br>Thorne's hairstreak | | G1 S1 | None | None | BLM:S | |
| +*Carolella busckana*<br>Busck's gallmoth | | G1G3 SH | None | None | | |
| +*Carterocephalus palaemon magnus*<br>Sonoma arctic skipper | | G5T1 S1 | None | None | | |
| *Cercyonis pegala carsonensis*<br>Carson Valley wood nymph | | G5T1T2 S1S2 | None | None | | |
| +*Chlosyne leanira elegans*<br>Oso Flaco patch butterfly | | G4G5T1T2 S1S2 | None | None | | |
| +*Coenonympha tullia yontockett*<br>Yontocket satyr | | G5T1T2 S1 | None | None | | |
| +*Danaus plexippus*<br>monarch butterfly | | G5 S3 | None | None | | |
| +*Euchloe hyantis andrewsi*<br>Andrew's marble butterfly | | G3G4T1 S1 | None | None | | |
| +*Eucosma hennei*<br>Henne's eucosman moth | | G1 S1 | None | None | | |
| +*Euphilotes battoides allyni*<br>El Segundo blue butterfly | | G5T1 S1 | Endangered | None | XERCES:CI | |
| +*Euphilotes battoides comstocki*<br>Comstock's blue butterfly | | G5T1T3 S1S3 | None | None | | |
| *Euphilotes baueri*<br>Bauer's dotted-blue | | G2G4 S1S2 | None | None | XERCES:IM | |
| +*Euphilotes enoptes smithi*<br>Smith's blue butterfly | | G5T1T2 S1S2 | Endangered | None | XERCES:CI | |

## Invertebrates

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **INSECTA, Order Lepidoptera (butterflies & moths)** | | | | | | |
| *Euphilotes mojave*<br>Mojave dotted-blue | | G2G3 S1S2 | None | None | XERCES:IM | |
| +*Euphydryas editha bayensis*<br>Bay checkerspot butterfly | | G5T1 S1 | Threatened | None | XERCES:CI | |
| +*Euphydryas editha monoensis*<br>Mono checkerspot butterfly | | G5T3? S1S2 | None | None | | |
| +*Euphydryas editha quino*<br>quino checkerspot butterfly | | G5T1 S1 | Endangered | None | XERCES:CI | |
| *Euphyes vestris harbisoni*<br>dun skipper | | G5T1 S1? | None | None | | |
| +*Euproserpinus euterpe*<br>Kern primrose sphinx moth | | G1 S1 | Threatened | None | XERCES:CI | |
| +*Glaucopsyche lygdamus palosverdesensis*<br>Palos Verdes blue butterfly | | G5T1 S1 | Endangered | None | XERCES:CI | |
| +*Hesperia miriamae longaevicola*<br>White Mountains skipper | | G2G3T1 S1 | None | None | | |
| *Hesperopsis gracielae*<br>Macneill's sooty wing skipper | | G2G3 S2S3 | None | None | XERCES:VU | |
| +*Lycaena hermes*<br>Hermes copper butterfly | | G1G2 S1S2 | None | None | IUCN:VU | |
| *Lycaena rubidus incana*<br>White Mountains copper | | G5T1 S1 | None | None | | |
| +*Panoquina errans*<br>wandering (=saltmarsh) skipper | | G4G5 S1 | None | None | IUCN:NT | |
| +*Philotiella speciosa bohartorum*<br>Boharts' blue butterfly | | G3G4T1 S1 | None | None | | |
| +*Plebejus icarioides albihalos*<br>White Mountains icarioides blue butterfly | | G5T2T3 S2? | None | None | | |
| +*Plebejus icarioides missionensis*<br>Mission blue butterfly | | G5T1 S1 | Endangered | None | XERCES:CI | |
| +*Plebejus icarioides moroensis*<br>Morro Bay blue butterfly | | G5T1T3 S1S3 | None | None | | |
| +*Plebejus icarioides parapheres*<br>Point Reyes blue butterfly | | G5T1T2 S1S2 | None | None | | |
| +*Plebejus idas lotis*<br>lotis blue butterfly | | G5TH SH | Endangered | None | XERCES:CI | |
| +*Plebejus saepiolus albomontanus*<br>White Mountains saepiolus blue butterfly | | G5T2 S1S2 | None | None | | |
| +*Plebejus saepiolus aureolus*<br>San Gabriel Mountains blue butterfly | | G5T1 S1 | None | None | | |
| +*Plebulina emigdionis*<br>San Emigdio blue butterfly | | G2G3 S2S3 | None | None | | |
| +*Polites mardon*<br>mardon skipper | | G2G3 S1 | Candidate | None | XERCES:IM | |
| *Polites sabuleti albamontana*<br>White Mountains sandhill skipper | | G5T2 S2 | None | None | | |
| *Psammobotys fordi*<br>Ford's sand dune moth | | GNR SNR | None | None | | |
| *Pseudocopaeodes eunus eunus*<br>alkali skipper | | G3G4T1T3 S1S3 | None | None | | |
| +*Pseudocopaeodes eunus obscurus*<br>Carson wandering skipper | | G3G4T1 S1 | Endangered | None | XERCES:CI | |
| +*Pyrgus ruralis lagunae*<br>Laguna Mountains skipper | | G5T1 S1 | Endangered | None | XERCES:CI | |
| +*Speyeria adiaste adiaste*<br>unsilvered fritillary | | G1G2T1 S1 | None | None | | |

## Invertebrates

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **INSECTA, Order Lepidoptera (butterflies & moths)** | | | | | | |
| +*Speyeria callippe callippe*<br>callippe silverspot butterfly | | G5T1 S1 | Endangered | None | XERCES:CI | |
| *Speyeria egleis tehachapina*<br>Tehachapi Mountain silverspot butterfly | | G5T2T3 S2S3 | None | None | | |
| +*Speyeria nokomis carsonensis*<br>Carson Valley silverspot | | G3T1 S1 | None | None | | |
| +*Speyeria zerene behrensii*<br>Behren's silverspot butterfly | | G5T1 S1 | Endangered | None | XERCES:CI | |
| +*Speyeria zerene hippolyta*<br>Hippolyta frittilary | | G5T1 S1 | Threatened | None | XERCES:CI | |
| +*Speyeria zerene myrtleae*<br>Myrtle's silverspot | | G5T1 S1 | Endangered | None | XERCES:CI | |
| **INSECTA, Order Trichoptera (caddisflies)** | | | | | | |
| +*Cryptochia denningi*<br>Denning's cryptic caddisfly | | G1G2 S1S2 | None | None | | |
| +*Cryptochia excella*<br>Kings Canyon cryptochian caddisfly | | G1G2 S1S2 | None | None | | |
| +*Cryptochia shasta*<br>confusion caddisfly | | G1G2 S1S2 | None | None | | |
| +*Desmona bethula*<br>amphibious caddisfly | | G2G3 S2S3 | None | None | | |
| +*Diplectrona californica*<br>California diplectronan caddisfly | | G1G2 S1S2 | None | None | | |
| +*Ecclisomyia bilera*<br>Kings Creek ecclysomyian caddisfly | | G1G2 S1S2 | None | None | | |
| +*Farula praelonga*<br>long-tailed caddisfly | | G1G2 S1S2 | None | None | | |
| +*Goeracea oregona*<br>Sagehen Creek goeracean caddisfly | | G2 S1S2 | None | None | | |
| +*Lepidostoma ermanae*<br>Cold Spring caddisfly | | G1G2 S1S2 | None | None | | |
| +*Limnephilus atercus*<br>Fort Dick limnephilus caddisfly | | G4 S1 | None | None | | |
| +*Neothremma genella*<br>golden-horned caddisfly | | G1G2 S1S2 | None | None | | |
| *Neothremma siskiyou*<br>Siskiyou caddisfly | | G1G2 S1S2 | None | None | | |
| +*Parapsyche extensa*<br>King's Creek parapsyche caddisfly | | GH SH | None | None | | |
| +*Rhyacophila lineata*<br>Castle Crags rhyacophilan caddisfly | | G1G3 S1S2 | None | None | | |
| +*Rhyacophila mosana*<br>bilobed rhyacophilan caddisfly | | G1G2Q S1S2 | None | None | | |
| +*Rhyacophila spinata*<br>spiny rhyacophilan caddisfly | | G1G2 S1S2 | None | None | | |
| **INSECTA, Order Hymenoptera (ants, bees, & wasps)** | | | | | | |
| +*Andrena blennospermatis*<br>Blennosperma vernal pool andrenid bee | | G2 S2 | None | None | | |
| +*Andrena macswaini*<br>An andrenid bee | | G1G3 S1S3 | None | None | | |
| +*Andrena subapasta*<br>A vernal pool andrenid bee | | G1G3 S1S3 | None | None | | |
| +*Argochrysis lassenae*<br>Lassen cuckoo wasp | | G1 S1 | None | None | | |
| +*Ashmeadiella chumashae*<br>Channel Islands leaf-cutter bee | | G2? S2? | None | None | | |

## Invertebrates

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **INSECTA, Order Hymenoptera (ants, bees, & wasps)** | | | | | | |
| *Bombus franklini*<br>Franklin's bumble bee | | G1 S1 | None | None | IUCN:CR<br>XERCES:CI | |
| *Bombus occidentalis*<br>western bumble bee | | GU S1 | None | None | XERCES:IM | |
| +*Ceratochrysis bradleyi*<br>Bradley's cuckoo wasp | | G1 S1 | None | None | | |
| +*Ceratochrysis gracilis*<br>Piute Mountains cuckoo wasp | | G1 S1 | None | None | | |
| *Ceratochrysis grisselli*<br>A cuckoo wasp | | GNR SNR | None | None | | |
| +*Ceratochrysis longimala*<br>A cuckoo wasp | | G1 S1 | None | None | | |
| +*Ceratochrysis menkei*<br>Menke's cuckoo wasp | | G1 S1 | None | None | | |
| +*Chrysis tularensis*<br>Tulare cuckoo wasp | | G1G2 S1S2 | None | None | | |
| *Cleptes humboldti*<br>A cuckoo wasp | | G1G2 S1S2 | None | None | | |
| +*Dufourea stagei*<br>Stage's dufourine bee | | G1? S1? | None | None | | |
| +*Eucerceris ruficeps*<br>redheaded sphecid wasp | | G1G3 S1S2 | None | None | | |
| *Euparagia unidentata*<br>Algodones euparagia | | G1G2 S1S2 | None | None | | |
| *Habropoda pallida*<br>white faced bee | | G1G2 S1S2 | None | None | | |
| +*Halictus harmonius*<br>haromonius halictid bee | | G1 S1 | None | None | XERCES:CI | |
| +*Hedychridium argenteum*<br>Riverside cuckoo wasp | | G1? S1? | None | None | | |
| +*Hedychridium milleri*<br>Borax Lake cuckoo wasp | | G1? S1? | None | None | | |
| +*Lasioglossum channelense*<br>Channel Island sweat bee | | G1 S1 | None | None | | |
| +*Melitta californica*<br>A mellitid bee | | G4? S2? | None | None | | |
| *Microbembex elegans*<br>Algodones elegant sand wasp | | G1G2 S1S2 | None | None | | |
| +*Minymischa ventura*<br>Ventura cuckoo wasp | | G1G3 S1S3 | None | None | | |
| +*Myrmosula pacifica*<br>Antioch multilid wasp | | GH SH | None | None | | |
| *Neolarra alba*<br>a cuckoo bee | | GH SH | None | None | | |
| +*Paranomada californica*<br>a cuckoo bee | | G1 S1 | None | None | | |
| +*Parnopes borregoensis*<br>Borrego parnopes cuckoo wasp | | G1? S1? | None | None | | |
| *Perdita algodones*<br>Algodones perdita | | G1G2 S1S2 | None | None | | |
| *Perdita frontalis*<br>Imperial Perdita | | G1G2 S1S2 | None | None | | |
| *Perdita glamis*<br>Glamis perdita | | G1G2 S1S2 | None | None | | |
| +*Perdita scitula antiochensis*<br>Antioch andrenid bee | | G1T1 S1 | None | None | | |
| +*Philanthus nasalis*<br>Antioch specid wasp | | G1 S1 | None | None | | |

## Invertebrates

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **INSECTA, Order Hymenoptera (ants, bees, & wasps)** | | | | | | |
| +*Protodufourea wasbaueri*<br>Wasbauer's protodufourea bee | | G1 S1 | None | None | XERCES:DD | |
| +*Protodufourea zavortinki*<br>Zavortink's protodufourea bee | | G1 S1 | None | None | | |
| +*Rhopalolemma robertsi*<br>Roberts' rhopalolemma bee | | G1 S1 | None | None | | |
| *Sedomaya glamisensis*<br>Glamis night tiphiid | | G1G2 S1S2 | None | None | | |
| +*Sphecodogastra antiochensis*<br>Antioch Dunes halcitid bee | | G1 S1 | None | None | XERCES:CI | |
| *Spheropthalma ecarinata*<br>Glamis night mutillid | | G1G2 S1S2 | None | None | | |
| *Stictiella villegasi*<br>Algodones sand wasp | | G1G2 S1S2 | None | None | | |
| +*Trachusa gummifera*<br>A leaf-cutter bee | | G1 S1 | None | None | | |

## Fishes

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **PETROMYZONTIDAE (lampreys)** | | | | | | |
| +*Entosphenus hubbsi*<br>Kern brook lamprey | | G1G2 S1S2 | None | None | AFS:TH<br>DFG:SSC<br>IUCN:NT | |
| *Entosphenus lethophagus*<br>Pit-Klamath brook lamprey | | G3G4 S3 | None | None | AFS:VU | |
| *Entosphenus similis*<br>Klamath River lamprey | | G3G4Q S3S4 | None | None | AFS:TH<br>DFG:SSC | |
| *Entosphenus tridentatus*<br>Pacific lamprey | | G5 S4 | None | None | AFS:VU | |
| +*Entosphenus tridentatus ssp. 1*<br>Goose Lake lamprey | | G5T1 S1 | None | None | AFS:VU<br>DFG:SSC<br>USFS:S | |
| *Lampetra ayresii*<br>river lamprey | | G4 S4 | None | None | AFS:VU<br>DFG:SSC | |
| **ACIPENSERIDAE (sturgeon)** | | | | | | |
| +*Acipenser medirostris*<br>green sturgeon | (southern DPS) | G3 S1S2 | Threatened | None | AFS:VU<br>DFG:SSC<br>IUCN:NT<br>NMFS:SC | Yes |
| *Acipenser transmontanus*<br>white sturgeon | | G4 S2 | None | None | AFS:EN<br>IUCN:LC | |
| **SALMONIDAE (trout & salmon)** | | | | | | |
| +*Oncorhynchus clarkii clarkii*<br>coast cutthroat trout | | G4T4 S3 | None | None | AFS:VU<br>DFG:SSC<br>USFS:S | |
| +*Oncorhynchus clarkii henshawi*<br>Lahontan cutthroat trout | | G4T3 S2 | Threatened | None | AFS:TH | |
| +*Oncorhynchus clarkii seleniris*<br>Paiute cutthroat trout | | G4T1T2 S1S2 | Threatened | None | AFS:EN | |
| +*Oncorhynchus gorbuscha*<br>pink salmon | | G5 S1 | None | None | DFG:SSC | |
| *Oncorhynchus keta*<br>chum salmon | | G5 S1? | None | None | DFG:SSC | |
| +*Oncorhynchus kisutch*<br>coho salmon - southern Oregon / northern California ESU | | G4T2Q S2? | Threatened | Threatened | AFS:TH<br>DFG:SSC | Yes |
| +*Oncorhynchus kisutch*<br>coho salmon - central California coast ESU | | G4 S2? | Endangered | Endangered | AFS:EN | Yes |
| +*Oncorhynchus mykiss aguabonita*<br>Volcano Creek golden trout | | G5T1 S1 | None | None | AFS:TH<br>DFG:SSC<br>USFS:S | |
| +*Oncorhynchus mykiss aquilarum*<br>Eagle Lake rainbow trout | | G5T1 S1 | None | None | AFS:TH<br>DFG:SSC<br>USFS:S | |
| *Oncorhynchus mykiss gilberti*<br>Kern River rainbow trout | | G5T1Q S1S2 | None | None | AFS:TH<br>DFG:SSC | |
| *Oncorhynchus mykiss irideus*<br>steelhead - Klamath Mountains Province DPS | | G5T3Q S2 | None | None | DFG:SSC<br>USFS:S | Yes |
| +*Oncorhynchus mykiss irideus*<br>steelhead - central California coast DPS | | G5T2Q S2 | Threatened | None | AFS:TH | Yes |
| +*Oncorhynchus mykiss irideus*<br>steelhead - south/central California coast DPS | | G5T2Q S2 | Threatened | None | AFS:TH<br>DFG:SSC | Yes |
| +*Oncorhynchus mykiss irideus*<br>southern steelhead - southern California DPS | | G5T2Q S2 | Endangered | None | AFS:EN<br>DFG:SSC | Yes |

## Fishes

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **SALMONIDAE (trout & salmon)** | | | | | | |
| *Oncorhynchus mykiss irideus*<br>steelhead - Central Valley DPS | | G5T2 S2 | Threatened | None | AFS:TH | Yes |
| +*Oncorhynchus mykiss irideus*<br>steelhead - northern California DPS | | G5T2Q S2 | Threatened | None | AFS:TH<br>DFG:SSC | Yes |
| +*Oncorhynchus mykiss irideus*<br>summer-run steelhead trout | | G5T4Q S2 | None | None | DFG:SSC | Yes |
| +*Oncorhynchus mykiss ssp. 1*<br>Goose Lake redband trout | | G5T2Q S1 | None | None | AFS:VU<br>DFG:SSC<br>USFS:S | |
| +*Oncorhynchus mykiss ssp. 2*<br>McCloud River redband trout | | G5T1T2Q S1S2 | None | None | AFS:VU<br>DFG:SSC<br>USFS:S | |
| *Oncorhynchus mykiss ssp. 3*<br>Warner Valley redband trout | | G5T2Q S1? | None | None | AFS:VU<br>USFS:S | |
| +*Oncorhynchus mykiss whitei*<br>Little Kern golden trout | | G5T2 S2 | Threatened | None | AFS:EN | |
| +*Oncorhynchus tshawytscha*<br>chinook salmon - spring-run Klamath-Trinity Rivers pop. | | G5 S1S2 | None | None | DFG:SSC<br>USFS:S | |
| +*Oncorhynchus tshawytscha*<br>chinook salmon - Central Valley spring-run ESU | | G5 S1 | Threatened | Threatened | AFS:TH | Yes |
| +*Oncorhynchus tshawytscha*<br>chinook salmon - Sacramento River winter-run ESU | | G5 S1 | Endangered | Endangered | AFS:EN | |
| *Oncorhynchus tshawytscha*<br>chinook salmon - Central Valley fall / late fall-run ESU | | G5 S2? | None | None | AFS:VU<br>DFG:SSC<br>NMFS:SC<br>USFS:S | Yes |
| +*Oncorhynchus tshawytscha*<br>chinook salmon - California coastal ESU | | G5 S1 | Threatened | None | AFS:TH | Yes |
| *Prosopium williamsoni*<br>mountain whitefish | | G5 S3 | None | None | | |
| +*Salvelinus confluentus*<br>bull trout | | G3 SX | Threatened | Endangered | IUCN:VU | |
| **OSMERIDAE (smelt)** | | | | | | |
| +*Hypomesus transpacificus*<br>Delta smelt | | G1 S1 | Threatened | Endangered | AFS:TH<br>IUCN:EN | |
| *Spirinchus thaleichthys*<br>longfin smelt | | G5 S1 | None | Threatened | DFG:SSC | Yes |
| *Thaleichthys pacificus*<br>eulachon | | G5 S3 | Threatened | None | DFG:SSC | |
| **CYPRINIDAE (minnows and carp)** | | | | | | |
| +*Gila coerulea*<br>blue chub | | G3 S2S3 | None | None | DFG:SSC | |
| +*Gila elegans*<br>bonytail | | G1 S1 | Endangered | Endangered | AFS:EN<br>IUCN:EN | |
| +*Gila orcuttii*<br>arroyo chub | | G2 S2 | None | None | AFS:VU<br>DFG:SSC<br>USFS:S | |
| +*Lavinia exilicauda chi*<br>Clear Lake hitch | | G5T2 S2 | None | None | AFS:VU<br>DFG:SSC<br>USFS:S | |
| *Lavinia exilicauda exilicauda*<br>Central Valley hitch | | G5T2T4 S2S4 | None | None | | |
| *Lavinia exilicauda harengus*<br>Pajaro/Salinas hitch | | G5T2T4 S2S4 | None | None | | |
| +*Lavinia symmetricus mitrulus*<br>Pit roach | | G5T3 S2 | None | None | AFS:VU<br>DFG:SSC | |

## Fishes

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **CYPRINIDAE (minnows and carp)** | | | | | | |
| +*Lavinia symmetricus navarroensis*<br>Navarro roach | | G5T1T2 S1S2 | None | None | DFG:SSC | |
| +*Lavinia symmetricus parvipinnis*<br>Gualala roach | | G5T1T2 S1S2 | None | None | DFG:SSC | |
| +*Lavinia symmetricus ssp. 1*<br>San Joaquin roach | | G5T3Q S3 | None | None | DFG:SSC | Yes |
| +*Lavinia symmetricus ssp. 2*<br>Tomales roach | | G5T2T3 S2S3 | None | None | DFG:SSC | |
| +*Lavinia symmetricus ssp. 3*<br>Red Hills roach | | G5T1 S1 | None | None | AFS:VU<br>BLM:S<br>DFG:SSC | |
| *Lavinia symmetricus ssp. 4*<br>Clear Lake - Russian River roach | | G5T2T3 S2S3 | None | None | | |
| *Lavinia symmetricus subditus*<br>Monterey roach | | G5T2T3 S2S3 | None | None | DFG:SSC | |
| +*Mylopharodon conocephalus*<br>hardhead | | G3 S3 | None | None | DFG:SSC<br>USFS:S | |
| +*Pogonichthys macrolepidotus*<br>Sacramento splittail | | G2 S2 | None | None | AFS:VU<br>DFG:SSC<br>IUCN:EN | |
| +*Ptychocheilus lucius*<br>Colorado pikeminnow | | G1 SX | Endangered | Endangered | DFG:FP<br>IUCN:VU | |
| +*Rhinichthys osculus ssp. 1*<br>Amargosa Canyon speckled dace | | G5T1Q S1 | None | None | AFS:TH<br>BLM:S<br>DFG:SSC | Yes |
| +*Rhinichthys osculus ssp. 2*<br>Owens speckled dace | | G5T1T2Q S1S2 | None | None | AFS:TH<br>DFG:SSC | Yes |
| +*Rhinichthys osculus ssp. 3*<br>Santa Ana speckled dace | | G5T1 S1 | None | None | AFS:TH<br>DFG:SSC<br>USFS:S | |
| *Rhinichthys osculus ssp. 5*<br>Long Valley speckled dace | | G5T1 S1 | None | None | AFS:EN | |
| +*Siphateles bicolor mohavensis*<br>Mohave tui chub | | G4T1 S1 | Endangered | Endangered | AFS:EN<br>DFG:FP | |
| *Siphateles bicolor pectinifer*<br>Lahontan Lake tui chub | | G4T3 S1S2 | None | None | DFG:SSC<br>USFS:S | |
| +*Siphateles bicolor snyderi*<br>Owens tui chub | | G4T1 S1 | Endangered | Endangered | AFS:EN | |
| +*Siphateles bicolor ssp. 1*<br>Eagle Lake tui chub | | G4T1 S1 | None | None | DFG:SSC | |
| +*Siphateles bicolor ssp. 2*<br>High Rock Spring tui chub | | G4TX SX | None | None | DFG:SSC | |
| *Siphateles bicolor ssp. 3*<br>Pit River tui chub | | G4T1T3 S1S3 | None | None | | |
| +*Siphateles bicolor thalassina*<br>Goose Lake tui chub | | G4T2 S1 | None | None | AFS:TH<br>DFG:SSC<br>USFS:S | |
| +*Siphateles bicolor vaccaceps*<br>Cow Head tui chub | | G4T1 S1 | None | None | AFS:EN<br>DFG:SSC | |
| **CATOSTOMIDAE (suckers)** | | | | | | |
| +*Catostomus fumeiventris*<br>Owens sucker | | G3 S3 | None | None | DFG:SSC | |
| +*Catostomus latipinnis*<br>flannelmouth sucker | | G3G4 S1 | None | None | | |
| +*Catostomus microps*<br>Modoc sucker | | G1 S1 | Endangered | Endangered | AFS:EN<br>DFG:FP<br>IUCN:EN | |

## Fishes

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **CATOSTOMIDAE (suckers)** | | | | | | |
| +*Catostomus occidentalis lacusanserinus*<br>Goose Lake sucker | | G5T2T3Q S1 | None | None | AFS:VU<br>DFG:SSC<br>USFS:S | |
| *Catostomus platyrhynchus*<br>mountain sucker | | G5 S2S3 | None | None | DFG:SSC | |
| *Catostomus rimiculus ssp. 1*<br>Jenny Creek sucker | | G5T2Q S1 | None | None | AFS:VU | |
| +*Catostomus santaanae*<br>Santa Ana sucker | | G1 S1 | Threatened | None | AFS:TH<br>DFG:SSC<br>IUCN:VU | |
| +*Catostomus snyderi*<br>Klamath largescale sucker | | G3 S2 | None | None | AFS:TH<br>DFG:SSC<br>IUCN:NT | |
| +*Chasmistes brevirostris*<br>shortnose sucker | | G1 S1 | Endangered | Endangered | AFS:EN<br>DFG:FP<br>IUCN:EN | |
| +*Deltistes luxatus*<br>Lost River sucker | | G1 S1 | Endangered | Endangered | AFS:EN<br>DFG:FP<br>IUCN:EN | |
| +*Xyrauchen texanus*<br>razorback sucker | | G1 S1 | Endangered | Endangered | AFS:EN<br>DFG:FP<br>IUCN:EN | |
| **CYPRINODONTIDAE (killifishes)** | | | | | | |
| +*Cyprinodon macularius*<br>desert pupfish | | G1 S1 | Endangered | Endangered | AFS:EN | |
| +*Cyprinodon nevadensis amargosae*<br>Amargosa pupfish | | G2T1 S1 | None | None | AFS:VU<br>BLM:S<br>DFG:SSC | |
| +*Cyprinodon nevadensis nevadensis*<br>Saratoga Springs pupfish | | G2T1 S1 | None | None | AFS:TH<br>DFG:SSC | |
| +*Cyprinodon nevadensis shoshone*<br>Shoshone pupfish | | G2T1 S1 | None | None | AFS:EN<br>DFG:SSC | |
| +*Cyprinodon radiosus*<br>Owens pupfish | | G1 S1 | Endangered | Endangered | AFS:EN<br>DFG:FP<br>IUCN:EN | |
| +*Cyprinodon salinus milleri*<br>Cottonball Marsh pupfish | | G1QT1 S1 | None | Threatened | AFS:TH | |
| +*Cyprinodon salinus salinus*<br>Salt Creek pupfish | | G1T1 S1 | None | None | AFS:VU<br>DFG:SSC | |
| **GASTEROSTEIDAE (sticklebacks)** | | | | | | |
| *Gasterosteus aculeatus microcephalus*<br>resident threespine stickleback | (South of Pt. Conception only) | G5T2T3 S2S3 | None | None | USFS:S | Yes |
| *Gasterosteus aculeatus santaannae*<br>Santa Ana (=Shay Creek) threespine stickleback | | G5T1Q S1 | None | None | AFS:EN | Yes |
| +*Gasterosteus aculeatus williamsoni*<br>unarmored threespine stickleback | | G5T1 S1 | Endangered | Endangered | AFS:EN<br>DFG:FP | Yes |
| **POLYPRIONIDAE (wreckfishes)** | | | | | | |
| *Stereolepis gigas*<br>giant sea bass | | G3 S1S2 | None | None | AFS:VU<br>IUCN:CR | Yes |
| **CENTRARCHIDAE (sunfishes)** | | | | | | |
| +*Archoplites interruptus*<br>Sacramento perch | (Within native range only) | G3 S1 | None | None | AFS:TH<br>DFG:SSC | |
| **EMBIOTOCIDAE (surfperches)** | | | | | | |
| *Hysterocarpus traski lagunae*<br>Clear Lake tule perch | | G5T2T3 S2S3 | None | None | | |
| +*Hysterocarpus traski pomo*<br>Russian River tule perch | | G5T2 S2 | None | None | AFS:VU<br>DFG:SSC | |

## Fishes

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **EMBIOTOCIDAE (surfperches)** | | | | | | |
| *Hysterocarpus traski traski*<br>Sacramento-San Joaquin tule perch | | G5T2T3 S2S3 | None | None | | |
| **GOBIIDAE (gobies)** | | | | | | |
| +*Eucyclogobius newberryi*<br>tidewater goby | | G3 S2S3 | Endangered | None | AFS:EN<br>DFG:SSC<br>IUCN:VU | |
| **COTTIDAE (sculpins)** | | | | | | |
| +*Cottus asperrimus*<br>rough sculpin | | G2 S2 | None | Threatened | AFS:VU<br>DFG:FP<br>IUCN:VU | |
| *Cottus gulosus*<br>riffle sculpin | | G5 S3S4 | None | None | | |
| *Cottus klamathensis klamathensis*<br>Upper Klamath marbled sculpin | | G4T1T2 S1S2 | None | None | | |
| +*Cottus klamathensis macrops*<br>bigeye marbled sculpin | | G4T3 S3 | None | None | AFS:VU<br>DFG:SSC | |
| *Cottus klamathensis polyporus*<br>Lower Klamath marbled sculpin | | G4T2T4 S2S4 | None | None | | |
| *Cottus perplexus*<br>reticulate sculpin | | G4 S2S3 | None | None | DFG:SSC | |

## Amphibians

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **AMBYSTOMATIDAE (mole salamanders)** | | | | | | |
| +*Ambystoma californiense*<br>California tiger salamander | | G2G3 S2S3 | Threatened | Threatened | DFG:SSC<br>IUCN:VU | |
| +*Ambystoma macrodactylum croceum*<br>Santa Cruz long-toed salamander | | G5T1 S1 | Endangered | Endangered | DFG:FP | |
| **RHYACOTRITONIDAE (Olympic salamanders)** | | | | | | |
| +*Rhyacotriton variegatus*<br>southern torrent salamander | | G3G4 S2S3 | None | None | DFG:SSC<br>IUCN:LC<br>USFS:S | |
| **SALAMANDRIDAE (newts)** | | | | | | |
| +*Taricha torosa*<br>Coast Range newt | (Monterey Co. south only) | G5T4 S4 | None | None | DFG:SSC | |
| **PLETHODONTIDAE (lungless salamanders)** | | | | | | |
| +*Batrachoseps campi*<br>Inyo Mountains slender salamander | | G2 S2 | None | None | BLM:S<br>DFG:SSC<br>IUCN:EN<br>USFS:S | |
| *Batrachoseps diabolicus*<br>Hell Hollow slender salamander | | G2 S2 | None | None | IUCN:DD | |
| +*Batrachoseps gabrieli*<br>San Gabriel slender salamander | | G2 S2 | None | None | IUCN:DD<br>USFS:S | |
| *Batrachoseps gregarius*<br>gregarious slender salamander | | G2G3 S2S3 | None | None | IUCN:LC | |
| *Batrachoseps incognitus*<br>San Simeon slender salamander | | G2G3 S2S3 | None | None | IUCN:DD | |
| *Batrachoseps kawia*<br>Sequoia slender salamander | | G1G2 S1S2 | None | None | IUCN:DD | |
| *Batrachoseps luciae*<br>Santa Lucia slender salamander | | G2G3 S2S3 | None | None | IUCN:LC | |
| +*Batrachoseps major aridus*<br>desert slender salamander | | G4T1 S1 | Endangered | Endangered | | |
| *Batrachoseps minor*<br>lesser slender salamander | | G1G2 S1S2 | None | None | IUCN:DD | |
| +*Batrachoseps pacificus*<br>Channel Islands slender salamander | | G3QT2 S2 | None | None | IUCN:LC | |
| +*Batrachoseps regius*<br>Kings River slender salamander | | G1 S1 | None | None | IUCN:VU | |
| +*Batrachoseps relictus*<br>relictual slender salamander | | G2 S2 | None | None | DFG:SSC<br>IUCN:DD<br>USFS:S | |
| +*Batrachoseps robustus*<br>Kern Plateau salamander | | G2 S2 | None | None | IUCN:NT<br>USFS:S | |
| +*Batrachoseps simatus*<br>Kern Canyon slender salamander | | G2 S2 | None | Threatened | IUCN:VU<br>USFS:S | |
| +*Batrachoseps sp. 1*<br>Breckenridge Mountain slender salamander | | G1Q S1 | None | None | DFG:SSC<br>USFS:S | |
| +*Batrachoseps stebbinsi*<br>Tehachapi slender salamander | | G2 S2 | None | Threatened | BLM:S<br>IUCN:VU<br>USFS:S | |
| +*Ensatina eschscholtzii croceator*<br>yellow-blotched salamander | | G5T2T3 S2S3 | None | None | BLM:S<br>DFG:SSC<br>USFS:S | |
| +*Ensatina klauberi*<br>large-blotched salamander | | G5 S2S3 | None | None | DFG:SSC<br>USFS:S | |
| +*Hydromantes brunus*<br>limestone salamander | | G1 S1 | None | Threatened | DFG:FP<br>IUCN:VU<br>USFS:S | |
| +*Hydromantes platycephalus*<br>Mount Lyell salamander | | G3 S3 | None | None | DFG:SSC<br>IUCN:LC | |

## Amphibians

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **PLETHODONTIDAE (lungless salamanders)** | | | | | | |
| +*Hydromantes shastae*<br>Shasta salamander | | G1G2 S1S2 | None | Threatened | BLM:S<br>IUCN:VU<br>USFS:S | |
| +*Hydromantes sp. 1*<br>Owens Valley web-toed salamander (AKA Oak Creek salamander) | | G1Q S1 | None | None | DFG:SSC | |
| +*Plethodon asupak*<br>Scott Bar salamander | | G1G2 S1S2 | None | Threatened | IUCN:VU | Yes |
| +*Plethodon elongatus*<br>Del Norte salamander | | G4 S3 | None | None | DFG:SSC<br>IUCN:NT | |
| +*Plethodon stormi*<br>Siskiyou Mountains salamander | | G2G3 S1S2 | None | Threatened | IUCN:EN<br>USFS:S | |
| **ASCAPHIDAE (tailed frogs)** | | | | | | |
| +*Ascaphus truei*<br>Pacific tailed frog | | G4 S2S3 | None | None | DFG:SSC<br>IUCN:LC | |
| **SCAPHIOPODIDAE (spadefoot toads)** | | | | | | |
| +*Scaphiopus couchii*<br>Couch's spadefoot | | G5 S2S3 | None | None | BLM:S<br>DFG:SSC<br>IUCN:LC | |
| +*Spea hammondii*<br>western spadefoot | | G3 S3 | None | None | BLM:S<br>DFG:SSC<br>IUCN:NT | |
| **BUFONIDAE (true toads)** | | | | | | |
| +*Anaxyrus californicus*<br>arroyo toad | | G2G3 S2S3 | Endangered | None | DFG:SSC<br>IUCN:EN | Yes |
| +*Anaxyrus canorus*<br>Yosemite toad | | G2 S2 | Candidate | None | DFG:SSC<br>IUCN:EN<br>USFS:S | Yes |
| +*Anaxyrus exsul*<br>black toad | | G1Q S1 | None | Threatened | DFG:FP<br>IUCN:VU | Yes |
| +*Incilius alvarius*<br>Sonoran desert toad | | G5 SH | None | None | DFG:SSC<br>IUCN:LC | Yes |
| **RANIDAE** | | | | | | |
| +*Lithobates pipiens*<br>northern leopard frog | (Native populations only) | G5 S2 | None | None | DFG:SSC<br>IUCN:LC<br>USFS:S | Yes |
| +*Lithobates yavapaiensis*<br>lowland (=Yavapai, San Sebastian & San Felipe) leopard frog | | G4 SX | None | None | BLM:S<br>DFG:SSC<br>IUCN:LC | Yes |
| +*Rana aurora*<br>northern red-legged frog | | G4T4 S2? | None | None | DFG:SSC<br>USFS:S | Yes |
| +*Rana boylii*<br>foothill yellow-legged frog | | G3 S2S3 | None | None | BLM:S<br>DFG:SSC<br>IUCN:NT<br>USFS:S | |
| +*Rana cascadae*<br>Cascades frog | | G3G4 S3 | None | None | DFG:SSC<br>IUCN:NT<br>USFS:S | |
| +*Rana draytonii*<br>California red-legged frog | | G4T2T3 S2S3 | Threatened | None | DFG:SSC<br>IUCN:VU | Yes |
| +*Rana muscosa*<br>Sierra Madre yellow-legged frog | | G1 S1 | Endangered | Candidate Endangered | DFG:SSC<br>IUCN:EN<br>USFS:S | Yes |
| +*Rana pretiosa*<br>Oregon spotted frog | | G2 S1 | Candidate | None | DFG:SSC<br>IUCN:VU<br>USFS:S | |

## Amphibians

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **RANIDAE** | | | | | | |
| +*Rana sierrae*<br>Sierra Nevada yellow-legged frog | | G1 S1 | Candidate | Candidate Endangered | DFG:SSC<br>IUCN:EN<br>USFS:S | Yes |

## Reptiles

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **CHELONIIDAE (sea turtles)** | | | | | | |
| +*Chelonia mydas*<br>green turtle | | G3 S1 | Threatened | None | IUCN:EN | |
| **KINOSTERNIDAE (musk and mud turtles)** | | | | | | |
| *Kinosternon sonoriense*<br>Sonoran mud turtle | | G4 SH | None | None | DFG:SSC<br>IUCN:VU | |
| **EMYDIDAE (box and water turtles)** | | | | | | |
| +*Emys marmorata*<br>western pond turtle | | G3G4 S3 | None | None | BLM:S<br>DFG:SSC<br>IUCN:VU<br>USFS:S | Yes |
| **TESTUDINIDAE (land tortoises)** | | | | | | |
| +*Gopherus agassizii*<br>desert tortoise | | G4 S2 | Threatened | Threatened | IUCN:VU | |
| **GEKKONIDAE (geckos)** | | | | | | |
| +*Coleonyx switaki*<br>barefoot gecko | | G4 S1 | None | Threatened | IUCN:LC | |
| +*Coleonyx variegatus abbotti*<br>San Diego banded gecko | | G5T3T4 S2S3 | None | None | | |
| **CROTAPHYTIDAE (collared & leopard lizards)** | | | | | | |
| +*Gambelia sila*<br>blunt-nosed leopard lizard | | G1 S1 | Endangered | Endangered | DFG:FP<br>IUCN:EN | |
| **PHRYNOSOMATIDAE (spiny lizards)** | | | | | | |
| +*Phrynosoma blainvillii*<br>coast horned lizard | | G4G5 S3S4 | None | None | BLM:S<br>DFG:SSC<br>IUCN:LC<br>USFS:S | |
| +*Phrynosoma mcallii*<br>flat-tailed horned lizard | | G3 S2 | None | None | BLM:S<br>DFG:SSC<br>IUCN:NT | |
| +*Sceloporus graciosus graciosus*<br>northern sagebrush lizard | | G5T5 S3 | None | None | BLM:S | |
| +*Uma inornata*<br>Coachella Valley fringe-toed lizard | | G1Q S1 | Threatened | Endangered | IUCN:EN | |
| +*Uma notata*<br>Colorado Desert fringe-toed lizard | | G3 S2? | None | None | BLM:S<br>DFG:SSC<br>IUCN:NT | |
| +*Uma scoparia*<br>Mojave fringe-toed lizard | | G3G4 S3S4 | None | None | BLM:S<br>DFG:SSC<br>IUCN:LC | |
| **XANTUSIIDAE (night lizards)** | | | | | | |
| +*Xantusia gracilis*<br>sandstone night lizard | | G1 S1 | None | None | DFG:SSC<br>IUCN:VU | |
| +*Xantusia riversiana*<br>island night lizard | | G1 S1 | Threatened | None | IUCN:LC | |
| *Xantusia sierrae*<br>Sierra night lizard | | G5T1 S1 | None | None | DFG:SSC<br>USFS:S | |
| **SCINCIDAE (skinks)** | | | | | | |
| +*Plestiodon skiltonianus interparietalis*<br>Coronado Island skink | | G5T2T3Q S1S2 | None | None | BLM:S<br>DFG:SSC | |
| **TEIIDAE (whiptails and relatives)** | | | | | | |
| +*Aspidoscelis hyperythra*<br>orangethroat whiptail | | G5 S2 | None | None | DFG:SSC<br>IUCN:LC | |
| +*Aspidoscelis tigris stejnegeri*<br>coastal whiptail | | G5T3T4 S2S3 | None | None | | |

## Reptiles

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **ANGUIDAE (alligator lizards)** | | | | | | |
| +*Elgaria panamintina*<br>Panamint alligator lizard | | G1G2 S1S2 | None | None | BLM:S<br>DFG:SSC<br>IUCN:VU<br>USFS:S | |
| **ANNIELLIDAE (Legless lizards)** | | | | | | |
| +*Anniella pulchra nigra*<br>black legless lizard | | G3G4T2T3Q S2 | None | None | DFG:SSC<br>USFS:S | |
| +*Anniella pulchra pulchra*<br>silvery legless lizard | | G3G4T3T4Q S3 | None | None | DFG:SSC<br>USFS:S | |
| **HELODERMATIDAE (venomous lizards)** | | | | | | |
| +*Heloderma suspectum cinctum*<br>banded gila monster | | G4T4 S1 | None | None | BLM:S<br>DFG:SSC<br>IUCN:NT | Yes |
| **BOIDAE (boas)** | | | | | | |
| +*Charina trivirgata*<br>rosy boa | | G4G5 S3S4 | None | None | IUCN:LC<br>USFS:S | Yes |
| +*Charina umbratica*<br>southern rubber boa | | G5T2T3 S2S3 | None | Threatened | USFS:S | |
| **COLUBRIDAE (egg-laying snakes)** | | | | | | |
| *Bogertophis rosaliae*<br>Baja California rat snake | | G4 S1 | None | None | DFG:SSC<br>IUCN:LC | |
| +*Diadophis punctatus modestus*<br>San Bernardino ringneck snake | | G5T2T3 S2? | None | None | USFS:S | |
| +*Diadophis punctatus similis*<br>San Diego ringneck snake | | G5T2T3 S2? | None | None | USFS:S | |
| +*Lampropeltis zonata (parvirubra)*<br>California mountain kingsnake (San Bernardino population) | | G4G5 S2? | None | None | DFG:SSC<br>IUCN:LC<br>USFS:S | |
| +*Lampropeltis zonata (pulchra)*<br>California mountain kingsnake (San Diego population) | | G4G5 S1S2 | None | None | DFG:SSC<br>IUCN:LC<br>USFS:S | |
| +*Masticophis flagellum ruddocki*<br>San Joaquin whipsnake | | G5T2T3 S2? | None | None | DFG:SSC | |
| +*Masticophis lateralis euryxanthus*<br>Alameda whipsnake | | G4T2 S2 | Threatened | Threatened | | |
| *Pituophis catenifer pumilus*<br>Santa Cruz Island gopher snake | | G5T1T2 S1? | None | None | DFG:SSC | |
| +*Salvadora hexalepis virgultea*<br>coast patch-nosed snake | | G5T3 S2S3 | None | None | DFG:SSC | |
| **NATRICIDAE (live-bearing snakes)** | | | | | | |
| +*Thamnophis gigas*<br>giant garter snake | | G2G3 S2S3 | Threatened | Threatened | IUCN:VU | |
| +*Thamnophis hammondii*<br>two-striped garter snake | | G3 S2 | None | None | BLM:S<br>DFG:SSC<br>IUCN:LC<br>USFS:S | |
| +*Thamnophis hammondii ssp.*<br>Santa Catalina garter snake | | G3T1? S1 | None | None | | |
| +*Thamnophis sirtalis ssp.*<br>south coast garter snake | (Coastal plain from Ventura Co. to San Diego Co., from sea level to about 850 m.) | G5T1T2 S1S2 | None | None | DFG:SSC | |
| +*Thamnophis sirtalis tetrataenia*<br>San Francisco garter snake | | G5T2 S2 | Endangered | Endangered | DFG:FP | |
| **VIPERIIDAE (vipers)** | | | | | | |
| +*Crotalus ruber*<br>red-diamond rattlesnake | | G4 S2? | None | None | DFG:SSC | |

## Birds

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **ANATIDAE (ducks, geese, and swans)** | | | | | | |
| *Anser albifrons elgasi*<br>tule greater white-fronted goose | (Wintering) | G5T2T3 S2S3 | None | None | DFG:SSC | |
| *Aythya americana*<br>redhead | (Nesting) | G5 S3? | None | None | DFG:SSC<br>IUCN:LC | |
| *Aythya valisineria*<br>canvasback | (Nesting) | G5 S2? | None | None | IUCN:LC | |
| *Branta bernicla*<br>brant | (Wintering & staging) | G5 S2? | None | None | DFG:SSC<br>IUCN:LC | |
| +*Branta hutchinsii leucopareia*<br>cackling (=Aleutian Canada) goose | (Wintering) | G5T4 S2 | Delisted | None | | |
| *Bucephala islandica*<br>Barrow's goldeneye | (Nesting) | G5 S1 | None | None | DFG:SSC<br>IUCN:LC | |
| +*Dendrocygna bicolor*<br>fulvous whistling-duck | (Nesting) | G5 S1 | None | None | DFG:SSC<br>IUCN:LC | |
| +*Histrionicus histrionicus*<br>harlequin duck | (Nesting) | G4 S2 | None | None | DFG:SSC<br>IUCN:LC | |
| **PHASIANIDAE (grouse and ptarmigan)** | | | | | | |
| +*Bonasa umbellus*<br>ruffed grouse | | G5 S4 | None | None | DFG:WL<br>IUCN:LC | |
| +*Centrocercus urophasianus*<br>greater sage-grouse | (Nesting & leks) | G4 S3 | Candidate | None | ABC:WLBCC<br>BLM:S<br>DFG:SSC<br>IUCN:NT<br>USFS:S | |
| +*Dendragapus fuliginosus howardi*<br>Mount Pinos sooty grouse | | G5T1T2 S1S2 | None | None | ABC:WLBCC<br>DFG:SSC | Yes |
| *Tympanuchus phasianellus columbianus*<br>Columbian sharp-tailed grouse | | G4T3 SX | None | None | DFG:SSC | |
| **ODONTOPHORIDAE (partridge and quail)** | | | | | | |
| *Callipepla californica catalinensis*<br>Catalina California quail | | G5T2 S2 | None | None | DFG:SSC | |
| **GAVIIDAE (loons)** | | | | | | |
| *Gavia immer*<br>common loon | (Nesting) | G5 S1 | None | None | DFG:SSC<br>IUCN:LC | |
| **DIOMEDEIDAE (albatross)** | | | | | | |
| *Phoebastria albatrus*<br>short-tailed albatross | | G1 S1 | Endangered | None | ABC:WLBCC<br>DFG:SSC<br>IUCN:VU | |
| **HYDROBATIDAE (storm petrels)** | | | | | | |
| +*Oceanodroma furcata*<br>fork-tailed storm-petrel | (Nesting colony) | G5 S1 | None | None | DFG:SSC<br>IUCN:LC | |
| +*Oceanodroma homochroa*<br>ashy storm-petrel | (Nesting colony) | G2 S2 | None | None | ABC:WLBCC<br>DFG:SSC<br>IUCN:EN<br>USFWS:BCC | |
| +*Oceanodroma melania*<br>black storm-petrel | (Nesting colony) | G2 S1 | None | None | ABC:WLBCC<br>DFG:SSC<br>IUCN:LC | |
| **PELECANIIDAE (pelicans)** | | | | | | |
| +*Pelecanus erythrorhynchos*<br>American white pelican | (Nesting colony) | G3 S1 | None | None | DFG:SSC<br>IUCN:LC | |
| +*Pelecanus occidentalis californicus*<br>California brown pelican | (Nesting colony & communal roosts) | G4T3 S1S2 | Delisted | Delisted | DFG:FP | |
| **PHALACROCORACIDAE (cormorants)** | | | | | | |
| +*Phalacrocorax auritus*<br>double-crested cormorant | (Nesting colony) | G5 S3 | None | None | DFG:WL<br>IUCN:LC | |

## Birds

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **ARDEIDAE (herons, egrets, and bitterns)** | | | | | | |
| +*Ardea alba*<br>great egret | (Nesting colony) | G5 S4 | None | None | CDF:S<br>IUCN:LC | |
| +*Ardea herodias*<br>great blue heron | (Nesting colony) | G5 S4 | None | None | CDF:S<br>IUCN:LC | |
| *Botaurus lentiginosus*<br>American bittern | | G4 S3 | None | None | IUCN:LC | |
| +*Egretta thula*<br>snowy egret | (Nesting colony) | G5 S4 | None | None | IUCN:LC | |
| +*Ixobrychus exilis*<br>least bittern | (Nesting) | G5 S1 | None | None | DFG:SSC<br>IUCN:LC<br>USFWS:BCC | |
| +*Nycticorax nycticorax*<br>black-crowned night heron | (Nesting colony) | G5 S3 | None | None | IUCN:LC | |
| **THRESKIORNITHIDAE (ibises and spoonbills)** | | | | | | |
| +*Plegadis chihi*<br>white-faced ibis | (Nesting colony) | G5 S1 | None | None | DFG:WL<br>IUCN:LC | |
| **CICONIIDAE (storks)** | | | | | | |
| *Mycteria americana*<br>wood stork | | G4 S2? | None | None | DFG:SSC<br>IUCN:LC | |
| **CATHARTIDAE (New World vultures)** | | | | | | |
| +*Gymnogyps californianus*<br>California condor | | G1 S1 | Endangered | Endangered | ABC:WLBCC<br>CDF:S<br>IUCN:CR | |
| **ACCIPITRIDAE (hawks, kites, harriers, & eagles)** | | | | | | |
| +*Accipiter cooperii*<br>Cooper's hawk | (Nesting) | G5 S3 | None | None | DFG:WL<br>IUCN:LC | |
| +*Accipiter gentilis*<br>northern goshawk | (Nesting) | G5 S3 | None | None | BLM:S<br>CDF:S<br>DFG:SSC<br>IUCN:LC<br>USFS:S | |
| +*Accipiter striatus*<br>sharp-shinned hawk | (Nesting) | G5 S3 | None | None | DFG:WL | |
| +*Aquila chrysaetos*<br>golden eagle | (Nesting & wintering) | G5 S3 | None | None | CDF:S<br>DFG:FP<br>DFG:WL<br>IUCN:LC<br>USFWS:BCC | |
| +*Buteo regalis*<br>ferruginous hawk | (Wintering) | G4 S3S4 | None | None | DFG:WL<br>IUCN:LC<br>USFWS:BCC | |
| +*Buteo swainsoni*<br>Swainson's hawk | (Nesting) | G5 S2 | None | Threatened | ABC:WLBCC<br>IUCN:LC<br>USFS:S<br>USFWS:BCC | |
| +*Circus cyaneus*<br>northern harrier | (Nesting) | G5 S3 | None | None | DFG:SSC<br>IUCN:LC | |
| +*Elanus leucurus*<br>white-tailed kite | (Nesting) | G5 S3 | None | None | DFG:FP<br>IUCN:LC | |
| +*Haliaeetus leucocephalus*<br>bald eagle | (Nesting & wintering) | G5 S2 | Delisted | Endangered | CDF:S<br>DFG:FP<br>IUCN:LC<br>USFS:S<br>USFWS:BCC | |
| +*Pandion haliaetus*<br>osprey | (Nesting) | G5 S3 | None | None | CDF:S<br>DFG:WL<br>IUCN:LC | |

## Birds

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **ACCIPITRIDAE (hawks, kites, harriers, & eagles)** | | | | | | |
| *Parabuteo unicinctus*<br>Harris' hawk | (Nesting) | G5 SH | None | None | DFG:WL<br>IUCN:LC | |
| **FALCONIDAE (falcons)** | | | | | | |
| +*Falco columbarius*<br>merlin | (Wintering) | G5 S3 | None | None | DFG:WL<br>IUCN:LC | |
| +*Falco mexicanus*<br>prairie falcon | (Nesting) | G5 S3 | None | None | DFG:WL<br>IUCN:LC<br>USFWS:BCC | |
| +*Falco peregrinus anatum*<br>American peregrine falcon | (Nesting) | G4T3 S2 | Delisted | Delisted | CDF:S<br>DFG:FP<br>USFWS:BCC | |
| **RALLIDAE (rails, coots, and gallinules)** | | | | | | |
| +*Coturnicops noveboracensis*<br>yellow rail | | G4 S1S2 | None | None | ABC:WLBCC<br>DFG:SSC<br>IUCN:LC<br>USFWS:BCC | |
| +*Laterallus jamaicensis coturniculus*<br>California black rail | | G4T1 S1 | None | Threatened | ABC:WLBCC<br>DFG:FP<br>IUCN:NT<br>USFWS:BCC | Yes |
| +*Rallus longirostris levipes*<br>light-footed clapper rail | | G5T1T2 S1 | Endangered | Endangered | ABC:WLBCC<br>DFG:FP | Yes |
| +*Rallus longirostris obsoletus*<br>California clapper rail | | G5T1 S1 | Endangered | Endangered | ABC:WLBCC<br>DFG:FP | Yes |
| +*Rallus longirostris yumanensis*<br>Yuma clapper rail | | G5T3 S1 | Endangered | Threatened | ABC:WLBCC<br>DFG:FP | Yes |
| **GRUIDAE (cranes)** | | | | | | |
| *Grus canadensis canadensis*<br>lesser sandhill crane | (Wintering) | G5T4 S3S4 | None | None | DFG:SSC | |
| +*Grus canadensis tabida*<br>greater sandhill crane | (Nesting & wintering) | G5T4 S2 | None | Threatened | DFG:FP<br>USFS:S | |
| **CHARADRIIDAE (plovers and relatives)** | | | | | | |
| +*Charadrius alexandrinus nivosus*<br>western snowy plover | (Nesting) | G4T3 S2 | Threatened | None | ABC:WLBCC<br>DFG:SSC<br>USFWS:BCC | Yes |
| +*Charadrius montanus*<br>mountain plover | (Wintering) | G2 S2? | Proposed Threatened | None | ABC:WLBCC<br>BLM:S<br>DFG:SSC<br>IUCN:NT<br>USFWS:BCC | Yes |
| **HAEMATOPODIDAE (oystercatchers)** | | | | | | |
| *Haematopus bachmani*<br>black oystercatcher | (Nesting) | G5 S2 | None | None | IUCN:LC<br>USFWS:BCC | |
| **SCOLOPACIDAE (sandpipers and relatives)** | | | | | | |
| *Numenius americanus*<br>long-billed curlew | (Nesting) | G5 S2 | None | None | ABC:WLBCC<br>DFG:WL<br>IUCN:LC<br>USFWS:BCC | |
| **LARIDAE (gulls and terns)** | | | | | | |
| +*Chlidonias niger*<br>black tern | (Nesting colony) | G4 S2 | None | None | DFG:SSC<br>IUCN:LC | |
| +*Gelochelidon nilotica*<br>gull-billed tern | (Nesting colony) | G5 S1 | None | None | ABC:WLBCC<br>DFG:SSC<br>IUCN:LC<br>USFWS:BCC | Yes |
| +*Hydroprogne caspia*<br>Caspian tern | (Nesting colony) | G5 S4 | None | None | IUCN:LC<br>USFWS:BCC | Yes |

## Birds

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **LARIDAE (gulls and terns)** | | | | | | |
| +*Larus californicus*<br>California gull | (Nesting colony) | G5 S2 | None | None | DFG:WL<br>IUCN:LC | |
| *Leucophaeus atricilla*<br>laughing gull | (Nesting colony) | G5 SH | None | None | DFG:WL<br>IUCN:LC | |
| +*Rynchops niger*<br>black skimmer | (Nesting colony) | G5 S1S3 | None | None | ABC:WLBCC<br>DFG:SSC<br>IUCN:LC<br>USFWS:BCC | |
| *Sterna forsteri*<br>Forster's tern | (Nesting colony) | G5 S4 | None | None | IUCN:LC | |
| +*Sternula antillarum browni*<br>California least tern | (Nesting colony) | G4T2T3Q S2S3 | Endangered | Endangered | ABC:WLBCC<br>DFG:FP | Yes |
| *Thalasseus elegans*<br>elegant tern | (Nesting colony) | G2 S1 | None | None | ABC:WLBCC<br>DFG:WL<br>IUCN:NT | Yes |
| **ALCIDAE (auklets, puffins, and relatives)** | | | | | | |
| +*Brachyramphus marmoratus*<br>marbled murrelet | (Nesting) | G3G4 S1 | Threatened | Endangered | ABC:WLBCC<br>CDF:S<br>IUCN:EN | |
| +*Cerorhinca monocerata*<br>rhinoceros auklet | (Nesting colony) | G5 S3 | None | None | DFG:WL<br>IUCN:LC | |
| +*Fratercula cirrhata*<br>tufted puffin | (Nesting colony) | G5 S2 | None | None | DFG:SSC<br>IUCN:LC | |
| *Ptychoramphus aleuticus*<br>Cassin's auklet | (Nesting colony) | G4 S2S4 | None | None | DFG:SSC<br>IUCN:LC<br>USFWS:BCC | |
| +*Synthliboramphus hypoleucus*<br>Xantus' murrelet | (Nesting colony) | G3G4 S3 | Candidate | Threatened | ABC:WLBCC<br>IUCN:VU<br>USFWS:BCC | |
| **CUCULIDAE (cuckoos and relatives)** | | | | | | |
| +*Coccyzus americanus occidentalis*<br>western yellow-billed cuckoo | (Nesting) | G5T3Q S1 | Candidate | Endangered | USFS:S<br>USFWS:BCC | |
| **STRIGIDAE (owls)** | | | | | | |
| +*Asio flammeus*<br>short-eared owl | (Nesting) | G5 S3 | None | None | ABC:WLBCC<br>DFG:SSC<br>IUCN:LC | |
| +*Asio otus*<br>long-eared owl | (Nesting) | G5 S3 | None | None | DFG:SSC<br>IUCN:LC | |
| +*Athene cunicularia*<br>burrowing owl | (Burrow sites & some wintering sites) | G4 S2 | None | None | BLM:S<br>DFG:SSC<br>IUCN:LC<br>USFWS:BCC | Yes |
| +*Micrathene whitneyi*<br>elf owl | (Nesting) | G5 S1 | None | Endangered | ABC:WLBCC<br>IUCN:LC<br>USFWS:BCC | |
| *Otus flammeolus*<br>flammulated owl | (Nesting) | G4 S2S4 | None | None | ABC:WLBCC<br>IUCN:LC<br>USFWS:BCC | |
| +*Strix nebulosa*<br>great gray owl | (Nesting) | G5 S1 | None | Endangered | CDF:S<br>IUCN:LC<br>USFS:S | |
| *Strix occidentalis caurina*<br>northern spotted owl | | G3T3 S2S3 | Threatened | None | ABC:WLBCC<br>CDF:S<br>DFG:SSC<br>IUCN:NT | Yes |

## Birds

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **STRIGIDAE (owls)** | | | | | | |
| *Strix occidentalis occidentalis*<br>California spotted owl | | G3T3 S3 | None | None | ABC:WLBCC<br>BLM:S<br>DFG:SSC<br>IUCN:NT<br>USFS:S<br>USFWS:BCC | Yes |
| **APODIDAE (swifts)** | | | | | | |
| *Chaetura vauxi*<br>Vaux's swift | (Nesting) | G5 S3 | None | None | DFG:SSC<br>IUCN:LC | |
| +*Cypseloides niger*<br>black swift | (Nesting) | G4 S2 | None | None | ABC:WLBCC<br>DFG:SSC<br>IUCN:LC<br>USFWS:BCC | |
| **TROCHILIDAE (hummingbirds)** | | | | | | |
| +*Calypte costae*<br>Costa's hummingbird | (Nesting) | G5 S3? | None | None | ABC:WLBCC<br>IUCN:LC | |
| *Selasphorus rufus*<br>rufous hummingbird | (Nesting) | G5 S1S2 | None | None | IUCN:LC<br>USFWS:BCC | |
| *Selasphorus sasin*<br>Allen's hummingbird | (Nesting) | G5 SNR | None | None | ABC:WLBCC<br>IUCN:LC<br>USFWS:BCC | |
| **PICIDAE (woodpeckers)** | | | | | | |
| +*Colaptes chrysoides*<br>gilded flicker | | G5 S1 | None | Endangered | ABC:WLBCC<br>IUCN:LC<br>USFWS:BCC | |
| *Melanerpes lewis*<br>Lewis' woodpecker | (Nesting) | G4 SNR | None | None | ABC:WLBCC<br>IUCN:LC<br>USFWS:BCC | |
| +*Melanerpes uropygialis*<br>Gila woodpecker | | G5 S1S2 | None | Endangered | IUCN:LC<br>USFWS:BCC | |
| *Picoides albolarvatus*<br>White-headed woodpecker | (Nesting) | G4 SNR | None | None | ABC:WLBCC<br>IUCN:LC<br>USFWS:BCC | |
| *Picoides nuttallii*<br>Nuttall's woodpecker | (Nesting) | G5 SNR | None | None | ABC:WLBCC<br>IUCN:LC<br>USFWS:BCC | |
| *Sphyrapicus ruber*<br>red-breasted sapsucker | (Nesting) | G5 SNR | None | None | | |
| **TYRANNIDAE (tyrant flycatchers)** | | | | | | |
| *Contopus cooperi*<br>olive-sided flycatcher | (Nesting) | G4 S4 | None | None | ABC:WLBCC<br>DFG:SSC<br>IUCN:NT<br>USFWS:BCC | |
| +*Empidonax traillii*<br>willow flycatcher | (Nesting) | G5 S1S2 | None | Endangered | ABC:WLBCC<br>IUCN:LC<br>USFS:S<br>USFWS:BCC | Yes |
| +*Empidonax traillii brewsteri*<br>little willow flycatcher | (Nesting) | G5T3T4 S1S2 | None | Endangered | ABC:WLBCC<br>USFWS:BCC | Yes |
| +*Empidonax traillii extimus*<br>southwestern willow flycatcher | (Nesting) | G5T1T2 S1 | Endangered | Endangered | ABC:WLBCC | Yes |
| +*Myiarchus tyrannulus*<br>brown-crested flycatcher | (Nesting) | G5 S2S3 | None | None | DFG:WL<br>IUCN:LC | |
| +*Pyrocephalus rubinus*<br>vermilion flycatcher | (Nesting) | G5 S2S3 | None | None | DFG:SSC<br>IUCN:LC | |

## Birds

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **LANIIDAE (shrikes)** | | | | | | |
| +*Lanius ludovicianus*<br>loggerhead shrike | (Nesting) | G4 S4 | None | None | DFG:SSC<br>IUCN:LC<br>USFWS:BCC | |
| *Lanius ludovicianus anthonyi*<br>Island loggerhead shrike | | G4T1 S1 | None | None | DFG:SSC | |
| +*Lanius ludovicianus mearnsi*<br>San Clemente loggerhead shrike | | G4T1Q S1 | Endangered | None | DFG:SSC | Yes |
| **VIREONIDAE (vireos)** | | | | | | |
| +*Vireo bellii arizonae*<br>Arizona bell's vireo | (Nesting) | G5T4 S1 | None | Endangered | ABC:WLBCC<br>IUCN:NT<br>USFWS:BCC | Yes |
| +*Vireo bellii pusillus*<br>least Bell's vireo | (Nesting) | G5T2 S2 | Endangered | Endangered | ABC:WLBCC<br>IUCN:NT | Yes |
| *Vireo huttoni unitti*<br>Catalina Hutton's vireo | | G5T2? S2? | None | None | DFG:SSC | |
| +*Vireo vicinior*<br>gray vireo | (Nesting) | G4 S2 | None | None | ABC:WLBCC<br>BLM:S<br>DFG:SSC<br>IUCN:LC<br>USFWS:BCC | |
| **CORVIDAE (jays, crows, and magpies)** | | | | | | |
| *Aphelocoma californica cana*<br>Eagle Mountain scrub-jay | | G5T1T2 S1S2 | None | None | DFG:WL | |
| *Aphelocoma insularis*<br>Island scrub-jay | | G1 S1 | None | None | ABC:WLBCC<br>IUCN:NT<br>USFWS:BCC | |
| *Pica nuttalli*<br>yellow-billed magpie | (Nesting & communal roosts) | G3G4 S3S4 | None | None | ABC:WLBCC<br>IUCN:LC<br>USFWS:BCC | |
| **ALAUDIDAE (larks)** | | | | | | |
| +*Eremophila alpestris actia*<br>California horned lark | | G5T3Q S3 | None | None | DFG:WL<br>IUCN:LC | |
| **HIRUNDINIDAE (swallows)** | | | | | | |
| +*Progne subis*<br>purple martin | (Nesting) | G5 S3 | None | None | DFG:SSC<br>IUCN:LC | |
| +*Riparia riparia*<br>bank swallow | (Nesting) | G5 S2S3 | None | Threatened | IUCN:LC | |
| **PARIDAE (titmice and relatives)** | | | | | | |
| +*Baeolophus inornatus*<br>oak titmouse | (Nesting) | G5 S3? | None | None | ABC:WLBCC<br>IUCN:LC<br>USFWS:BCC | |
| *Poecile atricapillus*<br>black-capped chickadee | | G5 S3 | None | None | DFG:WL<br>IUCN:LC | |
| **TROGLODYTIDAE (wrens)** | | | | | | |
| +*Campylorhynchus brunneicapillus sandiegensis*<br>coastal cactus wren | (San Diego & Orange Counties only) | G5T3Q S3 | None | None | DFG:SSC<br>USFS:S<br>USFWS:BCC | Yes |
| *Cistothorus palustris clarkae*<br>Clark's marsh wren | | G5T2T3 S2S3 | None | None | DFG:SSC | |
| *Thryomanes bewickii leucophrys*<br>San Clemente Bewick's wren | | G5TX SX | None | None | DFG:SSC | |
| **SYLVIIDAE (gnatcatchers)** | | | | | | |
| +*Polioptila californica californica*<br>coastal California gnatcatcher | | G3T2 S2 | Threatened | None | ABC:WLBCC<br>DFG:SSC | Yes |
| +*Polioptila melanura*<br>black-tailed gnatcatcher | | G5 S4 | None | None | IUCN:LC | |

## Birds

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **MIMIDAE (mockingbirds and thrashers)** | | | | | | |
| +*Toxostoma bendirei*<br>Bendire's thrasher | | G4G5 S3 | None | None | ABC:WLBCC<br>BLM:S<br>DFG:SSC<br>IUCN:VU<br>USFWS:BCC | |
| +*Toxostoma crissale*<br>Crissal thrasher | | G5 S3 | None | None | DFG:SSC<br>IUCN:LC | |
| +*Toxostoma lecontei*<br>Le Conte's thrasher | | G3 S3 | None | None | ABC:WLBCC<br>DFG:SSC<br>IUCN:LC<br>USFWS:BCC | Yes |
| **PARULIDAE (wood-warblers)** | | | | | | |
| *Dendroica occidentalis*<br>hermit warbler | (Nesting) | G4G5 S3? | None | None | ABC:WLBCC<br>IUCN:LC | |
| +*Dendroica petechia brewsteri*<br>yellow warbler | (Nesting) | G5T3? S2 | None | None | DFG:SSC<br>USFWS:BCC | |
| +*Dendroica petechia sonorana*<br>Sonoran yellow warbler | (Nesting) | G5T2T3 S1 | None | None | DFG:SSC<br>USFWS:BCC | |
| +*Geothlypis trichas sinuosa*<br>saltmarsh common yellowthroat | | G5T2 S2 | None | None | DFG:SSC<br>USFWS:BCC | Yes |
| +*Icteria virens*<br>yellow-breasted chat | (Nesting) | G5 S3 | None | None | DFG:SSC<br>IUCN:LC | |
| +*Oreothlypis luciae*<br>Lucy's warbler | (Nesting) | G5 S2S3 | None | None | ABC:WLBCC<br>DFG:SSC<br>IUCN:LC<br>USFWS:BCC | |
| +*Oreothlypis virginiae*<br>Virginia's warbler | (Nesting) | G5 S2S3 | None | None | ABC:WLBCC<br>DFG:WL<br>IUCN:LC<br>USFWS:BCC | |
| **EMBERIZIDAE (sparrows, buntings, warblers, & relatives)** | | | | | | |
| +*Aimophila ruficeps canescens*<br>southern California rufous-crowned sparrow | | G5T2T4 S2S3 | None | None | DFG:WL | |
| *Aimophila ruficeps obscura*<br>Santa Cruz Island rufous-crowned sparrow | | G5T2T3 S2S3 | None | None | DFG:SSC | |
| +*Ammodramus savannarum*<br>grasshopper sparrow | (Nesting) | G5 S2 | None | None | DFG:SSC<br>IUCN:LC | |
| +*Amphispiza belli belli*<br>Bell's sage sparrow | | G5T2T4 S2? | None | None | ABC:WLBCC<br>DFG:WL<br>USFWS:BCC | Yes |
| +*Amphispiza belli clementeae*<br>San Clemente sage sparrow | | G5T1Q S1 | Threatened | None | ABC:WLBCC<br>DFG:SSC<br>USFWS:BCC | Yes |
| +*Chondestes grammacus*<br>lark sparrow | (Nesting) | G5 SNR | None | None | IUCN:LC | |
| +*Junco hyemalis caniceps*<br>gray-headed junco | (Nesting) | G5T5 S1 | None | None | DFG:WL | |
| *Melospiza melodia*<br>song sparrow ("Modesto" population) | | G5 S3? | None | None | DFG:SSC | |
| *Melospiza melodia graminea*<br>Channel Island song sparrow | | G5T1 S1 | None | None | DFG:SSC<br>USFWS:BCC | Yes |
| +*Melospiza melodia maxillaris*<br>Suisun song sparrow | | G5T2 S2 | None | None | DFG:SSC<br>USFWS:BCC | |
| +*Melospiza melodia pusillula*<br>Alameda song sparrow | | G5T2? S2? | None | None | DFG:SSC<br>USFWS:BCC | |

## Birds

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **EMBERIZIDAE (sparrows, buntings, warblers, & relatives)** | | | | | | |
| +*Melospiza melodia samuelis*<br>San Pablo song sparrow | | G5T2? S2? | None | None | DFG:SSC<br>USFWS:BCC | |
| *Melozone aberti*<br>Abert's towhee | | G3G4 S2? | None | None | ABC:WLBCC<br>IUCN:LC | |
| +*Melozone crissalis eremophilus*<br>Inyo California towhee | | G4G5T1 S1 | Threatened | Endangered | | |
| *Passerculus sandwichensis alaudinus*<br>Bryant's savannah sparrow | | G5T2T3 S2S3 | None | None | DFG:SSC | |
| +*Passerculus sandwichensis beldingi*<br>Belding's savannah sparrow | | G5T3 S3 | None | Endangered | | |
| *Passerculus sandwichensis rostratus*<br>large-billed savannah sparrow | (Wintering) | G5T2T3 S2? | None | None | DFG:SSC | |
| *Pipilo maculatus clementae*<br>San Clemente spotted towhee | | G5T1 S1 | None | None | DFG:SSC<br>USFWS:BCC | |
| +*Piranga flava*<br>hepatic tanager | (Nesting) | G5 S1 | None | None | DFG:WL<br>IUCN:LC | Yes |
| +*Piranga rubra*<br>summer tanager | (Nesting) | G5 S2 | None | None | DFG:SSC<br>IUCN:LC | Yes |
| *Pooecetes gramineus affinis*<br>Oregon vesper sparrow | (Wintering) | G5T3? S3? | None | None | DFG:SSC<br>USFWS:BCC | |
| *Spizella atrogularis*<br>black-chinned sparrow | (Nesting) | G5 S3 | None | None | ABC:WLBCC<br>IUCN:LC<br>USFWS:BCC | |
| +*Spizella breweri*<br>Brewer's sparrow | (Nesting) | G5 S3 | None | None | ABC:WLBCC<br>IUCN:LC<br>USFWS:BCC | |
| *Spizella passerina*<br>chipping sparrow | (Nesting) | G5 S3S4 | None | None | IUCN:LC | |
| **CARDINALIDAE (cardinals)** | | | | | | |
| +*Cardinalis cardinalis*<br>northern cardinal | | G5 S1 | None | None | DFG:WL<br>IUCN:LC | |
| **ICTERIDAE (blackbirds)** | | | | | | |
| *Agelaius phoeniceus aciculatus*<br>Kern red-winged blackbird | | G5T1T2 S1S2 | None | None | DFG:SSC | |
| +*Agelaius tricolor*<br>tricolored blackbird | (Nesting colony) | G2G3 S2 | None | None | ABC:WLBCC<br>BLM:S<br>DFG:SSC<br>IUCN:EN<br>USFWS:BCC | |
| +*Xanthocephalus xanthocephalus*<br>yellow-headed blackbird | (Nesting) | G5 S3S4 | None | None | DFG:SSC<br>IUCN:LC | |
| **FRINGILLIDAE (finches and relatives)** | | | | | | |
| +*Spinus lawrencei*<br>Lawrence's goldfinch | (Nesting) | G3G4 S3 | None | None | ABC:WLBCC<br>IUCN:LC<br>USFWS:BCC | |

## Mammals

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **TALPIDAE (moles)** | | | | | | |
| +*Scapanus latimanus insularis*<br>Angel Island mole | | G5T1 S1 | None | None | | |
| +*Scapanus latimanus parvus*<br>Alameda Island mole | | G5T1Q S1 | None | None | DFG:SSC | |
| **SORICIDAE (shrews)** | | | | | | |
| +*Sorex lyelli*<br>Mount Lyell shrew | | G2G3 S2S3 | None | None | DFG:SSC<br>IUCN:LC | |
| +*Sorex ornatus relictus*<br>Buena Vista Lake shrew | | G5T1 S1 | Endangered | None | DFG:SSC | |
| *Sorex ornatus salarius*<br>Monterey shrew | | G5T1T2 S1S2 | None | None | DFG:SSC | |
| +*Sorex ornatus salicornicus*<br>southern California saltmarsh shrew | | G5T1? S1 | None | None | DFG:SSC | |
| +*Sorex ornatus sinuosus*<br>Suisun shrew | | G5T1 S1 | None | None | DFG:SSC | |
| +*Sorex ornatus willetti*<br>Santa Catalina shrew | | G5T1 S1 | None | None | DFG:SSC | |
| +*Sorex vagrans halicoetes*<br>salt-marsh wandering shrew | | G5T1 S1 | None | None | DFG:SSC | |
| *Sorex vagrans paludivagus*<br>Monterey vagrant shrew | | G5T1 S1 | None | None | | |
| **PHYLLOSTOMIDAE (leaf-nosed bats)** | | | | | | |
| +*Choeronycteris mexicana*<br>Mexican long-tongued bat | | G4 S1 | None | None | DFG:SSC<br>IUCN:NT<br>WBWG:H | |
| *Leptonycteris yerbabuenae*<br>lesser long-nosed bat | | G4 S1 | Endangered | None | IUCN:VU | Yes |
| +*Macrotus californicus*<br>California leaf-nosed bat | | G4 S2S3 | None | None | BLM:S<br>DFG:SSC<br>IUCN:LC<br>USFS:S<br>WBWG:H | |
| **VESPERTILIONIDAE (evening bats)** | | | | | | |
| +*Antrozous pallidus*<br>pallid bat | | G5 S3 | None | None | BLM:S<br>DFG:SSC<br>IUCN:LC<br>USFS:S<br>WBWG:H | |
| +*Corynorhinus townsendii*<br>Townsend's big-eared bat | | G4 S2S3 | None | None | BLM:S<br>DFG:SSC<br>IUCN:LC<br>USFS:S<br>WBWG:H | |
| +*Euderma maculatum*<br>spotted bat | | G4 S2S3 | None | None | BLM:S<br>DFG:SSC<br>IUCN:LC<br>WBWG:H | |
| +*Lasionycteris noctivagans*<br>silver-haired bat | | G5 S3S4 | None | None | IUCN:LC<br>WBWG:M | |
| +*Lasiurus blossevillii*<br>western red bat | | G5 S3? | None | None | DFG:SSC<br>IUCN:LC<br>USFS:S<br>WBWG:H | Yes |
| +*Lasiurus cinereus*<br>hoary bat | | G5 S4? | None | None | IUCN:LC<br>WBWG:M | |
| +*Lasiurus xanthinus*<br>western yellow bat | | G5 S3 | None | None | DFG:SSC<br>IUCN:LC<br>WBWG:H | Yes |

## Mammals

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **VESPERTILIONIDAE (evening bats)** | | | | | | |
| +*Myotis ciliolabrum*<br>western small-footed myotis | | G5 S2S3 | None | None | BLM:S<br>IUCN:LC<br>WBWG:M | |
| +*Myotis evotis*<br>long-eared myotis | | G5 S4? | None | None | BLM:S<br>IUCN:LC<br>WBWG:M | |
| *Myotis lucifugus*<br>little brown bat | (San Bernardino Mts population) | G5 S2S3 | None | None | IUCN:LC<br>WBWG:M | |
| +*Myotis occultus*<br>Arizona Myotis | | G3G4 S2S3 | None | None | DFG:SSC<br>IUCN:LC<br>WBWG:M | |
| +*Myotis thysanodes*<br>fringed myotis | | G4G5 S4 | None | None | BLM:S<br>IUCN:LC<br>WBWG:H | |
| +*Myotis velifer*<br>cave myotis | | G5 S1 | None | None | BLM:S<br>DFG:SSC<br>IUCN:LC<br>WBWG:M | |
| +*Myotis volans*<br>long-legged myotis | | G5 S4? | None | None | IUCN:LC<br>WBWG:H | |
| +*Myotis yumanensis*<br>Yuma myotis | | G5 S4? | None | None | BLM:S<br>IUCN:LC<br>WBWG:LM | |
| **MOLOSSIDAE (free-tailed bats)** | | | | | | |
| +*Eumops perotis californicus*<br>western mastiff bat | | G5T4 S3? | None | None | BLM:S<br>DFG:SSC<br>WBWG:H | |
| +*Nyctinomops femorosaccus*<br>pocketed free-tailed bat | | G4 S2S3 | None | None | DFG:SSC<br>IUCN:LC<br>WBWG:M | |
| +*Nyctinomops macrotis*<br>big free-tailed bat | | G5 S2 | None | None | DFG:SSC<br>IUCN:LC<br>WBWG:MH | |
| **OCHOTONIDAE (pikas)** | | | | | | |
| +*Ochotona princeps schisticeps*<br>gray-headed pika | | G5T2T4 S2S4 | None | None | IUCN:NT | Yes |
| **LEPORIDAE (rabbits and hares)** | | | | | | |
| +*Brachylagus idahoensis*<br>pygmy rabbit | | G4 S3 | None | None | BLM:S<br>DFG:SSC<br>IUCN:LC | |
| +*Lepus americanus klamathensis*<br>Oregon snowshoe hare | | G5T3T4Q S2? | None | None | DFG:SSC | |
| +*Lepus americanus tahoensis*<br>Sierra Nevada snowshoe hare | | G5T3T4Q S2? | None | None | DFG:SSC | |
| +*Lepus californicus bennettii*<br>San Diego black-tailed jackrabbit | | G5T3? S3? | None | None | DFG:SSC | |
| +*Lepus townsendii townsendii*<br>western white-tailed jackrabbit | | G5T5 S3? | None | None | DFG:SSC | |
| +*Sylvilagus bachmani riparius*<br>riparian brush rabbit | | G5T1 S1 | Endangered | Endangered | | |
| **APLODONTIDAE (mountain beavers)** | | | | | | |
| +*Aplodontia rufa californica*<br>Sierra Nevada mountain beaver | | G5T3T4 S2S3 | None | None | DFG:SSC<br>IUCN:LC | Yes |
| +*Aplodontia rufa nigra*<br>Point Arena mountain beaver | | G5T1 S1 | Endangered | None | DFG:SSC<br>IUCN:LC | Yes |
| +*Aplodontia rufa phaea*<br>Point Reyes mountain beaver | | G5T2 S2 | None | None | DFG:SSC<br>IUCN:LC | Yes |

## Mammals

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **SCIURIDAE (squirrels and relatives)** | | | | | | |
| +*Ammospermophilus nelsoni*<br>Nelson's antelope squirrel | | G2 S2 | None | Threatened | IUCN:EN | |
| *Callospermophilus lateralis bernardinus*<br>San Bernardino ground squirrel | | G5T1 S1 | None | None | | |
| +*Glaucomys sabrinus californicus*<br>San Bernardino flying squirrel | | G5T2T3 S2S3 | None | None | DFG:SSC<br>USFS:S | |
| +*Neotamias panamintinus acrus*<br>Kingston Mountain chipmunk | | G4T1T2 S1S2 | None | None | | |
| +*Neotamias speciosus callipeplus*<br>Mount Pinos chipmunk | | G4T1T2 S1S2 | None | None | USFS:S | |
| +*Neotamias speciosus speciosus*<br>lodgepole chipmunk | | G4T2T3 S2S3 | None | None | | |
| +*Xerospermophilus mohavensis*<br>Mohave ground squirrel | | G2G3 S2S3 | None | Threatened | IUCN:VU | |
| +*Xerospermophilus tereticaudus chlorus*<br>Palm Springs round-tailed ground squirrel | | G5T1T2 S1S2 | None | None | DFG:SSC | |
| **GEOMYIDAE (pocket gophers)** | | | | | | |
| *Thomomys bottae operarius*<br>Owens Lake pocket gopher | | G5T1? S1? | None | None | | |
| **HETEROMYIDAE (kangaroo rats, pockets mice, & kangaroo mice)** | | | | | | |
| +*Chaetodipus californicus femoralis*<br>Dulzura pocket mouse | | G5T3 S2? | None | None | DFG:SSC | |
| +*Chaetodipus fallax fallax*<br>northwestern San Diego pocket mouse | | G5T3 S2S3 | None | None | DFG:SSC | Yes |
| +*Chaetodipus fallax pallidus*<br>pallid San Diego pocket mouse | | G5T3 S3 | None | None | DFG:SSC | Yes |
| +*Dipodomys californicus eximius*<br>Marysville California kangaroo rat | | G4T1 S1 | None | None | BLM:S<br>DFG:SSC | |
| +*Dipodomys heermanni berkeleyensis*<br>Berkeley kangaroo rat | | G3G4T1 S1 | None | None | | |
| +*Dipodomys heermanni dixoni*<br>Merced kangaroo rat | | G3G4T2T3 S2S3 | None | None | | |
| +*Dipodomys heermanni morroensis*<br>Morro Bay kangaroo rat | | G3G4T1 S1 | Endangered | Endangered | DFG:FP | |
| +*Dipodomys ingens*<br>giant kangaroo rat | | G2 S2 | Endangered | Endangered | IUCN:EN | |
| +*Dipodomys merriami collinus*<br>Earthquake Merriam's kangaroo rat | | G5T1T2 S1S2 | None | None | | |
| +*Dipodomys merriami parvus*<br>San Bernardino kangaroo rat | | G5T1 S1 | Endangered | None | DFG:SSC | |
| +*Dipodomys nitratoides brevinasus*<br>short-nosed kangaroo rat | | G3T1T2 S1S2 | None | None | BLM:S<br>DFG:SSC<br>IUCN:VU | |
| +*Dipodomys nitratoides exilis*<br>Fresno kangaroo rat | | G3T1 S1 | Endangered | Endangered | IUCN:VU | |
| +*Dipodomys nitratoides nitratoides*<br>Tipton kangaroo rat | | G3T1 S1 | Endangered | Endangered | IUCN:VU | |
| +*Dipodomys panamintinus argusensis*<br>Argus Mountains kangaroo rat | | G5T1T3 S1S3 | None | None | | |
| +*Dipodomys panamintinus panamintinus*<br>Panamint kangaroo rat | | G5T3 S3 | None | None | | |
| +*Dipodomys stephensi*<br>Stephens' kangaroo rat | | G2 S2 | Endangered | Threatened | IUCN:EN | |
| +*Dipodomys venustus elephantinus*<br>big-eared kangaroo rat | | G3G4T2 S2 | None | None | DFG:SSC | |

## Mammals

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **HETEROMYIDAE (kangaroo rats, pockets mice, & kangaroo mice)** | | | | | | |
| +*Dipodomys venustus venustus*<br>Santa Cruz kangaroo rat | | G4T1 S1 | None | None | | |
| +*Perognathus alticolus alticolus*<br>white-eared pocket mouse | | G1G2TH SH | None | None | BLM:S<br>DFG:SSC<br>IUCN:EN<br>USFS:S | Yes |
| +*Perognathus alticolus inexpectatus*<br>Tehachapi pocket mouse | | G1G2T1T2 S1S2 | None | None | DFG:SSC<br>IUCN:EN<br>USFS:S | Yes |
| +*Perognathus inornatus inornatus*<br>San Joaquin pocket mouse | | G4T2T3 S2S3 | None | None | BLM:S | |
| *Perognathus inornatus neglectus*<br>McKittrick pocket mouse | | G4T2T3 S2S3 | None | None | | |
| +*Perognathus inornatus psammophilus*<br>Salinas pocket mouse | | G4T2? S2? | None | None | DFG:SSC | |
| +*Perognathus longimembris bangsi*<br>Palm Springs pocket mouse | | G5T2T3 S2S3 | None | None | BLM:S<br>DFG:SSC | |
| +*Perognathus longimembris brevinasus*<br>Los Angeles pocket mouse | | G5T1T2 S1S2 | None | None | DFG:SSC<br>USFS:S | |
| +*Perognathus longimembris internationalis*<br>Jacumba pocket mouse | | G5T2T3 S1S2 | None | None | DFG:SSC | |
| +*Perognathus longimembris pacificus*<br>Pacific pocket mouse | | G5T1 S1 | Endangered | None | DFG:SSC | |
| *Perognathus longimembris salinensis*<br>Saline Valley pocket mouse | | G5T1 S1 | None | None | | |
| *Perognathus longimembris tularensis*<br>Tulare pocket mouse | | G5T1 S1 | None | None | | |
| +*Perognathus parvus xanthonotus*<br>yellow-eared pocket mouse | | G5T2T3 S1S2 | None | None | BLM:S | |
| **MURIDAE (mice, rats, and voles)** | | | | | | |
| +*Arborimus albipes*<br>white-footed vole | | G3G4 S2S3 | None | None | DFG:SSC<br>IUCN:LC | |
| +*Arborimus pomo*<br>Sonoma tree vole | | G3 S3 | None | None | DFG:SSC<br>IUCN:NT | |
| *Microtus californicus halophilus*<br>Monterey vole | | G5T1 S1 | None | None | | |
| +*Microtus californicus mohavensis*<br>Mohave river vole | | G5T1 S1 | None | None | DFG:SSC | |
| +*Microtus californicus sanpabloensis*<br>San Pablo vole | | G5T1T2 S1S2 | None | None | DFG:SSC | |
| +*Microtus californicus scirpensis*<br>Amargosa vole | | G5T1 S1 | Endangered | Endangered | | |
| +*Microtus californicus stephensi*<br>south coast marsh vole | | G5T1T2 S1S2 | None | None | DFG:SSC | |
| +*Microtus californicus vallicola*<br>Owens Valley vole | | G5T1 S1 | None | None | BLM:S<br>DFG:SSC | |
| +*Neotoma albigula venusta*<br>Colorado Valley woodrat | | G5T3T4 S1S2 | None | None | | |
| +*Neotoma fuscipes annectens*<br>San Francisco dusky-footed woodrat | | G5T2T3 S2S3 | None | None | DFG:SSC | |
| +*Neotoma fuscipes riparia*<br>riparian (=San Joaquin Valley) woodrat | | G5T1Q S1 | Endangered | None | DFG:SSC | Yes |
| +*Neotoma lepida intermedia*<br>San Diego desert woodrat | | G5T3? S3? | None | None | DFG:SSC | |
| +*Neotoma macrotis luciana*<br>Monterey dusky-footed woodrat | | G5T3? S3? | None | None | DFG:SSC<br>IUCN:DD | |

## Mammals

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **MURIDAE (mice, rats, and voles)** | | | | | | |
| +*Onychomys torridus ramona*<br>southern grasshopper mouse | | G5T3? S3? | None | None | DFG:SSC | |
| +*Onychomys torridus tularensis*<br>Tulare grasshopper mouse | | G5T1T2 S1S2 | None | None | BLM:S<br>DFG:SSC | |
| +*Peromyscus maniculatus anacapae*<br>Anacapa Island deer mouse | | G5T1T2 S1S2 | None | None | DFG:SSC | |
| *Peromyscus maniculatus clementis*<br>San Clemente deer mouse | | G5T1T2 S1S2 | None | None | DFG:SSC | |
| +*Reithrodontomys megalotis distichlis*<br>Salinas harvest mouse | | G5T1 S1 | None | None | | |
| +*Reithrodontomys megalotis santacruzae*<br>Santa Cruz harvest mouse | | G5T1Q S1 | None | None | | Yes |
| +*Reithrodontomys raviventris*<br>salt-marsh harvest mouse | | G1G2 S1S2 | Endangered | Endangered | DFG:FP<br>IUCN:EN | |
| +*Sigmodon arizonae plenus*<br>Colorado River cotton rat | | G5T2T3 SH | None | None | DFG:SSC | |
| +*Sigmodon hispidus eremicus*<br>Yuma hispid cotton rat | | G5T2T3 S2 | None | None | DFG:SSC | |
| **DIPODIDAE (jumping mice)** | | | | | | |
| +*Zapus trinotatus orarius*<br>Point Reyes jumping mouse | | G5T1T3Q S1S3 | None | None | DFG:SSC | |
| **CANIDAE (foxes, wolves, and coyotes)** | | | | | | |
| *Urocyon littoralis*<br>island fox | (Mapped by subspecies) | G1 S1 | None | Threatened | IUCN:CR | Yes |
| +*Urocyon littoralis catalinae*<br>Santa Catalina Island fox | | G1T1 S1 | Endangered | Threatened | IUCN:CR | Yes |
| +*Urocyon littoralis clementae*<br>San Clemente Island fox | | G1T1 S1 | None | Threatened | IUCN:CR | Yes |
| +*Urocyon littoralis dickeyi*<br>San Nicolas Island fox | | G1T1 S1 | None | Threatened | IUCN:CR | Yes |
| +*Urocyon littoralis littoralis*<br>San Miguel Island fox | | G1T1 S1 | Endangered | Threatened | IUCN:CR | Yes |
| +*Urocyon littoralis santacruzae*<br>Santa Cruz Island fox | | G1T1 S1 | Endangered | Threatened | IUCN:CR | Yes |
| +*Urocyon littoralis santarosae*<br>Santa Rosa Island fox | | G1T1 S1 | Endangered | Threatened | IUCN:CR | Yes |
| +*Vulpes macrotis mutica*<br>San Joaquin kit fox | | G4T2T3 S2S3 | Endangered | Threatened | | |
| +*Vulpes vulpes necator*<br>Sierra Nevada red fox | | G5T3 S1 | None | Threatened | USFS:S | |
| **MUSTELIDAE (weasels and relatives)** | | | | | | |
| +*Enhydra lutris nereis*<br>southern sea otter | | G4T2 S2 | Threatened | None | DFG:FP<br>IUCN:EN<br>MMC:SSC | Yes |
| +*Gulo gulo*<br>California wolverine | | G4 S1 | Candidate | Threatened | DFG:FP<br>IUCN:NT<br>USFS:S | |
| +*Lontra canadensis sonora*<br>southwestern river otter | | G5T1 S1 | None | None | DFG:SSC | |
| +*Martes americana*<br>American (=pine) marten | | G5 S3S4 | None | None | IUCN:LC<br>USFS:S | |
| +*Martes americana humboldtensis*<br>Humboldt marten | | G5T2T3 S2S3 | None | None | DFG:SSC<br>USFS:S | |
| +*Martes americana sierrae*<br>Sierra marten | | G5T3T4 S3S4 | None | None | USFS:S | |
| +*Martes pennanti (pacifica) DPS*<br>Pacific fisher | | G5 S2S3 | Candidate | None | BLM:S<br>DFG:SSC<br>USFS:S | Yes |

## Mammals

| Species | Comment | Rank | ESA | CESA | Other Status | Notes |
|---|---|---|---|---|---|---|
| **MUSTELIDAE (weasels and relatives)** | | | | | | |
| +*Taxidea taxus*<br>American badger | | G5 S4 | None | None | DFG:SSC<br>IUCN:LC | |
| **MEPHITIDAE (skunks)** | | | | | | |
| +*Spilogale gracilis amphiala*<br>Channel Islands spotted skunk | | G5T3 S3 | None | None | DFG:SSC | |
| **FELIDAE (cats and relatives)** | | | | | | |
| *Lynx rufus pallescens*<br>pallid bobcat | | G5T3? S3? | None | None | | |
| +*Puma concolor browni*<br>Yuma mountain lion | | G5T1T2Q S1 | None | None | DFG:SSC | |
| **OTARIIDAE (sea lions and fur seals)** | | | | | | |
| +*Arctocephalus townsendi*<br>Guadalupe fur-seal | | G1 S1 | Threatened | Threatened | DFG:FP<br>IUCN:NT | |
| +*Callorhinus ursinus*<br>northern fur-seal | | G3 S1 | None | None | IUCN:VU | |
| +*Eumetopias jubatus*<br>Steller (=northern) sea-lion | | G3 S2 | Threatened | None | IUCN:EN<br>MMC:SSC | |
| **BOVIDAE (sheep and relatives)** | | | | | | |
| +*Ovis canadensis nelsoni*<br>Nelson's bighorn sheep | | G4T4 S3 | None | None | BLM:S<br>USFS:S | |
| +*Ovis canadensis nelsoni DPS*<br>peninsular bighorn sheep | | G4T3Q S1 | Endangered | Threatened | DFG:FP | Yes |
| +*Ovis canadensis sierrae*<br>Sierra Nevada bighorn sheep | | G4T1 S1 | Endangered | Endangered | DFG:FP | |

## End Notes

## Invertebrates

### INSECTA, Order Coleoptera (beetles)

*Trigonoscuta sp.*

Doyen's trigonoscuta dune weevil

1) Sometimes referred to as "Trigonoscuta doyeni" which is an unpublished manuscript name.

## Fishes

### ACIPENSERIDAE (sturgeon)

*Acipenser medirostris*

green sturgeon

1) Federal listing includes all spawning populations south of the Eel River.
2) The NMFS "Special Concern" designation refers to the northern DPS which includes spawning populations north of the Eel River (inclusive).

### SALMONIDAE (trout & salmon)

*Oncorhynchus kisutch*

coho salmon - central California coast ESU

1) The federal listing is limited to naturally spawning populations in streams between Punta Gorda, Humboldt Co. and the San Lorenzo River, Santa Cruz Co.
2) The state listing is limited to Coho south of Punta Gorda, Humboldt Co.

coho salmon - southern Oregon / northern California ESU

1) Federal listing refers to populations between Cape Blanco, Oregon & Punta Gorda, Humboldt Co. California.
2) State listing refers to populations between the Oregon border & Punta Gorda, Humboldt Co. California.

*Oncorhynchus mykiss irideus*

southern steelhead - southern California DPS

1) The federal designation refers to fish in the coastal basins from the Santa Maria River (inclusive), south to the U.S. - Mexico Border.
2) The DFG "Species of Special Concern" designation refers to southern steelhead trout.

steelhead - central California coast DPS

1) Federal listing includes all runs in coastal basins from the Russian River in Sonoma County, south to Soquel Creek in Santa Cruz County, inclusive. It includes the San Francisco and San Pablo Bay basins, but excludes the Sacramento-San Joaquin River basins.

steelhead - Central Valley DPS

1) Federal listing includes all runs in the Sacramento & San Joaquin Rivers and their tributaries.

steelhead - Klamath Mountains Province DPS

1) This ESU includes all naturally spawned populations residing in streams between the Elk River in Oregon and the Klamath River in California, inclusive.
2) The SSC designation refers only to the California portion of the ESU and refers only to the summer-run.

steelhead - northern California DPS

1) The federal designation refers to naturally spawned populations residing below impassable barriers in coastal basins from Redwood Creek in Humboldt Co. to, and including, the Gualala River in Mendocino Co.
2) The DFG "Species of Special Concern" designation refers only to the summer-run.

steelhead - south/central California coast DPS

1) Federal listing includes all runs in coastal basins from the Pajaro River south to, but not including, the Santa Maria River.
2) The DFG "Species of Special Concern" designation refers to southern steelhead trout.

summer-run steelhead trout

1) Summer-run steelhead are part of both the Klamath Mountains Province DPS and the Northern California DPS.

*Oncorhynchus tshawytscha*

chinook salmon - California coastal ESU

1) Originally proposed as part of a larger Southern Oregon & California Coastal ESU. This new ESU was revised to include only naturally spawned coastal spring & fall-run chinook salmon between Redwood Creek in Humboldt Co & the Russian River in Sonoma Co.

chinook salmon - Central Valley fall / late fall-run ESU

1) The Central Valley fall/late fall-run ESU refers to populations spawning in the Sacramento & San Joaquin Rivers and their tributaries.
2) The DFG "Species of Special Concern" designation refers only to the fall-run.

## Fishes

### SALMONIDAE (trout & salmon)

*Oncorhynchus tshawytscha*

chinook salmon - Central Valley spring-run ESU

1) Federal listing refers to the Central Valley Spring-run ESU. It includes populations spawning in the Sacramento River & its tributaries.

### OSMERIDAE (smelt)

*Spirinchus thaleichthys*

longfin smelt

1) AFS Threatened designation take from: Musick, J.T. et al. 2000. "Marine, Estuarine, and Diadromous Fish Stocks at Risk of Extinction in North America (Exclusive of Pacific Salmonids). Fisheries 25(11):6-30.

### CYPRINIDAE (minnows and carp)

*Lavinia symmetricus ssp. 1*

San Joaquin roach

1) Current taxonomy considers this taxon to be a population of Lavinia symmetricus symmetricus, the Sacramento-San Joaquin roach.

*Rhinichthys osculus ssp. 1*

Amargosa Canyon speckled dace

1) Current taxonomy considers this taxon to be a distinct population of Rhinichthys osculus nevadensis.

*Rhinichthys osculus ssp. 2*

Owens speckled dace

1) Current taxonomy includes the Benton Valley speckled dace (formerly ssp 4) with the Owens speckled dace.

### GASTEROSTEIDAE (sticklebacks)

*Gasterosteus aculeatus microcephalus*

resident threespine stickleback

1) The U.S. Forest Service "Sensitive" designation refers to the full species.

*Gasterosteus aculeatus santaannae*

Santa Ana (=Shay Creek) threespine stickleback

1) The U.S. Forest Service "Sensitive" designation refers to the full species.

*Gasterosteus aculeatus williamsoni*

unarmored threespine stickleback

1) The U.S. Forest Service "Sensitive" designation refer to the full species.

### POLYPRIONIDAE (wreckfishes)

*Stereolepis gigas*

giant sea bass

1) AFS Vulnerable designation taken from: Musick, J.T. et al. 2000. "Marine, Estuarine, and Diadromous Fish Stocks at Risk of Extinction in North America (Exclusive of Pacific Salmonids). Fisheries 25(11):6-30.

## Amphibians

### PLETHODONTIDAE (lungless salamanders)

*Plethodon asupak*

Scott Bar salamander

1) Newly described species from what was part of the range of Plethodon stormi.
2) Since this newly described species was formerly considered to be a subpopulation of Plethodon stormi, and since Plethodon stormi is listed as Threatened under the California Endangered Species Act (CESA), Plethodon asupak retains the designation as a Threatened species under CESA.

### BUFONIDAE (true toads)

*Anaxyrus californicus*

arroyo toad

1) Formerly Bufo microscaphus californicus, now considered a full species.
2) Formerly Bufo californicus; Frost, Grant, Faivovich, Bain, Haas, Haddad, De Sá, Channing, Wilkinson, Donnellan, Raxworthy, Campbell, Blotto, Moler, Drewes, Nussbaum, Lynch, Green & Wheeler (2006. The Amphibian Tree of Life. Bulletin of the American Museum of Natural History 297: 1-370) placed this species in the genus Anaxyrus (Tschudi, 1845). The standard common name remains arroyo toad.

## Amphibians

### BUFONIDAE (true toads)

*Anaxyrus canorus*

Yosemite toad

1) Formerly Bufo canorus; Frost, Grant, Faivovich, Bain, Haas, Haddad, De Sá, Channing, Wilkinson, Donnellan, Raxworthy, Campbell, Blotto, Moler, Drewes, Nussbaum, Lynch, Green & Wheeler (2006. The Amphibian Tree of Life. Bulletin of the American Museum of Natural History 297: 1-370) placed this species in the genus Anaxyrus (Tschudi, 1845). The standard common name remains Yosemite toad.

