

California's Path to Biocriteria

Peter Ode, DFG-ABL

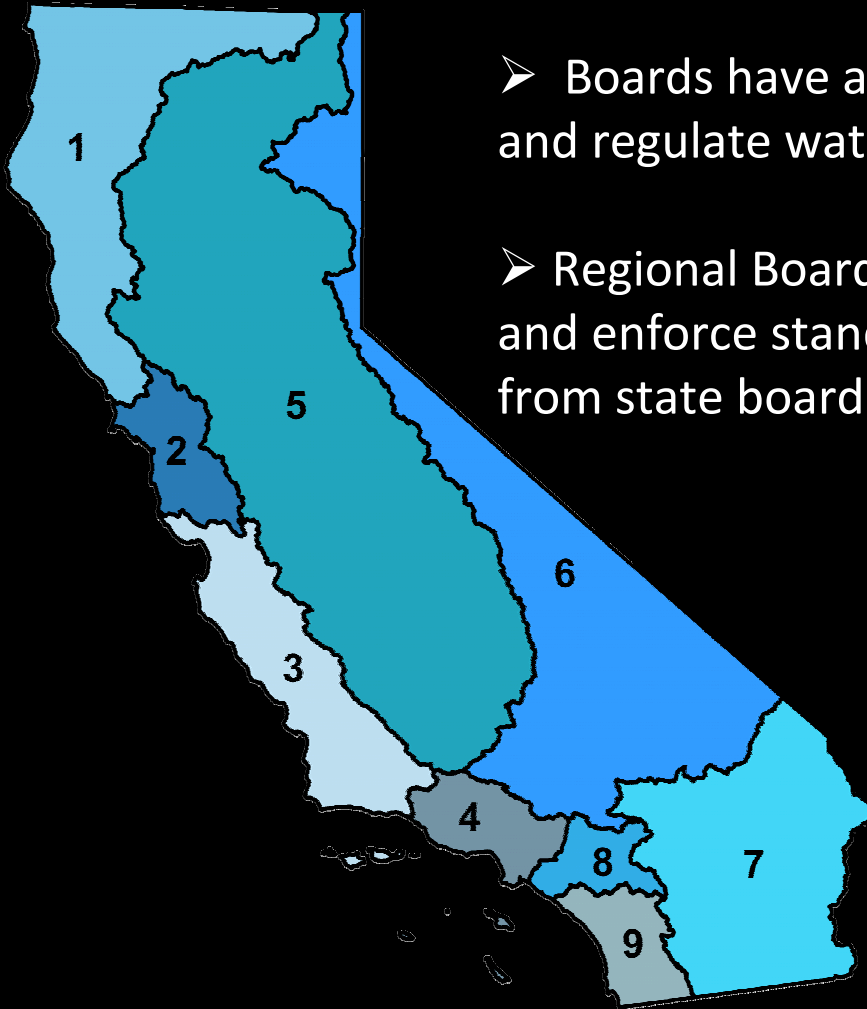


California's Path to Biocriteria

- Background
 - Regulatory Setting in CA
 - Technical Challenges: natural diversity, development intensity
- Chronology
 - Phase I: The Early Years (early 1990s to 2005)
 - Phase II: SWAMP commits to technical infrastructure development (2005-2010)
 - Phase III: SB commits to regulatory infrastructure development 2009 +

CA Water Quality Regulatory Setting

CA Porter-Cologne Act (1969) - established the **State Water Resources Control Board** and **9 Regional Water Quality Control Boards**

