

An underwater photograph showing a fish swimming through a dense field of green seaweed. The fish is positioned in the lower center of the frame, facing right. The seaweed consists of many thin, vertical blades that create a textured, green background. The lighting is somewhat dim, typical of an underwater environment.

# 2012 BIOLOGICAL ASSESSMENT

## Overview

Jim Harrington  
California Department of Fish and Game  
Office of Spill Prevention and Response  
Aquatic Bioassessment Laboratory

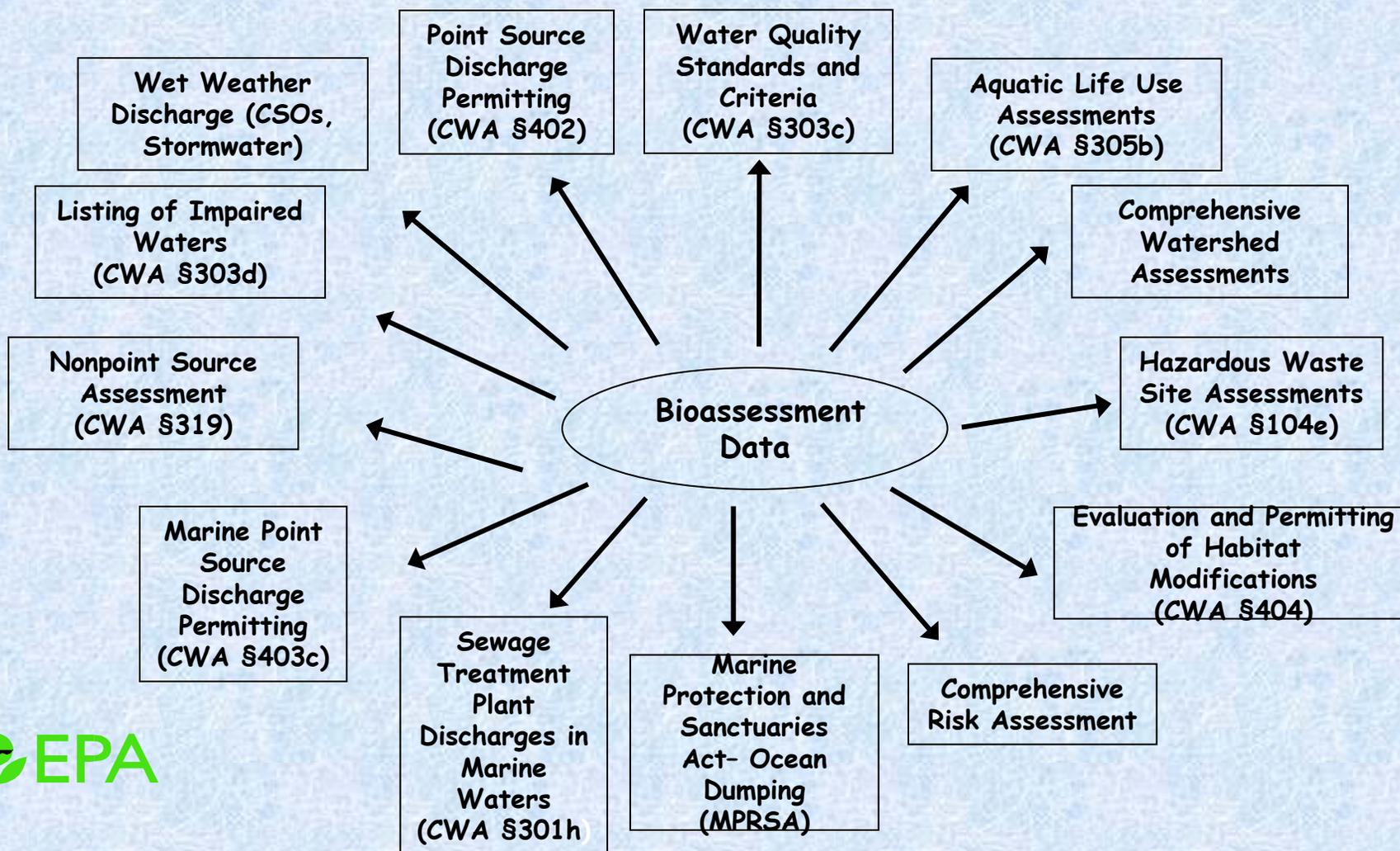
# Statutory Authority

- Clean Water Act Section 101(a) Purpose:
  - *"To restore and maintain the **chemical, physical and biological integrity** of the Nation's waters"*



**Biological integrity** - the capability of the waterbody to support and maintain a balanced, integrated, adaptive community of organisms having a composition and diversity comparable to that of natural habitats of the region

# Use of Bioassessment in Water Quality Monitoring



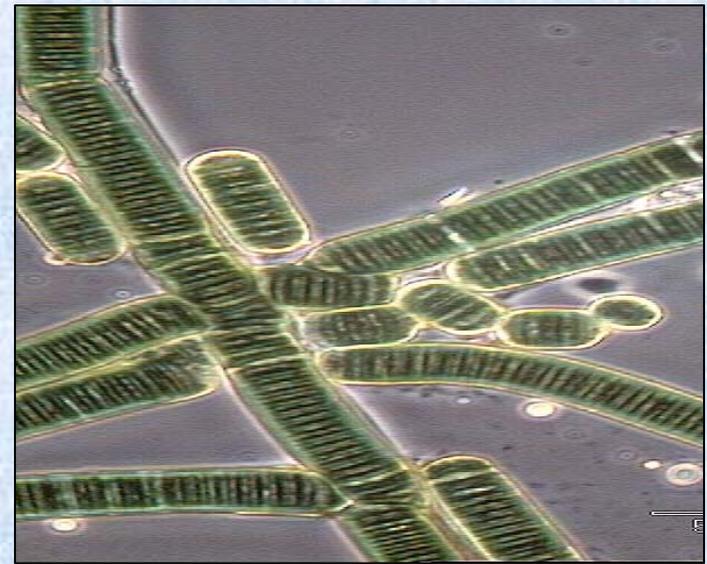


# FRESHWATER BIOASSESSMENT - THE USE OF AQUATIC ORGANISM TO MEASURE AQUATIC HEALTH -

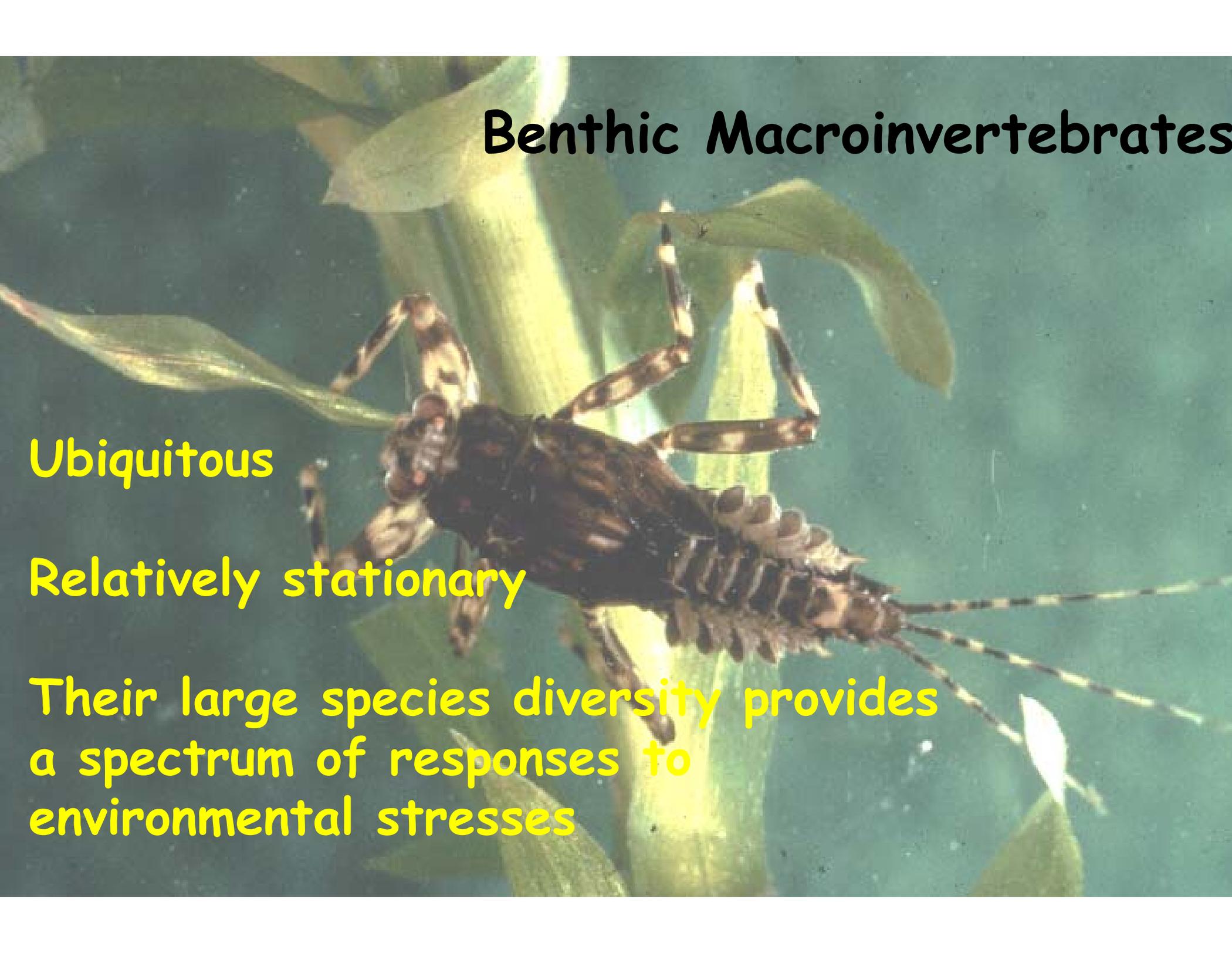
EPA Recommendation:

Multiple Assemblages

Fish, Invertebrates and Algae



# Benthic Macroinvertebrates

A large, brown, segmented aquatic insect, likely a hellgrammite (amphipod), is shown clinging to a green plant stem underwater. The insect has a dark, segmented body with lighter brown markings, long antennae, and several pairs of legs. The background is a clear, greenish-blue water environment with other plant stems visible.

Ubiquitous

Relatively stationary

Their large species diversity provides a spectrum of responses to environmental stresses