*Anaxyrus exsul*

black toad

1) Formerly Bufo exsul; Frost, Grant, Faivovich, Bain, Haas, Haddad, De Sá, Channing, Wilkinson, Donnellan, Raxworthy, Campbell, Blotto, Moler, Drewes, Nussbaum, Lynch, Green & Wheeler (2006. The Amphibian Tree of Life. Bulletin of the American Museum of Natural History 297: 1-370) placed this species in the genus Anaxyrus (Tschudi, 1845). The standard common name remains black toad.

*Incilius alvarius*

Sonoran desert toad

1) Formerly Bufo alvarius. Between 2006 & 2009 the scientific name has been changed to Cranopsis alvaria, to Ollotis alvaria, to Incilius alvarius, back to Ollotis alvarius and then back to Incilius alvarius. The common name has changed from Colorado River toad to Sonoran desert toad.

### RANIDAE

*Lithobates pipiens*

northern leopard frog

1) Formerly Rana pipiens; Frost, Grant, Faivovich, Bain, Haas, Haddad, De Sá, Channing, Wilkinson, Donnellan, Raxworthy, Campbell, Blotto, Moler, Drewes, Nussbaum, Lynch, Green & Wheeler (2006. The Amphibian Tree of Life. Bulletin of the American Museum of Natural History 297: 1-370) placed this species in the genus Lithobates (Fitzinger, 1843). The standard common name remains northern leopard frog.

*Lithobates yavapaiensis*

lowland (=Yavapai, San Sebastian & San Felipe) leopard frog

1) Formerly Rana yavapaiensis; Frost, Grant, Faivovich, Bain, Haas, Haddad, De Sá, Channing, Wilkinson, Donnellan, Raxworthy, Campbell, Blotto, Moler, Drewes, Nussbaum, Lynch, Green & Wheeler (2006. The Amphibian Tree of Life. Bulletin of the American Museum of Natural History 297: 1-370) placed this species in the genus Lithobates (Fitzinger, 1843). The standard common name remains lowland leopard frog.

*Rana aurora*

northern red-legged frog

1) A recent mtDNA study consludes that Rana aurora aurora and Rana aurora draytonii should be recongnized as separate species with a narrow zone of overlap.

*Rana draytonii*

California red-legged frog

1) A recent mtDNA study concludes that Rana aurora aurora and Rana aurora draytonii should be recongnized as separate species with a narrow zone of overlap, and that the range of draytonii extends about 100 km further north in coastal California than previously thought.

*Rana muscosa*

Sierra Madre yellow-legged frog

1) Federal listing refers to populations in the San Gabriel, San Jacinto, & San Bernardino Mountains only.
2) Federal Candidate status refers to all populations that occur north of the Tehachapi Mountains in the Sierra Nevada.
3) Rana muscosa has been split into Rana sierrae, the Sierra Nevada yellow-legged frog, found in the northern and central Sierra Nevada and Rana muscosa, the Sierra Madre yellow-legged frog, found in the southern Sierra Nevada and southern California.
4) Rana muscosa was petitioned to be listed as endangered. It is now a state candidate species for listing as threatened or endangered.

*Rana sierrae*

Sierra Nevada yellow-legged frog

1) Federal candidate status refers to all populations that occur north of the Tehachapi Mountains in the Sierra Nevada.
2) Formerly Rana muscosa. Rana muscosa has been split into Rana sierrae, the Sierra Nevada yellow-legged frog, found in the northern and central Sierra Nevada and Rana muscosa, the Sierra Madre yellow-legged frog, found in the southern Sierra Nevada and southern California.
3) Rana sierrae was petitioned to be listed as endangered. It is now a state candidate for listing as threatened or endangered.

## Reptiles

### EMYDIDAE (box and water turtles)

*Emys marmorata*

western pond turtle

1) The paper: Spinks, Phillip Q. & H. Bradley Shaffer. 2005. Range-wide molecular analysis of the western pond turtle (Emys marmorata): cryptic variation, isolation by distance, and their conservation implications. Molecular Ecology (2005) 14, 2047-2064. determined that the current subspecies split was not warranted. Therefore, we are now tracking the western pond turtle only at the full species level.
2) The paper: Spinks, Phillip Q., & H. Bradley Shaffer. 2009. Conflicting Mitochondrial and Nuclear Phylogenies for the Widely Disjunct Emys (Testudines: Emydidae) Species Complex, and What They Tell Us about Biogeography and Hybridization. Systematic Biology. 58(1): pp. 1-20 determined that the correct genus name is Emys.

### HELODERMATIDAE (venomous lizards)

*Heloderma suspectum cinctum*

banded gila monster

1) The BLM "Sensitive Species" designation refers to the full species.

### BOIDAE (boas)

*Charina trivirgata*

rosy boa

1) The Forest Service "Sensitive" designation refers only to the subspecies roseofusca.
2) The taxonomy of this species is in flux. The name Lichanura trivirgata is a synonym. Some sources list several subspecies while others don't recognize any subspecies.

## Birds

### PHASIANIDAE (grouse and ptarmigan)

*Dendragapus fuliginosus howardi*

Mount Pinos sooty grouse

1) Formerly merged with D. obscurus as blue grouse, but separated on the basis of genetic evidence and differences in voice, behavior, & plumage.
2) The American Bird Conservancy "WatchList of Birds of Conservation Concern" designation refers to the full species.

### RALLIDAE (rails, coots, and gallinules)

*Laterallus jamaicensis coturniculus*

California black rail

1) The American Bird Conservancy "WatchList of Birds of Conservation Concern" designation refers to the full species.
2) The IUCN designation of "Near Threatened" refers to the full species.

*Rallus longirostris levipes*

light-footed clapper rail

1) The American Bird Conservancy "WatchList of Birds of Conservation Concern" designation refers to the full species.

*Rallus longirostris obsoletus*

California clapper rail

1) The American Bird Conservancy "WatchList of Birds of Conservation Concern" designation refers to the full species.

*Rallus longirostris yumanensis*

Yuma clapper rail

1) The American Bird Conservancy "WatchList of Birds of Conservation Concern" designation refers to the full species.

### CHARADRIIDAE (plovers and relatives)

*Charadrius alexandrinus nivosus*

western snowy plover

1) Federal listing applies only to the Pacific coastal population
2) DFG "Species of Special Concern" designation refers to both the coastal & interior populations.
3) USFWS - Birds of Conservation Concern designation refers to non-listed subspecies or populations of Threatened or Endangered species.

# Birds

## CHARADRIIDAE (plovers and relatives)

*Charadrius montanus*

mountain plover

1) The June 29, 2010 proposed rule reinstates that portion of the December 5, 2002 proposed rule concerning the listing of the mountain plover as threatened. It does not reinstate the portion of that proposed rule regarding a special rule under section 4(d) of the Endangered Species Act.

## LARIDAE (gulls and terns)

*Gelochelidon nilotica*

gull-billed tern

1) Taxonomy recently changed from Sterna nilotica

*Hydroprogne caspia*

Caspian tern

1) Taxonomy recently changed from Sterna caspia

*Sternula antillarum browni*

California least tern

1) Taxonomy recently changed from Sterna antillarum browni.
2) The American Bird Conservancy "WatchList of Birds of Conservation Concern" designation refers to the full species.

*Thalasseus elegans*

elegant tern

1) Taxonomy recently changed from Sterna elegans

## STRIGIDAE (owls)

*Athene cunicularia*

burrowing owl

1) A burrow site = an observation of one or more owls at a burrow or evidence of recent occupation such as whitewash and feathers. Winter observations at a burrow are mapped. Winter observations with or without a burrow in San Francisco, Ventura, Sonoma, Marin, Napa & Santa Cruz Counties are mapped.

*Strix occidentalis caurina*

northern spotted owl

1) There are no northern spotted owl EOs in the CNDDB. All northern spotted owl location information is maintained in a separate data layer. This layer is packaged with the CNDDB layer in BIOS. All RareFind subscribers have access to this information through BIOS (http:BIOS.dfg.ca.gov)
2) The American Bird Conservancy "WatchList of Birds of Conservation Concern" designation refers to the full species.

*Strix occidentalis occidentalis*

California spotted owl

1) The American Bird Conservancy "WatchList of Birds of Conservation Concern" designation refers to the full species.

## TYRANNIDAE (tyrant flycatchers)

*Empidonax traillii*

willow flycatcher

1) State listing of the full species includes all subspecies
2) USFWS: Birds of Conservation Conern designation refers to non-listed subspecies or populations of Threatened or Endangered species.

*Empidonax traillii brewsteri*

little willow flycatcher

1) State listing of the full species includes all subspecies
2) The American Bird Conservancy "WatchList of Birds of Conservation Concern" designation refers to the full species.
3) USFWS - Birds of Conservation Concern designation refers to non-listed subspecies or populations for Threatened or Endangered species.

*Empidonax traillii extimus*

southwestern willow flycatcher

1) State listing of the full species includes all subspecies
2) The American Bird Conservancy "WatchList of Birds of Conservation Concern" designation refers to the full species.

## Birds

### LANIIDAE (shrikes)

*Lanius ludovicianus mearnsi*

San Clemente loggerhead shrike

1) Subspecific identity of shrikes currently on San Clemente is uncertain. Mundy et al. (1997a, b) provided evidence L. l. mearnsi is genetically distinct from L. l. gambeli and L. l. anthonyi, whereas Patten and Campbell (2000) concluded, based on morphology, that the birds now on San Clemente are intergrades between L. l. mearnsi and L. l. anthonyi.

### VIREONIDAE (vireos)

*Vireo bellii arizonae*

Arizona bell's vireo

1) The American Bird Conservancy "WatchList of Birds of Conservation Concern" designation refers to the full species.
2) The IUCN designation of 'Near Threatened" refers to the full species.

*Vireo bellii pusillus*

least Bell's vireo

1) The American Bird Conservancy "WatchList of Birds of Conservation Concern" designation refers to the full species.
2) The IUCN designation of "Near Threatened" refers to the full species.

### TROGLODYTIDAE (wrens)

*Campylorhynchus brunneicapillus sandiegensis*

coastal cactus wren

1) Nomenclature follows the draft DFG Bird Species of Special Concern report.

### SYLVIIDAE (gnatcatchers)

*Polioptila californica californica*

coastal California gnatcatcher

1) AKA Alta California gnatcatcher
2) The American Bird Conservancy "WatchList of Birds of Conservation Concern" designation refers to the full species.

### MIMIDAE (mockingbirds and thrashers)

*Toxostoma lecontei*

Le Conte's thrasher

1) The BLM "Sensitive Species" designation refers to the subspecies Toxostoma lecontei macmillanorum.
2) DFG "Species of Special Concern" designation refers only to the San Joaquin population, AKA T. l. macmillanorum.

### PARULIDAE (wood-warblers)

*Geothlypis trichas sinuosa*

saltmarsh common yellowthroat

1) AKA San Francisco common yellowthroat

### EMBERIZIDAE (sparrows, buntings, warblers, & relatives)

*Amphispiza belli belli*

Bell's sage sparrow

1) The American Bird Conservancy "WatchList of Birds of Conservation Concern" designation refers to the full species.

*Amphispiza belli clementeae*

San Clemente sage sparrow

1) Subspecific validity uncertain. Recognized by AOU (1957), but not by Patten and Unitt (2002).
2) The American Bird Conservancy "WatchList of Birds of Conservation Concern" designation refers to the full species.

*Melospiza melodia graminea*

Channel Island song sparrow

1) Subspecific validity is uncertain. This subspecies when referred to as Santa Barbara song sparrow is extinct. However, the subspecies was merged by Patten (2001) with the San Miguel (M. m. micronyx), and San Clemente (M. m. clementae) song sparrows as the Channel Island song sparrow with the subspecific name M. m. graminea.

*Piranga flava*

hepatic tanager

1) According to The A.O.U. Check-list of North American Birds, Seventh Edition, this species is probably misplaced in the current phylogenetic listing but for which data indicating proper placement are not yet available.

## Birds

### EMBERIZIDAE (sparrows, buntings, warblers, & relatives)

*Piranga rubra*

summer tanager

1) According to The A.O.U. Check-list of North American Birds, Seventh Edition, this species is probably misplaced in the current phylogenetic listing but for which data indicating proper placement are not yet available.

## Mammals

### PHYLLOSTOMIDAE (leaf-nosed bats)

*Leptonycteris yerbabuenae*

lesser long-nosed bat

1) Listed by the U.S. Fish & Wildlife Service as Leptonycteris curasoae yerbabuenae.

### VESPERTILIONIDAE (evening bats)

*Lasiurus blossevillii*

western red bat

1) The DFG "Species of Special Concern" designation is based on the draft updated Mammalian Species of Special Concern report.

*Lasiurus xanthinus*

western yellow bat

1) The DFG "Species of Special Concern" designation is based on the draft updated Mammalian Species of Special Concern report.

### OCHOTONIDAE (pikas)

*Ochotona princeps schisticeps*

gray-headed pika

1) All of the subspecies of pika in California have been synonymized under Ochotona princeps schisticeps.

### APLODONTIDAE (mountain beavers)

*Aplodontia rufa californica*

Sierra Nevada mountain beaver

1) The IUCN "Least Concern" designation refers to the full species.

*Aplodontia rufa nigra*

Point Arena mountain beaver

1) The IUCN "Least Concern" designation refers to the full species.

*Aplodontia rufa phaea*

Point Reyes mountain beaver

1) The IUCN "Least Concern" designation refers to the full species.

### HETEROMYIDAE (kangaroo rats, pockets mice, & kangaroo mice)

*Chaetodipus fallax fallax*

northwestern San Diego pocket mouse

1) The DFG "Species of Special  Concern" desgination refers to the full species.

*Chaetodipus fallax pallidus*

pallid San Diego pocket mouse

1) The DFG "Species of Special Concern" designation refers to the full species.

*Perognathus alticolus alticolus*

white-eared pocket mouse

1) The DFG "Species of Special Concern" and the BLM "Sensitive Species" designations refer to the full species.
2) The IUCN "Endangered" designation is at the species level.

*Perognathus alticolus inexpectatus*

Tehachapi pocket mouse

1) The DFG "Species of Special Concern" designation refers to the full species.
2) The IUCN "Endangered" designation is at the species level.

## Mammals

### MURIDAE (mice, rats, and voles)

*Neotoma fuscipes riparia*

riparian (=San Joaquin Valley) woodrat

1) This species is currently undergoing taxonomic revision

*Reithrodontomys megalotis santacruzae*

Santa Cruz harvest mouse

1) Synonomous with Reithrodontomys megalotus longicaudus, Santa Cruz Island Population.

### CANIDAE (foxes, wolves, and coyotes)

*Urocyon littoralis*

island fox

1) State listing is at the full species level and includes all subspecies on all islands. Federal listing does not include San Nicolas & San Clemente island subspecies.

*Urocyon littoralis catalinae*

Santa Catalina Island fox

1) The IUCN "Critically Endangered" designation refers to the full species.

*Urocyon littoralis clementae*

San Clemente Island fox

1) The IUCN "Critically Endangered" designation refers to the full species.

*Urocyon littoralis dickeyi*

San Nicolas Island fox

1) The IUCN "Critically Endangered" designation refers to the full species.

*Urocyon littoralis littoralis*

San Miguel Island fox

1) The IUCN "Critically Endangered" designation refers to the full species.

*Urocyon littoralis santacruzae*

Santa Cruz Island fox

1) The IUCN "Critically Endangered" designation refers to the full species.

*Urocyon littoralis santarosae*

Santa Rosa Island fox

1) The IUCN "Critically Endanagered" designation refers to the full species.

### MUSTELIDAE (weasels and relatives)

*Enhydra lutris nereis*

southern sea otter

1) The IUCN "Endangered" designation refers to the full species.

*Martes pennanti (pacifica) DPS*

Pacific fisher

1) The subspecies pacifica is no longer considered a valid subspecies.  The Pacific fisher is now considered to be a distinct population segment (DPS).
2) Federal candidate status refers to the distinct population segment in Washington, Oregon & California.
3) Was a candidate for state listing as an endangered or threatened species. The Fish and Game Commission at its Jun3 23, 2010 meeting determined that listing was not warranted.

### BOVIDAE (sheep and relatives)

*Ovis canadensis nelsoni DPS*

peninsular bighorn sheep

1) The subspecies O. c. cremnobates has been synonymized with O. c. nelsoni. Peninsular bighorn sheep are now considered to be a Distinct Population Segment (DPS).

State of California
The Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Biogeographic Data Branch
California Natural Diversity Database

# STATE & FEDERALLY LISTED ENDANGERED & THREATENED ANIMALS OF CALIFORNIA

**January 2013**

This is a list of animals found within California or off the coast of the State that have been classified as Endangered or Threatened by the California Fish & Game Commission (state list) or by the U.S. Secretary of the Interior or the U.S. Secretary of Commerce (federal list). The federal agencies responsible for listing are the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS).

The official California listing of Endangered and Threatened animals is contained in the California Code of Regulations, Title 14, Section 670.5. The official federal listing of Endangered and Threatened animals is published in the Federal Register, 50 CFR 17.11. The California Endangered Species Act of 1970 created the categories of “Endangered” and “Rare.” The California Endangered Species Act of 1984 created the categories of “Endangered” and “Threatened.” On January 1, 1985, all animal species designated as “Rare” were reclassified as “Threatened.”

Also included on this list are animal “Candidates” for state listing and animals “Proposed” for federal listing; federal “Candidates” are currently not included. A state Candidate species is one that the Fish and Game Commission has formally declared a candidate species. A federal Proposed species is one that has had a published proposed rule to list in the Federal Register.

| Designation | | Totals as of January 2013 |
|---|---|---|
| State listed as Endangered | SE | 46 |
| State listed as Threatened | ST | 34 |
| Federally listed as Endangered | FE | 91 |
| Federally listed as Threatened | FT | 39 |
| State Candidate (Endangered) | SCE | 3 |
| State Candidate (Threatened) | SCT | 2 |
| State Candidate (Delisting) | SCD | 1 |
| Federally proposed (Endangered) | FPE | 0 |
| Federally proposed (Threatened) | FPT | 0 |
| Federally proposed (Delisting) | FPD | 2 |
| Total number of animals listed (includes subspecies & population segments) | | 155 |
| Total number of candidate/proposed animals for listing | | 5 |
| Number of animals State listed only | | 32 |
| Number of animals Federally listed only | | 75 |
| Number of animals listed under both State & Federal Acts | | 50 |

Common and scientific names are shown as they appear on the state or federal lists. If the nomenclature differs for a species that is included on both lists, the state nomenclature is given and the federal nomenclature is shown in a footnote. Synonyms, name changes, and other clarifying points are also footnoted.

The “List Date” for **final** federal listing is the date the listing became effective. This is usually not the date of publication of the rule in the Federal Register; it is usually about 30 days after publication, but may be longer.

If an animal was previously listed or proposed for listing and no longer has any listing status, the entry has been grayed out.

For taxa that have more than one status entry, the **current status is in bold and underlined**.

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| | State Listing | | | Federal Listing | |
|---|---|---|---|---|---|
| **GASTROPODS** | | | | | |
| Trinity bristle snail<br>*Monadenia setosa*[1] | ST | 10-02-80 | | | |
| Morro shoulderband (=banded dune) snail<br>*Helminthoglypta walkeriana* | | | | FE | 1-17-95 |
| White abalone<br>*Haliotis sorenseni* | | | | FE[2]<br>FE | 11-16-05<br>6-28-01 |
| Black abalone<br>*Haliotis cracherodii* | | | | FE[3]<br>FE | 4-13-11<br>2-13-09 |
| **CRUSTACEANS** | | | | | |
| Riverside fairy shrimp<br>*Streptocephalus woottoni* | | | | FE | 8-03-93 |
| Conservancy fairy shrimp<br>*Branchinecta conservatio* | | | | FE | 9-19-94 |
| Longhorn fairy shrimp<br>*Branchinecta longiantenna* | | | | FE | 9-19-94 |
| Vernal pool fairy shrimp<br>*Branchinecta lynchi* | | | | FT | 9-19-94 |
| San Diego fairy shrimp<br>*Branchinecta sandiegonensis* | | | | FE | 2-03-97 |
| Vernal pool tadpole shrimp<br>*Lepidurus packardi* | | | | FE | 9-19-94 |
| Shasta crayfish<br>*Pacifastacus fortis* | **SE**<br>ST | 2-26-88<br>10-02-80 | | FE | 9-30-88 |
| California freshwater shrimp<br>*Syncaris pacifica* | SE | 10-02-80 | | FE | 10-31-88 |
| **INSECTS** | | | | | |
| Zayante band-winged grasshopper<br>*Trimerotropis infantilis* | | | | FE | 2-24-97 |
| Mount Hermon June beetle<br>*Polyphylla barbata* | | | | FE | 2-24-97 |
| Casey's June beetle<br>*Dinacoma caseyi* | | | | **FE**<br>FPE | 10-24-11<br>7-09-09 |
| Delta green ground beetle<br>*Elaphrus viridis* | | | | FT | 8-08-80 |
| Valley elderberry longhorn beetle<br>*Desmocerus californicus dimorphus* | | | | FPD<br>**FT** | 10-2-12<br>8-08-80 |

[1] Current taxonomy is *Monadenia infumata setosa.*
[2] Listed by NMFS in 2001 and by USFWS in 2005.
[3] Listed by NMFS in 2009 and by USFWS in 2011.

| | State Listing | | | Federal Listing | |
|---|---|---|---|---|---|
| Ohlone tiger beetle<br>*Cicindela ohlone* | | | | FE | 10-03-01 |
| Kern primrose sphinx moth<br>*Euproserpinus euterpe* | | | | FT | 4-08-80 |
| Mission blue butterfly<br>*Icaricia icarioides missionensis*[4] | | | | FE | 6-01-76 |
| Lotis blue butterfly<br>*Lycaeides argyrognomon lotis*[5] | | | | FE | 6-01-76 |
| Palos Verdes blue butterfly<br>*Glaucopsyche lygdamus palosverdesensis* | | | | FE | 7-02-80 |
| El Segundo blue butterfly<br>*Euphilotes battoides allyni* | | | | FE | 6-01-76 |
| Smith's blue butterfly<br>*Euphilotes enoptes smithi* | | | | FE | 6-01-76 |
| San Bruno elfin butterfly<br>*Callophrys mossii bayensis* | | | | FE | 6-01-76 |
| Lange's metalmark butterfly<br>*Apodemia mormo langei* | | | | FE | 6-01-76 |
| Bay checkerspot butterfly<br>*Euphydryas editha bayensis* | | | | FT | 10-18-87 |
| Quino checkerspot butterfly<br>*Euphydryas editha quino (=E. e. wrighti)* | | | | FE | 1-16-97 |
| Carson wandering skipper<br>*Pseudocopaeodes eunus obscurus* | | | | FE | 8-07-02 |
| Laguna Mountains skipper<br>*Pyrgus ruralis lagunae* | | | | FE | 1-16-97 |
| Callippe silverspot butterfly<br>*Speyeria callippe callippe* | | | | FE | 12-05-97 |
| Behren's silverspot butterfly<br>*Speyeria zerene behrensii* | | | | FE | 12-05-97 |
| Oregon silverspot butterfly[6]<br>*Speyeria zerene hippolyta* | | | | FT | 7-02-80 |
| Myrtle's silverspot butterfly<br>*Speyeria zerene myrtleae* | | | | FE | 6-22-92 |
| Delhi Sands flower-loving fly<br>*Rhaphiomidas terminatus abdominalis* | | | | FE | 9-23-93 |

[4] Current taxonomy is *Plebejus icarioides missionensis.*
[5] Current taxonomy is *Plebejus idas lotis.*
[6] Also known by the common name is Hippolyta fritillary.

| | State Listing | | | Federal Listing | |
|---|---|---|---|---|---|
| **FISHES** | | | | | |
| Green sturgeon - southern DPS<br>*Acipenser medirostris* | | | | FT[7] | 6-06-06 |
| Mohave tui chub<br>*Gila bicolor mohavensis*[8] | SE | 6-27-71 | | FE | 10-13-70 |
| Owens tui chub<br>*Gila bicolor snyderi*[9] | SE | 1-10-74 | | FE | 8-05-85 |
| Thicktail chub (**Extinct**)<br>*Gila crassicauda* | **Delisted**<br>SE | 10-02-80<br>1-10-74 | | | |
| Bonytail[10]<br>*Gila elegans* | **SE**<br>SR | 1-10-74<br>6-27-71 | | FE | 4-23-80 |
| Sacramento splittail<br>*Pogonichthys macrolepidotus* | | | | **Removed**[11]<br>FT | 9-22-03<br>3-10-99 |
| Colorado squawfish[12]<br>*Ptychocheilus lucius* | SE | 6-27-71 | | FE | 3-11-67 |
| Modoc sucker<br>*Catostomus microps* | **SE**<br>SR | 10-02-80<br>1-10-74 | | FE | 6-11-85 |
| Santa Ana sucker<br>*Catostomus santaanae* | | | | FT[13] | 5-12-00 |
| Shortnose sucker<br>*Chasmistes brevirostris* | **SE**<br>SR | 1-10-74<br>6-27-71 | | FE | 7-18-88 |
| Lost River sucker<br>*Deltistes luxatus* | **SE**<br>SR | 1-10-74<br>6-27-67 | | FE | 7-18-88 |
| Razorback sucker<br>*Xyrauchen texanus* | **SE**<br>SR | 1-10-74<br>6-27-71 | | FE | 10-23-91 |
| Delta smelt<br>*Hypomesus transpacificus* | **SE**<br>ST | 1-20-10<br>12-09-93 | | FT | 3-05-93 |
| Longfin smelt<br>*Spirinchus thaleichthys* | **ST**<br>SCE | 4-09-10<br>2-02-08 | | | |
| Pacific eulachon - southern DPS<br>*Thaleichthys pacificus* | | | | FT<br>FT | 4-13-11[14]<br>5-17-10 |
| Lahontan cutthroat trout<br>*Oncorhynchus clarkii henshawi*[15] | | | | **FT**<br>FE | 7-16-75<br>10-13-70 |

[7] Includes all spawning populations south of the Eel River.
[8] Current taxonomy: *Siphateles bicolor mohavensis.*
[9] Current taxonomy: *Siphateles bicolor snyderi.*
[10] Federal common name: bonytail chub.
[11] On 23 June 2000, the Federal Eastern District Court of Calif. found the final rule to be unlawful and on 22 Sept 2000 remanded the determination back to the USFWS for a reevaluation of the final decision. After a thorough review the USFWS removed the Sacramento splittail from the list of Threatened species.
[12] Current nomenclature and federal listing: Colorado pikeminnow.
[13] Populations in the Los Angeles, San Gabriel, and Santa Ana River basins.
[14] Eulachon was listed as Threatened by the NMFS in 2010 and by the USFWS in 2011.
[15] According to the American Fisheries Society Special Publication 29 (2004), "clarkii" has two i's.

| | State Listing | | Federal Listing | |
|---|---|---|---|---|
| Paiute cutthroat trout<br>*Oncorhynchus clarkii seleniris* | | | **FT**<br>FE | 7-16-75<br>3-11-67[16] |
| Coho salmon - south of Punta Gorda[17]<br>*Oncorhynchus kisutch* | SE[18] | 3-30-05 | **FE**[19]<br>FT | 8-29-05<br>12-02-96 |
| Coho salmon - Punta Gorda to the N. border of California[20]<br>*Oncorhynchus kisutch* | ST[21] | 3-30-05 | FT[22]<br>FT | 8-29-05<br>6-05-97 |
| Steelhead - Southern California DPS[23]<br>*Oncorhynchus mykiss* | | | FE[24]<br>FE | 2-06-06<br>10-17-97 |
| Steelhead - South-Central California Coast DPS[25]<br>*Oncorhynchus mykiss* | | | FT[26]<br>FT | 2-06-06<br>10-17-97 |
| Steelhead - Central California Coast DPS[27]<br>*Oncorhynchus mykiss* | | | FT[28]<br>FT | 2-06-06<br>10-17-97 |
| Steelhead - California Central Valley DPS[29]<br>*Oncorhynchus mykiss* | | | FT[30]<br>FT | 2-06-06<br>5-18-98 |
| Steelhead - Northern California DPS[31]<br>*Oncorhynchus mykiss* | | | FT[32]<br>FT | 2-06-06<br>8-07-00 |
| Little Kern golden trout<br>*Oncorhynchus mykiss whitei*[33] | | | FT | 4-13-78 |
| Chinook salmon - Winter-run[34]<br>*Oncorhynchus tshawytscha* | SE | 9-22-89 | FE[35]<br>FE | 8-29-05<br>2-03-94 |
| Chinook salmon - California coastal ESU[36]<br>*Oncorhynchus tshawytscha* | | | FT[37]<br>FT | 8-29-05<br>11-15-99 |

[16] All species with a list date of 03-11-67 were listed under the Endangered Species Preservation Act of October 15, 1966.
[17] The Federal listing is for Central California Coast Coho ESU and includes populations from Punta Gorda south to, and including, the San Lorenzo River as well as populations in tributaries to San Francisco Bay, excluding the Sacramento-San Joaquin River system.
[18] The Coho south of San Francisco Bay were state listed in 1995. In February 2004 the Fish and Game Commission determined that the Coho from San Francisco to Punta Gorda should also be listed as Endangered. This change was finalized by the Office of Administrative Law on March 30, 2005.
[19] The NMFS completed a comprehensive status review in 2005 reaffirming the status.
[20] The Federal listing is for Southern Oregon/Northern California Coast Coho ESU and includes populations in coastal streams between Cape Blanco, Oregon and Punta Gorda, California.
[21] The Fish and Game Commission determined that the Coho from Punta Gorda to the Oregon border should be listed as Threatened on February 25, 2004. This determination was finalized by the Office of Administrative Law on March 30, 2005.
[22] The NMFS completed a comprehensive status review in 2005 reaffirming the status.
[23] Coastal basins from the Santa Maria River (inclusive), south to the U.S.-Mexico Border.
[24] The NMFS completed a comprehensive status review in 2006 reaffirming the status.
[25] Coastal basins from the Pajaro River (inclusive) south to, but not including, the Santa Maria River.
[26] The NMFS completed a comprehensive status review in 2006 reaffirming the status.
[27] Coastal streams from the Russian River (inclusive) to Aptos Creek (inclusive), and the drainages of San Francisco, San Pablo, and Suisun Bays eastward to Chipps Island at the confluence of the Sacramento and San Joaquin Rivers; and tributary streams to Suisun Marsh including Suisun Creek, Green Valley Creek, and an unnamed tributary to Cordelia Slough (commonly referred to as Red Top Creek), exclusive of the Sacramento-San Joaquin River Basin of the California Central Valley.
[28] The NMFS completed a comprehensive status review in 2006 reaffirming the status.
[29] The Sacramento and San Joaquin Rivers and their tributaries.
[30] The NMFS completed a comprehensive status review in 2006 reaffirming the status.
[31] Naturally spawned populations residing below impassable barriers in coastal basins from Redwood Creek in Humboldt County to, and including, the Gualala River in Mendocino County.
[32] The NMFS completed a comprehensive status review in 2006 reaffirming the status.
[33] Originally listed as *Salmo aguabonita whitei*. The genus *Salmo* was reclassified as *Oncorhynchus* changing the name to *Oncorhynchus aguabonita whitei*. However, recent studies indicate this is a subspecies of rainbow trout, therefore *Oncorhynchus mykiss whitei*.
[34] The federal designation is for Chinook salmon - Sacramento River winter-run ESU and described as winter-run populations in the Sacramento River and its tributaries in California.
[35] The NMFS completed a comprehensive status review in 2005 reaffirming the status.

| | State Listing | | | Federal Listing | |
|---|---|---|---|---|---|
| Chinook salmon - Spring-run[38]<br>*Oncorhynchus tshawytscha* | ST | 2-05-99 | | FT[39]<br>FT | 8-29-05<br>11-15-99 |
| Bull trout<br>*Salvelinus confluentus* | SE | 10-02-80 | | FT | 12-01-99 |
| Desert pupfish<br>*Cyprinodon macularius* | SE | 10-02-80 | | FE | 3-31-86 |
| Tecopa pupfish (**Extinct)**<br>*Cyprinodon nevadensis calidae* | **Delisted**<br>SE | 1987<br>6-27-71 | | **Delisted**<br>FE | 1-15-82<br>10-13-70 |
| Owens pupfish<br>*Cyprinodon radiosus* | SE | 6-27-71 | | FE | 3-11-67 |
| Cottonball Marsh pupfish<br>*Cyprinodon salinus milleri* | ST | 1-10-74 | | | |
| Unarmored threespine stickleback<br>*Gasterosteus aculeatus williamsoni* | SE | 6-27-71 | | FE | 10-13-70 |
| Rough sculpin<br>*Cottus asperrimus* | ST | 1-10-74 | | | |
| Tidewater goby<br>*Eucyclogobius newberryi* | | | | Withdrawn<br>FPD[40]<br>**FE** | 12-09-02<br>6-24-99<br>2-04-94 |
| **AMPHIBIANS** | | | | | |
| California tiger salamander[41]<br>*Ambystoma californiense* | ST[42] | 8-19-10 | | (FE)<br>(FT) | |
| California tiger salamander - central California DPS<br>*Ambystoma californiense* | (ST) | | | FT[43] | 9-03-04 |
| California tiger salamander - Santa Barbara County DPS<br>*Ambystoma californiense* | (ST) | | | FE[43] | 9-15-00 |
| California tiger salamander - Sonoma County DPS<br>*Ambystoma californiense* | (ST) | | | FE[43] | 3-19-03 |
| Santa Cruz long-toed salamander<br>*Ambystoma macrodactylum croceum* | SE | 6-27-71 | | FE | 3-11-67 |
| Siskiyou Mountains salamander<br>*Plethodon stormi* | SCD<br>**ST** | 9-30-05<br>6-27-71 | | | |

[36] Rivers and streams south of the Klamath River to the Russian River.
[37] The NMFS completed a comprehensive status review in 2005 reaffirming the status.
[38] The State listing is for "Spring-run chinook salmon (*Oncorhynchus tshawytscha*) of the Sacramento River drainage." The Federal listing is for Central Valley spring-run Chinook ESU and includes populations of spring-run Chinook salmon in the Sacramento River and its tributaries including the Feather River.
[39] The NMFS completed a comprehensive status review in 2005 reaffirming the status.
[40] Proposal to delist referred to populations north of Orange County only.
[41] The State listing refers to the entire range of the species.
[42] Adopted May 20, 2010. The Office of Administrative Law approved the listing on Aug 2, 2010 and the effective date of regulations is Aug 19, 2010.
[43] In 2004 the California tiger salamander was listed as Threatened statewide. The Santa Barbara County and Sonoma County Distinct Vertebrate Population Segments (DPS), formerly listed as Endangered, were reclassified to Threatened. On Aug 19 2005 U.S. District court vacated the downlisting of the Sonoma and Santa Barbara populations from Endangered to Threatened. Therefore, the Sonoma & Santa Barbara populations are once again listed as Endangered.

| | State Listing | | | Federal Listing | |
|---|---|---|---|---|---|
| Scott Bar salamander<br>*Plethodon asupak* | ST[44] | 6-27-71 | | | |
| Tehachapi slender salamander<br>*Batrachoseps stebbinsi* | ST | 6-27-71 | | | |
| Kern Canyon slender salamander<br>*Batrachoseps simatus* | ST | 6-27-71 | | | |
| Desert slender salamander<br>*Batrachoseps aridus*[45] | SE | 6-27-71 | | FE | 6-04-73 |
| Shasta salamander<br>*Hydromantes shastae* | ST | 6-27-71 | | | |
| Limestone salamander<br>*Hydromantes brunus* | ST | 6-27-71 | | | |
| Black toad<br>*Bufo exsul*[46] | ST | 6-27-71 | | | |
| Arroyo toad<br>*Anaxyrus californicus*[47] | | | | FE | 1-17-95 |
| California red-legged frog<br>*Rana aurora draytonii*[48] | | | | FT | 5-20-96 |
| Southern mountain yellow-legged frog[49]<br>*Rana muscosa* | SCE[50] | 9-21-10 | | FE[51] | 8-01-02 |
| Sierra Nevada mountain yellow-legged frog<br>*Rana sierrae* | SCT[52] | 9-21-10 | | | |
| **REPTILES** | | | | | |
| Desert tortoise<br>*Gopherus agassizii* | ST | 8-03-89 | | FT | 4-02-90 |
| Green sea turtle[53]<br>*Chelonia mydas* | | | | **FT**<br>FE | 7-28-78<br>10-13-70 |
| Loggerhead sea turtle - North Pacific DPS[54]<br>*Caretta caretta* | | | | **FE**<br>FPE<br>FT | 10-24-11<br>3-16-10<br>7-28-78 |

[44] Since this newly described species was formerly considered to be a subpopulation of *Plethodon stormi,* and since *Plethodon stormi* is listed as Threatened under the CESA, *Plethodon asupak* retains the Threatened designation.
[45] Current taxonomy: *Batrachoseps major aridus.*
[46] Current taxonomy: *Anaxyrus exsul.*
[47] At the time of listing, arroyo toad was known as *Bufo microscaphus californicus,* a subspecies of southwestern toad. In 2001 it was determined to be its own species, *Bufo californicus*. Since then, many species in the genus *Bufo* were changed to the genus *Anaxyrus*, and now arroyo toad is known as *Anaxyrus californicus*.
[48] Current taxonomy: *Rana draytonii.*
[49] Though the scientific name *Rana muscosa* is not disputed, the State used this common name in the 16 Oct 2012 Notice of Proposed Changes in Regulation, whereas the USFWS listing refers to the distinct population segment listed as mountain yellow-legged frog – Southern California DPS. This species is also known by the common name Sierra Madre yellow-legged frog (Vredenburg et al. 2007).
[50] Filed with the Office of Administrative Law on 16 January 2013; Effective Date of Regulation is pending.
[51] Federal listing refers to the distinct population segment (DPS) in the San Gabriel, San Jacinto, and San Bernardino Mountains only, with a recognized common name of Mountain yellow-legged frog - Southern California DPS. MYLF north of the Tehachapi Mountains are a Federal candidate.
[52] Filed with the Office of Administrative Law on 16 January 2013; Effective Date of Regulation is pending.
[53] Current nomenclature: green turtle.

| | State Listing | | | Federal Listing | |
|---|---|---|---|---|---|
| Olive (=Pacific) ridley sea turtle<br>*Lepidochelys olivacea* | | | | FT | 7-28-78 |
| Leatherback sea turtle<br>*Dermochelys coriacea* | | | | FE | 6-02-70 |
| Barefoot banded gecko[55]<br>*Coleonyx switaki* | ST | 10-02-80 | | | |
| Coachella Valley fringe-toed lizard<br>*Uma inornata* | SE | 10-02-80 | | FT | 9-25-80 |
| Blunt-nosed leopard lizard<br>*Gambelia silus*[56] | SE | 6-27-71 | | FE | 3-11-67 |
| Flat-tailed horned lizard<br>*Phrynosoma mcallii* | | | | **Withdrawn**[57]<br>FPT[58] | 3-15-11<br>11-29-93 |
| Island night lizard<br>*Xantusia riversiana* | | | | FT | 8-11-77 |
| Southern rubber boa<br>*Charina bottae umbratica*[59] | ST | 6-27-71 | | | |
| Alameda whipsnake<br>*Masticophis lateralis euryxanthus* | ST | 6-27-71 | | FT | 12-05-97 |
| San Francisco garter snake<br>*Thamnophis sirtalis tetrataenia* | SE | 6-27-71 | | FE | 3-11-67 |
| Giant garter snake<br>*Thamnophis couchi gigas*[60] | ST | 6-27-71 | | FT | 10-20-93 |
| **BIRDS** | | | | | |
| Short-tailed albatross<br>*Phoebastria albatrus* | | | | FE<br>FE | 8-30-00[61]<br>6-2-1970 |
| California brown pelican[62] (**Recovered**)<br>*Pelecanus occidentalis californicus* | **Delisted**<br>SE | 6-03-09<br>6-27-71 | | **Delisted**<br>FE | 12-17-09<br>2-20-08<br>10-13-70 |
| Aleutian Canada goose **(Recovered)**<br>*Branta canadensis leucopareia*[63] | | | | **Delisted**<br>FT<br>FE | 3-20-01<br>12-12-90<br>3-11-67 |

[54] 1978 listing was for the worldwide range of the species. The Mar 16, 2010 proposed rule and Oct 24, 2011 final rule are for the North Pacific DPS (north of the equator & south of 60 degrees north latitude).
[55] Current nomenclature: Barefoot gecko.
[56] Current taxonomy: *Gambelia sila*. Both the State and Federal recognize the common name blunt-nosed leopard lizard (SSAR), but also known as bluntnose leopard lizard (CNAH). Originally listed under the ESA as *Crotaphytus wislizenii silus*.
[57] On June 28, 2006 the USFWS determined that the proposed listing was not warranted and the proposed rule that had been reinstated on Nov 17, 2005 was withdrawn. USFWS specifically reiterated that the 29 Nov 1993 proposal to list as Threatened was withdrawn as of 15 Mar 2011.
[58] On November 17, 2005, the U. S. District Court for the District of Arizona vacated the January 3, 2003 withdrawal of the proposed rule to list the flat-tailed horned lizard and reinstated the 1993 proposed rule.
[59] Current taxonomy: *Charina umbratica*.
[60] Current taxonomy and Federal listing: *Thamnophis gigas*.
[61] Listed as Endangered in one of the original species list, but "due to an inadvertent oversight" when the 1973 ESA repealed the 1969 Act, short-tailed albatross was effectively delisted. Proposed listing to fix this error in 1980, with final rule in 2000.
[62] Federal nomenclature: Brown pelican (*Pelecanus occidentalis*).
[63] Current taxonomy: Cackling goose (*Branta hutchinsii leucopareia*).

| | State Listing | | | Federal Listing | |
|---|---|---|---|---|---|
| California condor<br>*Gymnogyps californianus* | SE | 6-27-71 | | FE | 3-11-67 |
| Bald eagle<br>*Haliaeetus leucocephalus* | **<u>SE</u>** (rev)<br>SE | 10-02-80<br>6-27-71 | | **<u>Delisted</u>**[64]<br>FT<br>FE (rev)<br>FE | 8-08-07<br>7-06-99<br>8-11-95<br>2-14-78<br>3-11-67 |
| Swainson's hawk<br>*Buteo swainsoni* | ST | 4-17-83 | | | |
| American peregrine falcon **(Recovered)**<br>*Falco peregrinus anatum* | **<u>Delisted</u>**<br>SE | 11-04-09<br>6-27-71 | | **<u>Delisted</u>**<br>FE | 8-25-99<br>6-02-70 |
| Arctic peregrine falcon **(Recovered)**<br>*Falco peregrinus tundrius* | | | | **<u>Delisted</u>**<br>FT<br>FE | 10-05-94<br>3-20-84<br>6-02-70 |
| California black rail<br>*Laterallus jamaicensis coturniculus* | ST | 6-27-71 | | | |
| California clapper rail<br>*Rallus longirostris obsoletus* | SE | 6-27-71 | | FE | 10-13-70 |
| Light-footed clapper rail<br>*Rallus longirostris levipes* | SE | 6-27-71 | | FE | 10-13-70 |
| Yuma clapper rail<br>*Rallus longirostris yumanensis* | **<u>ST</u>**<br>SE | 2-22-78<br>6-27-71 | | FE | 3-11-67 |
| Greater sandhill crane<br>*Grus canadensis tabida* | ST | 4-17-83 | | | |
| Western snowy plover<br>*Charadrius alexandrinus nivosus*[65] | | | | FT[66] | 4-05-93 |
| Mountain plover<br>*Charadrius montanus* | | | | **<u>Withdrawn</u>**<br>FPT | 5-12-11<br>12-5-02 |
| California least tern<br>*Sterna antillarum browni*[67] | SE | 6-27-71 | | FE | 10-13-70 |
| Marbled murrelet<br>*Brachyramphus marmoratus* | SE | 3-12-92 | | FT | 9-30-92 |
| Xantus's murrelet<br>*Synthliboramphus hypoleucus* | ST[68] | 12-22-04 | | | |
| Western yellow-billed cuckoo<br>*Coccyzus americanus occidentalis* | **<u>SE</u>**<br>ST | 3-26-88<br>6-27-71 | | | |

[64] The Post-delisting Monitoring Plan will monitor the status of the bald eagle over a 20 year period with sampling events held once every 5 years.
[65] Current taxonomy: *Charadrius nivosus nivosus* (AOU 2011).
[66] Federal status applies only to the Pacific coastal population.
[67] Current taxonomy: *Sternula antillarum browni.*
[68] The Fish and Game Commission determined that Xantus's murrelet should be listed as a Threatened species February 24, 2004. As part of the normal listing process, this decision was reviewed by the Office of Administrative Law. The listing became effective on Dec 22, 2004.

| | State Listing | | | Federal Listing | |
|---|---|---|---|---|---|
| Elf owl<br>*Micrathene whitneyi* | SE | 10-02-80 | | | |
| Northern spotted owl<br>*Strix occidentalis caurina* | | | | FT | 6-22-90 |
| Great gray owl<br>*Strix nebulosa* | SE | 10-02-80 | | | |
| Gila woodpecker<br>*Melanerpes uropygialis* | SE | 3-17-88 | | | |
| Black-backed woodpecker<br>*Picoides arcticus* | SCE or SCT | 12-27-11 | | | |
| Gilded northern flicker[69]<br>*Colaptes auratus chrysoides* | SE | 3-17-88 | | | |
| Willow flycatcher<br>*Empidonax traillii* | SE[70] | 1-02-91 | | | |
| Southwestern willow flycatcher<br>*Empidonax traillii extimus* | (SE) | | | FE | 3-29-95 |
| Bank swallow<br>*Riparia riparia* | ST | 6-11-89 | | | |
| Coastal California gnatcatcher<br>*Polioptila californica californica* | | | | FT | 3-30-93 |
| San Clemente loggerhead shrike<br>*Lanius ludovicianus mearnsi* | | | | FE | 8-11-77 |
| Arizona Bell's vireo<br>*Vireo bellii arizonae* | SE | 3-17-88 | | | |
| Least Bell's vireo<br>*Vireo bellii pusillus* | SE | 10-02-80 | | FE | 5-02-86 |
| Inyo California towhee<br>*Pipilo crissalis eremophilus*[71] | SE | 10-02-80 | | FT | 8-03-87 |
| San Clemente sage sparrow<br>*Amphispiza belli clementeae* | | | | FT | 8-11-77 |
| Belding's savannah sparrow<br>*Passerculus sandwichensis beldingi* | SE | 1-10-74 | | | |
| Santa Barbara song sparrow **(Extinct)**<br>*Melospiza melodia graminea* | | | | **Delisted**<br>FE | 10-12-83<br>6-04-73 |
| **MAMMALS** | | | | | |
| Point Arena mountain beaver<br>*Aplodontia rufa nigra* | | | | FE | 12-12-91 |

[69] Current taxonomy: Gilded flicker (*Colaptes chrysoides*).
[70] State listing includes all subspecies.
[71] Current taxonomy: *Melozone crissalis eremophilus.*

| | State Listing | | Federal Listing | |
|---|---|---|---|---|
| San Joaquin antelope squirrel[72] *Ammospermophilus nelsoni* | ST | 10-02-80 | | |
| Mohave ground squirrel[73] *Spermophilus mohavensis* | ST | 6-27-71 | | |
| Morro Bay kangaroo rat *Dipodomys heermanni morroensis* | SE | 6-27-71 | FE | 10-13-70 |
| Giant kangaroo rat *Dipodomys ingens* | SE | 10-02-80 | FE | 1-05-87 |
| San Bernardino kangaroo rat[74] *Dipodomys merriami parvus* | | | FE | 9-24-98 |
| Tipton kangaroo rat *Dipodomys nitratoides nitratoides* | SE | 6-11-89 | FE | 7-08-88 |
| Fresno kangaroo rat *Dipodomys nitratoides exilis* | **SE**<br>SR | 10-02-80<br>6-27-71 | FE | 3-01-85 |
| Stephens' kangaroo rat *Dipodomys stephensi*[75] | ST | 6-27-71 | FE | 9-30-88 |
| Pacific pocket mouse *Perognathus longimembris pacificus* | | | FE | 9-26-94 |
| Amargosa vole *Microtus californicus scirpensis* | SE | 10-02-80 | FE | 11-15-84 |
| Riparian woodrat[76] *Neotoma fuscipes riparia* | | | FE | 3-24-00 |
| Salt-marsh harvest mouse *Reithrodontomys raviventris* | SE | 6-27-71 | FE | 10-13-70 |
| American pika *Ochotona princeps* | SCT | 10-26-11 | | |
| Riparian brush rabbit *Sylvilagus bachmani riparius* | SE | 5-29-94 | FE | 3-24-00 |
| Buena Vista Lake shrew[77] *Sorex ornatus relictus* | | | FE | 4-05-02 |
| Lesser long-nosed bat *Leptonycteris yerbabuenae* | | | FE | 10-31-88 |
| Gray wolf *Canis lupus* | SCE | 10-18-12 | FE[78] | 4-10-78 |

[72] Current taxonomy: Nelson's antelope squirrel.
[73] Current taxonomy: *Xerospermophilus mohavensis.*
[74] Federal nomenclature: San Bernardino Merriam's kangaroo rat.
[75] Federal taxonomy: included *Dipodomys cascus*, an invalid junior synonym for *Dipodomys stephensi.*
[76] Federal nomenclature: Riparian (=San Joaquin Valley) woodrat.
[77] Federal nomenclature: Buena Vista Lake ornate shrew.
[78] The full species, *Canis lupus*, was listed as Endangered in 1978. Though the status of the gray wolf is being challenged in other states, any gray wolves present or dispersing into California are considered federally Endangered.

| | State Listing | | Federal Listing | |
|---|---|---|---|---|
| Island fox<br>*Urocyon littoralis* | ST[79] | 6-27-71 | | |
| San Miguel Island Fox<br>*Urocyon littoralis littoralis* | (ST) | | FE | 4-05-04 |
| Santa Catalina Island Fox<br>*Urocyon littoralis catalinae* | (ST) | | FE | 4-05-04 |
| Santa Cruz Island Fox<br>*Urocyon littoralis santacruzae* | (ST) | | FE | 4-05-04 |
| Santa Rosa Island Fox<br>*Urocyon littoralis santarosae* | (ST) | | FE | 4-05-04 |
| San Joaquin kit fox<br>*Vulpes macrotis mutica* | ST | 6-27-71 | FE | 3-11-67 |
| Sierra Nevada red fox<br>*Vulpes vulpes necator* | ST | 10-02-80 | | |
| Guadalupe fur seal<br>*Arctocephalus townsendi* | ST | 6-27-71 | **FT**<br>FE | 1-15-86<br>3-11-67 |
| Steller sea lion - Eastern DPS<br>*Eumetopias jubatus* | | | FPD<br>**FT**<br>FT | 4-18-12<br>6-4-97[80]<br>4-05-90 |
| Southern sea otter<br>*Enhydra lutris nereis* | | | FT | 1-14-77 |
| Wolverine<br>*Gulo gulo* | ST | 6-27-71 | | |
| Fisher - West Coast DPS[81]<br>*Martes pennant* | **Not warranted**<br>SCT or SCE[82] | 6-23-10<br>4-14-09 | | |
| California (=Sierra Nevada) bighorn sheep<br>*Ovis canadensis californiana*[83] | **SE**<br>ST | 8-27-99<br>6-27-71 | FE | 1-03-00 |
| Peninsular bighorn sheep DPS[84]<br>*Ovis canadensis cremnobates* | ST | 6-27-71 | FE | 3-18-98 |
| North Pacific right whale<br>*Eubalaena japonica*[85] | | | FE[86]<br>FE | 4-7-08<br>6-02-70 |

[79] State listing includes all 6 subspecies on all 6 islands. Federal listing is for only 4 subspecies on 4 islands.
[80] The NMFS reclassified Steller sea lion as two distinct population segments: western DPS west of 144 degrees longitude (Endangered), and eastern DPS east of 144 degrees longitude (Threatened).
[81] The Fish and Game Commission during their review of the fisher petitioning recognized the common name Pacific fisher. Adopted here is the common name used in the USFWS candidacy (2 Apr 2004), fisher, for the West Coast distinct population segment for California, Oregon, and Washington.
[82] The Fish and Game Commission notice of finding stated that the Pacific fisher was a candidate for listing as either an Endangered or a Threatened species. At the June 23, 2010 meeting the Commission determined that the listing was not warranted.
[83] Current & Federal taxonomy: Sierra Nevada bighorn sheep (*Ovis canadensis sierrae)*
[84] Current taxonomy: the subspecies *O.c. cremnobates* has been synonymized with *O.c. nelsoni*. Peninsular bighorn sheep are now considered to be a Distinct Vertebrate Population Segment (DPS).
[85] The scientific name was clarified in the Federal Register Vol. 68, No. 69 April 10, 2003.

| | State Listing | | | Federal Listing | |
|---|---|---|---|---|---|
| Sei whale<br>*Balaenoptera borealis* | | | | FE | 6-02-70 |
| Blue whale<br>*Balaenoptera musculus* | | | | FE | 6-02-70 |
| Fin whale<br>*Balaenoptera physalus* | | | | FE | 6-02-70 |
| Humpback whale[87]<br>*Megaptera novaeangliae* | | | | FE | 6-02-70 |
| Gray whale **(Recovered)**<br>*Eschrichtius robustus* | | | | **Delisted**<br>FE | 6-15-94<br>6-02-70 |
| Killer whale (Southern resident DPS)<br>*Orcinus orca* | | | | FE[88]<br>FE | 4-04-07<br>2-16-06<br>12-22-04 |
| Sperm whale<br>*Physeter macrocephalus*[89] | | | | FE | 6-02-70 |

[86] The NMFS completed a status review of right whales in the N. Pacific and N. Atlantic Oceans and determined the previously Endangered northern right whale (*Eubalaena* spp.) as two separate Endangered species: North Pacific right whale (*E. japonica*) and North Atlantic right whale (*E. glacialis*).
[87] Also known as Hump-backed whale.
[88] The killer whale was listed as Endangered by the NMFS on Feb 16, 2006 and by the USFWS on Apr 4, 2007.
[89] Current taxonomy: *Physeter catodon* with *P. macrocephalus* as a synonym.

## ABBREVIATIONS

CESA: California Endangered Species Act

DPS: Distinct population segment

ESA: Endangered Species Act (Federal)

ESU: Evolutionarily significant unit

NMFS: National Marine Fisheries Service

NOAA: National Oceanic and Atmospheric Administration

USFWS: United States Fish and Wildlife Service

## ADDITIONAL RESOURCES

The California Fish and Game Commission publishes notices relating to changes to Title 14 of the California Code of Regulations: http://www.fgc.ca.gov/

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# Large, high-intensity fire events in southern California shrublands: debunking the fine-grain age patch model

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*Abstract*. We evaluate the fine-grain age patch model of fire regimes in southern California shrublands. Proponents contend that the historical condition was characterized by frequent small to moderate size, slow-moving smoldering fires, and that this regime has been disrupted by fire suppression activities that have caused unnatural fuel accumulation and anomalously large and catastrophic wildfires. A review of more than 100 19th-century newspaper reports reveals that large, high-intensity wildfires predate modern fire suppression policy, and extensive newspaper coverage plus first-hand accounts support the conclusion that the 1889 Santiago Canyon Fire was the largest fire in California history.

Proponents of the fine-grain age patch model contend that even the very earliest 20th-century fires were the result of fire suppression disrupting natural fuel structure. We tested that hypothesis and found that within the fire perimeters of two of the largest early fire events in 1919 and 1932, prior fire suppression activities were insufficient to have altered the natural fuel structure. Over the last 130 years there has been no significant change in the incidence of large fires greater than 10 000 ha, consistent with the conclusion that fire suppression activities are not the cause of these fire events. Eight megafires (≥50 000 ha) are recorded for the region, and half have occurred in the last five years. These burned through a mosaic of age classes which raises doubts that accumulation of old age classes explains these events. Extreme drought is a plausible explanation for this recent rash of such events, and it is hypothesized that these are due to droughts that led to increased dead fine fuels that promoted the incidence of firebrands and spot fires.

A major shortcoming of the fine-grain age patch model is that it requires age-dependent flammability of shrubland fuels, but seral stage chaparral is dominated by short-lived species that create a dense surface layer of fine fuels. Results from the Behave Plus fire model with a custom fuel module for young chaparral shows that there is sufficient dead fuel to spread fire even under relatively little winds. Empirical studies of fuel ages burned in recent fires illustrate that young fuels often comprise a major portion of burned vegetation, and there is no difference between evergreen chaparral and semi-deciduous sage scrub.

It has also been argued that the present-day fire size distribution in northern Baja California is a model of the historical patterns that were present on southern California landscapes. Applying this model with historical fire frequencies shows the Baja model is inadequate to maintain these fire-prone ecosystems and further demonstrates that fire managers in southern California are not likely to learn much from studying modern Baja California fire regimes. Further supporting this conclusion are theoretical cellular automata models of fire spread, which show that, even in systems with age dependent flammability, landscapes evolve toward a complex age mosaic with a plausible age structure only when there is a severe stopping rule that constrains fire size, and only if ignitions are saturating.

*Key words: 19th century; Baja California; chaparral; fine-grain age patch mosaic; fire history; high-intensity fires; megafires; sage scrub; Santa Ana winds.*

*During the past three or four days destructive fires have been raging in San Bernardino, Orange and San Diego ... It is a year of disasters, wide-spread destruction of life and property—and, well, a year of horrors.*

—*The Daily Courier*, San Bernardino, 27 September 1889

## Introduction

Shrubland-dominated landscapes in California have fuel characteristics conducive to high-intensity wildfires that commonly reach sizes of 10 000 ha or more (Keeley et al. 1999). Some researchers have postulated that such fire events are anomalous and were unknown prior to putative perturbations of the natural fuel structure by 20th-century fire suppression (Bonnicksen 1981, Minnich 1983, 1995, 2001). These authors have argued that

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historical fire regimes were profoundly different than contemporary fire regimes. In their model, frequent lightning or Indian burning created a fine-grain age patch mosaic of small low intensity smoldering fires, and the resulting patchwork of young and old fuels prevented large fires due to the inability of young seral stands to carry fire. Proponents of this model predict that if the purported 19th-century fire regime were restored to contemporary landscapes, then large high-intensity crown fires could be prevented. Although many have discounted this model (Keeley et al. 1989, 1999, Zedler 1995, Moritz 1997, 2003, Conard and Weise 1998, Zedler and Seiger 2000, Keeley and Fotheringham 2003, Moritz et al. 2004), it is being advocated in newspaper op-ed pieces (Minnich 2003, Chastain 2007), in national newspaper stories (LaFee 2004, Vick and Geis 2007) and Web sites of timber advocacy groups (e.g., California Forest Foundation 2007), as well as in a recent *Ecological Applications* paper (Goforth and Minnich 2007). We believe the time is right for a more thorough analysis of this fine-grain age patch mosaic model as it has the potential for affecting public opinion, and ultimately resource allocation for fire management activities, as well as stalling needed land zoning reforms (Gang 2007, McDaniel 2007, Phelps 2007).

### *Large high-intensity fires*

Large infrequent disturbances have always been major drivers of ecosystem structure and function (Turner and Dale 1998), but increasingly in a world filled with people, they pose significant challenges. This is certainly the case for wildfire, which has repeatedly overwhelmed the capacity of fire managers to regulate it, especially in the fire-prone Mediterranean climate region of the Pacific Coast. One of the most basic questions is what can be done, through modified management practices and land development policies, to make fires less damaging to humans and their property.

In the western United States, large wildfires in recent decades have been ascribed to past management practices that have altered fuels in many forested ecosystems (Allen et al. 2002). It is widely believed that very large high-intensity fires in these ecosystems are anomalous events that were unknown historically. This model is most applicable to southwestern U.S. ponderosa pine and southeastern U.S. longleaf pine forests. These landscapes historically experienced a very high frequency of lightning ignited fires, which in the absence of human interference, maintained open tree canopies and limited surface fuels, and this promoted a regime of low intensity surface fires (Glitzenstein et al. 1995, Allen et al. 2002).

Large high-intensity crown fires are considered to be a natural feature in many ecosystems (Turner and Romme 1994, Johnson et al. 2001, Meyn et al. 2007; Keane et al., *in press*), including California shrublands, which are often driven by severe winds known as Santa Anas (Fig. 1). However, some argue that in the absence of human interference, fires in California chaparral shrublands were small and of low to moderate intensity (Bonnicksen 1981, Minnich 1983, 1995). They claim that frequent natural lightning ignited fires burned small patches (100–1000 ha) at a sufficient frequency and arrangement to produce landscape mosaics of fuels, and once a patch burned it would act as a barrier to fire spread for several decades due to insufficient fuels. They contend that the appropriate fire management for this landscape is one that couples a wildland fire use policy for summer wildfires with extensive landscape scale fuel modification through rotational prescribed burning that produces a fuel mosaic putatively capable of preventing large wildfires (Minnich and Dezzani 1991, Minnich and Chou 1997, Minnich and Franco-Vizcaino 1999, Minnich 2001).

### *Hypothesis and predictions*

Here we test the null hypothesis that prior to aggressive fire suppression, fire regimes in the shrubland dominated landscape of southern California were characterized solely by low to moderate intensity fires that generated a fine-grain age patch mosaic of fuels, which prevented large fires. The alternative hypothesis is that large contemporary shrubland fires are within the historical range of variability for this landscape.

This fine-grain age patch model has profound implications for fire management because it contends that large catastrophic wildfires on these landscapes are the fault of fire suppression policy that has perturbed the 'natural' fire regime, and the appropriate remedy is to abandon total fire suppression. The alternative hypothesis argues that large catastrophic fires are the result of internal and external natural forces and vulnerability of human communities is tied more to inadequate land planning and infrastructure protection.

Predictions deduced from the fine-grain age patch null hypothesis, and tested here, are:

1) There is no credible evidence that 19th-century fires were large ($10^3$–$10^5$ ha) or high intensity (flame lengths $>$ 5 m).

2) Early 20th-century fires are linked to immediate disruptions in natural fire regimes due to fire suppression of natural lightning-ignited fires, and large fires have increased throughout the 20th century.

3) Fire spread in California shrublands is age dependent such that fires will not spread in early seral stages because of their low dead-to-live fuel ratio, imposing a threshold age of about two to three decades before these stands become flammable.

4) The fine-grain patchwork of fire sizes in Baja California represents the historical condition in southern California and when this model is coupled with the historical fire frequency from lightning ignitions it will predict a stable equilibrium in fire regime within the expected historical fire return interval of 50–100 years.

5) Theoretical models constrained by patch age should develop fine-grain structure spontaneously,

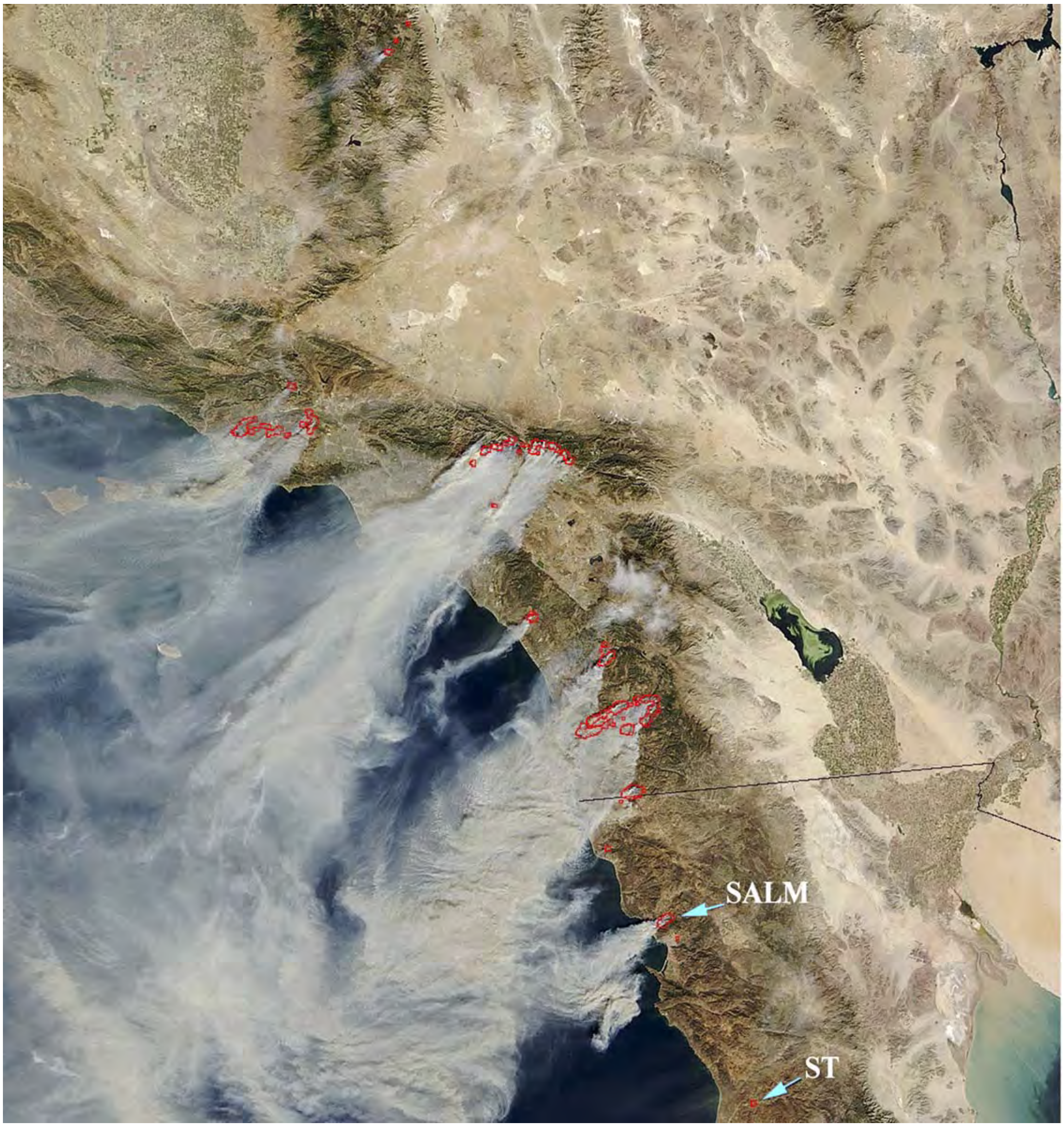


FIG. 1. Santa Ana wind-driven fires and smoke in 2003 from Ventura County, California, USA, to San Antonio de Las Minas near Ensenada, Mexico (SALM arrow). Note the apparent lack of Santa Ana winds on the fire farther south near Santo Tomás (ST arrow at bottom of panel) due to effects of the Gulf of California and San Pedro Mártir (see Keeley and Fotheringham 2001*a*, *b*). Image captured by the Moderate Resolution Imaging Spectro-radiometer (MODIS) on the Terra satellite on 26 October 2003. ⟨http://earthobservatory.nasa.gov/NaturalHazards/shownh.php3?img_ id=11799⟩

which once present will persist on the landscape due to resilience to changes in ignition and fire behavior.

## Methods

Historical accounts of 19th-century fires in southern California were obtained from newspapers on microfilm at the California State Library (Sacramento, California, USA), unpublished reports in the U.S. National Archives (San Bruno, California; Laguna Niguel, California; and Washington Archives II, College Park, Maryland) and U.S. Forest Service (USFS) Angeles National Forest (Supervisor's Office, Arcadia, California), and library materials. Copies of the 1878 Tujunga Cañon Fire perimeter map were copied from maps on file at the USFS Angeles Forest Supervisor's Office, Arcadia, California and from the U.S. National Archives, Washington Archives II, College Park, Maryland.

Numerical fire history data were obtained from multiple sources. The California Department of Forestry and Fire Protection, Fire and Resource Assessment Program (FRAP) Statewide Fire History electronic database is generally complete for fires greater than 40 ha but most fires less than 25 ha are not included.

Individual fire reports for selected years were obtained from one of the national archives offices listed above or directly from a regional USFS office. Long-term trends in fire size were done with least-squares regression analysis using Systat 11.0 (Systat, Richmond, California, USA).

Palmer drought severity indices (PDSI) were obtained from two sources: one for 20th-century data by month (*available online*)[6] and one for summer PDSI for the 19th century (*available online*).[7]

Modeling of expected fire behavior using either field measures of fuels or standard fuel models was done with Behave Plus 4.0. This is a PC-based software application for Microsoft Windows used to predict wildland fire behavior (software *available online*).[8] Rothermel equations that are used in the Behave Model have short comings when applied to chaparral (Zhou et al. 2005), but we believe it is appropriate to our application in young seral chaparral. Here dead fuels dominated and the bulk were within 75 cm of the soil surface.

Theoretical expectations of the fine-grain age patch model were explored with a cellular automata model, which creates a square map divided into cells that have two properties, location in the $x$–$y$ grid and age, the number of time steps (years) since that cell was "burned." These kinds of models have been proposed by a number of others, usually with the intent of building a model that would replicate fire behavior in real landscapes (Clarke et al. 1994, Encinas et al. 2007, Yassemi et al. 2008). The minimum age at which burning is possible (minage) is either a constant throughout a given run or allowed to vary from one year to the next. In both cases, it is assumed to be constant over the landscape. The model moves by 1-yr time steps, incrementing the age of all cells each year prior to the "burn season." Within a given year, the burning process is initiated by one or more random ignitions. If the age of the element receiving the ignition is greater than minage, that cell burns in its entirety and its age is set to zero, if it is less than minage, the cell does not burn. The fire spreads contagiously and probabilistically The propagation of the fire to the eight cells that touch on a burning cell (the "Moore neighborhood" [Gaylord and Nishidate 1996]) is limited stochastically by a "probability of propagation" that can vary from zero (the fire cannot spread from the cell ignited) to one (the fire will spread to all of the adjacent cells ≥minage unless they are already burning). The probability of propagation is constant for each simulation run. Wind and slope effects and spotting, the spread of fire by the dispersion of burning brands beyond the flame front, are not included in the model.

[6] ⟨http://www1.ncdc.noaa.gov/pub/data/cirs/drd964x.pdsi.txt⟩

[7] ⟨http://www.ncdc.noaa.gov/paleo/usclient2.html⟩

[8] ⟨http://www.firemodels.org/content/view/12/26/⟩

In the first series of simulations, all cells were of age 1 at the beginning to observe the development of the age mosaic from a uniform condition. In the second set of simulations, the starting landscape began with an age mosaic in which ages between 0 and *minage* years were assigned randomly and independently to each cell. The model was run to determine the length of time until coalescence was substantially achieved as indicated by 90% or more of the cells burning in a single year. Since the first simulations showed that coalescence would not occur for low values of probability of propagation only values of 0.4 and above were used. The simulation was run multiple times at each combination of propagation probability and number of strikes per cell to average out random variability. Runs were made with up to 40 000 cells, but as the outcomes for smaller areas were substantially the same, results are presented for a 900- and 2500-cell landscape. The model was programmed in MATLAB 7.5 (The MathWorks, Natick, Massachusetts, USA) and run on a Macintosh G5 computer (Apple Computer, Cupertino, California, USA).

## Results and Discussion

### *Large historical fires in the 19th century*

Here we investigate the question, are contemporary fires in southern California greatly outside the historical range of variability in terms of size and intensity because of 20th century fire suppression? We test the following prediction deduced from the fine-grain patch model: There is no credible evidence that 19th-century fires were large ($10^3$–$10^5$ ha) or high intensity (flame lengths $\gg$ 5 m).

On these landscapes, the fine-grain age patch model predicts that fire suppression is the primary factor disrupting natural fire regimes. Pre-suppression era logging, which is known to have increased fuels in some western forests is not a factor on these shrubland landscapes. Pre-suppression era grazing, which reduced the incidence of grass-driven fires and caused an increase in saplings and other ladder fuels in some southwestern pine forests (Savage and Swetnam 1990), does not apply to these shrubland landscapes as the primary impact of grazing has been to type convert shrublands to grasslands with lower fire hazard (Keeley and Fotheringham 2003).

In the 19th century, before development of roads in most mountainous areas of southern California, and lack of an organized fire fighting force, fire suppression was very limited. Rural residents did fight fires, but it was largely defensive and focused on stopping fires from destroying structures and crops on outlying ranches and farms (Kinney 1900) and "no effort was made to stop [fires] after they reached the mountains" (Mendenhall 1930). In short, fire suppression did not affect wildland fire regimes in any significant way in this region. The overview of 19th-century fires presented here depends heavily on historical accounts of large fires that are captured in the 108 newspaper reports transcribed in Appendix A.

### *1878 Tujunga Cañon Fire*

The earliest fire recorded in the CalFire FRAP historical fire database is a 24 100-ha 1878 fire in the vicinity of Tujunga Canyon in the western end of the San Gabriel Mountains of Los Angeles County. Many years later, Mendenhall (1930) described this fire and noted it was in the first half of September. The Los Angeles Daily Herald (Appendix A: transcript 6) reported for a dateline "SAN FERNANDO, Sept. 11 [1878]" that "A fire originated in the brush near the little Tujunga Cañon on the 9th instant, at about ten o'clock A. M., and was soon beyond control." The article notes that within the first four hours the fire consumed over 7000 ha and was still burning. Based on this initial rate of spread, and the fact that it was reported to be burning in the backcountry the following day (Appendix A: transcript 10) makes it likely that this was the 24 100-ha fire reported in the FRAP database. Based on the fire map, and accounts of the fire from residents (Mendenhall 1930), it is also possible that this fire joined another fire that ignited the same day to the east of Tujunga Canyon on the San Pascual Ranch, near the present-day town of Montrose (Appendix A: transcript 8). Fire complexes are not uncommon today, and thus this might appropriately be called the 1878 Tujunga Cañon fire complex.

This fire spread at such a rate that it could hardly have been of low or even moderate intensity. It certainly was not "a slow smoldering fire" of the kind postulated to be characteristic of the fine-grain age patch mosaic model. More likely it resembled another fire at the same time in that vicinity: "As soon as the brush was ignited the blaze traveled like wildfire, consuming everything in its way. In a short time it whiened [sic] out and swept along in a swathe of flame two miles broad…nobody can face the heat, it is so intense, and this morning a party who tried to control the cause of the fire found it impossible to live within sixty yards of it" (Appendix A: transcript 7). Other fires that same year also suggest high intensity, such as "The scene of the conflagration seemed not over a mile distant, while it was, in fact, nearer twenty miles. As a spectacle it was a superb success …" (Appendix A: transcript 8). Like these 1878 shrubland fires, many others during the 19th century were clearly high-intensity fires (Appendix A).

This 24 100-ha 1878 Tujunga Cañon Fire is not compatible with the picture of a historical fine-grain age patch model of small, low-intensity fires, therefore, it is not surprising that proponents of that model have questioned this event (Goforth and Minnich 2007). They presented "independent physical evidence" that purportedly showed the size of this fire was greatly exaggerated. Their evidence consisted of fire scar dendrochronology studies by Kerr (1996), which were putatively within the fire perimeter, yet showed no evidence of the 1878 fire. They failed to recognize, however, that although in close proximity, the fire perimeter and fire scar sample areas did not overlap (Fig. 2). Other evidence they presented against the existence of this fire is the suggestion that the fire perimeter map was fabricated and more urban legend than real. In support of this, they demonstrated that the 1878 fire perimeter map lacked detailed convolutions characteristic of modern fire perimeters However, in 1878, reconnaissance was done on foot and horseback, using Land Survey maps that were less detailed than later USGS topographic maps, and thus there would have been limited capacity to produce a detailed fire perimeter map. We doubt this lack of precision would be taken by many people as evidence that the fire event never occurred.

### *1889 Santiago Canyon Fire*

A contender for the largest wildfire in California history occurred in late September 1889; long before fire suppression policy in the region. It ignited in Santiago Canyon, in the northern part of the Santa Ana Mountains in Orange County, and is here referred to as the 1889 Santiago Canyon Fire (Fig. 3). Conditions leading up to this event include a somewhat more severe than usual annual drought, with less than 1 cm of precipitation being recorded south of there in San Diego for the previous five and one-half months (USDA Weather Bureau 1934). Ten days before the big fire event, there was "a Norther" (Appendix A: transcript 65) or foehn-type Santa Ana wind (Appendix B), further drying shrubland fuels. Following this, temperatures remained high and contributed to several significant fires in San Diego and San Bernardino counties (Appendix A: transcripts 19, 20, and 21).

Following closely on this period of severe fire weather, the Santiago Canyon Fire began the morning of 24 September 1889, coincident with a new Santa Ana or "Norther" wind event, which blew with considerable intensity throughout the region, including San Bernardino, Riverside, San Diego, and Orange counties. This particular Santa Ana wind event lasted three full days after the fire began with temperatures increasing to a peak of 32°C on 26 September and was described as being of unusual severity; "blowing a hurricane" and "the blinding dust and heat next to intolerable" (Appendix A: transcripts 24–29, 31, 32, 34, 37, 40–42, and 65).

Interpreting the historical reports on the behavior of this 1889 fire requires some understanding of Santa Ana winds. In the Santa Ana Mountains, these dry foehn winds commonly exceed 100 km/h and the primary orientation of these offshore winds changes from a northeast wind in the northern part of the range to an east wind farther south (Appendix B: Fig. B2). In addition, on the leeward (coastal) side of mountains, the differential heating and cooling of valleys vs. slopes, and land vs. ocean, produce thermal forces that can disrupt the foehn flow (Edinger et al. 1964:12, Rosenthal 1972:5.19–5.23). As a result, during midday, there is often a reverse flow (Appendix B: Fig. B3) that can

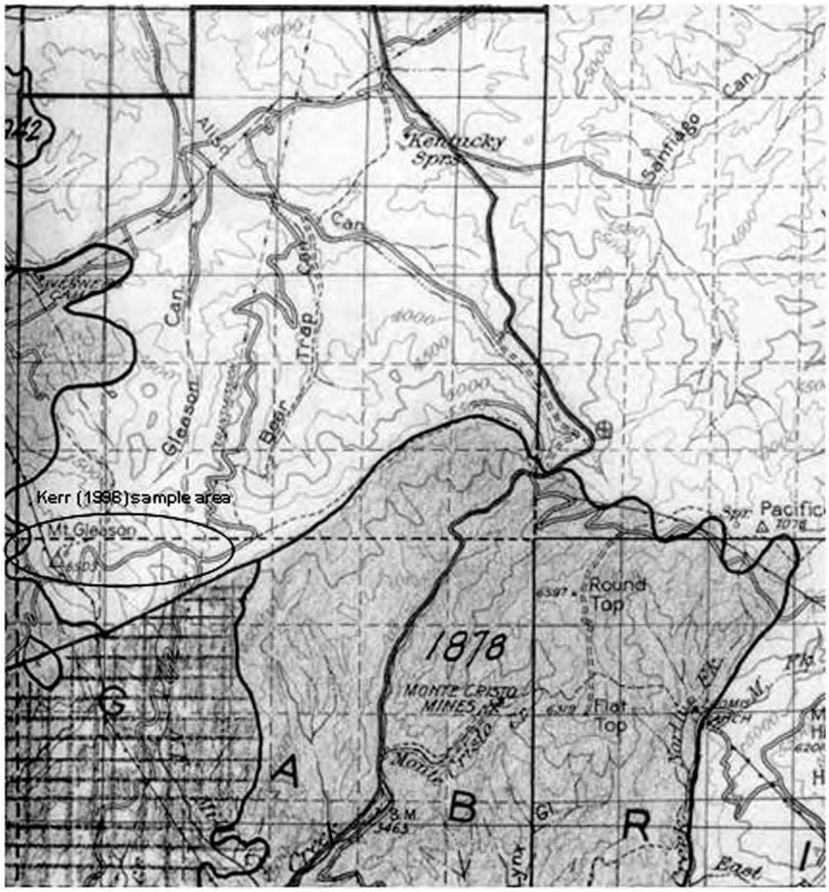


FIG. 2. Close up of the northern fire perimeter of the 1878 Tujunga Cañon Fire (shaded area) and location of fire-scar dendrochronology study area sampled by Kerr (1996) that is outside the fire perimeter. The fact that Kerr (1996) did not detect the 1878 fire would be expected and should not have been used by Goforth and Minnich (2007) as evidence that the fire perimeter map was in error.

spread fire in erratic and unpredictable directions. These alternating winds have profound impact on large-fire behavior. As described by Orange County Fire Authority Battalion Chief Mike Rohde (*personal communication*), "It's not uncommon for onshore winds to either develop at low elevations or at least to 'stall' a Santa Ana during peak daytime convective heating. The Santa Anas will often regain strength at night as the foehn wind doesn't have to 'fight for dominance' with the solar-driven diurnal wind. Santa Anas often peak shortly before or just after dawn because of this condition. With this kind of behavior, the fire receives the best of all possible burning conditions by either (1) developing high-intensity fire runs in canyons with accompanying strong thermal smoke columns (caused by slope and fuel driven fire), and then the deposition of fire brands and long range spotting as the Santa Ana winds aloft shear off the smoke column, causing heavy spotting downwind [see similar behavior described by Albini 1983], or (2) by stretching out the fire's perimeter when up-canyon runs are followed by the resurfacing of Santa Ana winds."

The 1889 Santiago Canyon Fire was accidentally ignited in the northwestern foothills of the Santa Ana Mountains (Fig. 3), east of El Modena in Santiago Canyon (apparently on Noland's ranch; Appendix A: transcript 40, but cf. transcript 47) "and as the wind was blowing a perfect gale from off the desert the mountains were soon red with the angry flames" (Appendix A: transcript 22). Reports show the fire burned very rapidly ("in less than five minutes from the time the fire broke loose, the whole side of the mountain was ablaze") (Appendix A: transcript 40), and within the first six hours extended 25 km northeast to southwest (Appendix A: transcript 26). Although the prevailing northeasterly offshore flow of air dominated the fire behavior, there were erratic winds in the foothills and mountains that also carried the fire north and eastward (Appendix A: transcript 22; see also Appendix B for further insights into erratic wind behavior during Santa Ana wind events). By the first evening of the fire, it was reported that "about 25 miles [40 km] of the mountains east of Santa Ana are on fire, and doing great damage east and south of El Toro" (Appendix A: transcript 28). It would

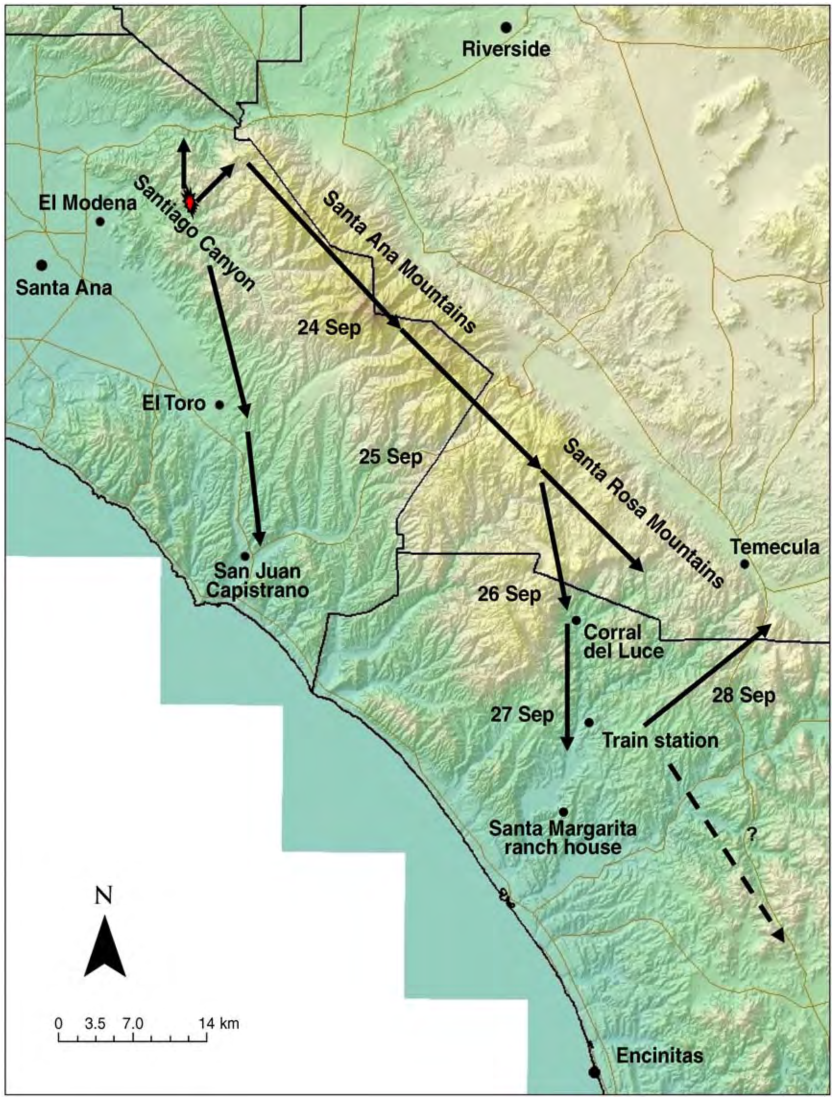


FIG. 3. The daily fire activity for the 1889 Santiago Canyon Fire based on newspaper accounts (see Appendix A for details). Fire runs are indicated with arrows, and associated dates are based on newspaper accounts cited here. These reports show that the fire ignited in Santiago Canyon (indicated by flames) and during the first day (Tuesday, 24 September 1889) burned south of El Toro in the coastal foothills, and in the mountains a distance of ~40 km (similar runs have been observed in recent Santa Ana wind-driven fires; see Appendix C). On Wednesday, the fire continued burning southward both in the mountains and along the coastal plain, at one point threatening the city of San Juan Capistrano. By the third day, the fire had burned about 50 km north–south in the mountains and to the present-day community of De Luz. Strong east winds then drove the fire toward the Santa Margarita ranch house. When the offshore flow abated, the onshore flow carried the fire eastward toward Temecula. At this point, the fire was likely driven by the steep topography, daytime down-canyon flowing winds that push fires eastward, as is the case with modern fires in this region (Schroeder 1959). Newspapers reported burning east of Encinitas (Appendix A: transcript 62), but it is unclear if this was part of the Santiago Canyon Fire. Other locations mentioned in the text include the Santa Ana River, which runs east to west along the northern end of the Santa Ana Mountains, and the city of Anaheim, northwest of El Modena.

appear that the winds were spreading the fire with embers far beyond the fire front based on the description that the first "night large fires were seen in many places on the hills, and the glow arising from the canyons showed that great fires were raging in them. The flames in many places spread with alarming rapidity" (Appendix A: transcript 26).

"The views from the housetops was a grand one. Never before have the people here witnessed such a natural pyrotechnic display. Looking eastward the entire heavens is one bright-red glare. Citizens in the entire valley are thoroughly aroused, and all are doing all they can to protect their property" (Appendix A: transcript 22). The immensity of this fire is illustrated by the report that not only citizens facing the fire on the western side of the range were impressed by the nighttime pyrotechnics, but the fire was also visible 50 km away on the eastern side of the range (with peaks 1200–1600 m):

TABLE 1. Details of megafires of ~50,000 ha or larger in southern California, USA.

| Year | Fire name | County† | Month ignited | Duration of Santa Ana winds (d) | Area burned (ha) | Number of structures lost | No. deaths |
|---|---|---|---|---|---|---|---|
| 1889 | Santiago Cyn | Orange | Sep | 3 | 125 000 (200 000?) | 0 | 0 |
| 1932 | Matilija | Santa Barbara | Sep | >5 | 89 100 | 0 | 0 |
| 1970 | Laguna | San Diego | Sep | 2.5 | 70 500 | 382 | 8 |
| 1985 | Wheeler #2 | Ventura | Jul | 0§ | 49 700 | 26 | 0 |
| 2003 | Cedar | San Diego | Oct | 2 | 109 500 | 2400 | 15 |
| 2006 | Day | Ventura | Sep | 1 | 65 500 | 11 | 0 |
| 2007 | Zaca | Santa Barbara | Jul | 0§ | 97 300 | 1 | 0 |
| 2007 | Witch | San Diego | Oct | 3 | 80 200 | 1736 | 2 |

*Notes:* Fire size is from California Department of Forestry and Fire Protection, Fire and Resource Assessment Program (FRAP) database, except 1889 Santiago Canyon Fire, which is based on the analysis in the present paper and 2007 Witch Fire from CalFire website. Associated duration of drought prior to fire was measured by the Palmer drought severity index (PDSI scale is –6 to 6, with negative values being drier than average). All fires were human ignited (either direct incendiary fires or indirectly due to power lines). Fires where Santa Ana winds were a factor some time during the fire are indicated; however, all fires were associated with weather that included high than normal temperatures, very low humidity, and erratic winds.

† County where the bulk of the fire burned.

‡ Monthly records unavailable; based on paleo reconstructions for summer drought; PDSI for 1887 = –0.65, 1888 = 0.39, 1889 = –0.47.

§ Although outside the Santa Ana wind season, severe fire weather including extreme temperatures, low humidity, and erratic winds were factors.

¶ For the six months prior, all months were below –5.00 PDSI.

"Forest fires in the mountains east of Santa Ana raged all day and last night the light reflected upon the sky from the fire in that direction was plainly seen in this [Riverside] city" (Appendix A: transcript 25).

In addition to burning in the mountains (Appendix A: transcripts 22, 24, 34, and 39) the fire burned westward into the coastal plain as passengers on the San Diego train [along a coastal route through San Juan Capistrano] reported "the fire was raging on both sides of the track, and they thought they would be smothered before they got through the burning district" (Appendix A: transcript 27).

The following day (25 September) it was reported that "this morning a stiff breeze is blowing and the smoke is increasing, showing that the fires are spreading" (Appendix A: transcript 26). At this time, winds were still going strong (Appendix A: transcript 40) and were driving the fire in a southwestward direction as it was reported that "The devastating fire still continues in portions of the canyons ... At San Juan Capistrano last night great danger was experienced in keeping fire from the heart of the city" (Appendix A: transcript 55, see also transcript 48).

The fire was still burning on the third day as reported from Santa Ana, "The fires in the mountains east of the city are not yet extinguished as was evidenced by the scene this morning at 3 o'clock. The whole eastern horizon was brightly illuminated and presented a majestic and sublime sight" (Appendix A: transcript 39). This was verified by the report, "fire which has been burning for the past two days still continues in the cañons" (Appendix A: transcript 51). Although the fire burned the coastal plain as far south as San Juan Capistrano, it is not clear from newspaper accounts whether or not this fire front continued burning southward. However, the fire was very active in the mountains of eastern Orange and western Riverside counties. For two days, it burned along an estimated 50 km of the Santa Ana and Santa Rosa Mountains, now the Santa Rosa Plateau (Appendix A: transcript 62). Around 26 September, the fire burned into San Diego County and at that point was described as having swept "an immense territory" (Appendix A: transcript 60). When it reached "Coral del Luce," a stable owned by an Englishman named Luce (Rivers 1999) at the site of the present-day community of De Luz (Fig. 3), the southward momentum switched and it was driven hard by a strong "east wind [(consistent with documented wind patterns, see lower portion of Appendix B: Fig. B2), which] then brought on fire in the direction of the [Santa Margarita] ranch" (Appendix A: transcript 60). Before reaching the ranch house near the coast, the offshore winds abated and the fire was picked up by onshore breezes (see Appendices B and C) that pushed the fire eastward, and days later "the fire [was] still raging in the mountains" (Appendix A: transcript 60). During this time it burned as far east as Temecula in Riverside County and may have been responsible for the burning as far south as Encinitas in San Diego County (Appendix A: transcript 62).

Based on the area circumscribed by the reports of 1889 (Fig. 3), we believe that a conservative estimate for this fire would be ~125 000 ha, and if the reported burning as far south as Encinitas were part of this same fire, it would have been more like ~200 000 ha. The aftermath of this and other fires in the region that same week is portrayed in a newspaper report the following week: "The fires in the valleys and foothills lately have almost hidden the lofty peak of San Bernardino [Mt. San Gorgonio] from sight. He appears dimly, if at all,

TABLE 1. Extended.

| Antecedent drought | |
|---|---|
| Number of months with negative PDSI | Mean PDSI for months antecedent to fire |
| ‡ | −0.25 |
| 23 | −2.22 |
| 14 | −1.81 |
| 7 | −1.23 |
| 54 out of prior 61 | −2.36 |
| 12 | −2.11 |
| 20 | −2.99 |
| 17 | −3.62¶ |

and as if floating in cloudland" (Appendix A: transcript 63). "It is a year of disasters, wide-spread destruction of life and property—and, well, a year of horrors" (Appendix A: transcript 53).

Of course, the exact dimensions of the 1889 Santiago Canyon Fire are not ever likely to be known for sure, however, the magnitude of our estimate is vetted by a first hand account that places it on the same scale as the largest 20th-century fires in California. USFS Assistant Regional Forester for California, L. A. Barrett (1935) reported in a compilation of newspaper accounts of California fires, "I was living in Orange County at the time and well remember the great fire reported herein from September 24 to 26 [1889]. Nothing like it occurred in California since the National Forests have been administered. In fact in my 33 years in the Service I have never seen a forest or brush fire to equal it. This one covered an enormous scope of country and burned very rapidly." Mr. Barrett's USFS career in California included the 1932 Matilija Fire that was over 89 000 ha, which provides a lower baseline for the 1889 Santiago Canyon Fire.

The 1889 Santiago Canyon Fire stands as a clear example of a massive high-intensity crown fire in the absence of a prior history of fire suppression. Its size was of the same magnitude as the largest fires recorded in southern California since annual record keeping began in the early 1900s (Table 1). Even if this fire was only half as large as our most conservative estimate (125 000 ha), it would still rank as one of the largest fires in California's history. This fire event was remarkably similar to modern fire events such as occurred in 2003 and 2007 in that significant fires were occurring in several counties at the same time. In 1889, in addition to the Santiago Canyon Fire, there were big fires in San Bernardino (Appendix A: transcripts 21, 25, and 43) and southern San Diego counties (Appendix A: transcripts 29, 30, 33, 36, 44, 50, 57, and 59), all driven by the same Santa Ana wind event. What is strikingly different from 21st-century fire events is that despite the magnitude of the 1889 fires, few structures and lives were lost. Thus, on this southern California landscape the primary change that has made fires destructive is not a change in the size and intensity of wildfires, but a change in the size and distribution of the human population (Keeley et al. 1999).

*An alternative interpretation of the 1889 Santiago Canyon Fire*

Goforth and Minnich (2007), as advocates of the fine-grain age patch hypothesis, do not believe that the historical accounts of the 1889 Santiago fire are accurate. In search of "objective" evidence of fire size, they investigated insurance claims made after the fire and mentions of damage to specific properties in the newspapers. They did not consider that there could be a substantial spatial bias in these accounts if the fire burned beyond the more densely settled lower foothills and coastal plain and into the mountain slopes where inhabitants were sparse, and insurance probably not the norm. That the fire did extend into these areas is attested by numerous accounts in the newspapers that report the fires burning in the "mountains" (Appendix A: transcripts 22, 24, 25, 28, 34, 39, 52, 55, and 60). Today there are 3 million people living in Orange County, primarily in the coastal plain, and the rugged chaparral covered Santa Ana mountain range is mostly national forest land and largely unoccupied; thus, it seems certain that in 1889, with a population of only 13 000 in the entire county, that other than a few miners and grizzly bear hunters (Sleeper 1976), these mountains were unsettled. One would not expect insurance claims from the vast majority of area burned by the 1889 Santiago Canyon Fire.

Goforth and Minnich (2007) estimate by their methods (elaborated in Appendix D) that the full extent of the fire was only about 15 km (see their Fig. 2a). This is grossly inconsistent with newspaper accounts that reported the fire having spread 25 km during the first six hours and 40 km by that evening. After two more days of intense Santa Ana winds, it would have spread considerably farther, and numerous newspaper accounts discussed here corroborate that conclusion.

One reason Goforth and Minnich (2007) failed to appreciate the extent of the Santiago Canyon Fire is their assumption that the fire reported on the Santa Margarita Ranch in northern San Diego County (Appendix A: transcript 60) was a smaller (Appendix D), separate, and isolated event. This, in part, is due to an error in interpreting historical names. Three days after the Santiago Canyon Fire began, *The Daily San Diegan* on 29 September 1889, in an article titled "An Immense Territory Swept by the Flames," stated that "...The fire originated at the Coral del Luce and extended to the Santa Rosa Mountains, and the east wind then brought on fire in the direction of the ranch, and it is estimated that fully 65,000 acres were burned before the fire was extinguished ... ." Goforth and Minnich (2007) make the unsubstantiated claim that the newspaper was in error and that the site they were really referring to was "Corral de la Luz," a train station in the coastal plain near the Santa Margarita Ranch house. Such an assertion might be credible if in fact there was no such place as "Coral del Luce" but there was a stable run by an Englishman named Luce (Corral del Luce) located between the eastern end of the Santa Margarita Ranch and Rancho Santa Rosa (Elliott 1883, Rivers 1999) in the mountains near the present-day community of De Luz (Fig. 3 and Appendix D). According to the newspaper account, the fire that threatened the ranch was an extension of burning in the "Santa Rosa Mountains" (present-day Santa Rosa Plateau), and Luce's corral was only about 5 km southwest of these mountains. Other newspaper accounts report that burning in these mountains extended for 50 km (Appendix A: transcript 62), which would have overlapped considerably with the Santiago Canyon Fire (Appendix A: transcript 28). In light of this, and the fact that there were three days of intense Santa Ana winds blowing fire in a southwesterly direction, and the newspaper story about the Santa Maragarita Ranch fire referred to an "immense territory" having been burned, there is good reason to interpret this as part of the Santiago Canyon Fire (Fig. 3).

Goforth and Minnich (2007) claim that newspaper reports of the 1889 fire are exaggerations, if not outright fabrications, and represent a classical case of "yellow journalism" designed solely to create readership. Yellow journalism is a pejorative term that was coined about a decade after the 1889 fire and connoted unethical or unprofessional journalism, particularly the use of highly sensational headlines. Goforth and Minnich (2007) quote 1889 headlines such as "Fearful Flames," "Small Towns in Peril," or "Great Fires Raging Around Santa Ana" as examples. Such headlines, however, are quite comparable to contemporary headlines; e.g., "Wildfires Rage" (San Diego Union-Tribune, 22 October 2007), "300,000 Flee Fires, Blazes March Toward Coast" (San Diego Union-Tribune, 23 October 2007), or "Amid Fear and Uncertainty, a 'Staggering' Evacuation" (USA Today, 24 October 2007). In fact, the 1889 headlines are not only similar but the articles (Appendix A) read very much like contemporary articles describing catastrophic fire events. One major difference is that contemporary headlines inevitably occur on the front page because they are a major concern to population centers that have expanded into the wildlands. Nearly all of the 19th-century reports occurred on subsequent pages, perhaps because mountain fires were of less immediate concern.

In what seems to be a desperate attempt to diminish the magnitude of the 1889 Santiago Canyon Fire, Goforth and Minnich (2007) fall back on "an old proverb [that] states that smoke travels farther than flames." They use this to dispute a first hand account of the fire appearing to extend from "the mouth of the Santiago Canyon southward toward San Juan Capistrano" (Appendix A: transcript 48). Their contention is that because the sky was smoky, the observer on the hotel roof in Anaheim would not have been able to see flames as far away as San Juan Capistrano, and therefore was reporting on smoke that had drifted that far south. However, they ignore the fact that during Santa Ana wind conditions smoke from wildfires is normally blown offshore and does not "drift" southward (Fig. 1). In addition, reliance on proverbs ignores a more trusted approach to vetting newspaper stories, namely corroboration from another source; in this case there is a separate newspaper report to the effect that "At San Juan Capistrano last night great danger was experienced in keeping a fire from the heart of the city" (Appendix A: transcript 55).

Finally, Goforth and Minnich (2007) dispense with the report of Regional Forester L. A. Barrett on the fire size by noting that it lacks credibility since he was only 15 years old at the time of the fire. Even if Barrett's statement were the only data on fire size, we don't see that his age is an important determinant of its validity. Regardless, it matches well with independent contemporary accounts from newspapers, and since it was given by a professional forester who had a long history of responsible leadership positions in the USFS, it would seem unlikely that it was a baseless exaggeration. See Appendix D for further discussion of their criticisms.

### *Summary of 19th-century shrubland fires*

Large high-intensity chaparral fires were regular occurrences throughout southern California in the 19th century, with such events occurring somewhere in the region in over 50% of the years during the last quarter of the century (Appendix A). These were fast moving and of considerable fire intensity, and based on the huge plume evident in 19th-century photographs (e.g., Fig. 4), it would appear they were substantial enough to create their own weather. Marine charcoal deposition records suggest such massive high-intensity wildfires have long been a part of this landscape (Byrne et al. 1977, Mensing et al. 1999).