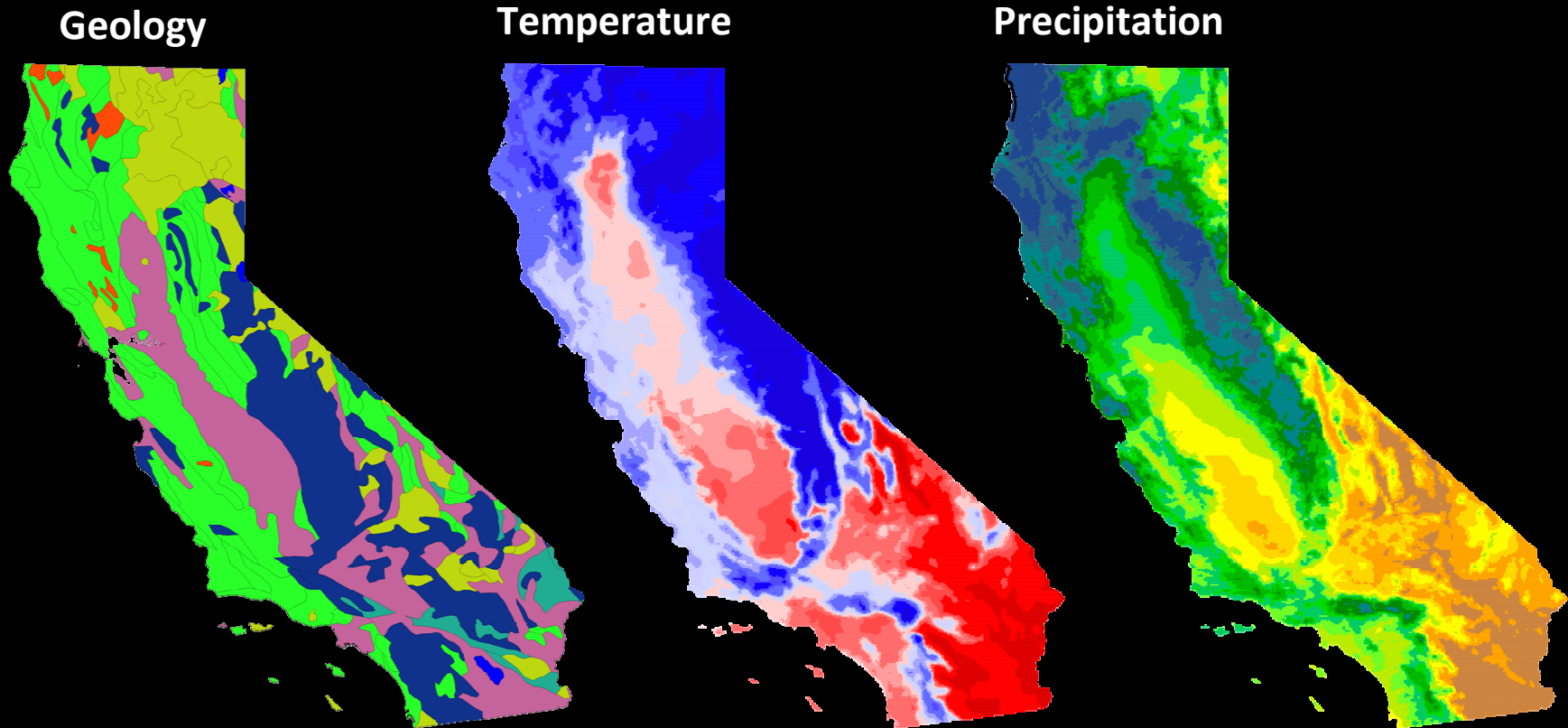


- Boards have authority to establish water quality policy and regulate water quality standards
- Regional Boards have **considerable autonomy** (apply and enforce standards with varying levels of coordination from state board)

Effective biological objectives
require both **technical
soundness** and **regulatory
viability**