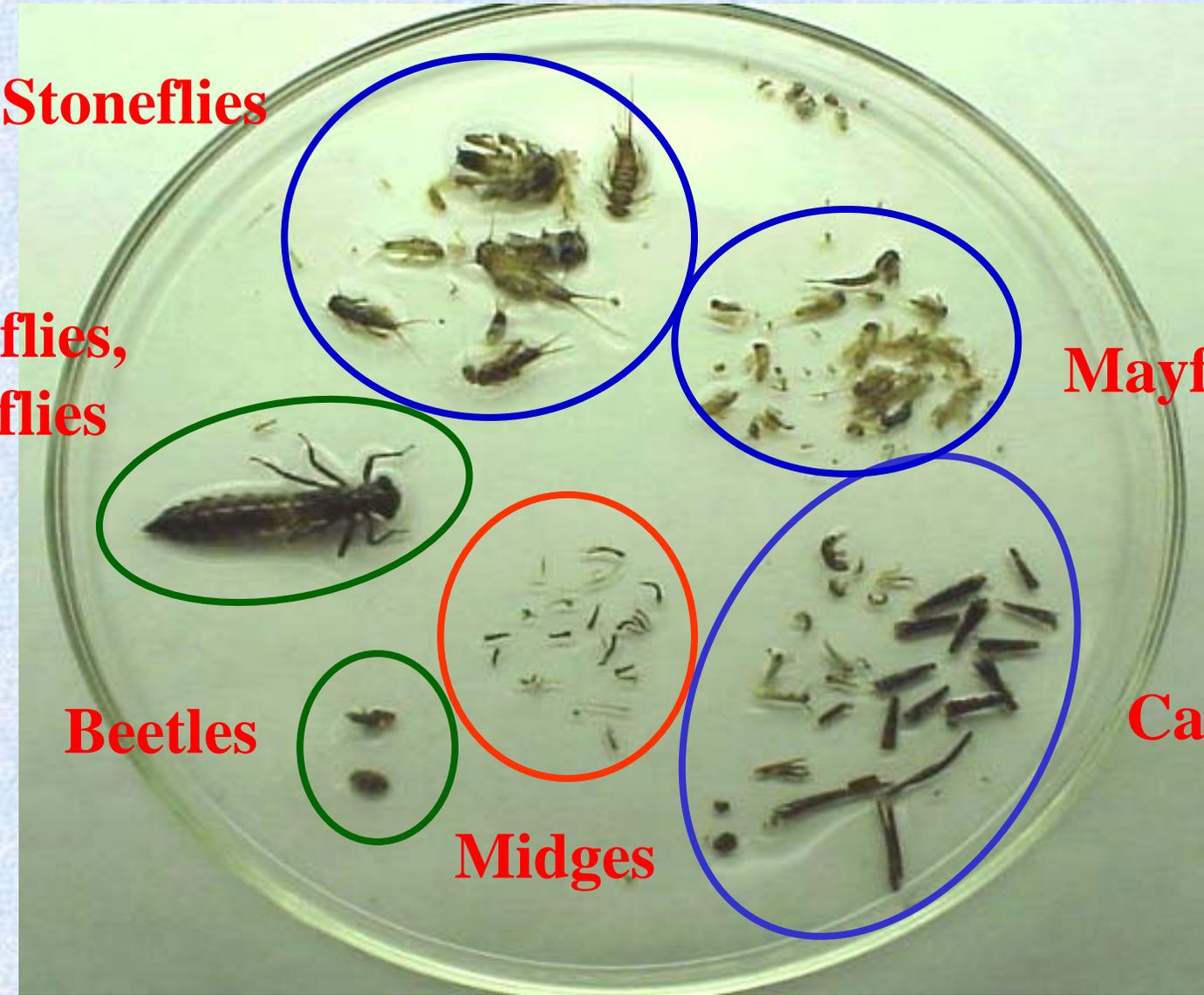








# BMI Metrics



**Stoneflies**

**Dragonflies,  
Damselflies**

**Beetles**

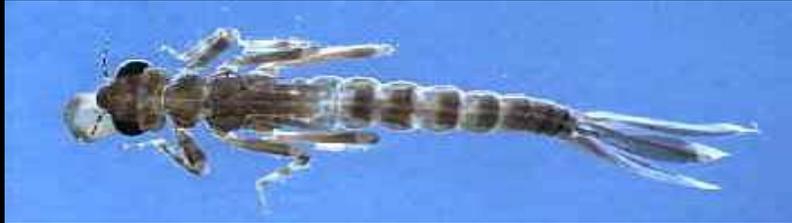
**Midges**

**Mayflies**

**Caddisflies**

# Sensitive Organisms in Streams

## Dragonflies and Damselflies



## Mayflies



## Stoneflies



## Caddisflies



Expected Response to Stress: ↓ abundance & proportion

# Tolerant Organisms in Streams

**Scuds**



**Snails**



**Leeches**



**Midges**



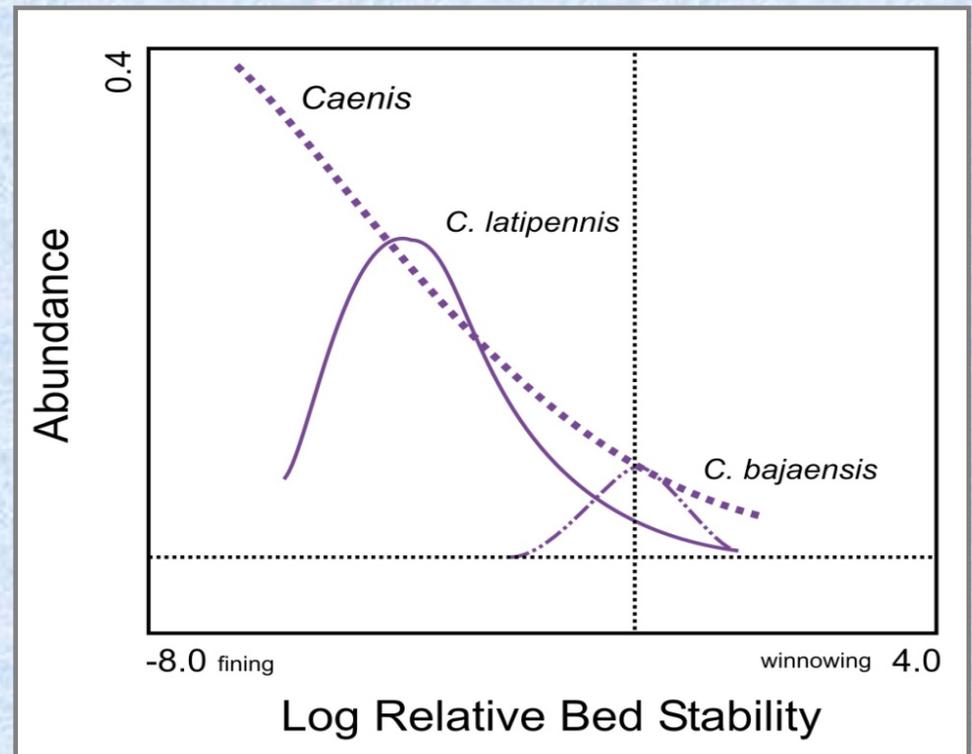
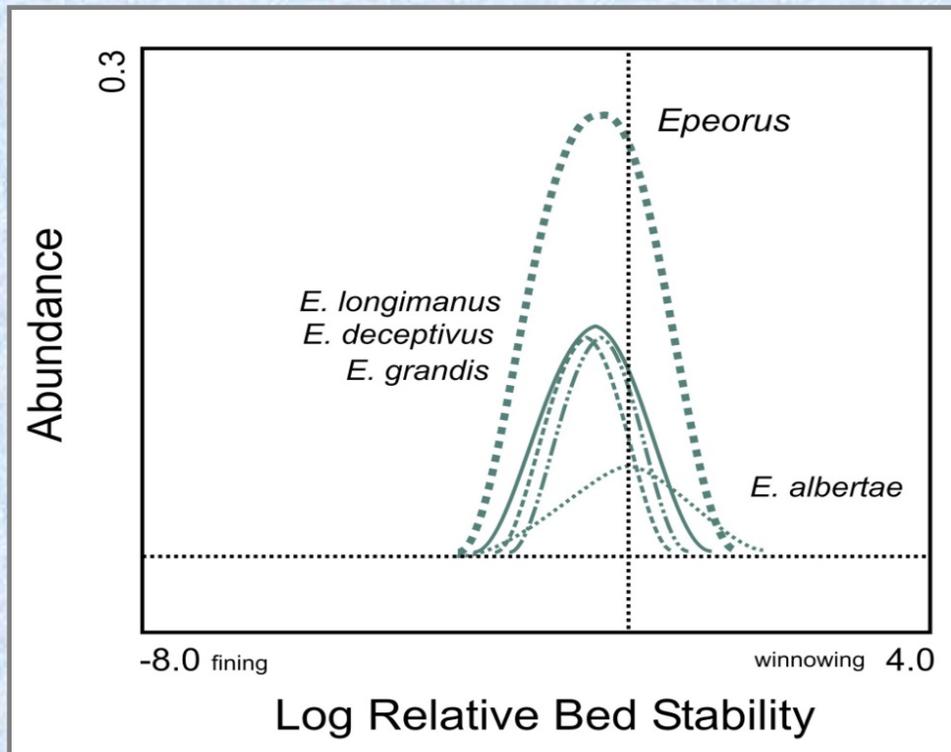
Expected Response to Stress: ↑ abundance & proportion

# Sediment intolerant vs. sediment tolerant

*Epeorus*



*Caenis*



# Types of BMI Metrics

## **Richness Measures**

EPT Taxa

## **Composition Measures**

Percent EPT Individuals

## **Tolerance/Intolerance Measures**

Percent Sensitive EPA Taxa

## **Functional Feeding Groups**

Percent Shredder Taxa

Total of 134

SAFIT Standard Taxonomic Effort I & II

# Standardize Taxonomy and Laboratory QA/QC Starting 1994 as CAMLnet and SAFIT since 2006

Home | Members-Only | Contact Us

## SAFIT

### Southwest Association of Freshwater Invertebrate Taxonomists

#### SAFIT Mission

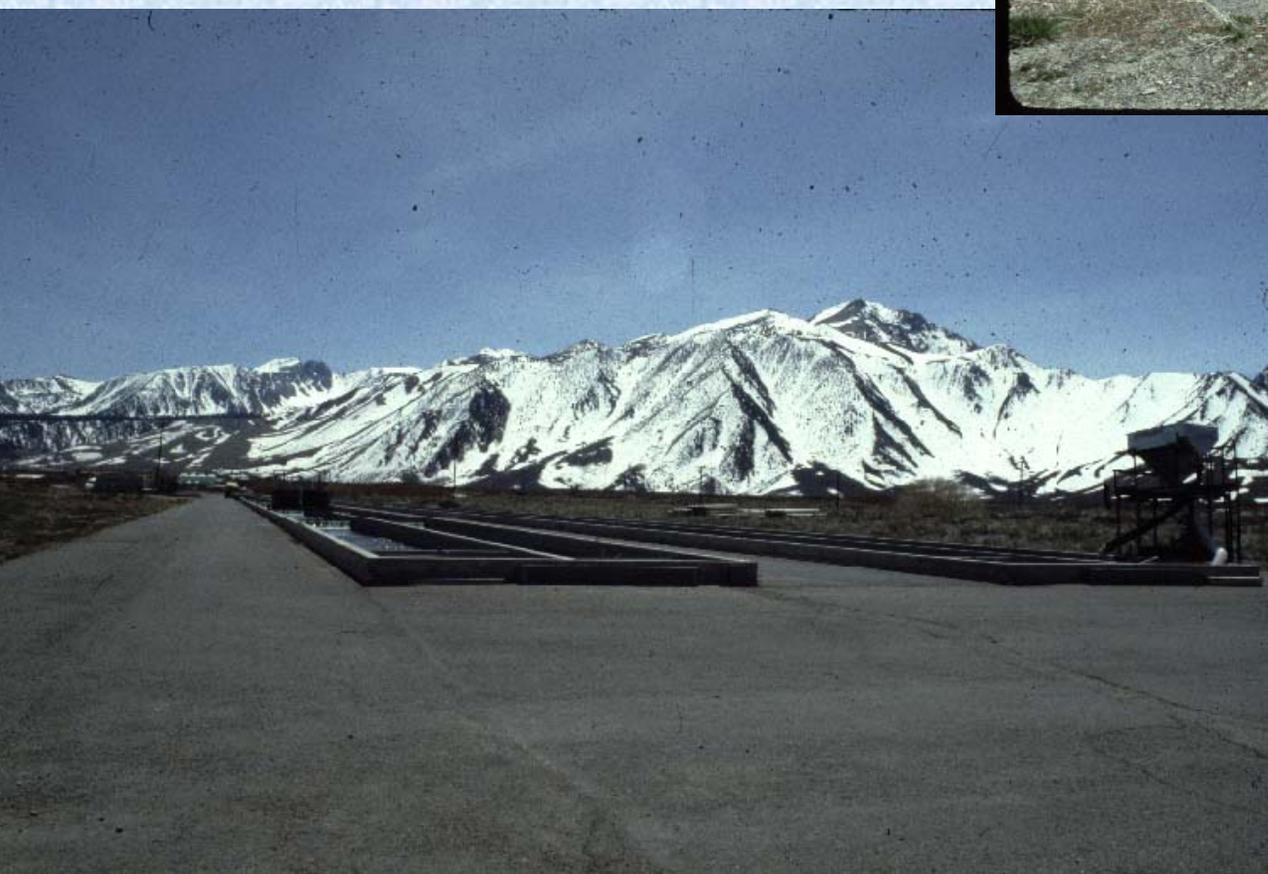
The mission of the Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT) is to promote understanding of the taxonomy and systematics of inland freshwater invertebrates in support of biotic condition of inland aquatic ecosystems of the southwestern United States. Fundamental to this mission is the standardization of identification and reporting of freshwater invertebrate taxa. SAFIT fosters scientific research, education, and professional development in the environmental sciences, as they pertain to inland freshwater invertebrate taxonomy. To accomplish this mission SAFIT will:

1. Establish standard taxonomic procedures.
2. Provide/maintain standard taxonomic effort document.
3. Facilitate information exchange.
4. Improve taxonomic QA/QC methods.
5. Promote scientific and educational programs.