Small fires would have occurred then, as now, but there is no evidence that their spatial distribution produced a landscape immune to large high-intensity fires. The primary evidence for a strictly fine-grain fire regime in southern California are the contemporary patterns of burning in Baja California, where it has been repeatedly assumed that the only difference between Baja and southern California is a difference in fire suppression policy (Minnich 1983, 1995, Minnich and Chou 1997). This conclusion has been challenged as there are numerous physical, biological, and sociological differences between these regions that have not been given sufficient consideration (Strauss et al. 1989, Keeley 1995, 2006, Moritz 1997, 2003, Zedler and Oberbauer 1998, Keeley and Fotheringham 2001*a*, *b*, Halsey 2004). Most relevant is the much greater rural population immediately south of the border with huge impacts on fire ignitions and vegetation fragmentation (Dodge 1975). Farther south, the fire regime changes due to the apparent lack of Santa Ana winds south of

Ensenada (contrast lack of smoke plume for the fire at Santa Tomas vs. the Santa Ana driven fire near San Antonio de las Minas north of Ensenada in the remote image in Fig. 1).

Prior to the modern era of intensive rural land use in Baja California, there is evidence that Baja California burned in large high-intensity wildfires similar to those in southern California. This is supported by the log book of English explorer George Vancouver (Vancouver 1798) who described a large Santa Ana wind-driven fire in 1793 in the vicinity of Bahia Todos Santos near present-day Ensenada in northern Baja California "[10 December 1793] ... During the forenoon immense columns of smoke were seen to arise from the shore in different parts, but principally from the south-east or upper part of the bay, which towards noon obscured its shores in that direction. These clouds of smoke, containing ashes and dust, soon enveloped the whole coast to that degree, that the only visible part was the fourth point of the above-mentioned bay, ..." [and on 11 December 1793] "The easterly wind still prevailing, brought with it from the shore vast volumes of this noxious matter. Two opinions had arisen as to the cause of the very disagreeable clouds of smoke, ashes, and dust, in which we had been involved the preceding day. Volcanic eruptions was naturally the first conjecture; but after some time, the opinion changed to the fire being superficial in different parts of the country; and which by the prevalence and strength of the north-east and easterly wind, spread to a very great extent. The latter opinion this morning evidently appeared to be correct. Large columns of smoke were still seen rising from the vallies behind the hills, and extending northward along the coast ... To the south of us the shores exhibited manifest proofs of its fatal effects, for burnt tufts of grass, weeds, and shrubs, being the only vegetable productions, were distinguished over the whole face of the country, as far as with the assistance of our glasses we were enable to discern; and in many places, at a great distance, the rising columns of smoke showed that the fire was not yet extinguished." Clearly, this was a very large fire by an objective observer who had little incentive to sensationalize his account. Such fire events may not have been unusual on the Baja landscape even into the 20th century because the 16–18 year span in aerial photographs used by Minnich (1995) to document the apparent lack of such fires in Baja could have easily missed large fire events (Keeley and Fotheringham 2001*a*, *b*). Also, satellite images from the 2003 firestorm indicate a large wildfire north of Ensenada, Mexico (SALM in Fig. 1), and a report from the 2007 firestorm documents a fire over 15 000 ha south of the border (Hernandez 2008).

### *The 19th-century vegetation patterns*

The fine-grain age patch model predicts that the landscape prior to 20th-century fire suppression comprised a complex mosaic of young and old patches of shrublands sufficient to provide barriers to fire spread. Definitive tests of this prediction are difficult because, despite a plethora of early California histories, the vast majority of historians have been concerned with the personalities that colonized this landscape and very few with the landscapes themselves. The primary evidence comes from 19th-century forest reserve surveys conducted by USGS biologist J. B. Leiberg.

FIG. 4. Fire plume from a 19th-century fire in the San Gabriel Mountains, Los Angeles County (from Kinney [1900:45] with the legend "Forest Fire in Sierra Madre Mountains, July 22, 1900. Taken Twenty-five miles from fire") (see Appendix A: transcripts 94–108). Photographs of other high-intensity southern California shrubland fires are on pages 43 and 49 in Kinney (1900).

Based on Leiberg's reports (1899*a*, *b*, *c*, 1900*a*, *b*, *c*) it has been estimated that 90% of the 214 000 ha of shrublands on the San Jacinto Forest Reserve in Riverside County were older than 30 years of age at the end of the 19th century and other reserves in southern California were in a similar state (Keeley and Fotheringham 2001*a*). Since there is general agreement that 30-year-old shrublands are highly flammable, it is hard to conceive of an age distribution pattern in which fuel age would have been a factor in preventing large wildfires.

To support their contention that the pre-suppression landscape had an age mosaic capable of stopping large fires, Minnich and his coauthors often cite Leiberg's (1899*a*, *b*, *c*, 1900*a*, *b*, *c*) forest reserve reports, pulling out quotes they claim support the notion of a fine-grain age patch mosaic due to small fires. For example, the

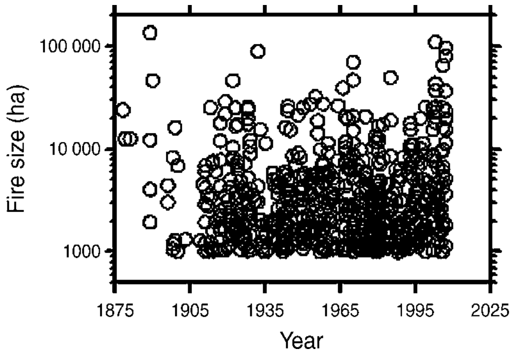


FIG. 5. Fire size during the latter part of the 19th and throughout the 20th century (based on the California Department of Forestry and Fire Protection, Fire and Resource Assessment Program [FRAP] database, plus U.S. Forest Service (USFS) data on 2007 large fires, and additional 19th-century fires not in the FRAP database but with clear estimates of size in newspaper reports in Appendix A). Regression analysis for year vs. fire size: $r^2 = 0.000$, $P = 0.67$, $n = 671$ fires for all fires 1000 ha or larger; $r^2 = 0.001$, $P = 0.73$, $n = 87$ fires for fires 10 000 ha or larger. This region does not fit the generalizations made by Westerling et al. (2007) of a temporal increase in the number of large fires for the western United States, although their conclusions were based on a much broader region and over a much shorter period of study.

Leiberg quote that "[Chaparral] ... is a growth which varies from extremely dense to thin or open, but rarely forms very large, uninterrupted patches. The dense portions are commonly separated by narrow lanes ['recent burns' inserted here by Goforth and Minnich (2007)], which are either wholly free from brush, or bear a scattered growth so thin as to offer no serious obstacles to travel." Goforth and Minnich's interpretation inserted in this sentence seems incorrect to us since fires do not burn in "narrow lanes" and the level of detail presented in Leiberg's documents suggests to us that he would have indicated these "narrow lanes" were past fires if in fact that were the case. More likely Leiberg was describing interruptions in the chaparral due to surface or subsurface rock outcrops, ridgelines or wildlife trails from deer or grizzly bears that made their homes in chaparral. More to the point though, Leiberg himself contradicts Goforth and Minnich's interpretation that these narrow lanes in the chaparral fit the fine-grain age patch mosaic model in his own conclusion that "The natural lanes existing throughout the chaparral are too narrow to serve as efficient fire breaks" (Leiberg 1900*c*:477). Other quotations from the literature (e.g., Kinney 1887, Mendenhall 1930) used by Minnich and co-authors follow a similar selective use of information and often do not provide a complete picture.

We find no support for the idea that the pre-fire-suppression landscape was a mosaic of young and old chaparral capable of preventing the spread of large fires.

### *20th-century fires*

Proponents of the fine-grain age patch mosaic model contend that fire suppression impacts were almost immediate and this accounts for well documented large fires throughout the 20th century (Minnich 1989, Goforth and Minnich 2007).

Organized fire suppression in southern California began in the early 1900s. In the first few decades, fire fighting was an extension of 19th-century practices in that it was largely defensive and focused on stopping fires from moving into rural areas. Minimal effort was made to suppress natural ignitions in remote regions. Where resorts had been constructed, such as in the canyons on the southeast side of the San Gabriel Mountains bordering the growing Los Angeles Basin, organized fire suppression began in the late 19th century, although it was not generally very effective (e.g., Appendix A: transcripts 95–108). Throughout the southern California region, a policy for suppression of all fires on USFS lands evolved slowly in the early part of the 20th century and was limited due to the inaccessibility of rugged and roadless areas, coupled with limited fire-fighting resources and transportation (Mendenhall 1930, Brown 1945, Show 1945). Sterling (1904) described the fire-fighting situation in the San Gabriel mountains of Los Angeles County, "the country itself, which is so rough as to be almost inaccessible in parts, and so wild and isolated that the maintenance of a thorough patrol is difficult," and this applied to other ranges in the region. On the lower-elevation lands protected by the state, fire suppression was limited and disorganized until the 1920s or later (Clar 1959). At both the state and federal level, fire suppression became much more aggressive following WWII with improved vehicles and road access and the increasing use of airplanes and helicopters (Pyne 1982, Cermak 2005, Godfrey 2005). However, despite all this, statistics show a shortening of the fire rotation interval in the second half of the 20th century due to limitations in fire fighting capacity to keep up with increased human ignitions (Keeley et al. 1999).

Since USFS record keeping began around 1910, there have been large fire events once or twice a decade somewhere in the region (Fig. 5). We interpret these as a natural continuation of the historical pattern of fire on these landscapes that likely has been present throughout the Holocene. However, proponents of the fine-grain age patch model have argued that even the very earliest 20th-century fires were the result of fire suppression activities disrupting natural fuel mosaics. For example, Goforth and Minnich (2007; also Minnich 1987) claim that one of the first big 20th-century fires, the 1919 Ravenna Fire (Fig. 6), which burned 30 350 ha of rugged chaparral landscape on the Tujunga District of the Angeles Forest (Mendenhall 1930), was an unnatural event resulting from fire suppression. Since Goforth and Minnich (2007) provided no evidence to support their claim that fire suppression was immediately effective in disrupting natural fuel patterns, it is at best a hypothesis. Here we test their hypothesis and predict that if true, then one would expect that prior to 1919 a large enough

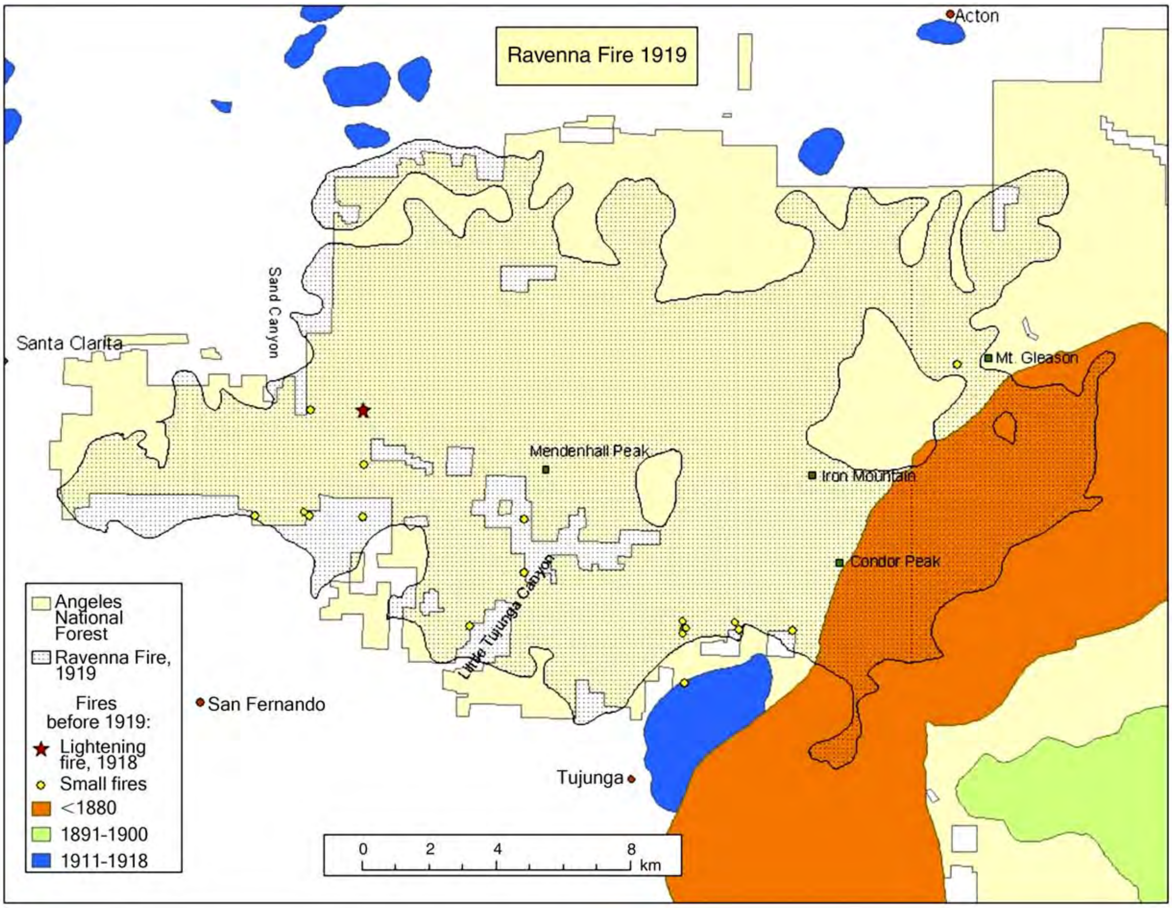


FIG. 6. The 1919 Ravenna Fire (name according to the CalFire FRAP database; named the Tujunga Fire in Show [1945] and the N. Fork Pacoima Canyon Fire by the Los Angeles County Fire Department). Since record keeping began in 1911, the only record of lightning fires suppressed within the 1919 fire perimeter is one 2-ha fire with point of origin indicated by a star. Points of origin for anthropogenic fires are indicated with solid circles, most of which were less than 0.1 ha; the largest was 150 ha (individual fire records from USFS Angeles National Forest). The only prior fire substantive enough to be included in the FRAP database was the 1878 Tujunga Cañon Fire, orange area on lower right.

number of lightning-ignited fires would have been suppressed within the perimeter of this fire to eliminate the "natural" fuel mosaic. One could postulate various models for the number of suppressed fires required to disrupt the putative fuel mosaic, but in all cases it surely would be a number far greater than the single lightning-ignited fire the records show was suppressed during the period of record keeping from 1911 to 1919 (Fig. 6). Clearly, disruption of the natural lightning-fire regime cannot explain the large high-intensity Ravenna Fire of 1919. Nor can elimination of Native American burning within the fire perimeter area as there were no permanent Indian settlements in this rugged landscape (McCawley 1996). Between 1911 and 1919, a small number of human-ignited fires were suppressed along the southern boundary of the subsequent Ravenna Fire perimeter (Fig. 6), but more than three-fourths of the interior and northern portion of that fire had no fire suppression activity prior to 1919. At the same time as this fire, there was another fire of similar magnitude burning on the same forest. Fire fighters at this time were under no illusion that these were the fault of past fire-suppression activities altering fuel patterns. Rather, as Cermak (2005:98) points out, in 1919 "Weary firefighters realized that despite all of the lessons learned over the previous nine fire seasons, they could not stop a wind-driven fire in southern California chaparral. . . . These fires established in the minds of the firefighters from District 5 and Washington the view that southern California national forests had a special fire problem that required special fire control measures.

Other large fire events that occurred early in the 20th century are also not explained by fire-suppression impacts. As early as 1913, the Barona Fire burned 26 500 ha of dense shrublands on the Cleveland National Forest. No lightning fires were reported suppressed during the first few years of fire reporting within the perimeter of that fire so there is no rationale for attributing this fire to suppression activities. On the Los Padres National Forest (then known as the Santa

FIG. 7. Seral-stage chaparral in spring 2007, five years after the Bouquet Canyon Fire, dominated by resprouting *Adenostoma fasciculatum* and ephemeral subshrubs from dormant seedbanks (primarily *Lotus scoparius*) in northern Los Angeles County (Photo credit: J. Keeley). During the 2007 Buckweed Fire, 2700 ha of this Bouquet Canyon Fire were re-burned.

Barbara National Forest) there were several large fires in the early 1920s, but the 1932 Matilija Fire, at nearly 90 000 ha (Table 1), stands out as one of the largest in California's history (Appendix E). The enormity of this fire can in no way be attributed to antecedent fire suppression actions disrupting natural fire regimes. In the prior 22 years of forest service protection, only two lightning-ignited fires were suppressed within the 89 100 ha area of the 1932 Matilija Fire, and loss of Native American burning was not likely a factor due to the extreme ruggedness of the area (Appendix E).

To summarize, on these shrubland dominated landscapes large fires over 10 000 ha are not unique to the 20th century and, as shown in Fig. 5, there is no evidence they are increasing. Such fires have occurred at least once a decade somewhere in the region since the late 19th century, and probably throughout most of the Holocene. As with other crown fire ecosystems (Johnson et al. 2001), it is apparent that large high-intensity wildfires are a predictable feature of chaparral dominated landscapes and are not the fault of past fire suppression policy.

### *The role of fuel age in shrubland fires*

Another prediction of the fine-grain age patch mosaic model is that chaparral shrublands do not accumulate a sufficient quantity of the more easily ignited dead fuels to propagate fire until it reaches at least 20–30 years of age (Minnich 1987, 1995, Minnich and Chou 1997, Goforth and Minnich 2007). These authors have never directly tested this proposition, rather they have relied on indirect evidence in the form of burning patterns north and south of the U.S./Mexican border, and assumptions about the role of fire suppression. One empirical study that could be cited in support of their model is Green's (1981) investigation of "controlled burns." He found that under normal fire prescriptions of little to no wind and moderately high humidity, some shrub fuel types were difficult to burn if less than 20 years of age. Green's findings were supported by Philpot (1977) who applied the Rothermel Fire Model to chaparral fuels and showed an apparent age effect when wind was not a factor. However, Philpot also found that under high winds the fine-grain model was not supported because fires readily carried in 10-year-old chaparral stands.

The notion that young chaparral acts as a barrier to fire spread, particularly under windy conditions, has been disputed from empirical studies of fire behavior (Dunn 1989, Keeley 2002*a*, Moritz 2003, Keeley et al. 2004). The primary reason early seral stages of chaparral readily carry fire is because they are dominated by an ephemeral flora that dries each summer, producing a highly combustible fine fuel load. During these years stands commonly have a substantial cover of subshrubs and slightly woody suffrutescents such as *Lotus scoparius*, *Helianthemum scoparium*, and *Calystegia macrostegia*, forming dense contiguous surface fuels (Fig. 7). A study of three-year-old chaparral stands in San Diego County showed that the fuel loads were substantial in these early seral stages; >15 Mg/ha, mostly divided between dead fine fuels (≤1 cm diameter) and coarser fuels (>1 cm) in unburned skeletons, plus a smaller quantity of live foliage, mostly resprouts (R. H. Halsey and J. E. Keeley, *unpublished data*). We have modeled the fire behavior for these early seral stage fuel loads and found that for fuel moisture conditions typical of late summer and fall, young chaparral is capable of rapid fire spread, even under low to moderate wind conditions (Fig. 8).

This model prediction is borne out by empirical analysis of fuel ages consumed in southern California wildfires. The 2003 Cedar and Otay fires burned through a mosaic of young and old age classes (Keeley et al. 2004). In addition, in the 2007 fires that consumed 279 700 ha, more than 30 000 ha was from reburning of four-year-old fuels from the 2003 fires (H. Safford, *unpublished data*). Although sometimes young age classes may present a barrier to fire spread, this is seldom the case under weather conditions typical of late summer and fall (Keeley 2002*a*).

One of the complications of the fine-grain age patch model is that, according to its advocates, it only applies to evergreen chaparral and not to sage scrub (Minnich 1995, Goforth and Minnich 2007). This conclusion derives from a study in Baja California that suggested differences in burn-patch size between sage scrub and chaparral (Minnich 1983). This was attributed to differences in fuel structure between these two vegetation types, and is the basis for their belief in fundamental differences between chaparral and sage scrub in susceptibility to reburning at young ages. However, they did not consider alternative explanations for their Baja patterns, such as distributional differences in sage scrub and chaparral relative to human ignitions (Wells et al. 2004). Minnich (1995) claims that the seral stage fuel structure in chaparral prevents it from burning when young, but not so in young sage scrub (apparently he believes the fine-grain age patch model only applies to chaparral). We tested the claim about age-related differences in burning of chaparral and sage scrub by examining the distribution of age classes burned in the 10 largest fires in the Santa Monica Mountains of Los Angeles and Ventura counties (Fig. 9). The analysis conducted by NPS resource specialist R. Taylor (*unpublished data*) demonstrated clearly that young chaparral readily burns (e.g., Fig. 9a, d, e, f, h) and that there is no consistent difference between chaparral and sage scrub. Thus, not only does the fuel structure in young shrublands not act as a barrier to fire spread, but there is no difference between chaparral and sage scrub.

This accords with the behavior of most southern California wildfires, which burn through many vegetation types and have fire perimeters that seldom correlate with vegetation boundaries. In the 2007 fires in southern California, the extensive reburning of 2003 fire scars comprised sage scrub and chaparral, more or less equally (J. Franklin, *unpublished data*). This should not

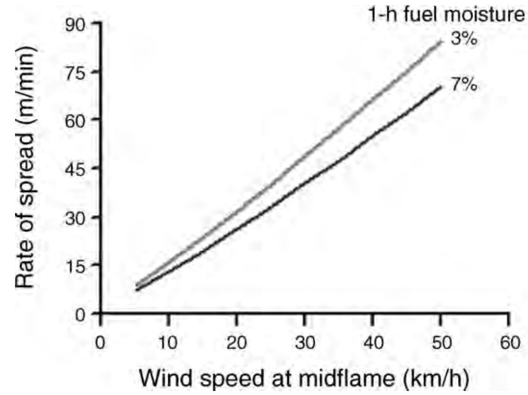


FIG. 8. BehavePlus 4 model results using a custom fuel model for early seral stage chaparral fuels similar to those depicted in Fig. 7, although from a site in San Diego County; dead fuels were 6, 4, and 3.58 Mg/ha for 1-, 10-, and 100-h fuels, respectively; and live fuels were 0.38 and 2 Mg/ha and 30% and 50% moisture for herbaceous and woody fuels, respectively; (R. H. Halsey and J. E. Keeley, *unpublished data*). Rothermel equations that are used in the Behave model have shortcomings when applied to mature chaparral where live fuels dominate; however, in these young seral stands, dead fuels dominated and the bulk of the dead fuels were within 75 cm of the soil surface. (See footnote 8 for BehavePlus 4 software.)

be at all surprising since there is a remarkable similarity in species composition and cover by the major growth forms between early seral stages of the two vegetation types (Keeley et al. 2005, 2006).

A corollary of the fine-grain age patch model is that large high-intensity wildfires are only possible when fire suppression creates a putatively unnatural coarse-grained pattern of older dead fuels. However, empirical studies show the probability of burning does not increase in older chaparral stands (Schoenberg et al. 2003, Moritz et al. 2004). Also, proponents of the fine-grain model have always assumed that fire suppression policy equates with fire exclusion, but this has not been the case in southern California (Moritz 1997, 2003, Conard and Weise 1998, Keeley et al. 1999, Weise et al. 2002). Indeed, contemporary fire regimes have had a much higher fire frequency than historical fire regimes (H. D. Safford and D. Schmidt, *unpublished data*).

### *Causes of megafires*

The observation that a majority of megafires on our landscape have occurred in recent decades (Table 1) is commonly cited as evidence that fire suppression has disrupted natural fuel patterns. The above discussion of fuels fails to support this conclusion, however, it does leave open the question of why the apparent rash of megafires? An obvious explanation lies in the effect of climate since modeling studies show that weather and climate are commonly more critical in driving fire behavior than fuels in many ecosystems (Cary et al. 2006).

We hypothesize that anomalously long and severe drought is a critical factor in the generation of 20th-century megafires and this is supported by a consistent

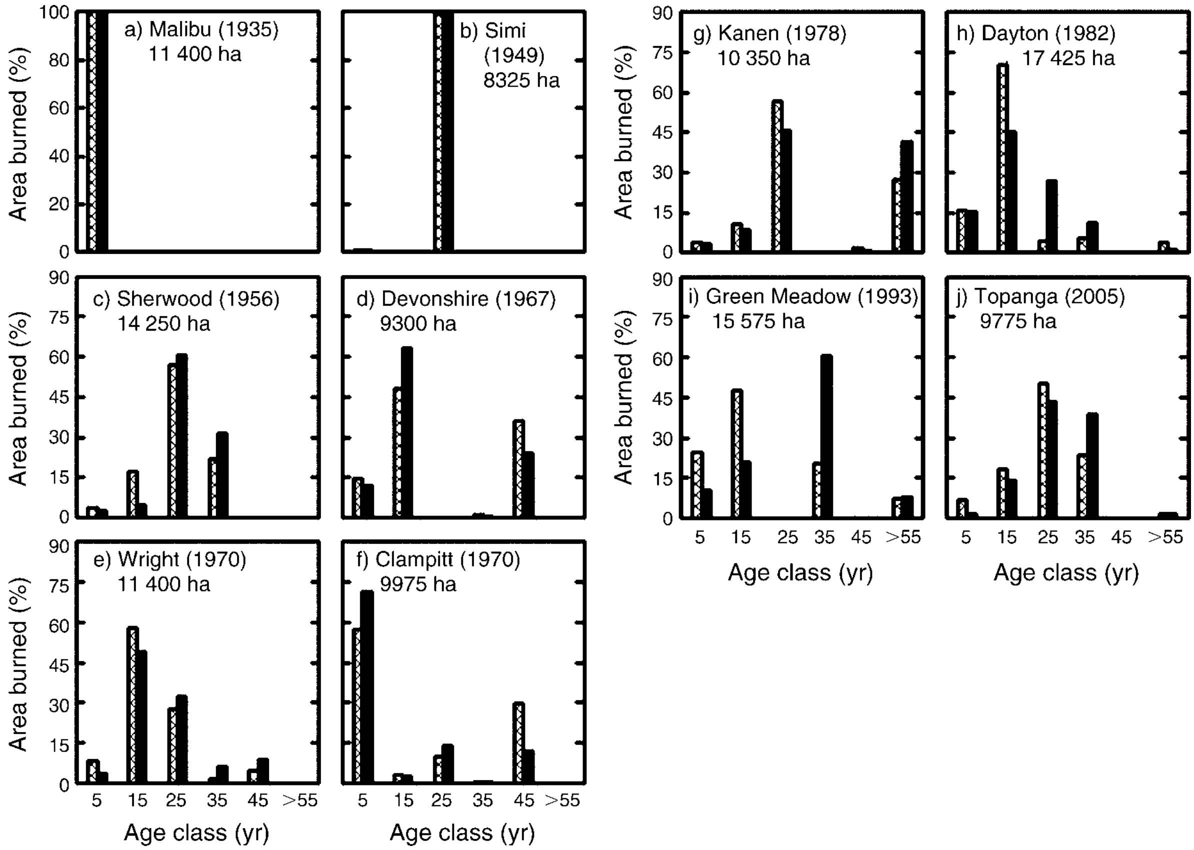


FIG. 9. Age classes of chaparral and sage scrub burned by the 10 largest fires in the Santa Monica Mountains (R. Taylor, *unpublished data*). Fire name, year, and area burned are shown also. Cross-hatched bars are sage scrub, and black bars are chaparral.

pattern of anomalously long droughts prior to our largest fires (Table 1). The causal relationship between drought and megafires may vary with the timing of the fire. For example, the 2007 Zaca Fire, which burned in midsummer, was likely facilitated by the extraordinarily low live fuel moisture for that time of year (Fig. 10). However, this explanation would not apply to autumn fires such as the 2007 Witch Fire (Table 1), since even during the extreme drought year of 2007, the live fuel moisture in October did not differ from the long term

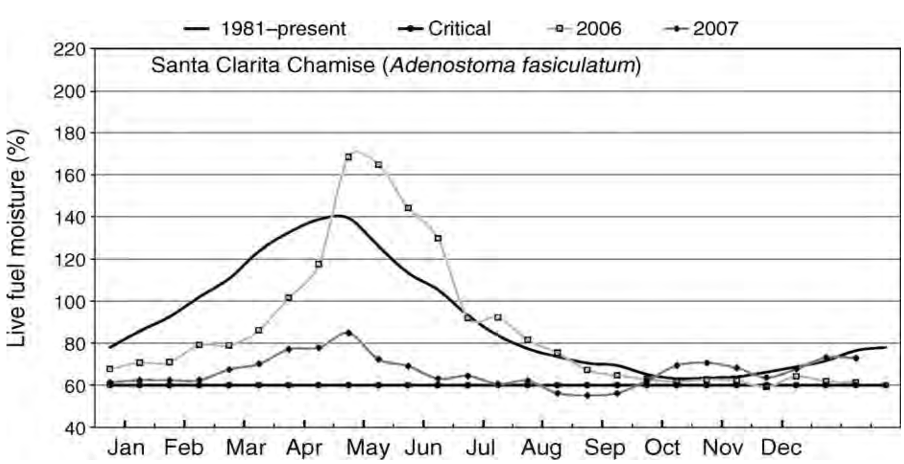


FIG. 10. Live-fuel moisture in the widespread chaparral shrub *Adenostoma fasciculatum* from Santa Clarita in northern Los Angeles County for 2006 and 2007, and the 27-year average. The critical level is 60%, which is the lower threshold for live foliage to survive. ⟨http://www.fire.lacounty.gov/Forestry/FireWeatherDangerLiveFuelMoisture.asp⟩

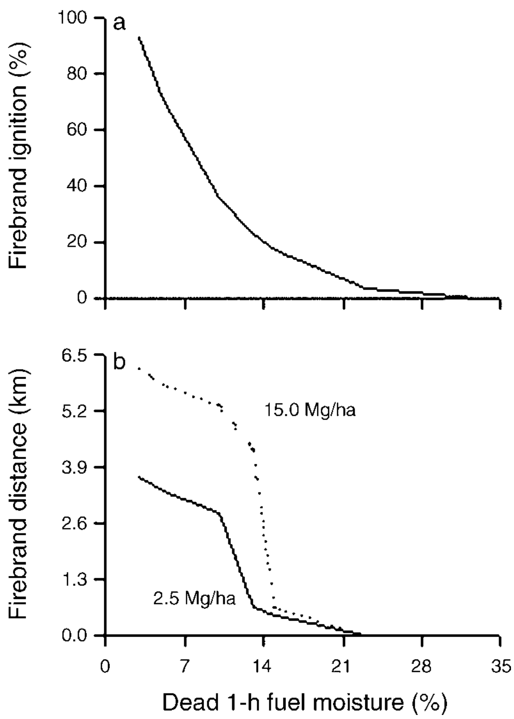


FIG. 11. BehavePlus 4 model results on (a) probability of firebrands igniting and (b) spotting distance from wind-driven surface fire for two amounts of dead fuel; using high-load dry-climate shrub S5 fuel model and wind speed of 80 km/h. (See footnote 8 for BehavePlus 4 software.)

average (Fig. 10). This is because in most years the mediterranean climate results in an annual late spring and summer drought, so that live fuels are normally at their lowest physiological threshold in the autumn; the main exceptions being years with unusually wet springs (Dennison et al. 2008).

We hypothesize that the primary reason anomalously long and extreme droughts lead to megafires is the increased generation of dead fuels in the year or years prior to the fire. Under extended droughts, the live-fuel moisture drops below physiological thresholds, resulting in mortality of twigs and branchlets, or entire shrubs, and greatly increases the dead fine fuel load (e.g., Buck 1951). This was widely observed prior to the 2003 and 2007 fires (Lloret et al. 2004, California Wildfire Coordinating Group 2007, Kelly 2007; J. E. Keeley, *personal observations*).

One of the important differences between live and dead fuels is in their role in spreading fires from embers or firebrands that ignite spot fires. Although live fuels can become embers, the probability of firebrands igniting in live fuels (nearly always with fuel moisture levels above 40%) is low. Under autumn Santa Ana wind conditions, dead fuels have less than 5% moisture content and when embers land in them they have a very high probability of igniting (Fig. 11a). Although the fire front spreads rapidly under high winds, it is always substantially slower than the wind speed (Beer 1991), and thus firebrands lofted above the fire have the potential for greatly increasing the rate of fire spread. As the quantity of dead fuels increase, the probability of long distance transport increases (Fig. 11b), and even more so in rugged terrain with high ridges and canyons characteristic of much of southern California. This hypothesis is supported by field observations; e.g., the fire management officer on the 2003 Cedar Fire has stated that the much greater success of long distance embers igniting spot fires was in his opinion a primary reason this fire ranks as one of the largest in state history (Richard Hawkins, *personal communication*). One of the important features of this model is that dead fuels persist long after drought and may have a continuing legacy for many years, even if the drought dissipates.

Whether or not these extraordinary droughts and the fires accompanying them are due to anthropogenically induced climate change, as may be the case in high elevation western forests (Westerling et al. 2006), is not known. Using the annual average Palmer drought severity index for southern California we find there is a significantly negative decline between 1895 and 2007 ($P = 0.004$, $r^2 = 0.07$, $n = 113$ years) and when averaged per decade it is apparent that the last several decades, on average, have been drier than earlier periods in the 20th century (Fig. 12). We contend that there is a causal relationship between this drought and the large number of megafires in recent years (Table 1), but it is too early to tell if this drought is part of an anthropogenically driven climate change induced trajectory of continued drought, or part of a natural cycle. The sequence of decades with negative PDSI observed in the last 40 years is not novel if a longer time scale is considered; e.g., a similar period of drought occurred in the 19th century (e.g., 1840–1880 in

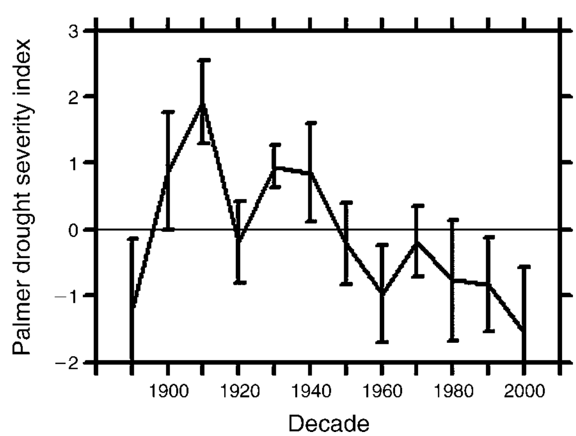


FIG. 12. Decadal average for the Palmer drought severity index (PDSI) for the southern California region (the first decade comprised only the years 1895–1899, and the last decade, 2000–2007). Negative values indicate drier than normal conditions. Error bars (SE) illustrate that all decades have had some wet years, but on average the region has experienced drought over the past half century. Analysis of variance of decadal mean PDSI was significant ($P < 0.001$).

TABLE 2. Frequency of fire events by size class observed in Baja California and considered to be representative of the natural fire pattern in southern California (Strauss et al. 1989, based on Minnich 1983) and calculated fire rotation intervals based on documented lightning fire densities.

| | | | Calculated area burned (ha)† | |
|---|---|---|---|---|
| Median size class (ha) | No. fires | Percentage of fires | Santa Ana Mountains‡ | Santa Monica Mountains§ |
| 40–100 | 167 | 43.2 | 12 096 | 5140 |
| 100–200 | 84 | 21.8 | 13 080 | 5559 |
| 200–400 | 61 | 15.8 | 18 960 | 8058 |
| 400–800 | 29 | 7.5 | 18 000 | 7650 |
| 800–1600 | 19 | 4.9 | 23 520 | 9996 |
| 1600–3200 | 17 | 4.4 | 42 240 | 17 952 |
| 3200–6400 | 4 | 1.0 | 1920 | 816 |
| 6400–12 800 | 4 | 1.0 | 3840 | 1632 |
| 12 800–25 600 | 1 | 0.3 | 19 891 | 8453 |
| 25 600–51 200 | 0 | 0.0 | 0 | 0 |
| >51 200 | 0 | 0.0 | 0 | 0 |
| Total area burned (ha) in 1 million ha of landscape after 100 years | | | 153 547 | 65 257 |
| Rotation interval (yr) | | | 651 | 1532 |

*Notes:* For the Santa Ana Mountains we used an average of four lightning-ignited fires per million hectares per year reported for Orange County (Keeley 1982) and for the Santa Monica Mountains an estimate of 2.2 lightning fires per 1 million hectares per year (Keeley 2006).

† Calculated area (ha) burned in 100 years, based on the number of lightning fires per 1 million hectares per 100 years.

Cook et al. [2004]), and in other periods before that (Stahle et al. 2007). Of course even if this recent drought is cyclical, anthropogenic global warming may diminish the magnitude of the upturn in this drought cycle.

In addition to climate-driven temporal variation in megafires (Table 1), there is also a marked pattern of spatial variation as well. These huge fires do not have an equal likelihood throughout the region because topography and vegetation distribution play important roles in determining the ultimate size of fires. It is more than mere coincidence that megafires (Table 1) have occurred either in San Diego County (in the southern part of the region) or in Santa Barbara/Ventura counties (in the northern part of the region). The general topography of both sub-regions supports large contiguous east-west swaths of shrubland fuels where both offshore and onshore wind flows can drive fire over very long distances. Indeed, the sites of the Matilija and Zaca fires (Table 1) are described as having "the greatest unbroken expanses of chaparral in California" (Cermak 2005:121). Counties such as Los Angeles, San Bernardino, and Riverside, dominated by the east–west transverse ranges, largely lack such topographic patterns. For example, the Santa Monica Mountains have been repeatedly burned by large Santa Ana wind driven fires, but the largest on record was a mere 17 400 ha (National Park Service, Santa Monica Mountains National Recreational Area, *unpublished data*). Megafires (e.g., Table 1) would not be predicted for this landscape because Santa Ana wind driven fires follow a north-south trajectory (Weide 1968) and ultimate fire size is constrained by urban development on the northern boundary of these mountains and by the Pacific Ocean on the southern boundary. Similar arguments have been offered for the apparent lack of recent megafires in northern Baja California (Keeley and Fotheringham 2001*a, b*), although prior to intensive land use and habitat fragmentation, such events did occur (Vancouver's Diary from 1793 cited above).

*Testing the fine-grain age patch model on southern California landscapes*

It has been argued that contemporary fine-grain burning patterns in Baja California represent the historical patterns in southern California (Minnich 1983, 1995). If this is so, then the distribution of fire sizes in pre-suppression California should have resembled that of Baja California (Table 2). If we take this as the fixed probability distribution for fire sizes, then knowing the number of natural fire starts per year allows the calculation of the average area burned per unit time, and from this the rotation interval (area burned divided by total area per year). We use lightning ignition data from two coastal mountain ranges, the Santa Ana Mountains in Orange, Riverside, and San Diego counties, and the Santa Monica Mountains in Los Angeles and Ventura counties (Table 2). We estimate that with the Baja model, the fire rotation intervals would be over 650 years for the Santa Ana Mountains and over 1500 years for the Santa Monica Mountains. Clearly, to produce fire rotations sufficient to maintain these fire-adapted ecosystems (one or two fires per century) the average area burned per year must be much greater than can be accounted for by this Baja model. Either there would need to be many more ignitions than the empirical data indicate, or, as we believe, the historical fire regime did not follow the Baja model but rather consisted of small fires punctuated at periodic intervals by large fire events. Since the lighting season in coastal California is just weeks prior to the Santa Ana wind season it seems likely that prior to human interference, lightning-ignited fires persisted on the landscape until they were picked up and driven by Santa Ana wind events, and this is when the bulk of the landscape burned (Keeley and Fotheringham 2003).

*Cellular model predictions from the fine-grain age patch mosaic model*

Can the fine-grain model work in theory? To explore this, begin with the simplest model that contains the essential parts of the hypothesis: age, ignition events, and fire size. This can be adequately represented by the "cellular automata" class of models. In an age when there is strong and often ill-placed bias toward complex multi-parameter models (May 2004, Pilkey and Pilkey-Jarvis 2007) it is necessary to justify this choice. Modeling fire behavior upward from first principles has proven difficult (e.g., Finney 2004, Zhou et al. 2005). Therefore it makes sense to take the simplest system and see if it reproduces in a qualitative way the postulated behavior of the fine-grained hypothesis. If it does not, then either the hypothesis is wrong, or there are one or more other factors that need to be considered.

But even a cellular model is more complex than is required to show that the fine-grain hypothesis cannot stand without the inclusion of a fire-stopping rule that is independent of age. Simple logic tells us that if we have a completely deterministic system and we start with a fine-grain age mosaic (not saying how it emerged) with no ages greater than the youngest age at which a cell will burn, and have at least one ignition event per year per age patch, the age mosaic will persist forever and can be as fine-grained as the distribution of lightning ignitions. As each age patch achieves the minimum age at which it will burn, it will be ignited, and since it will be surrounded by younger patches the fires will extinguish along the age boundaries. But if the age mosaic did not already exist, it would be impossible for it to emerge without an age-independent stopping rule. If the landscape had a uniform age no fire would spread when the landscape was less than the minimum age (hereafter, minage), and the entire landscape would burn if it were greater than or equal to minage. The proponents of the fine-grained hypothesis must explain how the fine-grained mosaic necessary to it arises.

If we approach reality more closely by including stochasticity, the flaw in the fine-grain assumption can be made clear by a simple diagram plotting the ages on the two sides of an age boundary (Fig. 13). Both sides will age at the same rate, so that the change in the system over time is represented by lines moving parallel to the line of no difference; farther from this line if the current difference in age is larger, and closer if the age difference is smaller. If it is zero, the system moves along the line of no difference (Fig. 13). The deterministic situation just described exists when a cell burns as soon as it reaches minage (Fig. 13a). After burning, the age of that cell drops to one of the axes (age of the cell just burned = 0). After this, the two cells age but the older cell will reach

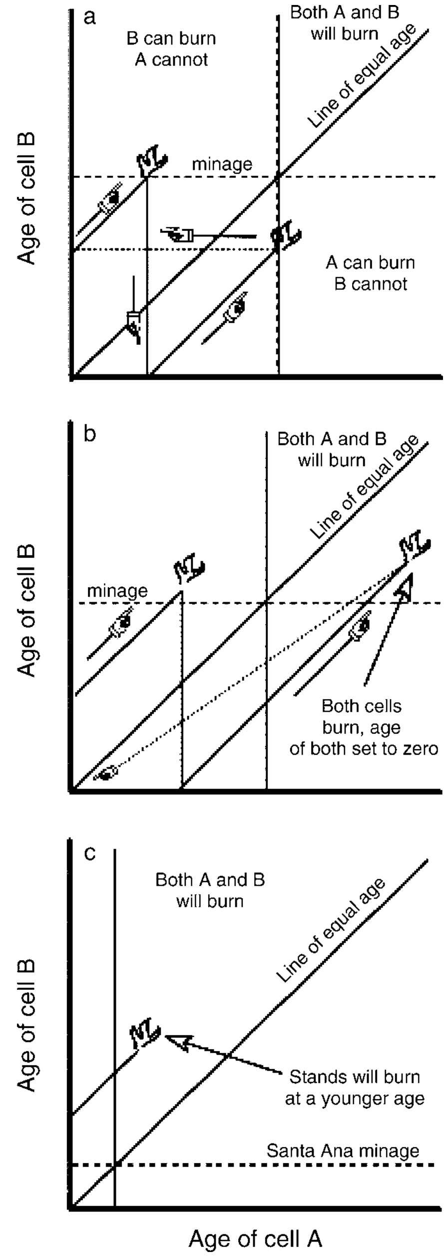


FIG. 13. Perpetuation or loss of an age boundary. (a) The deterministic behavior alleged in the "fuel paradigm." An age boundary persists because the older vegetation will first reach "minage" (youngest age at which vegetation will burn), receive an ignition, and burn. If fire is certain, the boundary will persist forever. (b) If random variation in timing of ignition allows vegetation on both sides of the boundary to reach an age at which they will burn, the age boundary will disappear at the next fire. Over the whole landscape, this process will tend toward coalescence of the age mosaic. (c) If minage varies, so that at some times more of the landscape is liable to burn, the age boundary is much more likely to be eliminated. From this, one would predict that variable "minage" would cause coalescence to occur more rapidly, with or without random ignition. The figure is modified from Zedler and Seiger (2000).

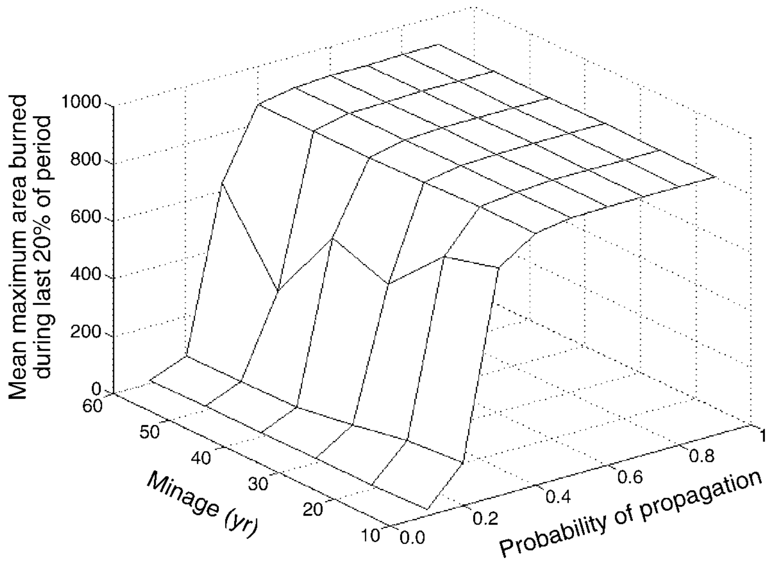


FIG. 14. Effect of minage (youngest age at which vegetation will burn) and probability of propagation (probability that fire will transfer to an adjacent unburned cell) on the maximum area burned during the last 20% of the simulation period (to minimize the effect of transient conditions). The simulation is run for 500 years for a 900-cell landscape. Beyond a probability of propagation of 0.5, the system is locked into very large fires, regardless of minage or, as shown in the text, the number of ignitions.

minage first, will burn, and return to zero on the other axis, and so on forever (Fig. 13a). But there are two ways this beautiful system can be disrupted stochastically. If ignition is not certain on a cell achieving a burnable state, then a cell can age past minage and the system can move into the upper right quadrant when both cells are older than minage. A fire at that time will set both cells to zero, the age boundary will disappear, and the system will be trapped forever along the line of no difference and the cells will coalesce (Fig. 13b). Alternatively, if minage is not fixed, so that in some years much younger cells can burn, it is possible for the condition in one year to be, e.g., "one could burn, one cannot" and in the next to be "both will burn" (Fig. 13c). As discussed above, this is what follows when an ignition event occurs during Santa Ana winds. And since these two departures from determinism are not mutually exclusive, both can operate to break down a preexisting age mosaic.

Adding both spatial pattern and stochasticity to the mix by use of a cellular model underscores the conclusions from these simple demonstrations. Since the proponents give no general guidance as to which factors other than age will cause a fire to go out, we incorporated this into our model by varying the probability that fire would spread from one cell to the next ("probability of propagation"), with these probabilities applying across the entire landscape. With a probability of 1, all adjacent cells greater than or equal to *minage* will burn, with a probability of 0, only the ignited cell would burn and fire size would be limited to one cell regardless of the age of the surrounding cells.

Our first series of runs varies the probability of propagation, the minimum age (*minage*) and the number of ignition events on a landscape of uniform age to explore the conditions under which a complex age mosaic will develop. To avoid the early transient conditions, the metric for our response variable is the largest fire in the last 20 simulated years. We choose a 30 $\times$ 30 landscape consisting of 900 grid cells.

Our results show that the postulated age mosaic will not develop except at low values of probability of spread. At probability values of 0.4 and above, the largest fires in the last 20 years of the simulation burn the entire landscape (Fig. 14). Varying minage has almost no effect, except at transitional probabilities of spread (Fig. 14). At a probability value of 0.3, greater values of minage result in smaller maximum fire size, though this may be a transient phenomenon.

The only possibility for the growth of a fine-grain mosaic is with a very low probability of spread. If ignitions are few (one per year, or in the simulation 0.0004 ignitions$\cdot$cell$^{-1}\cdot$yr$^{-1}$) and probability of propagation only 0.2, the system starts with a relatively large fire when the landscape first reaches minage, and then evolves toward a mixture of very small and medium size fires which appears to be the persistent state (Fig. 15a). The reason for this behavior can be gauged by noting that the average age of the landscape increases sharply and then tends to level off well above minage (Fig. 15). This is because the number of ignitions is not sufficient to burn all of the landscape that is burnable at this probability of propagation. These characteristics do not match those predicted by the fine-grain age patch model.

Increasing the ignitions by two orders of magnitude, but still with 0.2 probability of propagation also produces a complex age landscape and a pattern of burning that does resemble the ideal state postulated by

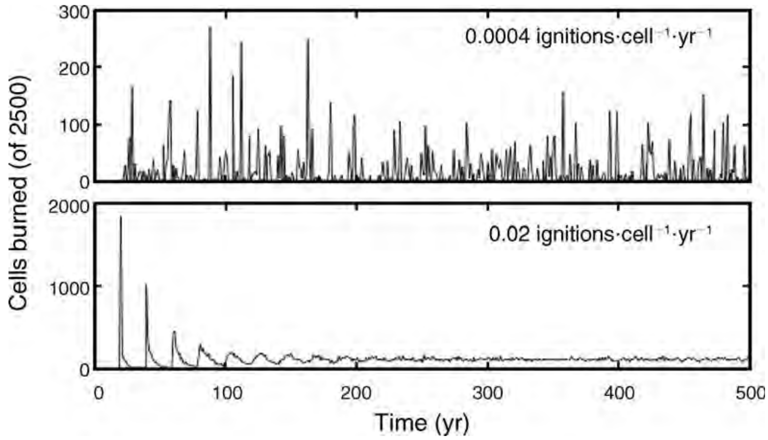


FIG. 15. Simulated results for a 2500-cell universe with a minage of 20 years, a probability of propagation from one cell to the next of 0.2, and 1 or 500 ignitions per year. At one ignition per year, this low probability of propagation produces a quasi-stable situation with a variable but generally small area burned per year. At 500 ignitions per year, the system oscillates with a period that corresponds to minage, toward a stable situation of consistently small area burned per year.

the fine-grain mosaic. As with the single ignition case, there is a large fire when the landscape first reaches minage, but then the system evolves toward small fires each year, corresponding closely to the situation postulated by the fuel-age paradigm proponents (Fig. 15), except that the average age of the vegetation oscillates toward a value well below minage (Fig. 16). Because of the high number of ignitions (500, or one for each five cells per year), any given age patch has a high probability of being ignited even if it is not burned in its entirety, making the evolution toward a complex age mosaic possible. While this outcome demonstrates the mathematical possibility of a fine-grain mosaic, it creates an unusually young landscape, and requires a severe stopping rule in the form of a low probability of propagation, and an unrealistically dense and uniform temporal and spatial coverage by ignition sources. With more realistic probabilities of propagation, the system rapidly moves to an all-or-nothing burn pattern, and with number of ignitions relatively unimportant (Fig. 14). We conclude that it is not possible to produce a landscape with a plausible fine-grain age distribution without unrealistic assumptions.

We also explored the problem from the other side, that is, beginning with a complex age mosaic and measuring the time it takes for this to revert to a large fire system, one in which 90% or more of the landscape burns in a single year. To show the strong effect of variable minage on the coalescence process (cf. Fig. 13), we ran two sets of simulations both of which started with 900 cell landscapes in which there were patches with random ages between zero and minage. In the first, minage was held constant across simulated time at 25 years. In the second, minage values varied from year to year. The minage in a particular year was selected from a normally distributed random population with a mean of 25 and a standard deviation of 5. In both, there was only a single ignition per year. The results show both that a constant minage takes more time to coalesce, and that the probability of propagation has a greater effect (Fig. 17). The results for both situations demonstrate that a random mosaic will coalesce with time, and that this coalescence process is greatly accelerated if minage varies stochastically, as the simple model of Fig. 13 would predict.

These simple models show that any convincing hypothesis for the evolution of the age patch structure of a chaparral landscape must have a much more complicated stopping rule that involves more than age. For a spatial pattern to have a stable age structure, a new age boundary must be created for each one that is destroyed. If the fine-grain mosaic hypothesis is to be

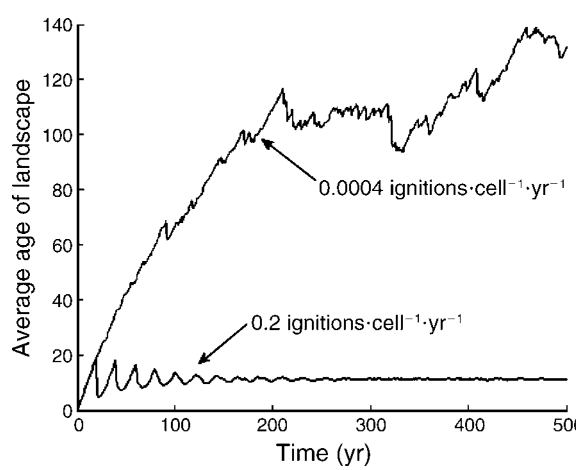


FIG. 16. Data from the simulations run for Fig. 15 expressed as the average age of the landscape. With only one ignition per year, the average age increases consistently and then tends to level off. This is because the low probability of spread insures that only a small part of the landscape will burn, despite the fact that many cells are well beyond the minage. In contrast, with saturating ignitions (lower line), the average age of the landscape stabilizes at about half of minage because any area that achieves minage will burn.

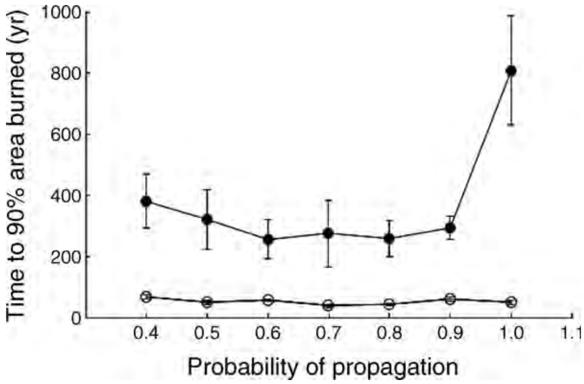


FIG. 17. Comparison of "time to coalescence" starting from a random distribution of ages in simulated landscapes subjected to constant (solid circles) and variable (open circles) minimum ages at which the cells will burn for different probabilities of spread from one "burning" cell to the next. Error bars are ±SD for samples of 25 runs. Note that the error bars for the variable case are contained within the symbols. For this run, the "landscape" consists of 900 grid cells, and minimum age is taken as 25 years. Above a probability of propagation of 0.4, all possibilities evolve toward eventual coalescence, but this occurs less than 25% of the time when the minimum age is allowed to vary normally about the mean with standard deviation of 5 years.

saved, how this process works must be clarified and real-world examples presented.

In summary, the only plausible conditions where the fine-grain age patch model would evolve toward a complex age mosaic would be if the environment were saturated with ignitions and if fires are patchy, which appears to be the case on certain forest types such as southwestern ponderosa pine and southeastern longleaf pine. These are ecosystems with historical patterns of frequent low severity understory surface-fire regimes made possible by an annually renewing herbaceous layer clearly separated from the tree canopy layer. Transferring that model to California shrublands cannot be justified.

## CONCLUSIONS

In southern California, modern fire regimes have much in common with historical regimes. This landscape has been subject to large high-intensity wildfires long before Euro-Americans settled the region and such fire events cannot be blamed on land management practices. As is the case today, historical fire regimes were characterized by many small fires but the bulk of the landscape burned in infrequent massive wildfires, often driven by severe weather that involved high temperatures, low humidity and high winds. The primary difference today is that, due to human ignitions, there are many more fires and the rate of burning far exceeds historical levels (as illustrated by fire frequency departure analysis [H. D. Safford and D. Schmidt, *unpublished data*]). Thus, the idea that fire suppression has altered fuel structure in ways that make this landscape more vulnerable to large fires is demonstrably false for southern California.

Historically, climatic variation probably caused considerable fluctuation in the timing and size of fires. Human ignitions have been part of the picture for thousands of years, and in coastal valleys Native American populations increased fires sufficiently to type convert shrubland landscapes (Timbrook et al. 1982, Keeley 2002*b*). However, the most important change in the region has been the 20th century increase in human populations and concomitant increase in fires, coupled with demographic patterns that have resulted in increased human mobility and dispersion into previously isolated chaparral landscapes. Although fire suppression policy has been in effect for over a century, aggressive fire control has been in effect for about half that time. Its increasing technological capacity and impressive organizational advances however, have not been able to counteract the temporal and spatial expansion of anthropogenic ignitions. In particular, contemporary populations have increased the likelihood of ignitions during Santa Ana wind events, and, by the increasing spread of population centers to interior regions, have increased the potential fire size under offshore wind patterns.

The present analysis points toward several management recommendations. Attempts to create a mythical fine-grain age mosaic are doomed to fail. Burning large areas on a 15–20 year rotation in small patches would require massive investments and a significant risk of damaging fire escapes that can cause expensive losses of property. In addition, even if such a mosaic were created, under a wide range of conditions, such sites would not prevent the spread of wildfires. Recent history suggests that the accumulated work of decades could be swept away in a single large fire under severe weather.

Fuel treatments may be a barrier to fire spread under benign weather, and under more severe weather, provide access and anchor points for fire fighting activities. They also contribute to reduced flame lengths and provide defensible space around urban developments. Thus, attention needs to be given to their most strategically useful placement on the landscape, so that they are cost effective. In addition to their monetary cost, fuel treatments have potential negative impacts on resources (Keeley 2005, Ingalsbee 2006), and thus they need to be done judiciously. Application of fuel treatments beyond the wildland-urban interface zone may have tactical value, but much research is still needed on the most cost-effective placement of these treatments.

This analysis suggests that the greatest improvements in reducing community vulnerability to wildfires is not like going to come from improved fuel treatments or fire suppression capabilities, but rather from changes in human infrastructure. The most significant advances are likely to come from improved fire prevention and careful analysis of land planning and zoning issues.

## Acknowledgments

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## APPENDIX A

Transcripts of newspaper articles or book sections describing large, high-intensity fires from the 19th century in California counties from Santa Barbara south. (*Ecological Archives* A019-004-A1).

## APPENDIX B

Southern California Santa Ana foehn wind characteristics and their relationship to fires in the region (*Ecological Archives* A019-004-A2).

## APPENDIX C

Lessons from the 2007 Santiago Fire applied to the reconstruction of the 1889 Santiago Canyon Fire (*Ecological Archives* A019-004-A3).

## APPENDIX D

Further notes on Gorforth and Minnich's (2007) alternative interpretation of the 1889 Santiago Canyon Fire published in Ecological Applications 17:779–790 (*Ecological Archives* A019-004-A4).

## APPENDIX E

The 1932 Matilija Fire perimeter and prior 20th-century fire history (*Ecological Archives* A019-004-A5).

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# Ecological Foundations for Fire Management in North American Forest and Shrubland Ecosystems

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Cover: Prescribed fire in Giant Forest, Sequoia National Park. Photo by Eric Knapp.

## Abstract

**Keeley, J.E.; Aplet, G.H.; Christensen, N.L.; Conard, S.C.; Johnson, E.A.; Omi, P.N.; Peterson, D.L.; Swetnam, T.W. 2009.** Ecological foundations for fire management in North American forest and shrubland ecosystems. Gen. Tech. Rep. PNW-GTR-779. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 92 p.

This review uses a scientific synthesis to provide an ecological foundation for management of the diverse ecosystems and fire regimes of North America. This foundation is based on the principles that inform management of fire-affected ecosystems. Although a large amount of scientific data on fire exists, most of those data have been collected at fine spatial and short temporal scales, whereas most of the potential issues and applications of those data are at broad and long-term scales. Basing decisions and actions on these data often requires extrapolation to different scales and different conditions, such that error can be introduced in the process.



Keywords: Fire ecology, fire hazard, fire regime, fire risk, fire management, fuels, fuel manipulation, prescription burning, restoration.

## Summary

This review uses a scientific synthesis to provide an ecological foundation for management of the diverse ecosystems and fire regimes of North America. This foundation is based on the following principles that inform management of fire-affected ecosystems:

- Potential future management options and goals need to be consistent with current and past fire regimes of specific ecosystems and landscapes and be able to anticipate and adjust to future conditions.
- The effects of past management activities differ among ecosystems and fire regime types.
- Differences in fire history and land use history affect fuel structures and landscape patterns and can influence management options, even within a fire regime type.
- The relative importance of fuels, climate, and weather differs among regions and ecosystems within a region; these differences greatly affect management options.
- Plant species may be unable to adapt to alterations in fire regimes.
- The effects of patch size must be evaluated within the context of fire regime and ecosystem characteristics.
- Fire severity and ecosystem effects are not necessarily correlated.
- Appropriate options for fuel manipulations differ within the context of vegetation structure, management objectives, and economic and societal values.
- Fuel manipulations alter fire behavior but are not always reliable barriers to fire spread.
- Understanding historical fire patterns provides a foundation for fire management, but other factors are also important for determining desired conditions and treatments.

Several challenges exist for implementing these principles in contemporary fire management. Although a large amount of scientific data on fire exists, most of those data have been collected at fine spatial and short temporal scales, whereas most of the potential issues and applications of those data are at broad and long-term scales. Basing decisions and actions on these data often requires extrapolation to different scales and different conditions, such that error can be introduced in the process. In addition, most land management organizations operate according to many

legal and regulatory mandates, some of which are compatible with ecologically based fire management and some of which constrain potential options. Finally, a warming climate and other dynamic changes in the biological, physical, and social environment are introducing new sources of complexity and uncertainty that influence strategic planning and day-to-day activities.

Sustainable ecosystem-based management, which is now the standard on most public lands, will be successful only if fire policy and management are (1) based on ecological principles, (2) integrated with other resource disciplines (wildlife, hydrology, silviculture, and others), and (3) relevant for applications at large spatial and temporal scales. Fire is such a pervasive disturbance in nearly all ecosystems that failure to include it as part of managing large landscapes will inevitably lead to unintended outcomes.

## Contents

## Introduction

**This paper places the role of fire in a framework that will inform fire management of ecosystems at different spatial and temporal scales.** Although we focus on North America, the concepts discussed here have broader application. Fire occurs in most North American ecosystems, and most of these systems are resilient to fires that occur within a broad range of variability in frequency and intensity. Fire has been influenced by humans since before European settlement. On some landscapes, human impacts have resulted in widespread disruption of historical fire regimes and placed ecosystems on a trajectory leading to a less stable and less sustainable future. This scenario can have profound impacts on human social and economic systems as well as on the natural resources that provide us with numerous tangible and intangible benefits. As human presence has increased, there has been a concomitant increase in property and other values that are potentially at risk from unintended fire and in the perceived need to manage fire to reduce those risks. Many "natural" ecosystems (box 1) are also threatened by past and present fire management and land management practices.

**We show the diverse roles fire has played in different ecosystems, necessitating a regional approach to fire management, at least partially in response to human effects through fire exclusion in some cases and increased fire occurrence in other cases; ecosystem-based management requires different strategies on different landscapes.** We also focus on the relative role of different land management practices on fuel accumulation and fire hazard. Fire suppression is only one factor leading to increased fire hazard, and has not changed fire hazard in all ecosystems. Furthermore, land management activities such as logging and grazing, which some assume have reduced fire hazard, have actually exacerbated fire hazards on some landscapes. We also discuss how climatic variability and change are expected to alter future fire regimes and the potential impact of management responses to these changes. Finally, we examine regions where expanding urban populations have resulted in large portions of human settlements being exposed to high fire danger and altered local management options.

**Fire suppression is only one factor leading to increased fire hazard, and has not changed fire hazard in all ecosystems.**

We begin by briefly describing examples of fire and fire management effects in six ecosystems. These examples illustrate the complexity of many fire issues, and the need for fire management that reflects the complexities of North American ecosystems and their different relationships to fire.

## *Box 1.* What Is Natural?

Referring to a place or process as "natural," ecologists most often mean "absent of human influence," which is the meaning intended for "natural" in this paper, although "limited" human impact may be a more realistic goal. This is not to dismiss or even participate in the dialogue about the relationship of humans and nature. Rather, we do this out of need for a word to describe a baseline frame of reference for understanding human influences. The tradition of using "natural" in this manner is well established, and no other word seems to fit the intent.

Over the past few millennia, only the more remote places in North America could be said to have been in this sense natural, and this is particularly true with respect to the occurrence and behavior of fire. Humans have used fire for most of their existence to modify and manage their environments (Pyne 1982, 2001), and that use has influenced the distribution of many species and ecosystems.

The historical range of variability (HRV) concept provides an alternative frame of reference for naturalness and gauging contemporary human influences on fire regimes. Past variations in fire frequency, magnitude, and in some cases, intensity, can be inferred in many ecosystems from analysis of tree rings, fire scars, and charcoal from lake sediments and soil. Historical variations in fire behavior in some regions are correlated with changes in climate and human activity. The relationships between HRV for fire and HRV for other environmental factors like climate on presettlement landscapes have been assumed to bracket conditions that might be considered "natural," although on many landscapes, human activities likely contributed to that variation (Landres et al. 1999, Swetnam et al. 1999, Willis and Birks 2006).

What role should these concepts play in fire management? Part of the justification for the HRV approach is that it is considered to be a conservative indicator of sustainability (Millar 1997) and provides a benchmark for restoration of perturbed ecosystems (Fulé et al. 1997). Few would question their value as benchmarks or bounds for assessing the effects of human actions and management on fire occurrence and behavior. However, HRV depends on the period on which it is based, and in most instances that period is before Euro-American interference in fire regimes. Of course the range of HRV increases as the historical timeframe increases (Millar and Wolfenden 1999).

Although significant departures from "natural" or HRV may in some cases present ecological risks, it is unclear if these concepts are appropriate as a sole basis for resource management (Vitousek et al. 2000). In some silvicultural situations and in certain applications of prescription fire to reduce forest fuels, naturalness or HRV may not be a useful reference. Fire events that might otherwise be judged as natural or within the HRV may have undesirable consequences where landscapes have been affected by human actions such as fragmentation or invasive alien species. Clearly articulating the relationship of management goals to HRV metrics, especially in an era of climate change, provides an important context for restoration. Regardless of whether HRV is used in a specific manner to set ecological restoration or management objectives, there is great inherent value in developing historical knowledge and understanding. Historical perspectives are often essential to identify dynamical behaviors, trends, and changes in ecosystems and their likely causes.

## Ponderosa Pine (Western United States)

Warnings of deleterious effects of fire suppression on semiarid forest ecosystems long preceded actions to address this issue. Cooper (1960), Weaver (1968), and Biswell et al. (1973) all showed that the historical pattern of frequent fires (one or more fires per decade from high-frequency lightning fire) in Southwest U.S. ponderosa pine forests (fig. 1a) had been disrupted by fire suppression and other land management practices. Further, they showed that reduction in burning had altered forest structure, causing accumulation of fine surface fuels, and increased density of understory saplings and smaller trees that act as "ladder fuels" that carry fire into the lower canopy (Dodge 1972).

These early reports led to a plethora of studies documenting the significant role of frequent low-intensity surface fires in ponderosa pine and other semiarid ecosystems, and documented long-term consequences of fire suppression (Allen et al. 2002, Covington and Moore 1994, Fulé et al. 2004b, Moore et al. 2004, Swetnam and Baisan 1996). Fire has essentially been eliminated for more than a century on broad portions of the forested landscape in the Southwestern United States, the result of reduction in fine grass fuels by intensive livestock grazing and effective fire suppression. The resulting accumulation of primarily woody fuels, which can intensify fire behavior and potentially carry fire into the overstory, exceeds what was present historically. Researchers have argued that these changes have resulted in increased frequency of large, high-severity crown fires in Southwest U.S. ponderosa pine forests (Allen et al. 2002, Covington and Moore 1994). Similar forest structure and fuels changes have occurred in other parts of dry, ponderosa pine-dominated forests of the inland West, such as the interior Columbia River basin (e.g., Hessburg and Agee 2003) and pine and mixed-conifer forests of the Sierra Nevada (Kilgore and Taylor 1979, Stephenson 1999, Swetnam 1993), and Colorado Front Range (Graham 2003).

## Chaparral (Pacific South Coast)

California chaparral (fig. 1b) typically burns in high-intensity crown fires, and fire spread is through shrub canopies with surface fuels accounting for little or no fire spread. Early studies characterizing differences in fire size north and south of the United States border invoked fire suppression as the primary explanation for these patterns (Minnich 1983, Minnich and Chou 1997). However, recent analyses show no evidence that 20$^{th}$-century fire suppression has diminished fire activity on these landscapes (Conard and Weise 1998, Keeley et al. 1999, Weise et al. 2002). In fact, throughout the 20$^{th}$ century, about a third of this region has burned every decade (Keeley et al. 1999), which reflects a relatively high fire frequency compared to

*All photos on this page: Jon Keeley*


Figure 1— Representative examples of ecosystems specifically discussed in this paper. (A) Ponderosa pine forest in the Southwestern United States illustrating the open nature of surface-fire regime forests dominated by large trees with clear bole and thick bark, (B) chaparral and sage scrub shrublands juxtaposed with urban sprawl in southern California, (C) closed nature of crown-fire boreal forests with dense stocking of trees and weak pruning of lower branches, (D) Great Basin sagebrush, (E) Southern Appalachian pine and hardwood forest, and (F) Southeastern longleaf pine.

the long-term historical fire regime (Keeley and Fotheringham 2003, Minnich and Chou 1997). The fire regime in this region is dominated by human-caused ignitions, and fire suppression has played a critical role in preventing the ever-increasing anthropogenic ignitions from driving the system wildly outside the historical fire-return interval. Because the net result has been relatively little change in overall fire regimes, there has not been fuel accumulation in excess of the historical range of variability, and as a result, fuel accumulation or changes in fuel continuity do not explain wildfire patterns (Keeley et al. 2004, Moritz 2003, Moritz et al. 2004, Zedler and Seiger 2000).

High-intensity chaparral crown fires pose a major threat to economic values because urban sprawl has placed vast stretches of residential areas within a matrix of these hazardous fuels. These landscapes are vulnerable to the most costly wildfires in the United States in terms of loss of lives and property owing to the annual threat of severe fire weather fanned by autumn Santa Ana foehn winds. Since 1970, 12 of the 15 most destructive wildfires in the United States have occurred in California chaparral, costing the insurance industry $4.8 billion (Halsey 2004: 48).

**High-intensity chaparral crown fires pose a major threat to economic values because urban sprawl has placed vast stretches of residential areas within a matrix of these hazardous fuels.**

The major resource threat posed by the current high-frequency fire regime is loss of native vegetation. Chaparral recovery requires two or more decades of fire-free conditions, and more frequent fires have a destabilizing effect. High fire frequency displaces native shrubs with alien annual grasses and forbs, leading to increased flammability, decreased slope stability, and loss of biodiversity (Keeley et al. 2005a). Without decreases in human ignitions, current fire suppression efforts must be sustained if we are to retain much of this ecosystem. Although fuel manipulations of ponderosa pine ecosystems may effectively reduce fire hazard on those landscapes, they are decidedly less effective on chaparral landscapes, and ultimately fire hazard reduction is likely to be achieved by directing fuel modifications away from wildland areas and more toward the wildland-urban interface. Closer integration of state and federal fire management with local land use planning would also enhance protection of urban environments and associated chaparral systems.

## Boreal Forest (Alaska and Canada)

Boreal forests (fig. 1c) are the largest biome in the Northern Hemisphere. Because of high tree density, retention of lower branches, accumulation of surface fuels, and compact arrangement of flammable fuel in the canopy, fires in North American boreal forests are dominated by crown fires with high flaming intensity and high rates of spread. These forests have a short fire season extending from June to August. Fire activity largely depends on co-occurrence of summer lightning and low fuel moisture resulting from a persistent high-pressure system (Nash and Johnson 1996).

Fire frequency has changed several times in the last 400 years more or less synchronously across the North American boreal forest, with changes apparently related to large-scale climate patterns (Bergeron and Archambault 1993, Johnson and Wowchuk 1993, Murphy et al. 2000). The hazard of burning seems to be independent of forest age, because younger and older forests have the same chance of burning, and there is little evidence that older forests have fuel accumulations that make them more flammable. Wildfires are propagated by small and medium-sized fuel, and the amounts of these fuels do not change after the closing of the forest canopy at about 20 years after the fire (Bessie and Johnson 1995, Hely et al. 2001). Of the fires that determine the age mosaic of the landscape, about 90 percent are >1000 ha and about 40 percent are >10 000 ha (Reed and McKelvey 2002). The landscape age mosaic comprises small older patches embedded within a matrix of younger forests initiated by more recent burn events. These older patches are the remnants of large burns that have been progressively reburned.

These patterns have been relatively undisturbed by humans because lightning is the dominant ignition source in most areas, and fire management has had minimal effect on most boreal forests in North America (Johnson 1992). Close to 50 percent of the area burned is the result of fires that receive no management action owing to their remote location (Stocks et al. 2003). The main exception is the southern margin of the boreal forest that has been fragmented by settlement (Mackintosh and Joerg 1935) and, particularly in the early 1900s, burned at very short intervals by escaped fires (Tchir et al. 2004, Weir and Johnson 1998). The efficacy of fuel treatments for reducing fire spread or intensity in boreal forest has not been shown.

## Great Basin Sagebrush (Intermountain West)

Much of the dryland region between the Sierra Nevada and Rocky Mountains has historically been shrublands (fig. 1d) with Great Basin sagebrush being an important dominant species (Blaisdell et al. 1982). Native understory bunchgrasses combine with forbs to form an understory with discontinuous patches between shrubs. Historical fire regimes were dominated by stand-replacement mixed surface and crown fires at variable return intervals from 35 years on moister sites to 70 to 200+ years on drier sites (Baker 2006a, Welch and Criddle 2003, Whisenant 1990). Most shrubs do not resprout and have limited seedling recruitment, and thus they gradually reestablish after fires, with full recovery of the shrub component taking from 15 to 60 years. Discontinuous fuel distribution often left unburned patches of sagebrush (Miller and Eddleman 2001), which were important parent seed sources for regeneration.

In the late 1800s, overgrazing by free-ranging cattle led to a depletion of perennial grasses and other palatable forage. The accidental introduction and rapid spread of cheatgrass in the early 1900s (Mack 1981) resulted in rapid invasion of overgrazed sagebrush rangeland (Billings 1990). As cheatgrass dominance increased, the fine fuel loads it produced added to site flammability, leading to increased fire frequency, greater continuity of fuels (which diminished unburned sagebrush seed source patches), and further decreases in native perennials, grasses, forbs, and shrubs (Knapp 1996). Adding to this problem were fire management activities such as prescription burning, introduced to increase the rangeland value of this ecosystem (Keeley 2006). Fire suppression effects have been largely eclipsed by rangeland practices that have favored the expansion of grasslands over sagebrush steppe vegetation. The destabilizing effects of grazing and fire have created systems that require assertive revegetation and strategic control of fire to reestablish species and structures that were present before the introduction of cheatgrass.

## Pine and Pine/Hardwood Forests (Southern Appalachians)

In the southern Appalachian Mountains (fig. 1e), forest composition and structure differ along gradients of topography, moisture, and elevation (Braun 1950). The role of fire across these gradients is a matter of considerable scientific debate (DeVivo 1991, Runkle 1985, van Lear and Waldrop 1989, Vose 2000) with significant implications for forest management (van Lear 1991). Moderate to high-intensity crown fires are critical for the maintenance of pine and pine/hardwood forests (dominated by pitch pine, Table Mountain pine and several species of oak in the overstory and a shrubby understory of mountain laurel and rhododendron species on dry, exposed ridges (Barden and Woods 1976, Waldrop and Brose 1999). Fire exclusion has limited the occurrence of such fires, thereby promoting increased dominance of hardwoods and a marked decline in pine populations. Selective logging in some areas has promoted establishment of dense thickets of mountain laurel, which suppressed herbaceous diversity and tree establishment, and increased the risk of intense fires (Elliott et al. 1999).

Before European settlement, oak and oak-American chestnut forests on mesic slopes were maintained by a combination of lightning and human-set fires (Abrams and Nowacki 1992, Clark and Robinson 1993). Fire suppression has been nearly 100 percent effective in these ecosystems. The elimination of fire, coupled with an array of other disturbances (e.g., logging and chestnut blight) facilitated the increased dominance of shade-tolerant species such as red maple (Abrams 1998, 2003; Crow 1988; Lorimer 1985). The role of fire in wetter areas, such as in mesic cove and northern hardwood forests, is poorly understood. It is likely that fires occurred at irregular intervals and at relatively low frequencies, probably associated with periods of extreme drought (van Lear and Waldrop 1989), and this may account for the prevalence of shade-intolerant species such as tulip poplar in some old-growth sites (Lorimer 1980).

The diversity of forest systems described above has existed as such in the southern Appalachians for only 10,000 years (Davis 1983), a period during which Native Americans actively used fire in this region (DeVivo 1991). Lightning strikes were sufficiently frequent on exposed slopes to maintain the pine and pine/hardwood forests on those sites, although human-caused ignitions were likely important across much of this forest gradient (Clark and Robinson 1993). The decline in Native American populations beginning in the $17^{th}$ century may have produced significant changes in southern Appalachian fire regimes, well before modern fire suppression. Assessments of the value of fire as a management tool in this region require some consideration of the effects of burning by Native Americans on cultural landscapes.

**The decline in Native American populations beginning in the $17^{th}$ century may have produced significant changes in southern Appalachian fire regimes, well before modern fire suppression.**

## Longleaf Pine (Southeastern United States)

Coastal plain forests dominated by longleaf pine are among the most threatened ecosystems in the Southeastern United States (fig. 1f). In presettlement times, longleaf pine savannas occupied over 25 million ha of the Southeastern coastal plain from Texas to North Carolina; today, these forest ecosystems occupy less than 2 percent of that area, and old-growth stands account for only a few thousand hectares (Early 2004). Although much of the loss of longleaf pine savannas was caused by logging and deforestation for agriculture, historical changes in the role of fire have also played a significant role.

Longleaf pine savannas are especially well known for their high herb diversity. In moist areas that are frequently burned, herb diversity is exceptionally high and the relationship between fire and general patterns of biological diversity has been well studied (Christensen 1977, Walker and Peet 1983, Wells 1942). Many of these herbs have fire-dependent life history traits such as fire-stimulated flowering and fire-dependent patterns of growth. Exclusion of fire allows relatively few species to dominate and shade out competitors, resulting in a rapid decline in herb diversity.

As in many savanna ecosystems, frequent and low-intensity fires play a significant role in the maintenance of longleaf pine ecosystems. Presettlement fire-return intervals likely ranged between 3 and 10 years (Christensen 1981, Garren 1943, Wells 1942). Because of unique seedling characteristics, longleaf pine is especially well adapted to and dependent on this fire regime (Chapman 1932, Platt et al. 1988, Wahlenberg 1946). Disruption of historical fire regimes prevents such establishment, allows invasion of shrubs and other tree species, and creates conditions favorable to longer return intervals and higher intensity fire regimes (e.g., Myers 1985). The remnants of this ecosystem that have survived intensive land use are currently threatened by fire suppression activities.

**Scientific understanding of fire can inform policy, with the dual objectives of managing for fire-safe environments (where appropriate) and sustaining the functional integrity of fire-prone ecosystems.** The six systems discussed above illustrate regional variation in fire activity and ways in which fire management and other human activities have altered ecosystem processes. The examples present different patterns of fire hazard, fire risk (box 2), and patterns of human impact. Each system requires a different management strategy to achieve specific desired outcomes. One of the important lessons to be learned from these contrasts is that a single model of past fire regimes or appropriate fire management action is inappropriate (Johnson et al. 1998, Schoennagel et al. 2004, Veblen 2003). The diversity of North American ecosystems requires a comparable diversity in fire management, with a flexible approach that characterizes adaptive management.

## Fire Regimes as a Framework for Understanding Fire Processes

**Regionally focused fire management is premised on a consideration of spatial variation in mechanisms that drive ecosystem processes, and how these processes lead to different fire hazards in different ecosystems.** Such insights can best be gained by a clear understanding of the factors that influence fire behavior (Johnson and Miyanishi 2001), and how those factors differ across the landscape. Fire regime (Gill 1973, Heinselman 1981, Johnson and Van Wagner 1985) is an ecosystem attribute with both temporal and spatial domains (Morgan et al. 2001). Traditionally, fire regime has been defined by fire frequency, intensity, and seasonality. We suggest a more detailed definition that includes (1) fuel consumption and fire spread patterns, (2) intensity and severity, (3) frequency, (4) patch size and distribution, and (5) seasonality.

### Fuel Consumption and Fire Spread Patterns

Fires consume different fuelbed strata (sensu Sandberg et al. 2001), and each fuelbed stratum is involved in different aspects of combustion, energy release, and fire effects (Ottmar et al. 2007) (fig. 2). **Surface fires** are spread by fuels that are on the ground, which can be either living herbaceous biomass or dead leaf and stem material. **Crown fires** burn in the canopies of the dominant life forms, and the term is most usefully applied to shrub- and tree-dominated associations

## *Box 2.*
## Fire Hazard vs. Fire Risk

Fire hazard refers to a fuelbed defined by volume, type, condition, arrangement, and location—these characteristics determine ease of ignition and resistance to control (National Wildfire Coordinating Group 2005). Fire hazard expresses potential fire behavior for a fuelbed, regardless of weather-influenced content of fuel moisture. Fire risk is the probability or opportunity that a fire might start, as affected by the nature and incidence of causative agents, including both natural and human ignitions. For example, data on the distribution of lightning strikes can quantify the risk of ignition for a particular landscape. Fire risk is sometimes considered to be the potential change in resource condition or value (e.g., dead trees), or change in economic value associated with human activities (e.g., structures), although these situations actually refer to values at risk.

Some examples can illustrate the contrast between fire hazard and fire risk. Temperate rain forest with a fuelbed that includes high down wood has very high fire hazard, but fire risk is very low because it is unlikely that fuel moistures will be low enough to sustain fire even if an ignition source were available. Undisturbed dense chaparral has high fire hazard because its high fuel loads can generate high fire intensities. Fire risk in this system is generally low except during the summer when fuel moistures are very low and during autumn when Santa Ana winds contribute to fire spread. Standing dead trees in a forest that has experienced bark beetle attack have relatively low fire hazard and low risk of fires igniting and spreading through the crown. However, dead branches subsequently fall, and eventually the trees fall, contributing large amounts of fuels and increasing fire hazard over time.

Fuel reduction projects in forests are intended to reduce fire hazard by reducing surface fuels, continuity of fuels from the surface to the canopy, and continuity of fuels within the canopy. Fire risk is unaffected, but if a fire does occur, fire intensity and effects on the overstory may be less owing to the lower fuel loading. Fuel reduction projects near roads may have the unintended consequence of increasing annual weeds that generate highly combustible fuels (increased hazard), and thus facilitate ignitions (increased risk).

The relative effects of hazard versus risk differ across ecosystems and fire regimes. For example, high fire risk is normal in ponderosa pine forests that are resilient to frequent fire, but high fire hazard, which may occur following many decades of fire exclusion, can damage the overstory if fuel loadings are high enough to cause high flame lengths. In contrast, sustainability of chaparral shrublands is threatened when fire-return intervals are long, because high fire intensity does not typically affect recovery and sustainability of this ecosystem.

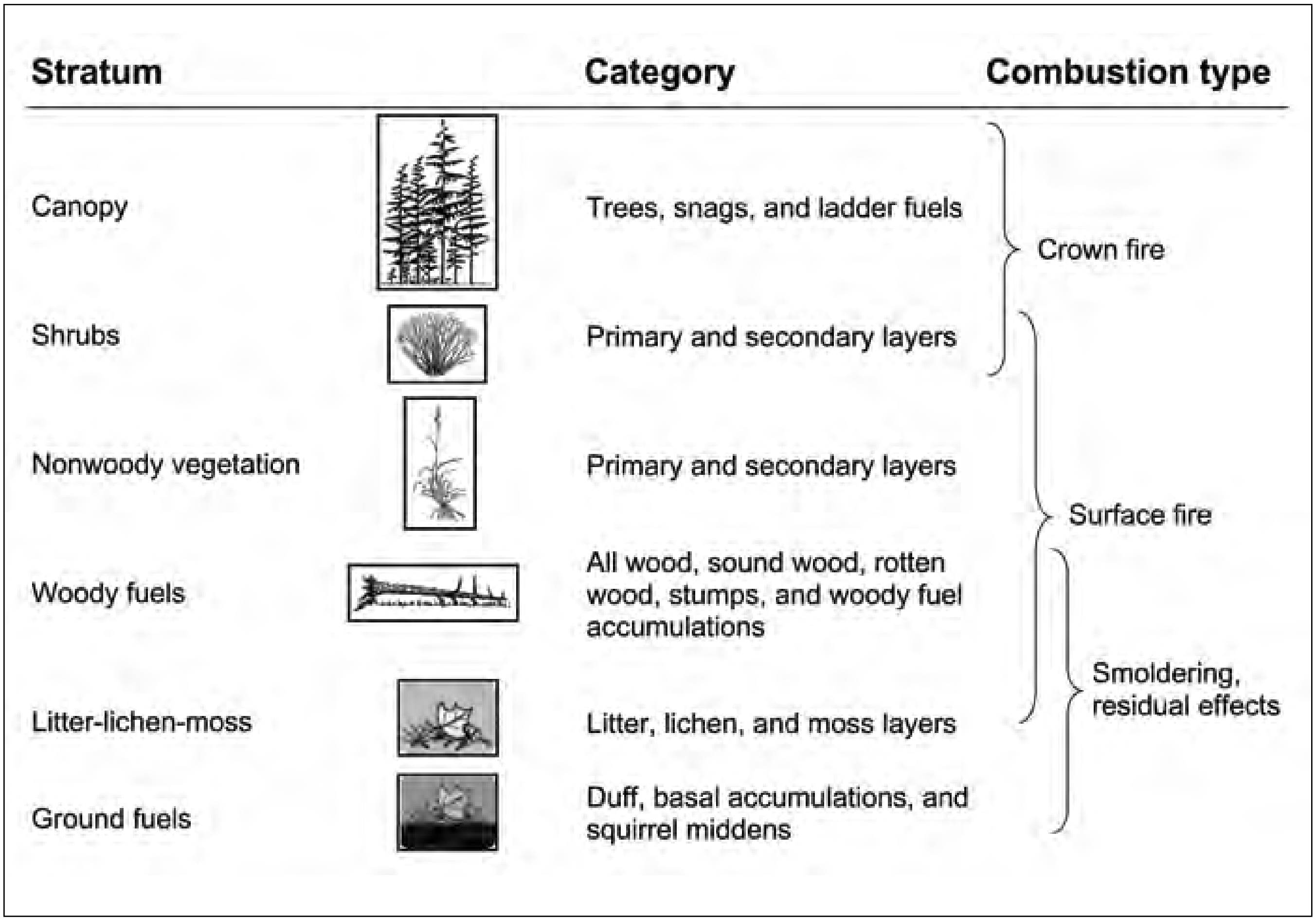


Figure 2—Fuelbed strata and their involvement in different types of combustion (from Ottmar et al. 2007).

(Scott and Reinhardt 2001, Van Wagner 1977). Crown fires tend to be less common in hardwood forests because of greater foliage moisture and lower canopy bulk density. **Passive crown fires** spread in surface fuels and then are carried into the canopy by shorter ladder fuels, often called "torching." **Active crown fires** are spread by both surface fuels and canopy fuels, but **independent crown fires** are not linked to surface fires, and generally require rather dense canopies and sufficient wind or steep terrain to carry fire. All of these surface and crown fire types are characterized by flaming combustion, whereas **ground fires** spread slowly by smoldering combustion through duff (or peat) and can be sustained at relatively high fuel moisture conditions (Miyanishi 2001). Because they can smolder for long periods, perhaps months, they may "store" ignitions from lightning fires during times when weather conditions are less suitable for more active burning, and then erupt into surface or crown fires with changes in weather or fuels.

Surface fires and crown fires have different effects on ecosystem processes and on the evolution of plant traits. For example, thick bark and self-pruning of lower branches are common traits in pines dominant under surface fire regimes, but thin bark, weak pruning, and serotinous cones are traits restricted to crown fire ecosystems (Keeley and Zedler 1998).

Some ecosystems are characterized by either surface fires or crown fires, but in many systems, mixtures of both fire types are common. These are sometimes called "mixed fire regimes" typified by a combination of surface fires and passive crown fires. The proportion of landscapes burned in one or the other fire type is a function of the time since last burning, rate of fuel accumulation, antecedent drought, and severity of fire weather. Sometimes such fires are referred to as being of moderate fire severity, but they are more properly called mixed-severity fires. Besides such spatial mixtures, some ecosystems experience a temporal mix of surface fires alternating in time with high-severity crown fires (Zimmerman and Omi 1998).

## Fire Intensity and Severity

Multiple burning patterns can occur in any given fire (fig. 3), with variation typically expressed by the terms intensity and severity. Fire intensity refers to the rate of energy release, or to other direct measures of fire behavior such as temperature or flame length. Fire severity refers to injury, loss of biomass, or mortality resulting from fire (Moreno and Oechel 1994). Although fire intensity and fire severity are often correlated, this is not always so. For example, high tree mortality commonly results from fires that burn actively in the canopy; however, fires that smolder in the duff are also lethal to some plants and animals (Sackett et al. 1996). Winter prescription burns in California chaparral typically generate lower fire intensities, but are more lethal to shrub regeneration (Keeley and Fotheringham 2003).

For many purposes the best physical descriptor of fire intensity is fireline intensity, which is the rate of heat transfer per unit length of the fire line (kW/m) (Byram 1959). This represents the radiant energy release in the flaming front, but is not specifically a measure of temperature (Alexander 1982). This is an important characteristic for propagation of a fire and thus has been built into models of fire behavior used during fire suppression activities in the United States (Rothermel 1983). In practice, flame length has been found to correlate with fireline intensity and is often used in such models because it is easier to measure (Andrews 1986). However, this relationship has not been widely tested, and accuracy likely differs depending on the ecosystem (Cheney 1990).

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Figure 3—The Aspen Fire burned over about 34 000 ha in June 2003 in the Santa Catalina Mountains near Tucson, Arizona. This human-ignited fire burned in a mosaic pattern of mixed severity, with (foreground) understory surface burn, including small patches of passive crown fire, and (background) active crown fire in ponderosa pine and mixed conifer on the steep slopes. Over 200 homes and commercial buildings burned in the village of Summerhaven, located just below the mountain ridgeline at right center in the photograph.

Fireline intensity has been used to predict scorch height of conifer crowns and other biological impacts of fire (Albini 1976, Borchert and Odion 1995), whereas other system components such as non-wettable layers in soil may be more closely related to duration of soil heating (DeBano 2000), and survival of seed banks may be more closely tied to maximum soil temperatures (Bradstock and Auld 1995).

Despite the importance of fire-intensity measures, fire managers do not always have the luxury of controlled experiments and are faced with describing fires after they have occurred. Fire effects such as extent of biomass loss and mortality are termed fire severity, and these are often correlated with fire intensity (e.g., Dickinson and Johnson 2001, Moreno and Oechel 1994). In ecosystems characterized by crown fire, all aboveground biomass is typically killed, and thus in these systems mortality may not be strongly tied to fire intensity. Fire intensity can have an effect on postfire resprouting of hardwoods and shrubs and thus is sometimes considered a measure of fire severity. However, because some species are incapable of resprouting, this cannot be used as a measure of fire severity without accounting for spatial variation in community composition.

Fire severity is often interpreted as a measure of ecosystem effects, defined as the capacity for regeneration of plant cover and community composition as well as recovery of hydrologic processes (National Wildfire Coordinating Group 2006). However, fire severity and ecosystem responses should be considered separately. Although they may be closely coupled in some ecosystems (e.g., in some forest types, high fire severity is coupled with poor regeneration), they are largely uncoupled in other ecosystems (e.g., in California chaparral, high fire severity is only weakly tied to the capacity for revegetation) (Keeley et al. 2005a). Also, watershed hydrologists often describe fire severity in terms of damage to physical soil structure that may affect erosion processes (Moody and Martin 2001), but although fire per se consistently affects watershed hydrology, the degree of fire severity sometimes does not (Doerr et al. 2006).

**Assessing fire frequency can involve considering complex fire behavior at different spatial scales.**

## Fire Frequency

**Fire frequency** is the number of occurrences of fire within an area and time period of interest. **Fire rotation interval** is the time required to burn the equivalent of a specified area, whereas **fire return interval** is the spatially explicit time between fires in a specified area. For example, wildlands in southern California have an average fire rotation interval of 36 years, but this can range from fires every few years at some sites to fires every 100 years at other sites (Keeley et al. 1999).

Assessing fire frequency can involve considering complex fire behavior at different spatial scales. At very broad spatial scales, fire frequency in ecosystems characterized by crown fire, such as the boreal forest or sagebrush, involves stand replacement and is documented in fire atlases or by time-since-last-fire (stand age) maps estimated from aerial photography and tree rings (fig. 4). One limitation to determining the historical extent of crown fires in forests is that many of the lower elevation forests of western North America have been logged, making it difficult to determine if large fires ever occurred on much of this landscape.

In surface-fire regimes, low-intensity fires documented in fire-scarred trees provide a unique record of long fire histories that typically span 200 to 500 years (fig. 5), and in the case of giant sequoias about 3,000 years (Swetnam 1993). Tree-ring-dated fire scar records have temporal resolutions of years

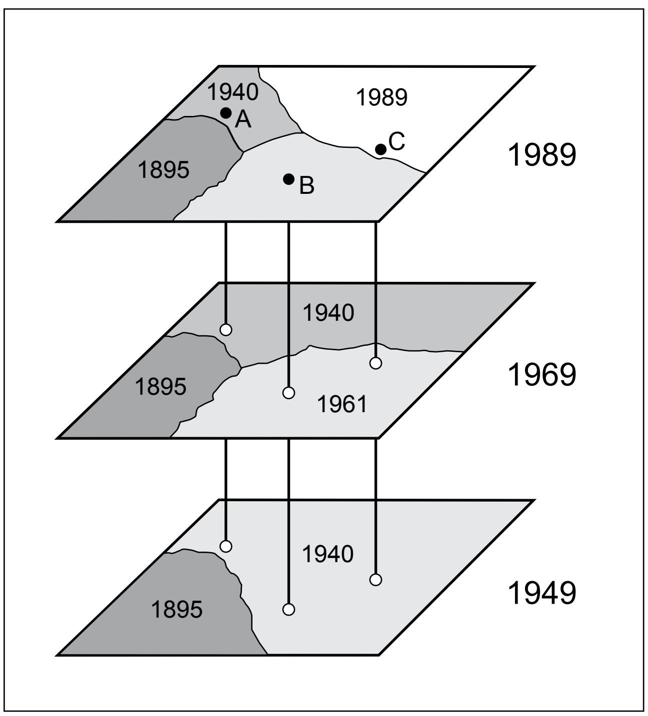


Figure 4—Layers making up time-since-last fire map created by burning over of previous burns.

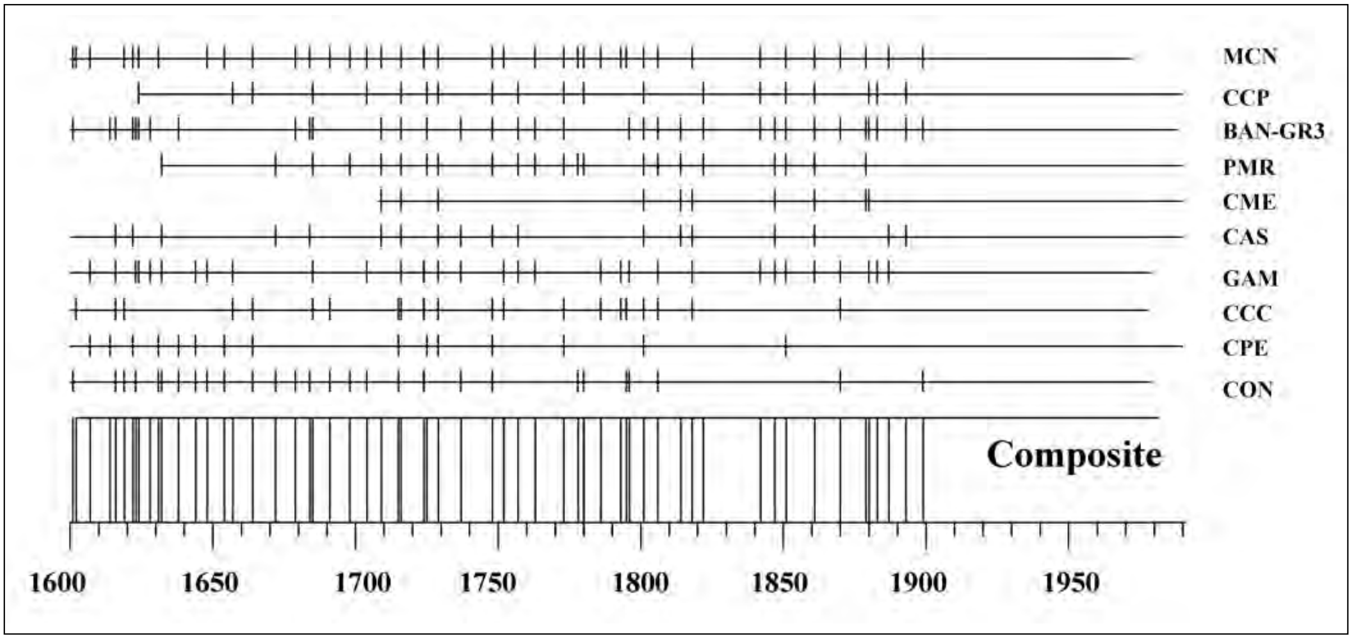


Figure 5—A 400-year set of fire-scar chronologies from 10 forest stands in the Jemez Mountains, New Mexico. These stands are broadly distributed around the mountain range, spanning an area of about 50 000 ha. The horizontal lines and tick marks in the upper graph show timespans and fire dates, respectively, of fires recorded by any sampled fire-scarred tree within each of the stands. The bottom graph shows the same stand chronologies, but only fire dates recorded by 25 percent or more of the trees within each of the stands. The long vertical lines at the bottom show the composite of all dates for each graph. Note that the 25 percent filter emphasizes fires that were probably relatively widespread within and among stands. The surface-fire regime disruption ca. 1900 is evident in both graphs. Early and persistent disruption of the fire regime is evident in the three lowermost stands (CCC, CPE, and CON); this is attributed to early livestock grazing in these specific sites. An early-1800s gap in fire occurrence in all chronologies is most apparent in the 25 percent filtered chronologies (bottom graph), possibly caused by a decadal-scale cool period during this interval (Kitzberger et al. 2001). MCN = Monument Canyon Natural, CCP = Capulin Canyon, BAN-GR3 = Ban-Group 3 (Apache Mesa), PMR = Pajarito Mountain Ridge, CME = Camp May East, CAS = Cañada Bonito South, GAM = Gallina Mesa, CCC = Clear Creek Campground, CPE = Cerra Pedernal, CON = Continental Divide.

and seasons (Dieterich and Swetnam 1984), which enable detailed spatial analyses when sampled over defined areas (e.g., Reed and Johnson 2004). Fire-scar dendrochronology has shown that fire frequency differs in a fine-grained spatial pattern, often with marked differences between north- versus south-facing slopes or upper slopes versus lower slopes (Caprio 2004, Caprio and Graber 2000, Hessl et al. 2004, Norman and Taylor 2002). In addition, regional networks of fire scar chronologies often show synchronous fire events among multiple watersheds and mountain ranges, and these events are often well-correlated with drought and atmospheric circulation indices (e.g., Hessl et al. 2004; Kitzberger et al. 2001, 2007; Swetnam and Betancourt 1990).

Charcoal and pollen deposits can provide fire frequency estimates covering the past 10,000 years or longer, but typically at temporal resolutions of decades to centuries (Clark and Robinson 1993, Millspaugh et al. 2004). These studies have shown vegetation changes in concert with changes in climate and fire (Whitlock et al. 2004). Of particular importance is the recognition that fire regimes have differed markedly throughout the Holocene such that fire regimes present at the time of Euro-American contact were in some cases relatively short-lived phenomena that were preceded by different fire regimes in earlier times (Millspaugh et al. 2004).