Technical Challenges: California is not Kansas

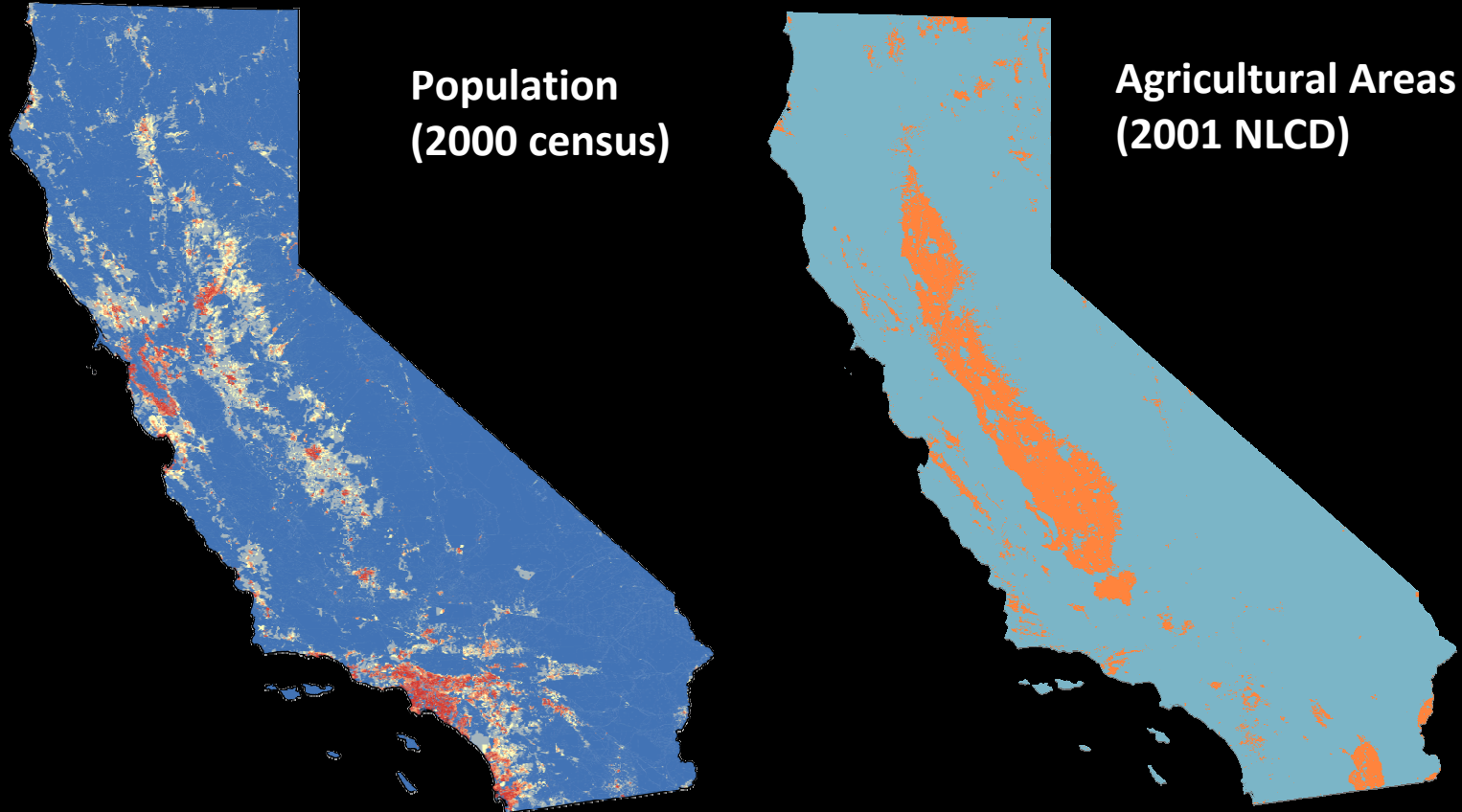
Strong natural gradients result in a large degree of **natural variation** in biological expectations



Management of biological variability requires good representation of biology at reference sites **across major gradients = need 100s of sites**

Technical Challenges: California **IS** Kansas

High degree of anthropogenic modification (e.g., impervious surface and intensive agriculture) in some regions



- Extensive human modification complicates the reference selection process because it introduces gaps in representation of natural gradients
- Intense development pressures make some regions unsuited for standard reference approaches

PHASE I: The Early Years

State Water Board had no formal bioassessment program before 2005, but bioassessment has been on the map since the early 1990s.



In the beginning...

- **Universities** - *Vince Resh @Berkeley, several faculty at CSU Humboldt, Dave Herbst @ SNARL (UC Santa Barbara)*
- **Federal programs** - using bioassessment techniques (USGS-NAWQA- *Larry Brown and Jason May*, EPA-REMAP, USFS (w/Utah State)- *Joseph Furnish and Chuck Hawkins*)

The Early Years

Early progress toward **regulatory** bioassessment was nurtured by staff at two regional boards

- Tom Suk @ Lahontan Board (R6)
.... working with Dave Herbst
@SNARL



- Dave Gibson @ San Diego Board (R9)
... working with Jim Harrington @ABL, part of DFG-WPCL

The Early Years (ABL)

DFG's Water Pollution Control Laboratory

- established by CA legislature in 1967
- mission to provide support to WBs
- Jim Harrington— came to DFG's WPCL in 1993 after his MS in bioassessment at CSU Humboldt
- Established DFG's Aquatic Bioassessment Laboratory (WPCL-ABL) to promote and support use of biological endpoints at WBs
 - demonstration projects
 - lots of trainings
 - currently 13 full time staff: units for field, BMI taxonomy, enforcement and research

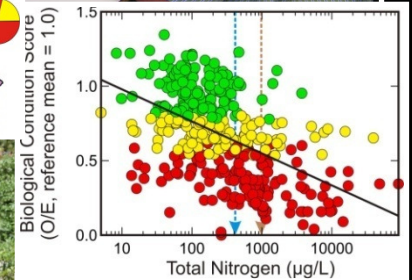
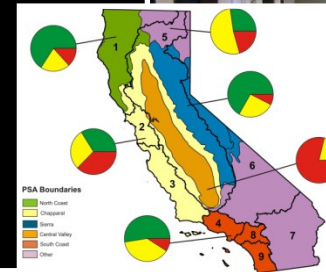