8:37 AM  
5/3/2012

# California Department Of Fish and Game

## Hot Creek Hatchery NPDES Permit



## Protocol History

1993 EPA RBP

1994 PMS

1996 CSBP

2000 EMAP

2007 SWAMP

# Targeted Sampling Site from Various Contracts as of 2000





2000  
through  
2007

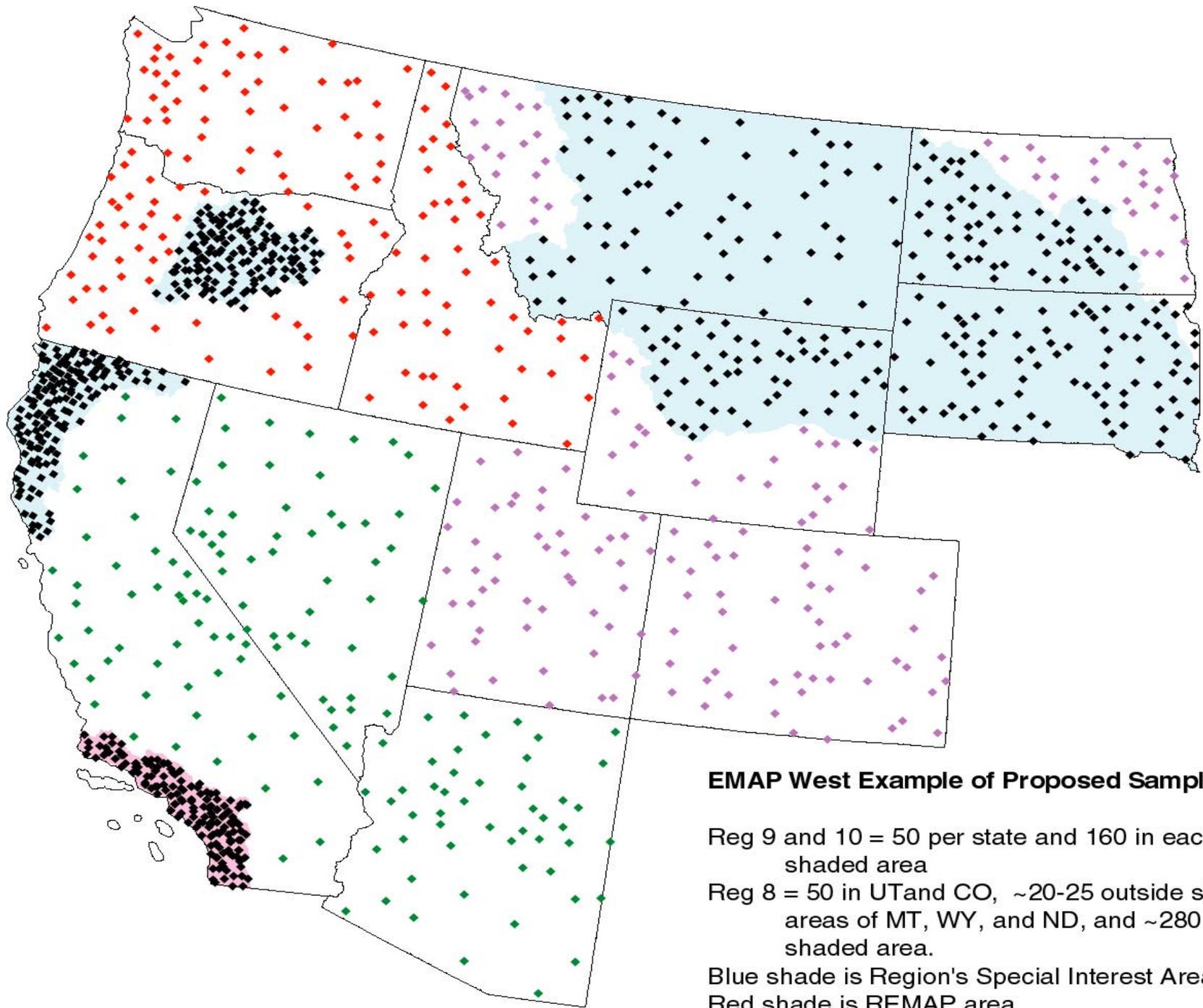


# Western Pilot EMAP and CMAP



CDFG  
U.S. EPA  
SWRCB  
RWQCB





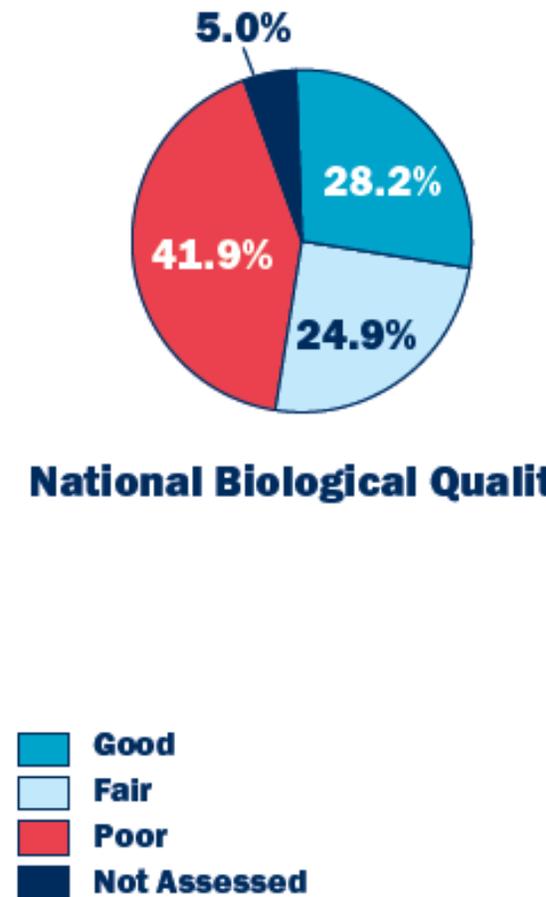
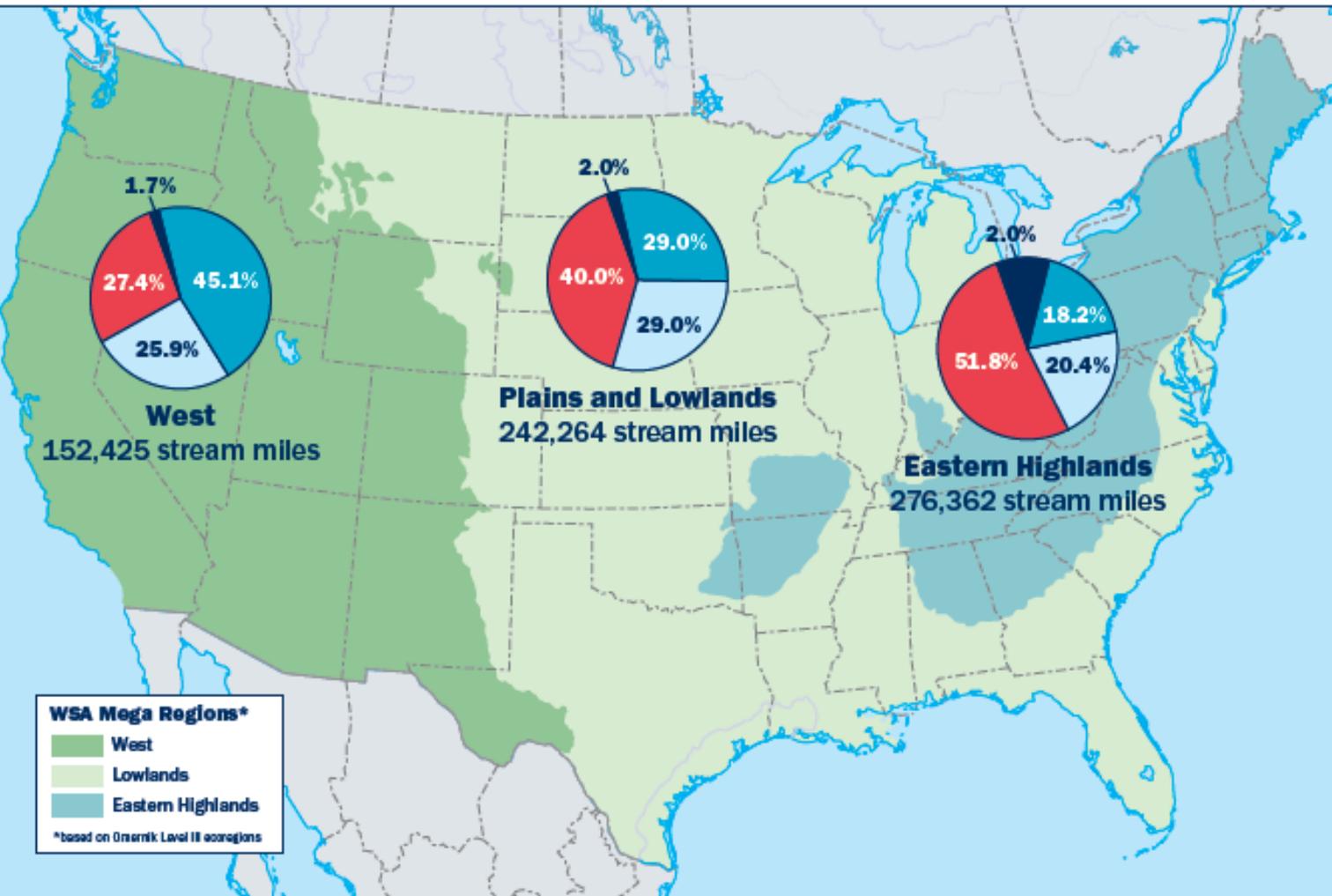
**EMAP West Example of Proposed Sample scheme.**

Reg 9 and 10 = 50 per state and 160 in each shaded area

Reg 8 = 50 in UT and CO, ~20-25 outside shaded areas of MT, WY, and ND, and ~280 within shaded area.

Blue shade is Region's Special Interest Areas  
 Red shade is REMAP area

# Biological condition the nation's streams (USEPA 2006)



# And Then Along Came SWAMP Surface Water Ambient Monitoring Program

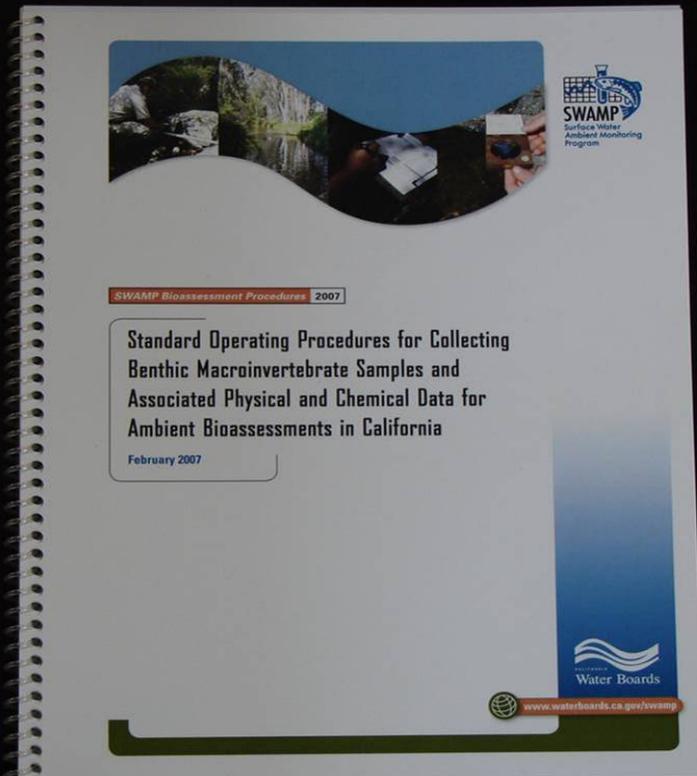


# 2007 SWAMP Bioassessment Procedures

Collect BMIs

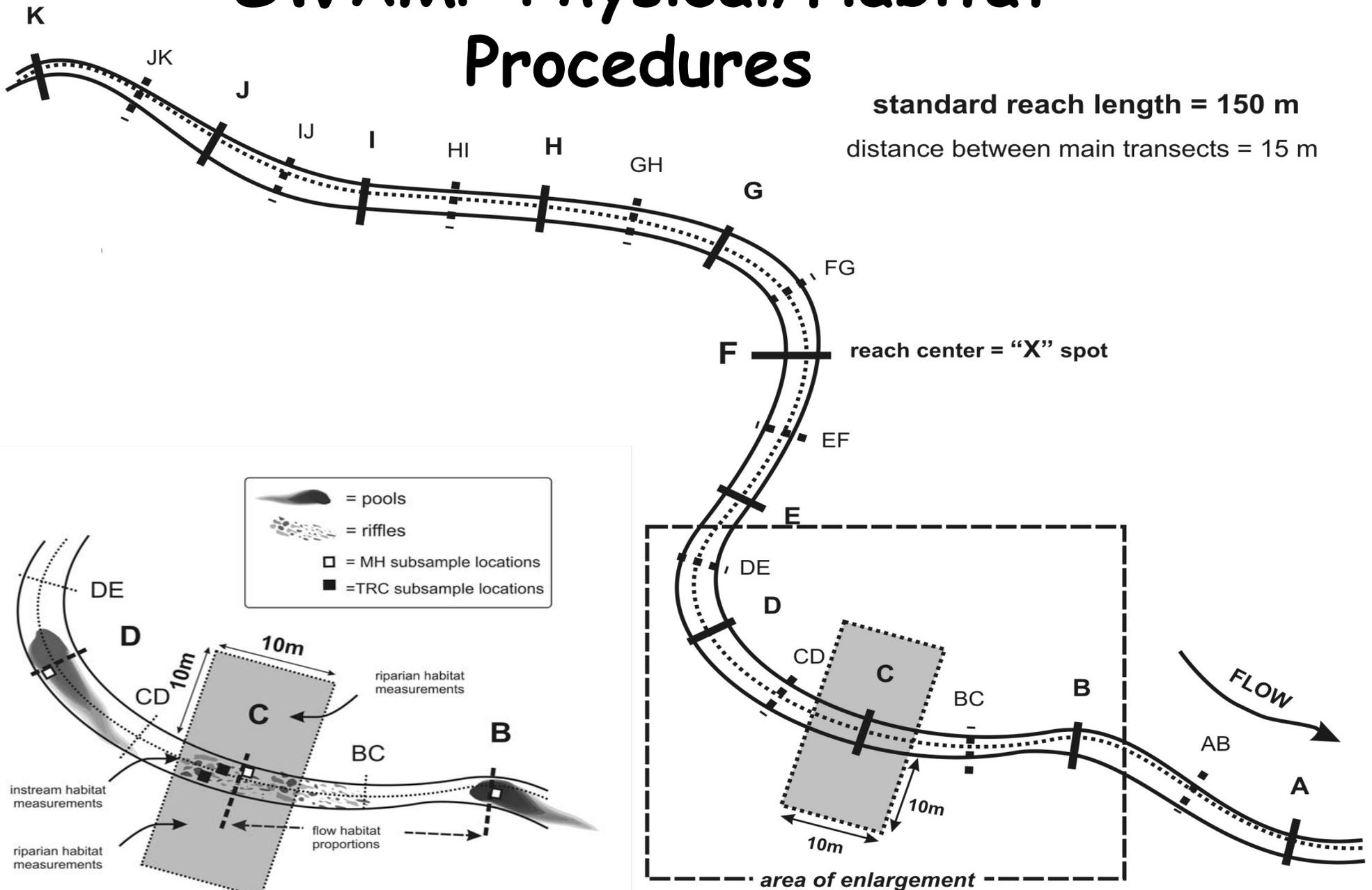
Measure Phab

Measure Basic  
Chemistry



# SWAMP Physical/Habitat Procedures

standard reach length = 150 m  
distance between main transects = 15 m

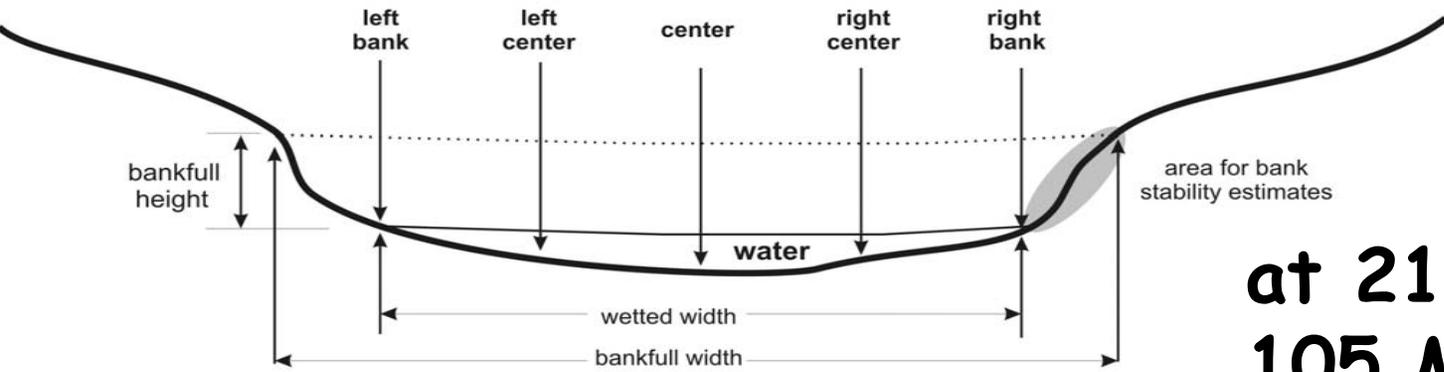


AMBIENT WATER QUALITY MEASUREMENTS				<i>turbidity and silica are optional; calibration date required</i>			
Temp (°C)		pH		Alkalinity (mg/L)		Turbidity (ntu)	
		cal. date				cal. date	
Dissolved O <sub>2</sub> (mg/L)		Specific Conduct (µS/cm)		Salinity (ppt)		Silica (mg/L)	
cal. date		cal. date		cal. date		cal. date	