Each of these fire-dating approaches presents challenges to correctly interpreting fire occurrence measures. Fire-scar records from individual trees can approximate the frequency of fire that occurred around a particular tree, but because a minority of trees in forests are scarred in surface fire regimes, and not all previously fire-scarred trees are rescarred during subsequent fires, fire event records from single trees are generally considered conservative estimates of point-fire occurrence. A composite fire frequency can be generated for a forest stand on the scale of about 10 ha or larger, with standwide fire frequencies estimated by an inventory of fires that scarred some minimal percentage (e.g., 25 percent) of sampled fire-scarred trees during the same year within the stand (Dieterich 1980, Swetnam and Baisan 1996). At the stand scale, this method captures the frequency of relatively widespread fire events (if samples are well distributed) but ignores intrastand spatial variation (e.g., fig. 6). Thus, for a given point, it is potentially an overestimate of fire frequency. Fire frequencies from fire-scar composites (or any other reconstruction method) differ as a function of the study area and sample size (Baker and Ehle 2001, Falk and Swetnam 2003, Hessl et al. 2004, Van Horne and Fúle 2006, Veblen 2003). Fire history reconstructions based on stand age and structure (e.g., Johnson and Gutsell 1994) are limited by low spatial resolution of past fire perimeters and intrastand variations, low temporal resolution of some past fire dates, and potential biases in model estimations of stand-age distributions and fire frequencies (Finney 1995).

Fire frequency estimates based on charcoal deposition are affected by wind patterns that affect dispersion of particles, which in turn are affected by particle size, which in turn is a function of fuel type, as well as sediment movement. Charcoal abundances in sediment cores may be functions of both fire frequency and severity, with concentrated charcoal layers (or charcoal "peaks") in the time series reflecting either individual high-severity events, frequent fire periods, concentrated erosion periods, or all of these processes in combination. Documentary sources of fire history (e.g., repeat aerial photographs and fire atlases) are also subject to errors, omissions, and problems of low temporal or spatial resolution (Morgan et al. 2001). Despite these limitations of data and methods of fire history reconstruction, both paleoecological and documentary sources have proven useful in providing knowledge of past fire regimes and their controls across a broad range of spatial and temporal scales (Morgan et al. 2001).

## Fire Patch Size and Distribution

Fire size differs from a lightning-ignited fire that remains localized around the tree it strikes, to massive boreal forest crown fires that burn millions of hectares. On most landscapes, a small proportion (5 percent or less) of fires account for 95 percent of the area burned (Strauss et al. 1989). This means that it is primarily the very large fires in the tail of the size distribution that determine the age distribution and spatial age mosaic of the landscape. Thus, for both ecological and practical reasons, large fires are often of most concern to fire and resource managers.

Distributions of overall fire size differ regionally and between surface fire and crown fire regimes. Likewise the size of different fire-severity patches within fire perimeters may differ greatly, creating a mosaic of patches (fig. 6). Many forests exhibit complicated patterns of fuel consumption, comprising a mixture of surface

**Many forests exhibit complicated patterns of fuel consumption, comprising a mixture of surface fire, crown fire, and unburned patches.**

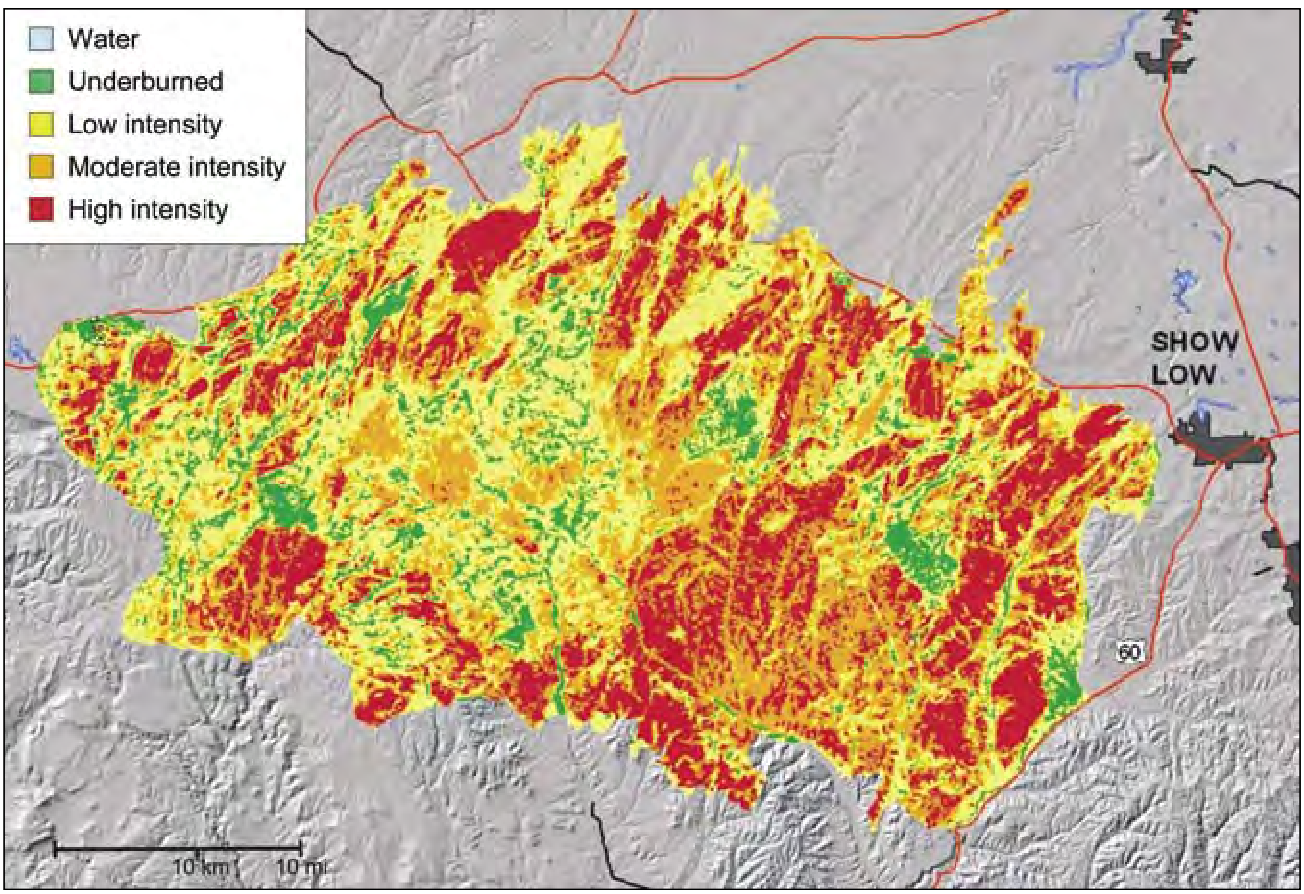


Figure 6—Mosaic fire pattern mapped for the Rodeo-Chedeski Fire, Arizona. Mapping was done by a Burned Area Emergency Response team, using a combination of remotely sensed data and on-the-ground observations. Severity categories were largely qualitative and coarse resolution, intended mainly for showing approximate spatial patterns of burn severity. High severity indicates locations where all or most vegetation was blackened and killed, and the ground was covered only with ash. Moderate severity indicates a mosaic of green areas and burnt areas, and the ground was covered with a mixture of ash, leaf litter, and unburned organic matter. Low severity indicates that some trees, shrubs, and grasses were burnt, but most of the vegetation remained green.

fire, crown fire, and unburned patches. This heterogeneity is important to ecosystem processes such as tree recruitment (Bonnet et al. 2005). For example, in the mixed-conifer forests of the Sierra Nevada in California, patches of high-intensity fires produce light gaps for tree regeneration (Rocca 2004, Stephenson et al. 1991). These gaps also accumulate fuels at a slower rate, and thus have a greater probability of fires missing them until saplings reach sufficient size to withstand fires (Keeley and Stephenson 2000).

Patch distribution at large spatial scales differs among ecosystems and affects patterns of vegetation recovery and habitat structure for animals. Mixed-conifer forests in the Western United States are particularly sensitive to patch-size distribution. The historical fire regime was often a mixture of surface fires, which left dominant trees alive, and passive crown fires that killed all trees within small patches from a few hundred square meters to a few hectares. A similar pattern may have prevailed in ponderosa pine forests in the central and northern Front Range of Colorado (Brown et al. 1999, Ehle and Baker 2003, Sherriff 2004). When patch size is hundreds or thousands of hectares, regeneration may be limited because the dominant trees lack a dormant seed bank, either in the soil or stored in serotinous cones. Reproduction (at least in the short term) requires mixed fire regimes that generate gaps in the canopy but allow survival of parent seed trees within dispersal distance (Allen et al. 2002, Greene and Johnson 2000, Savage and Mast 2005, Weyenberg et al. 2004). In boreal forests, the area of unburned patches per unit of area burned may remain constant during periods when climate is not greatly changing (Johnson et al. 2003). Thus, despite variation in fire size (taken to be the total area within the burn perimeter), the maximum dispersal distance either from the burn perimeter or from surviving patches typically is not greater than about 150 m (Greene and Johnson 2000).

Chaparral shrublands commonly experience large crown fires that cover significantly more than 10 000 ha. Heterogeneity of fire severity patches within the overall perimeter is relatively low as fires burn in a rather coarse-grained pattern of uniform high severity. This poses no threat to most plant species in these systems because regeneration mostly depends on dormant seed banks and resprouting from basal lignotubers. However, such large fires may inhibit recovery of large fauna that must disperse back into burned areas, a management concern in chaparral landscapes fragmented by roads and structures.

## Fire Seasonality

Fire seasonality is a function of the coincidence of ignitions with fuel conditions. Fire seasons generally center around the driest time of the year, but other factors may be involved. For example, in monsoon climates of the Southwestern United States, most area burned occurs in May or early June, whereas most fires are ignited in late June or early July when monsoon lightning storms break a several-month spring drought. Fires in eastern deciduous forests tend to be concentrated in late winter and early spring, coincident with surface leaf litter accumulation dried by open canopies. Mediterranean climates have fires spread out through the summer until ended by winter rains. In southern California, fire season may last 6 to 9 months, whereas in boreal forests, it may be constricted to 1 to 3 months, depending on annual climate patterns.

The peak numbers of ignitions do not always coincide with peak area burned, particularly where human-caused ignitions dominate. Season of burning affects types of fuels consumed, fire intensity, and composition of postfire herbaceous vegetation (Knapp et al. 2005, Snyder 1986). In California chaparral, winter burning may limit postfire recovery because of the truncated winter-spring growing season for postfire vegetation (Keeley 2006).

# Climate and Weather Effects on Fire Regimes

Climate and weather affect fire regimes in a diversity of ways in North American ecosystems, and understanding these relationships will improve predictions and management of future fire activity. Climate comprises atmospheric processes that characterize broad spatial and temporal scales ($10^4$ to $10^9$ km$^2$, seasons to millennia), whereas weather encompasses relatively fine-scale processes (1 to $10^4$ ha, minutes to seasons). Recent advances in fire climatology have led to the development of long-range fire forecasting tools that are most appropriate for regional scales and seasonal planning. Approaches include statistical associations between seasonal and interannual climate with regional fire activity (Collins et al. 2006, Westerling et al. 2002) and use of mechanistic models to predict fire responses to climate changes (e.g., Flannigan et al. 2000, Lenihan et al. 2003). Fire meteorology focuses on the fine-scale weather and other physical processes that drive fire behavior, and are used both in firefighting operations and to differentiate the relative roles of weather and fuels in determining fire behavior. The influence of weather conditions on fire behavior has been incorporated into fire behavior and spread models and fire danger rating systems (e.g., Finney 1998, Rothermel 1983, Van Wagner 1987).

## Climate and Fire Activity

Climate affects fire regimes by affecting fuel moisture, and thus flammability, and by changing patterns of primary productivity, and thus fuel quantity. Climate, of course, also affects the frequencies and magnitudes of various weather variables occurring at finer temporal and spatial scales. Over much of the Western United States there is a strong seasonal to interannual link between precipitation and fire with various time lags (Gedalof et al. 2005, Westerling et al. 2002). The negative correlation between fire activity and current-year rainfall is a direct consequence of effects on fuel moisture. However, 1- to 2-year lags with a positive relationship between rainfall and fire activity may reflect the effects of moisture on herbaceous fuel loads (Donnegan et al. 2001, Grissino-Mayer and Swetnam 2000, Knapp 1998, Westerling et al. 2002). Support for this interpretation comes from the lack of such lags in vegetation types without a substantial herbaceous fuel component (Littell 2006), such as in some Southwestern U.S. and Sierra Nevada mixed-conifer forests (Swetnam and Baisan 1996, 2003) and southern California chaparral (Keeley 2004).

**Climatic variability over the last century may have had a greater role than management activities in changes in fire behavior and effects in some regions and ecosystems.**

Climatic variability over the last century may have had a greater role than management activities in changes in fire behavior and effects in some regions and ecosystems. Recent studies show correlations among warming temperatures, earlier springs, and increased numbers of large forest fires in some parts of the Western United States (Westerling et al. 2006), and in Canada (Gillett et al. 2004). Anticipated warming trends as a consequence of greenhouse gas accumulation may lead to further increases in the numbers of large fires and total area burned in some regions (Brown et al. 2004, Flannigan et al. 2005, McKenzie et al. 2004). However, global climate changes are expected to produce large changes in vegetation distributions at unprecedented rates, particularly in semiarid fire prone ecosystems (Allen and Breshears 1998). These anticipated changes in fuel distribution could reduce fire activity in some regions and lead to unanticipated impacts on future fire regimes.

Climate signals are likely responsible for regional synchrony in fire activity evident in many parts of the Western United States (e.g., Swetnam and Baisan 2003, Weisberg and Swanson 2003). Similar relationships are evident in earlier warmer periods such as the Medieval Warm Period (1000 to 650 years B.P.) that have been shown to be associated with increased fire frequency (Clark 1988, Swetnam 1993, Umbanhowar 2004), and incidence of large fires (Millspaugh et al. 2004) in some regions. Climate-controlled changes in fuel production may also explain longer term patterns in fire activity. Higher levels of biomass may reflect the shift from cooler and drier conditions of the Little Ice Age (500 to 100 years B.P.) to warmer moister conditions of the 20th century (Mann et al. 1998), which may be partially attributable to human-caused forcing (Meehl et al. 2003). The climatic and ecological effects and timing of the Medieval Warm Period and Little Ice Age were highly variable (Hughes and Diaz 1994); some regions show no evidence of one or both of the episodes, and where they did occur, the timing of the warmest or coldest phases are sometimes asynchronous between regions. Therefore, without independent historical climate evidence, it cannot be assumed that the predominant conditions of these periods occurred everywhere.

Climate and weather control fire behavior ultimately through their effect on fuels. Fuels must be dry enough for fires to be propagated; the drier the dead fine fuels, the more fuel is involved in combustion and the more heat can be produced to drive moisture from live fuels. Fuels dry only when the weather is warm and dry, and that occurs when persistent high pressure systems block the normal westerly progression of highs and lows in the Northern Hemisphere. Thus, large fires are primarily controlled by large-scale mid-tropospheric anomalous patterns that affect the synoptic-scale weather and the amount of surface heating (Bessie and Johnson 1995, Gedalof et al. 2005, Schroeder et al. 1964).

Several climate patterns produce such blocking high-pressure systems in parts of North America and create extreme fire weather. The El Niño-Southern Oscillation (ENSO), with the alternating El Niño (warm phase) and La Niña (cool phase) events, is manifested as sea surface temperature anomalies in the tropical Pacific Ocean and associated changes in atmospheric pressure and circulation patterns. El Niño is linked to wetter winter and spring conditions and reduced area burned in the Southeastern and Southwestern United States (Beckage et al. 2003, Simard et al. 1985, Swetnam and Betancourt 1990, Veblen et al. 2000). This pattern is typically reversed in the Pacific Northwest and Central and South America, where El Niño events are often associated with drier conditions and increased fire occurrence (Hessl et al. 2004, Heyerdahl et al. 2002, Kitzberger et al. 2001). La Niña typically produces the reverse pattern, with severe winter-spring droughts and large fires in the Southwest, and reduced fire activity in the Northwest (Kitzberger et al. 2007, Schoennagle et al. 2005). These are general patterns, and ENSO events vary in strength and effects on climates and fire occurrence in particular regions.

The Pacific North America (PNA) pattern and the associated Pacific Decadal Oscilllation (PDO) affect area burned in the northwestern and interior Western United States and Western Canada (Johnson and Wowchuk 1993, Skinner et al. 1999). The positive mode of the PNA is characterized by an anomalous strong trough of low pressure over the North Pacific, upstream of a ridge of high pressure over western and eastern North America. The location of the high generally extends from the Canadian Rocky Mountains in Alberta to the interior Western

United States. When such conditions occur in spring or summer, the blocking high produces an extended period of warm, dry weather that causes extreme drying of forest fuels. This pattern has been associated with most of the big fire years in the past 20 years in the Southern Canadian Rocky Mountains and interior Western United States.

The frequency of these large-scale atmospheric patterns and their associated blocking highs, particularly in spring and summer, largely determine the frequency of severe fire weather and likelihood of high-intensity fires that burn large areas. Historical variability in these synoptic conditions makes it difficult to infer the relative influence of climate and management activities (e.g., fire suppression that leads to fuel accumulation) on fire activity. Even in relatively recent times, climate shifts could have affected fire activity. For example, since the 1970s the PNA (and PDO) pattern has changed, resulting in a deeper Aleutian low shifted eastward (Trenberth and Hurrell 1994), accompanied by increases in sea surface temperatures along the west coast of North America (Hurrell 1996). Besides ENSO, PDO, and PNA climate-fire associations, some recent studies of modern and paleo records (fire scars) have identified multidecadal correlations of the Atlantic Multidecadal Oscillation (AMO) and fire occurrence time series from western North America (Brown 2006, Collins et al. 2006, Kitzberger et al. 2007, Sibold and Veblen 2006).

The oscillatory climate patterns mentioned above reflect a revolution in our understanding of the ocean-atmosphere system, with implications for fire climatology and the biogeography of fire. These climate-fire patterns are more-or-less persistent over periods of seasons to decades, and are "quasi-periodic" (i.e., not classically cyclical, but recurrent within a particular range of periods). The temporal persistence and quasiperiodic nature of these events and processes mean that long-range fire danger can potentially be forecast as an aid to fire managers and planners.

## Fire Weather

Weather conditions sufficient to allow combustion and fire spread differ among fire regimes. For example, surface fires typically burn dead biomass, and the threshold for fire spread occurs at lower windspeeds and higher relative humidities than for crown fires in which fuels are commonly living material (Weise et al. 2003). Large fires that resist suppression efforts occur under severe fire weather conditions that include high temperatures, low humidities, and high surface winds (Brotak and Reifsnyder 1977, Schroeder et al. 1964). The largest fires generally are associated with the extremes of these conditions, as illustrated by the Hayman Fire in Colorado (June 2002). The previous 2 years were warm and dry, which promoted drying of fuels. During the first 10 hours, the fire consumed less than 500 ha, but after a shift in weather that brought wind gusts up to 85 km per hour, with 5 to 8 percent relative humidity, the fire consumed nearly 25 000 ha in the subsequent 24 hours (Graham 2003).

Synoptic or regional weather patterns that generate high winds are a major determinant of fire size on some landscapes. Wind increases combustion by mixing of oxygen within fuelbeds and by altering the flame angle such that there is greater heating of fuels ahead of the flaming front. Lacking significant wind, fires develop plumes that convect heat vertically and do not preheat fuels ahead of the flaming front (Rothermel 1991). Thus, it is to be expected that fuel treatments such as understory thinning would be less effective as windspeed increases.

In the eastern half of the United States, large fires appear to be associated with intense high-pressure troughs that bring strong winds without surface precipitation during the passage of a cold front (Brotak and Reifsnyder 1977). Foehn winds (strong warm dry winds that move down the lee sides of mountains) are also often associated with large uncontrollable fires in some mountainous regions. For example, in southern California, Santa Ana winds occur when a high-pressure system centered over the Great Basin coincides with a low-pressure trough off the California coast (Schroeder et al. 1964), reversing the normal pressure gradient that causes onshore breezes from the Pacific Ocean. The air is channeled south and west out of the Great Basin around the northern and southern end of the Sierra Nevada. These dry, gusty continental winds lose their moisture on the windward ascent and are further dried through adiabatic warming on the leeward descent. They not only cause excessive drying of fuels but can turn wildfires into firestorms. These winds typically occur in fall and early winter, after the summer dry season in southern California and are associated with most large fires in the region. As human populations have increased in this area, ignitions during severe weather events have also increased (Keeley and Fotheringham 2003).

Model studies also conclude that fire spread and intensity are more sensitive to weather variables than to fuel (Bessie and Johnson 1995). Comparative study of five different fire models that were designed for landscapes as diverse as Australian eucalyptus forests and northern Rocky Mountain conifer forests, all with mixed-severity or crown fire regimes, consistently showed a strong connection between weather, climate, and fire, and a lesser role for fuels (Cary et al. 2005).

It has been argued that, historically, fires in some vegetation types such as ponderosa pine savanna were not controlled by fire weather, and contemporary weather-driven high-severity fires in these forests are related to fire suppression and elevated fuel accumulations (Agee 1997). Fuel accumulation and forest structure changes are likely involved in recent fire regime changes in Southwestern U.S. ponderosa pine and mixed-conifer forests (e.g., Allen et. al. 2002, Fulé et al. 2004a) and in parts of the interior Pacific Northwest (Hessburg and Agee 2003), although crown fires of some unknown spatial extent may have played a natural role in these forest types in other regions (Ehle and Baker 2003, Pierce et al. 2004, Sherriff 2004). On some North American landscapes, weather effects on fire behavior are far more critical than antecedent climate impacts on fuels. For example, predictable annual autumn foehn winds in southern California are the primary determinant of large fires (Schroeder et al. 1964), and therefore droughts show little or no relation to interannual variation in area burned (Keeley 2004). However, droughts are associated with a lengthening of the fire season outside the foehn wind season.

## Biogeographical Patterns of Fire Regimes

Fire regime parameters differ in space and time and are affected by a complex set of factors. Nevertheless, there are patterns that can be recognized and used in designing fire management strategies. Fuel consumption forms the basis of most classification schemes, the most basic scheme being surface fire regimes, crown fire regimes, and mixed surface and crown fire regimes. These patterns are linked to differences in fire frequency and fire intensity such that modal groupings that capture much of the landscape variation in fire regime parameters can be recognized. For most applications, fire regimes can be categorized into three general classes of intensity and frequency: low-intensity, high-frequency surface fire; high-intensity, low-frequency crown fire; and mixed-severity fire regimes.

Schmidt et al. (2002) partitioned surface fire regimes into those in which surface fire burns under a canopy of overstory trees and those that burn in the open. They partitioned crown fire regimes into those that burn at frequencies of a century or less and those that burn very infrequently (table 1). They also classified contemporary landscapes based on departure from historical fire occurrence (table 2). These classes represent modal points on a continuum of fire regimes, and fire regimes in a particular vegetation type may differ regionally. For example, ponderosa pine forests in the Southwest generally burned frequently at low intensities, but farther north in the Rocky Mountains, some ponderosa pine had a mixed-severity fire regime (Schoennagel et al. 2004, Veblen et al. 2000).

Although this simple classification explains much of the variability among ecosystems, the multiple factors discussed earlier combine to create a wide variety of multidimensional fire regimes. Patterns of ignition and timing of burning differ regionally and in concert with seasonal changes in climate (Bartlein et al. 2003). In

**Table 1—Fire regime types[a] [b]**

| Fire | Fire-return interval | Fire spread driven by | Fire intensity | Fire effects | Ecosystem examples |
|---|---|---|---|---|---|
| | *Years* | | | | |
| I | 1–35 | Surface and other low understory fuels | Heavy understory and fuel consumption | Low to moderate fuel overstory mortality | Ponderosa pine, longleaf, pine oak savanna |
| II | 1–35 | Mostly surface fuels | Low to moderate | Aboveground biomass killed, most fuels consumed | Grassland, low scrub |
| III | 35–100 | Surface and canopy fuels | Mixed high and low | High understory mortality and fuel consumption, thinning of overstory | Western mixed-conifer, forest Appalachian pine-hardwoods |
| IV | 35–100 | Mostly canopy fuels | High | Aboveground biomass killed, high fuel consumption | Chaparral, boreal forest, sagebrush |
| V | >200 | Mostly canopy fuels | High | Aboveground biomass killed, high fuel consumption | Lodgepole pine forest, subalpine forest, Eastern U.S. deciduous forest |

[a] These are modal groups from a continuum of patterns seen in nature. See Kilgore (1987) for summary review of fire regime literature.
[b] Source: Modified from Schmidt et al. 2002.

**Table 2—Fire condition classes categorizing potential vegetation on landscapes for departure from historical fire regimes[a]**

| Condition class | Risk of ecosystem change | Condition of contemporary fire regimes |
|---|---|---|
| 1 | Low | Falling well within the historical range of variability |
| 2 | Moderate | |
| 2a | | Fire frequency at the low end of the range |
| 2b | | Fire frequency at the high end of the range |
| 3 | High | |
| 3a | | Fires excluded to the point where multiple expected fire-return intervals have been missed |
| 3b | | Fires greatly increased to the point where resilience thresholds are exceeded and type conversion occurs |

[a] Source: Modified from Schmidt et al. 2002.

southern California (fig. 7b) and the eastern Appalachians (fig. 7e) human-caused ignitions dominate, but with different seasonal patterns. There is substantial regional climate variation that exhibits different patterns even within similar fire regime types. For example, peak burning in longleaf pine (fig. 7f) coincides with peak lightning fires in July, whereas the same fire regime in ponderosa pine (fig. 7a) exhibits peak burning earlier in the season and offset from the lightning fire peak. Crown fire regimes in the boreal forest (fig. 7c) exhibit a June peak in burning that is driven largely by lightning, whereas southern California chaparral (fig. 7b) has an autumn peak, and lightning plays only a minor role.

**There is substantial regional climate variation that exhibits different patterns even within similar fire regime types.**

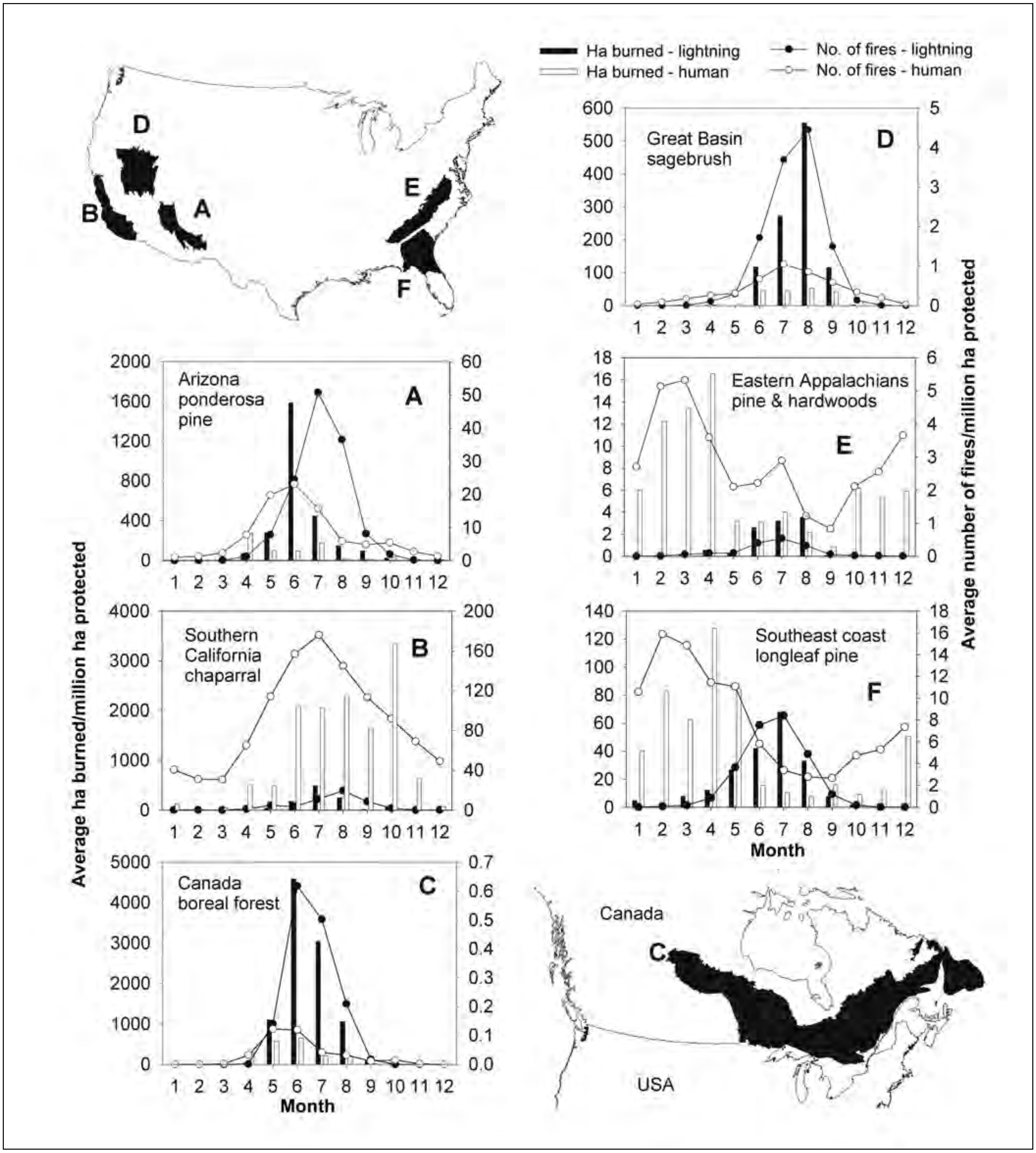


Figure 7—Seasonal distribution of lightning-ignited and human-ignited fires and area burned per million ha protected for (A) central Arizona ponderosa pine dominated landscape, (B) southern California coastal chaparral, (C) Canada boreal forest, (D) Great Basin sagebrush, (E) southeastern Appalachian pine and hardwood, (F) Southeast Coastal Plain longleaf pine landscape. A, B, D, E, and F are based on data from Schmidt et al. 2002, (A) subregions 54 and 59; (B) Santa Barbara, Ventura, Los Angeles, San Bernardino, Riverside, Orange, and San Diego Counties, (D) subregion 12, (E) subregions 43 and 59, (F) subregion 55. C is based on the Canada Large Fire database, Canadian Forest Service, Boreal Shield Ecozone, fires >200 ha for 1949 to 1999.

## Recent Changes in Fire Regimes

Detecting trends is complicated by the fact that during the 20th century, there has been considerable annual variation in area burned relative to area protected (fig. 8). The highest year of burning has occurred within the last two decades in the Southwest (fig. 8a), southern California (fig. 8b), the Great Basin (fig. 8d), and Canada (fig. 8c), making this period stand out, not only in these figures but in the minds of the public as well. In addition, in some of these regions, the frequency of high fire activity years has been greater in recent decades.

In the Southwest, one or more fires (or fires that joined to form complexes) exceeded 20 000 ha in every year between 2000 and 2004. Before this period, fires of such magnitude were uncommon. Several fires exceeding 40 000 ha occurred in 2003 and 2004. The 168 000 ha Rodeo-Chediski Fire (central Arizona, 2002) was two fires that merged, and collectively this event was many times larger than any single fire in Southwestern conifer forests during the previous century.

The historical record for Canada illustrates a pronounced recent change in fire activity (fig. 8c). Some have questioned whether or not this is driven by artifacts of sampling such as changes over time in area protected (Murphy et al. 2000), because for most regions, the size of the sample area from which fire statistics are drawn tends to increase with time (Podur et al. 2002). Van Wagner (1987) addressed this issue by incorporating a correction factor to account for historical changes in area sampled, and this correction is incorporated into the Canadian Large Fire database on which fig. 8c is based. However, this correction does not appear to account for all of the areas Stocks et al. (2003) indicated were likely missing from the early records. Other measures of fire activity, though, suggest that the recent increase in fire activity in the last two decades is not an artifact of sampling different size areas (Girardin 2007).

Such increases in recent fire activity are not characteristic of all regions. Indeed, in the Southeast (fig. 8e) fire activity has declined in recent decades. In southern California (fig. 8b), high fire activity years have occurred at periodic intervals throughout the 20th century, and there are no obvious trends in area burned. The magnitude of area burned (fig. 8) shows that, for most decades throughout the 20th century, southern California has had a substantially greater proportion of its landscape burned than any other region considered here.

Although recent area burned in the Southwest was exceptional on the scale of the past century, longer historical records estimated from newspaper accounts indicate that some 19th-century fires in the Southwest exceeded 400 000 ha (Bahre 1985). Broadly synchronous 17th- to 19th-century fire-scar dates recorded across many Southwestern mountain landscapes lead to similar conclusions: much larger

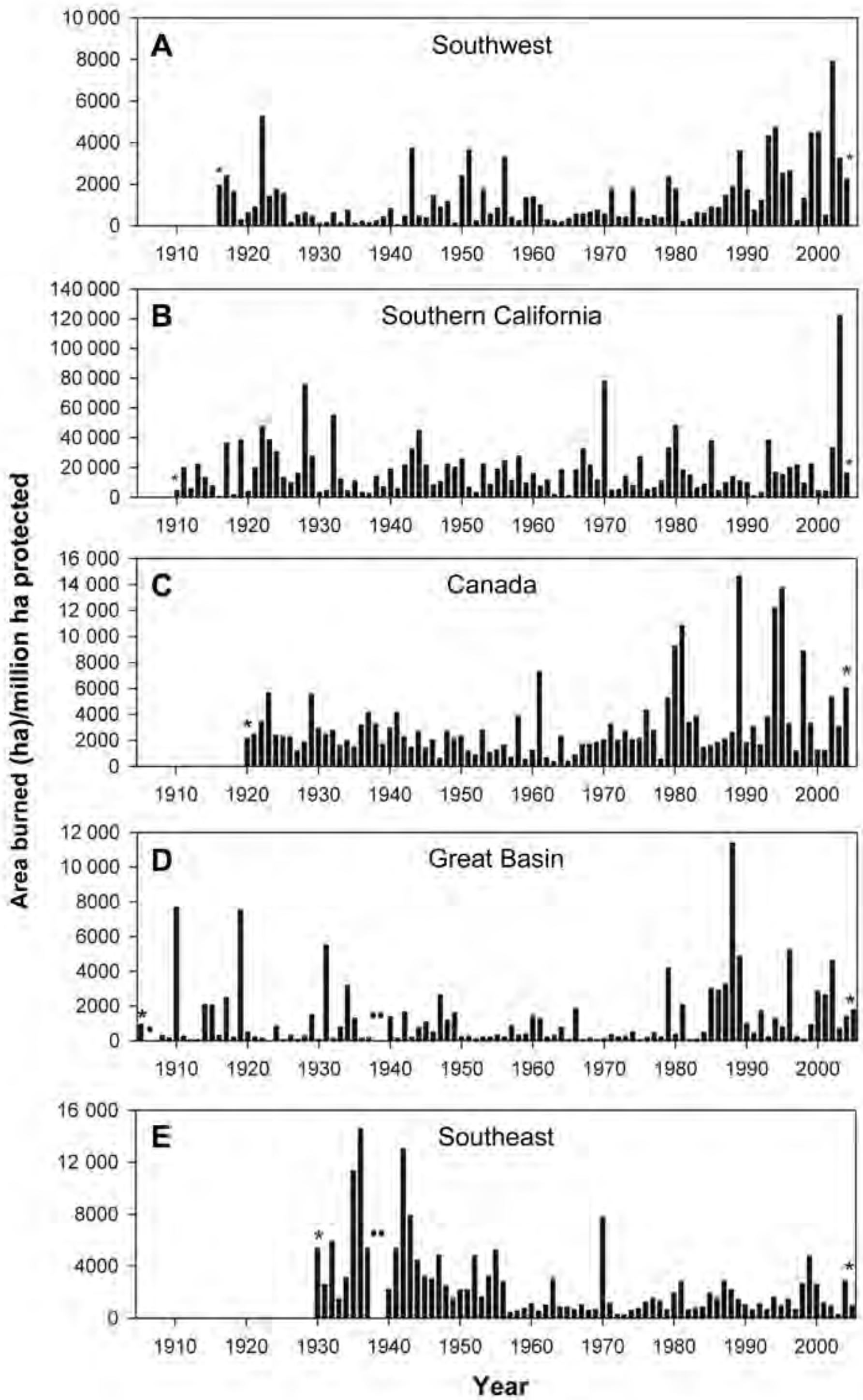


Figure 8—Historical patterns of burning. Because the area over which these data have been drawn tends to increase over time, these statistics are presented in units of hectares burned per million ha protected for (A) the Southwest, including Arizona and New Mexico private, state and federal lands (data compiled by Anthony Westerling, Scripps Institute, University of California, San Diego, from various federal databases), (B) southern California all state and federal lands for fires greater than 40 ha (data from the California Statewide Fire History database, California Department of Forestry and Fire Protection), (C) Canada, (data from Canada Large Fire Database, Canadian Forest Service), (D) Great Basin, U.S. Forest Service Intermountain Region, and (E) Southeast, U.S. Forest Service Southern Region (data from annual National Forest Fire Reports and National Interagency Fire Center). • = years of missing data. * = first and last years of available data.

areas burned during these centuries than during the 20th century (Swetnam and Baisan 1996, 2003). Similarly, the Biscuit Fire (southwestern Oregon, 2002) burned 200 000 ha, but two fires nearly twice that size occurred in the region in the mid-19th century (Walstad et al. 1990). In a similar vein, the large 2003 fires in chaparral of southern California resulted in a season with the highest area burned for the 20th century (fig. 8b), but several large fire events occurred in the 19th century (Keeley and Fotheringham 2003). For example, the Los Angeles Times (1887) reported a massive fire centered in Orange County, and Barrett (1935) provided a firsthand account of this event, which he described as the largest fire during his 33-year U.S. Forest Service career, a career that included the 93 000-ha 1932 Matilija Fire.

Assessing whether or not there have been recent changes in fire severity is difficult owing to the lack of mapped data on high-severity burns that occurred before the 20th century and lack of detailed age structure and patch size data for most forest stands (Baker and Ehle 2003). Regardless, some studies in the Southwest suggest that large crown fires were absent or rare in pure or dominant ponderosa pine forests before ca. 1900. These interpretations are based on documentary and photographic searches and comparisons (Cooper 1960), and tree age structure and fire history analyses (e.g., Barton et al. 2001, Brown and Wu 2005, Fulé et al. 2004b, Savage 1991). In some recent fires in the Southwest, e.g., the Cerro Grande, Rodeo-Chediski, and Hayman Fires, high-severity burn patches sometimes exceeded 2000 ha, which is considered outside the historical range of variability for this forest type (Allen et al. 2002, Covington and Moore 1994, Romme et al. 2003b). In contrast, there are age structure data from ponderosa mixed-conifer forests in South Dakota Black Hills, northern Colorado, and southern Idaho indicative of historical fire events dominated by crown fires (Brown et al. 1999, Ehle and Baker 2003, Kaufmann et al. 2000, Pierce et al. 2004, Sherriff 2004, Shinneman and Baker 1997). However, using age structure data to make such assessments is complicated by the evidence that even-aged ponderosa pine cohorts could be caused by episodic recruitment associated with climate changes (Brown and Wu 2005). Moreover, these studies have not clarified what the distribution of crown fire patch sizes were in the past.

Savage and Mast (2005) noted that because of the large and heavy seed of ponderosa pine, erratic seed crop production, and low success of germination and survival of seedlings, it appears that the large canopy holes (i.e., many patches 100 to 1000 ha) created by certain 20th-century fires have in some cases experienced little or no regeneration for more than 50 years. Therefore, if similar large crown fires occurred in the Southwest in the 18th or 19th centuries, they may still be visible as in-filling of canopy holes, but such events and locations have not yet been identified.

There is considerable documentary and paleoecological evidence that large, severe fires were the typical fire type in other Western ecosystems. Subalpine forests in the Rocky Mountains have historically burned in crown fires at intervals of 300 to 400 years (Buechling and Baker 2004, Despain and Romme 1991, Romme 1982). Past high-severity crown fire events can be partially reconstructed for boreal forests from stand age-structure analysis (e.g., Johnson and Gutsell 1994). Charcoal deposition studies in coastal southern California indicate that large fire events have occurred at the present frequency for at least the last 500 years (Mensing et al. 1999), although there is no evidence that these fires differed in severity from contemporary fires.

Absent old fire-scarred trees and appropriate depositional environments, it has been much more difficult to reconstruct presettlement fire regimes in the Eastern United States with any precision. Abrams (2003) and Nowacki and Abrams (2008) presented evidence for (decadal or less) frequent surface fires through much of the region now dominated by pine-oak and oak-hickory forest. Subsequent land clearing and agriculture have altered much of this landscape, and fires are almost certainly less frequent today than in the past (Delcourt and Delcourt 1998; Nowacki and Abrams, in press).

**In Southwestern ponderosa pine there has been an increase in area burned annually and the maximum size of fires during the past century.**

To sum up, the answer to the question of whether or not fire regimes are outside the historical range of variability in recent years differs among ecosystems and regions. In Southwestern ponderosa pine there has been an increase in area burned annually and the maximum size of fires during the past century. The size of recent high-severity patches appears to be anomalous, at least on time scales of 300 to 500 years (the typical maximum ages of these forests), although this evidence has been questioned (Baker 2006b, c.f. Fúle et al. 2006). In the Great Basin, fine fuel loads from cheatgrass invasion appear to be responsible for increased fire frequency (Knapp 1996), suggesting that fire severity has possibly decreased as area burned increased (fig. 8d). Regions such as the Pacific Northwest and southern California have experienced large high-severity fires on many occasions throughout the 19$^{th}$ and 20$^{th}$ centuries so there is little evidence that the size and intensity of fires has changed (Agee 1993, Keeley et al. 1999). However, in southern California, there has been a substantial increase in fire frequency (fig. 9). The Southeast (fig. 8e) likewise exhibits little evidence of a recent increase in fire activity or fire severity.

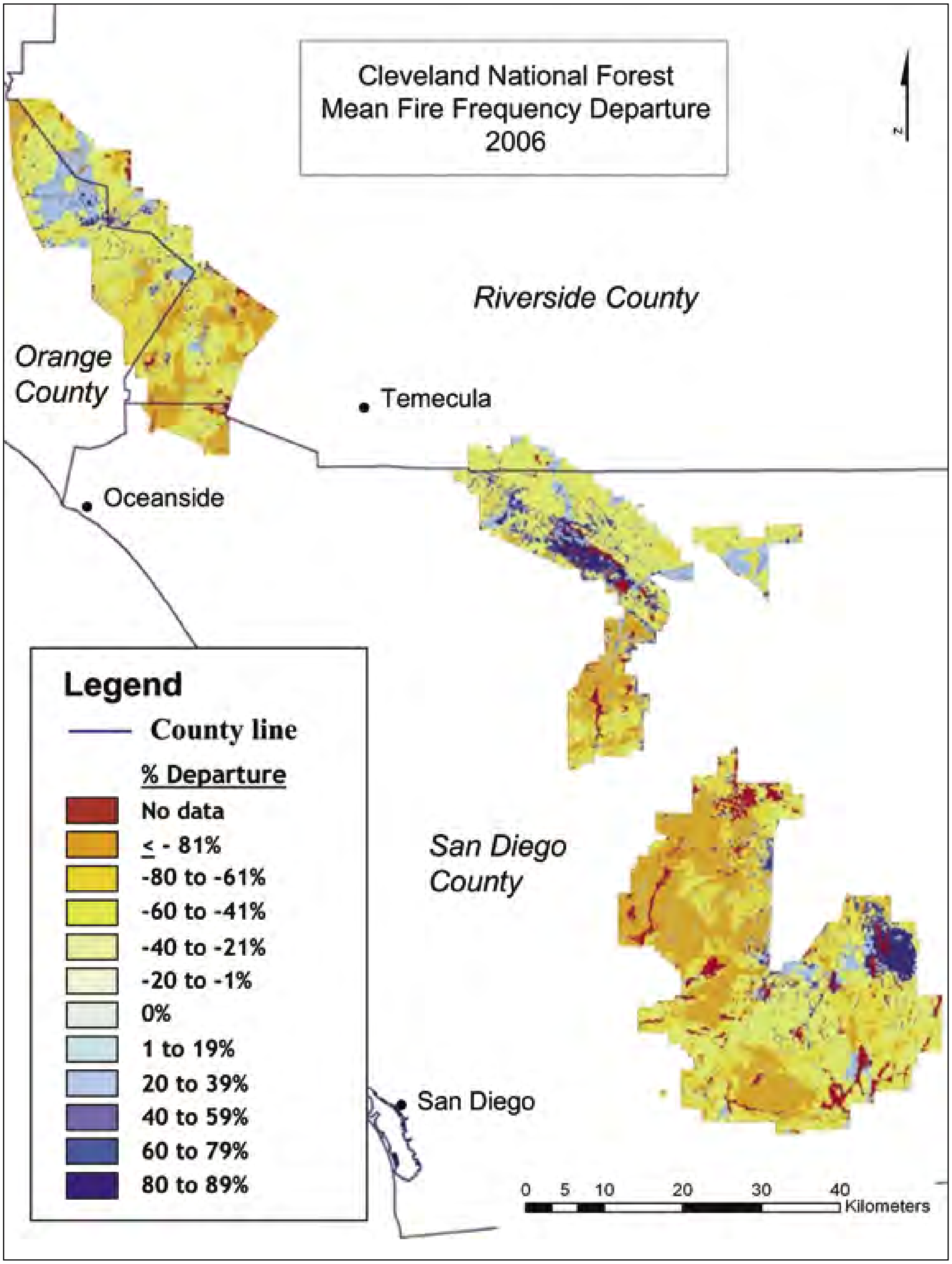


Figure 9—Percentage departure of current mean fire-return interval (1910–2006) from reference mean fire-return interval (pre-Euro-American settlement) in the Cleveland National Forest, California. Areas with negative departures (e.g., lowland chaparral and sage scrub) are experiencing more frequent fire today than in the presettlement period. Areas with positive departures (e.g., high elevation yellow pine) are experiencing less fire today than in the presettlement period. The presettlement fire-return interval is assumed to be chaparral fire-return interval assumed to be 65 years in chaparral, 75 years in coastal sage scrub is 75, and 10 years in Jeffrey pine (from Hugh Safford and Mark Borchert, U.S. Forest Service).

## Human Impacts on Fire Regimes

Land management practices—including livestock grazing, logging, fire suppression, human-caused ignitions, alien plant introductions, and habitat fragmentation owing to roads, timber harvest, and agriculture—individually and in combination have influenced fire regimes. Figure 10 illustrates how these factors interact to affect ecosystems. Fire suppression is often assumed to be of paramount importance in determining fire behavior, but on many landscapes, other factors are far more important. In some cases, timber harvest has been a bigger factor in increasing fire hazard; in other cases, grazing or alien species have been of greater importance. On some landscapes (e.g., southern California), human-caused ignitions during severe fire weather and inadequate land planning are the primary threats.

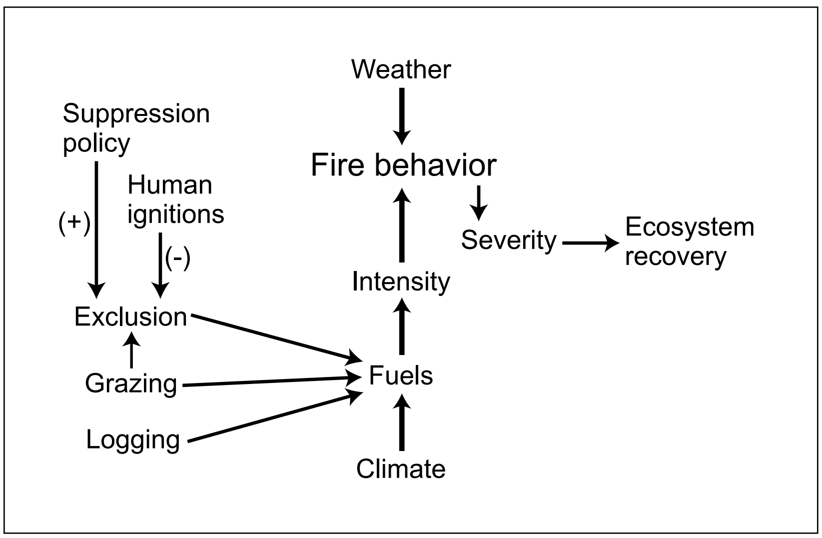


Figure 10—Schematic model that illustrates the effects of climate and fuels on fire behavior and subsequent ecosystem impacts.

In surface fire regimes, livestock grazing can greatly diminish fire frequency. Intensive livestock grazing in the Southwest (Savage and Swetnam 1990, Swetnam and Baisan 1996, Swetnam et al. 2001), parts of the Sierra Nevada (Vankat 1977), and in the Intermountain region (Heyerdahl et al. 2001, Miller and Rose 1999) has contributed to altered fire regimes since the late 19$^{th}$ century, well before effective fire suppression. Similarly, in Jeffrey pine forests of northern Baja California, fires occurred at 5- to 10-year return intervals, but declined sharply around 1790 (Stephens et al. 2003). These authors attributed this decline to the introduction of livestock grazing and cessation of burning by Native Americans (box 3), but these changes in land use are not readily parsed out from climate changes that occurred during this same period (Kitzberger et al. 2001).

*Box 3.*
## Native American Influence on Fire Regimes

Colonization of North America by humans started after the last Pleistocene glacial maximum, roughly 12,000 to 14,000 years BP. There is good evidence that humans very early in their colonization altered natural ecosystems by causing or contributing to the demise of many large (>100 kg) herbivores (Martin and Klein 1984). These early Native Americans also potentially altered ecosystems by disrupting the natural fire regime through additional ignitions (Wells 1962), which potentially increased frequency of ignitions and altered seasonality of fire.

The extent to which humans disrupted the natural fire regime likely differed markedly across the continent. There is some level of agreement that they played a significant and ubiquitous role in eastern North American forested landscapes (Denevan 1992, Vale 2000). However, their effects in the West are more contentious, with some arguing for a minimal role and others for a greater role in ecosystem patterns and fire distribution (Barrett and Arno 1982, Barrett et al. 2005, Keeley 2002, Vale 2002).

This topic is relevant because some have proposed basing ecosystem management in part on a historical context that includes burning by Native Americans. Schmidt et al. (2002) and Hann et al. (2004) have included burning by Native Americans in historical reconstructions that establish baselines by which deviation of modern fire regimes from historical range of variability (HRV) (box 1) are determined. These authors contend that human subsidy of fire has affected plant evolution, and although no evidence exists to support this claim, there are indicators that burning by Native Americans has affected distribution and abundance of some plant species (Stewart 2002).

Arguments for and against including burning by Native Americans in the natural or historical fire regime (Keeley and Stephenson 2000) include:

Arguments for:

- These ignitions were part of the pre-Euro-American environment.
- Native Americans were “in tune” with their environment and managed landscapes in a responsible manner unlike contemporary humans.
- Native Americans were a “natural” part of the landscape.
- In some Western forests, burning by Native Americans was insufficient to alter burning caused by lightning, and therefore inclusion has little effect on reconstructions of historical burning patterns and the **cause** of ignition is irrelevant to the patterns and processes that sustained biodiversity historically.

Arguments against:

- Sustainable ecosystem management goals require a shift in emphasis from pre-Euro-American ideals to conditions more resilient to environmental change.
- Native Americans exploited their environment in a manner that was not qualitatively different from contemporary humans, and given sufficient time they were capable of causing unwanted changes in their environments. If management of fire is based on past Native American burning patterns, then should management of other resources (e.g., wildlife and fish) also be based on past usage by Native Americans?
- This Euro-centric perspective presumes the existence of unknown qualities that separate Native Americans from the rest of humanity.

*(continued on next page)*

- Lightning ignitions alone are insufficient to account for fire-scar records or historical patterns of burning in some areas, and therefore inclusion is highly relevant to how we interpret fire histories.

The importance of whether or not to include burning by Native Americans in the reconstruction of natural (box 1) fire regimes differs among regions and fire regimes. Fire regimes with frequent surface fires and well-developed fire histories potentially have a historical record that combines both natural fires and burning by Native Americans. Sorting out the relative contribution of each is important to the correct interpretation of these historical patterns. Crown fire ecosystems generally lack a detailed record of past fires, and thus identifying and quantifying fire source is less compelling.

**Fire intensity and fuel consumption are substantially greater when fire is returned to places where grazing has caused herbaceous fuels to be replaced by woody fuels.**

Besides diminishing fuels, livestock grazing reduces grass competition for woody species and thus enhances the recruitment of pines, which contributes to dense thickets of saplings (Arnold 1950, Belsky and Blumenthal 1997). Grazing also appears to have altered forest structure and channel erosion since the late $19^{th}$ century (Leopold 1924), because fire intensity and fuel consumption are substantially greater when fire is returned to places where grazing has caused herbaceous fuels to be replaced by woody fuels (Zimmerman and Neuenschwander 1983). Grazing has been present much longer than fire suppression throughout western North America, and because 70 percent of Western U.S. wildlands are currently grazed (Fleischner 1994), it should be considered a widespread factor affecting fire regimes.

Past logging practices have usually not excluded fire, but in some cases have created hazardous fuel conditions commonly attributed to fire suppression (fig. 10). In some forests with mixed-severity fire regimes, fire severity may be affected more by past logging operations (owing to residual slash fuels) than fire suppression (Odion et al. 2004, Weatherspoon and Skinner 1995). For example, logging slash was a major factor in the 1871 Peshtigo Fire (Wisconsin) that burned 500 000 ha and killed over 1,200 people (Frelich 2002). Logging in and of itself is not a means of reducing fire hazard, unless slash fuels are removed or treated, either by burning or chipping (Peterson et al. 2005, Stephens 1998). However, logging can increase fire hazard owing to changes in forest composition as well as replacement of older fire-resistant trees with younger successional stages (Laudenslayer and Darr 1990, Stephens 2000) that can more readily propagate crown fire (Edminster and Olsen 1996) and increase fire severity (Agee and Huff 1987). Without surface fuel treatment, logging can increase fire intensity through its influence on insolation and surface windspeeds, leading to drier fuels and potentially more extreme fire behavior (Weatherspoon and Skinner 1995).

Timber harvest complicates our ability to make inferences about the effects of fire suppression on fire behavior. Ponderosa pine forests throughout the Western United States have been particularly targeted, and most accessible forests have been cut at least once (Ball and Schaefer 2000). For example, in northern Arizona, over 1000 km of railroads provided access for logging of large areas of forests (Stein 1993). As a result, forests that were once composed of widely spaced, old trees have been replaced by dense stands in which 98 percent of the trees are less than 100 years of age (Waltz et al. 2003). Thus, altered forest structure that contributes to fire hazard cannot be solely attributed to fire suppression. As early as the 1930s, it was evident that fires were much more common prior to fire suppression in logged areas of western Montana (Barrows 1951). The Rodeo-Chediski Fire was unusually large with a substantial level of high-severity burning, and although historical fire suppression activities played a role in altering fuel structure, logging, through its effects on fuels, insolation, and subsequent regeneration effects, may have been a factor in both the size and severity of that fire (Morrison and Harma 2002). Before this fire, much of the area had been logged one or more times, including some locations of the highest fire severity. The same can be said of the Biscuit Fire (Harma and Morrison 2003) and fires in the Klamath Mountains (Odion et al. 2004), where logged areas composed a larger portion of the high-severity burned area.

Fire spread, particularly in surface or mixed surface and crown fire regimes, is greatly disrupted by fragmentation of natural environments. Fuel disruptions owing to roads, trails, and other infrastructure may pose significant barriers to fire spread (Chang 1999). The disruption is often disproportionate to the actual size, and sometimes as little as 10 percent disruption of land cover can result in as much as 50 percent decline in fire extent (Duncan and Schmalzer 2004). This is less of a disrupting influence in crown fire ecosystems, where fires are often driven by extreme winds.

## Effects of Fire Exclusion on Forest and Shrubland Structure

Changes in ecosystem structure have the most immediate impact on fire management options, although altered fire regimes have a plethora of effects on ecosystem processes (box 4). In Southwestern ponderosa pine and oak savannas (table 1), historically frequent fire maintained a continuous understory of herbaceous fuels. This fuel distribution favored low-intensity surface fires that in turn suppressed woody plant invasion. Thus, fire maintained a distinct bimodal vertical distribution of foliage (i.e., surface and tree canopies) that resulted in a fuel gap, which limited the opportunities for surface fire to be carried into tree crowns. Fire exclusion increased surface fuels by one to two orders of magnitude and tree stem densities

### *Box 4.*
### Effects of Altered Fire Regimes on Ecosystem Processes

Alteration of fire regimes has implications for sustainable ecosystem management. The consequences differ considerably among fire regimes, as well as with the history of management activities.

**The carbon cycle.** The effects of fire exclusion on forest carbon dynamics have not been studied in detail. In the short term, such exclusion leads to increased storage of carbon in accumulating fuels. However, the extensive and very intense wildfires that may eventually occur as a consequence of this fuel accumulation oxidize large quantities of carbon, and might conceivably diminish average carbon storage in the long term (van der Werf et al. 2004, Zimov et al. 1999). Either fire or mechanical harvesting reduce carbon storage. In ecosystems where fire frequency increases, carbon storage capacity is reduced.

**Nutrient cycling.** Fire exclusion can result in accumulation of nutrients in fuels, with a larger proportion of the total nutrient capital found in relatively nondecomposable coarser materials (Boerner 1982, Christensen 1977, MacKenzie et al. 2004). Burning in many ecosystem types increases the availability of soil nutrients (e.g., Christensen 1973, Sackett and Haase 1998), which may account in part for increased growth often observed in trees and understory herbs immediately following fire. Withholding fire from such systems may exacerbate nutrient limitations on plant growth. However, adding fire at too high a frequency can have deleterious long-term effects on nitrogen cycling (Carter and Foster 2004, DeLuca and Zouhar 2000, Wright and Hart 1997). These generalizations refer to more nutrient-limited ecosystems and may not be applicable to more nutrient-rich forests (Boerner et al. 2004).

**Hydrologic flows and erosion.** Increased runoff and associated erosion following fire are well documented in many ecosystems (Cannon 2001, Kirchner et al. 2001, Swanson 1981). Where fire exclusion has produced fuel accumulations and fires that are outside the historical range of variability (HRV), stream channels have suffered from patterns of erosion and sedimentation that also may be outside the HRV, although longer term perspectives place doubt on this conclusion for some landscapes (Kirchner et al. 2001). Fire suppression in some areas may be denying hydrologic events and sediment relocation that is important to long-term watershed health (e.g., Meyer 2004). On landscapes in which fire frequency is higher than it was historically (e.g., fig. 9), it has increased the long-term sediment load from watersheds (e.g., Loomis et al. 2003).

**Community changes.** Fire exclusion can result in lower diversity and loss of rarer elements in longleaf pine (Christensen 1981, Walker and Peet 1983), ponderosa pine (Covington and Moore 1994), and mixed-conifer forests (Battles et al. 2001, Keeley et al. 2003). In addition, loss of reproduction of shade-intolerant trees occurs in deciduous (Abrams and Nowacki 1992) and coniferous forests (Cooper 1960, Harvey et al. 1980). Increased shade and increased woody litter can reduce postfire diversity patterns and, in some cases, create more uniform fuels and reduced postfire spatial variability (Rocca 2004). However, some fire-prone ecosystems are resilient to long fire-free periods that fall outside the historical range (Keeley et al. 2005b).

**Landscape changes.** Landscape patch dynamics at large spatial scales can be disrupted by removal of fire (Baker 1994). This can affect animal habitat, with the greatest effects on species that depend on landscape heterogeneity to provide a suitable range of habitats for breeding, foraging, and cover (Smith 2000). Decreased landscape heterogeneity can alter fuel patterns such that fuels are distributed more homogeneously and resultant fires burn in more coarse-grained patterns, although there are notable exceptions (Turner et al. 1989).

from <125 per ha to >2500 per ha (Moore et al. 2004, Robertson and Bowser 1999, Sackett et al. 1996). Live fuels retain more water than herbaceous fuels through much of the year and are actually less flammable, meaning that drier conditions are required for their ignition. This situation facilitates the continued invasion and growth of woody plants and increased vertical continuity of fuels that can carry fire into tree crowns (fuel ladders). Thus, while fire risk may be diminished, fire hazard is increased (see box 2), and fires are potentially of higher intensity and severity (Fulé et al. 2004b).

Savannas and some grasslands may exhibit conversion to woodlands and forest with effective fire suppression. This is particularly evident on the eastern edge of the Great Plains where woodland elements historically restricted to riparian areas have expanded into adjacent grasslands (Abrams 1992, Rice and Penfound 1959). Nowacki and Abrams (2008) argued that fire suppression has facilitated successional changes in many eastern forests that have greatly diminished fire risk and fire hazard. They present evidence that presettlement oak-pine and oak-hickory forests were much more open and savanna-like than their modern counterparts. The absence of fire has facilitated the ingrowth of shade-tolerant deciduous tree species with features such as high wood and leaf lignin content and water-retaining structures (e.g., flat leaves that form a compact forest floor) that make them highly nonflammable.

Mixed-severity fire regimes include mixed-conifer forests at higher elevations in the northern Rocky Mountains, and mid-elevation forests on the Pacific slope. Historically, fire occurred every few decades, and although surface fires dominated the fire regime, the landscape comprised a mosaic of fire-induced cohorts initiated by patchy high-intensity crown fires (Fulé et al. 2003, Stephenson et al. 1991). Fire exclusion on these landscapes has resulted in less deviation from the historical range of variation in fire-return intervals than it has in surface-fire regimes, and thus less of this landscape experienced structural changes that fundamentally alter fire regime. The primary ecological change in these forests is the potential for fuel accumulation to create larger patches of crown fire (fig. 11).

Fuels in forests with mixed-severity fire regimes consist of litter, duff, and fallen branches. Accumulation of these fuels is evident after prescription burning in old-growth forests where fires have been excluded for much of the 20th century (fig. 12). Fire markedly reduces duff and woody fuels, and woody fuels recover within the first decade to roughly prefire levels, but duff accumulation is substantially slower (Keifer et al. 2006). Ingrowth of understory saplings and immature trees provides additional fuel as well as fuel ladders. For example, fire exclusion in

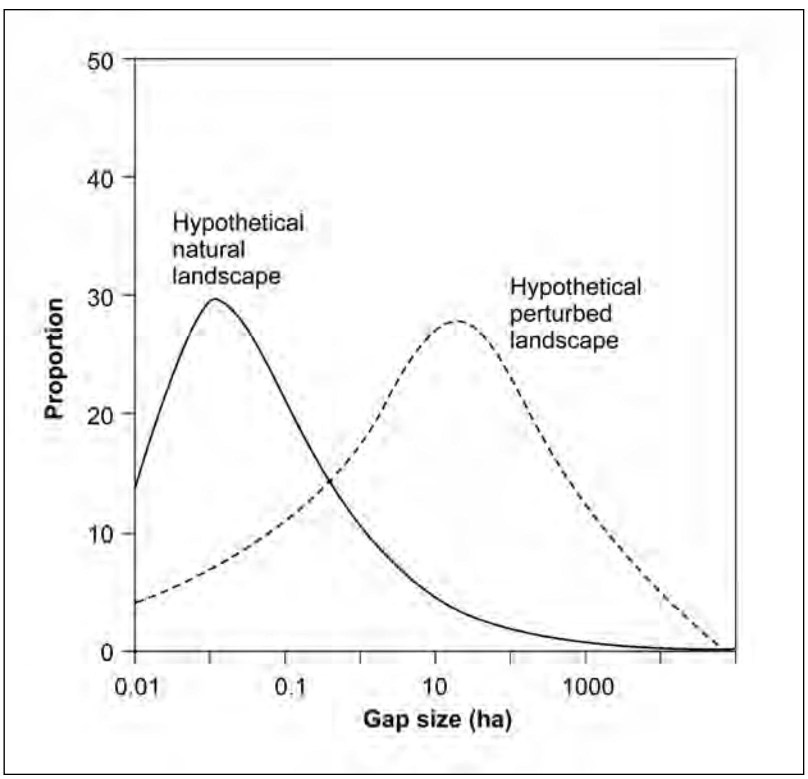


Figure 11—Hypothetical distribution of fire-generated gaps expected in forests with mixed-severity fire regimes under natural conditions, and systems perturbed by fire suppression (from Keeley and Stephenson 2000).

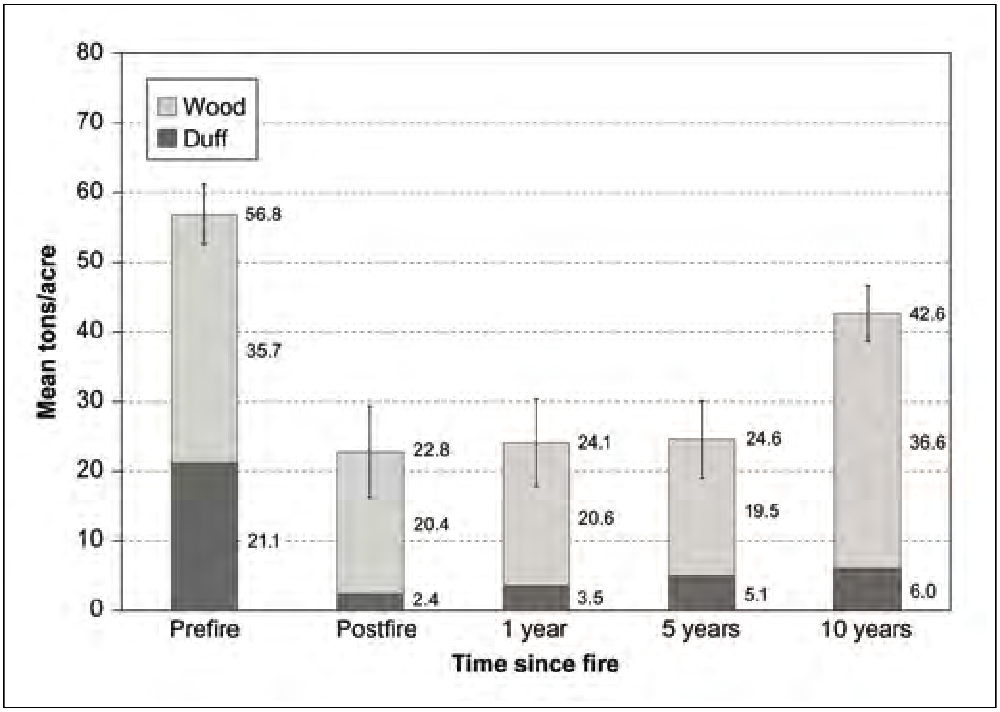


Figure 12—Fuel consumption following prescription burning and subsequent postfire accumulation in giant sequoia-mixed-conifer forests of the southern Sierra Nevada, California (mean and standard deviation bars, n = 7; from Keifer 1998). The prefire surface-fuel loads are within the range typically reported for fire regimes with return intervals of 35 to 100 years (e.g., Kauffman and Martin 1989).

Sierra Nevada giant sequoia mixed-conifer forests has increased the density of small-diameter white fir (Barbour et al. 2002, Parsons and DeBenedetti 1979) and less structural variability in tree size and distribution pattern (Taylor 2004), and the density of small-diameter trees is greatly reduced when fire is returned to these forests (fig. 13).

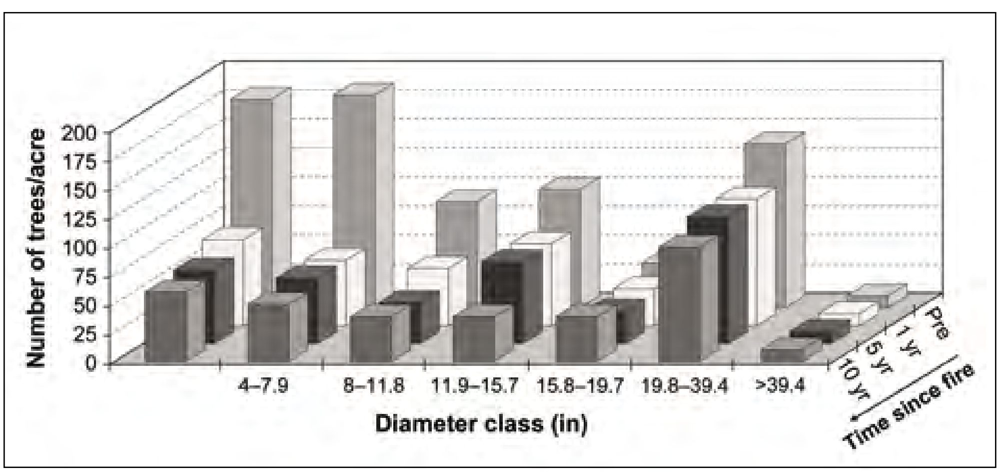


Figure 13—Density of white fir by diameter class over time following prescription fire in sequoia-mixed-conifer forests of the southern Sierra Nevada, California (Keifer 1998).

**Besides structural changes, fire exclusion results in compositional changes that differ across a moisture gradient, often favoring less fire-tolerant species.**

It is often presumed that fire exclusion produces conditions in old-growth forests that make them susceptible to high-severity fires with very high mortality of overstory trees. Increased tree mortality is sometimes recorded when surface fires are successfully reintroduced in forests where fires have been excluded for long periods as a consequence of overheating of roots in deep forest floor accumulations (Fulé et al. 2004a). However, high mortality of canopy trees is not always the case, as seen after prescription fires in giant sequoia mixed-conifer forests (fig. 13) or wildfires (Odion and Hanson 2006) in the Sierra Nevada, and in Douglas-fir mixed-conifer forests in northern California (Odion et al. 2004).

Besides structural changes, fire exclusion results in compositional changes that differ across a moisture gradient, often favoring less fire-tolerant species (box 5). Ponderosa pine forests at the arid end of the gradient typically exhibit

*Box 5.*
### Fire-Tolerance Terminology

Low-intensity surface fires are sometimes called "non-lethal" fires. This terminology appropriately describes effects on mature trees, but is of minimal value in understanding the ecological effects of fire. Surface fire regimes typically do not kill most of the larger trees, but may be lethal to seedlings, saplings, shrubs, and herbs.

"Fire tolerant," "fire sensitive," "fire dependent," and "fire adapted" are terms often applied to different tree species in mixed-conifer forests. They describe relative differences between species, but those responses differ across the landscape. For example, white fir is often termed fire intolerant or fire sensitive relative to ponderosa pine. This is most relevant in arid systems where ponderosa pine dominates in the face of frequent fire. Excluding fire from these landscapes allows the establishment of shade-tolerant white fir in the understory. When fire does occur, white fir typically experiences high mortality and is **fire sensitive** relative to pines. However, on more mesic and productive sites, white fir is the natural dominant despite the presence of frequent fires. Although seedlings can regenerate in the understory, recruitment is enhanced following fire (Mutch and Parsons 1998), and thus on these sites white fir may be considered **fire tolerant**.

**Fire dependent** refers to the necessity for postfire conditions for seedling recruitment. In this sense, white fir is clearly not fire dependent, but species such as giant sequoia are correctly termed fire dependent. Of course this term requires consideration of species within the context of communities or ecosystems. For example, in ponderosa pine savannas seedling recruitment can occur independently of fire, and dense thickets of young trees can convert these landscapes to closed-canopy forests where further recruitment is fire dependent. The related term **fire adapted** carries with it assumptions about trait origins and should be used with this understanding. The primary limitation of this term is that species in fact are not "fire adapted" as much as being adapted to particular fire regimes. For example, thick-barked oaks are often called fire adapted, but strictly speaking they are adapted to frequent surface fires, whereas thin-barked oaks may be equally fire adapted to crown fire regimes (Zedler 1995).

large changes, as higher tree density shades out further reproduction by that species but favors more shade-tolerant species such as white fir and Douglas-fir (Fulé et al. 1997). More subtle changes in composition were reported during the last half of the 20th century in old-growth Sierra Nevada mixed-conifer forests in more mesic locations (Ansley and Battles 1998, Roy and Vankat 1999). This is not surprising because ponderosa forests have missed more fire cycles than have mixed-conifer forests with mixed-severity fire regimes.

Exclusion of fire from forests with mixed-severity regimes has potentially increased fuel homogeneity on scales ranging from hillsides to large landscapes. Although it is often presumed that this has favored fires with more uniform fire behavior and effects, data demonstrating diminished heterogeneity are lacking. Also, heterogeneity of burning is controlled by a combination of fuel distribution, weather, and topography. Crown scorch patterns after prescription burning in California mixed-conifer forests unburned for 125 years show that such fuel conditions do not produce homogeneous fire effects (fig. 14).

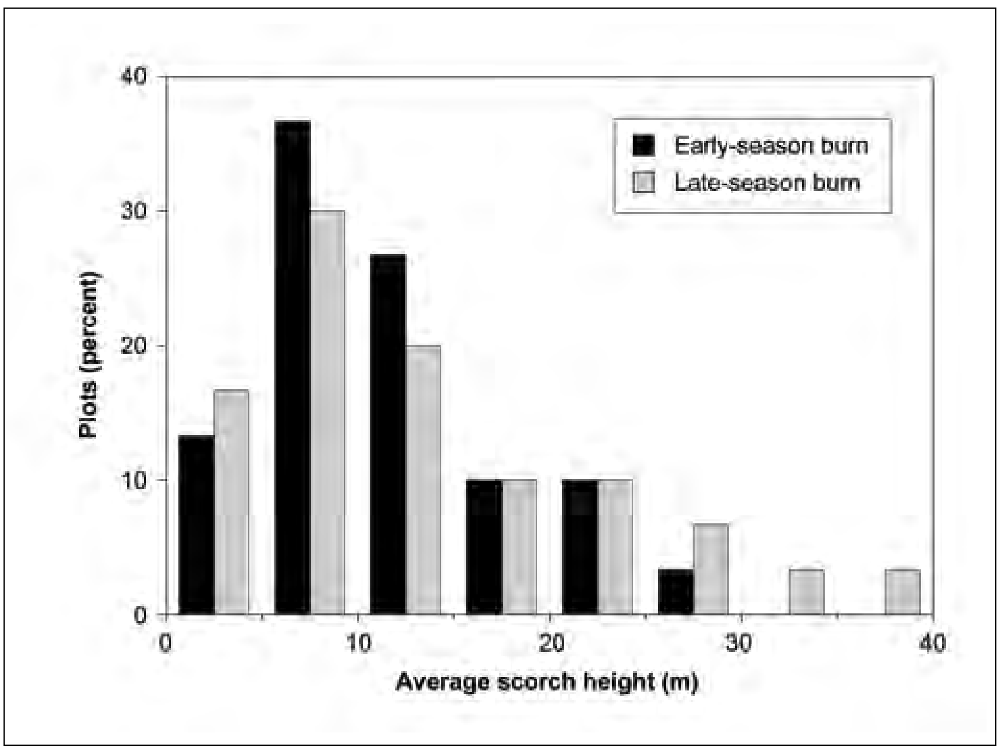


Figure 14—Heterogeneity of scorch height patterns in early- and late-season prescription burns in forests dominated by white fir, Sierra Nevada, California, following 125 years without fire (n = 30) (Knapp and Keeley 2006).

The primary disruption of fire regimes in natural crown fire ecosystems such as California chaparral shrublands has been **increased fire frequency** (fig. 9), resulting in the conversion of some portions of the landscape from native shrublands to alien herb-grasslands (box 6). In general, chaparral has not experienced the extended fire-free periods necessary for elevated fuel accumulations (Moritz 2003, Moritz et al. 2004). However, it has been suggested that the pattern of fuel distribution has become more homogeneous owing to the replacement of lightning-ignited fires, which historically would have created small patchy burns, with massive Santa Ana wind-driven fires that are most often ignited by humans (Minnich and Chou 1997). Such a change in fire size is considered unlikely to occur naturally owing to the low rate of natural lightning ignitions in this region (fig. 7). Estimates of historical burning potential suggest that without Santa Ana wind-driven fires, the rotation interval would likely have been very long, exceeding the lifespan of most shrubland species (Keeley and Fotheringham 2003). In addition, fuel mosaics, which Minnich and Chou (1997) contended are what

### *Box 6.*
### Effects of Fuel Manipulations on Alien Invasion

Alien plant species can disrupt fire regimes either by increasing or decreasing fire activity (Brooks et al. 2004). In Western U.S. forests, effective fire suppression appears to provide some measure of resistance to alien invasion (Keeley et al. 2003), whereas forest restoration directed toward returning historical fire regimes may, under some circumstances, favor alien annual invaders (Bradley and Tueller 2004, Crawford et al. 2001, Korb et al. 2005). Historical fires occurred on a landscape that lacked the presence of alien species, many of which can spread following disturbance. In some instances the problem may require prescriptions tailored to reduce alien invasion. Grazing history, alien distribution patterns, treatment size, and fire severity are all factors that might be manipulated to reduce the alien threat linked to necessary fuel reduction projects (Keeley 2006).

Historical use of prescription fire for type conversion in crown fire shrublands such as California chaparral and Great Basin sagebrush has played a role in the widespread increase of annual grasses in these ecosystems. Fuelbreaks pose a special risk because they promote alien invasion along corridors into wildland areas (Merriam et al. 2006), and they have lower fire intensity, which promotes alien seed bank survivorship. In one comparison of ponderosa pine forests, thinning plus burning produced significantly greater alien plant abundance than burning alone (Dodson 2004).

determined this historical patchwork of burning, would have been eliminated by just a single lightning-ignited fire that lasted a week or more and carried over until a Santa Ana wind event (Zedler and Seiger 2000).

Fire exclusion has not affected fire-return intervals in Gambel oak-dominated petran chaparral of the southern Rocky Mountains and some relatively productive areas on the Colorado Plateau that develop dense piñon-juniper forests (rather than open woodlands). These systems are characterized by infrequent, severe fires occurring at intervals of many centuries (Floyd et al. 2000). Stand structure, composition, and fire behavior have apparently not been substantially altered by fire suppression (Baker and Shinneman 2004, Romme et al. 2003a). Where piñon-juniper woodland occurs at the ecotone with ponderosa pine, surface fires burning every 10 to 20 years apparently limited the piñon and juniper trees to rocky microsites (Kaye and Swetnam 1999). Recent historical changes differ, but tree densities and fuels have likely increased in some places owing to fire suppression. At the low-productivity end of the range of piñon-juniper in the Southwest, sparse, stunted woodlands occur across extensive arid landscapes, and fire appears to occur only as isolated lightning-ignited burns around individual trees or small groups (Gottfried et al. 1995).

Infrequent stand-replacing crown fires typify many cool, moist forests. These fires occur under extreme weather conditions and burn without regard to the mosaic of patch ages on the landscape (Fryer and Johnson 1988, Johnson and Fryer 1987, Turner et al. 1989). Because the fire-return interval often equals or exceeds the period of contemporary fire exclusion, it is unlikely that fire suppression has greatly altered the condition of these landscapes (Noss et al. 2006, Veblen 2003). Examples of these include subalpine forests (Buechling and Baker 2004, Masters 1990), boreal forests (Johnson et al. 1998, Weir et al. 2000), some mixed-conifer forests of the Pacific Northwest (Agee 1993, Hessburg and Agee 2003), and much of the Eastern deciduous forest (Runkle 1985). In the case of some subalpine forests in the Rocky Mountains, fire frequency has increased during the 20th century (Sherriff et al. 2001).

## Effectiveness of Fire Suppression

The history and effectiveness of fire suppression in excluding fire differ considerably among ecosystems, landscapes, and regions. Formal policies and management protocols to suppress wildfires in the Western United States were put in place on public lands in 1911, immediately after the large fires of 1910 (Pyne 1982). Thus, one might argue that active fire suppression on public lands has been in place for nearly a century. Such management was immediately effective in areas of ready access, where fires could be discovered early and resources deployed quickly to extinguish them. In more remote areas over much of the West, suppression policies had minimal effect on fire behavior until fire towers, lookout systems, and roads in the 1930s facilitated early fire detection and deployment of firefighters. The U.S. Forest Service smoke jumping program was not used extensively until after 1945 (Cermak 2005, Pyne 1982). Thus, in more remote areas, suppression has altered fire regimes for <60 years (e.g., Whitlock et al. 2004).

The extent to which fire suppression has affected ecosystems is linked to fire regime and land use practices such as grazing and logging, as discussed above. In many western North American coniferous forests, firefighting policies have been highly effective, and many landscapes historically exposed to frequent fires have had fires suppressed for a century or more. The effect of this policy, coupled with other land management practices, is shown by fire histories in Southwestern U.S. ponderosa pine forests, wherein forests that had frequent fires until the late 19$^{th}$ century show a nearly total hiatus in burning in the 20$^{th}$ century (fig. 5). On these landscapes, intensive livestock grazing (usually by very large numbers of sheep) was typically the initial cause of fire regime disruptions, but active fire suppression by government agencies became a primary reason for fire exclusion after livestock numbers were greatly reduced after the 1920 (Swetnam and Baisan 2003). Disruptions of fire regimes in other parts of the Western United States followed various combinations of elimination of Native American burning practices, livestock introductions, and fire suppression efforts (e.g., Agee 1993, Arno 1980, Pyne 1982, Swetnam and Baisan 2003), whereas disruptions in Southern U.S. forests and woodlands probably related to a more complex history of human-set fires and land uses, landscape fragmentation, and fire suppression (Guyette and Spetich 2003).

It appears that fire exclusion in many conifer forests has resulted in numerous fire cycles (relative to historical frequency) being missed. However, this is not universal, and more remote forests with mixed-fire regimes did not experience fire exclusion until near the middle of the 20$^{th}$ century (Whitlock et al. 2004). This is also the case for northern Mexico, where fire suppression was not practiced through much of the 20$^{th}$ century (Stephens et al. 2003; Swetnam and Baisan 1996, 2003). In some mixed-conifer forests of the Pacific Northwest, fire suppression does not appear to have reduced fire activity until after the midpoint of the 20$^{th}$ century (Weisberg and Swanson 2003). Inferences about the effects of fire suppression in these forests are complicated by a complex mixed-severity fire regime that involves infrequent crown fires and surface fires (Agee 1993, Hessburg and Agee 2003, Weisberg 2004).

On southern California chaparral landscapes, fire suppression policy failed to exclude fire during the 20th century (fig. 8b). Fires are mostly human-caused, and the current fire rotation for these crown fire regimes is 30 to 40 years (table 1); the fire-return intervals are even shorter in wildlands surrounding urban environments (fig. 9). Although fire suppression cannot be equated with fire exclusion in this region, fire suppression has still caused some effects. Throughout the 20th century, this fire regime has been dominated by human-caused fires that have steadily increased over time. Fire suppression has prevented large-scale conversion from native shrublands to alien grasslands, which would be expected if all human-ignited fires were allowed to burn (Keeley 2001).

Boreal forests also have a crown fire regime, but fire suppression likely has not been effective at altering the historical fire-return interval (Bridge et al. 2005, Johnson et al. 2001, Ward et al. 2001). Prefire climate sufficient to dry fuels for extended periods is a major factor determining fire activity, and because lightning is the major source of ignition in boreal forests, humans have had only local effects (Nash and Johnson 1996).

## Fire Management and Ecosystem Restoration

The objectives of restoration are typically to retain functional integrity and in some cases to maintain ecosystems within a specified range of structural and process characteristics (box 1). Fire managers intervene before fire incidence because there is a widely held belief that large fires experienced throughout western North America in recent years are the result of changes in fuel quantity and structure, and that these fires could have been prevented by better fuel management practices. These conclusions have led to initiatives such as the National Fire Plan (USDA USDI 2001), which emphasizes aggressive management of fuels as a necessary condition for sustainable resource management. These activities target a spectrum of goals that range from thinning forests and increasing wildland fire use for fire hazard reduction to more holistic ecosystem restoration. The objectives of hazard reduction are typically to alter fire behavior, reduce the severity of fire effects, and, in some cases, improve effectiveness of fire suppression. In crown fire regimes (e.g., chaparral and some boreal forests), fuel accumulation has not been the cause of large fires, and ecosystems are often within their HRV; thus there is limited need for ecosystem restoration.

**The objectives of hazard reduction are typically to alter fire behavior, reduce the severity of fire effects, and, in some cases, improve effectiveness of fire suppression.**

## Effectiveness of Prescription Burning

Prescription burning in forests with a surface-fire regime that have missed fire cycles is typically done with the objective of reducing dead and living understory fuels, for resource benefit or increased human safety, or both. This use of fire has a long history beginning with Native Americans (box 3) and is part of traditional land use practices by American settlers and rural residents (MacCleery 1996, Putz 2003). This type of forest management has been called "understory burning" or "light burning" and was frequently advocated as an appropriate way to manage pine forests in California during the early part of the 20$^{th}$ century (Anonymous 1920, Cermak 2005, Olmsted 1911).

Managed prescription burns had their early origin as a means of enhancing game animal hunting in the Southeastern United States (Stoddard 1962), and today that region leads the U.S. national forests in area subjected to prescription burning (Cleaves et al. 2000). It has long been applied to limited areas of ponderosa pine in the Southwest (Biswell et al. 1973, Weaver 1968), and systematic application was initiated in mixed-conifer forests of Sequoia National Park in the late 1960s (Kilgore 1973).

Prescription burning can, in some cases, both restore historical ecosystem properties and decrease fire hazard. In the Southeastern United States there is evidence of major decreases in wildfire activity in treated forests (Davis and Cooper 1963) and reduced impacts of wildfires (Outcalt and Wade 2004). In Southwestern U.S. ponderosa pine forests, Wagle and Eakle (1979) and Finney et al. (2005) showed reduced fire severity in treated areas. Also, it has been shown that prescription burning alone is capable of meeting ecosystem restoration goals (based on conditions before Euro-American settlement) for tree density, species composition, and basal area in Southwestern U.S. ponderosa pine forests (Fulé et al. 2004a). After three decades of prescription burning in old-growth mixed-conifer forests of the Sierra Nevada, the U.S. National Park Service and U.S. Geological Survey documented that 19$^{th}$-century forest structure can be reestablished without mechanical thinning (Keifer 1998, Knapp and Keeley 2006, Knapp et al. 2005). Because surface fuels accumulate rapidly in these productive forests, the longer term impact of prescription burning is the killing of smaller trees and production of higher crown levels, thus reducing ladder fuels (Kilgore and Sando 1975). Similar results with prescription burning have been reported for other old-growth mixed-conifer forests in the Western United States (Bastian 2002, Lansing 2002).

However, prescription burning is severely constrained in many cases by policy and regulations that limit the extent to which this management practice can be applied (box 7). For example, to reduce the possibility of escapes, prescription burning is normally not permitted during extreme weather conditions and when fuels are very dry. To reduce the effects of smoke on local communities, local regulations typically allow burning only during a relatively narrow window of weather conditions. Finally, prescription burns may not mimic lightning-ignited patterns in that they are often designed to produce homogeneous burning patterns that may not reflect the historical range of ignition patterns and heterogeneity of unburned and high-severity patches. Such heterogeneity may be critical to sustainability of vegetation diversity, tree recruitment (Keeley and Stephenson 2000), and wildlife habitat in some ecosystems.

Potential for prescription burning differs between surface-fire regimes and crown fire regimes. Low-intensity understory burning is rarely an option in crown fire ecosystems, and prescription crown fires for intact forests and shrublands

*Box 7.*

### Realities of Using Management Fire

Resource managers are faced with solving historical problems not of their making, while at the same time complying with legislative and regulatory requirements that guide planning and on-the-ground activities. For example, prescription burning is limited by air quality regulations, logistical challenges associated with complex land ownership patterns, political perspectives about the aesthetics of burning, and liability issues related to escaped fires (Yoder et al. 2004).

The problem of analyzing "fire-return interval departure," a requirement for many U.S. federal land managers, illustrates the complexity and constraints associated with managing fire. This type of analysis examines annual burning rates for a landscape of both managed and unmanaged fires relative to what would be expected if those landscapes operated under "natural" conditions. For example, in Sequoia-Kings Canyon National Parks (California), extensive fire histories provide a scientific record of historical range of variability (HRV) (box 1) in fire interval from which one can calculate the average annual proportion of landscape that burned in the past (Caprio and Graber 2000). Despite a long history of managed fire use in the park (both prescription burning and managed wildland fire), there is a large gap between what currently burns and the historical benchmark (fig. 15). Given the landscape pattern of resources at risk, air quality restrictions, and other constraints, it is unlikely this gap can be addressed through prescription burning. Approaches such as expanding the seasonal window of opportunity for burning are being considered, but the effects of burning at different times of year are not well understood (e.g., Knapp and Keeley 2006).

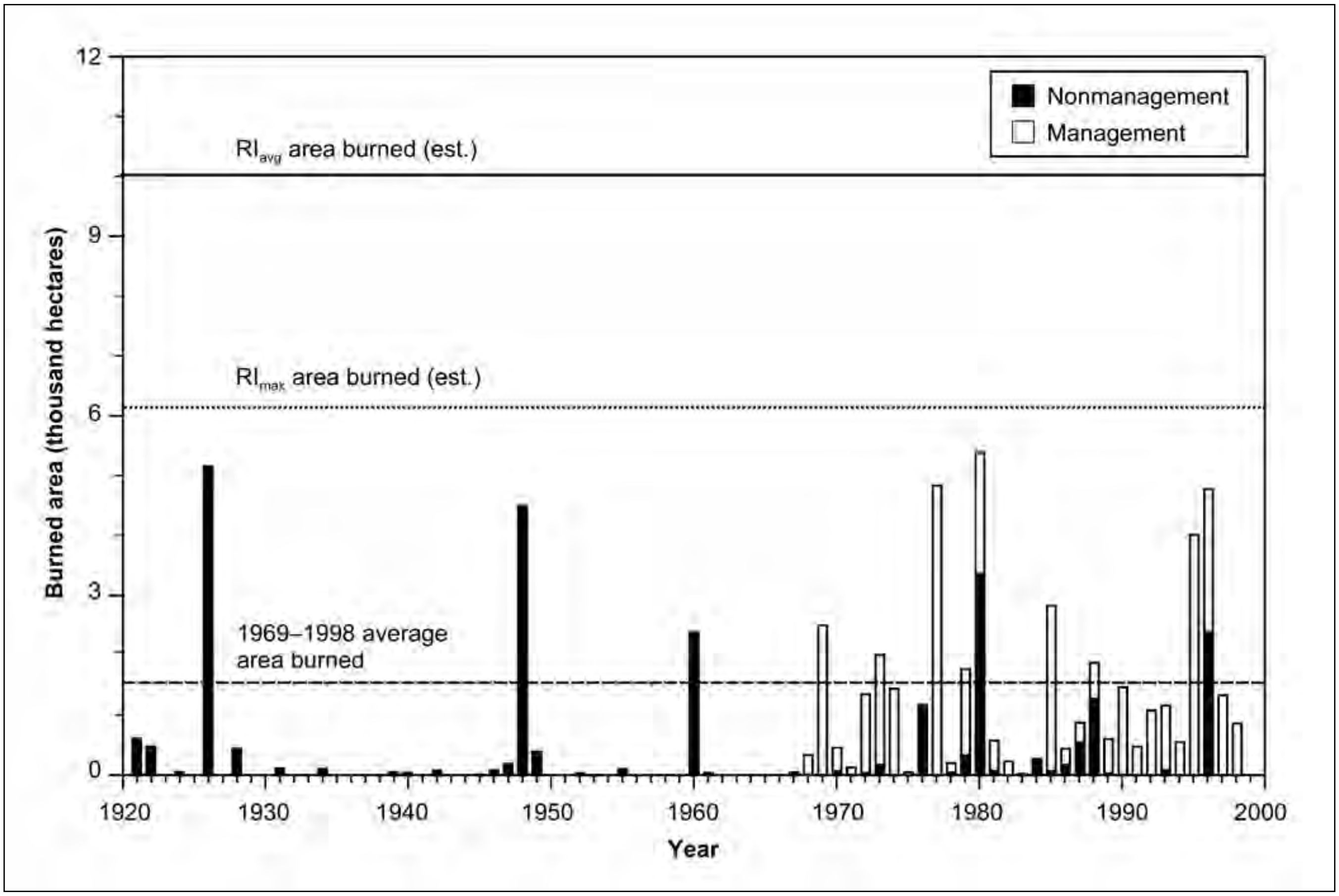


Figure 15—Annual area burned within Sequoia-Kings Canyon National Parks since 1921 by management and nonmanagement fires allowed to burn. Comparison of area burned over the last 20 years relative to estimates of area burned before Euro-American settlement is shown by horizontal lines. The largest annual area burned by management-ignited fires occurred in 1977 although the greatest number of hectares burned in any given year since 1921 was in 1980. (Caprio and Graber 2000). RI = average or maximum estimated return interval.

are challenging from an operational perspective. However, there are examples of ecosystems that have missed several fire cycles and have been managed with prescription fires. For example, Table Mountain pine in the Appalachians has serotinous cones and typically burns in high-intensity crown fires, and it has been shown that local stand-replacing prescription burning can be done safely with successful regeneration of this rare pine, although such high-intensity crown fires may not be required for successful regeneration (Waldrop et al. 2003). Sand pine, which often occurs as a sort of urban forest in Florida, also illustrates how stand-replacing prescription burning can be used successfully, in this case on fragmented landscapes (Outcalt and Greenberg 1998).

Fuel conditions in many crown fire ecosystems remain within their HRV. This applies to some Southwestern U.S. piñon-juniper woodlands where researchers have concluded that there is no ecological justification for aggressive fuel reduction

(Floyd et al. 2004). In these woodlands, the landscape is not dominated by long departures from historical fire-return intervals. Some of these ecosystems, such as some Alaskan boreal forests, can sustain prescription burning, for instance as a management tool for creating favorable wildlife habitat, without deviating from historical conditions (Vanderlinden 1996).

**Despite excessively frequent fire in some places, southern California chaparral largely retains its historical composition, structure, and fire behavior, so resource benefits associated with prescription burning are limited.**

Despite excessively frequent fire in some places, southern California chaparral largely retains its historical composition, structure, and fire behavior, so resource benefits associated with prescription burning are limited. Nevertheless, burning is often advocated on these landscapes to decrease fire hazard. Lack of surface fuels in these shrublands means most fires are independent crown fires, and thus the goal is to maintain a landscape mosaic of young age classes with less hazardous fuels (Minnich and Chou 1997, Minnich and Dezzani 1991). Under moderate summer weather conditions, with relative humidity above 30 percent and windspeeds below 15 km per hour, fires sometimes burn out in these treated areas (Green 1981), and thus fuel treatments may limit fire spread. In any case, summer fires can be controlled before they become destructive to property. However, most large fires are ignited during the autumn foehn winds; under these severe weather conditions, fuel structure does not control fire behavior, and fires burn through, around, or over the top of these young age classes (Keeley et al. 2004). Young fuels do burn at lower fire intensity, and thus they may provide defensible space for firefighters; however, the fires grow so quickly (often exceeding 10 000 ha in the first 12 hours) that by the time firefighting resources are mobilized, most firefighters are forced into defensive positions somewhere along the periphery of the wildland-urban interface. Although fuel manipulations at the wildland-urban interface provide benefit, there is little evidence that prescription burning at large spatial scales is cost effective. Similar conclusions have been drawn about the efficacy of prescription burning in reducing fire hazard from crown fires in lodgepole pine forests of Yellowstone National Park (Wyoming) (Brown 1989, Christensen et al. 1989). Analyses of the ecological and economic effectiveness of strategic application of fuel treatments are needed for other fire regimes as well (DellaSala et al. 2004).

Restoring fire to wilderness areas presents special challenges that have been met mostly with the use of wildland fire (Kilgore and Briggs 1972). Wildland fire use (as the policy is known in the United States) allows some lightning-ignited fires to burn with suppression applied only when deemed necessary for safety or other sociopolitical reasons. Wildland fire use has been successfully applied in Sequoia-Kings Canyon National Parks (Kilgore and Taylor 1979), and in the Gila Wilderness (New Mexico) where more than 60 000 ha have burned since its natural fire program was begun in the mid-1970s. Some areas have sustained as many as four burns during that period (Boucher and Moody 1998, Rollins et al. 2001). Although crown fire has created some canopy gaps (>100 ha, upper range of HRV), the forests generally appear to have been effectively thinned with surface fire, although many dense thickets were in place before burning. In the Rincon Mountain Wilderness (Arizona), wildfires and prescription fires have maintained a relatively frequent fire regime from the late 20th century to the present, resulting in generally open stand conditions in these ponderosa pine forests.

Wildland fire use is slowly increasing in the Western United States (Stephens and Ruth 2005). Although all major federal land management agencies have wildland fire programs, to date very little of the landscape has been allowed to burn (Parsons 2000). In most areas where this is practiced, only a small fraction of all lightning-ignited fires are allowed to burn, and commonly those under severe weather are suppressed. Thus, questions remain as to the degree to which this fire management practice restores historical patterns of ecosystem structure and function (cf. Christensen 2005).

## Effectiveness of Mechanical Fuel Manipulations

Thinning treatments are a useful means of reducing fire hazard in forests with surface and mixed-fire regimes. These treatments can differ widely in the extent to which they alter subcanopy fuels (ladder fuels), canopy base height, canopy bulk density, and canopy continuity (Agee and Skinner 2005, Peterson et al. 2005). Reduction in surface fuels decreases the potential fireline intensity and flame lengths of subcanopy fires. The distance between any remaining surface fuels and the base of the overstory tree canopies (canopy base height) is an important parameter because as this increases, so does the flame length required for canopies to ignite. Effectiveness of one treatment over another is necessarily tied to management objectives that may include reducing the severity of fire effects on forest resources, providing barriers to fire spread or defensive zones for firefighters, or restoring ecosystems to a specific condition. Much of our understanding of how mechanical fuel manipulations affect forest fire behavior is based on modeling studies that simulate fire spread (Fiedler and Keegan 2003, van Wagtendonk 1996). Results have been relatively consistent in indicating the value of combined thinning and surface fuel treatment (including but not limited to burning) for reducing subsequent fire spread rates, intensity, and severity (Johnson et al. 2007, Wallin et al. 2004).

**Empirical studies in ponderosa pine and mixed-conifer forests have shown that combinations of mechanical thinning and surface fuel treatment consistently reduce wildfire severity.**

Empirical studies in ponderosa pine and mixed-conifer forests have shown that combinations of mechanical thinning and surface fuel treatment consistently reduce wildfire severity, as measured by crown scorch and crown volume loss

(Finney et al. 2005, Omi and Martinson 2002, Pollet and Omi 2002, Raymond and Peterson 2005). Treatments that appear to affect fire behavior the most are reductions in tree density and canopy base height (Peterson et al. 2005), although thinning is not always effective at improving the latter (Lynch et al. 2000), especially if residual stand densities are >250 stems per ha (Johnson et al. 2007). Thinning is most effective when it removes understory trees, because larger overstory trees are more resistant to heat injury (Agee and Skinner 2005). In addition, shade and competition from larger trees slows the recruitment of younger trees in the understory. Forest thinning has added benefits in reducing water stress and increasing foliar nitrogen and resin levels that enhance insect resistance (Sala et al. 2005, Wallin et al. 2004). In such treatments, it is critical that both aerial and surface fuels be treated, as slash remaining on the surface may increase fire hazard (Cram et al. 2006).

Neither modeling nor empirical studies show that fuel treatments always act as a barrier to fire spread during very extreme fire weather. This was illustrated by the 2002 Hayman Fire in which some treated forests reduced fire behavior, but spotting breached treated areas during several days of severe weather (Martinson et al. 2003). In contrast, fires may burn out in treated areas under low wind conditions and less severe drought, as illustrated by the Cone Fire (California) that burned into treated forests (Nakamura 2002). Forests with less surface fuels after treatment assist fire suppression by providing safer defensible space for firefighters, even if the treated areas do not completely stop fire spread.

Mechanical thinning, often coupled with prescription burning and other forms of surface fuel treatment, is increasingly being used to reshape forests to more closely resemble the age structure and composition of presettlement conditions based on empirically determined reference conditions (Covington and Moore 1994, Moore et al. 2004). These projects are capable of setting forests on a trajectory toward those conditions, but initial treatments typically cannot completely return forests to their original condition (Waltz et al. 2003). Mechanical thinning followed by prescription fire is an economical means of handling slash, an effective means of pruning lower branches on overstory trees, and may produce ecosystem responses similar to natural fire (Fulé et al. 2002). Physical removal of slash from thinned sites is also used to reduce surface fuels, and although it is more expensive than prescription burning, it does not affect air quality unless it is also burned offsite.

Fuelbreaks are a special class of fuel manipulation that generally comprise a broad swath of fuel reduction that runs across an otherwise untreated landscape. The effectiveness of fuelbreaks remains a matter of debate (Agee et al. 2000). They seldom represent barriers to fire spread, but zones of reduced fuels generate lower fire intensities during active wildfires, and can be used as anchor points for igniting burnout fires (to remove fuels as a fire suppression tactic) or from which prescription burning can be conducted to treat larger areas. Even for cases where there is some proven value to treated areas, the question of cost effectiveness remains (box 8).