Created the California Aquatic Bioassessment Workgroup
(CABW) (17th Annual Meeting in November 2010)

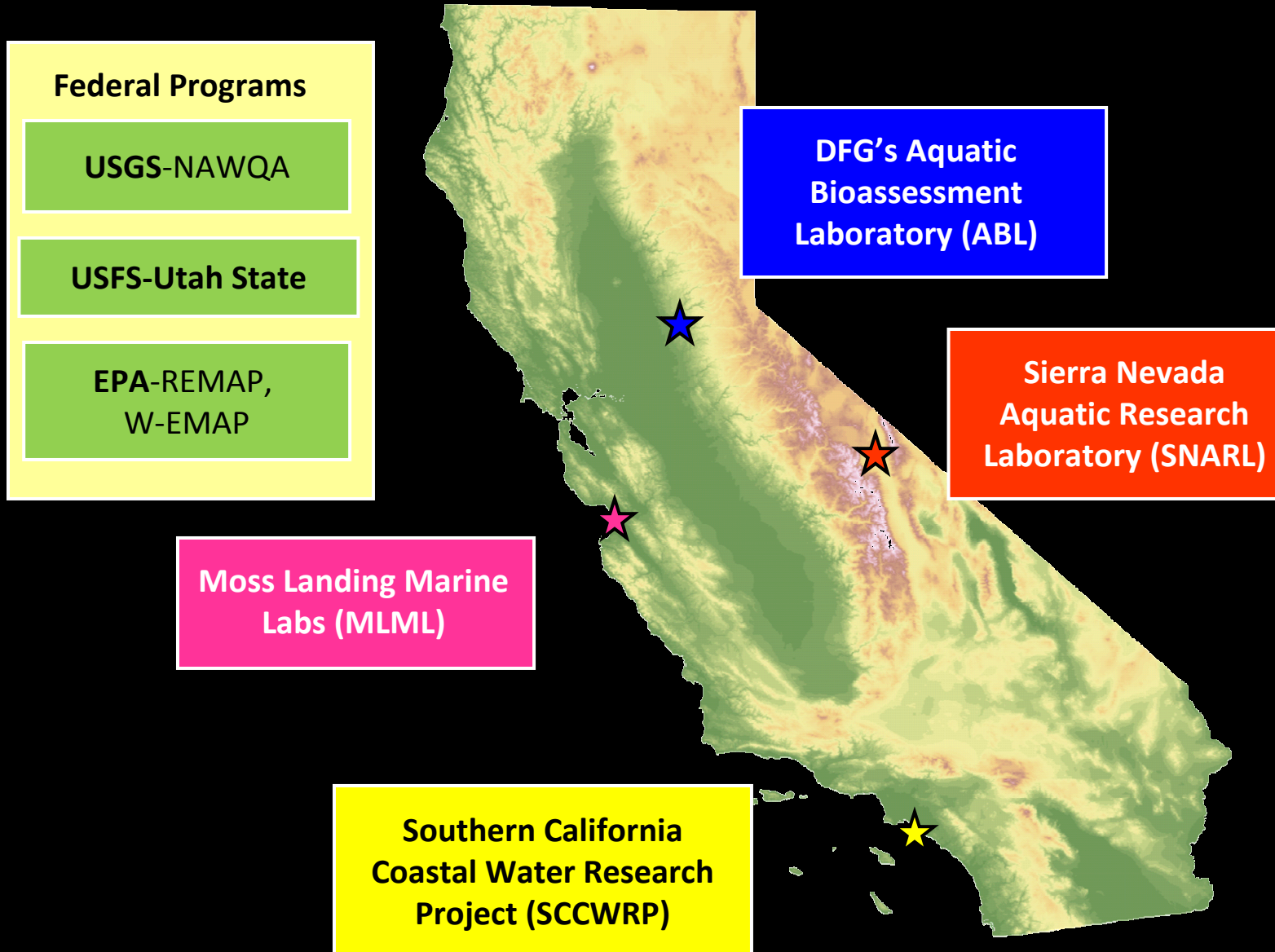


How CA bioassessment came together:

- Early efforts focused on demonstration projects, point-source monitoring, enforcement
- Citizen monitoring programs helped raise awareness
- Early infrastructure designed and developed without central support
- Established basic elements:
 - Standard field and lab methods
 - Taxonomic standards and QA-QC
 - Reference conditions
 - Scoring tools (MMIs and O/Es)
 - Data management
 - Research program
 - Probability surveys
 - Stressor associations
 - Ecological assessments



California Biological Assessment: a growing collaboration



PHASE II: SWAMP standardizes bioassessment

In 2005, bioassessment started to receive organized statewide support

- Biology incorporated into the **Surface Water Ambient Monitoring Program (SWAMP)** as a key program element
- Considerable support (~20-25% of total funds) from regional monitoring funds (stormwater discharge fees) and federal Clean Water Act funds (106, 319) ... *especially Terry Fleming, EPA Region 9, Office of Water*



PHASE II: SWAMP standardizes bioassessment

State Board Objective:

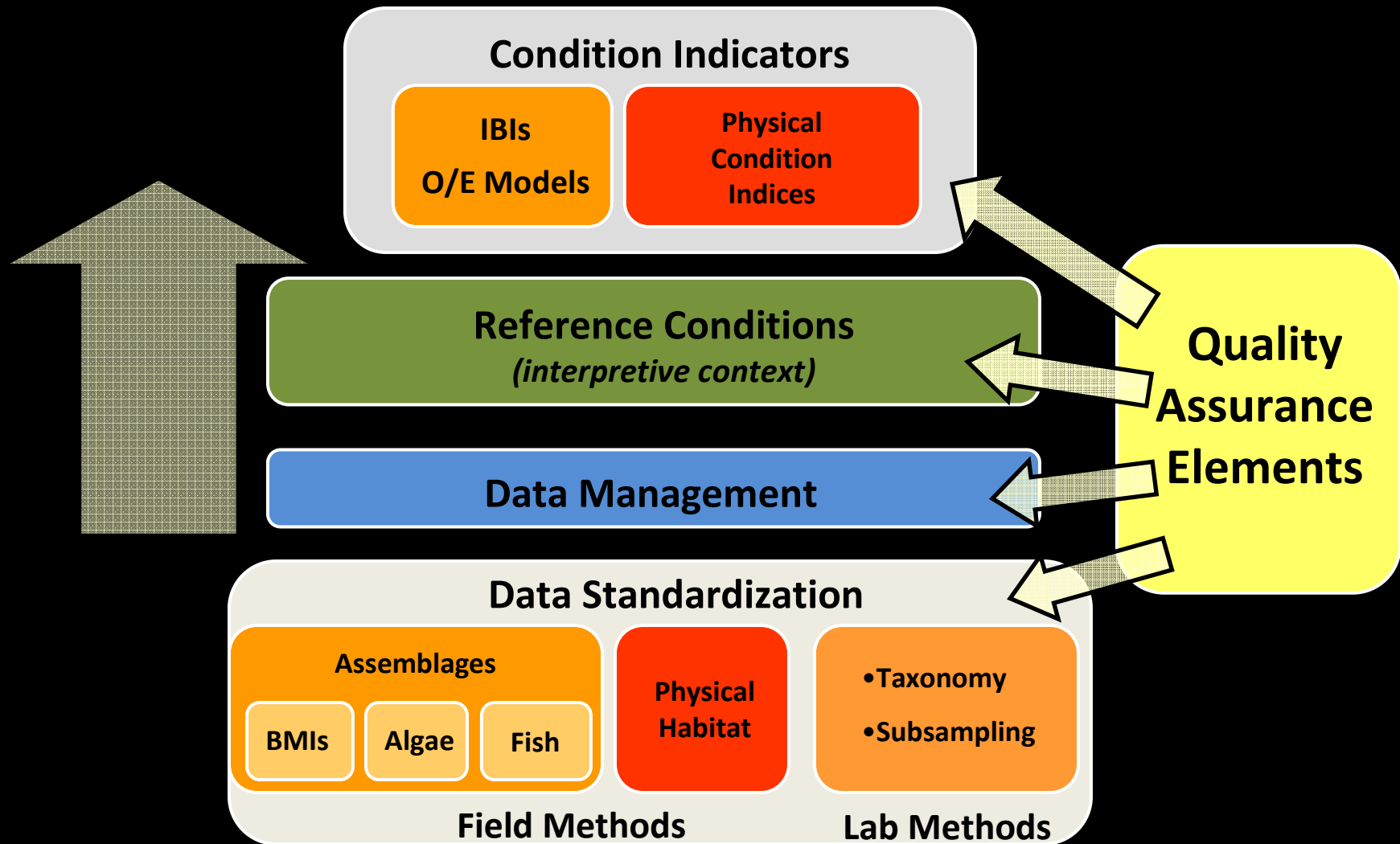
Assimilate biological integrity into California's state and regional WQ regulatory programs

SWAMP's Initial Role:

Develop and standardize the technical tools programs need to accomplish the goal

a strong biological objectives program requires many integrated components....