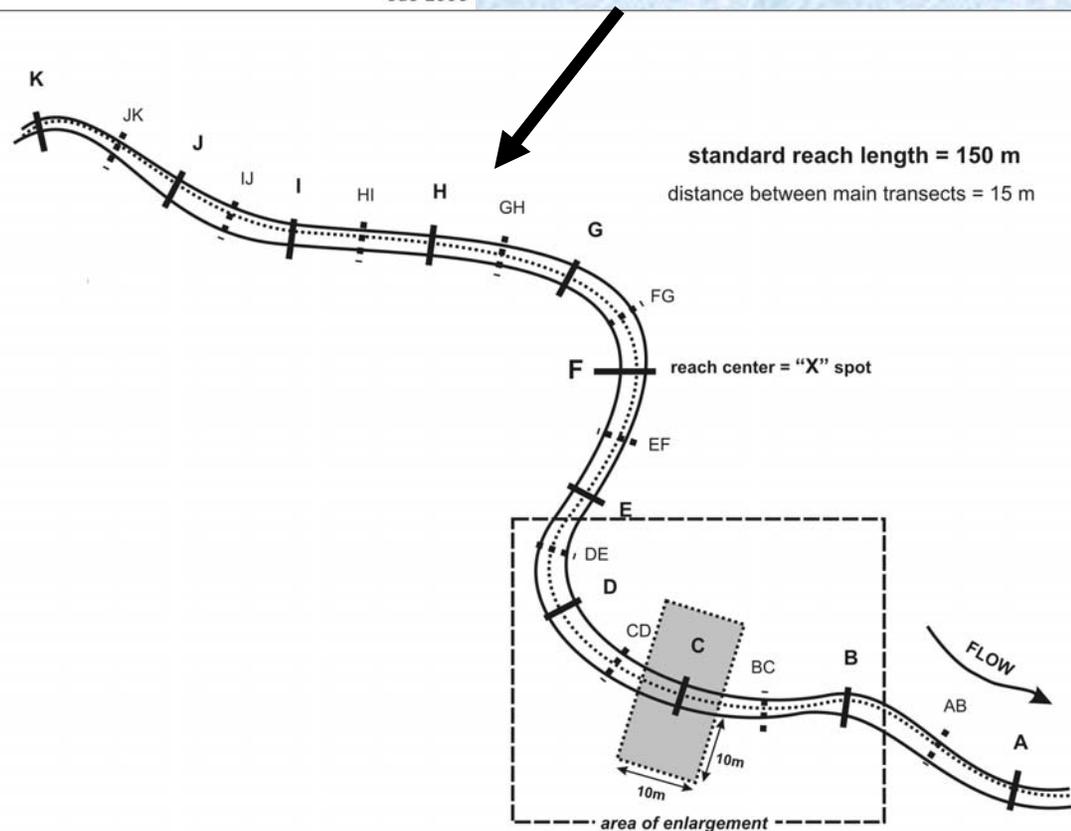
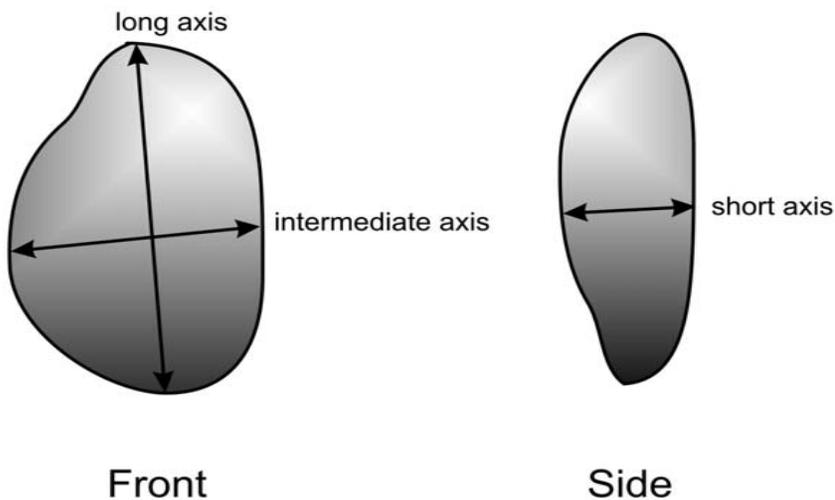
Channel Dimensions  
Channel Slope  
% Flow Habitats  
Discharge (cfs)



at 21 Transects for  
105 Measures Total

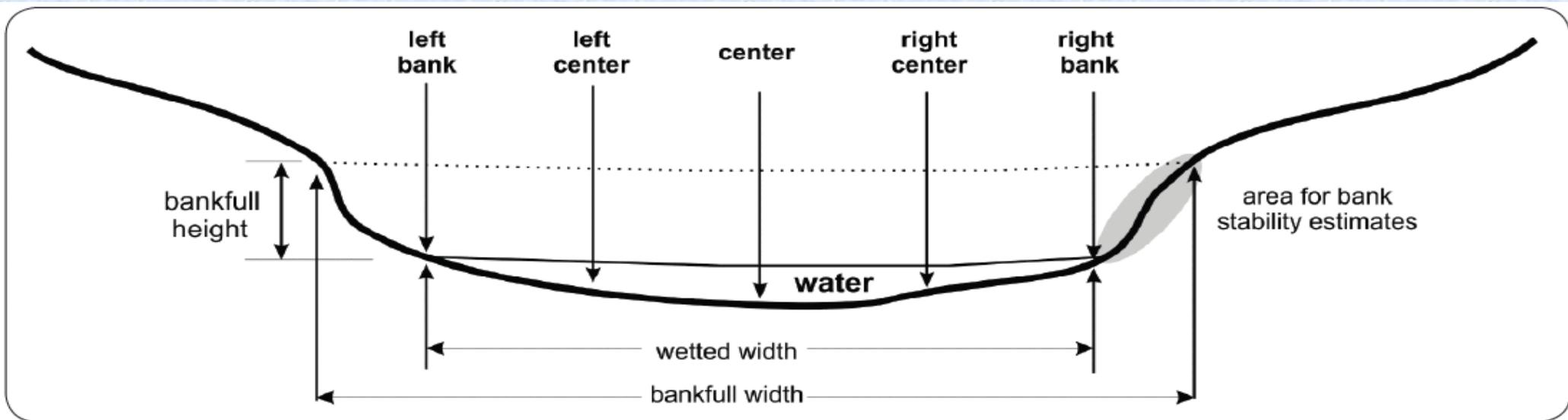
ode 2006

# Pebble Counts for Substrate Composition



ode 20

# Point-Intercept Algal Cover



## Transect Substrates

Position	Dist from LB (m)	Depth (cm)	mm/size class	% Cobble Embed.	CPOM	Microalgae Thickness Code	Macroalgae Attached	Macroalgae Unattached	Macrophytes	<b>Microalgae Thickness Codes</b> <b>0</b> = No microalgae present, Feels rough, not slimy; <b>1</b> = Present but not visible, Feels slimy; <b>2</b> = Present and visible but < 1mm; Rubbing fingers on surface produces a brownish tint on them, scraping leaves visible trail. <b>3</b> = 1-5mm; <b>4</b> = 5-20mm; <b>5</b> = >20mm; <b>UD</b> = Cannot determine if microalgae present, substrate too small or covered with silt (formerly Z code). <b>D</b> = Dry, not assessed
Left Bank					P A		P A D	P A D	P A D	
Left Center					P A		P A D	P A D	P A D	
Center					P A		P A D	P A D	P A D	
Right Center					P A		P A D	P A D	P A D	
Right Bank					P A		P A D	P A D	P A D	
Note: Substrate sizes can be recorded either as direct measures of the median axis of each particle or one of the size class categories listed on the supplemental page (direct measurements preferred).										

# HUMAN INFLUENCE

HUMAN INFLUENCE (circle only the closest to wetted channel)	0 = Not Present B = On Bank C = Between Bank and 10 m from Channel P = >10 m + <50 m from Channel Channel (record Yes or No)									
	Left Bank				Channel		Right Bank			
Walls/ Rip-rap/ Dams	P	C	B	0	Y	N	0	B	C	P
Buildings	P	C	B	0	Y	N	0	B	C	P
Pavement/ Cleared Lot	P	C	B	0			0	B	C	P
Road/ Railroad	P	C	B	0	Y	N	0	B	C	P
Pipes (Inlet/ Outlet)	P	C	B	0	Y	N	0	B	C	P
Landfill/ Trash	P	C	B	0	Y	N	0	B	C	P
Park/ Lawn	P	C	B	0			0	B	C	P
Row Crops	P	C	B	0			0	B	C	P
Pasture/ Range	P	C	B	0			0	B	C	P
Logging Operations	P	C	B	0			0	B	C	P
Mining Activity	P	C	B	0	Y	N	0	B	C	P
Vegetation Management	P	C	B	0			0	B	C	P
Bridges/ Abutments	P	C	B	0	Y	N	0	B	C	P
Orchards/ Vineyards	P	C	B	0			0	B	C	P

# RIPARIAN VEGETATION

<b>RIPARIAN VEGETATION</b> (facing downstream)	0 = Absent (0%)      3 = Heavy (40-75%) 1 = Sparse (<10%)    4 = Very Heavy (>75%) 2 = Moderate (10-40%)    circle one	
<b>Vegetation Class</b>	<b>Left Bank</b>	<b>Right Bank</b>
<b>Upper Canopy (&gt;5 m high)</b>		
Trees and saplings >5 m high	0 1 2 3 4	0 1 2 3 4
<b>Lower Canopy (0.5 m-5 m high)</b>		
All vegetation 0.5 m to 5 m	0 1 2 3 4	0 1 2 3 4
<b>Ground Cover (&lt;0.5 m high)</b>		
Woody shrubs and saplings <0.5 m	0 1 2 3 4	0 1 2 3 4
Herbs/ grasses	0 1 2 3 4	0 1 2 3 4
Barren, bare soil/ duff	0 1 2 3 4	0 1 2 3 4

# HABITAT COMPLEXITY BANK STABILITY CANOPY COVER

INSTREAM HABITAT COMPLEXITY	0 - Absent (0%) 1 - Sparse (<10%) 2 - Moderate (10-40%) 3 - Heavy (40-75%) 4 - Very Heavy (>75%)				
	0	1	2	3	4
Filamentous Algae	0	1	2	3	4
Aquatic Macrophytes/ Emergent Vegetation	0	1	2	3	4
Boulders	0	1	2	3	4
Woody Debris >0.3 m	0	1	2	3	4
Woody Debris <0.3 m	0	1	2	3	4
Undercut Banks	0	1	2	3	4
Overhang. Vegetation	0	1	2	3	4
Live Tree Roots	0	1	2	3	4
Artificial Structures	0	1	2	3	4

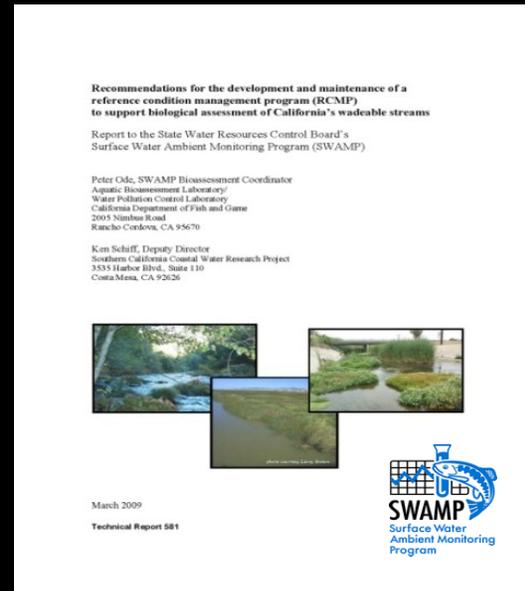
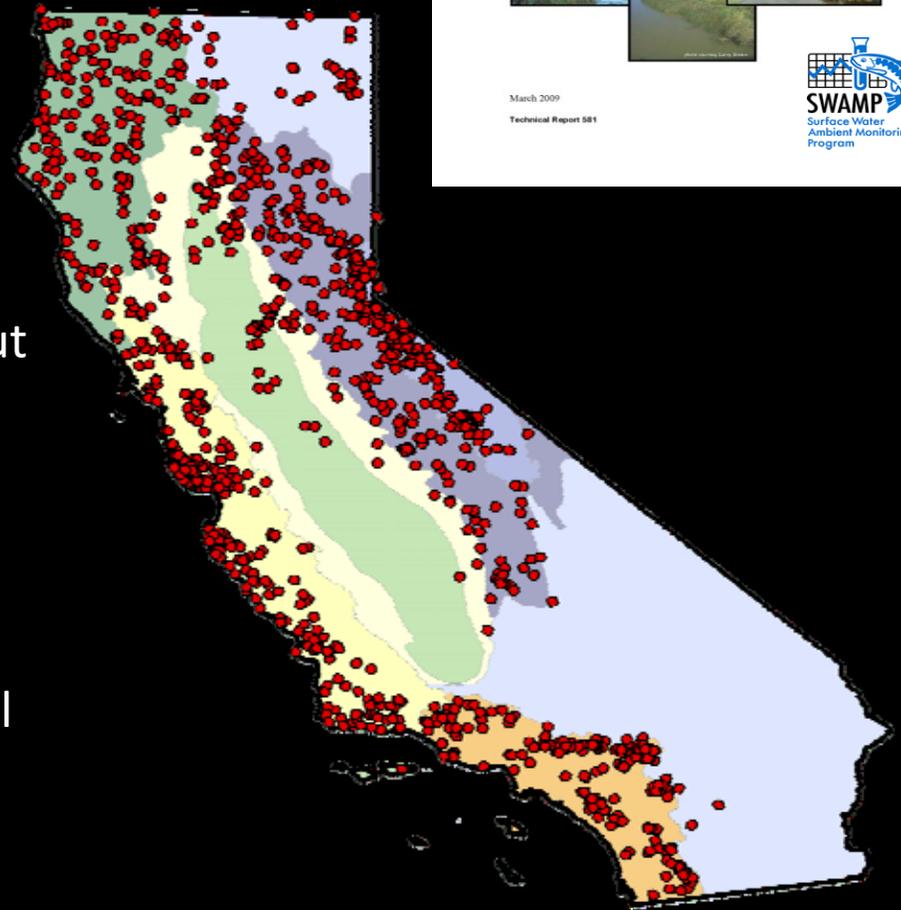
BANK STABILITY (score zone 5m up and 5m downstream of transect between bankfull - wetted width)			
Left Bank	eroded	vulnerable	stable
Right Bank	eroded	vulnerable	stable

DENSIOMETER READINGS (0-17) <i>count covered dots</i>	
Center Left	
Center Upstream	
Center Downstream	
Center Right	
<i>Left Bank (optional)</i>	
<i>Right Bank (optional)</i>	

# Reference Condition Management Plan

*(adopted March 2009)*

- RCMP is SWAMP's standardized process for identifying & sampling "reference sites" throughout CA
- Now in implementation phase:
  - ✓ Define reference criteria for streams throughout the state
  - ✓ Identify data gaps and collect bio/chem/hab data where missing
  - ✓ Monitor temporal variability (both inter-annual & intra-annual)