*Box 8.*
### Economic Considerations

Cost effectiveness is critical to decisions about fire management practices (Kline 2004), with a central issue being the extent to which fuel treatments reduce suppression expenditures and subsequent wildfire dangers. For example, "minimization of cost + net value change" is a model of wildfire optimization that stresses the importance of evaluating costs in the context of economic efficiency (Donovan and Rideout 2003). We have made rapid progress in the area of relating fuel treatments to subsequent fire behavior, but gaps persist in relating these treatments to effects on forest and shrubland resources, values at risk, and human safety.

Mechanical harvest is often the preferred means of fuel reduction and forest restoration on landscapes where it is logistically feasible. Costs are a major factor in planning for and implementing fuel treatments, and prescriptions focused on reducing fire hazard may not be supported by commercial markets (Barbour et al. 2004). Removal of small trees yields relatively little volume, and the operational cost may exceed the market value (Lynch 2001, USDA FS 2005). Harvesting larger trees is one way to make these operations pay for themselves (Fiedler et al. 2004), but large gaps may promote recruitment of new saplings that require subsequent treatment. In addition, removal of larger trees is inconsistent with sustainable management for late-seral structure and for fire resistance of the residual overstory.

The costs of passive management are evident on some landscapes in the extent of large crown fires that exceed all but the rarest historical events. Fuel manipulations on these landscapes can facilitate increased resilience and sustainability to future disturbances. At the same time, fuel manipulations can cause collateral damage to soils and aquatic systems and, in some cases, promote alien plant invasion (Bisson et al. 2003, Rhodes and Odion 2004). Resource damage also occurs on other landscapes from frequent fires that degrade native ecosystems and enhance alien plant invasion. Careful analysis is required to determine the appropriate frequency, intensity, and extent of fuel manipulations for achieving specific resource objectives while minimizing negative impacts. Fire regime characteristics provide the ecological context needed to evaluate management alternatives for different landscapes.

## Ecosystem Effects of Mechanical Harvesting Versus Fire

Creation or maintenance of historical ecosystem structure and processes, or both, are typically an objective of ecosystem restoration. Mechanical harvest of trees emulates one component of natural fire by reducing the number of smaller living stems in forests (McRae et al. 2001, Perera et al. 2004). However, it does not have the same effects as fire with respect to surface fuels, understory vegetation, soils, nutrient cycling, hydrology, patch size, and snag production (Gallant et al. 2003, Kauffman 2004). In boreal forests, wildfires create more landscape heterogeneity because fire frequency is controlled by fuel moisture and, as a result, fire frequency differs by slope, aspect, and other topographic variation (McRae et al. 2001). This is difficult to emulate by harvesting trees.

Diversity and successional trajectories appear to differ for mechanically treated versus burned forests in some cases (Metlen et al. 2004) but not in others (Wienk et al. 2004). In some boreal forests, fire increases plant species diversity through duff reduction more than does tree removal (Rees and Juday 2002). Lack of duff removal by logging may result in reduced eastern white pine recruitment in Midwestern forests that have been harvested rather than burned (Weyenberg et al. 2004). In one comparison of ponderosa pine forests, thinning plus burning produced significantly higher alien plant abundance than burning alone (box 6).

## Applications in Science-Based Resource Management

This report provides an ecological foundation for management of the diverse ecosystems and fire regimes of North America. Our primary focus has been on prefire management and the range of responses required for management of diverse fire-affected ecosystems:

**Potential management options and goals need to be consistent with current and past fire regimes of specific ecosystems and landscapes.** Fire regimes differ widely among regions and among ecosystems within a region. A "one-size fits all" policy will not adequately address management goals for broad regions or multiple ecosystems within a region. Restoring and maintaining long-term sustainability and health of fire-affected systems requires management objectives and strategies that are adapted to and consistent with the fire regimes of targeted ecosystems. Options for fire management strategies may in some cases be generalized within fire regime types. For example, practical and ecologically appropriate options clearly differ among forests with surface fire regimes, forests and shrublands with crown fire regimes, and grasslands.

**Restoring and maintaining long-term sustainability and health of fire-affected systems requires management objectives and strategies that are adapted to and consistent with the fire regimes of targeted ecosystems.**

**The effects of past management activities differ among ecosystems and fire regime types.** Where fire exclusion has led to fuel loads in excess of the HRV (box 1) , as in some dry forests in western North America, the severity and extent of wildfires has been increasing and fuel reduction may be essential to ecological restoration. Other systems, such as California chaparral, where the balance of ignitions and suppression has led to minimal alteration of fuel loads and fire regimes, may not be good candidates for fuel treatments. In ecosystems where grazing and invasive grasses have altered fire regimes, it may be more appropriate to focus restoration efforts on reducing invasive species.

**Differences in fire history and land use history affect fuel structures and landscape patterns and can influence management options, even within a fire regime type.** Fuel structures at different spatial scales determine potential fire behavior and fire effects and are affected by succession, disturbance (including fire), and dominant use of a particular landscape (timber production, grazing, etc.). For example, differences exist between dry forest ecosystems with surface fire regimes, because surface fuels may be dominated by grasses and herbs (dry forest dominated by ponderosa pine) versus woody litter (mesic forest dominated by mixed conifer). The history of livestock grazing, as modified by interannual variations in climate, may have greater effects on surface fuels in ponderosa pine forests than in mixed-conifer forests, although the history of harvest activities may have greater effects in mixed conifer. The spatial juxtaposition of different fire histories and land use creates a mosaic of potential fire behaviors, fire effects, and habitats. None of these factors affects ecosystems with crown fire regimes nearly as much as they affect ecosystems with surface-fire regimes.

**The relative importance of fuels, climate, and weather differ among regions and ecosystems within a region; these differences greatly affect management options.** Regardless of the fire regime, large uncontrollable fires are always associated with severe fire weather. The extent to which prefire fuel manipulations can alter the course of such fires differs with the fire regime. For ecosystems such as longleaf pine or southwestern ponderosa pine, fire hazard increases when management activities that interrupt natural fire cycles lead to high fuel accumulation. For other ecosystems such as chaparral, periods of extreme fire hazard occur in most years, and severe fires are a function of human ignitions occurring under severe fire weather. Fire prevention activities and better land planning and implementation of community protection strategies may be the greatest assets to managers in these ecosystems.

**Plant species in fire-affected ecosystems may be poorly adapted to alterations in fire regimes.** Some plant species are adapted to survive and reproduce under a particular fire regime. Changes in fire frequency, severity, or seasonality that affect key ecosystem characteristics can limit the ability of those species to survive fire or to regenerate after fire. For example, when surface fire-dominated regimes are replaced by crown fire regimes in dry conifer forests, high mortality of the dominant tree species can remove the seed source needed for postfire regeneration. In chaparral vegetation, changes in fire seasonality can lead to reduced germination or seedling survival of shrubs with heat-stimulated germination. In desert shrublands and grasslands, increases in fire frequency can favor invasive annual grasses, which compete with native species and provide fuel for future fires.

**The effects of patch size must be evaluated within the context of fire regime and ecosystem characteristics.** Fire and other disturbances help to create a mosaic of vegetation with different age, structure, and fuels. Large crown fires in historical crown fire ecosystems generally do not pose a major obstacle to vegetative recovery owing to endogenous mechanisms for regeneration. In contrast, large crown fires in forests with surface-fire regimes may inhibit regeneration that depends on survival of patches of parent seed trees within dispersal distance to the fire-induced gap. The latter systems are in greatest need of management intervention before and after large fires, if the objective is to retain vegetation and structure associated with a low-severity fire regime.

**Fire severity and ecosystem responses are not necessarily correlated.** Historical fire regimes in some ecosystems are characterized by high-severity fires that kill most aboveground vegetation. Such fires may be necessary for reproduction of key species and for maintaining long-term ecosystem health, such as in chaparral and in closed-cone pine forests. In grasslands, fire severity is always high, but fire recycles nutrients and stimulates regeneration from underground plant parts. Ecosystem effects of severe fires are either neutral or positive in these situations.

**Appropriate options for forest fuel manipulations differ within the context of vegetation structure, management objectives, and economic and societal values.** Different ecosystems have different options in terms of potential fuel treatments that would reduce fire hazard. Mechanical harvest reduces ladder fuels but generally increases surface fuels unless there is further treatment. Mechanical harvest of hazardous fuels is often not cost-effective, and commercial extraction may require removal of larger trees that provide fire resistance and animal habitat. Prescription burning can consume surface fuels and increase crown base heights, often at relatively low cost, but is less efficient at removing standing fuels. Even where prescription burning may be the most cost-effective means of reducing fire hazard, it may not be feasible owing to constraints such as air quality regulations and adjacent values at risk. Strategies for reduction of hazardous fuels are more likely to be successful if short- and long-term objectives are clearly stated relative to resource values and desired conditions, and if effectiveness of all fuel treatments is monitored over time.

**Fuel manipulations alter fire behavior but are not always reliable barriers to fire spread.** The value of hazardous fuel reduction for modifying fire behavior (e.g., from crown fire to surface fire) and fire effects (e.g., tree mortality) has been documented primarily in forests with low- and mixed-severity fire regimes. Fuel treatments in these forests may diminish resource damage and provide defensible space for fire suppression activities. Their effectiveness depends on strategic location, size, and residual fuelbed structure. Most fuel treatments do not inhibit fire spread completely, especially when fuels are very dry and weather is very severe.

**Management of fire regimes is more likely to be successful if it is compatible with ecosystem sustainability, feasible in the context of past disturbances and management activities, and consistent with meeting societal needs for products and values.**

**Understanding historical fire patterns provides a foundation for fire management, but other factors are also important for determining desired conditions and treatments.** Management of fire regimes is more likely to be successful if it is compatible with ecosystem sustainability, feasible in the context of past disturbances and management activities, and consistent with meeting societal needs for products and values. Resource use by early North Americans influenced fire regimes in many landscapes, but was not necessarily oriented toward the ecological and resource values for which those systems are managed today. Wildland ecosystems are affected by additional and novel ecosystem stresses such as invasive species, ecosystem fragmentation, and changing climate. Desired resource conditions and fire regimes are, to a great extent, a function of management objectives such as maintaining biodiversity, increasing animal habitat, protecting the functional integrity of ecosystems, reducing alien plant invasion, maintaining water supplies, and protecting local communities. Restoration of a particular historical condition of an ecosystem as an independent objective is rarely compatible with attaining these multiple objectives. Nevertheless, knowledge of historical processes and dynamics is valuable for understanding ecosystems and identifying recent changes that are extraordinary, and which may be incompatible with species or habitat preservation.

**A variety of anthropogenic changes in climate, landscapes (e.g., fragmentation) and ecological communities (e.g., invasive species) will likely alter future fire regimes.** Flexible adaptive management that recognizes the potential for regional variation in how fire regimes respond to these global changes will be most successful. Projected climate change poses one of the more significant challenges because there is good reason to expect both direct impacts on increased fire activity as well as indirect impacts through changes in plant distribution and ecosystem fuel structure.

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## English Equivalents

| When you know: | Multiply by: | To find: |
|---|---|---|
| Kilometers (km) | 0.621 | Miles |
| Hectares (ha) | 2.47 | Acres |
| Kilowatts per meter (Kw/m) | .289 | British thermal units per foot per second |
| Pascals (pa) | .000145 | Pounds per square inch |
| Kilograms (kg) | .0011 | Tons |
| Megagrams per hectare (Mg/ha) | .446 | Tons per acre |
| Tress per hectare | .405 | Trees per acre |

## Common and Scientific Names[1]

| Common name | Scientific name |
|---|---|
| American chestnut | *Castanea dentata* (Marsh.) Borkh. |
| Cheatgrass | *Bromus tectorum* L. |
| Chestnut blight fungus | *Cryphonectria parasitica* (Murrill) M.E. Barr |
| Chestnut oak | *Quercus prinus* L. |
| Douglas-fir | *Pseudotsuga menziesii* (Mirb.) Franco |
| Eastern white pine | *Pinus strobus* L. |
| Gambel oak | *Quercus gambelii* (Nutt.) |
| Giant sequoia | *Sequoiadendron giganteum* (Lindl.) J. Buchholz |
| Great Basin sagebrush | *Artemisia tridentata* Nutt. |
| Longleaf pine | *Pinus palustris* Mill. |
| Mountain laurel | *Kalmia latifolia* L. |
| Pitch pine | *Pinus rigida* Mill. |
| Ponderosa pine | *Pinus ponderosa* C. Lawson |
| Red maple | *Acer rubrum* L. |
| Sand pine | *Pinus clausa* (Chapm. ex Englm) Vasey ex Sarg. |
| Table Mountain pine | *Pinus pungens* Lamb. |
| Tulip poplar | *Liriodendron tulipifera* L. |
| White fir | *Abies concolor* (Gord. & Glend.) Lindl. ex Hildebr. |

[1] Source: USDA NRCS 2008.

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# Predicting spatial patterns of fire on a southern California landscape

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**Abstract.** Humans influence the frequency and spatial pattern of fire and contribute to altered fire regimes, but fuel loading is often the only factor considered when planning management activities to reduce fire hazard. Understanding both the human and biophysical landscape characteristics that explain how fire patterns vary should help to identify where fire is most likely to threaten values at risk. We used human and biophysical explanatory variables to model and map the spatial patterns of both fire ignitions and fire frequency in the Santa Monica Mountains, a human-dominated southern California landscape. Most fires in the study area are caused by humans, and our results showed that fire ignition patterns were strongly influenced by human variables. In particular, ignitions were most likely to occur close to roads, trails, and housing development but were also related to vegetation type. In contrast, biophysical variables related to climate and terrain (January temperature, transformed aspect, elevation, and slope) explained most of the variation in fire frequency. Although most ignitions occur close to human infrastructure, fires were more likely to spread when located farther from urban development. How far fires spread was ultimately related to biophysical variables, and the largest fires in southern California occurred as a function of wind speed, topography, and vegetation type. Overlaying predictive maps of fire ignitions and fire frequency may be useful for identifying high-risk areas that can be targeted for fire management actions.

**Additional keywords:** fire frequency, fire ignitions, generalised linear model, predictive mapping, wildland–urban interface.

## Introduction

Altered fire regimes threaten ecosystem structure and function, create hazards for people, and increase fire suppression costs (Calkin *et al*. 2005; Stephens 2005; Steele *et al*. 2006). In the United States, fire regimes have been altered both through fuel accumulation due to fire suppression and from the dramatic increase in the number of human-caused ignitions in fire-prone areas, particularly the wildland–urban interface (WUI) (Keeley and Fotheringham 2003), which is the contact zone where human development abuts and intermingles with undeveloped vegetation (Radeloff *et al*. 2005). The convergence of these trends has resulted in substantial federal funding, and social and political pressure, to decrease fire hazard by reducing fuel loads (USDA and USDI 2001; NPS 2005).

Although fuel buildup creates conditions favourable for intense, large-scale fires (Pyne *et al*. 1996; Allen *et al*. 2002), human population growth contributes to increased ignitions and fire frequency (Keeley *et al*. 1999; Rundel and King 2001; Radeloff *et al*. 2005; Syphard *et al*. 2007*a*). Information on fuel loading is often the only factor considered when planning management activities to reduce fire hazard (Dickson *et al*. 2006). In some forests, widespread fuel reduction methods, such as landscape-scale prescribed fire, can be beneficial for restoring natural disturbance regimes (Miller and Urban 2000; Scheller *et al*. 2005). However, in regions where human ignitions have increased fire frequency beyond its natural range of variability, widespread prescribed fire can be ecologically damaging to native plant communities (Keeley and Fotheringham 2003).

Also, management strategies based solely on fuel as a risk factor can become needlessly expensive if fuel treatments are placed in locations where fire hazard to humans is of little concern (G. Aplet and B. Wilmer, http://www.tws.org/OurIssues/Wildfire/CFPZ/index.cfm, accessed 11 August 2008). Considering that fire regimes vary among vegetation types and that humans impact fire regimes in different ways, there is growing awareness that fire management should be adapted to both the human and ecological landscape characteristics that vary from region to region (Odion *et al*. 2004; Halsey 2005; Badia-Perpinya and Pallares-Barbera 2006). With better understanding of regional context, fuels treatments can be prioritised and strategically placed in areas where fire is most likely to threaten values

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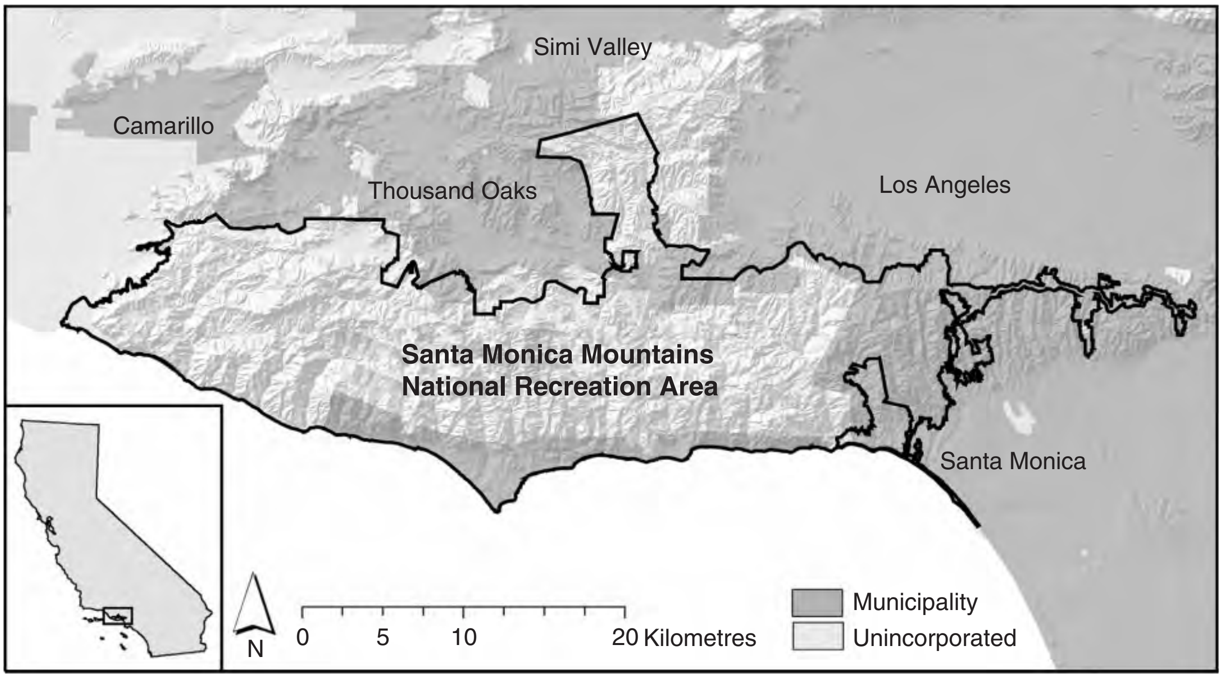


**Fig. 1.** The Santa Monica Mountains National Recreation Area, California, USA.

at risk or where placement will minimise ecological impacts (Halsey 2005; Dickson *et al*. 2006).

To identify the best locations for strategically placed fuels treatments, it is first necessary to understand how and why fire patterns vary across landscapes (DellaSala *et al*. 2004). Fire behaviour is largely a physical phenomenon, as illustrated by the fire environment triangle that places fire as a function of weather, fuels, and topography (Countryman 1972). Therefore, many fire risk and probability assessments have focussed on biophysical and climate variables (e.g. Bradstock *et al*. 1998; Fried *et al*. 1999; Diaz-Avalos *et al*. 2001; Rollins *et al*. 2002; Preisler *et al*. 2004), and several models and methods have been used to predict fire behaviour within different fuels types and from weather condition inputs (Burgan and Rothermel 1984; Forestry Canada Fire Danger Group 1992). Models that predict the probability of lightning ignitions have also been useful for identifying places where fires are likely to occur (Larjavaara *et al*. 2005; Wotton and Martell 2005). Although these biophysical approaches are critical for understanding fire patterns and behaviour, it is also important to understand the human influence on the frequency and spatial pattern of fire to help identify where fire risk is highest on a landscape, especially in places where fire regimes have been altered (Pyne 2001; DellaSala *et al*. 2004; Haight *et al*. 2004).

Human effects on the spatial distribution of fire have been accounted for in recent efforts to map or model fire risk. Most of these studies focussed on fire ignition points (i.e. the spatial location of fire's origin) (e.g. Pew and Larsen 2001; Badia-Perpinya and Pallares-Barbera 2006; Dickson *et al*. 2006; Yang *et al*. 2007), but fire risk probability has also been mapped using fire occurrence data (i.e. any location that burned regardless of point of origin) (e.g. Chou 1992; Chou *et al*. 1993). One problem is that fire patterns depend on both ignition locations and fire spread, but these are not necessarily determined by the same factors (Dickson *et al*. 2006; Syphard *et al*. 2007*a*, 2007*b*). For example, ignitions may or may not occur in fuel types that are highly flammable.

Our objective for the present research was to use a combination of biophysical and human explanatory variables to produce spatially explicit statistical models and maps predicting patterns of fire ignitions and fire frequency in a human-dominated southern California landscape. Most fires in the region result from human ignition sources (Keeley 1982; NPS 2005), so we expected proximity to human infrastructure to most strongly influence fire ignition patterns because the human activities that are likely to lead to ignitions are concentrated in or near these locations. The rate of spread for the largest fires in southern California is largely determined by wind speed, topography, and vegetation type (Keeley 2000). Therefore, we also expected the distribution of biophysical variables to be important predictors of fire frequency.

## Methods

### *Study area*

The Santa Monica Mountains National Recreation Area (hereafter referred to as the Santa Monica Mountains) encompasses ~60 000 ha of Mediterranean-type habitat, characterised by steep, coastal mountains that form the southernmost range in the Transverse Ranges of southern California (Fig. 1). Slightly more than half of the land in the mountains is in public ownership (including the National Park Service), and much of the privately owned land remains undeveloped. However, the Santa Monica Mountains include a substantial amount of WUI and have been experiencing increased development pressure due to their proximity to the Los Angeles metropolitan region, which is

**Table 1. Variables analysed in the regression models explaining fire ignitions and fire frequency in the Santa Monica Mountains, CA**
WUI, wildland–urban interface

| Variable | Resolution | Source | Description or range |
|---|---|---|---|
| Dependent variables | | | |
| Ignition points | Point | National Park Service | $n = 126$, V = 67, from 1981 to 2003 |
| Fire frequency | 10 m | National Park Service fire perimeters | 0 to 9, from 1925 to 2003 |
| Explanatory variables | | | |
| Human | | | |
| Distance to development | 10 m | Syphard *et al.* 2005 | Mean Euclidean distance |
| Level of development | 500-m buffer | Syphard *et al.* 2005 | None (0); low (0.01–0.33); intermediate (0.34–0.66); high (0.67–1.0) |
| Distance to WUI | 10 m | Radeloff *et al.* 2005 | Mean Euclidean distance |
| Level of WUI | 500-m buffer | Radeloff *et al.* 2005 | None (0); low (0.01–0.33); intermediate (0.34–0.66); high (0.67–1.0) |
| Distance to roads | 10 m | US Census Bureau TIGER/Line files | Mean Euclidean distance |
| Distance to trails | 10 m | National Park Service | Mean Euclidean distance |
| Biophysical | | | |
| January temperature | 1 km | J. Michaelson (Franklin 1998) | Interpolated by kriging |
| Elevation | 30 m | USGS Digital Elevation Model (DEM) | |
| Slope gradient | 30 m | Derived from DEM | |
| South-westness | 30 m | Derived from DEM | SW = (con(aspect(<dem>) == −12, 201,(cos(((aspect(<dem>) − 255) div deg) + 1) * 100))) |
| Vegetation type | 30 m | J. Franklin, J. J. Swenson and D. Shaari, pers. comm., 1997 | Coastal sage scrub; northern mixed chaparral; chamise chaparral; non-native grass; oak woodland; riparian; other (less flammable vegetation such as salt marshes, agriculture, or urban) |

home to more than 17 million people (Rundel and King 2001). The region that includes the study area is biologically rich, with ~1000 plant species, 50 mammal species, 400 bird species, and 35 species of reptiles and amphibians (NPS 2005). The region is also home to more than 20 federal or state-listed threatened or endangered animals and plants and another 46 animal and 11 plant species listed as species of concern (NPS 2002). The primary vegetation types are chaparral (e.g. *Ceanothus* spp. or *Adenostoma fasciculatum*, ~60%); coastal sage scrub vegetation (e.g. *Salvia* spp. or *Artemisia californica*, ~25%); exotic grass (~5%); oak woodland (~5%); and riparian vegetation (~5%).

Fire is a natural process in southern California Mediterranean-type ecosystems, and many of the region's native species are resilient to a range of fire frequencies (Zedler 1995). However, explosive population growth in the region has increased ignitions to the point that fire frequency exceeds its natural range of variability in many areas (Keeley *et al.* 1999). Repeated fires in short succession can also exceed the resilience of native species, and some shrublands have type-converted to exotic annual grasses under high fire frequencies (Zedler *et al.* 1983; Haidinger and Keeley 1993; Jacobsen *et al.* 2007). In the last 75 years, humans have been responsible for 98% of the fires in the Santa Monica Mountains, and some areas have burned up to 10 times (NPS 2005). Chaparral-dominated shrublands are typified by high-intensity, stand-replacing fires that are difficult or impossible to suppress under severe, high-wind weather conditions (Keeley 2000). Therefore, considering that fire frequency has increased despite aggressive fire suppression efforts, the most recent fire management plan in the Santa Monica Mountains recommends against using prescribed fire to reduce fuel across the entire landscape (NPS 2005). Instead, the National Park Service (NPS) recommends strategically positioned fuels treatment in areas with high fire hazard near the WUI.

## *Data description*

### *Dependent variables – fire ignitions and frequency*

The ignition data included 126 coordinate points acquired from the NPS fire records from 1981 to 2003 (Table 1, Fig. 2). Ignition locations were entered into the Shared Applications Computer System (SACS) at the National Interagency Fire Center (NIFC) in Boise, ID, and then converted into a Geographic Information System (GIS) database. The median accuracy of the ignition locations was 100 m.

Fire perimeter polygons originally reported by NPS and County Fire Departments were compiled by the California Department of Forestry–Fire and Resource Assessment Program (CDF-FRAP) into a GIS database (http://frap.cdf.ca.gov/data/frapgisdata/select.asp, accessed 8 August 2008). Although this database generally provides the most complete digital record of fire perimeters in California, the fire record was incomplete, with a minimum mapping unit of 4.04 ha (10 acres). Therefore, the NPS staff at the Santa Monica Mountains updated this database to include additional smaller fires (less than 1 ha), which resulted in a fire frequency map that delineated overlapping fire perimeter boundaries from 1925 to 2003. Within this database, more than 75% of the fires occurred within the last 20 years. Although the average area burned also increased over time, the fire size distribution has remained generally stable, with a slight decline (Table 1, Fig. 2).

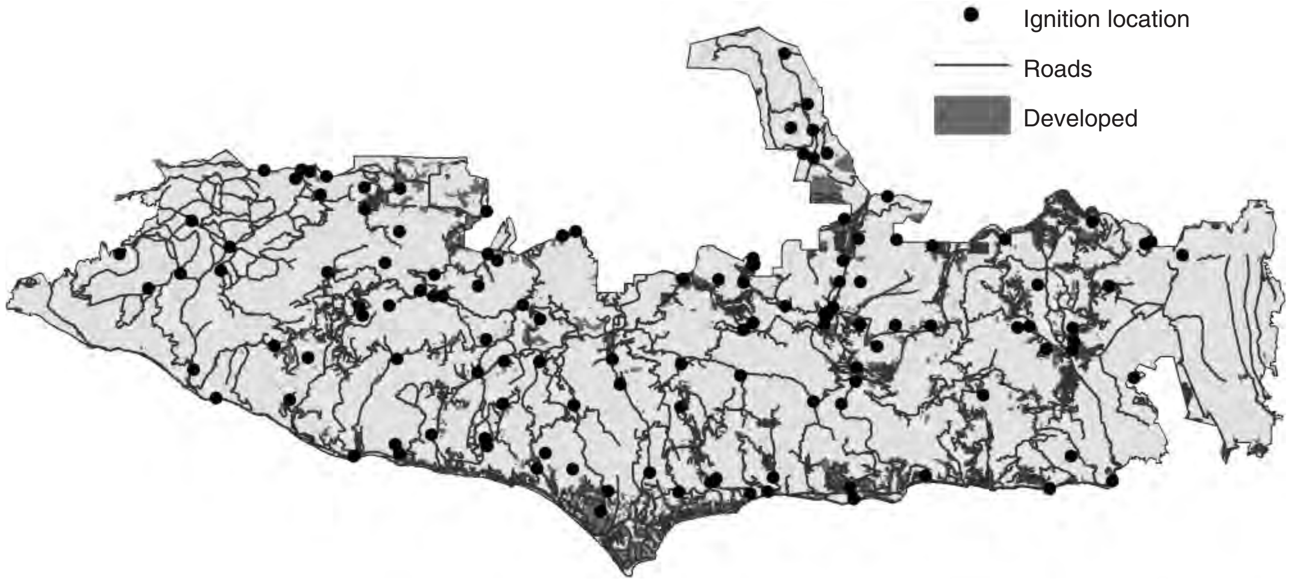


**Fig. 2.** Map showing proximity of ignition points (1981–2003) to roads and development in the Santa Monica Mountains, CA.

Using these boundaries, we created a continuous grid surface reflecting the number of fires that occurred during those 78 years for each cell. From this fire frequency grid, we randomly selected 1000 points to relate number of fires to the explanatory variables. We selected 1000 data points as our sample size because we wanted to use as many points as possible given the practical limitations of our statistical models. To ensure that the sample size was large enough to adequately represent the study area, we performed $\chi^2$ goodness of fit tests to compare the true distribution of fire frequency (14 million points) with the distribution of fire frequency in our sample size of 1000, and we found no significant difference between them.

### *Explanatory variables – human*

Human-caused ignitions frequently occur along transportation corridors and other areas where human activity is concentrated (Keeley and Fotheringham 2003; Stephens 2005). The ignition data points from the Santa Monica Mountains also appeared to be close to roads and development on a map (Fig. 2). Therefore, our explanatory human variables included distance to development, roads, trails, and WUI (Table 1, Fig. 2). We included trails because they provide a means of human access to otherwise undeveloped areas in the parks and protected areas. We created the map of development through airphoto interpretation and onscreen digitising of development evident on 1 : 12 000 at 1-m resolution digital orthorectified quarter quadrangles (DOQQs) from the US Geological Survey (USGS) for 2000. 'Development' included any part of the landscape with houses or other buildings, in addition to golf courses. We used 2000 US Topologically Integrated Geographic Encoding and Referencing system TIGER/Line files (US Census 2000) for our road data, and the NPS provided the GIS map of trails.

The interactions between human activities and natural dynamics tend to be spatially concentrated at the WUI, which has received national attention because housing developments and human lives are vulnerable to fire in these locations and because human ignitions are believed to be most common there (Rundel and King 2001; USDA and USDI 2001). Our WUI map was created as part of a nationwide mapping project that produced fine-scale maps of the conterminous United States (Radeloff *et al*. 2005; http://www.silvis.forest.wisc.edu/silvis.asp, accessed 8 August 2008). These data were created based on the definition of WUI published in the Federal Register (USDA and USDI 2001) using housing density data obtained from the US Census and land cover data obtained from the USGS National Land Cover Dataset (at 30-m resolution).

### *Explanatory variables – biophysical*

From a biophysical perspective, the expression of fire on a landscape is a function of its fire environment, including the climate, terrain, and fuels in a region (Pyne *et al.* 1996). Therefore, spatially explicit models that simulate fire behaviour use input measurements of elevation, slope, aspect, weather, and vegetation (Anderson 1982; Andrews *et al*. 2005). Likewise, we selected climate and terrain-derived variables, as well as vegetation type, as potential biophysical explanatory variables (Table 1, Fig. 2). The biophysical factors that influence fire ignitions and fire spread may produce multiple direct and indirect effects on the fire regime (Whelan 1995). For example, slope angle affects soil moisture and development, which in turn affects vegetation distribution and composition, and thus fuel characteristics and flammability (Franklin 1995). At the same time, slope produces a direct physical effect on active fire fronts because the flames are closer to the ground, and fires typically burn faster in an upslope direction (Whelan 1995). We expected that the spatial variability and distribution of these influential biophysical variables across the landscape would provide substantial explanatory power to predict and map where fire ignitions and fire frequency were likely to occur.

Our terrain variables included elevation, percentage slope, and transformed slope aspect ('south-westness'). These topographic factors explain variation in local climate, provide natural firebreaks, and indirectly influence factors such as fuel moisture, vegetation distribution, and relative humidity (Whelan 1995). We scaled aspect to an index of 'south-westness' using a cosine transformation because the index better distinguished xeric exposures (high index values) from mesic exposures (low index values) (Franklin *et al*. 2000).

Because we were not simulating annual fire behaviour or weather, we used spatially interpolated climate variables (mean annual precipitation, average January minimum temperature and average July maximum temperature), which were more appropriate for the broad spatial and temporal scale of our study. Moisture and temperature affect vegetation productivity and rate of fuel accumulation as well as soil moisture, rate of combustion, and rate of spread (Whelan 1995). We evaluated both January minimum and July maximum temperatures because these represented upper and lower limits, both of which would therefore maximise the distribution of variability in temperature gradients and plant species distributions across the landscape (Franklin 1998). Annual precipitation had high correlation with other variables and was removed from the analysis. The temperature data layers were developed as a 1-$km^2$ gridded surface that was interpolated from climate station data, elevation, and a digital elevation model. The surfaces were interpolated using universal and ordinary kriging (Franklin 1998).

Several sophisticated systems have been developed to create fuels models to use in fire behaviour prediction (e.g. Forestry Canada Fire Danger Group 1992). However, only three of the thirteen standard fuel models used in the United States (by the National Forest Fire Laboratory) are considered applicable to chaparral shrublands (Anderson 1982). In southern California shrublands, the fire regime is strongly differentiated according to broadly defined, structurally similar vegetation types, and fire tends to behave uniformly within those types (Wells *et al*. 2004). Therefore, instead of using fuel types as predictor variables, we used a generalised map of vegetation types, created through a classification of 30-m Landsat Thematic Mapper (TM) data (J. Franklin *et al*., pers. comm., 1997).

The fact that post-fire age (and thus fuel buildup) is a less critical factor in California chaparral than in some other vegetation types is an important additional consideration. Fire spread in North American coniferous forest areas is strongly affected by post-fire age, with younger stands having lower fuel loads and lower rates of fire spread. In contrast, post-fire age has relatively little effect on the spread of fires in California chaparral, particularly during high wind conditions (Moritz 2003). Owing to rapid post-fire fuel accumulation, chaparral and coastal sage shrublands can burn at high intensities at young ages (Radtke *et al*. 1982). Therefore, we assumed that post-fire age would not strongly influence temporal patterns of fire frequency in the Santa Monica Mountains as strongly as it would in other regions, and therefore we did not include it as a variable in our analysis. Some studies in forested regions have considered post-fire age and temporal autocorrelation when explaining fire frequency (e.g. Reed *et al*. 1998; Preisler *et al*. 2004).

### *Data manipulation*

Because we expected fire to occur close to human infrastructure, we created continuous surfaces reflecting mean Euclidean distances to all of the human explanatory variables, and we used these distances in our models. To obtain better precision in our Euclidean distance calculations, we resampled all of our grids to a 10-m resolution and used those for overlay and extraction of data to relate the explanatory variables to fire ignitions and frequency. Because fire frequency and area burned also tend to be highest at intermediate levels of human activity and are a function of the spatial pattern of development and fuels (Keeley 2005; Syphard *et al*. 2007*a*), we created 500-m buffers around all point locations and calculated the proportion of development and WUI within those areas (total extent = 78 ha). We chose this buffer size because the dense nature of chaparral makes it difficult for humans to traverse far into the vegetation (Halsey 2005); therefore, we assumed that human influence would not exceed 500 m. The proportions were then classified into four arbitrary categories: none (0), low (0.01–0.33), intermediate (0.34–0.66), and high (0.67–1.0) (Table 1). We used the Spatial Analyst Extension of *ArcGIS*, in addition to *ArcInfo Workstation*, for our GIS analysis and data processing.

### *Modelling approaches*

#### *Fire ignitions*

To predict the estimated probability, $P$, of a cell, i, in the study area experiencing an ignition, we developed a multiple logistic regression model. For logistic regression, if we let $P_i$ be the probability of an ignition in cell i, and $x_{ji}$ be the value of the jth covariate in cell i, the logistic regression model is:

$$P_i = \exp(\beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \ldots + \beta_n x_{ni}) / (1 + \exp(\beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \ldots + \beta_n x_{ni}))$$

where $\beta_0$ is a constant and $\beta_n$ are regression coefficients for the human and biophysical explanatory variables, $x_{ni}$. To determine whether the explanatory variables affected the ignition locations differently than what would be expected by chance, we also generated a random sample of 700 control points in the study area. Therefore, our model predicted the probability that ignitions would occur disproportionately as a function of multiple landscape characteristics compared with 700 randomly selected available locations within the study area. We chose 700 control points because we wanted to sample enough points to adequately capture the variability in the predictors across the entire landscape without substantially decreasing the ratio of ones to zeros. Our ratio (1 : 5.5) was similar to that of Brillinger *et al*. (2003) (1 : 4).

We first developed univariate logistic regression models for all of the explanatory variables because we wanted to evaluate their independent influence on the response variables and to determine the values and direction (i.e. positive or negative) of the coefficients independently of their interactions with other variables. The $P$ values for these models were Bonferroni-corrected to account for the large number of tests performed. Next, we developed a multiple logistic regression model using the R statistical package (R Development Core Team 2005). We selected the final model through a backwards elimination process using the Akaike Information Criterion (AIC)

(Venables and Ripley 1999). Significance of effects was determined using the likelihood ratio test.

To ensure that there were no collinearity problems, we implemented a collinearity diagnostic procedure, the variance inflation factor (VIF), to ensure low correlation (VIF lower than 10) between the variables in the multiple regression model (Belsey *et al*. 1980). Because July maximum temperature was correlated with other variables, we removed this variable and refitted the multiple regression models. We also plotted semi-variograms of the models' deviance residuals to ensure there was no evidence of spatial autocorrelation. For all of our models, we evaluated the variables for non-linear relationships with the response through graphical checks and by fitting the models with quadratic terms included and determining whether those terms were significant.

To evaluate the performance of the multiple logistic regression model, we used a leave-one-out cross-validation approach (Lachenbruch 1967; Bautista *et al*. 1999). The procedure was to drop a single data point (i.e. an ignition), fit the model without it, and then calculate the predicted probability of an ignition at that point. This was repeated for every point. We then performed a receiver operating characteristic (ROC) analysis to determine the optimal probability cutoff for predicting that an ignition would occur. Based on this prediction rule, we were able to compare the yes–no ignition prediction with whether an ignition actually occurred, and estimate the sensitivity (fraction of true positive), specificity (fraction of false positive), and overall predictive ability of the fitted model (Fielding and Bell 1997).

The overall area under the curve (AUC) reflected the overall probability that, when we drew one ignition and one non-ignition point at random, our prediction rule correctly identified them. AUC values vary from 0.5 (no apparent accuracy) to 1.0 (perfect accuracy), but the interpretation of what is considered high or low predictive ability is subjective and can vary according to sample size, with lower sample sizes resulting in lower evaluations of model accuracy (Hernandez *et al*. 2006).

### *Fire frequency*

Instead of using logistic regression, we used Poisson univariate and multiple regressions to develop the fire frequency models because they were appropriate for count data (Agresti 1996). For Poisson regression, if $N_i$ is the number of fires observed in cell i, and $x_{ji}$, $\beta_0$ and $\beta_n$ are as above, the model is:

$$N_i = \exp(\beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \ldots + \beta_n x_{ni})$$

As with the ignition multiple regression models, we developed univariate regression models for all of the explanatory variables because we wanted to evaluate their independent influence on the response variable, and adjusted the *P* values using the Bonferroni correction. For our multiple Poisson regression analysis, we again used a backwards stepwise elimination procedure based on the AIC to select the final model.

Although no spatial autocorrelation was present in the ignition data, we refitted the Poisson multiple regression model with allowance for a spatial exponential correlation between the deviance residuals owing to significant spatial autocorrelation in the fire frequency data (Littell *et al*. 1996). We fitted this model using the *GLIMMIX* macro of *SAS* Software (PROC GLIMMIX 2005).

To evaluate the performance of our multiple Poisson regression model, we randomly selected 300 independent observations in the study area. To determine how closely the observed and predicted values agreed in relative terms, we calculated Pearson's correlation coefficient. We also calculated the root mean square error (RMSE) and average error, which illustrate the discrepancy between the observed and predicted values (Potts and Elith 2006).

### *Predictive mapping*

To convert our models into predictive map surfaces, we applied the formulae from the multiple Poisson and multiple logistic regression models to the entire study area using the predicted coefficients and the GIS map layers of the significant explanatory variables. Because logistic regression uses a prespecified number of control points, the intercept for the logistic regression is meaningless. However, we were able to adjust the intercept, and thereby map meaningful predicted probabilities, by using the ratio of control to experimental points (Preisler *et al*. 2004). We used the formulae from the Poisson model to predict and map fire frequency.

Owing to the difference in scales of fire ignition and fire frequency maps (probability of ignition *v.* predicted number of fires), we reclassified both maps into five equal-interval categories using the GIS and then summed these derived maps to generate a new map. This combined map was beneficial for identifying areas where ignitions and fire frequency were either both high or both low; however, intermediate values on the combined map did not differentiate between areas of high ignitions and low fire frequency and areas of high fire frequency and low ignitions. Therefore, we created a second map that reflected the differences in the predicted map surfaces.

## Results

### *Fire ignitions*

All of the human variables were significant ($P \leq 0.05$) in explaining fire ignitions in the univariate models except for distance to WUI after the Bonferroni adjustment (Table 2, Fig. 3). Ignitions were negatively related to all the distance variables and occurred closer to human infrastructure than the randomly selected points (Table 2). Although logistic regression coefficients can only be interpreted with respect to the intercept for categorical variables, the univariate models did indicate that fewer ignitions occurred when there was no development within a surrounding 500-m buffer, and more ignitions occurred with low or high proportions of nearby development. Similarly, fewer ignitions occurred when there was no WUI in the buffer, and more occurred with higher proportions of WUI. In addition to the human variables, the pattern of ignitions was also significantly related to slope and vegetation type, with ignitions being negatively related to slope.

When all of the variables were evaluated in the multiple logistic regression analysis, the final model for fire ignitions retained most of the human variables (distance to development, distance to roads, distance to trails, and level of WUI) as well as January minimum temperature and vegetation type (Table 3). The final model was highly significant at $P < 0.0001$.

**Table 2. Univariate regression results for all variables explaining fire ignitions and fire frequency in the Santa Monica Mountains, CA**
WUI, wildland–urban interface

| Explanatory variable | Fire ignitions | | | Fire frequency | | |
|---|---|---|---|---|---|---|
| | Coefficient | s.e. | *P* value | Coefficient | s.e. | *P* value |
| Distance development | −0.001201 | 0.000258 | <0.0001 | 0.000131 | 0.000043 | 0.0026 |
| Distance WUI | −0.000298 | 0.000137 | 0.0183 | 0.000065 | 0.000045 | 0.1513 |
| Distance roads | −0.002635 | 0.000637 | <0.0001 | 0.000097 | 0.000059 | 0.1028 |
| Distance trail | −0.001785 | 0.0007 | 0.0045 | −0.00002 | 0.000073 | 0.7837 |
| January | −0.00012 | 0.000115 | 0.2964 | 0.000194 | 0.000057 | 0.0007 |
| South-westness | 0.002373 | 0.001392 | 0.0869 | 0.000334 | 0.00012 | 0.0055 |
| Slope | −0.039957 | 0.009359 | <0.0001 | 0.001927 | 0.00092 | 0.0364 |
| Elevation | −0.000414 | 0.000169 | 0.0132 | 0.000079 | 0.000044 | 0.0726 |
| Level of development | | | | | | |
| None (0) | −2.3706[A] | 0.2012 | 0.0002 | 1.2394 | 0.3444 | <0.0001 |
| Low (0–0.33) | 0.9784 | 0.2349 | | 1.1649 | 0.3426 | |
| Intermediate (0.34–0.66) | 0.6127 | 0.3972 | | 0.9595 | 0.3338 | |
| High (0.67–0.1) | 0.9843 | 0.8158 | | −0.2587[A] | 0.3604 | |
| Level of WUI | | | | | | |
| None (0) | −2.3302[A] | 0.2095 | <0.0001 | 0.07604 | 0.05809 | 0.5728 |
| Low (0–0.33) | 1.174 | 0.2704 | | 0.03285 | 0.04838 | |
| Intermediate (0.34–0.66) | 0.8506 | 0.3119 | | 0.01377 | 0.04237 | |
| High (0.67–0.1) | 0.4861 | 0.285 | | 0.8651[A] | 0.08816 | |
| Vegetation type | | | | | | |
| Coastal sage scrub | −1.39872[A] | 0.17656 | <0.0001 | −0.02177 | 0.6849 | 0.3812 |
| Northern mixed chaparral | −0.99918 | 0.24968 | | −0.00314 | 0.06824 | |
| Chamise chaparral | 0.01242 | 0.58624 | | −0.09035 | 0.1025 | |
| Non-native grass | 0.3001 | 0.3657 | | −0.05593 | 0.0823 | |
| Other | 0.19474 | 0.30509 | | −0.099 | 0.08529 | |
| Oak woodland | 0.64495 | 0.46368 | | −0.1134 | 0.09551 | |
| Riparian | 0.41789 | 0.69965 | | 0.9235[A] | 0.1039 | |

[A]Intercept of the model; the coefficients of the categorical variables (level of development and WUI, and vegetation type) are relative to the value of the intercept.

The map surface generated by applying the formula and coefficients of the final model to the original GIS maps showed the distribution of predicted ignition probabilities across the study area (Fig. 4). The spatial pattern of those areas predicted as having the highest likelihood of ignition reflected the influence of development, WUI, and roads, as seen through their similar distributions (Fig. 2).

The leave-one-out cross-validation of the final multiple logistic model resulted in an AUC of 0.71. An AUC of 0.71 indicates that, although our ability to predict is not perfect, our model performs considerably better than chance, and thus provides useful and novel information about the properties of the locations where ignitions are likely to occur. Our maximum sensitivity (true positive fraction) and specificity (false positive) occurred at a cutoff of 0.16, which yielded sensitivity = 0.685, and specificity = 0.667 (Fig. 4). In other words, if the model predicts a probability of ignition of 0.16 or more, we predict an ignition, otherwise we predict no ignition.

### *Fire frequency*

Unlike the univariate models for fire ignitions, there were more biophysical variables than human variables that were significant ($P \leq 0.05$) in explaining fire frequency (Table 2, Fig. 3). Specifically, January minimum temperature, south-westness, slope, and elevation all had a positive influence on fire frequency. However, elevation, slope, and south-westness were not considered significant with the Bonferroni adjustment. Whereas distance to development negatively influenced the likelihood of ignition, it had a significant positive influence on fire frequency, so that fires were more likely to burn farther away from development. Fire frequency was also significantly related to level of development, but the influence was opposite that for fire ignitions in that fires were more likely to occur in none, low, and intermediate levels than in high levels of development.

Except for distance to development, all of the variables that were significant in the non-adjusted univariate models were also retained in the final model for fire frequency (Table 3). This model was also highly significant at $P < 0.0001$. The spatial pattern of predicted fire frequency on the map generated from the final regression model showed a strong influence of level of development and reflected the influence of the 500-m buffers (Fig. 4). The influence of January temperature was also visually apparent in the predictions, with more fires occurring along the coast where the temperature is generally warmer. The areas predicted to experience the most fires roughly corresponded to the fire history map (Fig. 2).

The evaluation of our multiple Poisson regression fire frequency model with the independent dataset showed that we predicted the number of fires correctly 40% of the time,

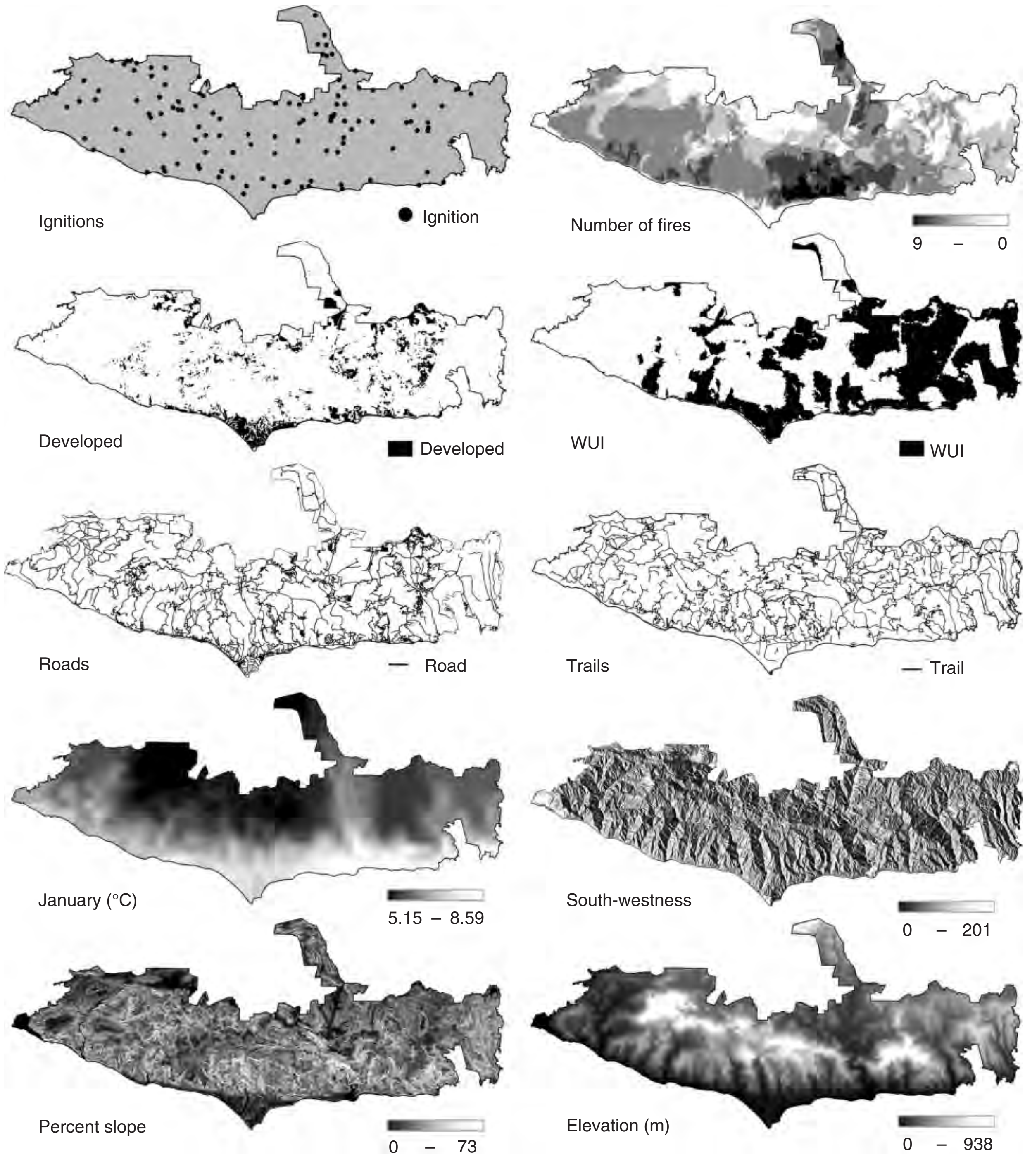


**Fig. 3.** Maps of variables used for regression models and predictive mapping of the Santa Monica Mountains, CA. Dependent variables included ignitions and number of fires; independent variables included developed, wildland–urban interface (WUI), roads, trails, mean January minimum temperature, south-westness, percentage slope, and elevation. Vegetation map not shown. The WUI is the area where houses meet or intermingle with undeveloped wildland vegetation, based on the definition in the Federal Register.

80% were within one fire of being correct, and 95% were within two. The Pearson's correlation coefficient was 0.490, the RMSE was 1.219. These statistics indicate that the model's performance was fair, but the positive error shows that we tended to underestimate fire frequency.

The combined map showed that, although some areas had a high potential for both fire ignition and frequency, not all areas with high potential for ignition were likely to experience many fires. In some of the most remote portions in the interior of the landscape, both fire ignition probability and fire frequency were predicted to be low. Along the coast and through some of the more developed canyons in the interior, however, both ignitions and frequency were predicted to be higher (Fig. 4).

## Discussion

As we expected, humans significantly influenced the spatial pattern of ignitions, which were located in close proximity to all measures of human infrastructure included in our univariate models and were most strongly related to distance to development and roads in the multivariate models. Previous research showed that fire frequency and area burned were highest at intermediate levels of human activity; however, at lower and higher levels of human activity, fire activity was lower (Keeley 2005; Syphard *et al*. 2007*a*, 2007*b*). In the present study, ignitions were more likely to occur with consistently larger proportions of both development and WUI within 500-m buffers. However, the spatial extent of these buffers may not have captured the intermediate effects that were apparent through the landscape and county scales used in the other studies. Slope, vegetation type, and January temperature were also significantly related to ignitions, which may in part reflect the fact that fire ignition success is conditional on factors such as fuel moisture content and stand structure (Tanskanen *et al*. 2005).

Considering that humans start most fires in the Santa Monica Mountains and that human activities are concentrated around roads and developed areas, these results are not surprising. Yet, statistically modelling these human relationships and their interactions with biophysical variables is necessary for more precisely explaining and mapping the parts of the landscape that are most likely to ignite. Although other regions may not experience the same proportion of human ignitions as southern California, human-caused ignitions along transportation corridors have been documented broadly (Stephens 2005), and the significance of our results underscores the importance of considering more than just fuel loads in fire risk assessments. The WUI is not just the area with the highest concentration of human

**Table 3. Variables retained in the multiple regression models explaining fire ignitions and fire frequency in the Santa Monica Mountains, CA**
WUI, wildland–urban interface

| Model | Explanatory variable | *P* value |
|---|---|---|
| Ignitions | Distance development | <0.0001 |
| | Distance roads | 0.002 |
| | Vegetation type | 0.002 |
| | Level of WUI | 0.011 |
| | January | 0.016 |
| | Distance trails | 0.08 |
| | Full model | <0.0001 |
| Fire frequency | Level of development | <0.0001 |
| | January | <0.0001 |
| | South-westness | 0.005 |
| | Elevation | 0.036 |
| | Slope | 0.045 |
| | Full model | <0.0001 |

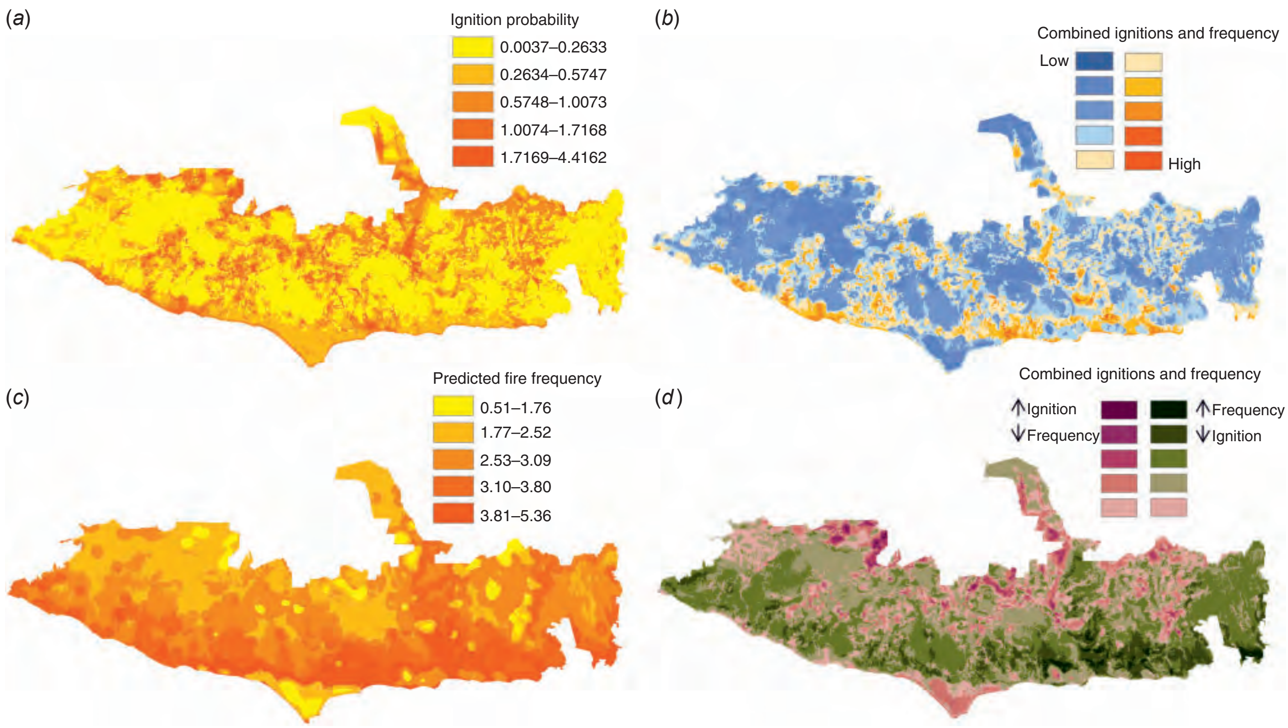


**Fig. 4.** Maps showing predicted probability of ignition (*a*), predicted fire frequency (*b*), overlay and sum of the classified ignition and fire frequency maps (*c*), and the distribution of differences between predicted ignition probabilities and predicted fire frequency (*d*) developed from multiple regression models in the Santa Monica Mountains, CA.

values at risk; it is also the area where humans are most likely to put these valuable assets at risk by starting fires, intentionally or not.

Although ignition locations were primarily related to the distribution of human activities, fire frequency was mainly determined by biophysical variables, which was expected because fire spread is ultimately a function of vegetation characteristics, climate, and terrain (Pyne *et al*. 1996). Fire frequency was significantly related to two human variables, but more fires occurred with longer distances to development and with lower proportions of development within buffers. Although this result seems surprising given the location of ignitions, one likely reason that fires burned more frequently when they were farther from human infrastructure is that there is typically more continuous vegetation in remote areas. Therefore, fires would not be interrupted by fragmented fuels that characterise urban areas. Also, there are lower concentrations of fire suppression resources outside urban areas (Calkin *et al*. 2005), so fires will be able to consistently burn longer and grow larger when they spread beyond their ignition source into more remote regions. This means that, although fires start closer to roads or development, the areas that actually burn most frequently are the non-urban regions where fire spreads after ignition.

A possible shortcoming in our fire frequency models was that the human explanatory variables only represented the contemporary time period, but the fire frequency data spanned a period of 78 years (although more than 75% of the fires in the record occurred within the last 20 years). Despite this temporal mismatch, our results were consistent with previous research in California that showed that, whereas human variables are the best predictors for the number of fires that start, biophysical variables are better at explaining the variation in area burned (Syphard *et al*. 2007*a*). Therefore, the most important predictors for the fire frequency models were the biophysical variables that remained constant over the temporal extent of the fire frequency data.

Although it would have been ideal to incorporate temporally extensive human variables in our multiple regression analysis, adding these data would have likely only improved the fit of our models, particularly because human development patterns have high spatial autocorrelation, particularly in the Santa Monica Mountains (Syphard *et al*. 2007*b*). Historic housing data were most likely distributed in the exact same locations as the contemporary housing data that we used in our analysis because houses persist over time. Nevertheless, the fair performance of our fire frequency models may have been improved if we had had access to temporally extensive data for the human variables.

The fact that the variables that best predicted fire ignitions differed from those that best predicted fire frequency explains why the spatial patterns in the predictive maps of ignitions and frequency were somewhat different from one another. Nevertheless, there were regions in the interior of the landscape where fire ignitions and fire frequency were predicted to be very low. Therefore, although fires spread away from ignition sources and burn more frequently outside urban areas, there are also even more remote areas that burn with much less frequency. However, some of the coastal areas and interior canyons are more likely to experience greater numbers of ignitions and more frequent fire. The coastal areas tend to be warmer and dryer than the more remote interior regions of the landscape, which makes them more conducive to fire. These regions also have gentler slopes and are more favourable for housing development and human activity.

From a management perspective, overlaying the two predictive maps is useful because the resulting combined map can identify areas that are not only at a high risk for experiencing an ignition, but also where those ignitions are likely to initiate into a full, spreading fire. Areas where high predicted ignition probability coincides with high predicted fire frequency can then be targeted for fire management actions, such as fuel reduction. The Santa Monica Mountains fire management plan has outlined additional criteria, including socioeconomic variables and other resources at risk, to further the decision-making process for identifying potential strategic fuel modification locations (NPS 2005). These additional criteria are important for ensuring that treatments are not placed in low-hazard areas where protection is not needed.

The present and other studies have determined that fire ignition locations, as well as areas where frequent fires occur, can be statistically modelled using readily measurable sets of social, biological, and physical features (e.g. Keeley *et al*. 1999; Cardille *et al*. 2001; Pew and Larsen 2001; Prestemon *et al*. 2002; Mercer and Prestemon 2005). Therefore, the approach used here can be used in other landscapes to refine the strategic placement of fuels treatments and to better anticipate where fires are most likely to occur. To adapt these methods to other regions, scientists and managers should be aware that the relative influence of human or biophysical variables is likely to vary according to region, temporal or spatial scale of analysis, and type of human activity. Therefore, the choice of predictor variables should be relevant to the primary characteristics driving each region's fire regime.

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Contributed Paper

# Conservation Threats Due to Human-Caused Increases in Fire Frequency in Mediterranean-Climate Ecosystems

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**Abstract:** *Periodic wildfire is an important natural process in Mediterranean-climate ecosystems, but increasing fire recurrence threatens the fragile ecology of these regions. Because most fires are human-caused, we investigated how human population patterns affect fire frequency. Prior research in California suggests the relationship between population density and fire frequency is not linear. There are few human ignitions in areas with low population density, so fire frequency is low. As population density increases, human ignitions and fire frequency also increase, but beyond a density threshold, the relationship becomes negative as fuels become sparser and fire suppression resources are concentrated. We tested whether this hypothesis also applies to the other Mediterranean-climate ecosystems of the world. We used global satellite databases of population, fire activity, and land cover to evaluate the spatial relationship between humans and fire in the world's five Mediterranean-climate ecosystems. Both the mean and median population densities were consistently and substantially higher in areas with than without fire, but fire again peaked at intermediate population densities, which suggests that the spatial relationship is complex and nonlinear. Some land-cover types burned more frequently than expected, but no systematic differences were observed across the five regions. The consistent association between higher population densities and fire suggests that regardless of differences between land-cover types, natural fire regimes, or overall population, the presence of people in Mediterranean-climate regions strongly affects the frequency of fires; thus, population growth in areas now sparsely settled presents a conservation concern. Considering the sensitivity of plant species to repeated burning and the global conservation significance of Mediterranean-climate ecosystems, conservation planning needs to consider the human influence on fire frequency. Fine-scale spatial analysis of relationships between people and fire may help identify areas where increases in fire frequency will threaten ecologically valuable areas.*

**Keywords:** fire, land cover, Mediterranean, MODIS, population density, remote sensing

Amenazas a la Conservación Debido a Incrementos en la Frecuencia de Incendios Causados por Humanos en Ecosistemas de Clima Mediterráneo

**Resumen:** *El fuego periódico es un proceso natural importante en los ecosistemas de clima mediterráneo, pero el incremento de la recurrencia de fuego amenaza la frágil ecología de esas regiones. Debido a que la mayoría de los incendios son causados por humanos, investigamos el efecto de los patrones de población humana sobre la frecuencia del fuego. Investigaciones previas en California sugieren que la relación entre la densidad poblacional y la frecuencia de incendios no es lineal. Hay pocas igniciones humanas en áreas con baja densidad poblacional, así que la frecuencia de incendios es baja. A medida que aumenta la densidad poblacional, los incendios causados por humanos y la frecuencia de incendios también incrementa; pero al*

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*llegar a un umbral de densidad, la relación se vuelve negativa ya que los combustibles son escasos y se concentran recursos para la supresión de fuego. Probamos sí esta hipótesis también aplica a los otros ecosistemas de clima mediterráneo en el mundo. Utilizamos bases de datos de satélite de población, actividad de fuego y cobertura de suelo para evaluar la relación espacial entre humanos y fuego en los cinco ecosistemas de clima mediterráneo en el mundo. Tanto las densidades medias y medianas fueron consistente y sustancialmente más altas en áreas con fuego como sin fuego, pero los incendios alcanzaron su máximo en densidades poblacionales intermedias, lo que sugiere que la relación espacial es compleja y no lineal. Algunos tipos de cobertura de suelo tuvieron incendios más frecuentemente de lo esperado, pero no se observaron diferencias significativas en las cinco regiones. La asociación consistente entre mayores densidades poblacionales y fuego sugiere que, independientemente de las diferencias entre tipos de cobertura de suelo, los regímenes de fuego naturales o la población total, la presencia de gente en regiones de clima mediterráneo afecta fuertemente a la frecuencia de incendios; por lo tanto, el crecimiento poblacional en áreas escasamente pobladas es preocupante para la conservación. Considerando la sensibilidad de las especies de plantas a incendios recurrentes y la significancia para la conservación de los ecosistemas de clima mediterráneo, la planificación de la conservación requiere que se considera la influencia humana sobre la frecuencia de incendios. El análisis espacial a fina escala de las relaciones entre gente y fuego puede ayudar a identificar áreas en las que el incremento en la frecuencia de fuego amenazará a áreas valiosas ecológicamente.*

**Palabras Clave:** cobertura de suelo, densidad poblacional, fuego, Mediterráneo, MODIS, percepción remota

## Introduction

The biodiversity of Mediterranean-climate ecosystems is among the highest of any biome in the world. The five regions in the world with Mediterranean climates (the Mediterranean Basin, central Chile, the Cape Region of South Africa, southwestern Australia, and parts of California and northern Baja California in North America) collectively occupy <5% of the Earth's unglaciated land surface, yet they contain 20% of the world's flora (Cowling et al. 1996), and many species are endemic (Mittermeier et al. 1998). Because of rapid global change and increasing anthropogenic pressure, all Mediterranean regions are of high global conservation concern (Médail & Quézel 1999; Olson & Dinerstein 2002; Vogiatzakis et al. 2006).

Although Mediterranean-climate ecosystems are geographically disjunct, they are classic examples of convergence in ecosystem structure and dynamics (Cody & Mooney 1978). The Mediterranean climate is characterized by cool, wet winters and warm to hot, dry summers, and the summer drought produces water stress that affects the seasonal distribution of wildfires. Vegetation in Mediterranean-climate regions is dominated by evergreen, woody, sclerophyllous shrubs that are very flammable and support crown fires (Christensen 1985). Nevertheless, specialized postfire persistence traits (e.g., seed banking in the soil and canopy and resprouting) make plant species resilient to periodic wildfire (Naveh 1975). The presence of fire-stimulated reproduction indicates an adaptive response to fire, and seed banking evolved independently in all Mediterranean-climate ecosystems except Chile (Bond & van Wilgen 1996). Nevertheless, all the woody shrubs in Chile resprout in response to fire, which is now frequent due to anthropogenic ignitions (Montenegro et al. 2004).

Fire in Mediterranean-climate ecosystems predates humans (except in Chile), and natural fire frequencies have varied between and among regions over time and in response to climate fluctuations (Rundel 1998). The history of human impact on fire regimes also differs among regions. For example, humans ignited fires in the Mediterranean Basin for thousands of years to support agropastoral activities (Lozano et al. 2008), Native Americans ignited fires in California since the early Holocene (Keeley 2002), and small populations of hunter-gatherers ignited fires in other regions until a few centuries ago (Rundel 1998). Evidence regarding early human influence on fire is circumstantial and controversial, but human activity is now thought to be a major determinant of the timing and location of fire. In fact, humans ignite most fires in Mediterranean regions (Bond & van Wilgen 1996). Current human influence on fire regimes and the potential ecological impact of their influence on fire is similar among Mediterranean-climate regions and differs strongly from fire problems in other forested systems.

In dry coniferous forests, like those in the western United States, the primary concern is a lack of fire primarily due to 20th-century fire suppression. Lower fire frequency in forests that naturally experienced high-frequency, low-intensity surface fires resulted in high accumulation of surface and canopy fuels (Parsons & Landres 1998). Fuel accumulation increases the likelihood fires will become uncharacteristically large and intense, which can kill even large, surface-fire-resistant trees.

Conservation threats and changes in fire regimes in Mediterranean-climate regions, however, are different. The shrublands are adapted to fire-return intervals that are generally longer than those historically experienced in conifer forests (Sugihara et al. 2006). Despite their capacity for rapid postfire regeneration, many shrubland plant species are sensitive to repeated burning. Serotinous species are particularly vulnerable (e.g., Wark et al. 1987; Pausas 1999; Syphard et al. 2006), but repeated burning may also extirpate resprouting species by reducing their capacity to regenerate and constraining their reproductive ability (e.g., Haidinger & Keeley 1993; Montenegro et al. 2004; Espelta et al. 2008). A related issue is that exotic species may facilitate fire and may expand under frequent fire (Mack & D'Antonio 1998). In California biodiversity is critically threatened by shrubland conversion to exotic annual grasses caused by atypically frequent fire (Keeley et al. 2005). Therefore, where the primary concern in dry coniferous forests is fire exclusion, the problem in Mediterranean-climate regions is repeated fires in the same location (Montenegro et al. 2004; Badia-Perpinyà & Pallares-Barbera 2006; Forsyth & van Wilgen 2008), although the intensity of fires may vary from region to region because of differences in prescribed management practices. Thus, understanding the causes and spatial distribution of altered fire regimes in Mediterranean-climate ecosystems has become a major research priority with strong conservation implications (Lavorel et al. 1998) and is particularly important given population growth in Mediterranean-climate ecosystems.

Studies in California show that area burned and number of fires are highest when population and housing densities are intermediate (Keeley 2005; Syphard et al. 2007). Fires initially increase with population and housing density and then decline where a threshold density is reached. There are several interrelated reasons for this. Ninety-five percent of California's fires are human caused; therefore, anthropogenic ignitions are lower in areas with low population density. As population and housing densities increase, fuels are still abundant and contiguous enough to carry fire, and the number and frequency of fires increase (Syphard et al. 2007). As population density increases further and an area is developed, wildland fuel is reduced and fragmented and fire-suppression resources are concentrated, resulting in lower fire frequencies at high population densities. Finally, even if fire frequency remains stable, fires may cluster in certain areas (e.g., human settlements) or land-cover types (Nunes et al. 2005; Forsyth & van Wilgen 2008), resulting in high fire frequency in localized areas.

Although the relationship between human population densities and fires has been studied in California, less is known about fire trends and patterns in other Mediterranean ecosystems. In recent years, fire frequency has escalated because of population growth and human ignitions in Chile (e.g., Montenegro et al. 2004) and South Africa (Forsyth & van Wilgen 2008), and fires increased exponentially in many areas in the Mediterranean Basin, in part due to the abandonment of traditional land-use practices (Pausas & Vallejo 1999). Interactions between fire and exotic species have been exacerbated by recurrent human-caused fires in Chile (Montenegro et al. 2004), South Africa (Bond & van Wilgen 1996), the Mediterranean Basin (Kark & Sol 2005; Vogiatzakis et al. 2006), and Australia (Offor 1990). In Spain fire ignitions cluster near urban areas (Badia-Perpinyà & Pallares-Barbera 2006), and population density has been correlated with the number of fires and area burned (Vázquez de la Cueva et al. 2006). Results of previous studies thus suggest that the relationship between human populations and fire frequency may be similar in all Mediterranean-climate ecosystems, but this idea has not been examined systematically across the different areas. Whether fire frequencies consistently peak at intermediate densities of human population is unclear. Nor is it clear whether certain land-cover types are more likely to burn.

Our objective was to quantify the relationship between humans and fire in Mediterranean-climate ecosystems across the globe. We asked, Are population densities higher in places where fires occur than in places without fires? Are fires consistently most frequent at intermediate population densities? Are certain land-cover types in each region more prone to fires?

## Methods

### Study Area

We used Bailey's ecoregion boundaries to demarcate Mediterranean-climate ecoregions (Bailey 1989). (Table 1). This is a hierarchical system with four levels (domains, divisions, provinces, and sections). For all five

**Table 1. Number of Bailey's ecoregions, total area, and biogeographic characteristics* of Mediterranean-climate regions.**

| | *Number of ecoregions* | *Total area ($km^2$)* | *Number of native vascular plants* | *Endemic species (%)* | *Threatened species (%)* |
|---|---|---|---|---|---|
| Mediterranean Basin | 25 | 2,392,048 | 23,300 | 50 | 18 |
| North America | 5 | 407,654 | 4,300 | 35 | 17 |
| Chile | 2 | 74,863 | 2,100 | 23 | unknown |
| South Africa | 1 | 69,401 | 8,550 | 68 | 15 |
| Southwest Australia | 1 | 118,882 | 8,000 | 75 | 18 |

**Biogeographic characteristics based on Calow (1998) and Vogiatzakis et al. (2006).*

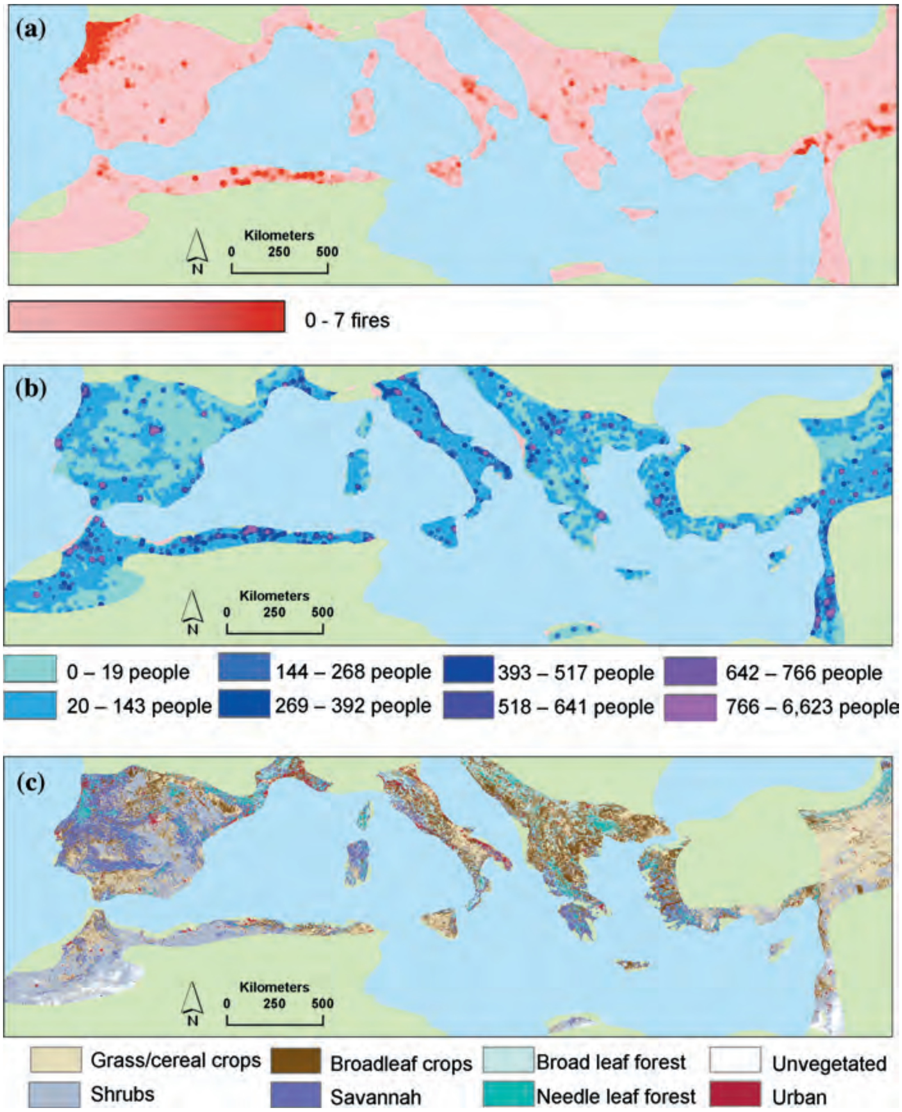


*Figure 1. For the Mediterranean Basin, (a) MODIS active-fire detections in 2005, (b) LandScan population density in 2005, and (c) MODIS land-cover data. Fire and population density values are averaged across 225-km$^2$ pixels.*

continents, we selected all ecoregions classified as either the Mediterranean Division or the Mediterranean Regime Mountains. To ensure comparability of area calculations, all spatial data were projected into an Albers equal area projection.

## Processing of Population Data

We used population data from the LandScan Global Population Product because it has the finest resolution (<1 km) of any global population data set (Dobson et al. 2000). The LandScan database represents ambient population, accounting for diurnal movement and travel patterns. Every grid cell is allocated a population count based on a distribution model that incorporates the best available data on human population for every country, proximity of people to roads, land cover, nighttime lights, and urban density.

Because the accuracy and precision of LandScan are continually being improved, we restricted our analysis to 2005, the year with the most current data (Fig. 1). For comparison purposes, we divided the population counts by area and analyzed population density.

## Processing of MODIS Fire Data

We used fire data from the Moderate Resolution Imaging Spectroradiometer (MODIS) to assess fire activity in Mediterranean-climate ecoregions because of its unmatched spatial and temporal detail (Justice 2002). With two polar-orbiting satellites, the MODIS active-fire product provides daily global information on fires. These data show actively burning fires based on radiant energy and comparisons of target pixels with surrounding pixels (Giglio et al. 2003).

Instead of mapping individual fires and area burned, MODIS indicates pixels in which fire activity was detected. Thus, there could be more than one fire active within a 1-km$^2$ MODIS pixel (Csiszar et al. 2006). In addition, fires occupying only a portion of a pixel can be detected (Dozier 1981). Although many small fires are missed, MODIS consistently detects larger fires that are ecologically relevant (Hawbaker et al. 2008), and the number of contiguous MODIS fire pixels tends to correlate with fire size (Giglio et al. 2006).

We analyzed MODIS fire data from the Land Processes Distributed Active Archive Center (LPDAAC, http://edcdaac.usgs.gov/modis/dataproducts.asp) for both sensors every day in 2005 to match the date of the population data. Using the boundaries of the Mediterranean ecoregions, we put all images into a mosaic (i.e., joined them together to form daily continuous tiles) for both sensors and summarized the daily data to create annual maps of fire for each region (Fig. 1). We included fire detections from all classified confidence levels because detection accuracy varies little whether fires are classified as low or high confidence (Hawbaker et al. 2008).

### Processing of MODIS Land-Cover Data

In addition to the active-fire product, we used the 2003 MODIS 1 km Land Cover Dataset (Friedl et al. 2002) to analyze fire activity by land-cover class (Fig. 1). We used the LAI/fPAR Biome land-cover classification scheme because it was designed to capture differences in vegetation structural types (grasslands and cereal crops, shrubs, broadleaf crops, savannah, broadleaf forest, needle leaf forest, unvegetated, and urban; Myneni et al. 1997).

### Analysis

In California fires are most likely to occur when the distance to housing is <15 km (Syphard et al. 2007). Because scale dependencies of ecological patterns and processes vary by region (Shugart 1998) and because people are mobile and affect their surroundings, we conducted our analysis of humans and fire at three levels of resolution (1, 15, and 45 km). Land-cover analyses were conducted only at the 1-km resolution, however, because we did not consider relationships between land cover and population measures.

We conducted a moving-window GIS analysis to summarize data across the entire land area. Within each window and at each resolution, we summarized the population density and the number of fires. Satellite fire detections can be obscured by clouds, and the MODIS active-fire product explicitly masks cloud cover in every daily image (Giglio et al. 2003). Therefore, we excluded cloud pixels, calculated the number of "observable days" within each window, and used this number to calculate average fire frequency. Uncertainty due to land-cover misclassification, undetected fires, and errors in population distribution was assumed to be consistent among the Mediterranean-climate ecoregions.

To determine whether population densities were higher in areas with fires, we selected all pixels and windows where there was one or more fires and calculated the mean and median population densities. We compared those with mean and median population densities in pixels and windows where no fires occurred. If there is a relationship between humans and fire, the proportion of fire should be higher where population is higher and lower where population is lower. We did not conduct a statistical test to determine whether the distributions differed because our data represent a complete enumeration, not a sample, and any difference would be statistically significant. Instead, we distributed the population data into 25 equally spaced categories and plotted the proportion of fires that occurred within each category for the three window sizes. The resulting bar charts showed whether more fires occurred at low, intermediate, or high population densities.

To determine whether fires burned more often (selectively) in different land-cover types, we calculated the total proportion of land-cover types in each region, then selected only the pixels with fires and recalculated the proportion. We calculated the ratio of the proportion of fires in the land-cover types and the proportion of the land-cover types in the landscape. A ratio of 1.0 means fire occurred in a land-cover type as often as would be expected by chance, >1.0 means fire occurred in the land-cover type more often, and <1.0 means fire occurred less often than expected by chance.

## Results

We observed substantial differences in population density among the regions. Both the mean and median population densities in southwestern Australia were lowest of all the regions, and those in the Mediterranean Basin were highest. Although median population densities were substantially lower than mean population densities for all regions, the difference in North America was so substantial that mean population density was highest among the regions, but median population density was equal to that in southwestern Australia.

Pixels or windows with fires typically had higher population densities than pixels or windows without fires (Fig. 2). The only exception was in the 1-km pixels in North America, where mean population density was higher in the pixels without fires. Median population densities were nearly equal with and without fire in 1-km pixels in North America, South Africa, and southwestern Australia.

The relationship between population density and fire was more pronounced at 15 km than at 1 km, and at 45 km the mean population densities in areas with fires were much higher than where there were no fires (Fig. 2a). The median population density with fire was almost 3 times larger than the population density without fire at 45-km resolution.

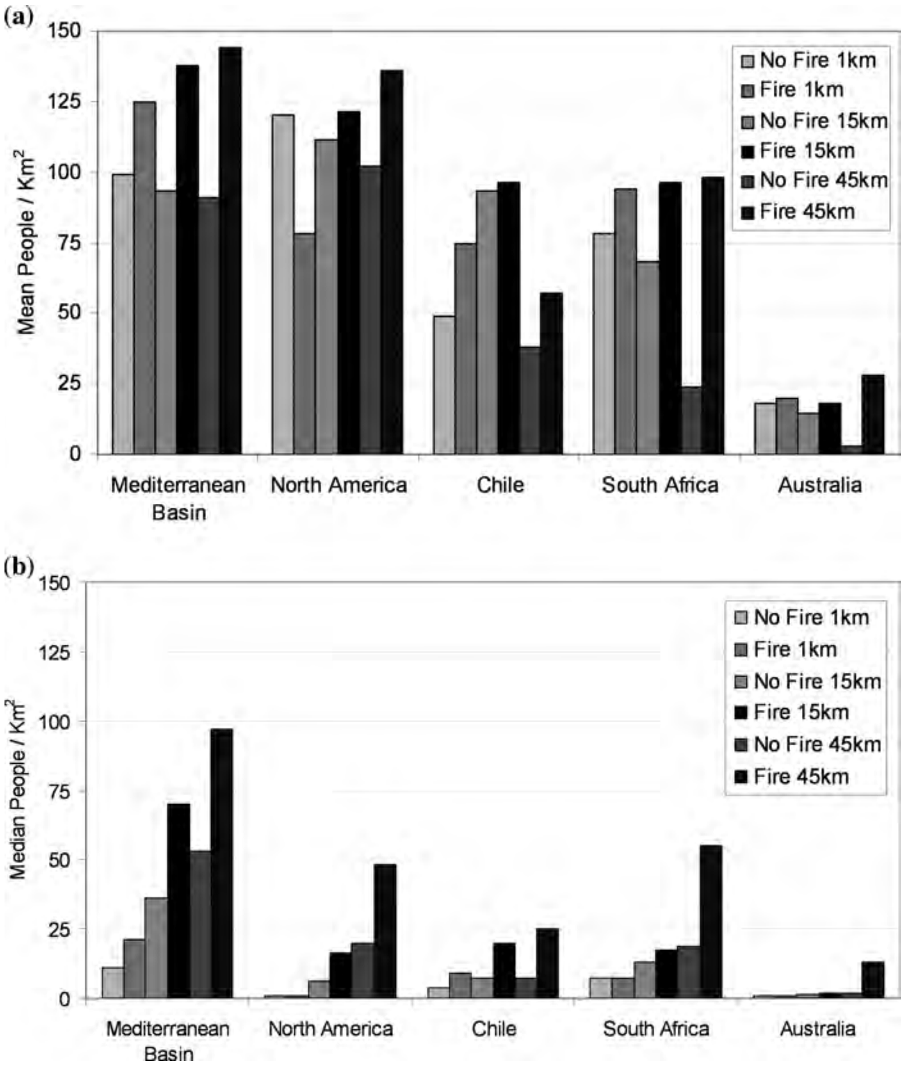


*Figure 2. (a) Mean and (b) median population densities in areas with and without fires for 1-, 15-, and 45-km resolution windows. The y-axis scales differ.*

Although population densities were, on average, higher where there were fires, the largest proportion of fires peaked at intermediate population densities (Fig. 3). Patterns of variation and peak population densities varied from region to region though, particularly at the 1- and 15-km window sizes. In addition, the peak in proportion of fires occurred in areas of lower population densities in North America at the 1-km resolution. In Chile and southwestern Australia, peak in proportion of fires occurred at the higher end of the population density distribution in the 1- and 45-km window sizes. The most consistent trend was apparent at the 45-km window size, where the highest proportion of fires occurred between 100 and 250 people per 45 $km^2$.

Land cover in the five regions included grasslands and cereal crops, shrubs, and savanna, with lower proportions of broad-leaf crops, broad-leaf forest, needle-leaf forest, unvegetated, and urban cover (Fig. 4). Distribution of these land-cover types, however, varied widely from region to region. Grasslands and cereal crops accounted for 40% of land cover in South Africa and southwestern Australia, but in Chile and North America they were just 20% of land cover. Substantially more needle-leaf forest was present in North America (21%) than in the other regions (<10%), and much of Chile was unvegetated (23%).

Some land-cover classes burned proportionately more than expected by chance given their areal distribution in the regions, but patterns were not consistent (Table 2; Fig. 4). In North America and Chile grasslands and cereal crops burned substantially more than expected but only as much as expected in the other three regions. Broadleaf forest burned more than expected in southwestern Australia but not in the other regions. In North America shrubs burned more than expected and needle-leaf forest burned less than expected, but in the Mediterranean Basin, shrubs burned less than expected and needle-leaf forest burned more. In all regions, except for North America, more fires occurred in savannah than expected. Overall, very little fire occurred in unvegetated or urban areas.

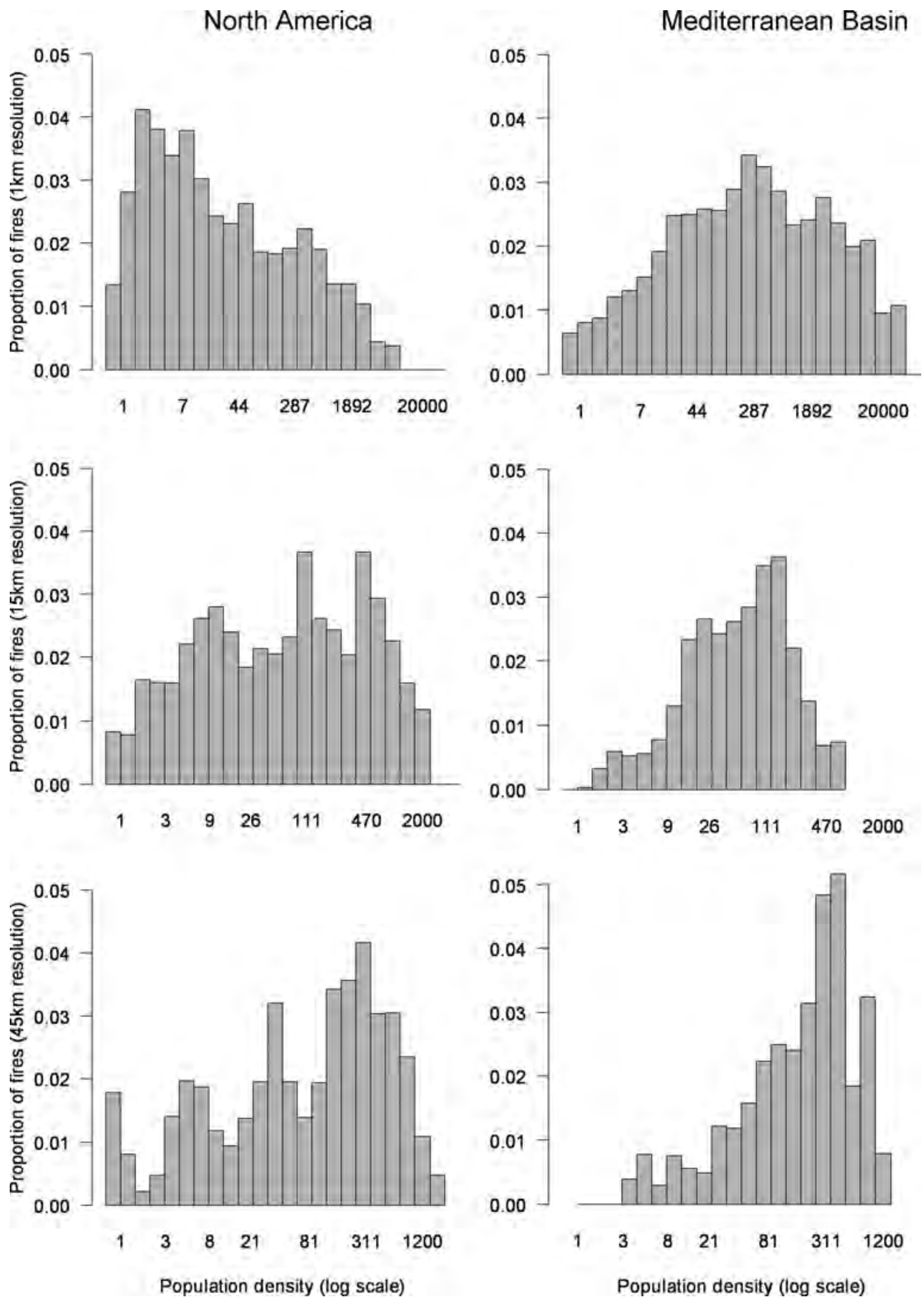


*Figure 3. Proportion of fires within population density classes for 1-, 15-, and 45-km resolution windows.*

## Discussion

We found strong evidence that people are associated with the frequency and spatial distribution of fire similarly in all five Mediterranean-climate regions. Both mean and median population densities were consistently and substantially higher in areas with fire than in areas that did not burn; fires in Mediterranean-climate regions tended to occur close to people. Despite their convergence in ecosystem structure and function, Mediterranean-climate regions do vary in fire history, land-use history, or socioeconomic and political conditions (Pignatti et al. 2002; Carmel & Flather 2004; Vogiatzakis et al. 2006). Because of these differences, variations among the regions in population densities and land cover are not surprising. But these differences make the consistency of spatial relationships between people and fire across the five regions even more striking. The spatial pattern of fires

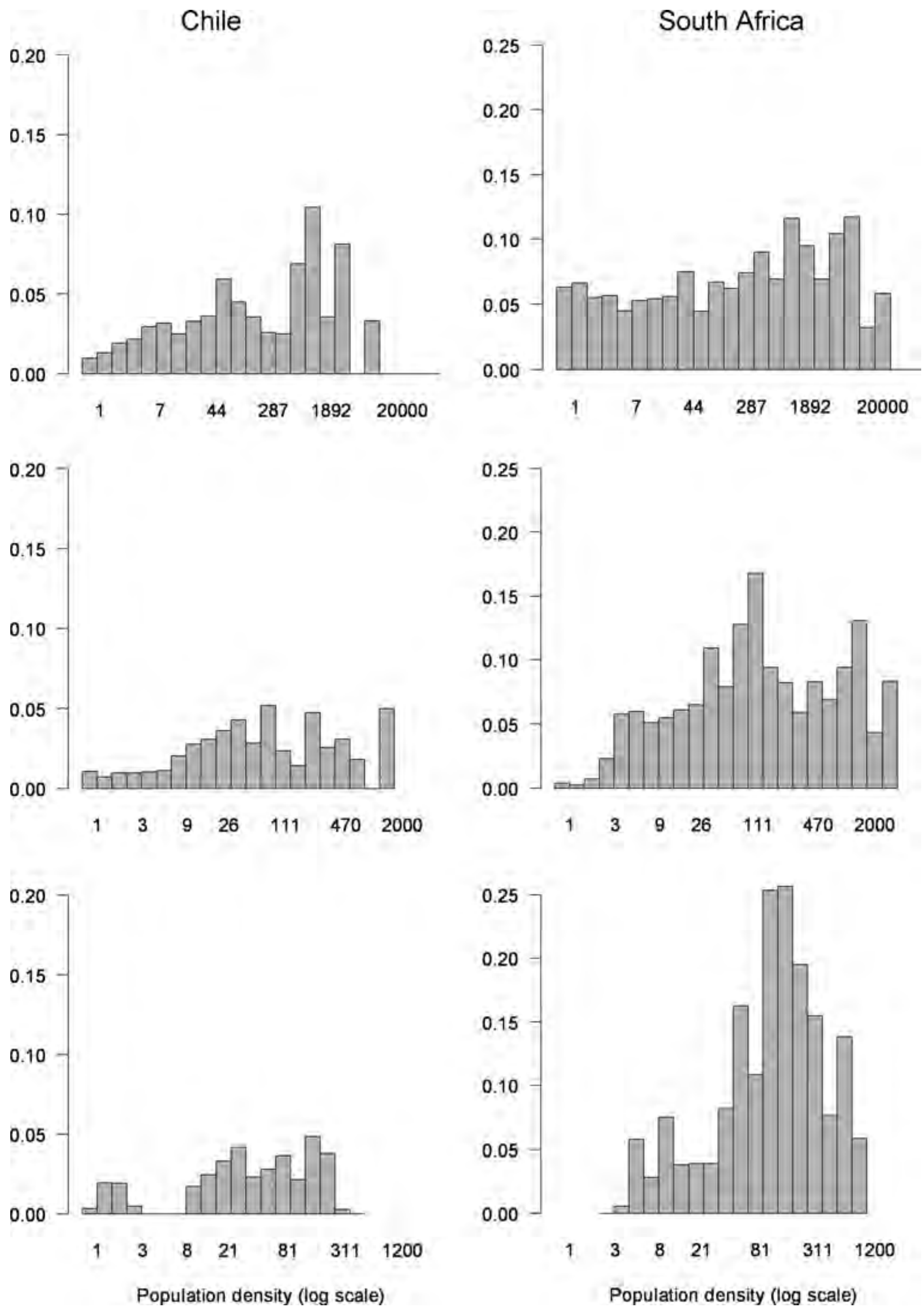


*Figure 3. (continued)*

in any region depends on complex interactions between ignition sources, landscape characteristics, and fuel continuity (Whelen 1995). So the consistent relationship between fire and population density suggests that the presence of people in Mediterranean-climate regions overrides these other factors.

Understanding the distribution of fire in Mediterranean-climate ecosystems is critical due to the vulnerability of its unique vegetation to repeated burning. Unlike other ecoregions in which decreased fire frequency threatens some species (Allen et al. 2002), in Mediterranean-climate ecoregions, the conservation concern is increased fire frequency (e.g., Keeley et al. 1999; Montenegro et al. 2004; Badia-Perpinyà & Pallares-Barbera 2006). The persistence of native plants is threatened and may have cascading ecological effects (Barro & Conard 1991; DellaSalla et al. 2004). Because Mediterranean regions are highly heterogeneous, the

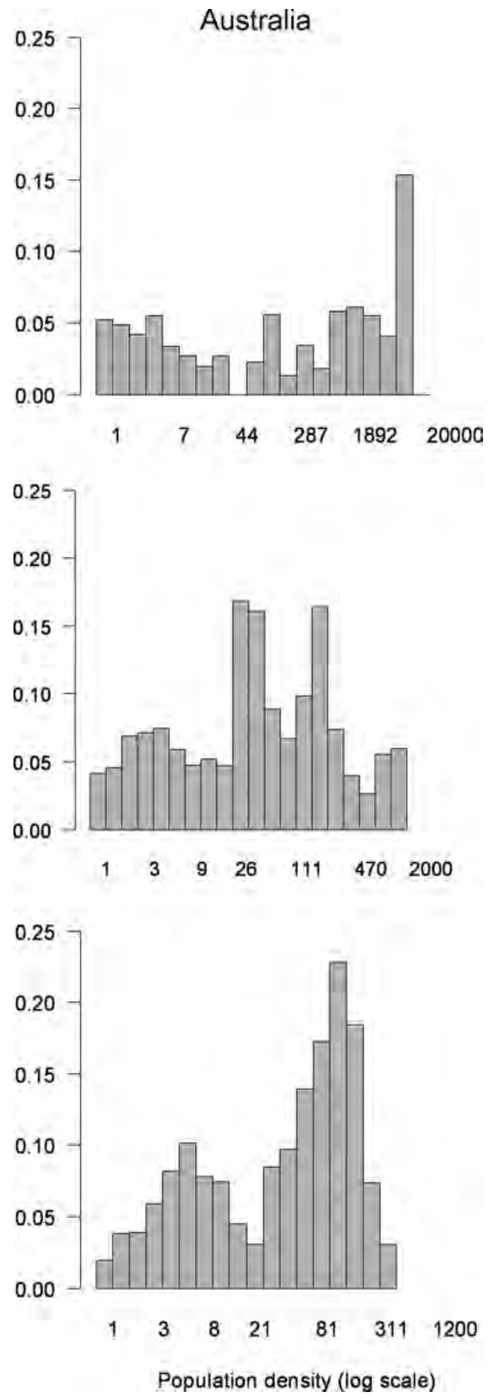


*Figure 3. (continued)*

**Table 2. Ratio of the proportion of fires by land-cover type and proportion of land-cover type in the landscape.***

| *Land-cover type* | *Mediterranean Basin* | *North America* | *Chile* | *South Africa* | *SW Australia* |
|---|---|---|---|---|---|
| Grass/cereal | 0.79 | 1.76 | 1.72 | 1.09 | 0.85 |
| Broad crops | 1.07 | 1.70 | 1.65 | 0.55 | 0.49 |
| Shrubs | 0.42 | 1.35 | 1.00 | 0.79 | 0.43 |
| Savannah | 2.01 | 0.72 | 1.51 | 1.46 | 1.35 |
| Broad leaf | 0.80 | 0.45 | 1.02 | 1.62 | 1.90 |
| Needle leaf | 2.01 | 0.54 | 1.03 | 0.94 | 2.64 |
| Unvegetated | 0.06 | 0.17 | 0.03 | 0.13 | 0.06 |
| Urban | 1.92 | 0.89 | 1.88 | 1.41 | 0.96 |

**A ratio of 1.0 means fire occurred in a land-cover type as often as would be expected by chance, >1.0 means that fire occurred more often than expected, and <1.0 less often than expected by chance.*

sensitivity of different plant species to specific fire frequencies will vary (Public Library of Science ONE DOI:10.1371/journal.pone.0000938. 2007). Nevertheless, identifying where the landscape is likely to burn frequently is an important step in identifying areas vulnerable to the extirpation of native species.

The association of people with the spatial distribution of fire occurrence is likely due to the fact that humans now cause the majority of ignitions in all five Mediterranean-climate regions (Bond & van Wilgen 1996), and human ignitions are likely to occur close to roads and human infrastructure (e.g., Yang et al. 2007; Syphard et al. 2008). Nevertheless, our results also showed that fire occurrence consistently peaked where population densities were intermediate, which suggests that fire patterns in Mediterranean-climate regions are related to the spatial arrangement between people, urban development, and fuel. When population density is lowest, human ignitions are also low but increase with population density. Nevertheless, there appears to be a threshold above which fire occurrence declines, possibly due to less open space and fuel fragmentation caused by urban development or other land-use change. Fire-suppression resources also tend to be concentrated near urban areas (Calkin et al. 2005), and intermediate-density housing when located within wildland vegetation is classified as the wildland–urban interface (WUI) in the United States and given special fire-management considerations (Radeloff et al. 2005).