SWAMP's bioassessment infrastructure



Methods Development and Standardization

Benthic Macroinvertebrates: CA's primary biological indicator

- CA started with a diversity of field methods (CSBP, SNARL, EMAP, Utah State, NAWQA)
- SWAMP standardized to EMAP's multi-habitat method (**RWB**) in most settings: 11 composited 1 ft² samples from 11 equidistant transects
- Supplement with targeted riffle method (**TRC**) in some situations



See BMI methods standardization papers (Ode et al. 2005, Herbst and Silldorff 2006, Rehn et al. 2007): comparisons of targeted riffle/ reachwide and low gradient protocols throughout CA

Methods Development and Standardization

SWAMP's Physical Habitat Methods (PHAB)

A close adaptation of the EMAP protocols removed several bed stability measures and fish surveys

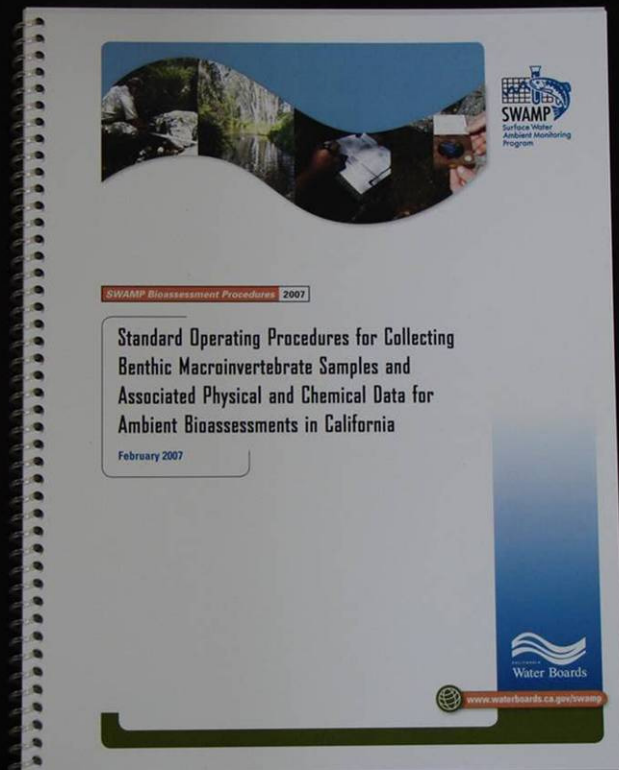
Emphasis on:

- Physical setting (slope, channel dimensions, discharge)
- Instream habitat and riparian condition
- Anthropogenic stress

Experienced field crews of 3 can complete the protocol in 2-3 hours at a site of average complexity



Standard field protocols and forms



Field SOP and field forms
for BMIs and habitat
(Ode 2007)