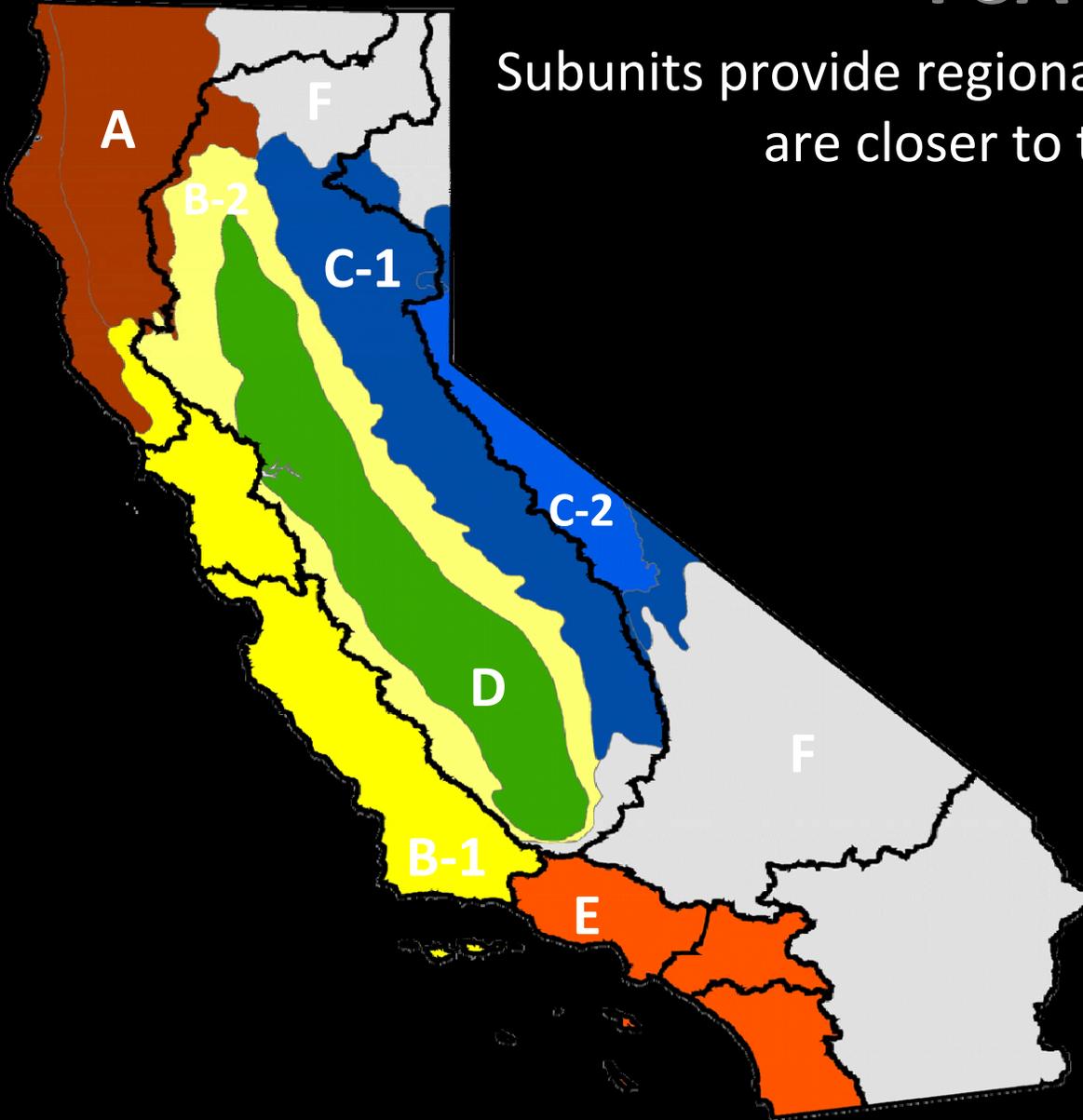
# Reference Sites

REGION	n
North Coast	79
Central Valley	1
Coastal Chaparral	87
Interior Chaparral	30
South Coast Mountains	96
South Coast Xeric	22
Western Sierra	131
Central Lahontan	142
Deserts + Modoc	27
<b>TOTAL</b>	<b>615</b>



# PSA Regions

Subunits provide regional perspective ....and assessments are closer to the scale of regulation



**A = North Coast**

**B = Oak Chaparral**

**1 = Coastal Chaparral**

**2 = Interior Chaparral**

**C = Sierra**

**1 = Main Sierra**

**2 = Central Lahontan**

**D = Central Valley**

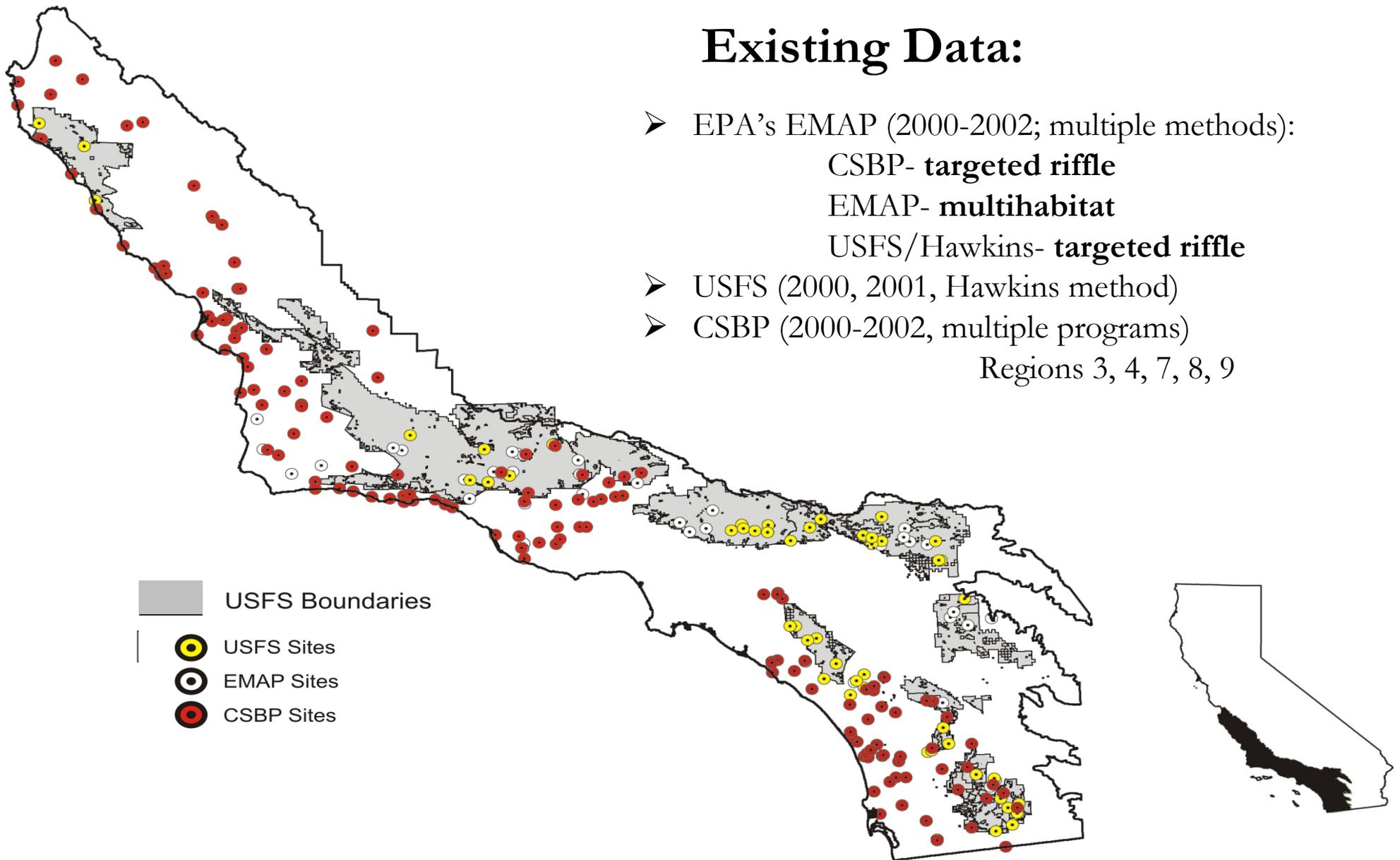
**E = South Coast (SMC)**

**F = Other:**

- Modoc Plateau
- Deserts

## Existing Data:

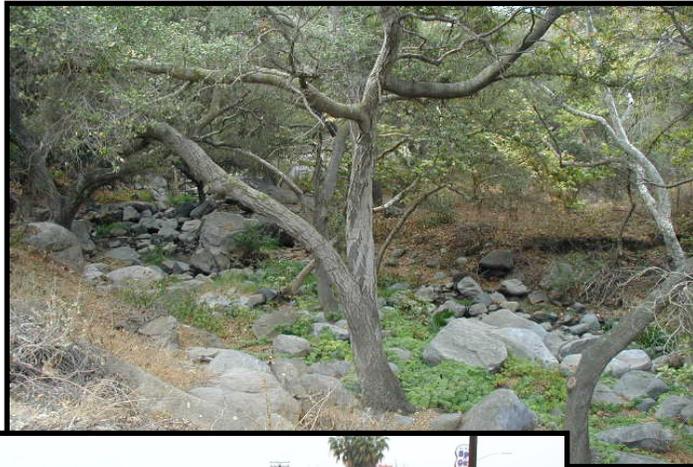
- EPA's EMAP (2000-2002; multiple methods):
  - CSBP- **targeted riffle**
  - EMAP- **multihabitat**
  - USFS/Hawkins- **targeted riffle**
- USFS (2000, 2001, Hawkins method)
- CSBP (2000-2002, multiple programs)  
Regions 3, 4, 7, 8, 9



# Application of a benthic invertebrate IBI to regional 305(b) reporting in southern California

Peter R. Ode, Andrew C. Rehn and Jason T. May

*Aquatic Bioassessment Laboratory*  
*Water Pollution Control Laboratory*  
California Department of Fish and Game  
California State University, Chico



Ode, P.R., A.C. Rehn and J.T. May. 2005. A quantitative tool for assessing the integrity of southern coastal California streams. *Environmental Management*. 35:493-504

# SoCal IBI Scoring Table

Metric Score	N_Coleop_T	N_EPT_T		N_Pred_T	P_CFCG_I		P_Int_I		P_NonIns_T	P_Tol_T
	All Sites	6	8	All Sites	6	8	6	8	All Sites	All Sites
10	>5	>17	>18	>12	0-59	0-39	25-100	42-100	0-8	0-4
9		16-17	17-18	12	60-63	40-46	23-24	37-41	9-12	5-8
8	5	15	16	11	64-67	47-52	21-22	32-36	13-17	9-12
7	4	13-14	14-15	10	68-71	53-58	19-20	27-31	18-21	13-16
6		11-12	13	9	72-75	59-64	16-18	23-26	22-25	17-19
5	3	9-10	11-12	8	76-80	65-70	13-15	19-22	26-29	20-22
4	2	7-8	10	7	81-84	71-76	10-12	14-18	30-34	23-25
3		5-6	8-9	6	85-88	77-82	7-9	10-13	35-38	26-29
2	1	4	7	5	89-92	83-88	4-6	6-9	39-42	30-33
1		2-3	5-6	4	93-96	89-94	1-3	2-5	43-46	34-37
0	0	0-1	0-4	0-3	97-100	95-100	0	0-1	47-100	38-100

<b>Very Poor</b> 0-14	<b>Poor</b> 15-28	<b>Fair</b> 29-42	<b>Good</b> 43-56	<b>Very Good</b> 57-70
--------------------------	----------------------	----------------------	----------------------	---------------------------

## Biological metrics for IBI

Number of coleopteran taxa

Number of EPT taxa

Number of Predator taxa

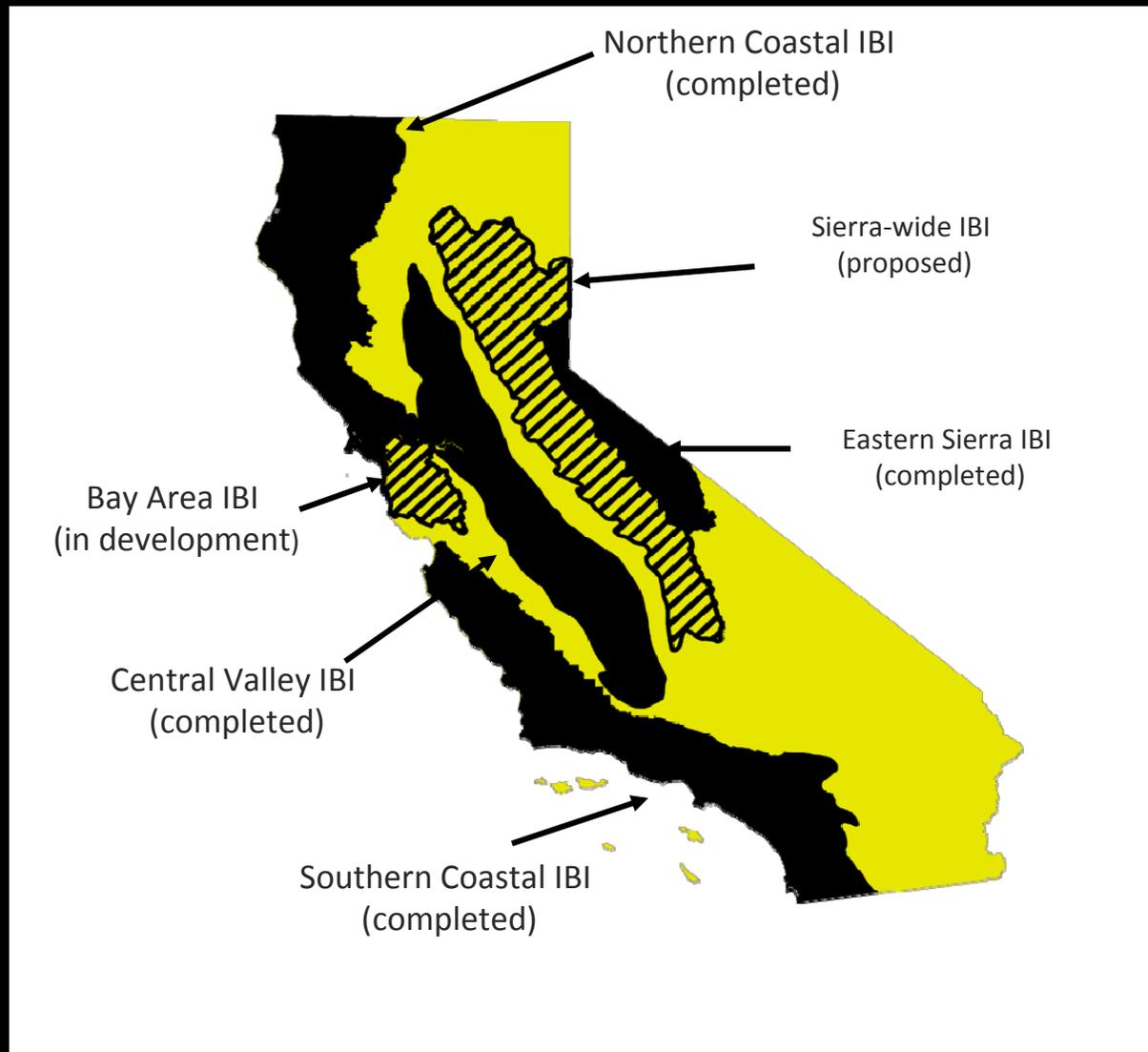
Percent collector filterers and collector gatherers

Percent Intolerant Individuals

Percent non-insect taxa

Percent tolerant taxa

# IBI Availability



# River Invertebrate Predictive and Classification System (RIVPACS)

Chuck Hawkins

Western Center for Monitoring and Assessment of  
Freshwater Ecosystems

Aquatic, Watershed, & Earth Resources

Ecology Center

Utah State University

**O/E is a measure of the taxonomic completeness of the biological community observed at a site (value ranges from 0 to 1.0)**