The relationship between people and fire in our study was most pronounced at the 15- and 45-km scales of analysis. Many ecological processes and spatial relationships have characteristic scales or space and time intervals over which the process can be detected (Shugart 1998). One explanation for the scale effect in our results is that analysis with the 15- and 45-km window sizes could include pixels where fires did, and did not, burn. The observed relationship and scale dependence of the results may therefore have been related to the relative proportion of burned cells within a window. At the 1-km resolution, the pixel either burned or it did not, and the analysis did not account for neighborhood effects.

Although our primary focus was to assess the relationship between population density and fire, other researchers have shown that land use and land cover may be important covariates of fire patterns due to their effects on fuel types, flammability, and human use of fire (e.g., Viedma et al. 2006; Baeza et al. 2007). In our analysis some land-cover types burned more frequently than expected, but no systematic differences were observed.

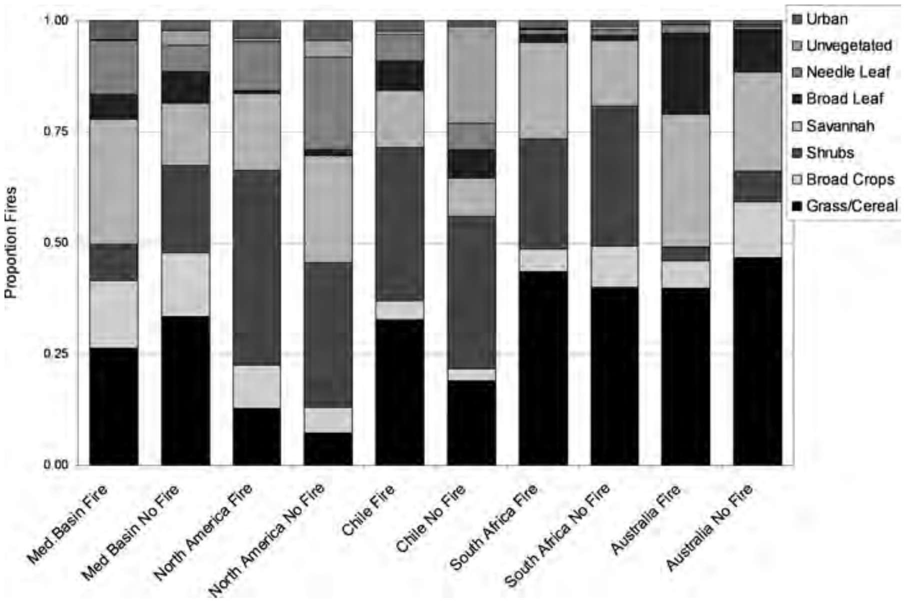


*Figure 4. Aerial proportion of land-cover classes in the ecoregions and within pixels with an active fire in 2005.*

Therefore, the patterns we observed in land-cover types were likely related to unique combinations of human land use and management practices within each region. For example, in North America, needle-leaf forest burned less than expected, whereas shrublands burned more. Fire suppression has successfully excluded fire from California's high-elevation-mixed conifer forests. On the other hand, the disproportionately high level of fire in shrubs is likely due to housing development and increased human ignitions in low-elevation areas where these shrubs (i.e., chaparral) are common (Keeley et al. 1999). More fires than expected in needle-leaf forests in the Mediterranean Basin may be due to land abandonment, which has resulted in substantial increases of fire in pine forests (Pausas & Vallejo 1999).

In North America and Chile fire burned more in grasslands and cereal crops than expected. Grasslands can sustain and even promote higher fire frequencies than other land-cover types (Mack & D'Antonio 1998), a major conservation concern in southern California, where exotic annual grasses have replaced native shrublands under unnaturally high fire frequencies (Haidinger & Keeley 1993). Problems with exotic annual grasses have also been reported in Chile and Australia (Pignatti et al. 2002) and may become more pronounced if fire frequency continues to increase.

## Conclusions

Mediterranean-climate ecosystems are among the most biologically diverse regions in the world with rates of endemism ranging from 23% (Chile) to 75% (southwestern Australia), and at least 15% of the taxa in Mediterranean-climate ecosystems are threatened (Calow 1998). Our results suggest that conservation planners in Mediterranean-climate regions should seriously consider human alteration of fire patterns. Although we used fire data for only 1 year, the consistency in our results demonstrates that, regardless of the overall fire frequency in a region and its annual weather-driven variations, it may be possible to predict where fires are concentrated. Our results therefore provide a foundation for further research and planning to identify where frequent fire threatens vulnerable Mediterranean-climate plant species.

Future research should identify regionally specific ranges of population densities where fire occurrence is highest, be conducted at the scales most relevant to planning and management, and incorporate other drivers of fire pattern, such as biophysical variables. Finally, compact development should be studied for its potential to mitigate the effects of human presence by limiting expansion into undeveloped vegetation. Education efforts to reduce human-caused ignitions were once the foundation of outreach programs, such as Smokey Bear; perhaps the time has come to bring the bear back from semiretirement.

## Acknowledgments

We gratefully thank the U.S. Forest Service Northern Research Station for supporting this research. Three anonymous reviewers and the assigning editor, B. McComb made valuable suggestions, which greatly strengthened our manuscript.

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# EXHIBIT 9

CALIFORNIA CHAPARRAL INSTITUTE

...the voice of the chaparral

January 25, 2013

Board of Forestry and Fire Protection
Attn: George Gentry
Executive Officer
VegetationTreatment@fire.ca.gov
Sacramento, CA 94244-2460

Re: Draft Program EIR for the Vegetation Treatment Program

Dear Mr. Gentry and Board Members,

> **There are two types of fires; the ones we prepare for and the ones that do all the damage** (Fotheringham 2012).

Unfortunately, the Draft Program Environmental Impact Report for the Vegetation Treatment Program (PEIR) continues to ignore the fires that cause the most damage by focusing exclusively on habitat clearance projects.

This despite extensive scientific research that clearly indicates that the best way to effectively protect lives, property, and the natural environment from wildfire is through a **comprehensive approach** that focuses on *community and regional planning, ignitability of structures, and fuel modifications within and directly around communities at risk.*

> **Every decade we increase funding for fuel modifications and fire suppression activities, followed by a decade of even worse fire impacts** (Keeley 2009).

By stating that, "The proposed program is intended to lower the risk of catastrophic wildfires on nonfederal lands by reducing hazardous fuels," the PEIR perpetuates and expands the same approach that has failed to reduce cumulative wildfire loss and firefighting expenditures over the past century. **Consequently, the Board of Forestry is NOT addressing the main causes for loss of life and property from wildfire.**

## Attempt to Exempt CalFire From CEQA

All projects within the 38 million acres of California (1/3rd of the state) the Board of Forestry (BoF) has targeted for habitat clearance by burning, grinding, grazing, or herbicide will only be evaluated by a vague, yet-to-be formulated checklist. They will not be reviewed through the California Environmental Quality Act (CEQA). This will prevent citizens and independent scientists from questioning a project under CEQA that they feel is environmentally damaging.

We find this attempt to exempt CalFire from the environmental protections of California's premiere environmental law disturbing, although not surprising. One of the objectives under Goal #5 of the 2010 California Fire Plan endorses efforts to "remove regulatory barriers that limit hazardous fuel reduction activities." As we stated in our comment letter on the Draft Fire Plan, we strongly disagree with this objective and believe it is inappropriate for a government entity to advocate such action.

Rather than seeking ways to circumvent proper scientific oversight and efforts to insure that scarce fire management resources are used in the most effective way, the BoF should recommend inclusive community processes that embrace environmental review and invite all stakeholders. While democracy can be inconvenient, and collecting information that may question a proposed project frustrating, it is the best way to create a successful fire risk reduction strategy.

**Impossible to Properly Evaluate the PEIR**

By creating an overly broad "program" EIR without explaining where projects will be done, the BoF is making it impossible for the public and the scientific community to properly evaluate its plan to clear more than two million acres of wildland in California per decade. This is not the intent of a program EIR.

A program EIR allows for a more "exhaustive consideration of effects and alternatives than would be practical in an EIR on an individual action" AND allows "the lead agency to consider broad policy alternatives and program wide mitigation measures at an early time when the agency has greater flexibility to deal with basic problems or cumulative impacts" (CEQA Tool Box).

The BoF should have taken this opportunity to truly consider the entire fire environment rather than merely duplicating and expanding a program of questionable efficacy, namely more habitat clearance. Instead, the BoF is proposing an unacceptably open-ended, hypothetical Program that amounts to a "blank check," preventing subsequent California Environmental Quality Act (CEQA) reviews of thousands of projects.

The only reference to where the projects will be is an approximate number of acres within broad, and incredibly diverse, bioreigons. Only a vague, yet-to-be-determined checklist will be used to evaluate individual projects. If a project "passes" the checklist, it will be within the scope of the PEIR and exempt from subsequent CEQA review.

Over the past decade, our experience has shown that citizen and independent scientific oversight is essential evaluating habitat clearance operations. Local, state, and federal agencies have repeatedly demonstrated a willingness to ignore potentially significant environmental impacts in order to complete projects.

The best opportunity Californians have to ensure that projects are both necessary and do not cause significant environmental damage, is their ability to the challenge agency actions through CEQA. This Program PEIR is attempting to take that protection away.

**Faulty Conclusions**

We find the PEIR's conclusions that individual and cumulative impacts are all less than significant are not supportable. The conclusions are based on broad, inaccurate assumptions and incomplete research, especially in regard to shrubland ecosystems. In fact, when it comes to using the most relevant, up to date scientific data, the PEIR fails to satisfy some of the most important standards required by CEQA.

Our analysis indicates there will likely be significant environmental impacts that cannot be mitigated as the PEIR describes.

**Therefore, this PEIR needs to be retracted.** In its place, the BoF should create a **comprehensive program** reflecting specific, regional differences that will achieve the Program's key goal, "to prevent loss of lives, reduce fire suppression cost, reduce private property losses and protect natural resources from devastating wildfire." (PEIR 1-1)

We offer a summary of such a comprehensive approach in our **suggested alternative to the Program** as part of our comments below.

In brief, a comprehensive approach will:

**Save more lives and property.** Most homes burn and lives are lost because communities are not fire safe, not because of inadequate wildland vegetation treatments of the type this PEIR proposes.

**Significantly reduce the amount of habitat clearance.** As demonstrated by science and codified in PRC 4291, fire safe structures and communities require much less surrounding vegetation management. As set forth in PRC 4291, local agencies may exempt from the law's standards, "structures with exteriors constructed entirely of nonflammable materials, or conditioned upon the contents and composition of the structure, and *may vary the requirements respecting the management of fuels* surrounding the structures in those cases."

It's not the absence of clearing distant wildand vegetation that is responsible for the loss of homes. The losses are caused by the fuels under the front porch, the needles in the rain gutter, and the location of the home.

**<u>Save the state a significant amount of money</u>.** Instead of continually clearing and re-clearing wildland areas, year after year, the state should focus on long term fixes to recurring wildfire hazards such as directing the removal of flammable cultivars (palms, acacia, etc.) within communities, focusing on science-based defensible space zones, help communities find funding to retrofit unsafe structural problems (vents, roofing, etc.), and most importantly **continue to develop its analysis of fire hazard areas in order to provide guidance to land planning agencies.** The BoF can use its current regulatory authority to accomplish much of this.

Habitat clearance activities beyond defensible space zones of the type the PEIR describes creates a financial black hole. In addition, it is likely the currently envisioned Program will become embroiled in expensive litigation.

## The Failings of the PEIR

### 1. Underlying Bias

The proposed Vegetation Treatment Program is based on a questionable, overly-broad assumption about a natural landscape that is recognized as one of the most diverse biological regions on the planet. As a consequence, the PEIR's proposed Program, conclusions, and mitigations fail to accomplish the document's stated goals and threaten California's natural environment.

The broad assumption that underlies the entire PEIR is presented in the Executive Summary:

> Past land and fire management practices have had the effect of increasing the intensity, rate of spread, as well as the annual acreage burned on these lands (BOF, 1996).
>
> Much of this change in threat can be attributed to fire exclusion policies instituted over the past 100 years (Bureau of Land Management, 2005). (PEIR ES ii)

While it is true some forested communities have missed fire cycles and may be burdened by increased vegetation due to past fire suppression efforts, this is not the case for a significant amount of the natural landscape in California. For example, in evaluating research over the past decade concerning southern California, leading fire scientists have concluded in a US Forest Service publication,

> The fire regime in this region is dominated by human-caused ignitions, and fire suppression has played a critical role in preventing the ever increasing anthropogenic ignitions from driving the system wildly outside the historical fire return interval. Because the net result has been relatively little change in overall

> fire regimes, **there has not been fuel accumulation in excess of the historical range of variability, and as a result, fuel accumulation or changes in fuel continuity do not explain wildfire patterns** (Keeley et al. 2009b).

Although there are incidental references in the PEIR that,

- most of the brush and chaparral systems are probably operating close to their natural range of variation in fire frequency (PEIR 4.2-9)
- plant communities being threatened by type conversion due to excessive fire frequency (as opposed to vegetation build up via past fire suppression)
- current forecast models indicate that there will be an increase in grasslands... (PEIR ES iii)

the PEIR did not incorporate this information into the Program, in limitations on the 38 million acres of landscape “available for treatment,” or within suggested mitigations.

The influence of the overly-broad and incorrect assumption can be seen in the predominant type of literature cited. Despite the fact that native shrublands, primarily chaparral, represent the most extensive native plant community in California, most of the literature cited is primarily concerned with forested ecosystems (specifically, research that conforms to the PEIR’s basic assumption).

We discuss the failure of the PEIR to discuss the main points of disagreement below, but the issue here is that these references do not reflect the incredibly diverse ecosystem types in California that the BoF intends to clear, nor do they “provide decision makers with information which enables them to make a decision which intelligently takes account of environmental consequences.” (Section 15151 Standard for Adequacy of an EIR, CEQA)

**By making the inaccurate assumption that all vegetation communities are overgrown due to past fire suppression practices and need to be “treated,” the BoF has designated about the third of the state of California to be included into its habitat clearance Program.**

Syphard et al. (2006) summed up the problem well when they wrote,

> Despite overwhelming evidence that fire frequency is continuing to increase in coastal southern California (Keeley et al. 1999, Moritz et al. 2004, NPS 2004), the current fire-management program subscribes to the paradigm that fire suppression has led to fewer, larger fires, and that landscape-scale prescribed fire should be used to create a fine-scaled age mosaic. Considering the results of our simulations, we believe that adding more fire to the landscape through broad-scale prescribed burning may have negative ecological effects. Instead, our results are consistent with recent recommendations from the U.S. National Park Service to change the fire management program to focus fuel-reduction efforts and prescribed fire on strategic locations such as the wildland–urban interface (NPS 2004).

Unfortunately, one of the Program's main "treatments" is the very broad-scale burning project being rejected by a growing number of agencies (Fire Management Plan FEIS Santa Monica Mts 2005). In fact, the previous California Fire Plan (1996) rejected such an approach:

> The typical vegetation management project in the past targeted large wildland areas without assessing all of the values protected... The vegetation management program will shift emphasis to smaller projects closer to the new developments.

Specifically the PEIR states,

> Large Scale Wildland Treatment—These are areas up to the watershed scale, or even greater, that are treated to reduce highly flammable or dense fuels, including live brushy plants in some vegetation types (such as chaparral), a build up of decadent herbaceous vegetation or, dead woody vegetation. (PEIR 1-12)

The concept of "decadent herbaceous vegetation" has been used for years by fire management agencies to justify burning chaparral for resource reasons (Halsey 2011). There is no scientific justification for such burning (Montygierd-Loyba and Keeley 1985, Keeley et al. 1985, Keeley et al. 2005). The tendency for the PEIR to view native shrublands within a biased, pejorative context is a common theme:

> However, in the absence of periodic disturbance, the continued productivity of the state's rangelands is being *threatened by the encroachment of non-native invasive plants and native shrubs*. Vegetation treatments can help counter these *negative trends*, and improvement of rangeland condition is a primary objective of the VTP. (PEIR 1-5) *Emphasis added.*

The desire to modify the landscape to improve economic output is certainly a reasonable objective for a statewide management plan. However, allowing a systemic, negative bias against native ecosystems to influence policy management decisions is not. This bias appears to be one of the reasons the PEIR has failed to properly consider the cumulative effects on shrubland ecosystems (see below).

## 2. Inadequate Support for Program's Key Goal

While we agree that vegetation management can be an essential part of reducing wildland fire risks and can be effective in moderating wildfire behavior, the PEIR fails to provide an adequate level of support for its exclusive, broad brush approach: clearing habitat on a statewide basis. This failure to find adequate support is likely because, as Mell et al. 2010 wrote,

> a clear link has not been established between specific fuel treatments (e.g. reducing tree density or raising crown base height) and the resulting change in

> wildland fire behaviour, *especially over a range of environmental conditions*. (emphasis added)

Instead of reducing the *risks* of wildland fire, the factors that actually lead to the loss of life and property, the Program focuses exclusively on addressing the *hazard* of wildland fire, which is an unrealistic approach (hazard is anything that can cause harm, risk is the chance the hazard can cause harm to you). **The Program's exclusive approach is equivalent to trying to prevent earthquakes** (the hazard) instead of addressing the actual risks by earthquake-safe land planning and retrofitting buildings and structures to survive tremors.

The support the PEIR provides for this approach is inadequate not only because it broadly misapplies papers that are generally forest-based (as discussed above), but it exaggerates the fire management benefits of fuel treatments by ignoring the critical role played by community and home fire prevention. For example, the PEIR cites the success of fuel treatments during the 2007 Angora Fire:

> The Angora fire burned 3071 acres of forest and urban interface, destroying 254 homes and costing $160 million dollars. The fuel treatments generally worked as designed, significantly changing the fire behavior and subsequent fire effects to the vegetation (Safford, et. al., 2009). (PEIR 4.2-25)

While the Safford et al. paper is an excellent analysis of how fuel treatments can modify fire behavior and protect trees, the paper's conclusion that is most relevant to the PEIR's key goal to "reduce private property losses" is that,

> **Many homes burned in the Angora Fire in spite of the fuel treatment network;** government efforts to reduce fuels around urban areas and private lands do not absolve the public of the responsibility to reduce the flammability of their own property. (Safford et al. 2009)

**Without an equal effort to address this issue, the BoF will be unnecessarily damaging the natural environment and wasting tax-payer dollars through its exclusive approach.**

The PEIR then cites the Emergency California-Nevada Tahoe Basin Fire Commission Report (2008) by noting its 48 findings, "that serve as a plan to reduce said wildfires and negative impacts in the future."(PEIR 4.2-25)

Of the 48 findings, six are directly related to community and home fire prevention and six more deal with fire suppression. This was in recognition that it wasn't flaming trees that ignited the 254 homes that were lost, but other burning houses. While no single one cause could be blamed for the losses, flammable housing materials, wind blowing in alignment with streets, and the presence of logging slash from past commercial logging projects played important roles (Murphy et al. 2007).

The failure of fuel treatments to protect flammable communities is a frequent phenomena as demonstrated in the 2007 Grass Valley Fire (Cohen and Stratton 2008, Rogers et al. 2008), the 2003 Cedar Fire (Keeley et al. 2004), and the southern California 2007 firestorm (Keeley et al. 2009a). Such observations indicate a clear case for the need to conduct an objective cost/benefit analysis of fuel treatments (Keeley 2005).

When addressing fires driven by severe weather conditions (the ones that cause the most damage to life and property), the PEIR is generally dismissive of the ability to deal with them because these fires are “difficult to control even by the world’s most comprehensive wildland protection system.” (PEIR 4.2-10)

We find the failure to address wind driven fires as one of the major failures of the PEIR. Research is showing that with proper land planning, much of the risk presented by wind driven fires can be reduced significantly (Syphard et al. 2012, Moritz et al. 2010, Parisien and Moritz 2009).

## 3. Inadequate Disclosure of Expert Disagreements, Literature Cited

CEQA guidelines clearly state that,

> Disagreement among experts does not make an EIR inadequate, but the EIR should summarize the main points of disagreement among the experts. The courts have looked not for perfection but for adequacy, completeness, and a good faith effort at full disclosure.

The PEIR has failed to meet this guideline.

For example, we found no reference to the ongoing controversy regarding the benefits of severe, stand replacing fires and associated treatments in forests (Bond et al. 2012, Bond et al. 2009).

Relating to an underlying assumption that is aligned with the forest/fuel accumulation bias noted above, the PEIR claims that short fire return intervals in “frequent fire adapted communities”,

> ...maintained an open, park-like forest stand with a continuous ground cover of grasses, herbs, and shrubs beneath the forest canopy (Kaufmann and Catamount, [nd]; Parsons and DeBenedetti, 1979). (PEIR 4.2-1)

The Kaufmann reference is a non-scientific publication that has more to do with dry-ponderosa pine forests in the southwest than the mixed conifer systems that are common in California. The Parsons paper did not conclude that forests in California were “open, park-like” with a “continuous ground cover of grasses.” What the paper actually said about the mixed-conifer zone of Sequoia and Kings Canyon National Parks was that,

> The varying intensities and frequencies of the fires that occurred in these forests under natural conditions would have created a mosaic of open and closed canopy conditions, as well as heavy to minimal ground fuels.

The hypothesis that a “continuous ground cover of grasses” in Sequoia has been rejected by more recent research (Evett et al. 2003).

There are also new studies the PEIR failed to note that raise questions concerning the impact past fire suppression practices have had on mixed conifer forests in California. Odion and Hanson (2008) and Odion et al. (2009) suggest that forested areas in California that have missed the most fire return intervals (i.e., the most fire suppressed) are burning mostly at low/moderate-intensity and may not be experiencing higher levels of high-intensity fire than areas that have missed relatively fewer fire return intervals.

The one-size-fits-all approach the PEIR takes regarding fire suppression is not scientifically supportable and raises serious questions about the PEIR’s conclusions.

For shrubland ecosystems, which have completely different fire regimes and responses to management than forests, there were less than a dozen peer-reviewed papers referenced (out of nearly 1,000 literature citations) relating directly to fire. Most of those were more concerned with the spread of invasive species than fire management. **We find this absence inexcusable, especially considering the fact that the most expensive, devastating wildland fires in California are associated with these ecosystems.** We are especially perplexed because there has been a wealth of research concerning shrubland ecosystems conducted over the past decade indicating that:

- Unlike some forests, native shrublands have not become unnaturally dense with vegetation due to past fire suppression practices (Keeley et al. 2009b, Keeley et al.1999)

- Prescribed burning is unlikely to have much influence on fire regimes in southern California (Price et al. 2012)

- Large, severe, infrequent wildfires are the natural, historical pattern in central and southern California (Lombardo et al. 2009, Mensing and Bryne 1999, Keeley and Zedler 2009)

- The age of vegetation has very little to do with the size of fires (Moritz 2003, Moritz et al. 2004)

- Old-growth shrublands are healthy, dynamic ecosystems (Keeley et al. 2005)

All of these findings are contrary to the Program’s rationale for conducting habitat clearance in central and southern California shrublands. For example,

> Well planned prescribed burning can be an effective means of reducing fuels that result from long periods of fire exclusion while moderating potential ecosystem damage (Knapp et al., 2005). (PEIR 1-4)

Here is what the cited Knapp et al. document actually said in reference to chaparral:

> Because of frequent human-caused ignitions and seasonal hot and dry winds, the fire regime remains similar today, despite fire-suppression efforts.
>
> The bottom line is that the potential for shifts in the plant community exists when the heat generated by prescribed burning is dissimilar to what would have been experienced with the fire regime that species evolved with.

The PEIR also continually refers to the creation of hydrophobic soils during severe fires as a justification for prescribed burns:

> Although the potential exists to create hydrophobic soils through prescribed burning, burning prescriptions typically are successful at keeping severity low enough to prevent formation of hydrophobic soils (DeBano, 1989). (PEIR 5.7-12)

Soils in chaparral are hydrophobic whether or not they are burned. There has not been any extensive study of quantitative effects of low, moderate and high severity burning on hydrophobicity and soil loss. Burning can cause the hydrophobic layer to sink in the soil and is thought to increase top soil erosion, but the field studies show that its effect disappears quickly after the first rains (Hubbert et al. 2006). More importantly, there have been quite a few studies of postfire erosion and debris flows and hydrophobicity is not typically a major component of these models as substrate type and slope incline are many times more deterministic in predicting soil loss (Cannon et al. 2009, Gartner et al. 2009).

It is clear the authors of the PEIR misunderstood the actual conclusions of some cited papers, did not conduct an adequate literature search, and appear to have ignored contrary evidence.

## 4. Questionable Citations

The two key references the PEIR provides to support its Program to conduct chaparral clearance projects in southern California are non-peer reviewed documents. One, San Diego County's 2003 Wildland Task Force Report, was removed from circulation on August 24, 2004, after the scientists who were quoted within wrote strong letters to the San Diego County Board of Supervisors indicating their work had been misquoted and misrepresented by county staff. The PEIR stated,

> In its August 2003 report, the San Diego Wildland Task Force agreed that fuel or vegetation management is the single most effective tool available to mitigate

> fires. The build-up of fuel greatly affected the intensity and speed of the recent fires contributing to the loss of lives and property. (PEIR 4.2-8)

The scientists cited in this Task Force Report made it clear they **did not support this conclusion**. In fact the scientists wrote to the Board that they found the report "woefully inadequate and biased in its treatment of the available scientific information, and flawed in many of its assumptions, its treatment of published data, and its recommendations concerning vegetation management as part of a comprehensive fire-risk reduction strategy" (Spencer et al. 2004, Halsey 2012).

There appear to be questionable citations in other subject areas as well. The PEIR cites only one outside reference in its Wildfire Trends Introduction to support its contention that "... streams are being infiltrated by silt and debris following high severity fires, and unnaturally severe wildfires have destroyed vast areas of forest (Bonnicksen, 2003)." (PEIR 4.2-3)

This reference is the testimony to the Committee on Resources, U.S. House of Representatives by a controversial timber industry spokesperson whose credentials have been questioned by other scientists. In an open letter to the press the scientists wrote that, "not only do the views and statements of Dr. Bonnicksen fall far outside the mainstream of scientific opinion, but more importantly that Dr. Bonnicksen has misrepresented himself and his qualifications to speak to these issues" (Rundel et al. 2006).

The concept that severe wildfires have "destroyed" vast areas of forest in California is a subjective perspective that does not belong in a what should be a scientifically-based analysis. Regarding streams "being infiltrated by silt," the National Marine Fisheries Service (2005) has properly examined the matter and has concluded:

> Wildfires occurring within various locations throughout the action area indirectly contribute fine sediment to streams. Although effects of fires may degrade stream habitat in the short-term, recent theory suggests wildfire has a role for creating and maintaining landscape characteristics, habitat complexity, and species diversity (Brown 1990, Rieman and Clayton 1997, Gresswell 1999).

The lack of transparency in the PEIR's citations is a pervasive issue. Some citations can't be found (e.g. BOF 1996), it's frequently unclear what they are referring to (e.g. Sugihara et al., 2006), and many are not relevant to the statement being supported (as noted above).

## 5. Areas of "Treatment" Unknown

According to CEQA Guideline 15124(a): "The precise location and boundaries of the proposed project shall be shown on a detailed map, preferably topographic. The location of the project shall also appear on a regional map." No such maps are included in this PEIR.

The maps that are included are either of the entire state or of large, complex bioregions. These are not helpful since approximately *only* 1/3 of those areas are apparently affected by the Program. These areas are not identified.

Even if the maps provided by the PEIR are used to estimate where projects might occur, there are conflicts between what the maps indicate and what the PEIR states. For example, the document's Condition Class map (4.2-13) indicates that much of southern coastal California is either significantly or moderately altered from its historical fire regime condition class. Yet the PEIR text cites research showing that most chaparral, the dominant ecosystem in coastal southern California, is within its historic fire return interval. In fact, the US Forest Service research has shown that most of the chaparral in the four National Forests in southern California actually has a positive departure from historical fire patterns, meaning the native shrubland ecosystem is being threatened by too much fire as opposed to not enough (Safford and Schmidt 2008).

Since the PEIR does not specify which landowners are part of this Program, a landowner, a land manager, or the neighbor of a cleared parcel has no way of determining whether or not they are subject to this Program, or even of knowing whether they are affected by it. As a consequence, effected parties have no idea if they should be concerned with this PEIR or not. Therefore, the lack of specific location information makes it impossible for this document to meet CEQA's requirement of notification.

Unfortunately, since the PEIR does not include information documenting public notices for its review period, we have no way of determining whether the public was properly notified at all.

## 6. Impossible to Determine Significant Impacts

Because the PEIR is so vague and does not identify any of the project areas, it is impossible for citizens and independent scientists to properly evaluate the potential for significant environmental impacts. The only place this can be done is at the specific project level. However, such a review, as normally provided by CEQA, is precluded as per this PEIR.

Depending on a yet-to-be made general checklist to evaluate projects (as indicated in the PEIR) is not a reasonable approach to situations that can be extremely complicated. The California gnatcatcher *(Polioptila californica californica)*, an endangered species in the highly flammable south coast bioregion, provides one example. The species is mentioned only once in the PEIR:

> The California gnatcatcher (*Polioptila californica californica*) and Southern California rufous-crowned Sparrow (*Aimophila ruficeps canescens*) are permanent residents of semi-open sage scrub habitats. These birds avoid dense, overgrown shrublands and so may benefit from treatments that create a better-proportioned mosaic of shrub mixed with open areas. (PEIR 5.5-64)

The PEIR never defines what “dense, overgrown shrublands” are, nor does it cite any references to support this overly broad statement, but the PEIR’s suggestion that treatments “create a better-proportioned mosaic” suggests the intent of habitat manipulation which aligns with Goal 8 of the Program (altering vegetation structure to “improve” wildlife habitat).

If the PEIR had conducted an adequate review of the literature it would have found that, although gnatcatcher reproductive success is higher in younger coastal sage scrub, most gnatcatcher pairs live in coastal sage scrub stands greater than 20 years old (Atwood et al. 2002). The most important result of the research, however, was that population <u>persistence</u> (through a regional population crash) was highest in the oldest stands, which serve as important refugia.

Suggesting that the habitat for the gnatcatcher is potentially open for manipulation is contrary to accepted practice. For example, the USFS Forest Plan Criteria S39 states, “Avoid fuel treatments in coastal sage scrub within the range of the California gnatcatcher, except in Wildland/Urban Interface Defense Zones and on fuelbreaks. (Federal Code 36 CFR 219)

Since the PEIR does not explain where its “fuel treatments” or habitat manipulations will be conducted, we find it difficult how the authors conclude that the Program will cause no significant impacts to the gnatcatcher. More troubling, the PEIR follows up by actually suggesting the clearance of habitat will be a positive in a bioregion subject to more than 200,000 *unspecified* acres of clearing:

> In summary, indirect effects of the VTP in the South Coast Bioregion are likely to be positive for species that occur in open habitats where exotic pest species are unlikely to invade. (PEIR 5.5-65)

Coastal sage scrub habitat is indeed extremely vulnerable to exotic, invasive pest species when disturbed, in the form of non-native grasses (O’Leary 1995, Talluto and Sudling 2008). Ironically, this is something the PEIR recognizes:

> However, gnatcatcher populations are likely to decline if shrub removal treatments result in a conversion of sage scrub to exotic grassland. (PEIR 5.5-64)

Then the PEIR indicates that,

> Treatments shall not remove essential habitat elements of special status taxa know [sic] or likely to occur in the area (Mitigation Method PEIR 5.5.2-11)

How will the BoF determine what is “essential habitat” for the gnatcatcher? This is never indicated. Since coastal sage scrub is one of the dominant plant communities (“fuel” in the parlance of the PEIR) in the south coast bioregion, we don’t know how the BoF will meet the goals of the PEIR without impacting gnatcatcher habitat.

Although contradictory statements and questionable conclusions within the PEIR are a deep concern, the bigger issue addressed here is that in many instances the PEIR fails to acknowledge well known environmental problems. If they had, as in the case of the gnatcatcher, they would have realized and acknowledged the potential for the Program to cause significant impacts.

In a 1997 Memorandum of Understanding (MOU), the US Fish and Wildlife Service (USFWS) agreed to allow the clearance of coastal sage scrub (gnatcatcher habitat) within the 100 foot defensible space zone around structures without the need for a take permit in each instance. In exchange, fire agencies were to report the number of acres cleared annually. Under this agreement, as per section 4(d) of the Endangered Species Act, a maximum cumulative loss of 5% of total gnatcatcher habitat in the county (approx 220,000 acres), or about 745 acres, was allowed due to fire clearance activities. The terms were clarified in an Incidental Take Statement from the USFWS.

Unfortunately, although fire agencies continue to clear vegetation in and around San Diego County, we have found that neither the USFWS nor the various fire authorities have made any effort to comply with the terms set forth in the Incidental Take Statement. In 2009 we issued a Freedom of Information Act request to the USFWS for any documentation relating to the MOU or compliance therewith. The sparse documentation delivered did not include any annual acreage reports and, instead, mostly consisted of internal USFWS correspondence asking why nothing was being done with regard to MOU compliance.

Based on the Program as described in the PEIR, it appears the BoF is proposing clearance operations over and above a level that has likely already exceeded USFWS guidelines.

Since the PEIR does not make clear where fuel treatments will be conducted in the south coast bioregion, nor does it provide the necessary evidentiary documentation to support its assumptions, it’s conclusion that the Program will not cause significant impacts to the gnatcatcher and other sensitive species is highly questionable. We have found similar problems relating to other species throughout the document.

## 7. Minimized Negative Impacts of Prescribed Fire/Type Conversion

Although the PEIR acknowledges that chaparral can be type converted by too frequent fires, it fails to provide any mitigation to actually prevent it.

The use of prescribed fire during in chaparral, especially when conducted during the cool season, can lead to type conversion (Keeley 2006). It is not an appropriate management strategy for that reason. The suggested mitigation to properly “time” or adjust the “intensity” of a prescribe burn is unrealistic and is only in reference to special status plants, not plant communities.

> Mitigation Measure 5.5.3-1**.** For fire-adapted special status plants, the timing or intensity of prescribed burns shall be adjusted and incorporated into Burn Plan prescriptions to simulate the natural fire regime. The project will be burned in a pattern to create and maintain a mosaic of old and young growth chaparral with diverse habitat structures. (PEIR 5.5-109)

The proper ecological "time" for a fire in chaparral is during the height of the fire season. Chaparral fires are naturally "intense." Attempting to reduce intensity can cause significant negative impacts to the ecosystem, namely type conversion (Keeley and Brennan 2012, Keeley et al. 2011, Keeley et al. 2005).

Regarding the use of prescribed fire to control invasive species, actual experience has demonstrated that with herbaceous weeds, prescribed fire usually does not result in sustainable control unless the program involves repeated burning. For example, the East Bay Regional Parks finds it successful if they burn every year to control yellow star thistle. However, once those treatments are stopped, the target species potentially returns with a vengeance (Alexander and D'Antonio 2003). Some woody species such as brooms may be controlled with a particular fire frequency, but that frequency will be detrimental to many native woody species as well. As a general rule, **reducing fire and other disturbances is likely to do more to restore native systems** than increasing broad scale disturbance, at least in California.

Due to the growing spread of Sahara mustard (*Brassica tournefortii*) in desert regions, the proposed Program has the potential of causing significant negative impacts to thousands of acres in chaparral and transition zones adjacent to, and potentially within, both the Mojave Desert and Anza-Borrego Desert by prescribed fire as well as mastication and herbicide spraying. The resulting denuded and disturbed soils would be highly vulnerable to type conversion into a Sahara mustard monoculture where native habitats are currently at low risk of takeover by this aggressive weed species. Fields of Sahara mustard decimate biodiversity of both native flora and fauna; produce dry, fire-prone landscapes; and eliminate the wildflowers that attract visitors to desert communities. We could not find a reference to this incredibly invasive species in the PEIR.

In regards to impacts of prescribed fire on wildlife, the PEIR appears to dismiss the problem by claiming, "Most shrub-dwelling wildlife will be able to avoid direct mortality by flying away or taking shelter on or under the ground before the fire arrives." (5.5-23)

Most chaparral animals are extremely territorial. They may fly away to "avoid direct mortality," but with their specific territory eliminated and lack of unoccupied territories at the fire edge, it is not unreasonable to assume the expatriated animal will die.

## 8. Ignored Cumulative Impacts

Another approach the author's use throughout the PEIR to dismiss potentially significant impacts relates to the percentage of the bioregion being "treated."

> Since no more than 0.28% of any life form will be treated annually, bioregion-level effects are expected to be relatively minimal. (PEIR 5.5-65)

We find this kind of thinking not only naive, but disingenuous. It is irrelevant how much of the broad landscape is being treated on an annual basis when there are numerous vegetation communities and specialized habitats found throughout each bioregion that only occupy limited areas. The clearance of the only surviving patch of old-growth chaparral near the town of Pine Valley, as the US Forest Service intended to do in its current Mt. Laguna/Pine Valley HFRA Project in the Cleveland National Forest, cannot be dismissed as insignificant just because it only represents a fraction of the total chaparral in the entire bioregion.

Thinking on a percentage and annual basis also precludes seriously considering the cumulative impacts over time.

The PEIR only considers “treatment” programs conducted by other agencies and timber harvest activities. It does not include the impact of increased fire frequency on ecosystems, such as chaparral, already impacted by such a trend. Such an approach precludes a proper analysis of cumulative effects.

The PEIR’s suggested mitigation measures regarding the spread of invasives that will result when native shrublands type-convert to non-native weedlands due to the Program’s “treatments,” fail to address resulting significant impacts of habitat loss. Cleaning the tires of clearance equipment, making sure the canopy cover of trees (where present) is at least 60% for shade, and informing local groups interested in noxious weed control (PEIR 5.5-112) to prevent the spread of invasives are not adequate.

The PEIR does recommend the “development of project level management measures and implementation methods are necessary to minimize likelihood of type conversion” (6-59), but this is in context of sagebrush steepe plant communities. It also is in alignment with the questionable assumption that underlies the PEIR. Namely, the “encroachment” of junipers due to fire suppression. While there is evidence that fire suppression may have allowed the spread of trees into the steepe, many of the management responses are extremely controversial, such as dragging massive chains across the steepe plant community to rip up junipers and sagebrush for range “improvement.”

To defer a proper plan “to minimize the likelihood of type conversion” to the project level will prevent a proper analysis of the Program’s cumulative effects.

To properly evaluate the cumulative impacts of the Program, the PEIR should have examined the *total* impact of all fire on the landscape, not dismiss such impacts by indicating, among other things, that the average size of its treatments (approx 260 acres) is not big enough to have significant impacts on the region.

For example, the PEIR seems to totally dismiss the potential impact on migratory birds when there is no indication in the proposed Program that clearance operations will not occur between February and September to protect bird nests.

> Significance criteria 1C. Interfere substantially with the movement of any native resident or migratory species or with established native resident or migratory species corridors, or impede the use of native species nursery areas; and permanently alter the habitat value of established wildlife corridors. (PEIR 6-60)
>
> Determination of Significance. *Based on average size of VTP prescribed burn project area (260 acres)*, frequency of occurrence, and expected spatial distribution, the cumulative impact of VTP with other related actions is considered less than significant with adopted implementation and mitigation measures when assessed at the scale of a bioregion. (PEIR 6-65) *Emphasis added.*

Mitigations for cumulative impacts? The standard response in the PEIR is “none required.” We find such findings in complete opposition to standard practices and in violation of the Migratory Bird Treaty Act and California State law. We provide an alternative mitigation measure in appendix I.

The first step in determining the cumulative impact of the proposed Program is to conduct a statewide evaluation of native shrublands and provide a reliable estimate of how many acres have been type converted historically, how much is currently threatened, and what impact the Program, development, increased fire frequency, and climate change may have on existing shrublands. Otherwise, any conclusions relating to the cumulative environmental impacts of a vegetation treatment program will be questionable.

The photo above demonstrates the impacts from one type of "fuel treatment" proposed in the PEIR. A rich, old-growth stand of chaparral in Santa Barbara County is being systematically compromised by clearance activities funded by a local FireSafe chapter. The foreground represents the impact of mastication showing significant soil disturbance. In the background, the longer-term impact of earlier treatments show the invasion and spread of highly flammable, non-native weeds and grasses. This process has increased the ignitability of this area with the addition of flashy fuels.

Additional pictorial examples of habitat clearance projects for the purpose of "treating fuels" can be found in the following albums:

Cuyamaca State Park:
https://plus.google.com/photos/111832478062101189732/albums/5794481180501585377

Cuyamaca State Park II:
https://plus.google.com/photos/111832478062101189732/albums/5795096192589480961

Clearance activities near and within the Los Padres National Forest:
https://plus.google.com/photos/111832478062101189732/albums/5512793492339288961

Clearance projects in the Cleveland National Forest:
https://plus.google.com/photos/111832478062101189732/albums/5444493002476885681

## 9. Inadequate Alternatives

As per CEQA (15126.6), "An EIR shall describe a range of reasonable alternatives to the project,... which would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project, and evaluate the comparative merits of the alternatives."

The only alternatives provided in the PEIR are variations on the amounts and types of treatment types used. Also, we reject the conclusion that "no alternative would create a potential increase in wildfire extent/severity..." (PEIR 5.2-14). The spread of invasive grasses that will likely result when shrublands are subject to the Program's "treatments" has been shown not only to increase the potential for ignitions, but to lengthen the fire season (Brooks et al. 2004). The PEIR has not provided any evidence that such a change would not increase wildfire extent, let alone an increase in the number of fires.

To achieve the CEQA requirement, the BoF's primary goal to "enhance the protection of lives, property and natural resources from wildland fire," and to conform to the PEIR's purpose "to analyze the environmental effects of the VTP, to indicate ways to reduce or avoid potential environmental damage resulting from the program, and to identify alternatives to the proposed program," there needs to be a **Wildland-Urban Interface (WUI) alternative.** The WUI alternative would take a comprehensive approach that focuses on *community and regional planning, ignitability of structures, and fuel modifications directly within and around communities at risk.*

There is an abundant amount of scientific research indicating that focusing vegetation treatment, as this PEIR does, as the preferred method to protect lives, property, and the environment from wildland fire is a failed policy. This was made clear during the 2007 Witch Creek Fire, among many others, in which more than 1,100 homes were destroyed and two people were killed. According to a comprehensive study from the Institute for Business and Home Safety (2008), "Wind-blown embers, which can travel one mile or more, were the biggest threat to homes in the Witch Creek Wildfire. There were few, if any, reports of homes burned as a result of direct contact with flames" from wildland fuels.

A much broader study (Syphard et al. 2012) confirmed and expanded upon this finding by examining data on 700,000 addresses in the Santa Monica Mountains and part of San Diego County. The researchers mapped the structures that had burned in those areas between 2001 and 2010, a time of devastating wildfires in the region.

Buildings on steep slopes, in Santa Ana wind corridors, and in low-density developments intermingled with wild lands were the most likely to have burned. **Nearby vegetation was not a big factor in home destruction.**

Looking at vegetation growing within roughly half a mile of structures, the authors concluded that **the exotic grasses that often sprout in areas cleared of native habitat**

**like chaparral could be more of a fire hazard than the shrubs.** “We ironically found that homes that were surrounded mostly by grass actually ended up burning more than homes with higher fuel volumes like shrubs,” Syphard said.

It is the houses themselves, their location, and the fuels within 120 feet of those houses (including litter in gutters, yard junk, cultivars like palms and acacia, wood piles, etc.), that determines whether the property is vulnerable to fire.

Dr. Jack Cohen (2000), a research scientist with the US Forest Service, has concluded after extensive investigations that home ignitions are not likely unless flames and firebrand ignitions occur within 120 feet of the structure. His findings have shown that,

> …effective fuel modification for reducing potential WUI (wildland/urban interface) fire losses need only occur within a few tens of meters from a home, not hundreds of meters or more from a home. This research indicates that home losses can be effectively reduced by focusing mitigation efforts on the structure and its immediate surroundings (Cohen 1999).

Cohen’s work is consistent with the research on homes with nonflammable roofs conducted by other scientists. During WUI wildland fire events, Foote and Gilless (1996) at Berkeley found an 86 percent home survival rate for homes with a defensible space of 84 feet.

The lack of a WUI alternative is surprising, especially in light of discussions within the Board of Forestry and Fire Protection itself. During a 2005 meeting of the Range Management Advisory Committee (RMAC), participants discussed strategies focused on actual assets at risk rather than landscape level “fuel treatments” of the type the current PEIR is proposing. The following is taken from the minutes of that meeting:

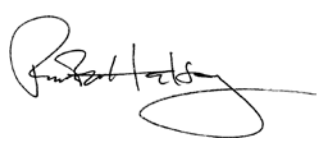
> Jeff Stephens asked to speak to RMAC as the VMP (Vegetation Management Program) Manager versus that of the RMAC Executive Secretary. He outlined three points for consideration by RMAC:
>
> • First, the original goals developed when VMP was created were developed in a different political and environmental climate than what exists today. Rather than eliminate the program perhaps what is needed is a reevaluation of the goals given the politics and environmental concerns of today.
>
> • Second, the VMP has historically been a prescribed fire program. Perhaps what is needed is a program that is more diverse in the type treatments, vegetation types, and circumstances where it may be used. This is a goal of the VMP PEIR.
>
> • Third, when developing recommendations to the Board RMAC may wish to consider the views of some researchers like Jon Keeley, who maintain that the fires that occurred in the south during October 2003 would have occurred regardless of vegetative stand age or structure developed via fuel treatments. This

> is because these fires occur under extreme fire weather events associated with low fuel moisture. **Therefore it is not a good use of resources to perform large landscape fuel reduction projects; rather it is more useful to concentrate efforts near the values to be protected** (RMAC 2005).

We urge the Department of Forestry and CalFire to retract this PEIR and create a **comprehensive program** as referenced above reflecting specific, regional differences, actual assets at risk, and current science without an attempt to exempt its projects from CEQA. In only this way will the state achieve the Program's key goal of preventing loss of lives, reducing fire suppression cost, reducing private property losses and protecting natural resources from devastating wildfire.

As a final note, while the protection of life and property will always be the primary focus of any fire management program, all too often the natural environment is viewed only as a "fuel" that needs to be mitigated, especially shrubland ecosystems. This often leads to decisions on the fire line and during vegetation management activities that have seriously compromised the natural environment. **Valuable natural resources such as old-growth chaparral, intact habitat, and important wildlife corridors need to be seen for what they are, assets at risk.**

Sincerely,



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**The California Chaparral Institute** is a non-profit science and educational organization dedicated to promoting an understanding of and appreciation for California's shrubland ecosystems, helping the public and government agencies create sustainable, fire safe communities, and encouraging citizens to reconnect with and enjoy their local, natural environments. www.californiachaparral.org.

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**APPENDIX I**

Migratory birds are perhaps the most highly valued component of North America's biological diversity, with approximately 1,200 species representing nearly 15% of the world's known bird species. The seasonal movement of migratory birds is one of the most complex and compelling dramas in the natural world. Migratory birds embark twice each year on long-distance journeys between their breeding areas and their wintering grounds, which are sometimes separated by thousands of miles. State, federal, and international law all recognize the importance of protecting migratory bird species from harm.

Pursuant to the MBTA, it is unlawful "at any time, by any means or in any manner to . . . take [or] kill . . . any migratory birds, [and] any part, nest, or eggs of any such bird." 16 U.S.C. § 703(a). This prohibition applies to federal agencies and their employees and contractors who may not intend to kill migratory birds but nonetheless take actions that result in the death of protected birds or their nests. *Humane Soc'y of the United States v. Glickman*, 217 F. 3d 882 (D.C. Cir. 2000) (holding that federal agencies are required to obtain a take permit from FWS prior to implementing any project that will result in take of migratory birds); see also *Robertson v. Seattle Audubon Soc'y*, 503 U.S. 429, 437–38 (1992) (finding that federal agencies have obligations under the MBTA) and *Center for Biological Diversity v. Pirie* (191 F.Supp.2d 161 (D.D.C. 2002) (allowing injunctive relief against federal agencies for violations of the MBTA). The prohibition on "take" of migratory birds includes destruction of nests during breeding season. Specifically, "nest destruction that results in the unpermitted take of migratory birds or their eggs, is illegal and fully prosecutable under the MBTA." U.S. Fish and Wildlife Service, Migratory Bird Permit Memorandum, from Director Steve Williams dated April 15, 2003.

In a *Memorandum of Understanding Between the U.S. Department of Agriculture Forest Service and the U.S. Fish and Wildlife Service to Promote the Conservation of Migratory Birds* ("MOU"), the agencies identified specific actions that, if implemented, would contribute to the conservation of migratory birds and their habitats. The MOU requires the Forest Service to alter the season of activities to minimize disturbances during the breeding season, to coordinate with the appropriate FWS Ecological Services office when planning projects that could affect migratory bird populations, and to follow all migratory bird permitting requirements. Importantly, the MOU "does not remove the Parties' legal requirements under the MBTA, BGEPA, or other statutes and does not authorize the take of migratory birds," (emphasis added).

Under the MBTA, "any person, association, partnership, or corporation" who violates the MBTA or regulations thereunder are subject to criminal and civil penalties. 16 U.S.C. §707. Violations of the MBTA are prosecuted as a misdemeanor, and upon conviction thereof, are subject to fines of up to $15,000 or imprisonment of up to six months, or both. *Id.*

**Requirements of the California Fish & Game Code**

In addition to the protections afforded by the federal MBTA and outlined above, several bird species within the project area are also protected under state law. Specifically, "[i]t is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird," and "it is unlawful to take or possess a migratory nongame bird." *See* Cal. Fish & Game Code §§ 3503, 3513.

To mitigate the potential take of migratory bird nests, we recommend that the following mitigation measure be implemented for all vegetation clearing projects:

*Source: Southern California Association of Governments. 2012. Final Programmatic Environmental Impact Report for the 2012-2035 Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS), Appendix G: Examples of Measures that Could Reduce Impacts from Planning, Development and Transportation Projects.*

**BIO/OS34:** Project sponsors may ensure that suitable nesting sites for migratory nongame native bird species protected under the Federal Migratory Bird Treaty Act and/or trees with unoccupied raptor nests (large stick nests or cavities) may only be removed prior to February 1, or following the nesting season.

A survey to identify active raptor and other migratory nongame bird nests may be conducted by a qualified biologist at least two weeks before the start of construction at project sites from February 1st through August 31st. Any active non-raptor nests identified within the project area or within 300 feet of the project area may be marked with a 300-foot buffer, and the buffer area may need to be avoided by construction activities until a qualified biologist determines that the chicks have fledged. Active raptor nests within the project area or within 500 feet of the project area may be marked with a 500-foot buffer and the buffer avoided until a qualified biologist determines that the chicks have fledged. If the 300-foot buffer for non-raptor nests or 500-foot buffer for raptor nests cannot be avoided during construction of the project, the project sponsor may retain a qualified biologist to monitor the nests on a daily basis during construction to ensure that the nests do not fail as the result of noise generated by the construction. The biological monitor may be authorized to halt construction if the construction activities cause negative effects, such as the adults abandoning the nest or chicks falling from the nest.

- Beginning thirty days prior to the disturbance of suitable nesting habitat, the project sponsor may arrange for weekly bird surveys conducted by a qualified biologist with experience in conducting breeding bird surveys to detect protected native birds occurring in the habitat that is to be removed and any other such habitat within 300 feet of the construction work area (within 500 feet for raptors) as access to adjacent areas allows. The last survey may be conducted no more than 3 days prior to the initiation of clearance/construction work.

- If an active raptor nest is found within 500 feet of the project or nesting habitat for a protected native bird is found within 300 feet of the project a determination may be made by a qualified biologist in consultation with CDFG whether or not project construction work will impact the active nest or disrupt reproductive behavior.

- If it is determined that construction will not impact an active nest or disrupt breeding behavior, construction will proceed without any restriction or mitigation measure. If it is determined that construction will impact an active raptor nest or disrupt reproductive behavior then avoidance is the only mitigation available. Construction may be delayed within 300 feet of such a nest (within 500 feet for raptor nests), until August 31 or as determined by CDFG, until the adults and/or young of the year are no longer reliant on the nest site for survival and when there is no evidence of a second attempt at nesting as determined by a qualified biologist. Limits of construction to avoid a nest may be established in the field with flagging and stakes or construction fencing marking the protected area 300 feet (or 500 feet) from the nest. Construction personnel may be instructed on the sensitivity of the area.

- Documentation to record compliance with applicable State and Federal laws pertaining to the protection of native birds may be recorded.

# EXHIBIT 10

CALIFORNIA
CHAPARRAL
INSTITUTE
...the voice of the chaparral

February 25, 2013

Board of Forestry and Fire Protection
Attn: George Gentry
Executive Officer
VegetationTreatment@fire.ca.gov
Sacramento, CA 94244-2460

Re: ADDENDUM to our January 25, 2013 comment letter on the Draft Program EIR (PEIR) for the Vegetation Treatment Program

Dear Mr. Gentry and Board Members,

Type conversion of native shrublands, the purpose of a Program EIR, and land planning were issues we addressed in our original letter of January 25, 2013. We would like to expand on these matters here. In addition, we are submitting a large number of exhibits for the administrative record including:

> 1. A petition with 3,080 signatures and comments requesting that the Board of Forestry retract its PEIR and to work with the California Natural Resources Agency and the Senate Committee on Natural Resources and Water to create a Comprehensive Fire Protection Program**.**
>
> 2. Scientific papers cited in this and our January 25, 2013 letter.
>
> 3. Our 2005 comment letter to Cal Fire on the NOP regarding the Vegetation Management Program DEIR identifying the need to incorporate current science into its planning process and to avoid using forest-based models when managing other ecosystems.

**Type Conversion**

As stated in our January 25, 2013 letter, contrary to statements in the PEIR, US Forest Service research has shown that most shrubland ecosystems within the four National Forests in southern California have **negative** departures from historical fire patterns, meaning the native shrublands are being threatened by too much fire as opposed to not enough. Based on this analysis, it is a fair assumption that many other native shrublands in State Responsibility Areas are being threatened by too much fire as well, and hence type conversion. We have included US Forest Service research maps at the end of this letter showing these negative departures (In our previous letter we mistakenly termed negative departure as positive).

**Program EIR: General**

A regulation enacted under CEQA, Title 14 of Cal. Code of Regulations (CEQA Guidelines) § 15168 defines a "Program EIR," its uses, and whether a Program EIR can eliminate the need for further CEQA documents for site-specific projects (either "tiered EIRs" or "negative declarations") as follows:

> (a) **General**. *A program EIR is an EIR which may be prepared on a series of actions that can be characterized as one large project and are related either*:
>
> (1) *Geographically,*
>
> (2) *As logical parts in the chain of contemplated actions*,
>
> (3) *In connection with issuance of rules, regulations, plans, or other general criteria to govern the conduct of a continuing program*, or
>
> (4) *As individual activities carried out under the same authorizing statutory or regulatory authority and having generally similar environmental effects which can be mitigated in similar way*s. (Italics added)

The PEIR fails to meet these criteria for a program EIR.

We find that since the 38 million acres targeted by the PEIR are neither geographically (1) nor ecologically similar, it is impossible for the Board to conclude as it does in the PEIR that *the individual activities carried out* under its authority in the Program will have *similar environmental effects* which *can be mitigated in similar ways* (4). This is especially true since the PEIR was dominated by forest-based research, some of which was misinterpreted and misquoted, and fails to address specific regional differences in ecosystem type, biodiversity, and wildland-urban interface issues.

We also find the huge, 500% expansion of Cal Fire's previous Vegetation Management that this PEIR proposes does not qualify as *a continuing program* (3). The massive area proposed for treatments requires an entirely different analysis as explained in our previous letter.

And finally, the projects the PEIR are proposing occur in so many different ecosystems with so many different variables, that considering them *as logical parts of contemplated actions* (2) is equivalent to classifying developments on flood plains, earthquake faults, and along the coastal zone as exempt from independent review because they all involve housing subdivisions.

In addition, the CEQA guidelines state,

> (5) A program EIR will be most helpful in dealing with subsequent activities if it *deals with the effects of the program as specifically and comprehensively as possible*. With a good and detailed analysis of the program, many subsequent activities could be found to be within the scope of the project described in the program EIR, and no further environmental documents would be required. (Italics added)

We find the PEIR fails to meet this standard of dealing *with the effects of the program as specifically and comprehensively as possible* as explained in our previous letter.

**Program EIR: Details**

A treatise on CEQA, Remy, Thomas, Moose & Manley, Guide To CEQA (11th ed. 2007) (Guide To CEQA), discusses Program EIRs. They state that Program EIRs can serve an important function by,

> "*. . . providing a single environmental document that can allow an agency to carry out an entire 'program' without having to prepare additional site-specific EIRs or negative declarations.* To effectively serve this second function, a program EIR must be very detailed; in other words, *it must include enough site-specific information to allow an agency to plausibly conclude that, in analyzing 'the big picture,' the document also addressed enough details to allow an agency to make informed site-specific decisions within the program*. (Guide To CEQA, pp. 637-638; italics added)

The Board's PEIR does not contain site-specific information, and hence has failed this standard. It appears then that the Board is depending on the second step of environmental analysis, that is, to go through a "written checklist" to determine if the significant environmental impacts of a site-specific project have been evaluated in the Program EIR. Since the PEIR has failed to do this, then the Board is required to prepare site-specific "tiered" EIRs or negative declarations (The factors that a lead agency must examine in the written checklist are set forth in Public Resources Code § 15162).

There are no checklists within the PEIR specific to each plant community and region the Program will be treating. Therefore, it is impossible to properly evaluate the Program's impacts.

In addition,

> . . . (*T*)*he authors believe that a lead agency should clearly inform the public whether future CEQA documentations are anticipated.* Such information will

affect the manner in which people review and criticize the 'first tier' EIR . . ." (Guide To CEQA, p. 638; italics added)

The PEIR has not done this.

After setting forth the definition of a "program" set forth in CEQA Guidelines § 15168(a), the Remy et al Guide To CEQA provides

. . . **What is a 'Program'?**

. . . The use of a program EIR allows a lead agency 'to characterize the overall program as the project being approved at the time.' . . . (A) program EIR acts as an analytical superstructure for subsequent more detailed analysis. *The program EIR should identify those probable environmental effects that can be identified.* For those impacts that cannot be predicted without undue speculation or for which the deferral of specific analysis is appropriate, the agency can defer such analysis until later points in the program approval or implementation process. . . . Subsequent EIRs need only focus on new effects that have not been considered before. . . ." (Guide To CEQA, pp. 638-639; italics added)

. . . (F)or a program EIR to allow an agency to dispense with additional EIRs or negative declarations for later site-specific projects, the program document must be at once both comprehensive and specific. It must concentrate on a project's long-term 'cumulative' impacts, but must also contain enough details to anticipate 'many subsequent activities within the scope of the project.' CEQA Guidelines, § 15168, subd. (c)(5). . . ." (Guide To CEQA at p. 639)

For the reasons stated in our previous letter, the PEIR has failed to properly *identify those probable environmental effects that can be identified.* Specifically, the PEIR's cursory treatment of shrubland type conversion that can certainly be identified, the cumulative impacts of such a change on ecosystem health and diversity that are ignored, and its flawed, forest-based analysis of the entire state, are all significant and fatal flaws in the PEIR.

**Poor Preparation**

List of Preparers and Individuals/Organizations consulted in preparation for the PEIR is almost exclusively dominated by northern California, forest-based consultants and Cal Fire staff. Only one outside agency scientist who has had significant involvement in fire research over the past decade involving Southern California was included (Geographer P.W. Wohlgemuth with the USFS Riverside Fire Lab). We find this especially odd since the Board is involved with the California Fire Science Consortium which is focused on exchanging and distributing knowledge concerning the most recent research in fire science.

As a consequence, we are asking the Board the following questions concerning the preparation of the PEIR:

1. How were consultants for the PEIR selected?

2. Why did the Board not include well known scientists familiar with shrubland-based ecosystems, especially those in southern California?

3. Why did the Board exclude important conservation groups who the Board knows have been extremely active in commenting on fire management issues in California (such as the California Native Plant Society and the California Chaparral Institute)?

4. How were the citations in the PEIR vetted to ensure they were relevant to the statements and conclusions made in the PEIR?

5. Why is there a lack of shrubland-based citations and applications in the PEIR when the majority of the most damaging fires in California have occurred in shrubland ecosystems?

6. Why did the Board only provide alternatives focused on vegetation treatment rather than more comprehensive approaches of the type suggested in our January 25, 2013 comment letter?

7. How does the Board intend to use the comments being submitted about the PEIR? We ask this question because while CEQA indicates that "an EIR should summarize the main points of disagreement among the experts," we are hoping the Board will not merely attach submitted comments to satisfy this requirement. We are hoping the Board will actually *use* the submitted comments to develop a more comprehensive fire management program. Such use is true to the intent of CEQA.

**Land Planning**

We mention the importance of land planning in reducing wildand fire risk in our prior letter. We wanted to provide additional research that affirms the importance of providing a **Wildland-Urban Interface (WUI) alternative** to the Board's proposed Program as we offered in our January 25, 2013 letter.

After examining housing that borders public forestlands in the West, Gude et al. (2008) concluded,

> Most importantly, national, state, and local policies that address **wildland fuels management need to be coupled with policies that address existing and future development in fire-prone private lands.** (Emphasis added).

In a follow-up, comprehensive examination of wildfire suppression costs in the Sierra Nevada area of California, Gude et al. (2013) concluded,

> In light of mounting evidence that increases in housing lead to increases in fire suppression costs, future policies aimed at addressing the rising costs should attempt to either reduce or cover the additional costs due to future home development. **To ignore homes in future wildfire policies is to ignore one of the few determinants of wildfire suppression cost that can be controlled.** For example, governments have limited ability to control factors such as weather and the terrain in which wildfires burn.
>
> **The most obvious means of reducing additional suppression costs due to future home development would be to limit future home development in wildfire prone areas.** Based on our findings, future savings may be achieved by a combination of policies that aim to keep undeveloped land undeveloped and encourage new development within existing urban growth boundaries and existing subdivisions. (Emphasis added)

**Failure to Incorporate Comments**

According to the PEIR,

> All scoping comments received by the Department in response to its earlier NOP have been incorporated by the Board as a part of the scoping for the Vegetation Treatment Program EIR proposed herein. (PEIR 9-1)

We are not sure what the Board means by "incorporated," but we have found that prior comments provided by us to the Board appear to have been generally ignored.

For example, in our 2005 comment letter concerning the NOP we wrote,

> ... much of what is within the California Fire Plan tends to treat different types of fuels with the same broad brush, "one-size-fits-all" approach, failing not only to recognize the distinct differences between forest and chaparral, but also the important differences within chaparral types themselves. These differences have important fire management implications that need to be addressed. Not doing so will dramatically reduce the effectiveness of our state's fire management efforts."

Our January 25, 2013 comment letter repeats the same point:

> The one-size-fits-all approach the PEIR takes regarding fire suppression is not scientifically supportable and raises serious questions about the PEIR's conclusions. For shrubland ecosystems, which have completely different fire regimes and responses to management than forests, there were less than a dozen

peer-reviewed papers referenced (out of nearly 1,000 literature citations) relating directly to fire.

The need to appropriately address and incorporate the different fire regimes of coniferous forest vs. chaparral and other ecosystems into the Program's vegetation treatment prescriptions is a substantial issue that was raised during the scoping process in 2005, and one that still remains inadequately addressed in the PEIR.

We urge the Board to take advantage of the the wealth of information available from independent scientists, conservation organizations, and private citizens who care deeply about California and use it to shape its future policy documents and fire management programs.

Sincerely,

Richard W. Halsey
Director
California Chaparral Institute
rwh@californiachaparral.org

Justin Augustine
Attorney
Center for Biological Diversity

**The California Chaparral Institute** is a non-profit science and educational organization dedicated to promoting an understanding of and appreciation for California's shrubland ecosystems, helping the public and government agencies create sustainable, fire safe communities, and encouraging citizens to reconnect with and enjoy their local, natural environments. www.californiachaparral.org

**The Center for Biological Diversity** is a 501(c)3 nonprofit conservation organization with more than 450,000 members and online activists dedicated to the protection of endangered species and wild places. www.biologicaldiversity.org

**New signatories to our letter:**

Claudia Foster
Richard Foster
Board of Directors
Del Dios Volunteer Fire Department

Richard Foster
President
Del Dios Mutual Water Company

Terry Frewin
Chair
Sierra Club California/Nevada Desert Committee
Santa Barbara, CA

Las Virgenes Homeowners Federation
Kim Lamorie, president
Mary Ellen Strote, vice president
Kathy Berkowitz, secretary
Joan Yacovone, treasurer

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Environmental Protection Information Center
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**Prior signatories**

Kevin Barnard
President
The Escondido Creek Conservancy

Pat Barnes
Chairperson
Orange County Group Executive Committee
Sierra Club, Angeles Chapter

Monica Bond, Principal Scientist
Wild Nature Institute

Cindy Crawford
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Michael J. Connor, Ph.D.
California Director
Western Watersheds Project

Penny Elia
Task Force Chair
Save Hobo Aliso Task Force
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David Garmon, President
Tubb Canyon Desert Conservancy

George Hague
Co-Chair
Santa Ana Mountains Task Force
Sierra Club, Angeles Chapter

Tom Hopkins, President
Ventana Wilderness Alliance
Santa Cruz, CA

Gordon Johnson
Director
California Wilderness Project

Eric Johnson, Chair
Puente-Chino Hills Task Force of the Sierra Club

Frank Landis, Ph.D.
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California Native Plant Society, San Diego Chapter

Travis Longcore, Ph.D.
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The Urban Wildands Group
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Ulrike Luderer
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Sierra Club, Angeles Chapter

Greg McMillian, Chair
Executive Committee
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Patricia S. Muir
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Oregon State University

Tom O'Key
Southern California Desert Video Astronomers
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Doug Paulson
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Escondido Citizens' Ecology Committee

Claire Schlotterbeck
Executive Director
Hills for Everyone

Geoffrey D. Smith
Founder
Wilderness4All

Joel Robinson
Director
Naturalist For You

Michele Roman
Environmental Photographer

Terry Welsh
President
Banning Ranch Conservancy
Sierra Club Banning Ranch Park and Preserve Task Force

Fred Woods
Friends of Daley Ranch
Escondido, CA

George Wuerthner
Western Wildlands Council
Bend, Oregon

David Younkman
Vice President for Conservation
American Bird Conservancy

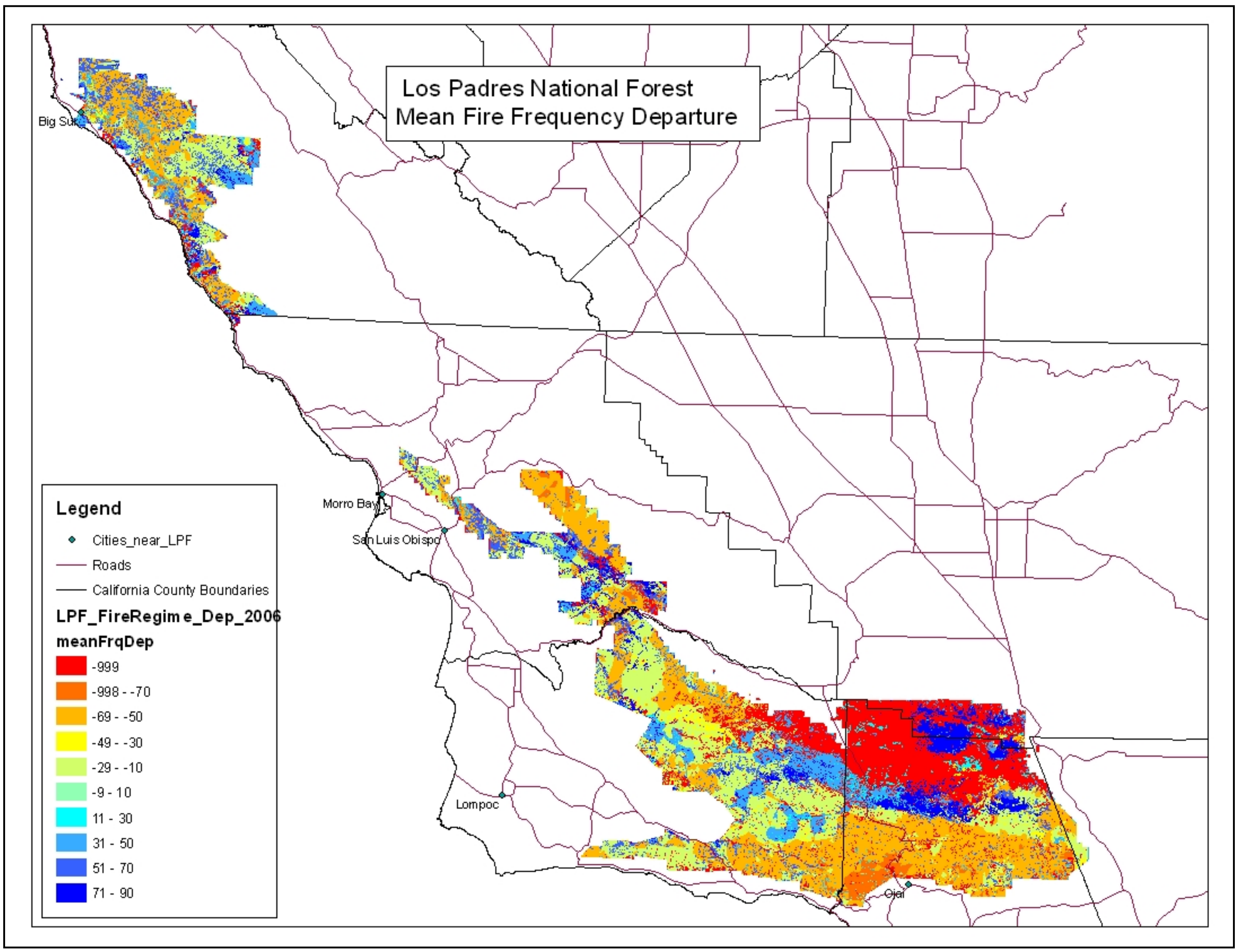
**Cited References**

Gude, P.H., K. Jones, R. Rasker, M.C. Greenwood. 2013. Evidence for the effect of homes on wildfire suppression costs. International Journal of Wildland Fire - http://dx.doi.org/10.1071/WF11095

Gude, P., R. Rasker, J van den Noort. 2008. Potential for future development on fire-prone lands. Journal of Forestry, June: 198-205.

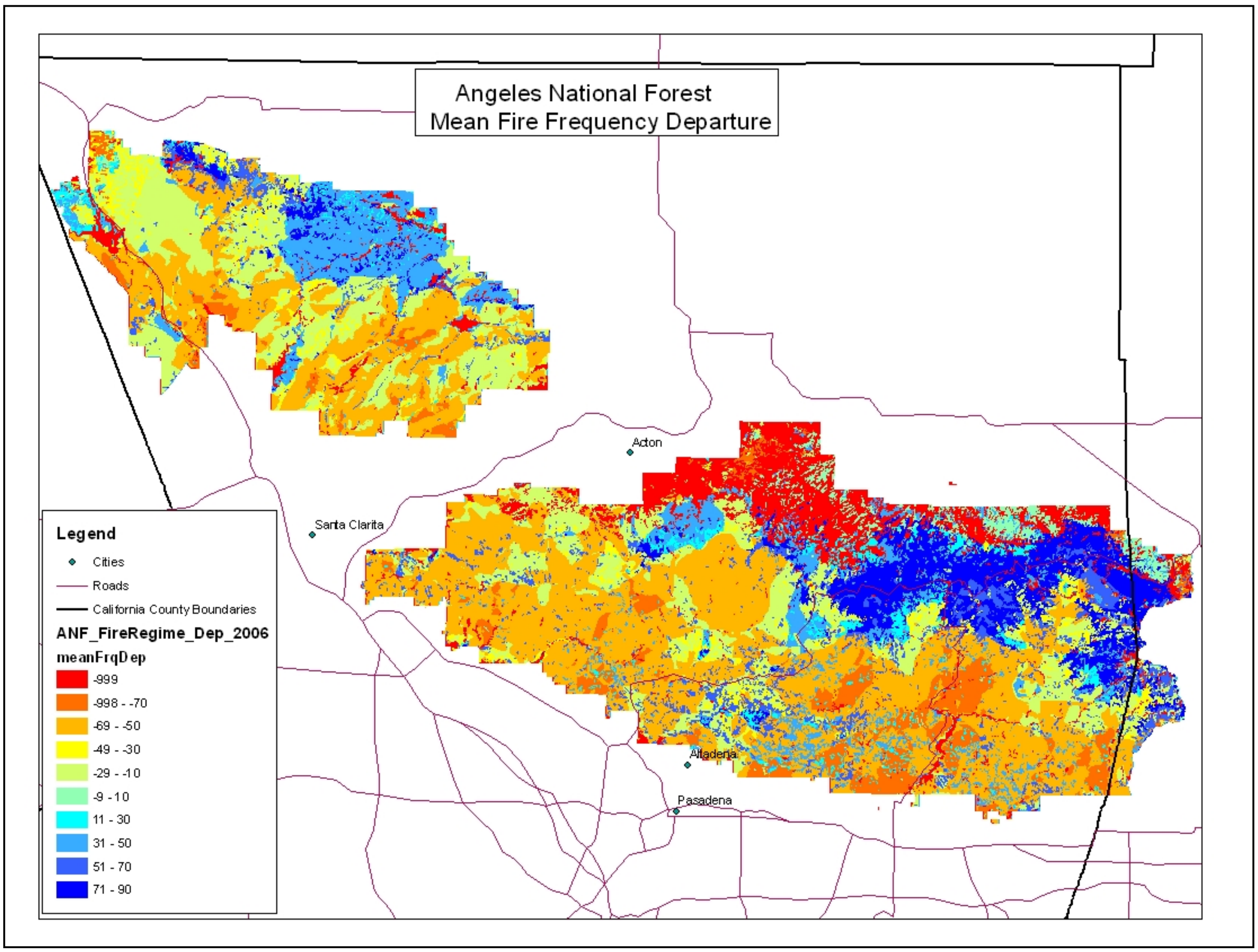
**Los Padres National Forest Mean Fire Frequency Departure Map**
Hot colors represent negative departures (more fire than historical)
Cool colors represent positive departures (less fire than historical)

From Safford, H. D. and D. Schmidt. 2008. Fire departure maps for southern California national forests. USDA Forest Service and The Nature Conservancy.



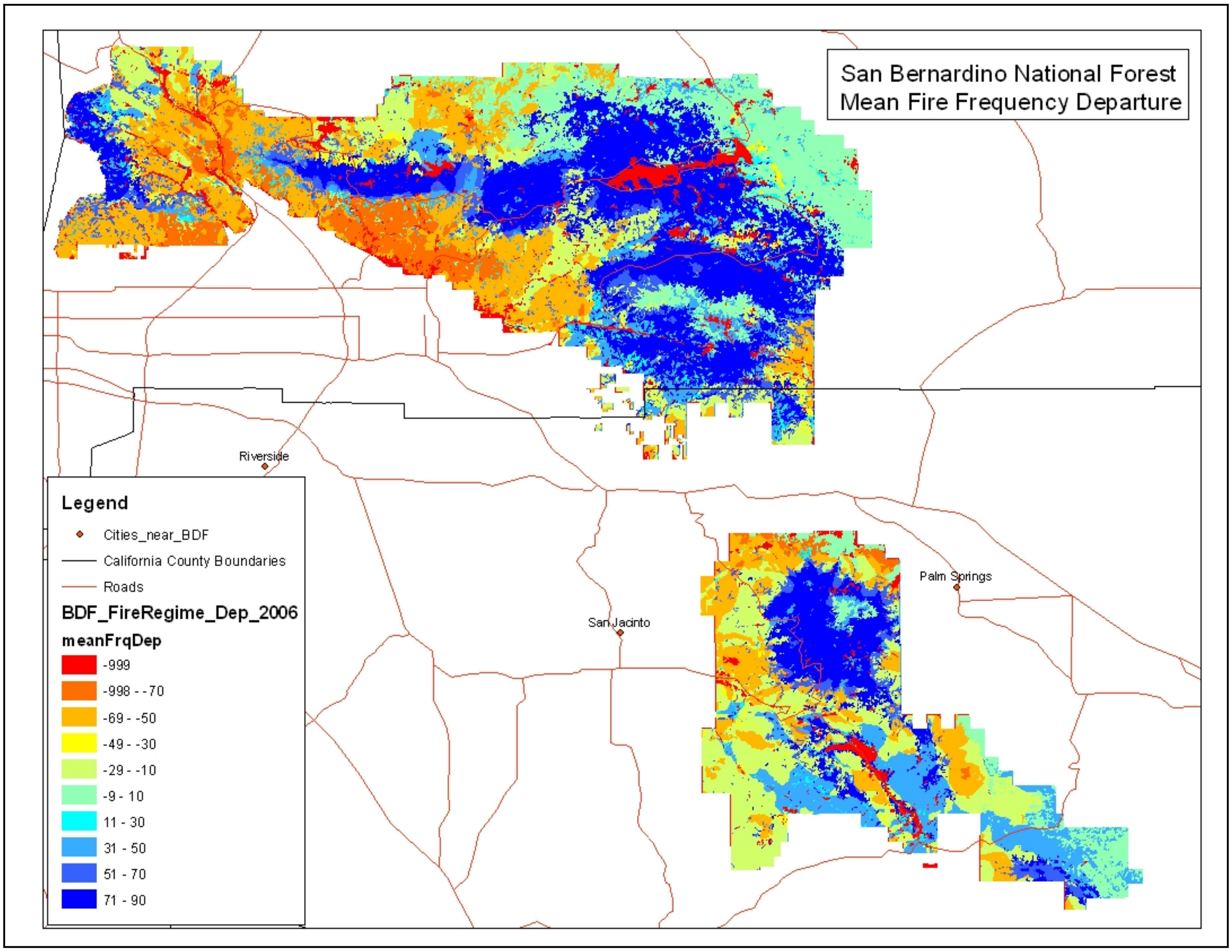
**Angeles National Forest Mean Fire Frequency Departure Map**
Hot colors represent negative departures (more fire than historical)
Cool colors represent positive departures (less fire than historical)

From Safford, H. D. and D. Schmidt. 2008. Fire departure maps for southern California national forests. USDA Forest Service and The Nature Conservancy.



**San Bernardino National Forest Mean Fire Frequency Departure Map**
Hot colors represent negative departures (more fire than historical)
Cool colors represent positive departures (less fire than historical)

From Safford, H. D. and D. Schmidt. 2008. Fire departure maps for southern California national forests. USDA Forest Service and The Nature Conservancy.



**Los Padres National Forest Mean Fire Frequency Departure Map**
Hot colors represent negative departures (more fire than historical)
Cool colors represent positive departures (less fire than historical)

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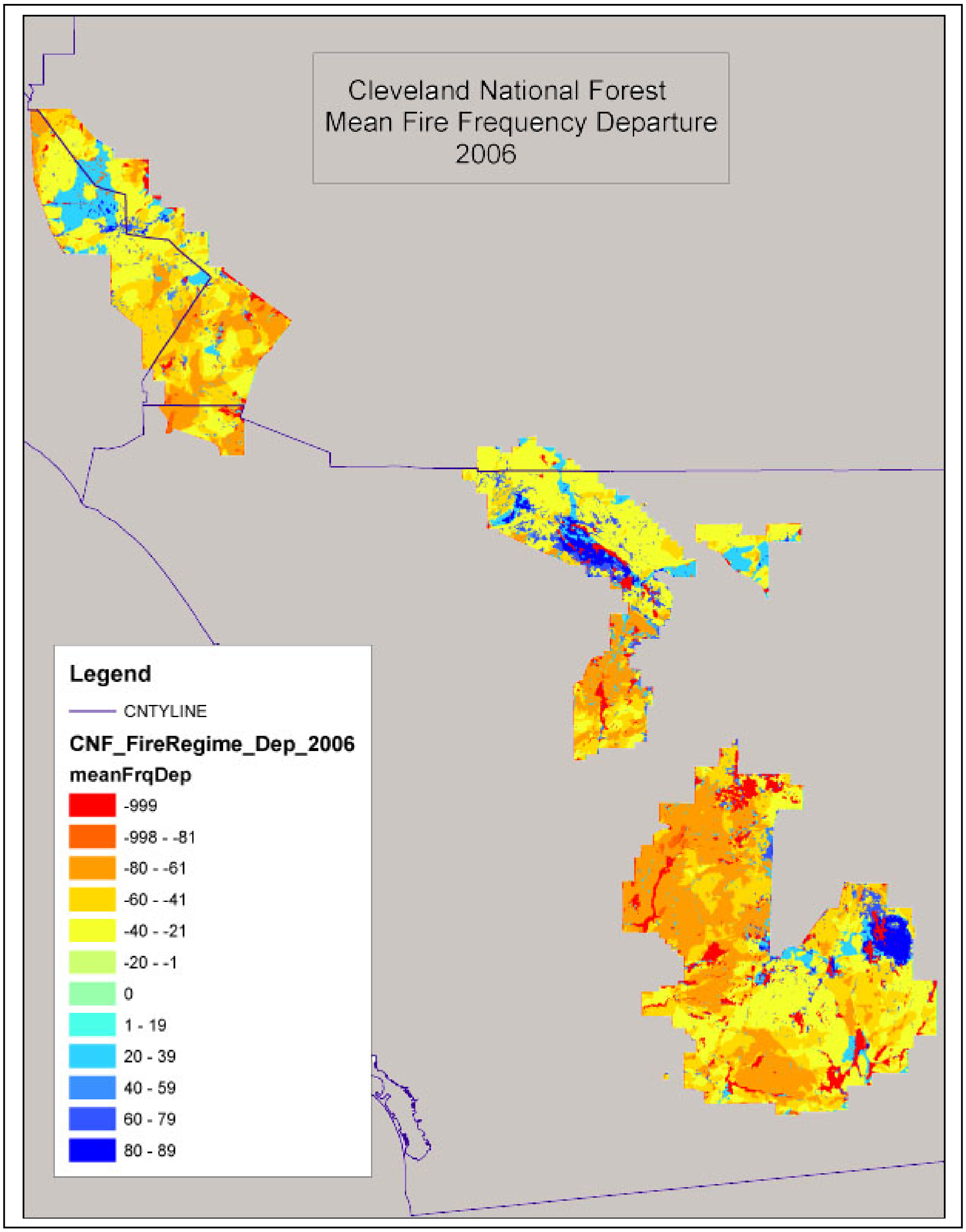


# EXHIBIT 11

CALIFORNIA
CHAPARRAL
INSTITUTE
...the voice of the chaparral

April 8, 2013

Board of Forestry and Fire Protection
Attn: George Gentry
Executive Officer
VegetationTreatment@fire.ca.gov
Sacramento, CA 94244-2460

Re: CCI 3rd comment letter on the Draft Program EIR (PEIR) for the Vegetation Treatment Program

Dear Mr. Gentry and Board Members,

In this, our final comment letter on the PEIR, we would like to submit some questions relating to the PEIR document and the proposed Program.

**A False Dichotomy**

The primary question we have always asked about vegetation treatment projects in native shrubland ecosystems is why, if the science concerning the efficacy of such an approach is mixed at best, are vegetation treatments the default response to the threat of wildland fire?

This default response was illustrated in a San Diego Union-Tribune article on April 5, 2013, when it quoted Mr. Gentry as saying,

> *People have to expect one of two things. They're going to have to expect a large-scale fire that San Diego has already seen or they're going to have to accept some form of treatment to help mitigate those large-scale fires. That's the choices we're basically faced with.*

This is a false dichotomy. When the science has clearly shown that the best way to protect lives and property from wildland fire is through a combination of fire safe community planning, fire safe structures, and appropriate defensible space, the choices offered by the Board of Forestry and the PEIR do not reflect what we know. Spending millions of dollars on clearing habitat is not an effective use of fire management resources. The research is conclusive on the inadequacy of focusing exclusively on vegetation treatments:

> "Wind-blown embers, which can travel one mile or more, were the biggest threat to homes in the Witch Creek Wildfire. **There were few, if any, reports of homes burned as a result of direct contact with flames" from wildland fuels.**
> - Institute for Business and Home Safety 2008

and,

> Examining data on 700,000 addresses in southern California it was found that buildings on steep slopes, in Santa Ana wind corridors, and in low-density developments intermingled with wild lands, were the most likely to have burned between 2001 and 2010. **Nearby vegetation was not a big factor in home destruction. Exotic grasses that often sprout in areas cleared of native habitat like chaparral could be more of a fire hazard than the shrubs.**
> - Alexandra D. Syphard et al. 2012

and finally,

> …effective fuel modification for reducing potential WUI (wildland/urban interface) fire losses need only occur within a few tens of meters from a home, not hundreds of meters or more from a home. This research indicates that **home losses can be effectively reduced by focusing mitigation efforts on the structure and its immediate surroundings.**
> - Jack Cohen 1999

The Board's assumption appears to be that the *attempted mitigation* of large-scale wildland fires through vegetation treatment is the main goal in and of itself, rather than the actual protection of life and property. The one goal out of nine in the PEIR that does address protecting life and property is stated in a way that precludes any alternatives to vegetation treatment projects.

> *2. Modify wildland fire behavior to help reduce catastrophic losses to life and property consistent with public expectation for fire protection.*

### Changing the Question

We suggest an alternative way of looking at the fire environment so that all the knowledge we have concerning wildland fire risk reduction is utilized. The Board of Forestry needs to ask itself,

**How can we protect lives and property from wildland fire,**
rather than,
**How can we try to stop wildland fires?**

In light of the two very different approaches these two questions can produce, we respectfully ask the Board to provide the public answers to the following as they apply to the PEIR:

1. Why has the Board of Forestry not taken a more comprehensive approach to fire risk reduction (by including all factors known to reduce the loss of lives and property during wildland fires), and instead focused exclusively on vegetation treatment in the PEIR?

2. Considering that the Board's mandate is focused on forests, forestry, and forest fires, that the majority of the Board's members are associated with forestry, that the PEIR is a forest-based document, and that the PEIR preparers' expertise is primarily in forested ecosystems, how did the Board adjust its approach in the PEIR to reducing the threat of wildand fire in non-forested ecosystems such as chaparral where most of the damaging fires occur?

3. The Board has claimed that there will be local input into the planning of individual vegetation treatment projects. However, if the PEIR is certified, the ability of citizens to challenge a project under the California Environmental Quality Act will be eliminated. If citizens believe a project approved by the Board and/or Cal Fire will cause significant environmental damage, what recourse will citizens have to challenge such a project?

4. In light of the data presented in the three studies cited above, Institute for Business and Home Safety (2008), Syphard et al. (2012), and Cohen (1999), what scientific rationale does the Board use to focus exclusively on vegetation treatment to reduce the loss of life and property from wildland fire, especially in southern California? We could find no such rationale in the PEIR.

5. What role, if any, did the economic incentive of federal grant dollars or other monies available for vegetation treatments play in the PEIR's exclusive focus on vegetation treatment?

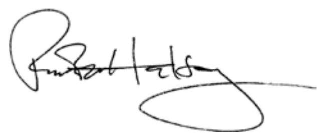
6. It was impossible to determine from the PEIR how much of the proposed program would be involving vegetation treatments on private ranch and farm land that would provide economic benefits to the owners of such lands. Would the Board please identify such projects if any exist?

Without changing the question as mentioned above, the Board of Forestry will continue to support a policy that has consistently failed to protect communities from wildland fire over the past one hundred years. It's time we start focusing on what we actually want to accomplish rather than supporting an approach that requires continual expenditures year after year on habitat clearance projects.

**Plants grow back. In contrast, fire safe land planning and fire safe communities provide self-sustaining, long term solutions that do not require constant government expenditures to maintain.**

Again, we urge the Board and the State of California to retract the current PEIR and instead deal with wildfire threats in a **collaborative**, science-based manner, involving all stakeholders and tailored to the wildly variable environments of California, that focuses on what really matters: lives, property, and the natural environment.

Sincerely,



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Cohen, J.D. 1999. Reducing the wildland fire threat to homes: where and how much? USDA Forest Service Gen. Tech. Report PSW-GTR-173, pp 189-195.

Institute for Business and Home Safety. 2008. Mega Fires: The Case for Mitigation. The Witch Creek Wildfire, October 21-31, 2007.

Syphard, A.D., J.E. Keeley, A. Bar Massada, T.J. Brennan, V.C. Radeloff. 2012. Housing arrangement and location determine the likelihood of housing loss due to wildfire. PLoS ONE 7(3): e33954. doi: 10.1371/journal.pone.0033954.

# EXHIBIT 12

**Anne S. Fege, Ph.D., M.B.A.**
**12934 Texana Street**
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**Phone 858-472-1293, Email afege@aol.com**

February 23, 2013

Mr. George Gentry, Executive Officer
Board of Forestry and Fire Protection
P. O. Box 944246
Sacramento, CA 94244-2460

Re: Draft Programmatic Environmental Impact Report for the Vegetation Treatment Program

Dear Mr. Gentry and Board of Forestry Members:

Thank you for the opportunity to provide comments on the Draft Programmatic Environmental Impact Report (PEIR) for the Vegetation Treatment Program (VTP). Vegetation reduction treatments are an important part of state-wide programs to reduce losses of life, property and resources due to wildfires. A programmatic EIR is a well-established, efficient way to address impacts, and these comments are intended to improve the VTP and PEIR. As I have worked as a land manager and research in southern California, my comments are focused on that region and on chaparral shrubland ecosystems.

**<u>Insufficient Range of Alternatives</u>**

The PEIR does not include a range of reasonable alternatives that would attain the primary goal, to "enhance the protection of lives, property and natural resources from wildland fire." The stated purpose of the PEIR is to "analyze the environmental effects of the VTP, to indicate ways to reduce or avoid potential environmental damage resulting from the program, and to identify alternatives to the proposed program." The PEIR only provides alternatives that vary the amounts and types of treatment types used, and lacks the full range of alternatives to reduce loss of life, property and natural resources.

Other effective actions to reduce loss of lives, property and natural resources need to be fully considered as alternatives. These include actions that would occur in the wildland-urban interface (WUI), focused on community and regional planning, ignitability of structures, and fuel modifications directly within and around structures and communities at risk. It is the structures (design, materials and maintenance), their location, and the fuels within 120 feet (including litter in gutters, yard junk, cultivars like palms and acacia, wood piles, etc.), that determine whether the property is vulnerable to fire. Research findings on the ignitability of structures are lacking and need to be incorporated in this PEIR. This includes research by Jack Cohen (US Forest Service), Steve Quarles (University of California Extension, retired), Institute for Business and Home Safety (2008), and National Bureau of Standards and Technology.

**Absence of Evidence for Treatment Effectiveness and Monitoring Plan**

The PEIR provides no evidence, research results, or citations for the effectiveness of the vegetation treatments outlined. In addition, the PEIR lacks rationale for changes from the treatments employed in the current Vegetation Management Program (VMP), and does not disclose the practices, extent and effectiveness of current treatments.

Fuel treatments have failed to protect flammable structures, as documented for the 2003 Cedar Fire in San Diego, 2006 Angora Fire near Lake Tahoe, 2007 Grass Valley Fire, and 2007 wildfires in southern California. Evidence is not provided for the best management practices to accomplish those treatments. A recent study found that vegetation near structures was not a primary factor in predicting home destruction.[1] Researchers examined data on 700,000 addresses in the Santa Monica Mountains and part of San Diego County, mapping the structures burned between 2001 and 2010. Structures were most likely to be burned if they were built on steep slopes, in Santa Ana wind corridors, and in low-density developments intermingled with wildlands.

The VTP fails to provide a monitoring plan to assess the effectiveness of vegetation treatments, relative to wildfire areas burned, property losses, and natural resources (from the goals). A monitoring plan for vegetation treatments would be integrated with and assess data from related activities, such as water and air quality monitoring, wildlife and rare plant surveys.

**Insufficient Specifity of Treatment Areas and Conditions**

The precise location and boundaries of the vegetation areas are not shown on any map. The PEIR only has maps of the entire state or of large bioregions, all insufficient to identify where the treatments would be applied. Whereas a programmatic EIR is intended to address impacts over a specified range of areas and conditions, the areas are so broad and diverse that the impacts cannot be reliably predicted.

There are contradictions in the application of the Condition Class maps. Figure 4.2-13 indicates that much of southern coastal California is either significantly or moderately altered from its historical fire regime condition class. Yet the PEIR asserts that most chaparral, the dominant ecosystem in coastal southern California, is within its historic fire return interval. Analyses by the US Forest Service have shown that most of the chaparral in the four national forests in southern California has a negative departure from historical fire patterns, meaning the native shrubland ecosystem is being threatened by too much wildfire rather than not enough.

Since the PEIR does not specify which landowners are part of the VTP. Thus a landowner, a land manager, or the neighbor of a cleared parcel has no way of determining whether or not they would

[1] Syphard, A.D., J.E. Keeley, A. Bar Massada, T.J. Brennan, V.C. Radeloff. 2012. Housing arrangement and location determine the likelihood of housing loss due to wildfire. PLoSONE 7(3): e33954. doi: 10.1371/journal.pone.0033954

be covered or affected by the VTP and PEIR. The lack of specific locations results in the document failing to meet CEQA's requirement of notification of such affected parties.

Since the PEIR does not explain where the treatments will be conducted, it is difficult to predict impacts to various sensitive wildlife species. For example, the PEIR fails to identify the potential decline in gnatcatcher populations if shrub removal treatments result in a conversion of sage scrub to non-native grasses. The PEIR asserts that most wildlife in shrub habitats would avoid direct mortality by flying away or taking shelter on or under the ground before the fire arrives, and fails to address sufficiency of post-fire availability and occupancy of territories. Impacts to wildlife corridors cannot be identified with information provided.

**Insufficient Consideration of Cumulative Impacts**

The PEIR fails to describe the impacts resulting from the application of various treatments. Their impacts vary with the duration and timing of treatments, amount of vegetation removed, ground disturbance, residual vegetation, and other factors. To properly evaluate the cumulative impacts of the Program, the PEIR should have examined the total impact of all fire on the landscape. It is misleading to indicate that the average treatments (about 260 acres) would not have significant impacts within a region.

The "baseline" for cumulative impact is lacking. There is no consideration of historic range of shrublands and other ecosystem types, how many acres have been type converted historically, how much is currently threatened, and other trends (development, increased fire frequency, and climate change), and finally the impact the vegetation program may have on shrubland ecosystems.

The computation of acres treated as a percentage of the bioregion is inappropriate as an estimate of significance of impacts. There are many small, unique, and sensitive habitats in California, and even small treatment areas may remove those specific habitats. Cumulative impacts need to be considered over long periods of time, not in terms of annual estimates of impacted acres. The PEIR fails to consider the impact of increased prescribed fire frequency on chaparral and other ecosystems, already impacted by wildfire frequency.

The PEIR acknowledges that the spread of invasive grasses will likely increase the potential for ignitions, and fails to incorporate effective mitigation for invasion of weeds and grasses that commonly follow vegetation treatments in shrublands.. The report's suggested mitigation measures to reduce the spread of invasive weed species are inadequate (cleaning tires of equipment, and informing local groups interested in noxious weed control) and there is no evidence that these mitigations will reduce the infestation of weeds in areas with frequent wildfires and/or prescribed burns. The suggested mitigation to properly "time" or adjust the "intensity" of a prescribe burn is practical only for special status plants, not plant communities.

**Incomplete and Inaccurate Citation of References**

The source of data is not provided for a number of tables and figures, to list a few:

- Table 4.2.2 Area of Potential Fire Behavior
- Figure 4.2.6 Fire Rotation
- Table 4.2.4 Condition Class Status

- Table 4.2.6 and 4.2.7 Area of Wildland Urban Interface and Housing Units, 2010

The PEIR has misrepresented the actual conclusions of some cited papers and omits many key literature references about vegetation treatments and their effects. The PEIR fails to incorporate evidence that large and infrequent wildfires are the natural and historic pattern in southern California, the effect of age of vegetation on wildfire spread and size, and the effect of fuel treatments on wildfire behavior and structure ignitions. A comprehensive overview of fire in California's ecosystems was published in an edited book[2] and the PEIR could have drawn extensively on the southern California and other chapters in this book.

**Closing Comments**

Natural vegetation is not simply "fuel" but part of healthy, functioning ecosystems. The choice of words for chaparral, "decadent herbaceous vegetation," is unfortunate and prejudicial (PEIR 1-12). Chaparral has successional stages (even "old growth"), and ecological terms can be used.

It is imperative that California implement effective programs to present loss of lives, reduce property losses, reduce fire suppression costs, and protect natural resources from large-scale widlfires. The vegetation treatments can be planned and implemented to be effective, grounded in scientific evidence, minimize cumulative loss of chaparral shrublands, and be complementary to efforts that reduce ignition of structures.

Please feel free to contact me, for clarification and reference citations (phone 858-472-1293, email afege@aol.com).

Sincerely,

Anne S. Fege
Anne S. Fege, Ph.D., M.B.A.
Retired Forest Supervisor, Cleveland National Forest
Adjunct Professor, Department of Biology, San Diego State University

cc: Thomas Porter-CalFire, Kathleen Edwards-CalFire, Rick Halsey, Wayne Spencer

[2] Sugihara, N.G., J.W. Van Wagtendonk, K.E. Shaffer, J.Fites-Kaufman, A.E. Thode. 2009. Fire in California's Ecosystems. Berkeley: University of California Press. 596 p.

# EXHIBIT 13

CALIFORNIA
NATIVE PLANT SOCIETY

*VIA U.S. and Electronic Mail* February 25, 2013

George Gentry, Executive Officer
State Board of Forestry and Fire Protection
P.O. Box 944246
Sacramento, CA 94244-2460

E-mail: VegetationTreatment@fire.ca.gov

**Re: Draft Programmatic Environmental Impact Report for the Vegetation Treatment Program of the California State Board of Forestry and Fire Protection (SCH #2005082054)**

Dear Mr. Gentry:

The California Native Plant Society appreciates the opportunity to comment on the Draft Programmatic Environmental Impact Report for the Vegetation Treatment Program of the California State Board of Forestry and Fire Protection (Program, or VTPEIR).

The California Native Plant Society (CNPS) works to protect California's native plant heritage and preserve it for future generations. CNPS promotes sound plant science as the backbone of effective protection of natural areas. We work closely with decision-makers, scientists, and local planners to advocate for well informed and environmentally friendly policies, regulations, and land management practices.

CNPS supports appropriate land management practices that will result in the protection and sustainability of special status California native plant species and plant communities. We strongly agree that fire and invasive species are critical issues that must be actively managed. However,

**CNPS strongly recommends that this VTPEIR NOT be certified in its present form, due to:**

- **Its pervasive lack of substantial evidence to support contentions and conclusions made throughout the document.**
- **Its substantial procedural lapses and irregularities.**
- **Other issues listed below.**

## I. QUESTIONS AND CONCERNS

CNPS' study of the VTPEIR has brought up many questions:

1. Why does it contain so many procedural lapses and irregularities?
2. Is it based on adequate science?
3. Have all the impacts have been properly considered?
4. Are the Alternatives reasonable and have they been well analyzed and considered?

5. Will mitigation of the impacts considered be monitored to determine that the impacts fall below the level of significance?
6. Can the Program as proposed meet its stated goals? Would doing nothing (the Status Quo Alternative) better achieve the goals? Can the Program managers determine whether the Program meets any of its goals?

The following groups of questions are based on the concerns summarized above. We formally request that the Board of Forestry fully consider and respond to our questions in order to clarify, among other things, the purpose, rationale, and management structure of the Draft VTPEIR.

## 1. PROCEDURAL LAPSES AND IRREGULARITIES

### 1.A Why is the Report an EIR, not an EIR/S?

In Chapter 2: Proposed Program (Page 2-1), the VTPEIR states:
*"The 38,000,000 acres that might be treated under the Proposed Program are comprised of about 34,958,000 acres, which are either privately owned or State owned lands (e.g. Department of Parks and Recreation (DPR) lands) that are designated as SRA or LRA, and about 3,000,000 acres of federal DPA lands (see glossary for description of DPA)."*

And from the VTPEIR Glossary:
*"Federal DPA are lands that would normally receive fire protections services from CAL FIRE; however, due to efficiency of operations these lands receive fire protection from federal agencies according to written agreements with CAL FIRE."*

A project on federal land, requiring a federal discretionary permit, entitlement, authorization, or receiving federal funding is subject to NEPA. Why is the VTPEIR not a joint EIR/EIS? How will a NEPA analysis be accomplished for projects on federal land?