Electronic field forms

Methods Development and Standardization

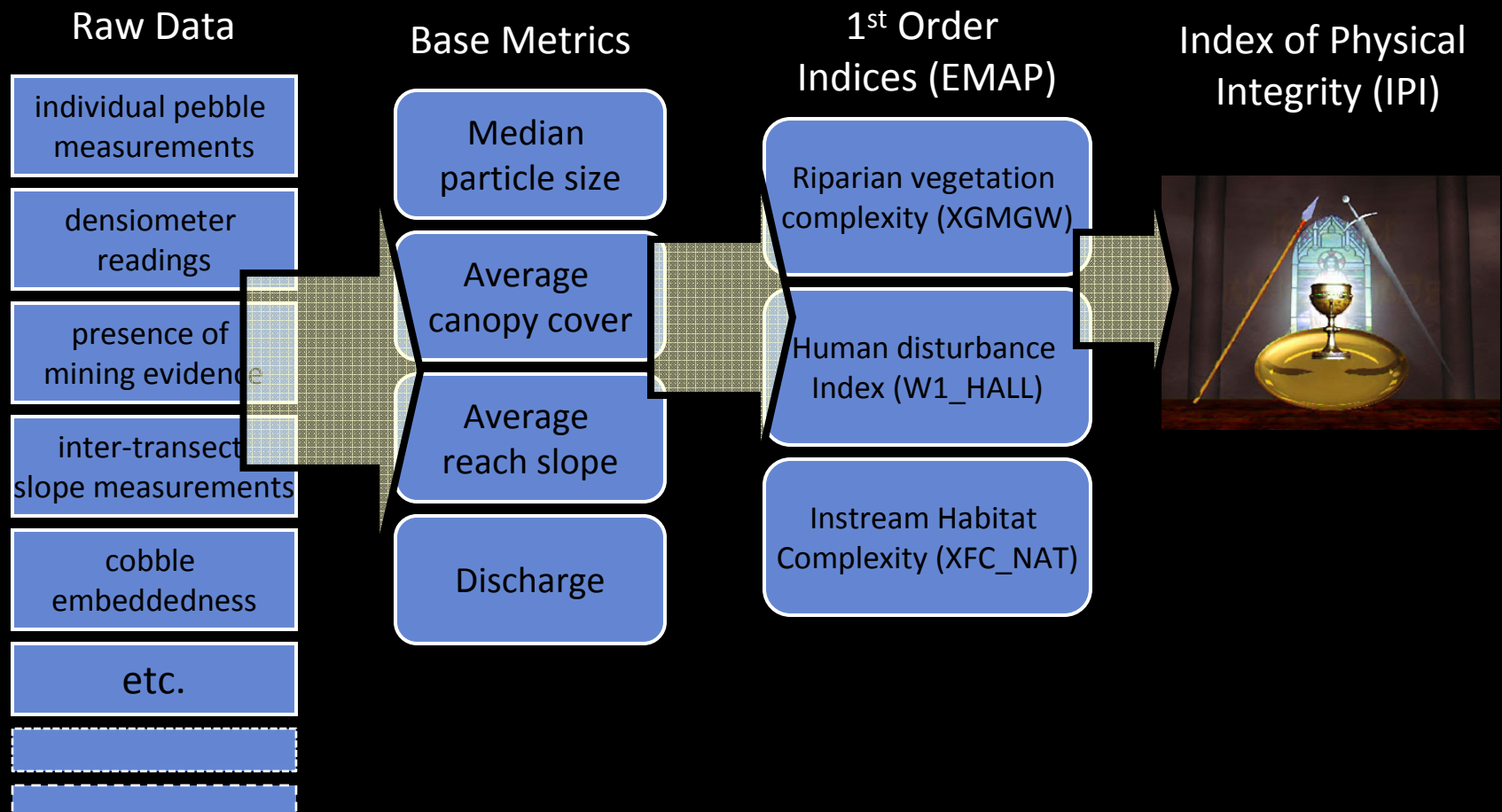
SWAMP's Physical Habitat Methods (PHAB)

SWAMP is also exploring potential for integrating **CRAM**, a protocol for riverine wetland condition assessments (California Rapid Assessment Method)

PHAB Workplan (products timed to coincide with biological objectives rollout)

1. Develop reporting module to standardize habitat metrics
2. Evaluate PHAB elements for information content, signal to noise, efficiency create new metrics as appropriate
3. Integrate results into training and auditing program
4. Revise full and basic versions of protocols and provide guidance for which elements to include for different program objectives

Physical habitat endpoint hierarchies:



Methods Development and Standardization

BMI Taxonomy



SAFIT: The Southwest Association of Freshwater Invertebrate Taxonomists -- provides essential standardization of the identification and reporting of freshwater invertebrates for SWAMP (www.safit.org)

Key Products:

- Standard Taxonomic Effort (STE) documents
 - defines appropriate taxonomic resolution for all taxa
- Maintains database master taxa list (used by SWAMP and CEDEN)
- Taxonomic training workshops and documents

Methods Development and Standardization

Multiple Indicators

- SWAMP's current focus is on **BMI**s, but long term strategy will include multiple assemblages
- Ongoing efforts to develop **algal** indicators for streams
- Some exploratory work on **fish**



algae photos courtesy Robert Sheath

Methods Development and Standardization

Algae Methods

Algae are a better candidate than fish for CA:

- Low fish diversity, pervasive non-native fauna
- Algae provide complementary signals to BMIs (esp. nutrients)