**E = 8 taxa**



**O = 3 taxa**

$$\frac{O}{E}$$
$$0.38$$



**excellent biological condition (IBI = 100-80)**

**$O/E > 0.8$**



**Good to fair biological condition (IBI = 79-40)**

**O/E = 0.6**



**poor biological condition (IBI = 39-20)**

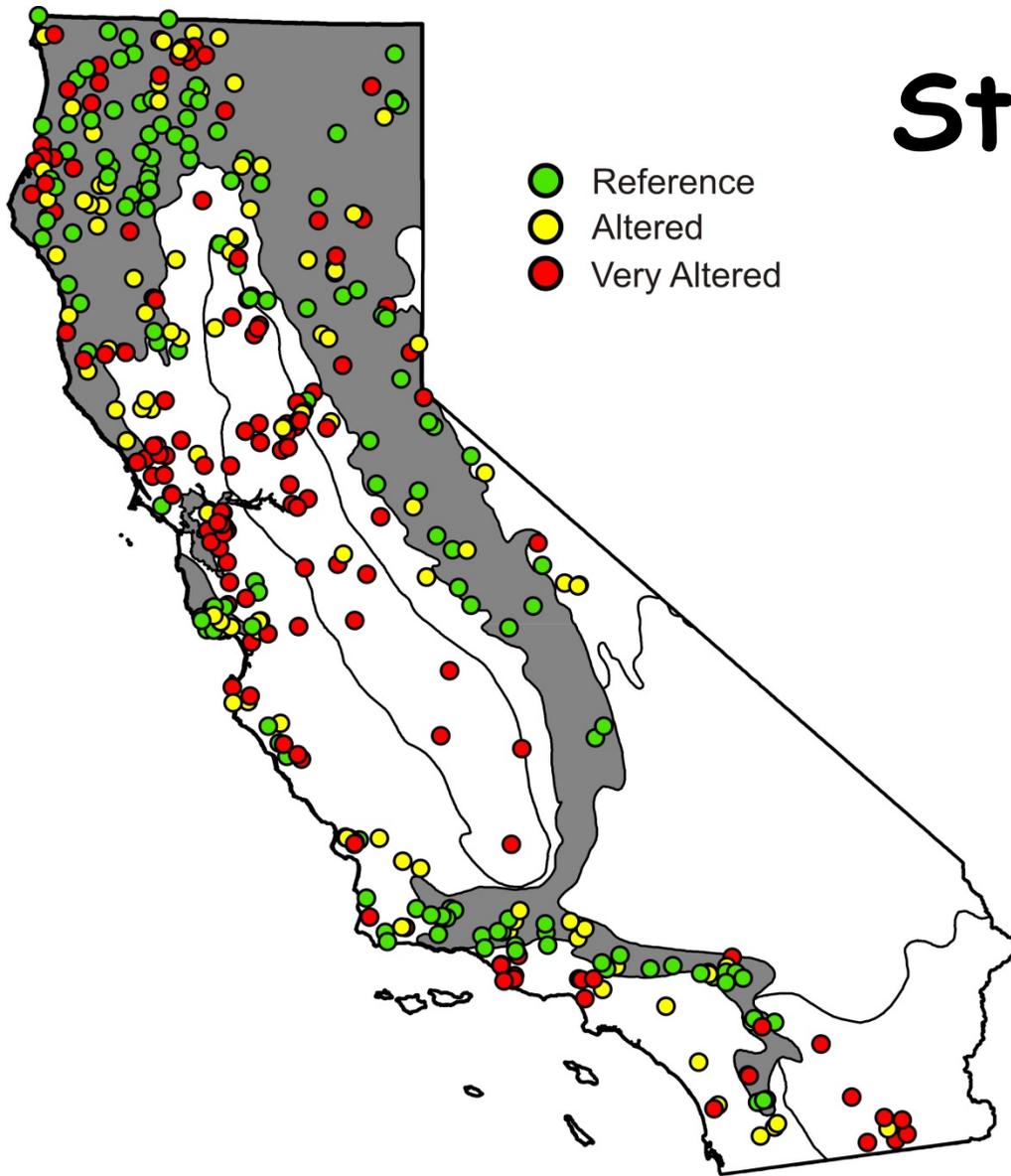
**O/E = 0.3**



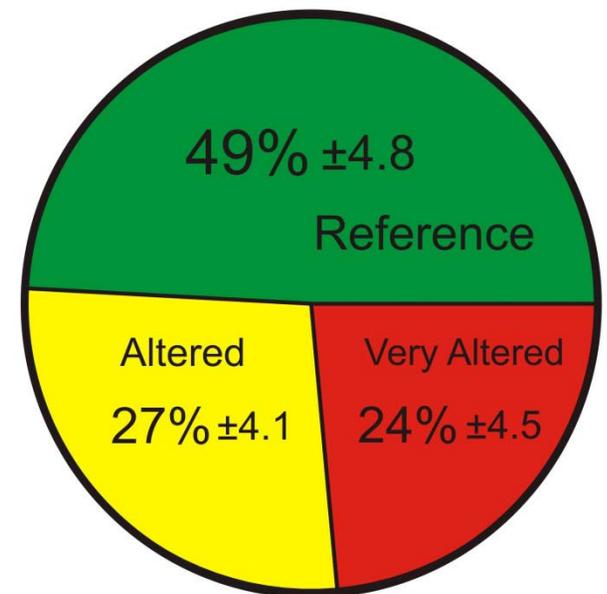
**very poor biological condition (IBI < 20)**

**O/E < 0.2**

# Statewide Condition Assessment

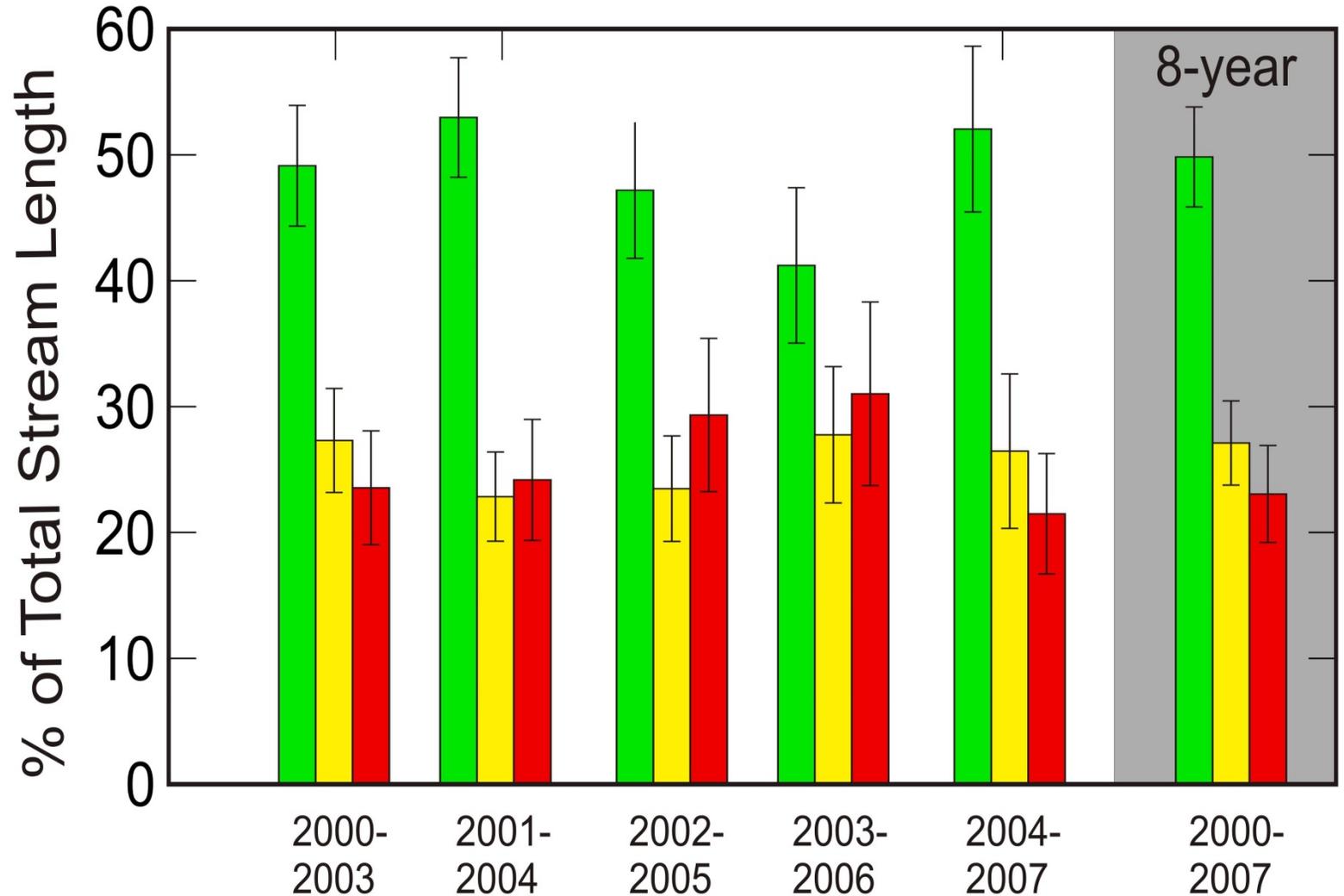


- Reference
- Altered
- Very Altered

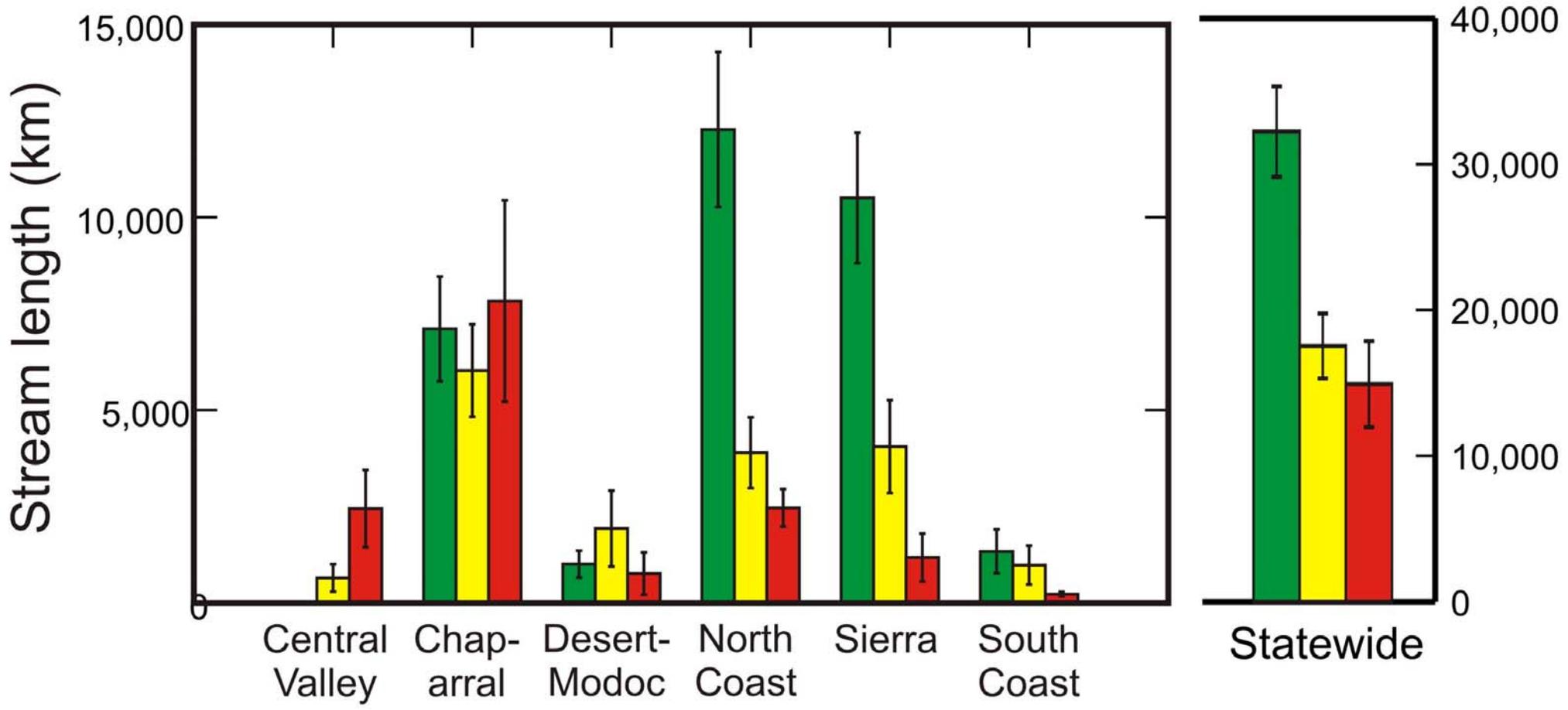


# Biotic Condition 2000 - 2007

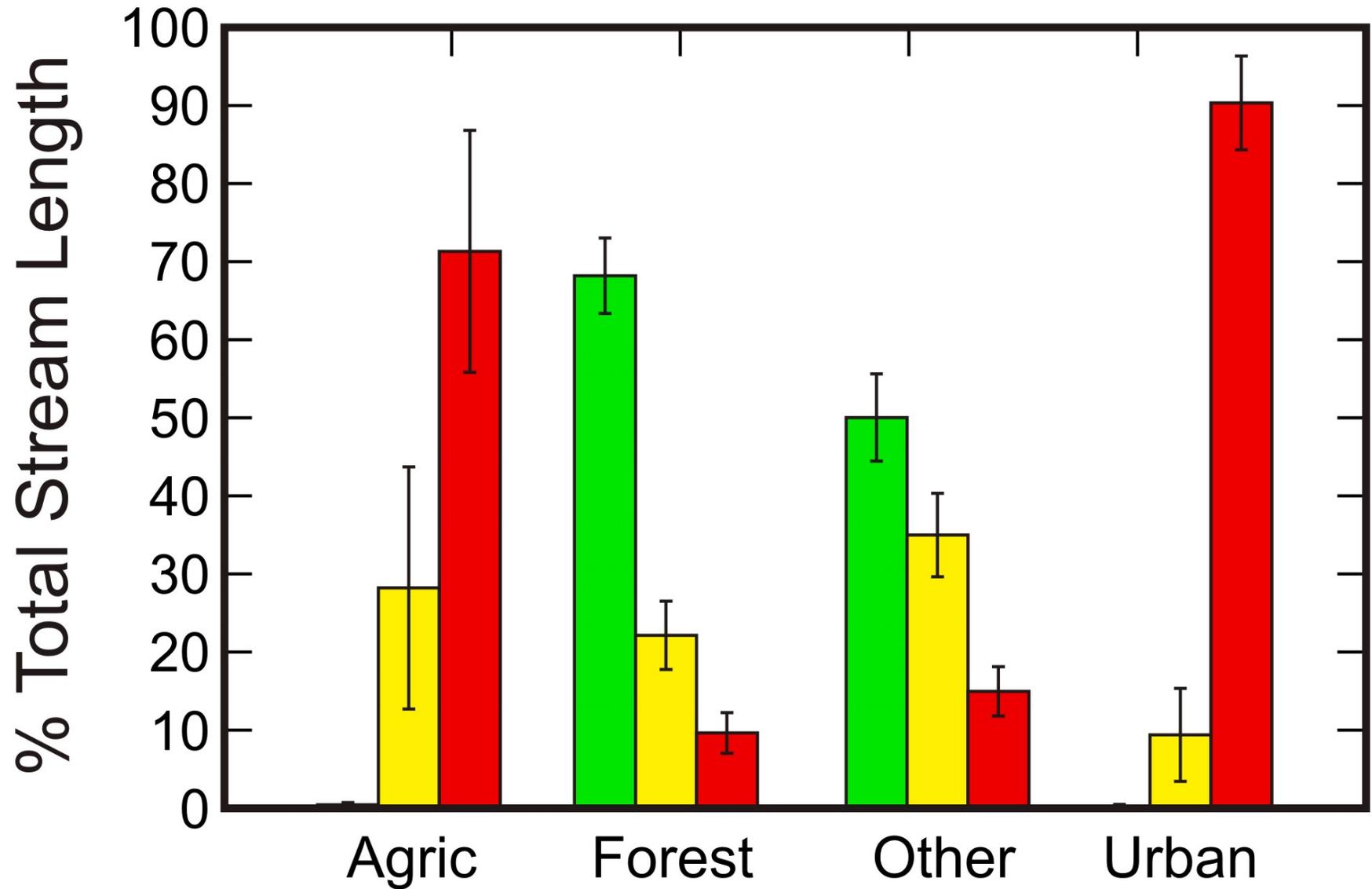
200 sites  
6% error  
12% to  
detect  
difference