### 1.B How was the Notice of Availability publicized?

CEQA Guideline 15087 states:
*"Notice ... shall also be given by at least one of the following procedures:*

> *"(1) Publication at least one time by the public agency in a newspaper of general circulation in the area affected by the proposed project. If more than one area is affected, the notice shall be published in the newspaper of largest circulation from among the newspapers of general circulation in those areas. (2) Posting of notice by the public agency on and off the site in the area where the project is to be located. (3) Direct mailing to the owners and occupants of property contiguous to the parcel or parcels on which the project is located. Owners of such property shall be identified as shown on the latest equalized assessment roll."*

Normally, EIRs include an appendix documenting their public notices. The VTPEIR fails to provide this information. What is more, we failed to find a Notice of Availability using online searches of:

- The *Los Angeles Times* (http://classifieds.latimes.com/classifieds?category= public_notice). (According to Wikipedia, the *Los Angeles Times* has the largest distribution of California newspapers).
- The *Sacramento Bee* (http://www.sacbee.com/adperfect/).

- The *San Francisco Chronicle* (http://www.sfgate.com/ chronicle/).
- The *San Jose Mercury News* (http://www. mypublicnotices.com/BayAreaNewsGroup/PublicNotice.asp).
- The *UT San Diego* (http://www. legalnotice.org/pl/sandiego/landing1.aspx).

The website legalnotice.org covers legal notices in newspapers throughout the US, and we were unable to find the VTPEIR noticed there. Since the project site is not defined, posting the notice on and off-site was not practicable.

We found no evidence of public notice beyond the Project website itself. For example, a CNPS member owns property immediately adjacent to State Park land. This land contains chaparral and coastal sage scrub, and has been the periodic target of vegetation management. Nonetheless, this person did not receive any written or emailed notice about this program. How was the Notice of Availability publicized?

**1.C Where is the Environmental Checklist? How will the Checklist protocol described preclude EIRs for projects under the Program?**
The proposed Program relies on the creation of an environmental checklist to streamline environmental review of projects instituted under the Program. Chapter 8: Environmental Checklist contains a set of descriptions for generating an initial study, however there is no Environmental Checklist in the presented in the VTPEIR.

Because
a) the VTPEIR fails to provided substantial evidence to support conclusions that adverse effects to botanical resources from Program implementation will not be significant for any treatment type, in any bioregion (e.g., Table 3.11 and Table 5.5.3.1), and

b) the landscape constraints (LCs), Minimum Management Requirements (MMRs), and mitigation measures meant to ensure that impacts to special status plant species and plant communities will be reduced to less than significant are insufficient (see #1.E, #3.B below),

the checklist relying on the conclusions and measures mentioned above, and generated per the vague specifications in Chapter 8 will neither comply with CEQA, nor replace a CEQA initial study.

Given the Program's lack of specificity regarding vegetation types affected, its reliance on outdated, incomplete, and questionable science, on obsolete vegetation maps, and its failure to explain how local interested parties would participate in the local implementation of MMRs, a project proposed under the Program described in the draft VTPEIR would face fewer obstacles were it to generate its own EIR independently.

**1.D Where is the Program Map, and what parcels are subject to the Program?**
CEQA Guideline 15124(a) states:
*"The precise location and boundaries of the proposed project shall be shown on a detailed map, preferably topographic. The location of the project shall also appear on a regional map."*

Neither of these maps is supplied. While maps of California and bioregions are presented, only approximately 1/3 of the state is actually affected by the Program--so these maps are inadequate for land owners to determine whether they are affected by the Program or not.

How can the Report represent that the impact analysis is sufficient, if neither the place nor the timing of the Program are given? Environmental impacts must, by definition, have an environment in which to occur. Phrasing the acreage as "might be treated" is insufficient. If a parcel is considered eligible for the Program, then the Program has a boundary, and all parcels within that boundary must shown on maps, to circumscribe the environment impacted by the Program.

Where are the maps delineating clearly and exactly the boundaries of Federal, State and local jurisdictional parklands?

Where are the maps delineating clearly all the locations of Cal Fire stations, fire camps and other property and structures under the management or ownership of Cal Fire?

Where is there any map showing clearly the location of rivers, watersheds, streams, reservoirs, lakes, dams, deltas?

Is the map of Fire Safe Councils in Figure 2.10 considered an accurate map of locations? Is it considered suitable enough for one to assess where their local consultation in the CEQA process might apply?

Where are maps on the County level showing accurate property and parcel information necessary for those involved in the CEQA process? Why isn't this PEIR following CEQA guidelines and presenting general, then more detailed information at a county or regional level for landowners and users?

**1.E Why does the Report state that floristic surveys "may be necessary" when CEQA states that they are mandatory?**

On page 2-6 of the VTPEIR, MMR 5 states:

*"A database search will be conducted for each project by a query of the most reasonably available sources and databases for biological information, including but not limited to, the CNDDB and BIOS. The search shall include a minimum search area of nine (9) USGS Quadrangles surrounding the project area. In cases where the project area extends into multiple quadrangles all adjacent quadrangles shall be included. Surveys may be necessary to determine presence/absence of special status plants or animals and to determine and evaluate site-specific impacts. The applicant will evaluate the potential direct and indirect impacts caused by the Project."*

CEQA guideline 15125 states:

*"An EIR must include a description of the physical environmental conditions in the vicinity of the project, as they exist at the time the notice of preparation is published."*

Floristic surveys are a fundamental part of describing the environmental setting for the project. A 9-quadrangle or CNDDB search is an essential first step to determine which sensitive species and rare natural communities might be present on the project site. All databases are known to be incomplete, sometimes radically so. They cannot be relied upon to determine conclusively either the presence or the absence of any sensitive species. What's more, private lands are largely unsurveyed. Current surveys of project sites are absolutely necessary to determine what occurs on project sites. Why does the Report state that these are optional, i.e., may be necessary? How does this comply with the California and national Endangered Species Acts and agency regulations for implementing these Acts?

**1.F Where are the opportunities for external consultation with local agencies and/or community groups in relation to implementation of Minimum Management Requirements?**
At the local level, projects are meant to be responsive to the MMRs listed in Chapter 2.3 of the VTPEIR. Examples of MMRs with a nexus to plant issues in which CNPS and others would have interest include MMR 5 and MMR 6. These state:

> *"5. A database search will be conducted for each project by a query of the most reasonably available sources and databases for biological information, including but not limited to, the CNDDB and BIOS. The search shall include a minimum search area of nine (9) USGS Quadrangles surrounding the project area. In cases where the project area extends into multiple quadrangles all adjacent quadrangles shall be included. Surveys may be necessary to determine presence/absence of special status plants or animals and to determine and evaluate site-specific impacts. The applicant will evaluate the potential direct and indirect impacts caused by the Project. The wildlife agencies shall be notified in writing with the Project scoping information (including the evaluation of direct and indirect impacts and the results of the database search), and asked for comments and recommendations.* ***The lead agency as a result of consultation with the appropriate State or Federal agencies, or a qualified biologist, will modify project design, and/or incorporate mitigation to avoid significant adverse environmental impacts to special status species and other species****. [Emphasis added] If avoidance is not possible, appropriate take permits (Federal Endangered Species Act (ESA) or California ESA) will be required.*
>
> *6. No new roads (including temporary roads) may be constructed or reconstructed (reconstruction is defined as cutting or filling involving >50 cu. yds/0.25 linear road miles). Existing roads, skid trails, fire lines, fuel breaks, etc. that require reopening or maintenance shall have drainage facilities (see Glossary) applied at the conclusion of the project that are at least equal to those of the California Forest Practice rules."*

According to the text in bold font above, there appears to be no exterior consultation requirement for local agencies, or other interested community groups or individuals during the development or implementation of Minimum Management Requirements. Evaluation at the local level has essentially been internalized within government agencies.

Both the preferred project and the alternatives set up a Program whose structural approach has no provision for consultation with local interests knowledgeable in local conditions concerning ecosystem integrity or with local experience concerning impacts.

The following would more clearly describe the transparency and disclosure of information during the review process for projects that tier from the VTPEIR:
1. A flow chart illustrating;
a) lead agency decision points for a project that would navigate through the VTPEIR, from submittal of application to post-implementation monitoring and maintenance,
b) where in the process opportunities for local public consultation on a project would occur under the Program, and
c) how and when in the process the lead agency is required and/or would make available notifications of these opportunities.

2. A table comparing the opportunities for public consultation that would be available under the VTPEIR to opportunities available under current Vegetation Management Programs.

How will the VTPEIR incorporate local consultation into the structure of the Program beyond what is currently presented?

**1.G Why doesn't the PEIR concentrate on the land use planning and defensible space policy components of the California Fire Plan?**
Chapter 1.3: Regulatory Authority, states the California Fire Plan (BOF, 2010), as authorized under Public Resources Code Sections 4114 and 4130, has the following major policy components:

- Land use planning that ensures increased fire safety for new development.
- Creation of defensible space for survivability of established homes and neighborhoods.
- Improving fire resistance and structural survivability of homes and other constructed assets.
- Fuel hazard reduction that creates resilient landscapes and protects the wildland and natural resource values
- Adequate and appropriate levels of wildland fire suppression and related services
- Commitment by individuals and communities to wildfire prevention and protection through local fire planning

Recent research and publications[1] [2] show that land use planning appears to be more important than fuel modification for reducing fire hazards. Additionally, replacing woody fuels with herbaceous fuels appears to increase fire risks to homes, and treating the wildland-urban interface is critical for making homes safe.

This VTPEIR recognizes the problems that stem from California's increasing population that is increasingly encroaching into wildlands or into wildfire-prone topography. Cal Fire emphasizes the importance of the first thirty feet from a house or other structures as the most importance area of defensible space. Why has the VTPEIR not included Program elements that concentrate resources toward implementing defensible landscaping within the first thirty feet from structures, in all jurisdictions?

[1] Syphard, et al . *2012. Housing arrangement and location determine the likelihood of housing loss due to wildfire*. PLoS ONE 7(3): e33954
[2] http://www.cnps.org/cnps/publications/ fremontia/Fremontia_Vol38-No2-3.pdf, and references therein.

## 2. THE REPORT'S USE OF SCIENCE

**The Program description lacks substantial evidence to justify fundamental premises, is inaccurate, and overly simple.** It is based on a number of unjustified assumptions that ignore best available science. In very many instances the VTPEIR cites inappropriate, irrelevant, or refuted references. We note the extensive descriptions of the VTPEIR's scientific failings as detailed in comments submitted by both the California Chaparral Institute and the Endangered Habitats League, which we incorporate herein by reference.

**2.A How can CEQA be appropriately applied to the VTPEIR in a Program sense when groups of projects addressed as similar within the Program are NOT similar in impacts, and when potential impacts of groups of projects can NOT be avoided or mitigated in a similar manner?**

In Chapter 1.6 of the VTPEIR, the Report states,

> *"An agency is generally not permitted to treat each separate permit or approval under a program, such as the VTP, as a separate project segment if the effect is to avoid full disclosure of environmental impacts. However, CEQA does encourage the application of a programmatic approach* ***where a group or series of projects are similar in activities and impacts and where potential impacts can be avoided or mitigated in a similar manner."*** [emphasis added]

One of the overriding problems in the document is the simplistic approach that attempts to make fire issues out as broadly similar across the region, when in fact they are very different. For example, the VTPEIR does not distinguish between surface fires in ponderosa pine and crown fires in chaparral, nor does it explain how these different fire regimes, having been affected by very different past fire management activities, now require very different approaches to future management. Nevertheless, the VTPEIR treats both fire regimes similarly by employing a simple one-size-fits-all premise upon which to base the rationale for treatments and impact analyses, in short - increasing treatments will result in less frequent and less severe uncontrolled burns (based on "the 35% level," section 5.2.4) and increased treatments pose no significant impacts to the environments treated (Table 3-11 and Table 5.5.3-1).

Much of the literature supporting treatments comes from surface fire regimes in coniferous forests and therefore is not appropriately applied to shrubland ecosystems. One important example of where these two ecosystems differ markedly is in the impact of fire severity. High severity fires have some negative impacts on certain forest types. However, shrubland ecosystems are highly resilient to high severity fires and in fact one of the major threats, alien plant invasion, is promoted by low severity fires. Does Cal Fire recognize the fact that, in southern California, wildfire frequency intervals have become so short as to threaten the continued existence of natural habitats such as chaparral, inland sage scrub, pinyon-juniper, and coastal sage scrub? These habitats are the ones stabilizing and protecting our watersheds in highly erodable mountain and hill ranges. If so, why does the VTPEIR conclude that more frequent, low intensity prescribed burns in South Coast chaparral will provide a benefit to this vegetation type?

Similar groups or series of projects, and similar impact avoidance/mitigation measures could be identified only through categories of ecosystems within finer geographic regions, and only among finer vegetation classifications than are presented in the VTPEIR. The similar treatment of vastly different vegetation types operating under different fire regimes, the broad characterization of program area (i.e. all of California) and landcover types (CWHR classifications) as presented in the draft VTPEIR grossly oversimplify the "similarities" intended to justify a program approach to the CEQA. All this makes it impossible to assess "full disclosure of environmental impacts" of treatments, which obstructs the Board of Forestry's ability to certify this draft VTPEIR under CEQA.

**2.B Where is the substantial evidence to support the VTPEIR's plan to increased burning across the Program area's bioregions by 36%?**
In Table 2-4, Proposed Program Treatment Acreage by Bioregion, the VTPEIR indicates the Approximate Annual Acreage Treated during the ten-year program period is 216, 910 acres. The VTPEIR also states that 53% of vegetation treatments will be prescribed burns. Therefore each year 115,000 acres will be burned under this program. At page 4.2-3, historical wildfire trends are estimated (since late 1800s) to average 320,000 acres burned per year in California. The Program will increase the number of acres burned (generally in wildland habitats) by 115,000 acres per year. How does the PEIR justify increasing the acreage burned by 36%?

**2.C Where is the substantial evidence to support the increase in chaparral treatment planned in the VTPEIR?**
Where is the justification for burning, masticating/mechanically clearing, and eventually degrading and destroying southern California chaparral and sage scrub in areas where these plant habitats are forming deep, complex root systems, sequestering vast amounts of carbon, stabilizing slopes, preventing soils from becoming hydrophobic, acting as guardians of broad steeply-sloping watersheds and providing nesting, resting and food sources for a highly biodiverse wildlife, both resident and migratory? These habitats need 40 to 100 years to recover from fires, replenish their seedbanks, restore their canopies and replenish their root systems.

**2.D Where is the substantial evidence to justify increasing the number of acres to be treated, generally by burning or mechanical removal, from 34,824,500 to 37,958,400?**
Where in the VTPEIR is there provided evidence to substantiate the purported need to increase treated acres in order to achieve Program goals?

**2.E Where is the substantial evidence that supports the evaluation of effects from non-native invasive species?**
Assessment conclusions in the VTPEIR lack clear, supporting evidence. After stating under cumulative impacts that areal quantification of cumulative impacts cannot be known (see under cumulative impacts) the VTPEIR boldly states what the effects will be. An example is Table 5.5.2, Summary of Effects from Non-Native Invasive Species from Implementing the Proposed Program. This takes each bioregion and assesses the effect on weeds from the Program's use of Prescribed Fire, Mechanical, Hand, and Herbivory treatments. For every region the chart states NA/NB - negligible adverse or beneficial effects - those effects that are imperceptible or undetectable. The document presents no quantitative evidence in support of this evaluation, but the narrative does describe many examples where each of the fuel treatments can make the

invasive species situation worse. This has been made very evident from regular wildland fire fighting, where the equipment used to fight the fire is frequently “dirty” regarding alien seeds.

**2.F How will the Program "modify wildland fire behavior to help reduce catastrophic losses to life and property consistent with public expectation for fire protection?" How will the VTPEIR "reduce the severity and associated suppression costs of wildland fires by altering the volume and continuity of wildland fuels."** (Page ES-ix)
These questions are mutually dependent. The Program's assumption that wide scale vegetation treatment will reduce catastrophic losses to life and property is not supported by current science (e.g. Syphard et al 2012, noted above). Rather, evidence suggests that these goals are better met through urban planning, updated building codes, and focusing fuels management on the Wildland-Urban Interface. Indeed, intensive management of wildland fuels is more likely to replace hard-to-ignite woody vegetation with highly ignitable herbaceous vegetation, increasing the likelihood of fires that destroy lives and property. Why wouldn't doing nothing have an equal, if not greater, likelihood of reducing fire danger?

**2.G Why would the Program "reduce the risk of large, high intensity fires by restoring a natural range of fire-adapted plant communities through periodic low intensity vegetation treatments?" What is the evidence that varying "the spatial and temporal distribution of vegetation treatments within and across watersheds to reduce the detrimental effects of wildland fire on watershed health" would work? Where is the evidence that the Program would "improve wildlife habitat by spatially and temporally altering vegetation structure and composition, creating a mosaic of successional stages within various vegetation types?"** (Page ES-ix).
These are similar goals with the same shortcoming. There is little evidence, especially in southern California, that a mosaic of plant communities impedes fire progress. There is, additionally, little evidence that the proposed Program will result in a true vegetation mosaic. After all, it takes a century to grow a 100 year-old plant, and most California plant communities can last at least that long between disturbances. The proposed regime will result in a mosaic of early successional communities that are likely highly susceptible to invasive species, likely inefficient at capturing and retaining nutrients and greenhouse gases, and incapable of supporting late-successional species. The disturbance by "low intensity vegetation treatments" is also likely to introduce invasives that increase the ignitability of otherwise intact vegetation[3] Why would the Status Quo Alternative 1 not have an equal, if not greater, likelihood of accomplishing the three goals questioned above than any of the other Alternatives or the Program?

**2.H What is the evidence that the Program would "maintain or improve long term air quality through vegetation treatments that reduce the severity of large, uncontrolled fires that release air pollutants and greenhouse gases?"** (Page ES-ix). The California Air Resources Board (CARB) has guidelines in place both for prescribed burning and wildfires. There is no evidence that the VTPEIR has coordinated with the CARB to determine whether the Program complies with current guidelines. It is unclear whether the proposed controlled burns and destruction of plants will result in net improvements to air quality, and whether they will likely release as much greenhouse gases as wildfires would.

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[3] Lambert et al., 2010. in http://www.cnps.org/cnps/ publications/fremontia/Fremontia_Vol38-No2-3.pdf, and references therein.

**2.I What is the evidence that the Program would "reduce noxious weeds and non-native invasive plants to increase desirable plant species and improve browse for wildlife and domestic stock?"** (Page ES-ix)
The Proposed Program will likely increase the populations of non-native invasive plants. What and where is the evidence that the Program will accomplish the goal of not doing that?

**2.J Why does the VTPEIR assert that biomass burning will ameliorate climate change?**
The Report repeatedly considers biomass burning as a renewable resource that will help ameliorate climate change (e.g. 4.4-18, 4.11-6). This seems mistaken on three levels. First, biomass holds carbon out of the air, while burning it returns the carbon to the air. This short-circuits biological processes that take carbon out of the air and sequester it back in the ground or in biomass. If we practiced nothing but biomass burning, we would retain our high levels of atmospheric CO2 indefinitely, so this solution prolongs the problem. Second, plants contain more than just carbon and energy. Burning biomass will release large quantities of nitrogen, and nitrogen deposition has already been shown to favor non-native invasive species.[4] This will exacerbate both air pollution and invasive species problems. Undisturbed native vegetation can effectively exclude most exotics, sequesters carbon, and sequesters nitrogen. Therefore, leaving the vegetation intact helps to solve three problems, while burning it exacerbates all three.

**2.K Why does the VTPEIR cite Wildland Task Force August 2003 *Mitigations Strategies for Reducing Wildland Fire Risks*?**
On page 4.2-8, the VTPEIR states that,
*"In its August 2003 report, the San Diego Wildland Task Force agreed that fuel or vegetation management is the single most effective tool available to mitigate fires."*

Its authors withdrew this report after protest by the scientists cited, and over numerous errors, and a fictitious citation.[5] Why was a retracted report used to support a premise of the VTPEIR?

**3. WERE ALL IMPACTS CONSIDERED?**

**3.A Why does the Report not provide a full list of special status plant species and rare plant communities potentially impacted by bioregion in the Program?**
The VTPEIR lists special status plants and rare plant communities potentially impacted by treatments by bioregion, but limits these lists to those "with the most occurrences" per bioregion (Tables 5.3.3.12-21). Appendix B appears to be a list of most or all plant taxa on CRPR 1A, 1B, and 2 lists, and all FESA / CESA listed plants in California. The lists make little or no sense for several reasons, among them:

<u>Tables 5.3.3.12-21</u>
a) The VTPEIR states,
*"In order to ensure that impacts to special status plants and communities would be less than significant, the BIOS database was used to obtain lists of species and communities with the most*

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[4] Allen et. al. 2009. http://www.plantbiology.ucr.edu/faculty/ Allen et al. 2009.pdf.
[5] http://www.californiachaparral.com/images/Letters_to_SD_County_Oberbauer.pdf).

*element occurrences by bioregion. Many plants in the database have very small, localized populations. These would not be impacted at the* ***programmatic*** *level because project level assessment carried out by local DFG biologists or other qualified botanists would identify these populations and lead to the application of necessary mitigations as stipulated in MMR 5. On private land in particular, where the extent of rare plant occurrences is largely unknown, the scoping process would likely lead to surveys being done prior to project implementation. California Rare Plant Rank 1B and 2 will be treated as state or federal listed species for the purposes of developing mitigations at the project level (see the BIOS/CNDDB Element Ranking Key later in this chapter). Special Status plants and communities with more widespread occurrences potentially could be adversely affected at the programmatic scale."* p. 5.5-93 [underline added]

For the VTPEIR to state that impacts to plant species and communities with restricted ranges would not occur at the programmatic level is nonsensical. The VTPEIR describes vegetation treatments whose potential for impact on *any* species occurring at a treatment location is the same regardless if a species' distribution is broad reaching or narrowly restricted. If a species occurs in only small, localized populations but those populations coincide with treatment locations, they will be impacted by the Program.

How then did the VTPEIR determine which species or communities would or would not be potentially affected by the Program for its impact analysis? It is unclear which plant species other than those listed by bioregion in tables 5.3.3.12-21 were included in Program impact analyses, or what rationale was used for their inclusion other than,

*"...the cutoff for inclusion was necessarily arbitrary."* p. 5.5-13, or

*"Available spatial data from various sources (mostly CAL FIRE) was synthesized into watershed-based evaluations ...using logic developed by CAL FIRE staff."* p. Appendix A-1.

Appendix B

b) The Program does not affect all listed plants, it affects a subset of them. For example, the list presented in Appendix B includes plants such as the extremely rare *Cercocarpus traskiae* which should not be subject to vegetation treatment under this or any Program. Nor will a wide selection of beach dune plants (e.g. *Acmispon nuttallianus* (= *Lotus n.*), *Phacelia stellaris*, and *Nemacaulis denudata* var. *denudata*) that mostly occur on urban dunes, in small areas that are highly unlikely to ever come under any of the vegetation treatments proposed. Why was this subset not identified?

Inclusion of these and other plant taxa in Appendix B list is troubling when one considers that certification of the VTPEIR provides regulatory authority to carry out treatment actions addressed in the VTPEIR.

**3.B How will VTPEIR MMRs and mitigation measures that call for CalFIRE to consult with CA DFW achieve desired outcomes (to reduce impacts to less than significant) when, in practice, CalFIRE ignores DFW recommendations to conduct plant surveys and mitigate for project impacts to plants?**

The VTPEIR continually defaults to a conclusion that impacts to species not included in the Program's impact analyses, as described in Appendix A and Chapter 5, will be less than significant when implementing MMR 5. For example,

*"Appendix B lists the special status wildlife species considered herein. Some potential exists for substantial adverse effects, but MMR 5 should prevent them."* p. 5.5-13

According to MMR 5, surveys "may be necessary," the applicant will determine if impacts will result from treatments, the lead agency will consult with a local DFW biologist, and if avoidance is not possible, FESA / CESA take permits will be required. MMR 5 fails to ensure prevention of substantial adverse effects for the following reasons:

1. Surveys will be necessary if suitable habitat for special status species exist and surveys have not previously been done, or have not been done within 3 years, following USFWS protocols. MMR5 does not clearly require this, leaving the requirement for surveys as optional.

2. The applicant should not be the one to determine if impacts will result from a treatment, this should be evaluated by botanists, plant ecologists, and/or biologists. Mitigation should include monitoring of the mitigations' success.

3. The VTPEIR describes project applications being administered through local CalFIRE units. Thus CalFIRE will consult with DFW to obtain recommendations regarding when floristic surveys will be required, and if project impacts are found to be significant. However, CalFIRE has, in practice, dismissed recommendations from DFW to prescribe exactly these types of plant survey and mitigation requirements. In recent years, the CA DFW (then DFG) has issued letters of non-concurrence to CalFIRE for the latter's refusal to require special status plant surveys and to follow avoidance recommendations provided by DFW on timber harvest plans[6]. How will the implementation of MMR 5 differ from current practices?

4. If avoidance of project impacts to non-FESA/CESA listed CRPR 1B, 2, and 4 (if found to be locally significant) species is not possible, FESA/CESA permits will not be required for these species. However mitigation for impacts to these species will still be required under CEQA, and/or under many existing local (General Plans) and regional land-use or conservation plans. Will VTPEIR MMR 5 ignore these requirements?

**3.C What consultations were performed with the California Water Resources Board, Regional Water Control Boards, California Air Resources Board, California Department of Fish and Wildlife, U.S. Fish and Wildlife Service, the Army Corps of Engineers, The Environmental Protection Agency, the US Forest Service, and the National Park Service? What other agencies should have been consulted that were not?**

Normally, all consultations are included in the EIR as appendices--but the Report does not include <u>any</u> information about consultations. Providing the text of such consultations would help determine how the impacts were determined, and whether all impacts were determined to the satisfaction of the responsible agencies.

[6] THP #2-08-009-SIS(6), "Big Red"; THP #2-09-011-SIS(6), "Crater Lake 2009"

**3.D How does the Program comply with the CARB Smoke Management Program of 2000?**
The report appears to assume that the CARB has yet to develop a Smoke Management Plan (Page 4.6-2). According to the CARB website, the CARB adopted a Smoke Management Plan in 2000[7], and guidelines are available online. It appears that the proposed Program will render the state out of compliance with EPA guidelines, and it is unclear whether the Board of Forestry consulted with the Air Resources Board both on these impacts and on mitigating them.

**3.E Why was the WHR system used?**
The CA Wildlife Habitat Relationships system is obsolete and does not comply with the National Vegetation Classification Standards (NVCS)[8]. It has been superseded by the *Manual of California Vegetation, 2nd Edition*[9] (MCV2), which does comply with national standards. The 2nd edition of *Manual of California Vegetation* represents the most detailed description of California vegetation available in 2013, and is based on modern field surveys done over a large portion of California. The MCV2 uses the National Vegetation Classification Standards (NVCS) to define rare plant communities Alliance and Association-level vegetation classifications. Plant communities with a state rank of S2S3 or less, as referenced in the VTPEIR, are defined using NVCS Alliance and Association classifications. Some, but not all, of the S1-S3 plant communities are listed in the CNDDB. Alliance-level vegetation maps for California are available on BIOS. Why not seek as accurate a vegetation dataset as is available?

Why was the WHR chosen? Why did the VTPEIR not incorporate the wealth of fire characteristics given for vegetation types in the MCV2?

How will the Program fit current, compliant, maps of California vegetation into the inadequate, outdated framework of the WHR? Wouldn't the current system provide more information for less effort? Won't such problematic mapping generate significant ecological impacts due to errors and data loss? How will the Program mitigate for such problems?

**3.F How will the Program assess cumulative effects to unique or rare vegetation Alliances?**
The VTPEIR assesses the degree of treatment impacts to vegetation types by calculating the percentage of WHR vegetation types being treated by bioregion. The VTPEIR also calls for the avoidance of special status plant communities with a state rank of 3.2 or lower. Mitigation measure 5.5.3-2 states,
"*Mechanical treatment shall be avoided to the greatest extent possible in special status plant communities with a state rank of 3.2 or lower. If mechanical treatment cannot be avoided, impacts will be mitigated on an acre-for-acre basis by enhancing or restoring the same community type elsewhere in the region.*"

These special communities are defined at the NVCS Alliance classification level. It is not possible to assess the effect of treatments, either at the Program or project level, on rare vegetation Alliances and Associations by using WHR vegetation types. What's more, it is premature to conclude that Program treatments will have no significant or cumulative effects on

[7] http://www.arb.ca.gov/smp/ smp.htm

[8] http://www.fgdc.gov/standards/projects/FGDC-standards-projects/vegetation/NVCS_V2_FINAL_2008-02.pdf/.

[9] Sawyer, Keeler-Wolf and Evens, 2009. A Manual of California Vegetation, 2nd Edition. California Native Plant Society. Sacramento, CA. 1300 pp.

rare natural communities when the effect of prescribed burning on rare communities has not been analyzed.

It is not possible to identify, let alone assess, Program impacts to rare plant Alliances using WHR classifications. How will the Program assess effects to rare (S1-S3) vegetation Alliances and Associations?

Regarding mitigation measure 5.5.3-2, special-status plant communities must be avoided or mitigated through compensatory mitigation since enhancing or restoring these communities is likely unfeasible. Due to the unique nature of these habitats that are often associated with specific types of bedrock, soil, and climate interactions it would be unreasonable to assume it could be recreated elsewhere as a mitigation measure.

**3.G Why has the PEIR not analyzed the potential for wildlands vegetation clearing to promote new developments, thereby expanding the WUI treatment scenarios?**
The VTPEIR Executive Summary (p. xii) states,
*"The proposed program will not have any growth-inducing impacts because it will not foster growth or result in new housing or construction of facilities. Based on the above conclusion, no reasonably foreseeable growth-inducing impacts have been identified that would result from implementation of the Proposed Program or the Alternatives of the Program."*

Despite the summary conclusion of this statement, the emphasis of vegetation treatment (= clearing) at the WUI provided in the VTPEIR would provide counties a CEQA-certified tool to clear vegetation, under a guise of fire safety, and subsequently build in the type-converted wildlands.

Rather than present summary conclusions of no foreseeable growth, the VTPEIR must provide clear narrative describing how vegetation treatments related to the WUI are specific to fire and habitat management objectives, and that they are not meant to provide avenues for future development at the WUI.

## 4. ARE THE ALTERNATIVES WELL-ANALYZED AND CONSIDERED?

The four alternatives to the proposed program offer to either maintain the current Vegetation Management Program (VMP) instead of adopting the proposed one, or to eliminate/minimize aspects of the proposed program for herbicide use, water quality, or air quality.

**4.A Alternative 1, Status Quo: How are the current Vegetation Management Programs (VMPs) collectively unable to meet the goals of the proposed Program and Alternatives?**
The VTPEIR does not address how the goals of the existing VMPs are being constrained by water quality and air quality issues that are driving the need for Alternatives 3 and 4 presented in this VTPEIR. Is it possible for current collection of programs to meet the goals of the proposed Program, or of Alternatives 3 or 4? If not, why not?

How do the project-level consultation requirements of the current VMPs differ from those described in the VTPEIR for the proposed Program?

**4.B Why does Alternative 2, the "No Herbicide Treatment," treat 300% more acres / year with herbicides than the status quo?**
The title No Herbicide Alternative is deceptive. Alternative 2 actually says that the department would not prescribe or fund vegetation treatment projects where the project applicant,
*"had applied herbicides at any time up to 1 year prior to the proposed project or intended to apply herbicides within 3 years after the proposed project."*

It is not strictly a "no herbicide" Alternative. In fact, based on Table 5.0.1 of the VTPEIR, the No Herbicide Alternative will treat over 300% more acres with herbicides annually (216,910 acres) than the Status Quo Alternative 1 (65,800 acres). How does either the Program or Alternative 2 represent a reasonable alternative to the current VMP?

**4.C Why aren't Alternative 3's treatments that minimize potential impacts to water quality part of the Program and every Alternative?**
Since the VTPEIR makes it clear that the department and applicants have to get permits from Regional Water Quality Boards before implementing any vegetation treatment project near or possibly impacting water resources, why isn't Alternative 3 part of the proposed Program and other Alternatives?

On p. 6-32 of the VTPEIR, Alternative 3 cites avoidance of treatments on soils-slopes with high erosion hazard (EHR). Does this mean that the other Alternatives will treat those slopes, and if so, would this not be a highly adverse impact? Wouldn't the RWQCB prohibit slope treatments on EHR anyway? If so, how is Alternative 3 a feasible alternative?

**4.D Why did the Program reject the Environmentally Superior Alternative?**
While the Report states that the Program is the Environmentally Superior Alternative, the document does not make the case. Alternative 3 and Alternative 4 make the case for following water quality or air quality regulations, but the document states on page 3-15 that treatment acreage goals have priority over complying with both air quality and water quality regulations, and therefore the proposed Program does not comply with either. Nowhere in the Program goals does it say that acres treated is a goal, so privileging acres treated over attaining stated goals goes against the Program.

**4.E Why were the alternatives (both accepted and rejected) not evaluated in terms of how they would meet the Program's stated goals ?**
CEQA guideline 15126.6. states that alternatives
*"shall include those that could feasibly accomplish most of the basic objectives of the project."*

Since the VTPEIR fails to list the Program's objectives, we assume that the Program's goals are the "basic objectives of the project." How the alternatives are found to would meet or fail to meet Program goals. None of the alternatives were rejected by how they would fail to meet the Program's stated goals. On pages 3-15 and 3-16, the Report rejects both an alternative that complies with air and water quality regulations, and a proposal that concentrates efforts where fire risk is greatest. In both cases, the proposals are rejected on the grounds that too few acres would be treated, or they would be treated in the wrong place. How do the rejected alternatives fare when evaluated in how they will meet the Program's stated goals?

**5. WILL MITIGATION OF THE IMPACTS CONSIDERED BE MONITORED TO DETERMINE THAT THE IMPACTS FALL BELOW THE LEVEL OF SIGNIFICANCE?**

**5.A How will before/after monitoring be used to assess mitigation efficacy? or to provide evidence that Program Goals are achievable?**
Chapter 7, Monitoring and Implementation, discusses the concept of baseline monitoring and its importance to project mitigation. However, no specific project surveys appear to be required before or after treatment. Without valid surveys, how can there be any analysis of the kinds of impacts that might occur, or the requirement that the benefits of a treatment at least equal its damage?

Without requiring pre and post project monitoring, how will project managers determine if the Program meets the stated goals of wildlife and habitat enhancement and protection, protection of watershed values, and rangeland enhancement? And how can the VTPEIR forecast with any accuracy that vegetation treatments will be able to meet Program goals?

For example, on page 3 of the Executive Summary, Goal 7 states that the Program intends to, *"Reduce noxious weeds and non-native invasive plants to increase desirable plant species…."*

Yet on p. 8, the Executive Summary concludes that,
*"Because of the need to treat invasives, the Proposed Program would have a slightly adverse to slightly beneficial impact on invasives.…"*

It is not clear that Goal 7 can be achieved, nor does the VTPEIR make clear how monitoring will be required to assess whether treatments are meeting their goals.

**5.B How will the responsibilities of Lead, Trustee, and Responsible agencies be implemented when required on projects, and where will the funding for these staff come from?**
As lead agency for proposed Program projects, CalFire will be required to consult and coordinate with Trustee and/or Responsible agencies, e.g. DFW, DPR, on vegetation treatment projects on their lands or when there is a permitting nexus. Trustee and/or Responsible agencies may be the lead agencies for any such projects. CalFire will also consult with Federal agencies if VTPEIR projects are on or near their lands.

Given the current budget and staff resource constraints throughout participating State and Federal agencies, how many CalFIRE staff are available to implement an increase in projects proposed by the Program? Have trustee / responsible agency confirmed they also have enough staff to dedicated to the review of VTPEIR projects? If current resource agency staffing levels are not sufficient to review projects, how can the Board of Forestry ensure MMRs, mitigation measures, landscape constrictions, and checklist items put in place to reduce impacts to less than significant can be implemented? Will this require new staff for these agencies? If so, where will funding for new staff come from?

## II. RECOMMENDATIONS

CNPS feels the greatest failure of the Draft VTPEIR is the top-down approach upon which the Program is based. To be effective and valued at the local project level, a greater degree of local consultation must be explicitly incorporated into a Program than is described in this draft VTPEIR.

A better framework would be to gather information on optimal vegetation management for fire safety from local knowledge and experience, which would then be passed up to a regional level. Regionally generated information would then be used to develop region-specific plans that would optimize outcomes. Region-specific plans would then be combined in an overall Program that would address ONLY the issues common among the regional plans. To that end, we provide the following alternative framework recommendations.

**An Alternative Program Framework**
A Program framework that would be relevant to and improve the VTPEIR, is a division of analysis whereby treatment options and analyses of their effects are split into subregions. Possible subregions could be split into a Northern / Central / Southern California division, or by bioregions (e.g., VTPEIR Figure 2.1), by fire regime types, or by vegetation types.

Within each subregion, vegetation treatment prescriptions are further divided into Treatment Category Zones, which could include the WUI Lands Zone, the Urban to Agriculture Transition Lands Zone, and the Wildlands Zone.

Based on this Program framework, regional prescriptions of treatments are developed through a process that requires public consultation into Subregional Plans that:

- address the management needs appropriate to meet Program goals for each vegetation type identified in subregions,
- describe the types of notifications and permits that will be necessary for the prescribed management measures by administrative boundaries within a subregion, and
- include a revised checklist for tiered projects, as generally described in Chapter 8 of the VTPEIR, that includes an element to ensure a mandatory, local consult of project impacts among local fire and fuels management experts.

The common elements among Subregional Plans become the Program-level elements that will allow streamlining and broad administrative applicability, while providing sufficient information to allow project-level applications to tier from the Program EIR.

**WUI-specific Recommendations**
<u>1. The first thirty feet</u>
As a first step toward the goal of creating defensible space within the first thirty feet of structures, all Department of Forestry and Fire Protection structures can represent models for local residents by having the first thirty feet landscaped with locally appropriate native plants as a working demonstration of appropriate landscaping for defensible space.

These examples would provide models for local residents, would use locally appropriate native plants, and could most likely attract volunteer help from local garden clubs and California Native Plant Society Chapters.

<u>2. Retrofitting structures against ember ignitions</u>
The program should be set up to also use the publicly funded fuel clearance work to leverage homeowners into performing their own privately funded home improvement projects to harden them against ember ignitions.

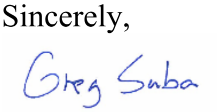
**Recommendations to improve the VTPEIR**
We strongly urge the Board of Forestry to discontinue development of this document in its current framework. It is deeply flawed in terms of CEQA, and use of best/current environmental and fire science and planning principles. The VTPEIR fails to offer specifics to the Program and its analyses, and rationale to support basic premises.

We offer these comments and recommendations from a desire to see the CA Board of Forestry develop and approve a multifaceted, specific, statewide Program that effectively treats lands at the wildland-urban interface and recreation areas, while addressing goals for habitat types within bioregions, that addresses landowner responsibility 'from the structure outward,' and employs most current fire and biological science.

We appreciate the opportunity to provide these comments to the California Board of Forestry regarding the proposed Vegetation Treatment Program EIR. Included below are the names of Chapters whose members have contributed comments directly to this letter and/or have held special meetings to discuss and vote on expressing their support for these comments. Some have submitted letters of their own, whose comments we incorporate herein by reference. We ask again that you fully consider and respond to our comments.

On behalf of all 33 CNPS Chapters, I would like to thank you for providing an extension to the draft VTPEIR review period. I appreciate your willingness to meet with me to discuss CNPS' initial reactions to the draft, and would be glad to discuss our comments further with you or your staff.

Sincerely,



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Contributing Chapters

Alta Peak Chapter
Bristlecone Chapter
Channel Island Chapter
Dorothy King Young Chapter
East Bay Chapter
Kern County Chapter
Los Angeles/Santa Monica Mountains Chapter
Marin Chapter
Milo Baker Chapter
Monterey Bay Chapter
Mount Lassen Chapter
North Coast Chapter
Orange County Chapter
Redbud Chapter
Riverside/San Bernardino Chapter
Sacramento Valley Chapter
San Diego Chapter
San Gabriel Mountains Chapter
San Luis Obispo Chapter
Santa Clara Valley Chapter
Santa Cruz County Chapter
Sequoia Chapter
South Coast Chapter
Willis L. Jepson Chapter
Yerba Buena Chapter

EXHIBIT 14

California Native Plant Society

San Diego Chapter of the California Native Plant Society
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info@cnpssd.org | www.cnpssd.org

*VIA U.S. and Electronic Mail* February 15, 2013

George Gentry, Executive Officer
State Board of Forestry and Fire Protection
P.O. Box 944246
Sacramento, CA 94244-2460
E-mail: VegetationTreatment@fire.ca.gov

**Re: Draft Programmatic Environmental Impact Report For The Vegetation Treatment Program of the California State Board of Forestry and Fire Protection (SCH #2005082054)**

Dear Mr. Gentry:

We appreciate the opportunity to comment on the Draft Programmatic Environmental Impact Report for The Vegetation Treatment Program Of the California State Board of Forestry and Fire Protection ("Report," “Program,” "VTPEIR").

The San Diego Chapter of the California Native Plant Society (CNPSSD) works to protect California's native plant heritage and preserve it for future generations. CNPSSD promotes sound plant science as the backbone of effective natural areas protection. We work closely with decision-makers, scientists, and local planners to advocate for well informed and environmentally friendly policies, regulations, and land management practices.

CNPSSD is a supporter of appropriate land management practices which result in sustaining special status California native plant species, both on properties dedicated to that purpose (e.g. State, Federal, County, or local and private conservation parks or preserves) and other properties (private and public) where these species occur, and where their continued survival helps provide a genetic buffer for their survival, should catastrophic events destroy them in protected areas. We strongly agree that fire and invasive species are critical issues that must be actively managed. However:

**CNPSSD strongly recommends that this VTPEIR NOT be certified, due to lack of substantial evidence to support contentions and conclusions made throughout the document, due to substantial procedural lapses and irregularities, as well as the other issues we list below.**

Based on the Report, we have many questions, including:

1. How the Report deals with its procedural lapses and irregularities
2. Whether all the impacts have been properly considered
3. Why does the Program description lacks substantial evidence to justify fundamental premises? Why is it inaccurate and overly simple?
4. How will the Program achieve its goals?

The following groups of questions are based on the concerns summarized above. We formally request that the Board of Forestry fully consider and respond to our questions in an effort to improve the Draft VTPEIR by clarifying, among other things, its purpose, rationale, and management structure.

**1. Procedural Lapses and Irregularities**

**1.A. Why did the Report writers choose to create an EIR, not an EIR/S?** In Chapter 2: Proposed Program, on Page 2-1: "The 38,000,000 acres that might be treated under the Proposed Program are comprised of about 34,958,000 acres, which are either privately owned or State owned lands (e.g. Department of Parks and Recreation (DPR) lands) that are designated as SRA or LRA, and about 3,000,000 acres of federal DPA lands (see glossary for description of DPA)." According to the CEQA Guidelines, the Program should have a combined EIR/S, not an EIR, since the Program proposes to cover federal lands as well as State lands.

**1.B. Where is the Program Map, and what parcels are subject to the Program?** According to CEQA Guideline 15124(a): "The precise location and boundaries of the proposed project shall be shown on a detailed map, preferably topographic. The location of the project shall also appear on a regional map." Neither of these maps is supplied. While maps of California and "bio-regions" are presented, approximately 1/3 of the state is actually affected by the Program, so these maps are insufficient for land owners to determine whether they are affected by the Program or not. How can the Report represent that the impact analysis is sufficient, if neither the place nor the timing of the Program are given? Environmental impacts must, by definition, have an environment in which to occur. Phrasing the acreage as "might be treated" is insufficient. If a parcel is considered eligible for the Program, then the Program has a boundary, and all parcels within that boundary must shown on maps, to circumscribe the environment impacted by the Program.

**1.C. What are the objectives of the Proposed Program? Do the Goals of the Program adequately cover the Program's Objectives under CEQA?** According to CEQA Guideline 15124(b), an EIR must contain "a statement of objectives sought by the proposed project. A clearly written statement of objectives will help the lead agency develop a reasonable range of alternatives to evaluate in the EIR and will aid the decision makers in preparing findings or a statement of overriding considerations, if necessary. The statement of objectives should include the underlying purpose of the project." We failed to find clearly labeled objectives, and assume in this analysis that the Goals (Report Page ES-iii) are the objectives. However, the alternatives are evaluated entirely on how much acreage will be treated, which subset of laws will be followed, how expensive it is to follow all Federal and State regulations, and so forth, and the goals were never mentioned in consideration of alternatives. Furthermore, the goals are vague and never quantified, they are never referred to in the environmental checklist that is apparently the heart of the Proposed Program, there is no system proposed for monitoring Projects to determine whether they further Program goals, and there is no system to mitigate cumulative impacts from potential Projects below the level of significance, nor to monitor or report on mitigation efforts. Were we reading this document cynically, we would assume the objective of the program is to clear as much land as possible every year. Due to this lack of clarity, we want to know what the true Objectives of the Program are, and whether they are properly represented by the Goals.

**1.D. How was the Notice of Availability publicized?** According to CEQA Guideline 15087: "Notice ... shall also be given by at least one of the following procedures: (1) Publication at least one time by the public agency in a newspaper of general circulation in the area affected by the proposed project. If more than one area is affected, the notice shall be published in the newspaper of largest circulation from among the newspapers of general circulation in those areas. (2) Posting of notice by the public agency on and off the site in the area where the project is to be located. (3) Direct mailing to the owners and occupants of property contiguous to the parcel or parcels on which the project is located. Owners of such property shall be identified as shown on the latest equalized assessment roll."

Normally, EIRs include an appendix documenting their public notices. The Report failed to provide this information, so we investigated. We failed to find a Notice of Availability using online searches of the *Los Angeles Times* (http://classifieds.latimes.com/ classifieds?category=public_notice) (which, according to Wikipedia, has the largest distribution of California newspapers), the *Sacramento Bee* (http://www.sacbee.com/ adperfect/), the *San Francisco Chronicle* (http://www.sfgate.com/ chronicle/), the *San Jose Mercury News* (http://www.mypublicnotices.com/BayAreaNewsGroup/ PublicNotice.asp), or the *UT San Diego* (http://www.legalnotice.org/pl/sandiego/ landing1.aspx). The website legalnotice.org covers legal notices in newspapers throughout the US, and we were unable to find it in there. As for posting the notice on and off-site, the site is not defined, so this is not practicable. As for direct mailing, a close relative owns a house immediately adjacent to state parks land. This land contains chaparral and coastal sage scrub, and has been the periodic target of vegetation management. Nonetheless, this relative never received any written or emailed notice about this program. While our investigation was not exhaustive, we found no evidence of public notice beyond the Project website itself. How was the Notice of Availability publicized?

**1.D Why does the Report state that floristic surveys "may be necessary" rather than being mandatory?** In the "Minimum Management Standards" section (page 2-6), Item 5 states: " A database search will be conducted for each project by a query of the most reasonably available sources and databases for biological information, including but not limited to, the CNDDB and BIOS. The search shall include a minimum search area of nine (9) USGS Quadrangles surrounding the project area. In cases where the project area extends into multiple quadrangles all adjacent quadrangles shall be included. Surveys may be necessary to determine presence/absence of special status plants or animals and to determine and evaluate site-specific impacts. The applicant will evaluate the potential direct and indirect impacts caused by the Project."

According to CEQA guideline 15125: " An EIR must include a description of the physical environmental conditions in the vicinity of the project, as they exist at the time the notice of preparation is published." This includes the plants and animals within the project's boundary.

Floristic surveys are never optional. They are a fundamental part of describing the environmental setting for the project. All a 9-quadrangle or CNDDB search does is that it helps to determine what sensitive species may be present on the project site. All databases are known to be incomplete, sometimes radically so. They cannot be relied upon to determine either the presence or the absence of any sensitive species, and current surveys of project sites are absolutely necessary to determine what occurs on all project sites. Why does the Report state that these are optional? How does this comply with the California and national Endangered Species Acts and agency regulations for implementing these acts?

**1.E. Why does the Report not state which plants are impacted by the Program?** Appendix B appears to be a list of all List 1A-4 plants in California. This makes no sense, for a number of reasons:

1. Why consider List 1A species? They are thought to be extinct, and therefore not affected by the Program.
2. Why consider all species? Yes, the report says " Addressing potential impacts of the VTP to every taxon at the programmatic level would be impractical," (Page 5.5-12), but the list presented in Appendix B is silly. It includes plants such as the extremely rare *Cercocarpus traskiae* which will never be subject to vegetation treatment. Nor will a wide selection of beach dune plants (e.g. *Acmispon nuttallianus* (*Lotus nuttallianus*), *Phacelia stellaris*, and *Nemacaulis denudata* var. *denudata*) that mostly occur on urban dunes, in small areas that are highly unlikely to ever come under any vegetation treatment. This list of non-impacted could be extended almost indefinitely, and should have been, because the Report notes which vegetation types are excluded from its purview. The fundamental point is that the Program does not affect all listed plants, it affects a subset of them. Why was this subset not identified? Certainly, a CNDDB search of the parcels affected by the Program would produce a suitable list. Why was this search not performed?

**1.F. Why did the Report reject the Environmentally Superior Alternative?** While the Report states that the Program is the Environmentally Superior Alternative, the document does not make the case. Alternative 3 and Alternative 4 make the case for following water quality or air quality regulations, but the document states on page 3-15 that treatment acreage goals have priority over complying with both air quality and water quality regulations, and therefore the proposed Program does not comply with either.

We were not aware that failure to comply with state and federal regulations was an option for state agencies. Ever.

Nowhere in the Program goals does it say that acres treated is a goal. Therefore, acres treated is an invalid criterion, and using it goes against the Program's stated Goals. Given that acres treated is an invalid criterion by which to assess the alternatives, why did the Report reject the Environmentally Superior Alternative of complying with the laws, regulations, and guidelines of the United States and the State of California?

**1.G. How can a Program that fails to comply with all state and federal regulations be certified?** As noted in 1.F. above, complying with both air and water quality regulations (which are both state and federal) was rejected. If the Program as proposed cannot comply with all relevant state and federal regulations, how can it be certified as compliant with CEQA and NEPA?

**1H. Why were the alternatives (both accepted and rejected) not evaluated in terms of how they would meet the Program's stated goals ?** CEQA guidelines state that alternatives "shall include those that could feasibly accomplish most of the basic objectives of the project." (CEQA Guidelines 15126.6. Consideration and Discussion of Alternatives to the Proposed Project"). Since the Report fails to list the Program's objectives, we assume that the Program's goals are the "basic objectives of the project." None of the alternatives listed are characterized by how they would meet the Program's goals. None of the alternatives were rejected by how they would fail to meet the Program's stated goals. On pages 3-15 and 3-16, the Report rejects both an alternative that complies with air and water quality regulations, and a proposal that concentrates efforts where fire risk is greatest. In both cases, the proposals are rejected on the grounds that too few acres would be treated, or they would be treated in the wrong place. How do the rejected alternatives fare when evaluated in how they will meet the Program's stated goals?

**1I. Where is the Environmental Checklist? How will the Checklist protocol described preclude EIRs for all projects under the Program?** The Program appears predicated on the creation of an environmental checklist to streamline environmental review of Projects instituted under the Program. However, there is no Environmental Checklist in the Report. Chapter 8 "Environmental Checklist" contains a set of criteria for generating an initial study. Such lists are already freely available on the internet through the Association of Environmental Professionals, so the idea of generating a special checklist is unnecessary. Worse, since the Program admittedly fails to comply with both air quality and water quality regulations, and because we have many other questions about whether it properly complies with CEQA and NEPA, a checklist generated per the vague specifications in Chapter 8 will not, in fact, comply with CEQA, nor will replace a CEQA initial study. Given the lack of specificity, outdated, incomplete, and questionable science, lack of consultation with agencies, failure to generate fauna and flora lists, and reliance on obsolete vegetation maps, among other problems, any project proposed under this Program might do better to ignore the Program and generate its own EIR independently, using existing the existing CEQA checklist.

**2. Were all impacts considered?**

**2.A. What consultations were performed with the California Water Resources Board, Regional Water Control Boards, California Air Resources Board, California Department of Fish and Wildlife, U.S. Fish and Wildlife Service the Army Corps of Engineers, The Environmental Protection Agency, the US Forest Service, and the National Park Service? What other agencies should have been consulted that were not? What other agencies were consulted, and what was the result of the consultation?** Normally, all consultations are included in the EIR as appendices, but these do not appear in the Report. Providing the text of consultations will help determine how the impacts were determined, and whether all impacts were determined to the satisfaction of the responsible agencies.

**2. B. How does the Program comply with the CARB Smoke Management Program of 2000?** The report appears to assume that the California Air Resources Board (CARB) has yet to develop a Smoke Management Plan (Page 4.6-2). According to the CARB website (http://www.arb.ca.gov/smp/ smp.htm), the CARB adopted a Smoke Management Plan in 2000, and guidelines are available online. It appears that the proposed Program will render the state out of compliance with EPA guidelines, and it is unclear whether the Board of Forestry consulted with the Air Resources Board both on these impacts and on mitigating them.

**2.C. Why did the Report Writers and Program choose to use the WHR?** The Wildlife Habitat Relationships (WHR) system is obsolete and does not comply with national vegetation mapping standards ((http://www.fgdc.gov/standards/projects/FGDC-standards-projects/vegetation/NVCS_V2_FINAL_2008-02.pdf/), It was superseded most recently by the *Second Edition of the Manual of California Vegetation* (Sawyer, Keeler-Wolf and Evens, 2009), which does comply with national standards.

A. Why was the WHR chosen?
B. Why did the writers choose to ignore the wealth of fire characteristics given in the *Second Manual* for every flammable vegetation type in California?
C. How will the Program fit current, compliant maps of California vegetation into the inadequate, outdated framework of the WHR? Wouldn't the current system provide more information for less effort? Won't such problematic mapping generate significant ecological impacts due to errors and data loss? How will the Program mitigate for such impacts?

**2. D. How will the Program affect carbon sequestration efforts?** On page 4.4-18, "The Role of the VTP in Carbon Sequestration and in Reducing California’s Greenhouse Gas Emissions" fails to explicate the role of the Program in carbon sequestration. So far as we can determine, the only role the Program plays in carbon sequestration is by providing fuel to biomass-burning power plants. This has the effect of taking sequestered carbon out of vegetation  and blowing it back into the air. In fact, most of the activities under the Program will decrease sequestration by removing biomass and causing it to degrade, releasing carbon back into the air. Worse, the Program may scuttle market-based carbon sequestration efforts in California. After all, why should anyone invest in forest lands to sequester carbon in biomass, if the Program will allow someone to arbitrarily come along and reduce the biomass on that land within the next decade or two? Such a risk is totally unacceptable to most businesses, and insuring carbon sequestration against inadvertent or deliberate loss to Program treatments would impose a ruinous tax on carbon sequestration efforts.

**2.E. Why does the Program exacerbate the type conversion of woody vegetation into herbaceous vegetation? How will it ameliorate the increased threats imposed by too-frequent vegetation treatments?** On page 2-23, the Program states that "maintenance is assumed to occur at the following time intervals: Grasslands – 2-5 years after previous treatment, • Shrublands – 5-10 years after previous treatment, • Forestland – 10-15 years after previous treatment." According to well-established science, chaparral will type-convert to weedlands if the fire return interval is less than 30 years, and it is no stretch whatsoever to assume that any shrub-based vegetation will be replaced by herbs if it is treated more than once a decade. This is the basis for the centuries'-old practice by ranchers of converting brush to pasture by burning. Since herbaceous vegetation is more ignitable, and demonstrably more dangerous to houses (e.g. Syphard, et al. Housing arrangement and location determine the likelihood of housing loss due to wildfire. PLoS ONE 7(3): e33954), we strongly question these treatment intervals. They seem to run contrary to the stated goals of the Program, to " reduce catastrophic losses to life and property consistent with public expectation for fire protection" (Goal 2).

**2.F. How does the program justify destroying more acres of vegetation than recently documented wildfires consume?** According to the Program, 216,910 acres are considered for annual treatment  (p. 2-25), while 198,769 acres of CAL FIRE lands were burned each year, according to CAL FIRE's own data (five year running average). (http://cdfdata.fire.ca.gov/ incidents/incidents_stats?year=2012, accessed 1/29/2013), If the Program achieves anything like its proposed scope, it will be more destructive than the fires it purports to ameliorate, because it guarantees type conversion, exotic plant invasion, soil damage, and other impacts that are noted in the Report. Even if we count the 53% of lands subject to prescribed burns (114, 962 acres/year), this is 57.8% of the total lands burned every year. Indeed, 114,962 acres burned/year would match the nineteenth largest California fire in recent history (http://www.fire.ca.gov/ communications/downloads/fact_sheets/20LACRES. pdf), and would happen every single year. It appears that the Program wants to destroy California's vegetation in order to save it, in a grotesque echo of the worst parts of the Vietnam War. How does the Program justify such sustained, epic-scale destruction? How will it monitor and demonstrate that such destruction will meet any of the Program's goals? What will it do if this level of destruction fails to make Californians safer from fire?

**3. Why does the Program description lacks substantial evidence to justify**

**fundamental premises? Why is it inaccurate and overly simple?** The various sections of the document, generally organized following the format of an EIR, appear at first glance to offer a broad historic, statistical, regulatory, land use, and geographic context to the topics. But upon closer inspection, one finds the proposed program is based on a number of unjustified assumptions, that it ignores best available science, and that in very many instances the report cites inappropriate, irrelevant, or debunked references. Moreover, although the PEIR is over 1300 pages long, why does it contain no meaningful information about the program's proposed project level planning? The closest the Report gets to a project level environmental analysis is a carefully documented process of combining a lot of coarse data that CAL FIRE states to be unreliable into variously unreliable, extremely coarse, over-generalized, and not very informative indices plotted statewide on a series of tiny maps at an effective scale of 1:25 million. For all these reasons and more, the document is legally inadequate for its intended purpose as an Environmental Impact Report.

**3.A. How can CEQA be appropriately applied to the VTPEIR in a Program sense when groups or series of projects addressed within the Program are NOT similar in impacts, and when potential impacts can NOT be avoided or mitigated in a similar manner? What standards does the Program propose to determine similarity of impact and similarity of mitigation? How will these similarities be assessed at the Programmatic level? What will the Program do if Project implementation uses it incorrectly, to justify impacts that would not have otherwise occurred?** In Chapter 1.6 of the VTPEIR, the Report states, "An agency is generally not permitted to treat each separate permit or approval under a program, such as the VTP, as a separate project segment if the effect is to avoid full disclosure of environmental impacts. However, CEQA does encourage the application of a programmatic approach **where a group or series of projects are similar in activities and impacts** and **where potential impacts can be avoided or mitigated in a similar manner**." [bold added for emphasis]

One of the over-riding problems in the Report is the simplistic approach that attempts to make fire issues out as broadly similar across the region, when in fact they are very different. For example, the PEIR does not distinguish between surface fires in ponderosa pine and crown fires in chaparral, nor does it explain how these different fire regimes have been affected very differently by past fire management activities and as a consequence require very different approaches to future management. Nevertheless, the VTPEIR treats both fire regimes similarly by employing a simple one-size-fits-all premise upon which to base the rationale for treatments and impact analyses, in short; the Report claims that "increased treatments will result in less frequent and less severe uncontrolled burns, and increased treatments pose no significant impacts to the environments treated."

Much of the literature supporting treatments comes from surface fire regimes in coniferous forests and therefore is not appropriately applied to shrubland ecosystems. One important example of where these two ecosystems differ markedly is in the impact of fire severity. High severity fires have some negative impacts on certain forest types, however, shrubland ecosystems are highly resilient to high severity fires and in fact one of the major threats, alien plant invasion, is promoted by low severity fires. Does CAL FIRE recognize the fact that, in southern California, wildfire frequency intervals have become so short as to threaten the continued existence of natural habitats such as chaparral, inland sage scrub, pinyon-juniper, and coastal sage scrub? These habitats are the ones stabilizing and protecting our watersheds in highly erodible mountain and hill topography.

Similar groups or series of projects, and similar impact avoidance / mitigation measures could be identified only through categories ecosystem within finer geographic regions, and only among finer vegetation classifications than are presented in the VTPEIR. The similar treatment of vastly different vegetation types operating under different fire regimes, the broad characterization of program area (California) and landcover types (CWHR classifications) as presented in the draft VTPEIR grossly oversimplify the "similarities" intended to justify a program approach to the CEQA, making it impossible to assess "full disclosure of environmental impacts" of treatments, and thereby voiding the BoF/CAL FIRE's ability to legally certify this draft PEIR under CEQA.

**3.B. Where is the substantial evidence to support the PEIR's plan to increase burning across the Program area's bioregions by 36%?** In Table 2-4 - Proposed Program Treatment Acreage by Bioregion, the PEIR indicates the Approximate Annual Acreage Treated during the ten-year program period is 216, 910 acres. The PEIR states that 53% of vegetation treatments will be prescribed burns. That means that each year 115,000 acres will be burned under this program. At page 4.2-3 of the PEIR historical wildfire trends are estimated (since late 1800s) to average 320,000 acres burned per year in California. CAL FIRE intends to increase the number of acres burned (generally in wildland habitats) by 115,000 acres per year. How does the PEIR justify increasing the acreage burned by 36%?

**3.C Why doesn't the PEIR concentrate on the first three "major policy components" of the California Fire Plan?** In Chapter 1.3 - Regulatory Authority: The California Fire Plan (BOF, 2010) has the following "major policy components":
"• Land use planning that ensures increased fire safety for new development
"• Creation of defensible space for survivability of established homes and neighborhoods
"• Improving fire resistance and structural survivability of homes and other constructed assets
"• Fuel hazard reduction that creates resilient landscapes and protects the wildland and natural resource values
"• Adequate and appropriate levels of wildland fire suppression and related services
"• Commitment by individuals and communities to wildfire prevention and protection through local fire planning."

1. Land use planning that ensures increased fire safety for new development inside or adjacent to wildlands requires planning agencies to understand what measures the developer and the residents must take to ensure fire safety while preserving soil stability, groundwater retention and natural resources. This requires not just a website, but demonstration structures and seminars for planners showing topographic layouts of developments that have survived wildfires. Board of

Forestry and CAL FIRE structures should all meet this requirement so they can be shown as examples to visitors or on special days like "open houses" at fire stations.

2. Creation of defensible space for survivability of established homes and neighborhoods is a crucial policy that CAL FIRE must implement. This Report recognizes the increasing population in California and the increasing encroachment into wildlands or into wildfire-prone topography. CAL FIRE emphasizes the importance of the "first thirty feet from a house or other structure" as the most importance area of defensible space". Where is that discussed in this PEIR? Where is the program element that requires all Department of Forestry and Fire Protection structures to have the first thirty feet landscaped (with locally appropriate native plants) as a defensible space for demonstration and for defense? Where is the program element that requires pressure on all county fire stations located in or adjacent to wildfire prone lands to landscape the first thirty feet from all their structures as defensible space as demonstrations of what defensible space looks like for local residents, using locally appropriate native plants and working with local garden clubs and California Native Plant Society Chapters?
3. Improving fire resistance and structural survivability of homes and other constructed assets requires instructing local and regional planning agencies on what requirements they, their fire departments and their building and safety departments need to add to building or remodeling permits to improve or to ensure survivability of new or remodeled structures in areas prone to wildfire impacts.
4. These first three policy components are the most important in today's world. People are not going to the CAL FIRE website, they are not reading their brush notices, they do not know what "defensible space" means and brush inspectors do not look at the first thirty feet from the structure when they inspect homes for compliance with local fuel modification regulations. Why aren't CAL FIRE and the Forestry Board setting up demonstration gardens and teaching these residents of fire areas how to defend their structures and their resource values? Why aren't brush inspectors inspecting the first thirty feet from structures and out to one hundred feet from the structure?
5. The last three major policy components are what CAL FIRE and Forestry do already. The Fire Safe Councils are an excellent idea but where is CAL FIRE and County Fire Departments buy-in on their own properties?
6. Vegetation treatments start at the structure. Why isn't this PEIR strongly advocating for vegetation treatment and management in the first thirty feet from all structures, in all jurisdictions?

**3.D. Where is the substantial evidence to support the increase in chaparral treatment planned in the PEIR?** Where is the justification for burning, masticating/mechanically clearing, and eventually degrading and destroying shrublands such as southern California chaparral and other types of shrub communities around the state, as well as sage scrub in areas where these plant habitats are forming deep, complex root systems, sequestering vast amounts of carbon, stabilizing slopes, preventing soils from becoming hydrophobic, acting as guardians of broad steeply-sloping watersheds and providing nesting, resting and food sources for a highly biodiverse wildlife, both resident and migratory? These habitats need 40 to 100 years to recover from fires, replenish their seedbanks, restore their canopies and replenish their root systems. Where in the Report is the scientific literature that would demonstrate these facts to be true?

**3.E. Where is the substantial evidence to justify increasing the area to be treated, generally by burning or mechanical removal, from 34,824,500 acres to 37,958,400 acres?** Where in the PEIR is there provided evidence to substantiate the purported need to increase treated acres in order to achieve Program goals?

**3.F. Where is the substantial evidence that supports the evaluation of effects from non-native invasive species?**
Assessments quantification in the DEIR apparently created from thin air
Having stated that areal quantification of cumulative impacts cannot be known (see italics section under cumulative impacts) the DEIR boldly states what effects will be. A great example is Table 5.5.2 "*Table 5.5.2 Summary of Effects from Non-Native Invasive Species from Implementing the Proposed Program.* " This takes each Bioregion and assesses the effect on weeds from the programs use of Prescribed Fire , Mechanical, Hand, and Herbivory treatments. For every region the chart states "NA/NB - negligible adverse or beneficial effects - those effects that are imperceptible or undetectable." The document presents no quantitative evidence in support of this evaluation, but the narrative does describe many examples where each of the fuel treatments can make the invasive species situation worse. This has been made very evident from regular wildland fire fighting, where the equipment used to fight the fire is frequently "dirty" regarding alien seeds.

**3.G. Why was the Program based on questionable science?**
The document is characterized by cursory descriptions of mostly out-dated science with little or no summary of points of disagreement. For example, within the summary of Known Areas of Controversy listed in Chapter 2.7, "wildlife, conservation, or biological diversity issues" is not mentioned. We note the more complete descriptions of the PEIR's scientific failings as detailed in comments submitted by both the California Chaparral Institute and Endangered Habitats League.

**3.H. Why does the Program assert that biomass burning will ameliorate climate change?** The Report repeatedly considers biomass burning as a renewable resource that will help ameliorate climate change (e.g. 4.4-18, 4.11-6). This seems mistaken on three levels. First, biomass takes carbon out of the air, while burning it returns the carbon to the air. This short-circuits biological processes that take carbon out of the air and sequester it back in the ground or in biomass. If we practiced nothing but biomass burning, we would retain our high levels of atmospheric $CO_2$ indefinitely, so this solution prolongs the problem. Second, plants do not contain just carbon and energy. Burning biomass will release large quantities of nitrogen, and nitrogen deposition has already been shown to favor non-native invasive species (e.g. Allen et. al. 2009. http://www.plantbiology.ucr.edu/faculty/ Allen et al. 2009.pdf). This will exacerbate both air pollution and invasive species problems. Undisturbed native vegetation can effectively exclude most exotics, sequesters carbon, and sequesters nitrogen. Therefore, leaving the vegetation intact helps to solve three problems, while burning it exacerbates all three.

**3.I. Why does the report assume that anthropogenic fire, anthropogenic disturbance, and browsing by goats and sheep or other Eurasian herbivores will favor native plants?** One central problem is that California's plants have experienced 10,000-20,000 years of anthropogenic fire and disturbance, a few centuries of grazing by domestic livestock, and a few centuries of anthropogenic soil disturbance. In contrast, Eurasian weeds have adapted to 40,000-100,000 years of anthropogenic fire, 8,000-10,000 years of grazing by domestic livestock, and 8,000-10,000 years anthropogenic soil disturbance. Given this history, it seems obvious that Eurasian weeds are better adapted to anthropogenic fire, livestock grazing, and anthropogenic soil disturbance. We are at a loss to understand why the Program assumes any of these methods (fire, grazing, and clearing) can be used on a broad scale to restore native vegetation. As targeted treatments in small areas, they are fine. Antibiotics similarly work when targeted against susceptible bacteria, but wreak havoc when used indiscriminately. Widespread use of the Program's proposed methods will simply favor those species that are better adapted to such disturbances, and elementary evolutionary theory (as well as common sense) strongly suggests those species are non-native invasive weeds, rather than native species.

**3.J. Why does the Program not focus on the wildland urban interface?** According to recent publications (e.g. Syphard, et al . Housing arrangement and location determine the likelihood of housing loss due to wildfire. PLoS ONE 7(3): e33954; http://www.cnps.org/cnps/publications/ fremontia/Fremontia_Vol38-No2-3.pdf and references therein), land use planning appears to be more important than fuel modification for reducing fire hazards. Additionally, replacing woody fuels with herbaceous fuels appears to increase fire risks to homes, and treating the wildland-urban interface is critical for making homes safe. None of this appears to be considered in the report. How does the Program plan to incorporate this information in creating an effective strategy, and how will the Program be amended to take this information into account?

**3.K. Why did the Report cite the San Diego County Wildland Task Force August 2003 "Mitigation Strategies for Reducing Wildland Fire Risks"?** In 4.2-8, the Report states that "In its August 2003 report, the San Diego Wildland Task Force agreed that fuel or vegetation management is the single most effective tool available to mitigate fires." **This report was withdrawn by its authors**, after protest by seven of the scientists whose work contradicts the Program's premise that mosaics of age classes reduce shrubland wildfires (detailed in http://www.californiachaparral.com/images/ Letters_to_SD_County___Oberbauer.pdf). Why was a retracted and discredited report used to support the Program?

**4. How will the Program achieve its goals?** In general, the Report does a very poor job of relating the treatments proposed in the Program to its stated Goals. Therefore, we want to understand how the Program will achieve its goals. This is critical in understanding the impacts of the Proposed Program and its alternatives, and in assessing the cumulative impacts of Projects proposed under the Program.

**4.A. How will the Program "Maintain and enhance forest and range land resources including forest health to benefit present and future generations?" (Page ES-iii).**

1. What forest and rangeland resources are under consideration? What science supports this determination?
2. How will resource enhancement be quantitatively determined? What science supports this determination?
3. How will forest and rangeland resources be monitored? What science supports this determination?
4. What is the definition of forest health? What science supports this definition?
5. What metrics will be used to assess forest health? What science supports this determination?
6. How will monitoring efforts feed back to determine success for the overall program?
7. What is the proposed budget for this part of the Program?

**4. B. How will the Program "modify wildland fire behavior to help reduce catastrophic losses to life and property consistent with public expectation for fire protection?" (Page ES-iii).**

1. How does the large body of fire science not considered in the Report address this goal? What substantial evidence supports its validity?
2. How will the Program monitor wildland fire behavior, and losses to life and property? What substantial evidence supports use of these monitoring techniques?
3. What will the Program do if it fails to attain this goal?

**4.C. How will the Program "reduce the severity and associated suppression costs of wildland fires by altering the volume and continuity of wildland fuels?" (Page ES-iii)**

1. Given that the Program proposes to clear more land every year than fires do on average, how much does the Program budget for its activities, and how will it compare these with suppression costs? How will it make these figures available to the public and to the Lead Agency?
2. How does current science address the notion that altering the volume and continuity of wildland fuels reduces the severity of fires? Is this the consensus view of experts in the field?
3. What will the Program do if it fails to attain this goal?

**4.D. How will the Program "reduce the risk of large, high intensity fires by restoring a natural range of fire-adapted plant communities through periodic low intensity vegetation treatments?" (Page ES-iii)**

1. What does the Program consider to be the natural range of fire-adapted plant communities? What quantitative measurements do they use to justify this? Is this the consensus opinion of scientific experts in the field?
2. How will the Program incorporate the extensive body of fire relationships in the *Second Manual of California Vegetation* into the Program?
3. Given that most California plant communities burn once or twice per century, how does the program justifying burning more than once every 20 years? This appears to be an increase in fire frequency?
4. How does the Program deal with plant communities such as chaparral, where large, infrequent, high intensity fires are the norm, and frequent low-intensity fires cause type conversion to more highly ignitable (and more dangerous) herbaceous plant communities?
5. What will the Program do if it fails to attain this goal?

**4.E. How will the Program "maintain or improve long term air quality through vegetation treatments that reduce the severity of large, uncontrolled fires that release air pollutants and greenhouse gases?" (Page ES-iii)**

1. How will the Program measure long-term air quality? Has it consulted with the California Air Resources Board on these measurements? With the EPA?
2. How will the Program measure greenhouse gases released by large, uncontrolled fires? How will the Program measure greenhouse gases released by its proposed operations? What science supports these measures?
3. What will the Program do if it fails to attain this goal? What will the Program do if its normal operations release more air pollution and greenhouse gases than large, uncontrolled fires do?

**4.F. How will the Program "vary the spatial and temporal distribution of vegetation treatments within and across watersheds to reduce the detrimental effects of wildland fire on watershed health?" (Page ES-iii)**

1. How does the Program define watershed health? What quantitative metrics does it use to measure watershed health? What science supports the use of these metrics?
2. How are these watershed health metrics affected by fire? How will the Program monitor these metrics? What will it cost, and who pays?
3. What science supports the goal? What science is against the goal? What is the current scientific consensus on this topic?
4. What will the Program do if it fails to attain this goal?

**4.G. How will the Program "reduce noxious weeds and non-native invasive plants to increase desirable plant species and improve browse for wildlife and domestic stock?" (Page ES-iii)**

1. What science supports the notion that the Programs methods will help it attain this goal?
2. How will the Program monitor noxious weed and non-native invasive plant populations? What science supports this?

3. What criteria will determine whether these populations are reduced or not? What science supports these criteria?
4. How will monitoring of noxious weeds and non-native invasive plants be funded?
5. What criteria will the Program use to determine desirable plant species? What science supports these criteria?
6. Will desirable plant species be increased at the expense of sensitive species? If so, why? If not, how will the Program determine that this hasn't happened?
7. How will the Program monitor populations of desirable plants? What science supports these methods?
8. What methods will the Program use to determine whether browse has been improved? What science supports these methods?
9. How will information gathered on the populations of weeds, desirable species, and browse feed back to inform the Program?
10. What will the Program do if it fails to attain this goal?

**4.H. How will the Program "Improve wildlife habitat by spatially and temporally altering vegetation structure and composition, creating a mosaic of successional stages within various vegetation types?" (Page ES-iii)**

1. Given that in most of California's vegetation, succession takes over a century, how can treatments occurring every 20 years at most establish a mosaic of successional stages? Most shrublands will be converted to weedfields by such frequent impacts.
2. Why does the Program assume that all wildlife benefits from edges and mosaics? Many of the rarest species in California require late successional stages and lack of disturbance. How will the Program mitigate impacts to these rare species?
3. Given that mosaics increase the distance propagules have to cover from parent to suitable niche, won't this goal impair species spread, thereby endangering them through habitat fragmentation? How will the Program mitigate for creating such habitat barriers? What science justifies this approach?
4. How will the Program keep invasives out of the mosaic, given that most invasives are favored by disturbance? How will the Program mitigate for treating these invasives? What science justifies this approach?
5. How will the Program monitor mosaics? What science justifies this approach?
6. What quantitative criteria will be used to determine whether habitat is improved for wildlife? What science justifies this approach?
7. What will the Program do if it fails to attain this goal?

**4.I. How will the Program "provide a CEQA-compliant programmatic review document process/mechanism for other state or local agencies, which have a vegetation management program/project consistent with the VTP, to utilize this guiding document to implement their vegetation treatment programs/project?" (Page ES-iii)**

1. Given the substantial procedural irregularities, how can any document prepared under this PEIR be considered compliant with CEQA, NEPA, and other pertinent state and federal laws, regulations, and guidelines?
2. What can be done to make the process comply with CEQA and NEPA?

3. How will projects be assessed to determine that they comply with relevant laws through complying with the Program?
4. How will projects be monitored by Program managers to determine that they are complying with all relevant laws under the Program?
5. What will the Program do if it fails to attain this goal?

Thank you for consideration of our comments and questions.

Sincerely,

Frank Landis, PhD
Conservation Chair, CNPSSD

EXHIBIT 15

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**Public Comment Submittal**

**VTP EIR CALFIRE VEGETATION TREATMENT PROGRAM (VTP)**

February 24, 2013

Dear Mr Gentry:

Sweetgrass Environmental Consulting is pleased to have the opportunity to remark on the *Draft Programmatic Environmental Impact Report, CAL FIRE Vegetation Treatment Program* (henceforth in this letter referenced by 'VTP EIR'). We thank you for extending the public comment period.

Sweetgrass Environmental Consulting is a private firm offering expertise and analytical services for agriculture, open space, wildland-urban interface (WUI), fire, habitat, water, cultural, and historic resources planning. Our company was started in 1996 and continues to collaborate with numerous partners on a diversity of projects including federal and private lands botanical inventories, community wildfire protection planning, regional and urban revitalization surveying and plans, cultural, ethnographic, and historical oral histories and inventories, wildland and waterways restoration, and conservation policy development. Our principal investigator, Julie Clark De Blasio, studied and worked on CAL FIRE (*nee* CDF) Vegetation Management Program projects in San Luis Obispo County from 1991-1996 as part of her academic career, thesis research, and community volunteer collaboration.

<u>Overview</u>
The sizeable document offers broad historical, statistical, regulatory, land use, and geographical information. The Executive Summary espouses the objective for this program in the context of one paragraph giving the primary reason, '*The proposed program is intended to lower the risk of catastrophic wildfires on nonfederal lands by reducing hazardous fuels.*' Additional substantiation includes forest, range, wildlife

habitat, and water quality improvements. It is clear after viewing the VTP EIR primary focuses are protection of land-based resources from wildfire and for purposes of specific types of agricultural productivity.

The VTP EIR is a tiered environmental document, broadly descriptive, and offers few specifics regarding the proposed program. Chapter 4 – Environmental Setting and Chapter 5 – Environmental Analysis and Mitigation enumerate menus of seemingly every possible treatment method available for vegetation management with potential use by the program. Chapter 6 – Cumulative Effects distills the information from the previous chapters and makes a determination for each category. The VTP EIR fails to develop an argument the proposed 38 million treatment acres constitute 'same issues,' as is required for programmatic documents. It is not possible for vegetation treatment to constitute 'same issues' when the diversity of the project area varies dramatically in terms of geography, aspect, elevation, climate, microclimate, habitat type, bio-region, land use, and changes to vegetation based on historic use.

The VTP PEIR states the Final PEIR will allow most projects within the program to be initiated under the filings of either Negative or Mitigated Negative Declarations except those that clearly host known sensitive species or habitat. The tiered approach to a PEIR is one of deferment until the lead agency prepares future documents that address geographically-scaled projects (Cal. Code Regs., tit. 14, § 15152, subd. (b) (c).). Each individual project within the Program is thus subject to environmental review and planning.

<u>Context</u>
Rationale for the VTP program is anchored in the auspices of threat to life and property from wildfire. It broadly adds the *lands of California are fire prone* with supporting argument:

- VTP lowers the risk of catastrophic wildfire on non-federal lands
- VTP deals with the hazardous fuel conditions from years of suppression activities
- severity and intensity of fires has increased dramatically since the 1970s

This rationale infers all acreage in the state is susceptible to burning without regard to the biological diversity of the state. The document promises to lower incidence of catastrophic wildfire by citing numerous studies yet fails to create the argument that wildfire frequency spurned by native habitats is the threat throughout the state. The US Congressional Research Service recently determined 'acreage burned on wildlands protected by state or federal agencies declined substantially since the 1930s and has been relatively stable the last forty years' (RW Gorte, K Bracmort. 2012. Forest fire/wildfire protection. Congressional Research Service. Washington DC).

The intent of the VTP EIR clearly focuses on *economic improvements* of the two main non-intensive agricultural industries in the state: forestry and livestock. The program centers on forest and rangelands with state parklands a tertiary priority. Trace mention of possible project treatments in residential neighborhoods of the Wildland Urban Interface (WUI) is given consideration in the document adding a caveat that availability of federal funding will be a determining factor for inclusion on the VTP. Chapter 4.1 vegetation map depicts Wildland Urban Interface (WUI) lands located near metropolitan areas as 'barren' and thus not areas of program focus. This miscalculation fails to recognize and acknowledge the potential, growing science, incidences, and statistics for wildfire throughout the state within the built environment and urban forests.

The VTP EIR most frequently and consistently cites analyses, supporting documentation, and examples in the context of forestlands. The document fails to develop rationale why these ecosystems are a focus when:

1. they constitute 12.2 million acres of the proposed 38 million possible treatment acres
2. rangeland comprises a majority of total treatment acres in the VTP
3. urban, suburban, and exurban sprawl are the main threats to wildlands in the state

<u>Effects</u>

Chapter 6 – Cumulative Effects distills information contained in Chapter 4 – Environmental Setting and Chapter 5 – Analysis and Mitigation. Several topics addressed in Chapters 4 and 5 are not mentioned in the cumulative effects of Chapter 6.

*Air Quality*

Analysis for air quality from the VTP concludes, 'Long run cumulative effects of air quality will be beneficial as projects will lower wildfire and harmful air quality.' The document fails to address extreme ongoing air quality problems and collective effects of VTP projects in the Bay, Sacramento, Sierra Foothills, and San Joaquín Valley that will further deteriorate current unattainable air quality standards in the San Joaquín Valley. Prevailing winds from San Francisco Bay and Sacramento Valleys accumulate pollution from the built environment, transportation corridors, and agriculture as they move into the southern San Joaquín Valley (San Joaquín Valley Unified Air Pollution Control District [APCD]. 2002. Proposed Smoke Management Plan). The VTP EIR confidently assures the programmatic benefits of wildfire prevention and forest/rangeland improvement will successfully outweigh the trade-off of air quality problems. It adds the the VTP projects will prevail with the permitting authority APCD because project proponents intend to argue there will be 'imminent and substantial economic loss' if projects are not approved. The document states project 'impacts will be similar to those of any wildfire and last only one to two days.'

*Climate Change*

The VTP EIR fails to discuss cumulative effects the program will have to climate change and greenhouse gas emissions (GHGs). Activities proposed will eliminate acreage in key vegetation areas that serve as GHG sinks. California's pine forests are the only ecosystems in the state that sequester more GHGs than they emit (CA Air Resources Control Board. 2010. California Greenhouse Gas Inventory 2000-2008). Biomass removal greatly diminishes the environmental services of native vegetation. The Board of Forestry and CAL FIRE respectively serve as chair and supporting agency to the Interagency Forest Working Group on Climate Change. A key investigation of this group includes studying the *Effects of California Forests and Rangeland Regulations and*

*Programs on Greenhouse Gas Goals*. The VTP EIR fails to reflect the commitment of ameliorating affects of climate change.

*Geology and Soils*
The VTP EIR concludes 'Degree of ground disturbances is minor.' The analysis fails to address ground impacts from heavy equipment including trucks, firefighting equipment, construction equipment such as bulldozers, sheepsfoot, flatbeds, water trucks, methods including ripping, and impacts to roadless areas.

*Herbicide Use*
The VTP EIR states all herbicide treatments will be applied in accordance with labeling requirements and ≤10% of all annual program acreage will use herbicides. The VTP EIR infers the entire spectrum of herbicides is available for use in projects because no specific compounds or classes are named. The twenty most used herbicides used in the state between 2005 and 2010 are listed in Chapter 4.17.9. Environmental data for these 20 show:

- 10% are known for birth and developmental damage to mammals
- 15% are acutely toxic to the environment
- 30% are endocrine disruptors
- 35% are carcinogenic
- 100% have the potential for water contamination

(US Environmental Protection Agency. Toxics Release Inventory Database. 2013)

The VTP EIR Appendices C through H inclusive address herbicides. The one and only formulation specifically addressed in the six appendices is 2,4-D. This compound is one of the most commonly used herbicides besides glyphosate. The drift capacity for 2,4-D can be 400% greater than other herbicide compounds (Association of American Pesticide Control Officials. 1999. Pesticide Enforcement Survey).

The one fungicide is proposed for application in the VTP EIR. Boron is registered as three formulations in California. One of these is acutely toxic (US Environmental Protection Agency. Toxics Release Inventory Database. 2013). The VTP EIR fails to specify which of the three compounds will be approved for use in projects.

Chapter 4.17.11 places herbicide use of the program in the context of forest practices. Again, forest management rules do not necessarily apply to lands management in other and all regions in the diverse state.

Chapter 5 – Environmental Analysis and Mitigation states project cooperators will have the responsibility of follow-up treatment for as many as ten years following the initial treatment. Applications will be done either by hand or aerially. The VTP EIR fails to state discuss environmental protections with subsequent treatments.

Chapter 6 – Cumulative Effects fails to address environmental implications of repeated use of any formulation that has an extended half-life, capacity for drift, and controls for application. 'The relative size of the VTP program is small and it is unlikely this program will create cumulative effects or further degrade a currently impaired watershed.' The narrative adds VTP target area Sacramento Valley is one of the bioregions most impaired for pesticide loading. The analysis fails to correlate the already existent environmental pressures and bioaccumulation resulting from regional pesticide use in that area with additional applications from the VTP and the ecosystem connectivity and interdependence of the Sacramento Valley, San Joaquín Valley, Delta, and San Francisco Bay Regions.

The document fails to differentiate which herbicide formulations are general or restricted use, which host residual effects, how/where each will target which vegetation, size, scope of treatment areas, and how many acres per year will be chemically treated, especially with regard to annual follow-up maintenance. The DEIR narrative focuses on protecting salmonid habitat from herbicide drift and fails to specify how the program intends to address other short and long-term effects on water bodies, non-target species, wildlife, domestic animals, and humans.

*Prehistoric, Historic, Ethnographic, and Paleontological Resources*
Chapter 4.8 states most VTP projects will be located in areas of the coast, rivers, creeks, springs, grasslands, and woodlands. These areas are the predominant ones where cultural, ethnographic, and historical resources are found. It is highly likely and probably that not only will these resources be identified in project areas including cemeteries (CPRC ch 1.75 §§5097.9 - 5097.991; HSC §7050; CCR Title 14, ch 3). Table 5.8.1 concludes no adverse effects from the program anywhere in the state. Chapter 6 - Cumulative Effects categorically states VTP projects will not affect these resources. There is categorically no rationale for this determination.

*Rangeland*
The VTP EIR refers to the potential projects in the program's main target areas of rangelands as necessary to protect natural resources, water quality, production, and the land base itself from wildfires and encroaching development. It fails to develop an argument for fire protection on these lands except to address 'invasives and suitable forage.' Rangelands were once considered areas supporting stands of native plants. They are universally now defined as marginal lands that have been or are susceptible to alteration to introduce and support agronomically desirable exotic species (LA Stoddart, AD Smith, TW Box. 1975. *Characteristics of Rangeland.* Range Management. McGraw Hill). The VTP EIR fails to develop an argument to support the program primary focus of rangeland in terms of overall projected treatment acreage.

*Visual / Aesthetic Resources*
The VTP EIR Chapter 6 Cumulative Effects analysis states no mitigation is required in the program as impacts will be less than significant. It adds an unqualified and uncited *rule* that viewshed disturbance must be 'greater than 10% of scenic byways in a bioregion in a 10-year period.'

California District Court determined 'Scenery, unlike air and water quality or even recreational access, is difficult to quantify. It can include:

- scenic resources viewed
- major roadways and geographical features
- quality of special views of scenic features in the natural landscape
- viewshed from public resource areas and trails

(League to Save Lake Tahoe v. Tahoe Regional Planning. 2010. 739 F. Supp. 2d1260 – Dist. Court, ED California)

The VTP EIR fails to acknowledge the effects of temporary visual damage to project sites and viewsheds. The context for analyzing visual and aesthetic resources in the document is with regard to forestry.

*Water Resources and Water Quality*
Chapter 2 of the VTP EIR states, 'Class I and II watercourses located within project areas will be within protection zones and secured from heavy equipment.' Mitigation measures listed in Chapter 7 add Class III watercourses will be protected. 'Other wetland areas will be permitted for use to help contain escaped wildfire by US Army Corps of Engineers and CA Department of Fish and Game [sic].'

Vegetation treatment activities listed in the VTP EIR will have negative environmental effects to all types of wetland and riparian areas throughout the state in addition to Classes I, II, III watercourses that are located in proximity to projects. State law broadly encompasses all Waters of the State with any and all vegetation management projects located near or adjacent to waters subject to regulatory authority, permitting, mitigation and reporting requirements to ensure water quality. Projects are subject to local permitting authority including and not limited to grading ordinances and stormwater permits.

Drafting of surface water is subject to review, application, and permitting appropriations through State Water Resources Control Board. The VTP EIR discusses other water quality issues including state impaired water bodies, the accompanying §303(d) list and Total Maximum Daily Loads (TMDLs), Basin Plans, and Beneficial Uses. It fails to address how program projects may affect these criteria. A deduction can be made from the summary table of state impaired water bodies (Table 4.7.3) that proposed VTP activities will contribute to pollutant loading due to: grazing, atmospheric deposition, construction/land development, habitat modification, hydromodification, sediment loading, non-point source discharge, and urban runoff.

The watercourses class system definition used in the VTP EIR is one generally applied to forested watersheds and definitionally too narrow for appropriate planning and use in the proposed large-scale and geographically diverse program. Two tools employed by the VTP to assess watersheds and water quality are: 1) *California Forest Practice Rules*; 2) *Cumulative Equivalent Road Acres* (CERA). CERA is designed for and primarily used in forestry analyses, does not utilize field data, and is considered a 'paper tool' to calculate hill slope disturbance. Key analytical components omitted when using this tool include: physical and biological processes and sediment loading (US Forest Service. 2010. Lower Trinity and Mad River Motorized Trail Management FEIS). It is not appropriate to correlate proposed projects to forest science and analysis in this document since forested acres are significantly less than other land types. The environmental analysis for water quality in the VTP EIR is flawed because it utilizes inappropriate analytical tools and does not consider the potential for watershed level effects to natural processes and life forms inherent in the watersheds and sub-watersheds.

<u>Omissions</u>
*Chapter 8 - Environmental Checklist* is a key and required component of the document. It was not released for public review prior to the comments deadline. The Checklist is essential to assess the potential environmental impacts of each proposed project in the program.

The VTP EIR fails to focus on the greatest losses to life and property in the state, which are located in the *Wildland Urban Interface (WUI).* There is increased likelihood of fires starting closer to urban development (Syphard, AD; Radeloff VC; Keeley JE, *et al*. 2007. Human influences in California fire regimes. *in Ecological Applications*. 17:1388-1402). The US Congressional Research Service recently concluded wildland fire protection needs to focus on structural, landscaping, maintenance, planning, zoning, renovations, and building regulations. Appropriations need to be allocated away from wildland vegetation and toward communities. The successes of wildland treatments that focus solely on vegetation realize only moderate successes (RW Gorte, K Bracmort. 2012. Wildfire protections in the wildland urban interface. Congressional Research Service. Washington DC).

The VTP EIR lacks programmatic specificity, analysis, and fails to address if the program:

- requires a specific frequency of follow-up treatments
- will involve associated post-treatment applications that may require environmental planning such as large-scale application of nitrogen, phosphorus, sulfur, micronutrients, and herbicides
- will convert natural habitat to introduced flashy fuel grasslands
- requires a grazing management plan or other planning documentation
- requires adherence to a grazing systematic approach to include activities such as long-term managed, exclusionary, rotational, or other prescription for grazing after treatment
- prescribes private lands cooperator to protect listed species, untreated habitat, water, soil, cultural, and historic resources
- exacerbates possibilities of increased fire frequency and associated dangers to firefighters, life, and property for rangeland improvement/conversion projects

<u>Conclusion</u>
The VTP EIR as an environmental document fails to provide a framework for the larger proposed program. The VTP and its predecessor program, CAL FIRE Vegetation Management Program, are designed to be cooperative and share cost under-takings. The plan fails to discuss program content, CAL FIRE and cooperators roles, fiscal and actual responsibilities for all participants, legal and stewardship requirements, short and long

term accountabilities. The concept is grotesquely broad in scope, intended to address both wildfire and land based economic improvement in the third largest and most populous state in the union. It fails to acknowledge the most pressing wildfire threat to the WUI, suburbs, exurbs, and most current fire science that affords the compelling argument the risks of wildfire must be addressed at both planning and community levels.

It is our strong opinion the VTP EIR model is based in anachronous principles and goals that once governed land management in California. Agriculture, forestry, and open space thankfully remain strong assets of the state and clearly should be protected to uphold their economic, cultural, and environmental values. The VTP EIR fails to be a working document that addresses sources, places, and science of current wildfire risks and land protections. A paucity of federal and state dollars for fire, land management, and environmental stewardship in California deserve more rational, inclusive, and broad-based public participation at levels of planning and project execution.

<u>Closing remarks: Suggestions to strengthen this VTP EIR</u>

- Abandon efforts to move forth with the VTP EIR. The tenets of the approach to vegetation management are based on an old planning model that should be updated to reflect and meld modern fire science, built environmental planning standards, and incorporate agricultural industry objectives. The document should not focus on forestry science as a basis for planning due to the landscape diversity and myriad land uses within California
- Create a new science and planning based fire model and associated treatment program that incorporates addressing statewide fire management at two primary and distinct focus levels: 1) Wildland Urban Interface, including urban, suburb, and exurb areas; 2) economic land features including rangeland and forest production
- Form an inclusive working group to create the new plan and document with input from CAL FIRE, Board of Forestry, academic, state, and federal agency environmental scientists, planners, and managers, representatives from landowner and industry groups, environmental working and law groups
- Include less encyclopedic background information and add more specificity than found in the existing PEIR VTP. Address projects of particular habitat types within bioregions, proximity to wildland-urban interface and recreation areas, landowner responsibility for structural and ornamental vegetation design and maintenance, employs most current fire and biological science. Ensure scientific and planning analyses are conducted for all proposed actions, best management practices, mitigation, and alternatives
- Distinguish and separate mitigation measures from Best Management Practices (BMPs). Incorporate BMPs and mitigation measures into the narrative of the document to highlight their respective actions and roles in the program
- Require both an *independent* biological monitor unaffiliated with the cooperating agencies and landowner AND *Most Likely Descendent* (MLD) referred by California Native American Heritage Commission at each and every project site to ensure compliance with environmental and cultural resource laws

- Conduct environmental review of the document from a representative committee of the larger working group prior to public release

# EXHIBIT 16

## Panel Review Report

of

# Vegetation Treatment Program Environmental Impact Report Draft

by

California Board of Forestry and Fire Protection

In Association With

CAL FIRE Agency

Report coordinated by: California Fire Science Consortium


VTPEIR Peer Review Panel

*Oversight and co-coordinators:*

Scott Stephens, UC Berkeley Professor of Fire Science (CFSC co-chair)

Robin Wills, Regional Fire Scientist, National Park Service (CFSC co-chair)

*Project coordinator*

Stacey Sargent Frederick, California Fire Science Consortium Program Coordinator

*Panel members:*

Jay Perkins, Fire behavior specialist, US Forest Service (ret) and consultant

Ed Smith, Ecologist, The Nature Conservancy

Bill Stewart, UC Berkeley Forestry Specialist

Jan van Wagtendonk, National Park Service scientist, emeritus

Paul Zedler, Professor of Environmental Studies, University of Wisconsin


August 2014

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# Chapter 1. Introduction

The draft Vegetation Treatment Program Environmental Impact Report (VTPEIR) was completed by CAL FIRE staff and their consultants in 2012. It was delivered to the California Board of Forestry and Fire Protection who have the legal responsibility to approve the EIR. Actions under this EIR were to be implemented primarily by the CAL FIRE agency. The draft details vegetation treatments that would be used to reduce fuels for fire prevention, safety, ecological restoration and other purposes. Projects using the CEQA of the VTPEIR could be undertaken on non-federal lands with some of the costs provided by funds awarded annually through the state legislature. The VTPEIR draft was opened for public review in 2013. Given the response from the public and other stakeholders, it was recommended by the state legislature that an outside review of the draft VTPEIR should be conducted. The results of that review are provided in this report.

The process of the review, information on the panel members, and an overview of the main findings are in Chapter 1. From this overview, each major issue and recommendations on how to address the issues are given in Chapters 2.1 through 2.6. Additional information (background, specific issues, and recommendations) can be found in the Appendix. Specific and global questions that were provided by the legislature and CAL FIRE staff are briefly addressed in Chapter 3. However, once it was clear that the Panel's consensus was to recommend a major revision to the VTPEIR, many of these questions became too specific or irrelevant, and thus were not addressed extensively in this report. Finally, additional information and a list of bibliographic references are provided to assist with the revision of this VTPEIR in the Appendix.

## 1.1 Review Process

The California Fire Science Consortium (CFSC) was commissioned by CAL FIRE and the Board of Forestry and Fire Protection to assemble and coordinate a team for a peer-review of the Draft VTPEIR.

### *VTPEIR Peer Review Panel*

*Oversight and co-coordinators:*
Scott Stephens, UC Berkeley Professor of Fire Science (CFSC co-chair)
Robin Wills, Regional Fire Scientist, National Park Service (CFSC co-chair)

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Jan van Wagtendonk, National Park Service scientist, emeritus
Paul Zedler, Professor of Environmental Studies, University of Wisconsin

### *Summary of Panel Activities*

During the course of this review process the panel was given the following documents and examples:

- The VTPEIR Draft
- Letters of public comment from the VTPEIR comment period
- Project level Vegetation Treatment Plans from within the CAL FIRE agency
- Global and specific questions regarding the VTPEIR that were negotiated between CAL FIRE, Board of Forestry, and the Legislature

#### *Panel meetings*

04/28-05/01 Pasadena, CA and San Diego, CA

> During this meeting, personnel from CAL FIRE took the panel on a tour of example fuel reduction projects conducted by CAL FIRE and LA County Fire. CAL FIRE staff from many position levels participated in this field tour. Stakeholders of the area who sent in comment letters from the initial comment collection period were also invited to attend meetings and provide input to panel members during this week. *Stacey Frederick and Robin Wills were absent, all others present.*

05/29-05/30 Auburn, CA

> This meeting began with field tours of three fuel reduction projects conducted by CAL FIRE. Associated VTP and project level documents were given to the panel. Again, various CAL FIRE staff, from the chief to the VTP planner attended this field tour and the following meeting. The following day consisted of a panel-only meeting to begin organizing thoughts for this draft. *Scott Stephens and Robin Wills were absent, all others present.*

## 1.2 Overall Evaluation

It is the panel's recommendation that the VTPEIR undergo major revision if it is to be a contemporary, science-based document. This will enable CAL FIRE's VMP foresters and fire staff to prioritize and design vegetation management projects framed around the different vegetation communities and their fire regimes throughout the state. VTPEIR projects should explicitly address project specific questions concerning the relative efficacy and appropriateness of different fuel treatments. Proposed treatments and re-treatment strategies tailored to historic fire regimes would theoretically minimize adverse ecological effects in situations where a goal is to maintain the current vegetation. In other situations, the goal may be to alter the current vegetation for ecological restoration or public safety goals. The complexity of California's vegetation as well as the many goals for vegetation management in fire prone areas means that there are no guaranteed 'best practices.' One avenue to move forward on defining and implementing best practices would be to utilize formal adaptive management: rigorous analysis of monitoring data collected in response to implementation of a representative sample of VTP projects. From monitoring efforts, the EIR could be used to implement projects and collect information on the relative efficacy and ecological effects of treatment and vegetation combinations.

The VTPEIR should explicitly describe how the treatments proposed for private lands fit into the state's overall fire plan, including protection of high value assets, state and local land use planning policies, and federal land use practices. Links between this EIR and the broader structure of fire management (including CAL FIRE's 2012 Strategic Plan, the Board of Forestry's 2010 Strategic Fire Plan and Community Wildfire Protection Plans (CWPPs)) should be described. There must also be a better explanation of how CAL FIRE will provide the Legislature and Governor's office with a logical and transparent plan of why and where increased expenditures on fuels management would be appropriate and effective. A revised VTPEIR should also include: a more realistic set of alternatives that would have lower acreages (10-15 year EIR) than those that are currently proposed; assumptions and plans that rely more strongly on scientific research results; results from internal and external monitoring of the different treatment and vegetation combinations; use of monitoring results to revise future plans and; adaptation suggestions to mitigate the potential for increased risk from treatments to public safety, public assets and environmental assets.

If the current EIR document is used as is, projects could be implemented without valuable planning and collaboration that would ensure both ecological and social goals are being met with minimal environmental impacts. Without deliberate oversight and revisions to the VTPEIR, unassessed environmental impacts and irreparable damage to public-agency relationships could result. This risk is what compels the panel to recommend the following revisions.