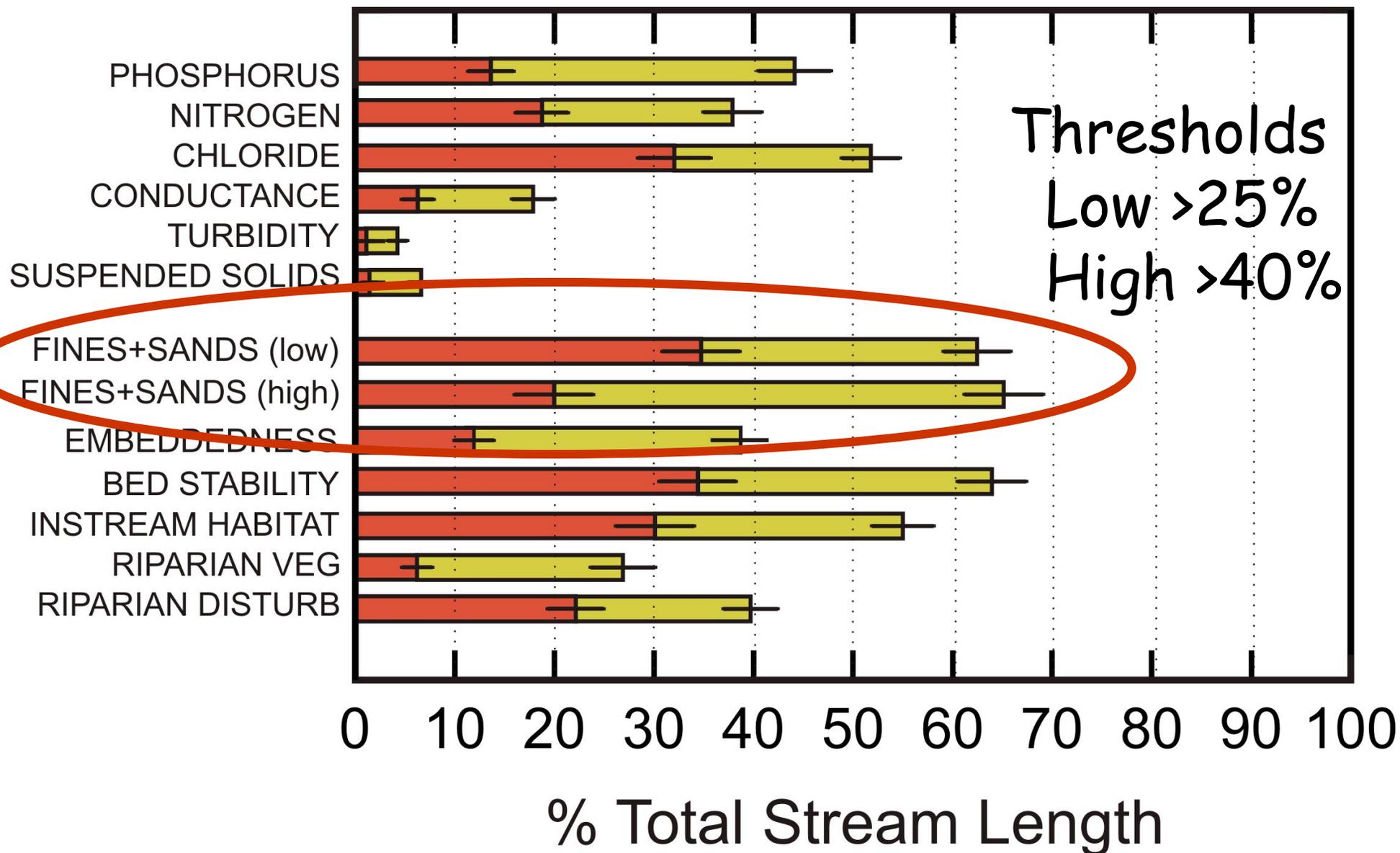
# Statewide Condition Assessment



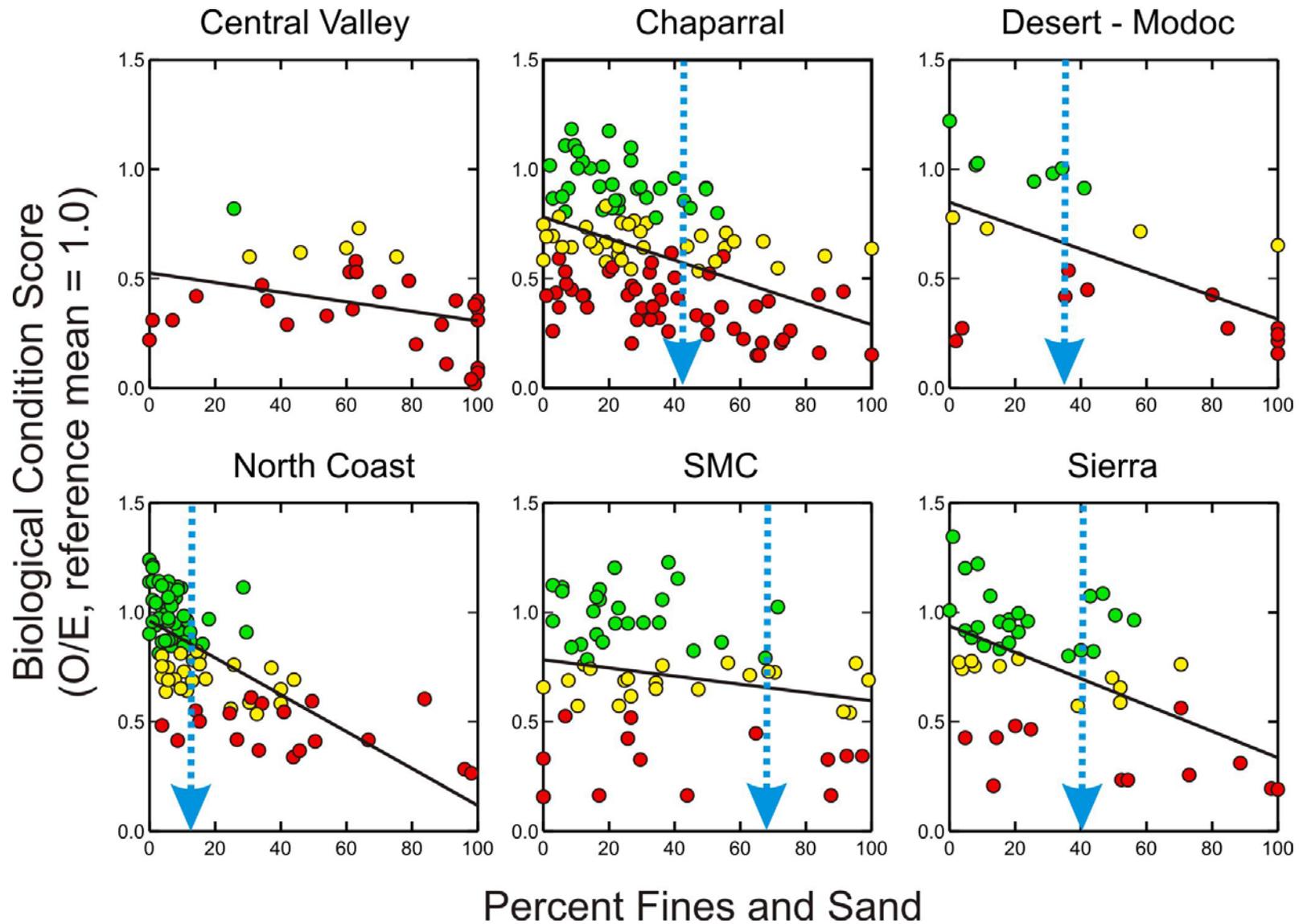
# Biotic Condition for Landcover

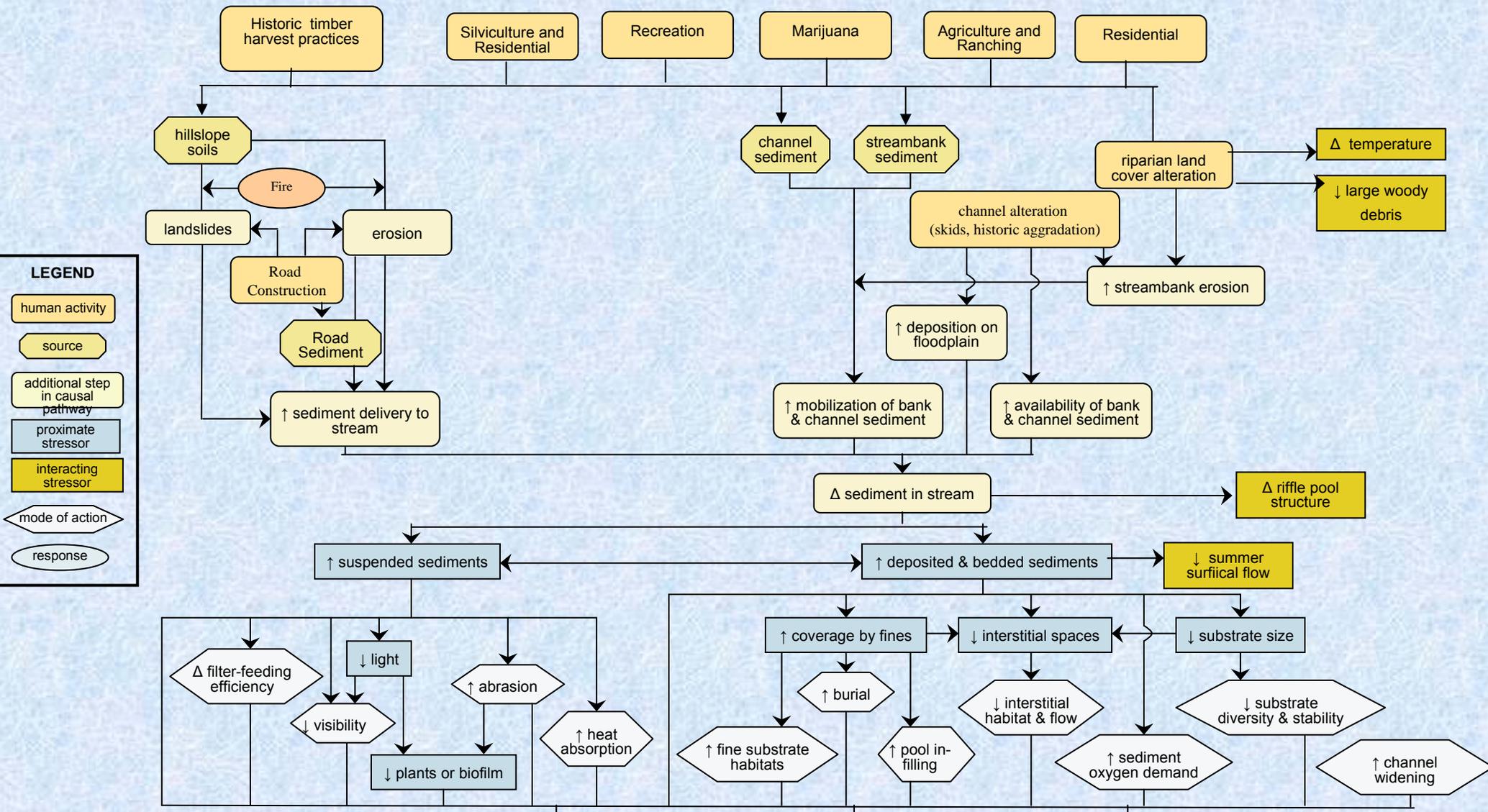


# Extent of Chemical and Habitat Stressors



# Regional Relationships

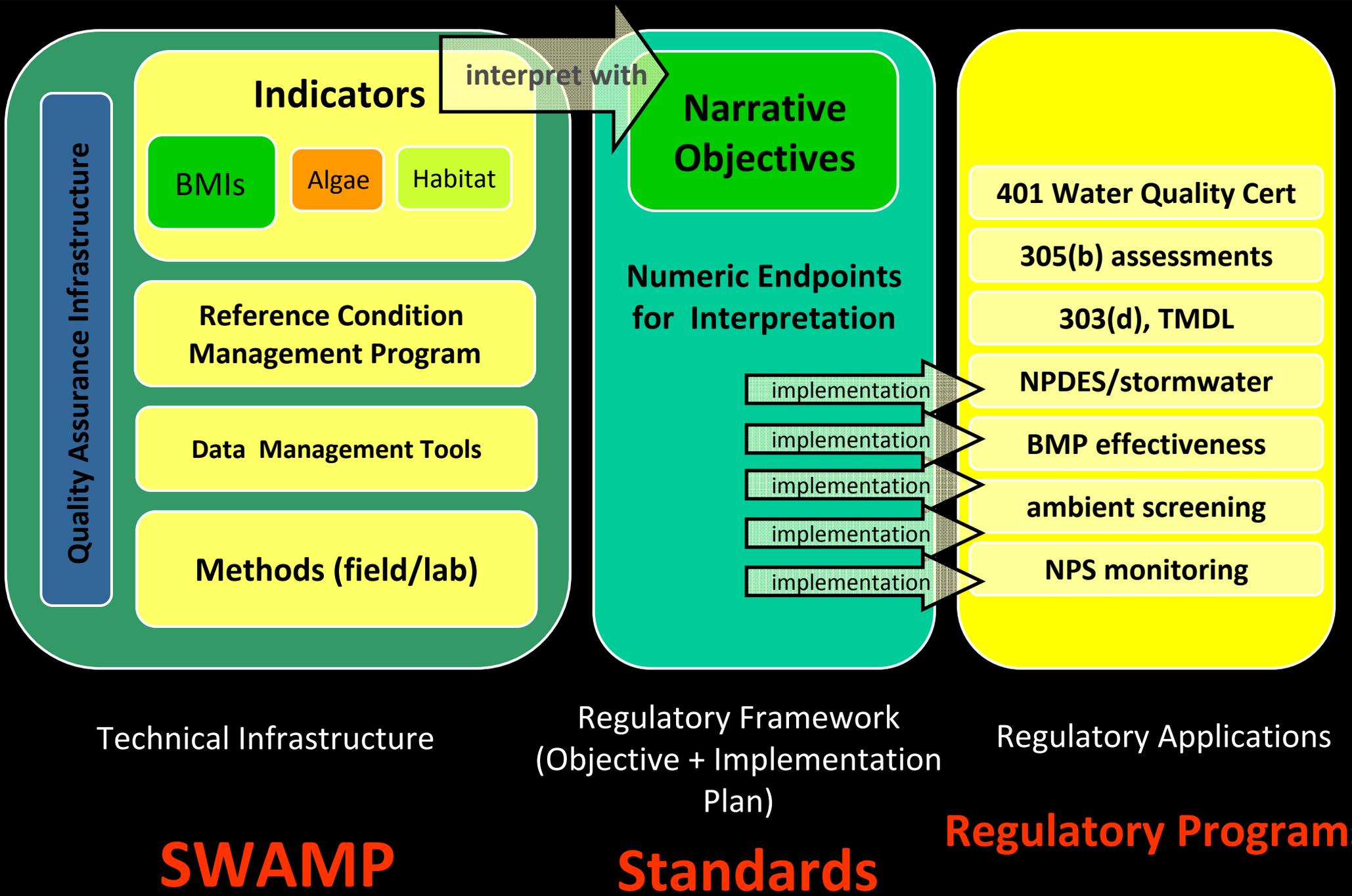




# 2012 Garcia River Causal Assessment Sediment Pathway

# Achieving regulatory biological objectives in California





Technical Infrastructure

**SWAMP**

Regulatory Framework  
(Objective + Implementation  
Plan)

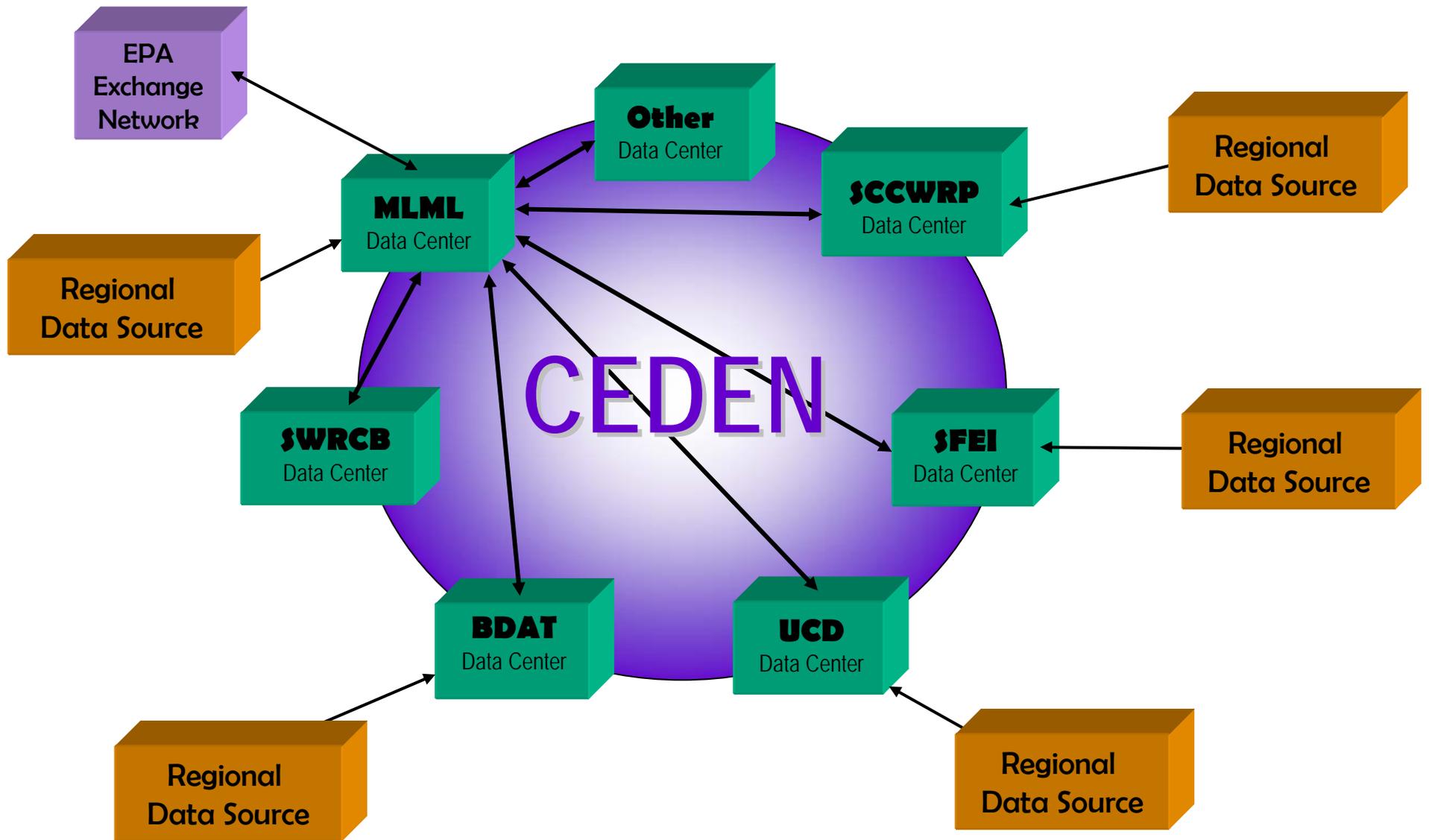
**Standards**

Regulatory Applications

**Regulatory Programs**

# CEDEN Network

## California Environmental Data Exchange Network





# California Aquatic Bioassessment Workgroup

1994 Established as a forum to communicate and exchange information

1995 Finalization of the California Stream Bioassessment Procedures (CSBP)

1996 Formulate the process for developing biocriteria in California

1997-1999 Provided a forum for updating attendees on bioassessment and gave examples of current projects

2000- 20011 Changed format from 3 day workgroup to 2 day platform presentation and panel discussion



# California Aquatic Bioassessment Workgroup

**Next Meeting**

**19<sup>th</sup> Annual Meeting  
November 7 and 8 2012**

# Bioassessment Competency Training 2-Day Courses

Concepts of Bioassessment and Program  
Implementation

SWAMP Bioassessment Field Procedures

Aquatic Invertebrate Laboratory Procedures and  
Generating Biological Metrics

Introductory Lab/Data Analysis



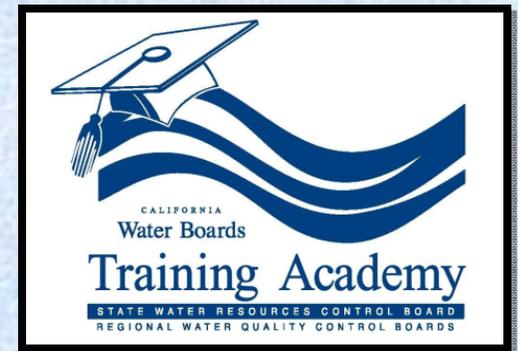
# Bioassessment Field QA Elements

Pre-Season Regional Field Calibration

Mid-Season Crew Calibration

Personal SWAMP Conducted Field Audits

DFG Sampling Permit (LAI/MOU)





State of California - The Natural Resources Agency  
 DEPARTMENT OF FISH AND GAME  
 830 S Street  
 Sacramento, CA 95814  
 (916) 327-8840

ARNOLD SCHWARZENEGGER, Governor  
 John McCamman Director



May 27, 2010

**MEMORANDUM OF UNDERSTANDING  
 BY AND BETWEEN**

**Individuals Conducting Macroinvertebrate Bioassessment Coordinated with  
 the Office of Spill Prevention and Response's Aquatic Bioassessment  
 Laboratory**

**AND  
 CALIFORNIA DEPARTMENT OF FISH AND GAME (STATEWIDE)  
 REGARDING ROUTINE FRESHWATER BIOASSESSMENT ACTIVITIES**

This Memorandum of Understanding (MOU) is made and entered into by and between the individual(s) listed under the List of Authorized Individuals (LAI) and the California Department of Fish and Game, California (Department). The Department has general authority to enter into MOUs in support of our missions. Each authorized individual has applied to conduct routine freshwater bioassessment activities that adhere to the protocols required by the Department's Office of Spill Prevention and Response's Aquatic Bioassessment Laboratory (ABL).

Routine freshwater bioassessment activities include: the collection of benthic macroinvertebrate (BMI) samples, measurements of physical/habitat parameters, laboratory analysis of BMI samples, incorporation of field and laboratory quality assurance procedures, and reporting of biological and physical/habitat data. Take of freshwater vertebrates is prohibited under the authority of this MOU.

It is understood by the Department that each monitoring event or program (ambient, compliance and enforcement) may have unique requirements (number of samples, sites, replicates and events per year). However all routine freshwater bioassessment activities follow the standardized Surface Water Ambient Monitoring Program (SWAMP) bioassessment procedures.

Therefore, it is mutually agreed and understood as follows:

**PERMITEE**

There are three designations under this MOU: a Primary Monitor, Field Monitor and supervised individuals. The authorized individual that oversees the activities is designated as the Primary Monitor. Field Monitors are the authorized individuals who may conduct routine bioassessment activities under the general oversight of the Primary Monitor although the Primary Monitor need not be physically present on-site. Any other individuals assisting in freshwater bioassessment activities must be

*Conserving California's Wildlife Since 1870*



State of California - The Resources Agency  
 FISH AND WILDLIFE WATER POLLUTION CONTRL LABORATORY  
 OFFICE OF SPILL PREVENTION AND RESPONSE

JERRY BROWN, Governor



**LIST OF AUTHORIZED INDIVIDUALS  
 Conducting Macroinvertebrate Bioassessment  
 COORDINATED WITH  
 The Office of Spill Prevention and Response's Aquatic  
 Bioassessment Laboratory  
 AND THE  
 CALIFORNIA DEPARTMENT OF FISH AND GAME (STATEWIDE)**

This Letter of Authorized Individuals (LAI) is made and entered on April 18, 2011 as supplement to the Memorandum of Understanding (MOU) by and between the names listed and the California Department of Fish and Game (Department).

The Department has reviewed the qualifications of the following individual(s) and has determined they are eligible to be designated as Primary Monitor(s) or Field Monitor(s) as described in the MOU:

Names: Annie Gillespie - Primary Monitor  
 Morro Bay National Estuary Program  
 601 Embarcadero, Ste. 11  
 Morro Bay, CA 93442

Anna Halligan - Field Monitor

Supervised individuals may conduct activities under this permit only under the direct on-site supervision of one of the above named individuals.

A copy of the MOU dated May 27, 2010 and Amendment 1 for 2011 must be carried with a copy of this LAI when conducting activities authorized by the MOU. The signature signifies his/her/their understanding of and agreement to abide by the conditions and authorizations of the MOU.

Date \_\_\_\_\_

Signature of PM \_\_\_\_\_

Contact Phone Number \_\_\_\_\_

James Harrington  
 Staff Environmental Scientist  
 DFG Water Pollution Control Laboratory  
 2005 Nimbus Road  
 Rancho Cordova, CA 95670

This list is only valid if it is dated on or after the MOU issuance date.

*Conserving California's Wildlife Since 1870*

All incidentally caught vertebrates shall be released unharmed back into the waters from which they were taken. Any incidental take of a listed species shall cease all collection activities and be immediately reported to the appropriate regional DFG biologist.

All sampling must be conducted during the appropriate Index Period. Note: It is important that macroinvertebrate samples be collected at the proper time of year for comparison to the appropriate criteria.

Macroinvertebrates must be identified according to the Standard Taxonomic Effort (STE) Level I or Level 2 of the Southwestern Association of Freshwater Invertebrate Taxonomists (SAFIT),<sup>1</sup> and using a fixed count of 600 organisms per sample.

To guarantee that the freshwater bioassessments are being conducted by qualified field and laboratory staff, Primary Monitor must prepare and make available to the Department, a Quality Assurance Project Plan (QAPP) that addresses field and laboratory activities. The QAPP should follow USEPA guidance and requirements as found in *USEPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5, EPA/240/B-01-003, March 2001), and *USEPA Guidance for Quality Assurance Project Plans* (EPA QA/G-5, EPA/240/R-02/009, December 2002) or fall under the umbrella of the official SWAMP QAPP.

The QAPP shall include, or be supplemented to include, a specific requirement for external quality assurance checks (i.e. verification of taxonomic identifications and correction of data where errors are identified). External QA checks shall be performed on one macroinvertebrate sample per year, or ten percent of the samples per year (whichever is greater). QA samples shall be randomly selected by the Primary Monitor and not by the taxonomic laboratory. The external QA checks shall be paid for by the Primary Monitor or the company/organization/agency that is responsible for the project, and performed by the Department's Aquatic Bioassessment Laboratory. An alternate laboratory with equivalent or better expertise and performance may be used if approved in advance by the Department.

#### COORDINATION

The Department contact on matters relating to this MOU is the Department's Regional contact (Jane Vorpapel, Region 1; Carol Oz, Region 2; Tim Stevens, Region 3; Andrew G. Gordus, Ph.D., Region 4; and Dwayne Maxwell, PhD Region 5), and the Regional designee James Harrington, Aquatic Bioassessment Laboratory, 2005 Nimbus Rd., Rancho Cordova, 95670.

<sup>1</sup> The current SAFIT STEs (28 November 2006) list requirements for both the Level I and Level II taxonomic effort, and are located at: [http://www.swrcb.ca.gov/swamp/docs/safit/ste\\_list.pdf](http://www.swrcb.ca.gov/swamp/docs/safit/ste_list.pdf). When new editions are published by SAFIT, they will supersede all previous editions. All editions will be posted at the State Water Board's SWAMP website.

## Must Use SWAMP Bioassessment Procedures

No Fish, just bugs/algae

Proper Index Period

Use SAFIT STE

Need to Develop QAPP

Follow QAPP for field and BMI Laboratory so data will be CEDEN compatible

*Get to Know  
Your Mayflies*



# And your Beetles