# Chapter 2. Specific areas of Concern

## Section 2.1 Conceptual Framework

### *2.1.A. Issue: Organization*

The current VTPEIR attempts to collapse the state's varied fire and fuel regimes into a standardized matrix where all treatments are equally effective in all landscapes and fire regimes. California is the most diverse and endemic-rich state in the Union from a biodiversity standpoint (Stein *et al.* 2000, Stein 2002); thus management of its vegetation cannot be covered in a single document without different sections to reflect this diversity. Not only are there significant differences in the ecological role fire plays among trees, shrubs, and grasses, but these roles differ by ecoregion. Varying roles mean that vegetation treatments, fire behavior, and fire effects are also different.

While the panel recognizes that the VTPEIR included specific goals for different ecoregions, locating this information was very difficult. The information given also lacked the specificity to be of any real use given the various combinations of fuel types and project types within each ecoregion.

### *2.1.a. Recommendations*

The diversity of vegetation across California and the statewide complexity should be recognized and explained throughout the document. These factors should also be explained in the introduction and executive summary. Furthermore, information related to any aspects of on-the-ground planning (i.e. specific goals, objectives, fire behavior, flora and fauna considerations), should be separated into three sections.  These sections will be one for each of the major vegetation formations found in California: forests, grasslands, and shrublands. For further justification and descriptions of these three fuel types, see Appendix 1.1.

Within each of these three sections of the EIR, different project types should be delineated. These project types are Wildland-Urban Interface (WUI), fuel breaks, and ecological restoration. The result should be displayed in a matrix with specific goals and rationales under different project types given different vegetation types. Finally, for each of these projects, a sound scientific justification should be provided for both the fire and fuel management aspects as well as any ecological rationales.  An example rational matrix under the new organization scheme is in Appendix 1.5 (Table 1.5.1).  As will be noted in the following sections, projects in the WUI should become a stronger focus for this VTPEIR given their importance in other fire management documents (i.e., 2010 Strategic Plan) and their effectiveness (Calkin *et al*. 2014; Cohen 2010; Cohen 2008).

### *2.1.B. Issue: Executive summary needs more useful information*

Given the complexity and length of the whole VTPEIR, the importance of having an easily accessible, clear, and useful executive summary is heightened. Currently, this section does not function as a standalone or useful document. This is primarily due to the lack of vital information. The executive summary also fails to lay out a clear, compelling justification for why these outlined projects need to be implemented.

### *2.1.b. Recommendations*

The following pieces of information should be included in the executive summary:

- A clear statement about the problem the state is trying to solve, e.g., provide a compelling case for expending tax dollars on the hazard of wildland fuels reduction program
- A discussion on how this investment will affect the wildfire environment and how projects done under the EIR will benefit the state and its' occupants
- An introduction to the organizational structure of the document to assist in navigation
    - Specifically, this executive summary should guide a VMP planner to the sections most pertinent to their planned project.

## Section 2.2. Fire Behavior

### *2.2.A. Issue: Fire behavior and suppression effectiveness need additional discussion*

The wildfire analysis in Chapter 4 of the EIR is robust and quite complete. In particular, the "Fuel Rank Potential Fire Behavior" (FRAP 2010) product gets at the heart of what needs to be altered or modified in order to change fire behavior, fuel and vegetation. Of the three determinants that drive fire behavior—topography, weather and fuels— only fuels can be modified in order to change fire behavior. When fuels are altered, these two important fire behavior characteristics are altered: fire line intensity and rate of spread.

CAL FIRE already has tools to address these fire behavior aspects. Within the body of the data used for developing the Potential Fire Behavior product, it is stated that:

> *"CDF has developed a Fuel Rank assessment methodology for the California Fire Plan to identify and prioritize pre-fire projects that reduce the potential for large catastrophic fire. The fuel ranking methodology assigns ranks based on expected fire behavior for unique combinations of topography and vegetative fuels under a given severe weather condition (wind speed, humidity, and temperature). The procedure makes an initial assessment of rank based on an assigned fuel model (see surface fuels) and slope"* (FRAP 2010).

### *2.2.a. Recommendations*

The EIR should use the Fuel Rank Potential Fire Behavior (FRAP 2010) metric as means for analyzing and setting goals and objectives for hazardous fuels reduction work. The use of this tool should be clearly outlined in the VTPEIR.

There are myriad citations (many in need of more recent references) within the EIR that support and explain the value in manipulating vegetation fuels to a point where fire behavior can be altered (reducing intensity, extent, and rate of spread). Below is one example (page 5.2-2)

> *"Fuel management practices clearly reduce fire behavior, particularly for area treatments such as broadcast prescribed fire (Biswell 1963, Truesdell 1969, Van Wagner 1968, Helms 1979, Rawson 1983). Fuel treatments removing ladder fuels on forested systems can significantly affect potential for crown fires, which are extremely difficult to control and often devastating (Dodge 1972, Rothermel 1991, Sapsis and Martin 1994). Fuels management also significantly reduces wildfire occurrence and acreage burned (Weaver 1955 & 1957, Davis and Cooper 1963, Wood 1978, 1979). In Southern California, fuelbreaks, areas previously burned by wildfires, and areas that had been prescribed burned, all contributed to limiting the final size of the 1985 Wheeler Fire (Salazar and Gonzalez-Caban 1987). Walker (1995) reports that the 1995 Warner Fire*

*and the 1993 Geujito Fire similarly lost intensity when they ran into recent prescribed burn areas."*

The VTPEIR should clearly show the suppression effectiveness of current vegetation condition and analyze how moderating the fuels will improve the state's effectiveness in keeping fires small and more controllable. This, in turn, should present fewer, costly large fires. A key point of the rationale for treatments that modify fire behavior is that escaped large fires generate much of the costs for fire suppression.

#### *Specific recommendations*

1. Define the probability of successful suppression (Initial Attack (IA) and Extended Attack (EA)) effectiveness for each of the Fuel Rank Potential Fire Behavior classes. This analysis will set the stage for the current situation and provide a benchmark against which each EIR Alternative can be evaluated. For a demonstration of this, see Appendix table 1.2.2.

2. Evaluate Probability of Success for each EIR Alternative: After quantifying the Probability of Success (step 1) the next step is to assign Probability of Success for each Alternative. By altering surface, ladder and/or crown fuels, the Fire Behavior ranking will change. The fuel profiles can then be targeted for priority treatment and to reduce the Fuel Ranking Fire Behavior Potential. Comparing the outcomes by EIR alternatives will give the decision makers a sense for whether there is an incentive for investing in a given set of fuels reduction projects. This will help to answer both EIR Goals 2 and 3.

3. Unit Fire Management Plans should specifically address a strategy within their Units for targeting areas of concern and how their treatment proposals will reduce the Fire Behavior Potential of each specific project.

### *2.2.B. Issue: Need a better rationale of how different fuel treatments meet different goals, especially that of fuel reduction near communities*

The EIR has limited discussion or analysis on goals or objectives to be achieved in or proximate to communities. However, Cohen's research has shown many times over that the most effective treatments for home survival are those proximate to structures and infrastructure (Calkin *et al*. 2014; Cohen 2010; Cohen 2008).

Effective treatments are those that alter surface, ladder or crown fuels (Agee and Skinner 2005) to the extent that fire suppression can be done more safely and effectively. They are ecologically effective if a treatment alters fuels so that when the next wildfire does occur, the resulting fire severity is not deleterious to the immediate or surrounding ecosystems. For examples of these, see Appendix table 1.2.3. A discussion on how effective the hazardous fuels treatments will perform for both fire weather scenarios (levels) previously described should be included.

The EIR uses Finney's (2001) work and assumes that strategically treating 20-35% of a landscape is sufficient for changing fire behavior. The intent of Finney's work is to strategically place area treatments (a mosaic of treatments across a landscape) where fire behavior will be altered. By having strategically placed patches of fuel-reduced areas across the landscape, the fire behavior could be altered, perhaps at a landscape scale or perhaps more locally. Typical examples that have been effective are thinning or timber harvest projects that can visibly show a change in fire behavior (Skinner *et al.* 2004). Regardless of ownership or purpose, the reduction of fuels often greatly slows a fire and can allow the firefighters the needed chance to suppress or manage a fire.

### *2.2.b. Recommendations*

The EIR needs to explain separately how treatments of fuels will be designed to function in the WUI (i.e. as a linear fuel break along one side of a community) and how they will be designed to function in larger landscapes where potentially complementary activities such as forest management, grazing, or irrigated pastures can also be part of the overall fuels modification. Given that CAL FIRE does not own the land and bases much of their work on having willing landowners step forward, achieving 35% of lands treated in a strategic manner may not be possible.

Irrespective of the manner by which a fuel profile is modified (grazing, prescribed fire, mechanical means, etc.) for fire suppression and community defense purposes, if the treatment does not reduce or change fire behavior, then the proposed project should be reconsidered. Additionally, if the fuel modification project is for reducing fire effects and fire severity, and the modeling indicates that it will not, then the project should be reconsidered. Project level fire planners should be using state of the art analytical tools for evaluating the effectiveness of reducing fire line intensity and spread rates. The same is required for analyzing fuels management treatment effectiveness on post-wildfire fire severity. Examples of these tools include FOFEM, Farsite, BehavePlus, FlamMap, and FireFamilyPlus.

The VTPEIR needs to include a more rigorous analysis on the interface problem and how projects should be utilized to enhance community protection objectives besides just treating landscapes. The EIR should be able to display the tradeoffs between performing fuels reduction work in support of community protection projects (i.e. Community Wildfire Protection Plans) and using fuel reduction on a landscape scale. CAL FIRE has participated in such an analysis and it could be carried forward in the VTPEIR. From the Sierra Nevada Forest Plan Amendment (FEIS Volume 2, Chapter 3, part 3.5 – page 273- Affected Environment and Environmental Consequences):

> *"Working collaboratively the SNFP Interdisciplinary Team and the California Department of Forestry and Fire Protection (Sapsis et al. 2000) tested the potential threat to Sierra Nevada communities located in urban wildland interface areas. For the purposes of their analysis, urban interface areas of settlement were defined as those with housing*

*densities of 16 or more houses per square mile (1 structure per 40 acres). From these areas, two zones were buffered: (1) an inner "Fire Defense Zone" (0.25 miles wide) and (2) an outer "Fire Threat Zone" as a 1.25- mile area immediately adjacent to the inner fire defense zone. These zones are consistent with the California Department of Fire and Forestry's working definition of the Wildland Urban Interface (WUI) and the definition of urban wildland intermix zones used in this FEIS."*

This level of analysis would help to evaluate how much investment in fuel modification in and around communities would be needed to continue working towards safer and better fire-adapted communities.

### *Specific Recommendations*

**STATE-WIDE**

Develop a state-wide set of hazardous fuels management desired future conditions. Each Unit Fire Plan should address how their hazardous fuels reduction projects will achieve this desired condition. For example:

> Priority 1: Reduce very high and high ranked fuels (see the Fuel Rank Potential Fire Behavior) to 'moderate' or 'below moderate' (where ecologically appropriate) in and around WUI/communities threatened by wildfire. Ecological principles should be considered; i.e., not introducing high severity burns or serious ground disturbing activities in areas where invasive species threaten local native species. Proposed fuels treatment activities should examine alternatives or mitigations to the proposed actions so that hazardous fuels reduction goals can still be met while minimizing the chance of an invasion by the exotics.
>
> Priority 2: Focus hazardous fuels work on landscapes that are severely threatened and are in Condition Class 2 or 3 (VTPEIR Page 4.2-13). Alternatively, use the Fire and Resource Assessment Program analysis of threatened landscapes from the CAL FIRE 2010 Strategic Fire Plan.
>
> Priority 3: Maintain areas already rated 'moderate' in the Fuel Rank with a priority on areas adjacent to WUI and critical or threatened ecological objectives.

### *Ranger Unit/Project Level*

Husari *et al*. in Chapter 19 from "Fire in California's Ecosystems" (Sugihara *et al*. 2006) set out clearly that the fuels management objectives should be for modifying fuels for fire behavior and/or for ecological benefits.

A set of fire behavior-driven hazardous fuels reduction objectives could be established that would aid the project implementers in setting project goals and objectives (see Section 2.1). For the set of fire modeling tools Unit-level fuels abatement plans should be using, refer to the Section 2.2.b Fire Behavior (Recommendations b (p. 10)).

## *2.2.D. Issue: Need to clarify terms and concepts in relation to the VTPEIR*

A few terms and concepts in the VTPEIR are recommended below for review.

## *2.2.d. Recommendations*

1. Use fire behavior analysis, where appropriate, instead of fire severity

   The terms fire severity and fire behavior are interchangeably used in VTPEIR Chapter 5. However, these terms are not synonymous and each portray a unique factor in the wildland fire world. The VTPEIR uses the fire severity analysis as the metric for evaluating Alternatives and achieving EIR goals. In many cases, a more accurate metric would be fire behavior analysis. For a more in-depth description of the differences between these two terms and their use, see Appendix 1.2.

2. Define 'severe weather'

   The fire related modeling in the VTPEIR is for 'severe fire weather conditions.' The term 'severe fire weather condition' is not defined in the VTPEIR nor is there a rationale as to why this level of fire weather was used for modeling purposes. Fire modeling should be tested against the severe fire weather event (i.e. 95$^{th}$ percentile and 97$^{th}$ percentile) as well as a fire weather event that is a more typical fire season event, i.e. 80$^{th}$ percentile. Fire weather breakpoints are points on the cumulative distribution of one fire weather/danger index computed from climatology without regard for associated fire occurrence/business. For example, the value of the 90$^{th}$ percentile energy release component (ERC) is the climatological breakpoint at which only 10 percent of the ERC values are greater in value (National Wildfire Coordinating Group 2014).

3. Fuel breaks

   Another hazardous fuels strategy that needs to be analyzed is the design, development, and maintenance of fuel breaks. Fuel breaks as defined in the CAL FIRE 2010 Strategic Fire plan are "*wide strips of land on which trees and vegetation has been permanently reduced or removed. These areas can slow, and even stop, the spread of a wildland fire because they provide less fuel to carry the flames. They also provide firefighters with safe zones to take a stand against a wildfire, or retreat from flames if the need arises."* There is much discussion over the effectiveness of fuel breaks as embers and crown fires may easily be able to cross this barrier, especially given certain weather conditions.

   Fuel breaks require up-front investment to establish and routine maintenance to retain their effectiveness. The VTPEIR should address how fuel breaks fit into the hazardous fuels reduction programs and expenditures of hazardous fuels reduction dollars. The Alternatives in the VTPEIR should evaluate different levels of investment and maintenance while considering their effectiveness (Reinhardt *et al*. 2008). The tradeoffs between fuel break effectiveness and the ecological damage done should be carefully considered.

The VTPEIR needs to make a case for the effectiveness of fuels breaks across various fuel types, i.e. grass, shrubs, and timber. There should be an inventory and evaluation of the fuel breaks within the state that includes the development costs associated with continuing to develop and maintain a system. In the absence of fuel break data, the Unit Fire Plans should justify their expenditures of hazardous fuels reduction dollars for the continuing investment in developing and/or maintain existing fuel break against doing projects on a landscape scale or projects proximate to communities. Across all of the Alternatives within the VTPEIR, different levels of investment (capital and maintenance) in fuels breaks should be clearly detailed (Agee *et al*. 2000).

## Section 2.3. Southern California Chaparral and related systems

### *2.3.A. Issue: Acknowledgement of the diversity and complexity of shrub ecosystems*

The VTPEIR as written does not appropriately represent the significant difference between the fire-vegetation relation for chaparral types and that of forests. Fire recurrence in forests is typically dependent on frequent ignitions resulting in moderate to low intensity fires burning in light fuels mostly beneath mature trees. These are not “stand replacing” fires (except perhaps for some understory herbs and shrubs and occasional small, patchy crown fires). In contrast, chaparral fire recurrences are much less frequent and typically kill most of the above ground biomass (Hanes 1971). Although in one sense these are “stand replacing fires,” as most or all of the above ground portions of the plant are consumed or killed in another they are not, because the chaparral will have much the same species composition as it had before the fire after a transient period in which short lived herbs and some shrubs may be prevalent or even dominant. This will be the case as long as the species can reproduce from sprouts or viable seeds.

The diversity of California shrub ecosystems is confirmed by the fact that the Manual of California Vegetation (Sawyer *et al*. 2009) defines more than 100 shrub dominated “vegetation alliances.” In addition, there are multiple tree alliances that include substantial shrub components. Over large parts of California, shrublands and forests intermingle in complex ways. There is a gradient from uniform shrublands (chaparral, coastal sage scrub, sagebrush steppe) to shrublands with scattered trees (e.g., “Foothill Pine Woodland” — shrublands with emergent trees) to mosaics of shrub patches within forest, to forests with varying densities of shrub understories. Shrublands and grasslands also intermingle in a similar way, though this has been much more confused by human activities, especially fire, land clearing, and grazing, than the forest-shrub relation.

This taxonomic and ecological richness of shrublands should be kept in mind when viewing shrubs and shrublands strictly as fuel. As fuel, shrubs are more often than not seen as needing to be modified. But from an ecological perspective, shrublands are an essential element of California landscapes, providing cover in places where forest and grassland cannot be stable.

### 2.3.a. Recommendations

The complexities of this ecological diversity require a much attuned ecological understanding to effectively manage this vegetation type and preserve the functions of this ecosystem. While many individuals within an agency like CAL FIRE are very knowledgeable about the natural history and ecology of the systems with which they work, no institution or group can be said to possess all the knowledge necessary to provide infallible guidance for the multiplicity of situations on the ground that potentially require management. What this situation suggests is that evolving a maximally efficient and minimally ecologically damaging regime of pre- and post-fire vegetation management is a task that must enlist the expertise of multiple agencies and many persons with expert knowledge. But "the current best science" is not sufficient. There are uncertainties that arise because we do not fully understand how ecosystems respond to our actions under known environmental conditions, and because the environmental conditions, which have never been wholly predictable, promise to become even less predictable in the near future.

To address these concerns, the first step is to weave a firm understanding of the complexities of the shrub ecosystem throughout the VTPEIR document. As suggested in Section 2.1.A, the diversity of California's vegetation must be a major component of this VTPEIR. As the vegetation types are different, the treatments and rationale for treatments must also differ. The second step is to redefine the goals of projects in shrublands to focus more on the main CAL FIRE responsibility — fire protection in ways that minimize damage to natural systems— and less on the conservation of natural systems. For further discussion and background on both these steps, see Appendix 1.3.

As there is not strong scientific agreement on how fire and fuel reduction should be used in these southern shrub areas for ecological restoration, the current recommendation is to focus on projects that protect WUI areas with minimal harm to the ecosystem rather than attempting to achieve ecological goals in these areas. Until the intricacies of shrub-dominated ecosystems are better understood, limited projects should be completed outside the WUI. If treatments are performed beyond the WUI, there should be a strong justification that demonstrates:

- That there are not more suitable WUI-project alternatives that could achieve goals more efficiently and with less environmental harm
- That there is a detailed plan designed by those with expert knowledge that shows a strong rationale based on literature
- How the goals will be achieved (e.g. that a fuel break is __% likely to be effective)
- That mitigation measures for adverse impacts and monitoring provisions are provided
- That, in addition to the normal public meeting required, comments are collected and formal responses (possibly showing changes to the plan in response to such comments) are given

## Section 2.4. Monitoring

### *2.4.A. Issue: Lack of standardized and systematic monitoring programs*

From both the VTPEIR document and the site visits by the Panel, there was a consensus that a monitoring program is needed to ensure that treatments are implemented as planned, and to check the effectiveness and impacts of any vegetation management program. The VTPEIR does not currently outline satisfactory requirements for monitoring to occur but rather relies on anecdotal methods of observation with limited to no pre/post observations. Specifically, the current 'checklist' does not accomplish either verification of implementation or effects of management on biota or fuels. Chapter 7-1 of the VTPEIR states four main monitoring programs. While the 'baseline' and' implementation' programs are well-defined, the 'effectiveness' and 'validation' monitoring programs are not. The latter two programs are very important and should be outlined in more detail in the VTPEIR or another program of monitoring should be included.

Furthermore, many assumptions within the VTPEIR are drawn from broad-based research and may not be inferable to specific VTPEIR projects. While vegetation management has been done for decades in California, there is still a dearth of systematic information relating to projects in different ecosystems. The VTPEIR provides the opportunity to learn much about California ecosystems and their response to fuel treatments. By outlining and creating a system that requires strong monitoring principles across the state, CAL FIRE will be able to employ the principles of adaptive management to determine project-specific information.

### *2.4.a. Recommendations*

It is recommended that a monitoring system be created that is similar to CAL FIRE's post incident analysis program. This system will utilize mandatory reporting on selected treatments to improve future management. This would also require clearly stating the measurable objectives of projects up-front as well as require stakeholder support of these objectives. It is recommended that every three years, an independent review team will randomly select project sites and report on the effects of treatment. Budgetary requirements that enforce monitoring should be incorporated into the VTPEIR to ensure monitoring occurs. A dedicated budget for monitoring should also be set to ensure the work is achieved.

While the example recommendation is adaptive management, the key element is implementing a monitoring program that has a self-learning component and provides for collaborative decision-making. Requiring that all VTPEIR projects to be monitored would be far too daunting of a task. Instead, it is proposed that representative and randomly selected projects be subjected to closer monitoring (with both pre-project and post-project data collection). By using an established selection method throughout California, the application of the scientific method to a large representative data set can provide for better information on how to manage the landscape in a changing future. The use of sampling over monitoring-holistically will also relieve some of the expense and time of a monitoring program. Rather than having monitoring resources used for all projects poorly, the resources can be devoted to some projects effectively while still providing the needed information.

The monitoring program should include a mechanism for reporting that facilitates constant improvement in both business practices and ecological management. In other words, the results of the monitoring program should be used to plan future treatments based on the success or failures of previous ones. Changes that result in future plans could be related to anything from a lack of change in actual fire behavior characteristics to the protection of an ecological function or even a specific species. Programs, such as CAL MAPPER, that increase transparency within the organization will be a valuable tool in the monitoring process and are an admirable step forward (see Section 2.5 for more information on programs/tools that should be discussed in the VTPEIR).

Although the exact details of this program will be left up to the discretion of the CAL FIRE revision team, a few additional suggestions for the framework follow:

### *Design*

- Each project should rely on reputable and contemporary science (fire ecology, fire behavior, climate amplification, etc.) when characterizing and setting explicit goals and SMART objectives (**S**pecific, **M**easurable, **A**chievable, **R**elevant, and **T**ime-bound) (Doran 1981).
- The design of these monitoring programs should follow that of a scientific experiment and include the testing of hypotheses, identification of uncertainties, and description of assumptions (Before-After-Control-Impact or BACI) embedded within management experiments.
- Any additional tools (i.e. fire behavior models) should be used to show how the proposed management actions will move ecosystems towards the objectives. This stage should use modeling to explicitly show how the proposed strategy is predicted to work during and after implementation.
- Using external, third party groups to implement and analyze these monitoring programs should be strongly considered or required. The benefits of using a third party over an internal reporting system include increased accountability and neutrality, as well as expert oversight throughout the process. Results obtained through a third party may also be perceived as less biased or with a more developed knowledge base (given the potential to include expert ecologist) than an internal monitoring team. Thus additional benefits for the publics' positive perceptions of these programs may result.

### *Data Collection*

- Sample selection: it is recommended that a number of projects for each specific vegetation type and area be randomly selected for inclusion in the monitoring program,

comprising 20% (for example) of total project areas in a given year. However, if a particular project or suite of projects is perceived by the public as controversial (i.e. in chaparral systems), then monitoring this project with heightened scientific rigor and transparency should be considered.
    - A sample could be drawn that represents a TBD percentage of planned projects per year per vegetation/project type.
- Rigorous data collection using standard scientific methods should be used to produce verifiable data.
    - All monitoring should include pre-and-post assessments.
    - Methods should include guidelines for sample size estimation, and statistical power assessment. Resources regarding this recommendation can be found here: http://www.statsoft.com/Textbook/Power-Analysis.

*Analysis and Use of Information*

- The analysis procedures and reporting of results should be outlined with a clear assessment of whether or not the proposed goals were met by the project, and specific procedures that will be followed when goals are not met.
- The knowledge derived from empirical results should be integrated into the next round of management.
- Common criticism and roadblocks for the use adaptive management include too much flexibility for managers to make decisions without a formal and transparent decision-making process. It has been criticized as a program that allows unclear goals and even more unclear future management plans to be implemented. To mitigate these criticisms, the monitoring and management program should provide a site-specific and scientific rationale for all projects (see Section 2.1).

*For additional resources on adaptive management, see Appendix 1.4.*

## Section 2.5. Interaction of projects to be covered under VTPEIR with other projects that change fire behavior

### *2.5.A. Issue: The VTPEIR has limited congruity with previous projects and independent projects*

As initially drafted, the nine goals for the VTPEIR go far beyond the desired accomplishments of fuels reduction projects (for example: Goal 2 is to modify wildfire behavior, Goal 3 is to reduce suppression costs). It currently includes goals that will be the result of a much larger range of projects than will be conducted on private and public lands outside of VTPEIR related projects. Larger environmental outcomes such as enhancing forest health, restoring the natural range of fire-adapted plant communities, maintaining air quality, maintaining water quality, reducing the area of noxious weeds and non-native invasive plants, improving wildlife habitat, and providing a multiple use CEQA compliant document for a wide range of vegetation management projects will be the result of projects covered by the VTPEIR as well as other projects that do not fall under the scope of this VTPEIR.

Reports and projects such as the 2010 Strategic Fire Plan and CAL FIRE's 2012 Strategic Plan provided valuable information that was not clearly integrated into the VTPEIR. While there was mention of some aspects of these reports, the overall linkage between the VTPEIR and these plans was lacking. The previous plans did not appear to be a clear, driving force for the writing of the current VTPEIR. For example, the focus of the Strategic Plans was predominantly based on using fuel reduction to minimize the risk of wildfire to high value assets such as communities. In the VTPEIR, this distinction was not made, but rather all goals were held at the same level of importance. Plans to incorporate programs that provide a proven public-involvement model, such as Community Widlfire Protection Plans, were also lacking.

### *2.5.a. Recommendations*

The larger goals (those other than 2 and 3) cannot realistically be achieved through fuel treatments alone. Instead of promoting all these goals as equivalent, the EIR can hold these as supplementary and ensure that projects do not negatively affect the additional goals. A more tractable EIR would focus on Goals 2 and 3 and treat the other 7 goals as constraints for each project. A greater focus on Goals 2 and 3 would provide a more measurable overlap with the Board of Forestry's 2010 Strategic Fire Plan and CAL FIRE's 2012 Strategic Plan.

Our Panel proposes reorganizing the potential landscape around key vegetation related fire behavior variables (see Sections 2.1 and 2.2.). Specific projects would not be defined by how the fuels/vegetation is altered (e.g. prescribed burn, mechanical or manual treatment, grazing or herbicides) but by three dominant local landscape purposes: 1) wildland urban interface (WUI) around defined communities, 2) creation of fuel breaks, and 3) ecological restoration (where CAL FIRE or another lead agency has well defined and measurable outcomes). Each project should document fire management and/or ecological rationales and explain how it fits into the larger scheme of landscape management. For additional discussion on each of these, see Appendix 2.5.

Other programs, like the Community Wildfire Protection Plans (CWPP) done in conjunction with Fire Safe Councils, are also recommended to be included in a revised VTPEIR, especially given the positive collaboration that already exists between CAL FIRE and such entities. By using the provisions set-up in the CWPP's, the prioritization of goals and projects would be more likely to reflect a cohesive plan that better incorporates the needs of the private landowners and fosters cooperation. Other examples of programs that CAL Fire uses but should be thoroughly discussed in the VTPEIR include CAL MAPPER, fire hazard severity zones (PRC 4201-4204), SRA/DPA Review, and the database of historic fire perimeters.

## *2.5.B. Issue: Recalculate acreage estimates to be more accurate given constraints and conditions*

Throughout the VTPEIR, the estimates of acres treated (especially for prescribed burn treatments) exceeds the realistic limits given the numerous constraints on implementing such projects. These overestimates are not conducive to envisioning the future of treatments in California and may cause both confusion and dissatisfaction among readers of the VTPEIR.

## *2.5.b. Recommendations:*

### *Treatment acres*

The next version of this EIR should not dictate where CAL FIRE can do projects (within the SRA's 37 million acres), but should offer a realistic assessment of the number of treatment acres to undergo treatment per decade. According to the current VTPEIR, over 216,000 acres a year will be treated (if 47,000/year is the status quo, four times which total equals 216,000/year). This is poorly justified. An alternative approach would set an upper limit of acres treated. This limit should be in line with the Fire Plan goal of focusing on high value assets; mainly WUI acres and larger projects of lower cost fuel mosaic acres. Based on the Fire Plan logic, maximizing total acres is not the goal. The goal is to protect assets with effective fuels treatments *and* fire suppression. To better achieve this goal, a fire risk assessment could be used to determine the best areas to apply treatments (see Section 2.2). The revised VTPEIR needs more realistic numbers that better reflect the actual and likely projects that will be completed.

### *Prescribed burn acres*

Much like the overall treatment acres proposed, the amount of projected annual prescribed burning acreage should to be calibrated to a more realistic number that takes into account the many additional restrictions and barriers that may relate to different tools. For example, the use of prescribed fire as a management tool or the burning of piles created by manual or mechanical harvests may be limited in some air basins. The VTPEIR would be more useful if it included current information on the recent experience with the number of burn days, appropriate weather, and public health limitations in different parts of the state. These same considerations and calibrations should be factored into the acreage number for manual treatment acres if these treatments will utilize pile burning to dispose of debris. A provision that encourages cooperation between CAL FIRE units and the local Prescribed Fire Councils could be useful in achieving these goals.

For examples of how the tables should be revised to more accurately reflect acreage, see Appendix 1.5 and Appendix Tables 1.5.2-1.5.4.

## Section 2.6. Information availability and public transparency

### *2.6.A. Issue: Updated, relevant, and scientifically sound information needs to be included in the VTPEIR and in the future project plans*

To improve the VTPEIR, a sound scientific foundation should be reflected with each vegetation management plan providing a clear rationale for the selected action. This should be done by providing additional references to support claims in the VTPEIR and including additional scientific concepts that are relevant to the planned actions.

### *2.6.a. Recommendations*

a) Include additional scientific findings throughout VTPEIR. For specific recommendations on references and concepts see other sections of Chapter 2 and the Appendix in this review report.

b) Create a system to supply CAL FIRE personnel with easy-to-access and relevant information sources.

   i. With the wealth of information constantly being produced and added to fire science, keeping up-to-date can be overwhelming and time consuming. Additionally, many staff of natural land resource agencies do not have access to academic journals, which remain the main avenue for disseminating scientific findings. Given these stipulations, the California Fire Science Consortium can work with CAL FIRE to connect its personnel to needed information through a database of references.

   ii. A major role of CFSC is to translate the scientific research into accessible and understandable products. These include research briefs, summaries, webinars, workshops, and field visits. An overview of the current resources provided by the CFSC will be presented to CAL FIRE staff. If additional information needs are identified, the CFSC may be a source of future assistance.

   iii. An additional tool that may be of use to CAL FIRE staff are trainings that both relay new, applicable scientific findings as well as teach skills to access additional research in the future.

### *2.6.B. Issue: Public interaction and transparency regarding CAL FIRE VTP projects could be greatly improved*

Proposed projects on private land require permission from the landowner to be completed. Lack of landowner cooperation may be a significant barrier to placing fuel treatments, particularly in residential communities. CAL FIRE should take steps to build a stronger, more trusting relationship with the public.

Completing projects with greater transparency is a vital element of creating and maintaining a trusting work relationship between the public and land management agencies (Shindler *et al*. 2014). As the Vegetation Management Program uses public funds from taxpayer dollars, CAL FIRE holds some responsibility to use a transparent process that allows stakeholder involvement beyond project commentary. Providing such information, being open to receiving feedback, and making fair decisions will help to build agency trust (Olsen and Sharp 2013, Shindler *et al*. 2011). Engaging other agencies involved in fire and natural resource management as well as fostering collaboration with the public are goals mentioned in the 2010 Strategic fire plan that would be applicable to VTPEIR projects.

### *2.6.b. Recommendations*

a) The current VTPEIR could greatly benefit from a communication plan that informs the public and interested parties about upcoming vegetation management projects. This communication plan should go beyond merely informing the public of a project, but should also include the rationale and the general implementation plan.

Sharing the extensive internal work done for the Vegetation Management Program (VMP) and promoting and showcasing upcoming projects would be a major step towards transparency. With a few exceptions to outside agencies, this work is not currently being shared outside of CALFIRE (with the new exception of efforts such as CAL MAPPER). To protect issues of privacy, specific details such as property addresses and names should be deleted from internal project documents before being made publicly available to avoid potential privacy concerns that are often raised with the sharing of such documents.

*The suggested communication plan should include the following elements:*

Projects should include a general description of what is expected to be done. This should be announced at least six weeks before the project takes place. A more detailed description of the project, including project goals and scientifically-grounded rationale as to why and how these goals will be met, should be released prior to the project implementation. The monitoring plan and its results should be made publically available when completed.

At minimum, the above information should be posted on a website database. Additional outreach via newsletters, TV, radio, or events may be included. Public meetings are likely to be required in the future under the 2015 Budget language and are somewhat effective at raising awareness of actions. However, they are often one of the lowest rated sources of information (McCaffrey and Olsen 2012) as they are focused on the agency transmitting information to the public rather than an interactive format. These meetings provide limited to no opportunities for the pubic to give input or to feel that their comments are being legitimized and heard. Other options that allow for more interaction are strongly encouraged as these are typically the most trusted and valuable sources of information (McCaffrey and Olsen 2012).

i. CAL FIRE should champion collaborative efforts that focus on preemptive conflict resolution with the public. For example, when a new project comes out, a public meeting with *at least 6 weeks' notice* of the date should be announced to discuss the proposed project. Public comments and suggestions should be addressed in the plan. An outline of how these comments and meetings will be addressed should be included in the VTPEIR or other internal documents to promote consistency throughout the Units.
ii. For these interactions (and others) it is highly recommended that CAL FIRE invest in trainings for staff and personnel that will provide the necessary skills for fostering positive relationships and conflict resolution.
iii. The VTPEIR should be made public once completed. While an additional formal process of public comment period may not be required, the VTPEIR technical revision team should remain available to answer questions and concerns about the EIR.

b) Another major goal of the 2010 Strategic Fire Plan was to increase the effective enforcement of laws like CA 70, Public Resources Code (PRC) §4290 and §4291, Code of Regulations (CCR) Title 14, with CCR Titles 19 and 24. These laws require vegetation buffers for fire safety and other fire safe principles. It is recommended that CAL FIRE use this tool to increase the effectiveness of fuel reduction projects under the VTPEIR by adding provisions to encourage landowners to comply with these laws before CAL FIRE works on their private property.

c) For inspiration and advice on how to better communicate with the public on both these suggestions, the County of Los Angeles Fire Department may provide relevant expertise. http://www.fire.lacounty.gov/forestry-division/fire-hazard-reduction-programs/

# Chapter 3. Responses to legislative queries

After the consensuses from the Review Panel showed that major revisions to the VTPEIR were needed, a broader review that resulted in the six major points, Sections 2.1-2.6 become the focus. However, the questions raised by the legislative queries were still discussed by the Panel. In order to address all questions, the following bullet points (with references to the section(s) that best elaborate on the question) are provided.

## Global Questions

1. *Are VTPEIR vegetation management activities and goals clearly stated? Are the goals and activities the appropriate ones?*

**Panel Response: Needs improvement**

- While clearly stated, the goals are very broad and do not appropriately reflect the complexity of various ecosystems and their management needs
- The supporting detail of how they will be achieved is difficult to find or absent (Sections 2.1 and 2.2)
- Being able to achieve all goals at one time, especially given additional restrictions like air quality management and shrub ecology, would be difficult at best (Sections 2.1 and 2.3)
- The treatments should be based on specific goals for specific project types (Section 2.1)
- The protection of human life and property should be a major goal for this VTPEIR, given the responsibilities of CAL FIRE and the Strategic Fire Plans (Sections 2.1 and 2.5)
- An additional goal of creating a transparent and trusted agency through VTPEIR should be included (Section 2.6)

*2. Is the Program (the intended activities under the VTPEIR) stated in the VTPEIR sufficiently described so as to permit a reasoned determination whether it will achieve the proper goals and objectives? Is it based on the best available scientific information? If not, provide suggested changes to the Program that would meet the goals and objectives.*

**Panel Response: Needs improvement**

- The complexity of the issues at hand are not well-reflected in the goals; the goals are simply too broad
- The goals need to be based on additional recent, sound science references (Appendix and Chapter 2)
- Amount (acres) of prescribed fire proposed is not possible given other restrictions on fire as a management tool (Section 2.5)
- Does not adequately address the different ecosystems and associated fire regimes (Sections 2.1 and 2.3)
- No plan for to strategic placement of treatments or the fire risk assessment (Sections 2.2 and 2.5)
- No monitoring and thus no ability to objectively see if goals are met (Section 2.4)

*3. The Program goals, as laid out in the Executive Summary of the VTPEIR, include improving forest health, reducing the severity and intensity of wildfires, modifying wildland fire behavior to help reduce catastrophic losses to life and property, safeguarding watershed health, and improving wildlife habitat. Does the VTPEIR document adequately address whether alternative* *means of achieving the Program goals exist that might reflect a better balance of achieving key project goals in an environmentally superior way and at less cost?*

**Panel Response: Needs improvement**

- Need to explore more alternatives, i.e.:
  - o treating only the wildland urban interface (Section 2.1 and 2.3)
  - o Community protection strategies to strengthen "zones" PRC 4291 (Section 2.6)
  - o emphasizing ecological restoration through adaptive management (Section 2.1 and 2.4)
  - o return to a more "natural state" of fire and return interval
- Improved justification for program instead of alternatives
- State the justification for using VTP, especially over suppression costs (possibly with monetary cost/benefit analysis)

*4. Do potential impacts from vegetation management activities proposed in the VTPEIR exist that are not addressed? Impacts identified should be supported by current science.*

**Panel Response: Needs improvement**

- Need to address more specific impacts on a more local basis (Sections 2.1, 2.2, and 2.3)
- Needs to include provisions that avoid over treatment of land and to ensure the treatments are successful (Section 2.4); a balance between action and caution
- The impacts of fuel breaks on vegetation, soil, etc. (esp. bulldozer-created and soil related impacts)
- Additional references needed (Appendix)

*5. Are the identified benefits and evaluation of potential significant adverse impacts of the proposed vegetation treatment activities consistent with current science?*

**Panel Response: Needs improvement**

- Improve the scientific discussion here; currently there is no/limited discussion of different ecosystems and how fire affects them (Appendix; Sections 2.1-2.4)
- This is especially true for treatments in shrub ecosystems (Section 2.3)

6*. Were fire behavior, fire ecology, and the role of fire in supporting resilient ecosystems in relation to fuel load and fuel treatments evaluated consistent with the current science?*

**Panel Response: Needs improvement**

- Needs additional detail and description, (Section 2.2)
- Need to clarify use of terms (Section 2.2)
- Needs additional references (Appendix)

- Limited current science on fire in south coast chaparral exists to justify treatments; change goal here to public safety in most cases (Section 2.3)

7. *The landscape constraints, minimum management requirements and mitigation measures in the VTPEIR are intended to mitigate the potential significant adverse impacts from projects and prevent substantial degradation of the environment from vegetation management activities. Does the current science support this conclusion, considering the landscape constraints, minimum management requirements and mitigation measures provided in the VTPEIR?*

**Panel Response: Needs minimal improvement**

- Mitigation measures may be satisfactory
    - But given the project scope, the impacts are unknown and thus the mitigation measure may be insufficient
- Document is too broad to cover all this effectively (Section 2.1)
- Measures often based on an "as needed" basis, leaving much decision to the project manager. Instead, incorporate an adaptive management plan (Section 2.4) that is carried out by an outside party to prevent bias.
- No overall size restrictions on projects themselves, resulting in huge estimates for treatments like prescribed fire (Section 2.5). If there was a self-decided maximum to project acres, this could alleviate some public concern.

8. *Are the objectives of fuel treatments for public safety clear in the VTPEIR? If not, what should be added or deleted to these objectives for clarification? How should prioritization of potential treatments occur? Under what conditions are such treatments effective?*

**Panel Response: Needs improvement**

- Need specific objectives for public safety and clear priorities were applicable (Section 2.1)
- Outline the priority of treatment placement to maximize public safety and economic efficiency
- Enforce defensible space regulations, encourage CWPP co-op; could include incentive/disincentive for private-land owners to do treatments on their land before receiving CAL FIRE assistance (Sections 2.5 and 2.6)
- Prioritize 100' buffer zone around houses for citizens to complete (Section 2.5)
- Public safety should be a major focus throughout the document

## Specific Questions

*1. Does the VTPEIR adequately explain the role of fuels treatments in maintaining a vegetative pattern over a chaparral landscape that would contribute to a resilient ecosystem? If not, what changes should be made to the VTPEIR to assist in achieving that outcome?*

**Panel Response: Needs substantial improvement**

- Needs scientific references (Appendix)
- Given the lack of available scientific understanding, forgo goal of restoration and in these areas and instead focus on public/property protection with the least ecological impact (Section 2.3)
- Fuel reduction and fire is not always ecologically beneficial here or may only be beneficial if implemented a certain way (Section 2.3)

2*. The VTPEIR proposes treated acre targets for each of the bioregions (California Biodiversity Council classification) in the state. Are the targets for bioregions where chaparral ecosystems are predominant consistent with the maintenance and promotion of ecosystem resilience? If not, what is a range of treated acres that would support maintenance of a resilient chaparral ecosystem or what other substitute metric should be proposed that is based on the best available scientific information?*

**Panel Response: Needs substantial improvement**

- Needs details on size, placement, and frequency that are based on science (Section 2.5)
- Ecosystem resilience may not be compatible with public safety: reprioritize goals (Section 2.1)
- Resilient southern chaparral not caused by more fire, may be made worse: need to correct this assumption (Section 2.3)

3. *Does the process outlined in the document governing subsequent activities undertaken in reliance on the VTPEIR provide sufficient oversight and control to ensure that they will be adequately monitored, assessed, and mitigated? Does the proposed monitoring approach in Chapter 7 (Monitoring) provide information and direction consistent with current science to enable the program to evaluate ecological performance and fuel treatment effectiveness over time? Given current science, what is the appropriate scale of evaluation?*

**Panel Response: Need substantial improvement**

- Need specific requirements on both pre and post monitoring with a dedicated budget for this monitoring (Section 2.4)
- Needs monitoring for more than just mitigation impacts (Section 2.4)

- Incorporate adaptive management principles (Section 2.4)
- Currently, modeling could be easily manipulated to reflect a desired report without actual effectiveness assessment; use of an outside party to monitor projects would remove the ability of mangers to rely on self-rating checklists that may not always show sound evaluation
- Mitigation measures should be more similar to best practices rather than mitigation

4. *Are the mitigations within the VTPEIR to prevent the spread of invasive species that can be expected to result from vegetation treatment activities addressed in a manner consistent with current science?*

**Panel Response: Needs improvement**

- Need references to support mitigation measures (Appendix)
  - Distinguish between measures for invasives vs. exotics
- Need more specificity based on location/vegetation type (Section 2.1)

5. *Is there evidence to support the conclusion that fuel treatments can effectively assist fire suppression efforts on the head, flanks, or heel of the fire over a range of fire weather conditions in chaparral dominated landscapes?*

**Panel Response: Needs improvement**

- Needs references (Appendix)
- Need to clarify fire danger metric and state suppression effectiveness analysis, especially given different weather conditions (Section 2.2)
- Connect the fire behavior/intensity to suppression effectiveness (Section 2.2)

6. *Does the content of the environmental checklist reflect sufficient scientific rigor to identify and address environmental issues at a local project scale to ensure individual projects are within the scope of the VTPEIR?*

**Panel Response: Needs substantial improvement**

- No required public input/review (Section 2.6)
- Checklist not available as part of VTPEIR draft and there is no way to assess this question without this example
- The checklist should include sufficient rigor, specificity, and quantitative approach (Section 2.4)
- Few “triggers” that cause outside agency or public input, nor a change in management
- No clear definition for what constitutes “no significant adverse impacts”

# Chapter 4. Comments on individual goals

The recommended restructuring of the VTPEIR discussed in the previous sections will lead to changes that make many of these comments null. While the previous sections should be the basis for revision, individual comments on the original goals are provided below for informational purposes.

1. *Maintain and enhance forest and range land resources including forest health to benefit present and future generations*

    - Too general
    - Assumes the treatments are *always* beneficial, does not admit to the negative impacts fuel treatments may have or justify their need
    - Does not include shrublands or watersheds
    - Limited justification on how this goal is met beyond showing the acres treated
    - Assumes landowner cooperation
    - Consider including collaboration with other agency partners in this goal as this is not the priority for CAL FIRE
        - Ex: "In collaboration with other state and federal agencies, NGOs, and private landowners, maintain and enhance …"

2. *Modify wildland fire behavior to help reduce catastrophic losses to life and property consistent with public expectation for fire protection*

    - Use more than 'acres treated' to justify meeting a goal
    - Need a direct tie between fire behavior and a safer/more successful firefighting environment
        - Analysis is present in the VTPEIR document but the justification should be in the executive summary with a clear link to how this will be achieved
    - The phrase "consistent with public expectations for fire protection" should be clarified or deleted
        - Or reword as "Modify wildland fire behavior to help reduce loss of life and catastrophic losses of property consistent with public expectation for fire protection."

3. *Reduce the severity and associated suppression costs of wildland fires by altering the volume and continuity of wildland fuels*

        - Clarify that severity can only be reduced by affecting fire intensity (not to be used interchangeably, perhaps fire behavior was meant here (see Section 2.2))

- State that indirect attack can save resources and reduce risk to life and property
- Reducing  fuel volume on a landscape scale may not be appropriate for all areas (i.e. South Coast)
- Limited or hard to find the support for this conclusion
    - A cost/benefit analysis may be of use
- Explicitly state the wildfire metric that is being measured, mitigated, or affected
    - Are the fuels being treated to reduce wildfires for 75th percentile fire season/fire danger wildfires? 85th percentile fires? 90th percentile fires?
    - How will these treatments affect the resulting fire ecology and future pattern (size, frequency, extent)? Are they trying to change public perspective?

4. *Reduce the risk of large, high intensity fires by restoring a natural range of fire-adapted plant communities through periodic low intensity vegetation treatments*
    - This is not appropriate for shrub-dominated ecosystems. Burning in southern chaparral is not low intensity and the science does not support “frequent” historic fires (this goal is applicable to Northern Shrub ecosystems and other forest types)
    - No compelling case made for reducing the risk of large, high intensity wildfires through fuel management

5. *Maintain or improve long term air quality through vegetation treatments that reduce the severity of large, uncontrolled fires that release air pollutants and greenhouse gases*
    - This goal may be unachievable under the current Clear Air Act restrictions; exemption may need to happen before it can be met
    - Inappropriate use of the word “severity”
    - Need to show the tradeoffs between fuel treatment smoke and wildfire smoke
    - The statement is aspirational – it is not inevitable that vegetation management will result in greater carbon storage over long periods of time
    - If this a major goal, a strong case could be made to not use prescribed burning but rather an alternative; even with the mitigation measures described in Chapters 5.6.1 and 5.6.2 of the VTPEIR, smoke emissions will occur

6. *Vary the spatial and temporal distribution of vegetation treatments within and across watersheds to reduce the detrimental effects of wildland fire on watershed health*

- The spatial pattern is predominantly determined by private-owner agreement; ability to strategically place treatments may be limited
- In southern chaparral, creating a mosaic of ages is likely to mean that some patches will burn at younger ages than they would have if the landscape had not been subjected to management
- Fuel mosaics will not necessarily constrain fire size given different weather conditions but will reduce fire intensity

7. *Reduce noxious weeds and non-native invasive plants to increase desirable plant species and improve browse for wildlife and domestic stock*

- The goal should be modified by adding maintenance of native ecosystems as a desired outcome; focusing on "desirable" species is very narrow goal
- Need more support as to why this goal will be achieved through the plan
- Need to address that soil disturbance and open canopies can favor invasive species

8. *Improve wildlife habitat by spatially and temporally altering vegetation structure and composition, creating a mosaic of successional stages within various vegetation types*

- It would be difficult to accomplish this even with unlimited resources and a high degree of cooperation among agencies and private landowners
- Planning "spatial and temporal" alteration of vegetation in a way that is sustainable and that avoids negative consequences such as weedy invasion seems daunting and would surely require an adaptive management approach. That is, the state of knowledge is not such as to permit a plan to be drafted (probably by limited staff) that can then be implemented in perpetuity

9. *Provide a CEQA-compliant programmatic review document process/mechanism for other state or local agencies, which have a vegetation management program/project consistent with the VTP, to utilize this guiding document to implement their vegetation treatment programs/project*

- Delete this goal: other agencies should be required to write their own CEQA document due to dissimilar goals and requirements

# Chapter 5. Corrections and additions

These are specific, minor issues that the Panel wished to address. While not expansive, these are included to provide example of issues that should be considered when revising the VTPEIR.

- Include additional glossary terms used within the VTPEIR to not only inform the reader of necessary background information but to also clarify terms that may have other meanings elsewhere.
    - Ex: fuel breaks, severe fire weather, etc.
- Broken/missing links: Many website links within the document are no longer valid
    - Ex: 4.2-21
        - http://cdfdata.fire.ca.gov/ fire_er/fpp_planning_plans
        - http://cdfdata.fire.ca.gov/fire_er/fpp_planning_cafireplan
- *Overall Table ES.3*: the +,-,0 system is inadequate
    - Too broad of a measurement metric to show the weighing of alternatives; should instead have a specific measurement of achieving each goal
    - Limited connection between chart analysis and conclusion

# Appendix

## Appendix 1.1

### *Support for the division of VTPEIR sections into three fuel-type sections and project types (Chapter 2.1)*

#### *Fuel type distinctions (Chapter 2.1.a)*

Rather than using the ecoregions to provide details on planning projects, it is recommended that a combination of fuel types and project types be used to provide a matrix that allows for more specificity.

Bishop (2007) used the primary drivers of large, short-term changes in rate of fire spread to distinguish among the three fuel types associated with trees, grasses, and shrubs.  He found that effective wind speed and the fuel layer carrying the fire were the most important drivers. For forests, fires spread primarily in surface fuel, for shrubs fires spread through the crowns, and for grasses the grass was the primary carrier.  Within each formation, subtypes can further be distinguished by fire behavior, fire regimes, and the ecological role of fire can be identified. Important fire behavior characteristics include rate of spread and fire line intensity.  Fire regime attributes include seasonality, return interval, size, spatial complexity, and severity. Based on these distinctions, the formations can be further divided into the following subtypes:

**Appendix Table 1.1.1. Vegetation subtypes by dominant vegetation formation**

| Tree dominated | Grass dominated | Shrub dominated |
|---|---|---|
| Hardwood forests<br>Long-needled conifers<br>Short-needled conifers | Annual<br>Perennial | Vigorous post-fire sprouters<br>Weak post-fire sprouters<br>Obligate seeders |

Within subtypes are Wildlife Habitat Relations (WHR) types that have specific fuel models associated with them that can be used for fire behavior predictions using either the 13 Northern Forest Fire Laboratory models (Anderson 1982) or the 40 Standard Fire Behavior Fuel Models (Scott and Burgan 2005). In addition, fire return interval (FRI)s and return interval departures can be assigned to each WHR type (Van de Water and Safford 2011, Safford *et al.* 2011). This information should be used in the EIR descriptions of the vegetation to be treated to develop the ecological and fire managerial rationales.

Based on the FRAP vegetation map (fvegwhr13b_map) and the State Responsibility Area map (SRA13_2), the following tables show the number of SRA acres, fuel models, and median FRIs for each Wildlife Habitat Relationships type for the subtypes. Additional fire regime attributes can be associated with each subtype. Information on the fire regime attributes of vegetation alliances found in the Manual of California (Sawyer *et al*. 2009) can be found in Appendix 2 of the manual and associated with the WHR types.

**Appendix Table 1.1.2. Hardwood forest WHR types in State Responsibility Areas (SRA)**

| WHR Type | Acres | Anderson | Scott and Burgan | Median FRI |
|---|---|---|---|---|
| Montane Riparian | 98,556 | 8 | TL2 | 13 |
| Aspen | 3,827 | 8 | TL2 | 20 |
| Montane Hardwood | 2,513,090 | 9 | TL6 | 13 |
| Hardwood | 130 | 9 | TL6 | 13 |
| Eucalyptus | 15,300 | 9 | TL9 | 5 |
| Valley foothill riparian | 15,131 | 9 | TL6 | 12 |
| Total | 2,646,034 | | | |

**Appendix Table 1.1.3. Long-needled conifer WHR types in State Responsibility Areas (SRA)**

| WHR Type | Acres | Anderson | Scott and Burgan | Median FRI |
|---|---|---|---|---|
| Sierran Mixed Conifer | 1,713,946 | 9 | TL8 | 9 |
| Montane Hardwood-Conifer | 885,450 | 9 | TL8 | 13 |
| Ponderosa Pine | 446,265 | 9 | TL8 | 7 |
| Eastside Pine | 442,993 | 9 | TL8 | 7 |
| Klamath Mixed Conifer | 291,315 | 9 | TL8 | 12 |
| Jeffrey Pine | 27,716 | 9 | TL8 | 7 |
| Undetermined Conifer | 2,447 | 9 | TL8 | 12 |
| Total | 3,810,132 | | | |

**Appendix Table 1.1.4. Short-needled conifer WHR types in State Responsibility Areas (SRA)**

| WHR Type | Acres | Anderson | Scott and Burgan | Median FRI |
|---|---|---|---|---|
| Douglas Fir | 1,472,636 | 8 | TL3 | 12 |
| Redwood | 1,216,416 | 8 | TL2 | 15 |
| Red Fir | 103,168 | 8 | TL3 | 33 |
| Closed-Cone Pine-Cypress | 69,894 | 9 | TL2 | 59 |
| Lodgepole Pine | 31,216 | 8 | TL3 | 36 |
| Subalpine Conifer | 9,890 | 8 | TL1 | 132 |
| Juniper | 304,340 | 8 | TL4 | 77 |
| Pinyon-Juniper | 58,626 | 8 | TL4 | 94 |
| White Fir | 167,223 | 10 | TL5 | 12 |
| Total | 3,433,308 | | | |

**Appendix Table 1.1.5. Grassland WHR types in State Responsibility Areas (SRA)**

| WHR Type | Acres | Anderson | Scott and Burgan | Median FRI |
|---|---|---|---|---|
| Annual Grassland | 6,504,573 | 1 | GR4 | 3 |
| Blue Oak-Foothill Pine | 527,950 | 2 | GR4 | 12 |
| Valley Oak Woodland | 67,860 | 2 | GR4 | 12 |
| Blue Oak Woodland | 2,561,158 | 2 | GR4 | 12 |
| Coastal Oak Woodland | 675,444 | 2 | GR4 | 12 |
| Perennial Grassland | 5,740 | 3 | GR6 | 3 |
| | 10,342,725 | | | |

**Appendix Table 1.1.6. Shrubland WHR types in State Responsibility Areas (SRA)**

| WHR Type | Acres | Anderson | Scott and Burgan | Median FRI |
|---|---|---|---|---|
| Mixed Chaparral | 1,214,087 | 4 | SH7 | 59 |
| Montane Chaparral | 278,187 | 4 | SH5 | 24 |
| Sagebrush | 837,521 | 5 | SH7 | 41 |
| Bitterbrush | 99,010 | 5 | SH2 | 53 |
| Low Sage | 21,734 | 5 | SH2 | 53 |
| Chamise-Redshank Chaparral | 528,025 | 6 | SH6 | 59 |
| Coastal Scrub | 575,917 | 5 | SH2 | 100 |
| Total | 3,554,481 | | | |

**Appendix Table 1.1.7. Desert shrub WHR types in State Responsibility Areas (SRA)**

| WHR Type | Acres | Anderson | Scott and Burgan | Median FRI |
|---|---|---|---|---|
| Desert scrub | 223,502 | 5 | SH2 | 610 |
| Alkali Desert Scrub | 196,390 | 5 | SH2 | 610 |
| Desert Succulent Scrub | 13,494 | 5 | SH1 | 610 |
| Joshua Tree | 6,609 | 5 | TU5 | 610 |
| Desert Riparian | 1,736 | 9 | TL6 | 610 |
| Palm Oasis | 3 | 9 | TL6 | 610 |
| Total | 441,734 | | | |

## Appendix 1.2 Support for the use of Fire Behavior concepts (Chapter 2.2)

### *Additional information on how to utilize know fire behavior to manage for fire (Chapter 2.2.b)*

Flame length is the firefighter's gauge to fire line intensity, which, in turn, aids in deciding how to attack a wildfire. All firefighters are taught from the beginning of their careers the thresholds for successful and safe firefighting as shown in Table 1.2.1 (National Wildfire Coordinating Group 2014). Rate of spread is an indicator of the number of resources needed to build fire containment lines quickly enough to arrest or stop an advancing wildfire. The VTPEIR's goal is to change the fuel characteristics so that wildfires may exhibit a less intense flaming front and/or slow the spread rate. This will provide firefighters an improved probability of success at suppressing a wildfire thus resulting in fewer acres burned. Fire intensity (radiant heat and flame impingement) is also the key for defensible space in and around homes and communities (Cohen and Butler 1996; Cohen 2000).

**Appendix Table 1.2.1 Firefighting guidelines from the Incidental Response Pocket Guide (National Wildfire Coordinating Group 2014)**

**Fire Behavior Hauling Chart**

**Tactical Interpretations from Flame Length**

| Flame Length | Interpretations |
|---|---|
| **Less than 4 feet** | Fires can generally be attacked at the head or flanks by firefighters using hand tools. Handline should hold fire. |
| **4 to 8 feet** | Fires are too intense for direct attack on the head with hand tools. Handline cannot be relied on to hold the fire. Dozers, tractor-plows, engines and retardant drops can be effective. |
| **8 to 11 feet** | Fire may present serious control problems: torching, crowning, and spotting. Control efforts at the head will probably be ineffective. |
| **Over 11 feet** | Crowning, spotting, and major fire runs are probable. Control efforts at the head of the fire are ineffective. |

The probability of successful suppression (Initial Attack (IA) and Extended Attack (EA)) effectiveness should be evaluated for each of the Fuel Rank Potential Fire Behavior classes and vegetation types. An example of this analysis is in Appendix Table 1.2.2. This analysis will set the stage for the current situation and provide a benchmark against which each EIR Alternative can be evaluated.

**Appendix Table 1.2.2 Example of quantification of suppression effectiveness in different vegetation types**

| Life Form | Grass Dominated | Shrub Dominated | | Tree Dominated | |
|---|---|---|---|---|---|
| | | Young | Old | Litter | Crown |
| **Subtype** | Annual<br>Perennial | Vigorous post-fire sprouters<br>Weak post-fire sprouters<br>Obligate seeders<br>Other | | Hardwood forests<br>Long-needled conifers<br>Short-needled conifers | |
| **Expected Fire Behavior** | Surface Fire: expected rate of spread is moderate to high, with low to high fire line intensity (flame length).* | Surface/crown fire: expected rates of spread and fire line intensities (flame length) are moderate to high.* | Crown fire: control efforts at the head of the fire are Ineffective.** | Surface (litter): spread rates are low to moderate, fire line intensity (flame length) may be low to high.* | Crown fire: control efforts at the head of the fire are Ineffective.** |
| **Fuel Rank** | **Probability of Initial Attack/EA Success**** | | | | |
| Very High | Less Likely | Not Likely | Not Likely | Highly Likely | Not Likely |
| High | Likely | Likely | Not Likely | Highly Likely | Not Likely |
| Moderate | Highly Likely | Very Likely | Likely | Highly Likely | Not Likely |

This table is for demonstration purposes only and to generate a discussion on how to quantify suppression effectiveness that could, in turn, be used to further assess at-risk "landscapes" or human "communities.

*Probability of Success will be driven by flame length and rate of spread (National Wildfire Coordinating Group 2014)

** NWCG Fireline Handbook Appendix B (2006).

## Example table for effective treatment goals (Chapter 2.2.C).

**Appendix Table 1.2.3 An example of the types of intensity of treatment that would alter fire behavior or enhance ecological function**

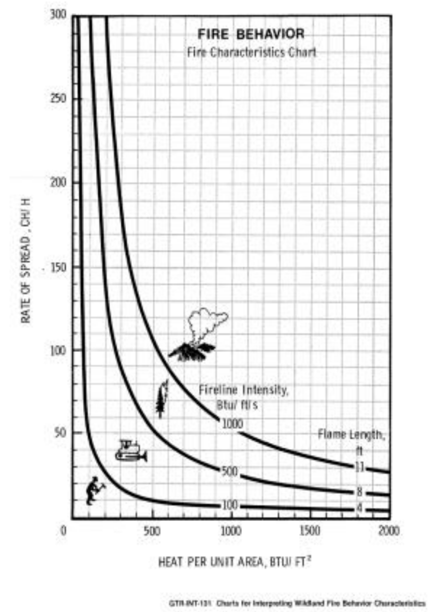
| Purpose for Treatment | Effective Fuels Treatment | Grass Dominated Systems | Shrub Dominated | Tree Dominated |
|---|---|---|---|---|
| **Community Protection-Private landowner responsibility** | 30’ to 100’ buffer’ from structure. | Treat Annually Follow CAL FIRE Defensible space Guidelines | Treat as needed. Follow CAL FIRE Defensible space Guidelines | Treat as needed. Follow CAL FIRE Defensible space Guidelines |
| **Community Protection-outside landowner responsibility** | 100 to 1320’ Defense zone | Treat Annually | Eliminate continuity in brush, leaving occasional single or small group acceptable. Understory should be treated annually. | Prune trees to at least 8’, thin trees so that no crowns are touching, preferably below 40% crown closure, eliminate all ladder fuels,<br><br>(Agee and Skinner 2005) |
| **Ecological Purposes** | Landscape Level (watershed) treatments for community protection or ecological purposes. | Proposed activities should follow Fire Return Intervals displayed in Table I.5 “Conceptual Framework and Organization” | Proposed activities should follow Fire Return Intervals displayed in Tables I.6 & I.7 “Conceptual Framework and Organization” | Proposed activities should follow Fire Return Intervals displayed in Tables I.2, I.3 & I.4 “Conceptual Framework and Organization” |

## Fire Severity vs. Fire behavior (Chapter 2.2.d)

The two goals that are addressed using fire severity analysis are:

> EIR Goal 2: Modify wildland fire behavior to help reduce catastrophic losses to life and property consistent with public expectation for fire protection.
>
> EIR Goal 3: Reduce the severity and associated suppression costs of wildland fires by altering the volume and continuity of wildland fuels.

The basis for much of the analysis in Chapter 5 is fire severity. The EIR on page 5.2-1 states that "wildfire severity is usually measured by the percent mortality of the resulting burned vegetation." Fire severity is a post-fire metric for evaluating how intense a fire burned and the resulting effects. Keeley (2009) and Sugihara *et al*. (2006; Chapter 3) both describe fire severity as the effect on ecosystem components. There is a part of EIS Goal 3 for which a severity assessment is appropriate. However, a robust fire behavior based assessment for addressing the fire suppression related EIR Goals and issues is lacking. Using fire severity as a proxy for fire behavior is inappropriate. Sugihara *et al*. (2006; Chapter 3) further states that "***a high-intensity fire of short duration could result in the same level of severity as a low-intensity fire of long duration***." By using fire severity we miss the opportunity to evaluate the components that are most important from a fire suppression viewpoint: flame length (fire intensity) and rate of spread (forward, lateral or backwards). Fire intensity and rate of spread get right at whether firefighters will be effective and successful in their mission (Anderson 1982; Rothermel 1983). More importantly, these two fire behavior characteristics are key for assessing firefighter and public safety.




**Appendix Fig. 1.2.1 Fire Behavior Characteristics from GTR-INT-131**

# Appendix 1.3

## *Additional information on fire in shrub ecosystems (Chapter 2.3)*

The issues of fire and fire protection in shrubland ecosystems of California is not currently well-represented in the VTPEIR. To address this, two steps were advised. These two steps are discussed in more detail here. The shrub ecosystems discussed in this section refer predominantly to those in the southern parts of California.

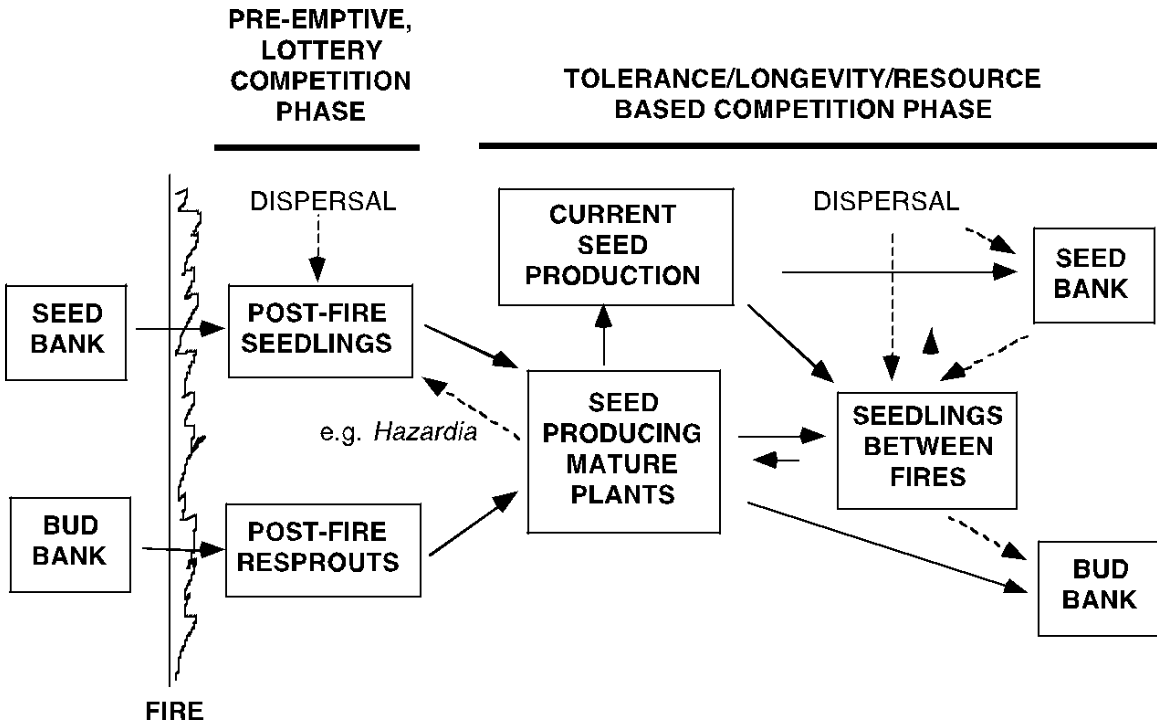
### *Step 1: Weave ecological background of shrub ecosystems throughout VTPEIR*

The following is included to provide a brief summary of some key understandings that should be alluded to throughout the revised VTPEIR.

#### SIMPLIFIED DESCRIPTION OF LIFE HISTORY FEATURES OF SHRUBS WITH RESPECT TO FIRE

The capacity of species to recover from fire is assumed to be based on two types of regeneration – from buried seeds (the "seed bank") and from the sprouting from roots or lower stems that have survived the fire (the "bud bank") (Appendix Fig. 1.3.1). The "lottery competition phase" is assumed to be relatively short, 1-2 years during which the regeneration potential of seeds and resprouting is largely expended. One feature not included in this scheme is the distinction between species that continue to produce new sprouts—though not as vigorously as after fire, but sufficient to rejuvenate their canopies—and species with a much reduced capacity for continual recruitment of new stems from sprouts. This is not a dichotomous condition but a continuum. At one extreme are species of *Cercocarpus* which develop into individuals with a whole range of stem ages and, in old stands, an accumulation of large dead stems. At the other are some obligate seeding *Arctostaphylos* species which rarely produce new sprouts.

Another continuum that approaches a dichotomy is the capacity to establish seedlings that can eventually recruit to the canopy in unburned vegetation after the initial post-fire phase is past. A few chaparral species do this readily (*Prunus ilicifolia, Rhamnus* spp.) but most do not. Many drought deciduous species of the coastal sage scrub have this ability. Species that are able to expand their populations from seed dispersal post-fire can sustain plant cover without the intervention of fire.




**Appendix Fig 1.3.1 Simplified scheme of fire response and post fire population dynamics of shrubs**

**HOW THE FIRE ECOLOGY OF SOUTHERN SHRUB ECOSYSTEMS DIFFERS FROM THAT OF FOREST IN REGARDS TO FIRE**

Shrublands, like nearly all other California ecosystems, have a history of more or less frequent fire. Accordingly, the species that make up the shrublands are fire resilient. The means by which resilience is achieved differs among shrub species and can be simplistically divided into vigorous post-fire sprouters, weak post-fire sprouters, obligate seeders, and other. The vigorous sprouting species are of two types, those that also establish seedlings in abundance post fire (e.g., *Adnenostoma fasciculatum*) and the much more numerous group of species that do not (e.g. *Heteromeles arbutifolia*). The weak resprouters include many coastal sage scrub drought deciduous species such as *Salvia* spp. and *Artemisia californica*. These species also reestablish by seed and many can recruit new individuals to the canopy in the periods between fire if suitable gaps appear or are present. The 'other' category is included because there are possibilities not covered in the simple scheme as laid out here. Finally, it needs to be emphasized that there is geographic variation in fire response. Some species will sprout readily in some areas and not in others.

Taking all of this together, it can be said that virtually all shrub ecosystems will recover well from wildfire. To clarify the management-relevant risks Zedler (1995) proposed the concepts of "senescence risk" and "immaturity risk," defined as follows: **Senescence risk** is the risk that species populations may be greatly reduced or go locally extinct because of death or a loss of vigor of individual plants resulting from extreme age. Stands facing senescence risk will change significantly when burned because of the inability of formerly dominant species to regenerate.

It should be stressed that this is a largely hypothetical risk, as will be explained below. **Immaturity risk** is the risk that species will be burned before they have accumulated enough reserves of seeds or stored energy for resprouting at the time of fire. This risk is real, as has been demonstrated not only in California (e.g., Sampson 1944), but also in other Mediterranean climate regions. Though in theory species that resprout may face immaturity risk, in fact all demonstrated instances are for species that do not resprout or resprout only weakly and rely on seed banks for their recovery after fire.

In the past, some managers have felt strongly that because of the obvious capacity of some shrub systems to recover from fire, such systems needed frequent fire to remain “healthy.” Since this belief aligned with the objective of reducing fuel loads and “flammability” the idea that chaparral in particular needed to have management burning imposed was widely accepted. As this belief was being held, however, instances of the loss or significant reduction of species that were victims of immaturity risk began to accumulate. In addition, study of chaparral, some of which was conducted in mid-century and so should have been part of general knowledge, began to reveal that chaparral in addition to being resilient to fire at shorter intervals was also resilient to fire at long intervals (e.g. Sampson 1944, Horton and Kraebel 1955). Contrary to ideas that chaparral was subject to significant senescence, it was observed that the accumulation of dead and dying plants was part of a normal cycle of post fire stand development. Though in theory it might be possible for chaparral to become “senescent” in the sense defined above, it was evident that this would not occur for many decades and at ages far in excess of those that were the target for fuel reduction strategies.

### *Chaparral and Fire*

In some forested types, actions that reduce the probability of severe fires can be more or less aligned with the restoration of a more natural fire regime. That is, the asymmetry between human needs and ecological needs can be acceptably small. The desired management regime of the ponderosa/Jeffrey/mixed conifer forest types can fall into this category. There is good reason to believe that past management actions and non-action has resulted in fuel structures that are significantly different from those that existed historically, with the result that fires are larger and especially more severe and damaging to the system than those that occurred historically. This may justify actions to modify fuel structure to permit management burning to be used to simulate the historical pattern.

But this “fuel reduction model” which aims at the restoration of a more natural fuel structure and a more natural fire regime through fuel manipulations and the imposition of management burns does not apply to southern chaparral and coastal sage scrub. These are vegetation types that might be characterized as being “obligate crown fire systems.” That is, if they burn, they burn in an intense crown fire that kills most or all of the above-ground plant tissue. Because of this, unmanaged chaparral is seen as a serious hazard to humans and their property. Given past and (regrettably) current development policy, chaparral wildfires have indeed wreaked serious damage to human life and property. Thus from a strict "human hazard reduction" viewpoint, management to reduce the amount of burnable biomass is said to be justified.

But in chaparral landscapes the discrepancy between what is best for the ecological integrity of the chaparral and what is best to minimize hazards to humans is very large. The best available information strongly suggests that fire return intervals for chaparral are much longer than many have believed. The Van de Water and Safford (2011) review of fire frequency estimates for California vegetation types supports the idea that chaparral is an infrequent fire system. The mean and median fire return intervals for the composite type "chaparral and serotinal conifers" are 55 and 59 years respectively. The mean minimum is 30 years. These numbers are significantly greater than those that have traditionally been cited. A widely help misconception is that the typical fire return interval is between 25-30 years (e.g., Dodge 1970), when in fact it is on the low end of the Van de Water and Safford (2011) estimates. This leads to the conclusion that in its present state, and in consideration of the substantial pressure from human-caused or human-related fire, chaparral does not need more fire, it needs less (Safford and Van de Water 2014). However, new scientific information could modify that conclusion in the future as it become available. For example tree-ring data collected by Lombardo *et al*. (2009) in bigcone Douglas-fir stands surrounded by chaparral indicate that both extensive and smaller fires were present in historical time.

Summarizing the important features of chaparral with respect to fire: 1) Mature chaparral has a more or less continuous canopy. If chaparral has not evolved to burn, it seems as though it has. 2) Chaparral rarely experiences surface fire. If fire is burning beneath the shrubs, ignition of the canopy is almost certain to result. Thus there is no possibility of instituting frequent "light" management burns to reduce the fuel in a manner analogous to what is done in certain forest types 3) It is of course true that after a fire the fuel loads of chaparral drops precipitously. Thus very young stands (meaning stands in the early stages of recovery after fire) are significantly less likely to propagate fires. But this period of significantly reduced propensity to burn is brief (less than 10 years) relative to the 50 year median time to the next fire. 4) If very young stands do burn, the obligate seeding species face significant risk of dramatic population decline because of a lack of seeds 5) Immaturity risk aside, burning chaparral at high frequency opens up stands, and if continued over long periods will degrade chaparral and foster the invasion of undesirable aliens, specifically the annual grasses 6) In some cases the increase in light fuels following fire-induced degradation can result in shorter intervals between fires, furthering the rate of degradation.

Considering these facts leads to this conclusion: Though it may theoretically be the case that completely removing fire from the landscape would cause significant and perhaps undesirable shifts in southern chaparral communities (that is, that senescence risk is real), it would be many decades before this became a practical worry. Therefore, at present there is very little to no <u>ecological</u> basis for imposing management burns on chaparral. Even if complete fire exclusion would be deleterious lighting, human accident, and arson will ensure that there are ignition events to forestall serious ecological problems related to the lack of fire in these ecological types.

These remarks do not consider the question of how much burning to impose on shrublands from a ranching perspective. On private lands there is no obligation to preserve native systems and burning at high rates to convert shrubs to systems with a higher proportion of grass can perhaps be economically justified. There are cases where aggressive burning that reduces shrub cover can have adverse ecological consequences. The most likely negative effect will be on steep erodable slopes where shrub removal can destabilize slopes. Another example of fuel reduction in shrubs are projects that might contribute to a landscape level plan for improving access and control in the event of a wildfire.

### OTHER SHRUB SPECIES AND FIRE

#### *NORTHERN CHAPARRAL*

The management of shrublands in the northern areas of the state do not necessarily hold the same concerns as those in the southern portion of the state. Vegetation type-conversion here is of far lower concern given the observed recovery of these ecosystems post-fire. Northern shrublands also do not necessarily require a reduction in fire on the landscape as the southern ecosystems do (Safford and Van de Water 2014) and do not have the high number of anthropogenically caused fires. For these reasons, an ecological rationale for fuel treatments in shrub dominated and co-dominated ecosystems in northern California can be used.

#### *COASTAL SAGE SCRUB TYPES*

Coastal sage scrub (CSS) is a general term to describe shrub vegetation that is generally of lower stature (but with exceptions – such as *Malosma laurina*) and with a much higher occurrence of facultatively drought deciduous species, for example *Salvia* spp., *Eriogonum fasciculatum*, and *Artemisia californica*. Further north, *Baccharis pilularis* is a common species that fits with CSS in the broad sense. In general, the response of coastal sage scrub is similar to that of chaparral in that burned CSS will quickly recover after fire undergoing the same kind of so-called “autosuccesional” process (Hanes 1971) in which species present before a fire are predominately the species present after the fire. This species composition is because of resprouting and germination from a seedbank. Unlike most evergreen chaparral species, however, many of the non-evergreens are capable of expanding and rejuvenating their populations without fire. Seedlings will germinate and, when vegetation openings are present, can survive to maturity. This same ability makes CSS species more invasive than most chaparral species. This process has blurred the patterns of distribution of CSS from its historical range. For example, disturbed roadsides through chaparral landscapes will often be dominated by, e.g. *Eriogonum fasciculatum* and other opportunistic species.

The prescription and cautions applying to chaparral mostly also apply to CSS. Like chaparral, CSS does not “require” frequent fire to remain “healthy.” In fact, in the Van de Water and Safford

(2011) paper CSS is assigned a median fire return of 100 years, about double the fire return interval of chaparral. Thus the cautions about prescribed burning apply equally to CSS.

#### *SAGEBRUSH STEPPE AND RELATED TYPES*

Sagebrush dominated vegetation occurs in mountain valleys and in the northeast portion of California that belongs to the Great Basin biotic province. Van de Water and Safford (2011) report median return intervals in the 30 and 40 year cycles. Despite the relatively short return intervals, sagebrush vegetation is not as clearly fire adapted as the vigorously resprouting and reseeding chaparral species. It is not clear if fire exclusion would seriously disrupt sagebrush systems. This leads to a general recommendation to avoid imposing burning treatments unless there are compelling reasons. One of these reasons may exist where sagebrush forms an understory in some forest types.

### *Step 2: Refocusing the goals for treatments*

There are two fundamental motivations for any fire-related management action: 1) to reduce risks to human life and property, and 2) to take actions, such as restoration, that counteract trends or correct situations that are harmful to biodiversity and a healthy natural ecosystem. It may happen that any one action will fully serve both purposes, but in general, it is usually not the case. Therefore the proper approach to assessing impacts of hazard reduction actions that have as their objective reducing the risks to human life and property should assume a probability of undesirable ecological impacts. It is the purpose of an environmental impact statement to recognize these impacts. A common formula is to a) avoid the resource to be damaged, if not that, then b) minimize the impact, then c) repair or restore the site impacted, and finally d) if there is no alternative to damaging a site compensation in some manner financially or by actions that preserve or improve habitat elsewhere.

For reasons given above, in general (some exceptions in the next section) there is currently no ecological justification for fuel manipulations in the southern chaparral. Whether fuel manipulations are designed to slow or stop the spread of wildfires, or to serve as the control lines to facilitate management burning, justification for these types of actions must be focused on the benefits that they yield for protection of life and property. It is generally acknowledged that these justifications are compelling in the immediate Wildland Urban Interface—where human development abuts burnable wildlands. The question is, however, if there are significant benefits to offset the ecological costs for actions that take place in more remote locations. This question should be answered by fire behavior and fire management experts in conjunction with ecologists. It is argued that having, for example, a fuel break on a ridgeline will “break up the fuels” and permit crews access for setting backfires or doing additional clearing (something that can cause significant ecological damage if done recklessly). But such clearings will only be of utility for a specific set of circumstances – crews must be available, the fire must be moving in a direction to make action on the fuel break useful, and conditions must be such that there is a high probability that the fire will not just blow past the fuel break and continue to spread.

The use of fuel reduction zones or breaks as control lines for prescribed fire in southern chaparral is rarely justified because, as stated above, there is in general no reason to impose more fire on chaparral than it experiences at present.

**POSSIBLE EXCEPTION TO FIRE AS AN ECOLOGICAL TOOL:**
Because in many places there is too much fire, there can be cases in which fuel reduction by clearing or burning may have value in protecting valuable natural resources from too much burning. For example, in San Diego and Orange Counties the Tecate cypress is considered to be facing possible extirpation over large parts of its historical range because of too frequent fire. Carefully planned fuel breaks might have utility in helping to protect cypress stands from urban fires spreading.

If there are high value areas because of threatened or endangered species or other special natural attributes that would be harmed by untimely wildfire, carefully planned and judiciously targeted fuel reduction zones may be justified. In essence, this is the reverse of the fuel reduction along a WUI. In this case, it is to protect the natural vegetation against fires spreading from developed areas. The Tecate cypress example from above is one situation where this may be applicable. A county road runs along the southern boundary of Otay Mountain and the vegetation adjacent to this road is mostly of low quality because of a past history of intensive grazing. It may be worthwhile to restore perennial grassland along the highway as a low fuel zone. The “judicious” structure may apply here, because of the possibility that such an action might make things worse rather than better (fire might ignite more easily and propagate more rapidly in grassland and thus increase and not decrease the fire danger). But it is an option that merits consideration. If fuel reduction was to occur here, the plan should be designed and implemented by experts as well as presented to the public to an open comment period.

# Appendix 1.4

## *Additional information on Adaptive management (Chapter 2.4)*

Adaptive management is a formal process of “learning while doing” practiced by many agencies and organizations especially in “high stakes” natural resource management situations. Adaptive management typically includes the following steps: implement, evaluate, and integrate (or respond to) the lessons as they are learned.

High stakes means that there are either:

- values at risk
- uncertainties like climate change impacts
- a need for transparency and accountability
- controversial activities planned (disagreements about science and/ or policy)
- and/or controversial desired outcomes (e.g., fuel breaks in chaparral)

Adaptive management monitoring methods are often more complicated, expensive, and time consuming than others. However, the results gained can be far more valuable. If this process is done in a transparent manner, it can also improve the credibility of projects with stakeholders. This is by no means a perfect system; while many agencies are using this method of monitoring, struggles to effectively use and fund adaptive management programs still exist. This is why so many resources from collaborative workshops to online databases are being developed to further improve the design and use of adaptive management  There are a couple of collaborative groups using adaptive fire management in California. Three examples are:

- California Klamath-Siskiyou Fire Learning Network (http://www.thewatershedcenter.com/?page_id=347)
- FireScape Monterey (http://firescape.ning.com/)
- FireScape Mendocino (http://mendocinofirescape.blogspot.com/2014_06_01_archive.html).

These three groups work with a limited set of stakeholders to manage a defined landscape with fire and other management activities for socio-cultural and ecological goals. We strongly recommend that CAL FIRE staff attend meetings and utilize available resources from these groups to help formulate plans for implementing successful vegetation management projects. CAL FIRE is already an integral participant in the FireScape Monterey.

### Additional resources for Adaptive Management

#### *Examples of the use of adaptive management in problem solving, group learning, and collaboration*

- http://www.ecologyandsociety.org/issues/view.php?sf=77
- DOI: http://www.doi.gov/archive/initiatives/AdaptiveManagement/
- NPS: http://www.usgs.gov/ecosystems/wildlife/adaptive_management.html

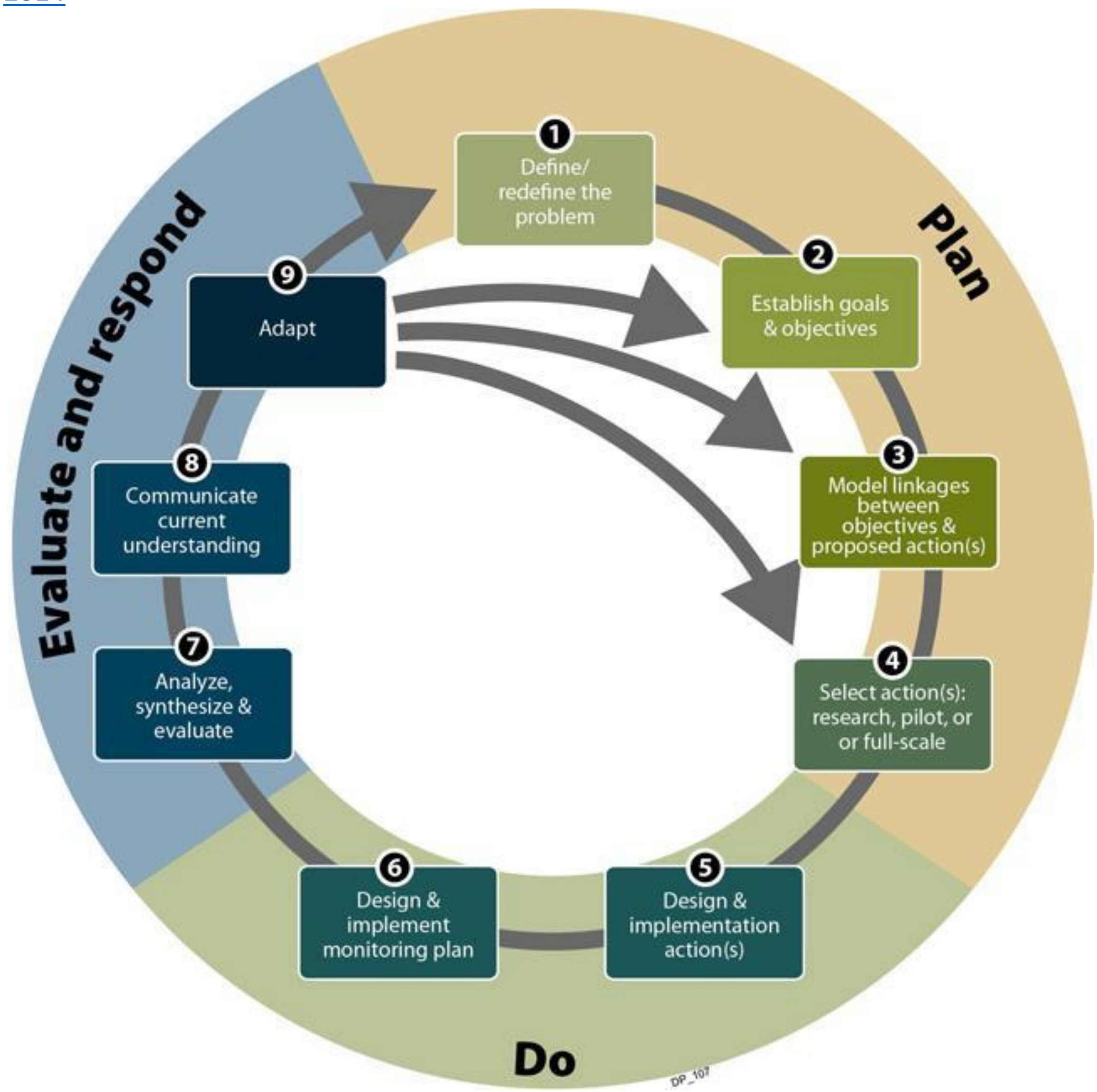
#### *Resources for designing the management plan*

- Landscape Ecology, Modeling, Mapping & Analysis Project http://lemma.forestry.oregonstate.edu/projects/cmonster
- Collaborative resource management group resource: http://library.eri.nau.edu/gsdl/collect/erilibra/archives/D2013003.dir/doc.pdf
- Monitoring of vegetation composition and structure as habitat attributes (see Chapter 4): http://www.fs.fed.us/research/publications/gtr/gtr_wo89/gtr_wo89.pdf
- Conceptual model for resource management in the Sierra Nevada area: http://www.fs.fed.us/psw/publications/zielinski/psw_2000_zielinski002_manley.pdf

#### *Training*

The CAMnet rendezvous this fall (The Sixth Collaborative Adaptive Management Rendezvous in Weaverville, California on October 6-8, 2014) may provide a valuable training opportunity for CAL FIRE staff. This event includes the local host of the Trinity River Restoration Program

(TRRP), sponsors U.S. Bureau of Reclamation, ESSA Technologies and the Platte River Recovery Implementation Program. http://www.adaptivemanagement.net/content/camnet-rendezvous-2014




**Appendix Fig.1.4.1 Adaptive management conceptual diagram from California Department of Fish and Wildlife** (https://www.dfg.ca.gov/erp/adaptive_management.asp)

# Appendix 1.5

## *Additional information on project types (Chapter 2.1.a and 2.5.a)*

### *Wildland-Urban Interface (WUI)*

Projects in the WUI should arguably be a major focus for treatments under this VTPEIR and will be most effective when applied in conjunction with other projects. For example, residents would remain responsible for maintaining the 100’ buffer zone of defensible space (PRC 4291) but CAL FIRE projects could be done in conjunction to further fire-safe these private properties.

As many commenters have noted, the WUI is anchored by a concentration of homes that each have a variety of building specific fire risk factors. The Homeowner Wildfire Assessment is one tool (http://firecenter.berkeley.edu/homeassessment/home_assess_intro.html) that guides a homeowner through major risk factors. CAL FIRE is responsible to enforce the PRC 4291 defensible space treatments within 100' of private homes. The treatable WUI is the area outside of the PRC 4291 defensible 'circles' out to the edge of the defined WUI. Around some communities, there may also be high risk areas such as wind swept canyons that may be outside of a defined WUI but also part of the high risk landscape. Historical experience and the concentration of assets at risk suggest that the WUI areas will be the focus on most projects. Furthermore, treatments (i.e., prescribed burn, mechanical, manual, grazing, and herbicides) with limited chance of environmental spillover effects from fire, air, and water quality impacts will be favored. The expected higher than average costs per acres may well be justified by the concentration of public and private assets at risk.

*Fuel breaks and complementary resource management actions (i.e., forest management, grazing, recent post-fire areas) that create significant areas where fire spread metrics are reduced*

Fuel breaks area defined as *"... wide strips of land on which trees and vegetation has been permanently reduced or removed. These areas can slow, and even stop, the spread of a wildland fire because they provide fewer fuels to carry the flames. They also provide firefighters with safe zones to take a stand against a wildfire, or retreat from flames if the need arises" (*Strategic Fire Plan 2010). Fuel breaks should be established using science-based guidelines. For example, researching fuel break characteristics that are projected to increase the chance of fuel break success for each of the three different vegetation types should be tested. This would include defining proper fuel break widths and then collecting high quality post-fire data on effectiveness. If a project is designed to mitigate fire behavior and subsequent effects, the discussion must show how the treatment will affect fire behavior and how it will tie in with other treatments.

Placing fuel treatments inside of or adjacent to areas where complementary resource management actions and non-VTPEIR treatments take place will increase the effectiveness of treatments. The largest potential area of projects will be in the vegetation types where projects under this VTPEIR may only be a minor percentage of overall manipulation of vegetation to mitigate fire behavior. On both public lands adjacent to potential VTPEIR projects as well as on private lands, wildfires are the largest signal cause of fuels reduction. Forest management activities can significantly reduce fuels (especially if added expenses are incurred to treat or remove low value logging slash) and provide road access for fire suppression vehicles in the case of a future wildfire. Grazing can also reduce fuels if they are palatable to the grazing animals and the grazers are kept on site long enough to consume significant amounts of fuel. Areas that have experienced wildfire or prescribed burning have significantly reduced fuel loads, providing additional opportunities for projects that will strategically reduce fuel continuity and the landscape scale. The overall landscape level effectiveness of VTPEIR treatments that create fuel breaks and fuel mosaics will be a function of VTPEIR projects, non-

VTPEIR land-use treatments, and the amount of fuels that have regrown since treatments. The probable change in fire behavior within each project should be estimated with one of the proven modeling tools (see Section 2.2), but the larger landscape impacts require that each project also map the surrounding fuel mosaics and consider them when estimating the overall effectiveness.

### *Ecological restoration*

If a project is proposed to restore the ecological integrity of an area, a thorough discussion of the ecological role of fire in the area must be included. This should be especially true for projects in shrubland ecosystems.

Some agencies such as the National Park Service have an overarching institutional goal of ecological restoration, detailed methodologies for designing projects, monitoring pre- and post-conditions, and use experience to develop improvements to the program. However, the lack of an explicit ecological restoration mandate as a major priority at CAL FIRE combined with the limited number of private parties or state agencies that have such a mandate, suggest that it will be difficult for CAL FIRE to use measurable fire severity metrics that can be successfully applied to WUI and fuel mosaic projects to ecological restoration projects.

**Appendix Table 1.5.1 Example of potential project rationales for different projects in tree dominated fire systems**

| Project type | Fire/fuels managerial rationale | Ecological rationale |
|---|---|---|
| **Wildland urban interface** | Reduce fuels for hazard mitigation | Maintain some shrubs for wildlife habitats, minimize soil erosion over time |
| **Fuel breaks and fuel mosaics** | To be successful a large scale, long time frame strategy is needed with private forest/range managers and federal agency coordination as well as local community participation | Limit areal extent of large wildfires burning across ecologically modern continuous fuels |
| **Ecological restoration** | Create fire resilient forests and grasslands/meadows and reduce landscape scale high severity fire | Reduce meadow encroachment |

## *Table revision recommendations (Chapter 2.5.b)*

Given the above comments, the VTPEIR revision needs to fill in tables (see below Table 1.5.2-1.5.3) with realistic numbers or ranges of numbers. These numbers should be based on the real data obtained by CAL FIRE over the past decade that shows the realistic project size. Based on this data, CAL FIRE can provide an estimate of the median and range of project areas. If CAL FIRE desires larger projects to be completed in the future, the justification and rationale as to why this may be an option should be included.

**Appendix Table 1.5.2 Proposed VTPEIR treatment acreage maximum per decade**

| Long term land cover type | WUI beyond defensible space circles | Fuel breaks, other fuel reduction units | Ecological restoration |
|---|---|---|---|
| Tree dominated | | | |
| Grass dominated | | | |
| Shrub dominated | | | |

**Appendix Table 1.5.3 Range of acres per project for Proposed VTPEIR treatments**

| | WUI beyond defensible space circles – (20- 100 ac?) | Fuel breaks, other fuel reduction units | Ecological restoration (200 – 2000 ac?) |
|---|---|---|---|
| Tree dominated | (30-85 ac in Prop 40) | | |
| Grass dominated | | (100-1000 ac in Prop 40) | |
| Shrub dominated | | | |

**Appendix Table 1.5.4 Proposed number of projects for VTPEIR treatments**

| | WUI beyond defensible space circles | Fuel breaks, other fuel reduction units | Ecological restoration |
|---|---|---|---|
| Tree dominated | | | |
| Grass dominated | | | |
| Shrub dominated | | | |

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# EXHIBIT 17

October 2, 2014

*VIA ELECTRONIC MAIL*

Duane Shintaku
Deputy Director, Resource Management
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**RE: California Fire Science Consortium, Panel Review Report of Vegetation Treatment Program Environmental Impact Report Draft (August 2014)**

Dear Duane:

Endangered Habitats League, California Native Plant Society, California Chaparral Institute, and Audubon California wish to commend CAL FIRE for its constructive response to the peer review. We find that the review provides a sound basis for moving forward, and concur that a revised VTP EIR is the best route to achieve a science-based plan that has broad consensus.

We also wish to express our sincere appreciation to the panel for its diligent review, outreach to stakeholders, field trips, and constructive advice. Their review was shared with fire scientists, including from Conservation Biology Institute, who endorse the basic recommendations to 1) reformulate program objectives to the narrower task of public safety and 2) tailor treatments to the diverse vegetation communities in our state. The panel's recommendation to focus treatments within shrublands to the WUI is also crucial.

As you move ahead, we strongly urge CAL FIRE to coordinate with stakeholders and with scientists both within and outside the Consortium. Scientists with expertise in shrubland ecosystems are particularly important for Southern California. Developing a revised VTP EIR should be viewed as an iterative process, with public and scientific input at key intervals. Indeed, the peer review itself raises many issues that will need further refinement and deliberation. Please find a list of these enclosed. I would be happy to assist in periodic outreach to conservation stakeholders and scientists.

The goals of our organizations include public safety as well as environmental protection, and let me convey our strong commitment to working with you to craft a program that will well serve Californians into the future.

Yours truly,

Dan Silver
Executive Director

<u>Enclosure</u>

Issues Raised by California Fire Science Consortium Panel Review Report

cc: CAL FIRE
Board of Forestry
California Fire Science Symposium
California Legislature
California Dept. of Fish and Wildlife
US Fish and Wildlife Service
Interested parties

**Issues Raised by**
**California Fire Science Consortium Panel Review Report on**
**Vegetation Treatment Program Environmental Impact Report Draft (August 2014)**

## FRAP Fuel Rank Potential Fire Behavior data

To what extent should FRAP data models be relied upon? The *limitations* of this data and modeling will need to inform decision-making so that there is not over-reliance.

Data limitations include:

- The data not accounting for locally varying wind patterns, such as Santa Ana wind corridors, or human factors that influence fire patterns and hazard.
- The coarse scale of the data spatially, indicating the most appropriate use is for broad-scale decision-making rather than for siting treatments at specific locations.
- The need to incorporate local-scale factors that influence hazard in any type of risk mapping, such as interactions among wind, fire history, housing patterns, and topography (e.g., fire corridors or refugia).
- Scientific studies showing that locations delineating threats to communities in these data layers do not correspond well with areas where homes have historically been destroyed by fire.

Fire behavior modeling limitations include:

- Recognizing that is it one of many available tools for anticipating how effective a treatment might be at modifying fire line intensity or spread.
- Fuel models for chaparral and coastal sage scrub ecosystems have not been well-developed, and there are many known difficulties for modeling fire spread in interface areas that contain large patches of urban or exotic landscaping for which no fuel models exist.
- The need to ensure that extreme weather in these models includes Santa Ana winds in Southern California.
- The profound effects of periodic droughts on fire behavior, which may vary on different temporal scales than weather (e.g., years to decades).
- The critical need for the modeling to be performed by unbiased experts.

## Reliance on examples and the scientific literature

If the revised VTP EIR relies on examples, these must be well conceived and directly relevant. Literature citied should be current, published, and peer reviewed.

**Southern California shrublands**

It will be important to ensure that language and direction are clear and unambiguous. It is the job of the EIR to recognize that there is much more agreement than there is uncertainty regarding shrubland ecology in the scientific literature, and to make clear conclusions on the basis of the best science rather than leave important issues open to varying interpretation. For example, there must be clarity as to the likely negative ecological impacts of fuel reduction and prescribed fire in shrublands, and that senescence risk is irrelevant on the current landscape. Another example of the importance of clarity is the question of recovery of shrub systems from fire. To say that shrub systems recover from wildfire is only correct if it acknowledges that recovery is dependent upon the fire return intervals to which they are adapted and upon the absence of post-fire drought.

**Cost-benefit analysis and stringent monitoring and adaptive management**

These excellent concepts can increase effectiveness and reduce impacts, but caution is needed due to the potential for abuse. As noted in the peer review in the case of monitoring, these analyses and programs need to be conducted by an external third party and to be transparent to stakeholders and the scientific community.

**The Wildland Urban Interface**

As the revised VTP EIR addresses shrublands, it will need to carefully define terms and provide specific delineations and protocols for how treatments are to be directed to the WUI. First, the WUI itself needs a definition that reflects the program focus on structural safety. If a "community defense zone" is to be utilized, its definition must be grounded in the scientific literature, with full justification of the distance needed to create and maintain necessary access for firefighter suppression and safety. Risks inherent in vegetation treatment, such as expanding areas of dry, weedy, flammable exotic grass, must be accounted for. Indeed, higher fuel moisture shrublands may provide *protection* if outside of the 100' defensible space zone. Distances from structures must account for the degree of flammability and for the predominant method of ignition – embers alighting on flammable vegetation or building material – rather than from direct contact from flames. The cost-effectiveness of alternative methods should also be compared.

As noted in the peer review, if the probability of initial attack success is used for judging the efficacy of suppression, it will be important to account for whether firefighting crews have the access and manpower available to actually reach a treatment site.

Finally, it will be vital for the VTP EIR to build upon the peer review's finding that in shrublands there is no compelling case for treatments outside the WUI. If findings are used to justify such treatments in highly circumscribed situations, there must be unambiguous protocols that can be tailored to local circumstances and that are transparent, understood by stakeholders, and subject to public comment.

**Recommendation to organize the VTP EIR based on major vegetation formations**

The review recommends separating the VTP EIR into three sections to recognize fuel type differences between forests, grasslands, and shrublands (and later recommends considering differences in "subtypes," such as hardwood vs long-needled vs short-needled conifers). Although we agree this is a good first step, we point out that this simple breakdown cannot account for the great diversity in fire regimes, fire behavior patterns, and effective management approaches within each of these categories, especially forests. The strategies for reducing fires risks and sustainable ecological conditions vary hugely between different forest types, and management actions must therefore differ between, for example, coastal redwoods, dry yellow-pine forests, and mesic fir forests. The VTP EIR should further subdivide the three major vegetation formations, based on differences in fire regimes or fuel types, and the effectiveness of different management approaches.