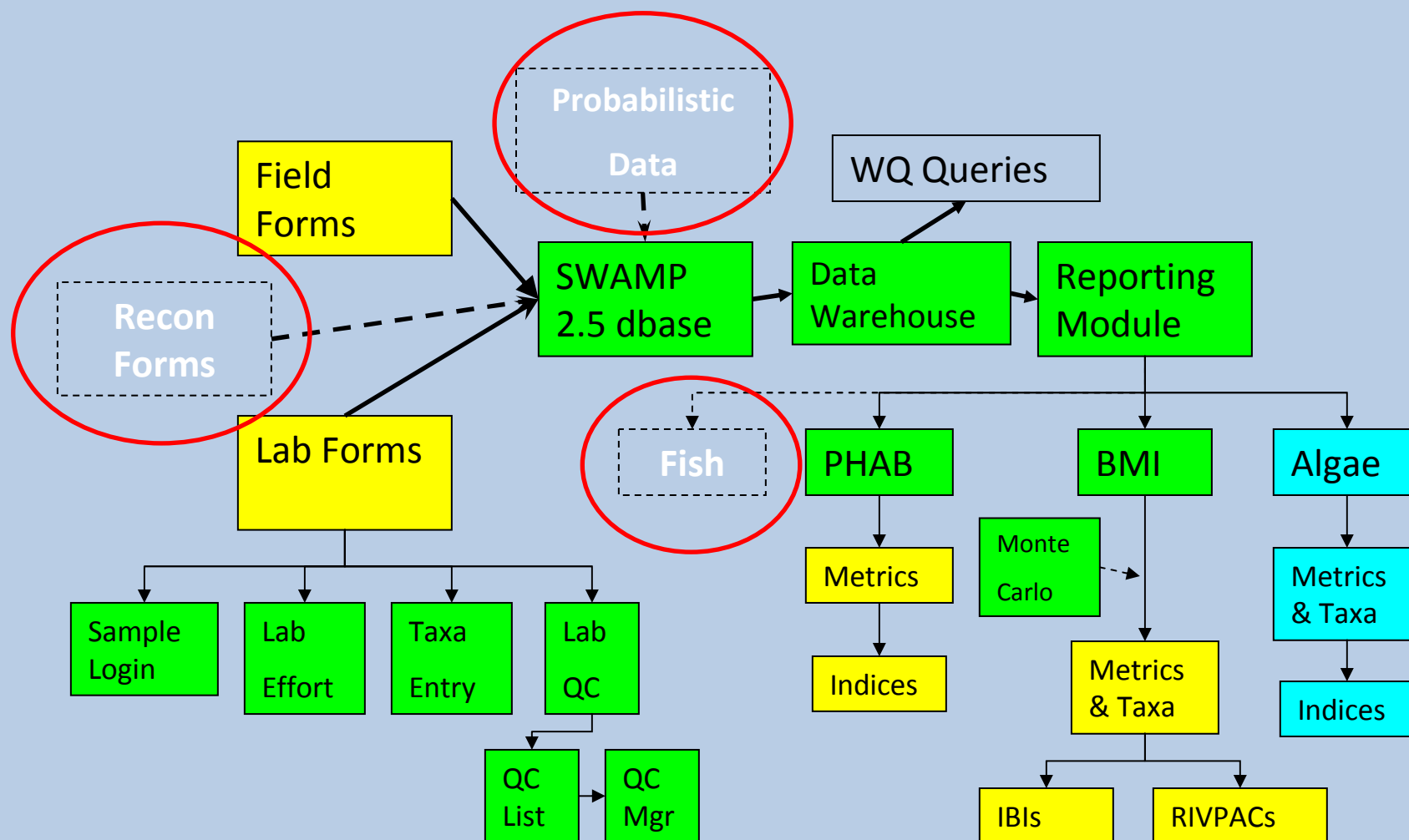
SWAMP Algae Plan: “steps SWAMP should take to incorporate algae into its biomonitoring programs”

- SWAMP now has standard field methods¹ for algae
- Now working toward taxonomic standards
- Two large grants awarded for developing algal indicators for Southern CA and Central Coast (~\$2 m)

¹Fetscher, A.E., L. Busse, and P. R. Ode. 2009. *Standard Operating Procedures for Collecting Stream Algae Samples and Associated Physical Habitat and Chemical Data for Ambient Bioassessments in California. California State Water Resources Control Board Surface Water Ambient Monitoring Program (SWAMP) Bioassessment SOP 002. (updated May 2010)*

SWAMP Data Management Structure

more later...



Bioassessment Tools Depend on Reference Sites

(sites with low levels of disturbance)

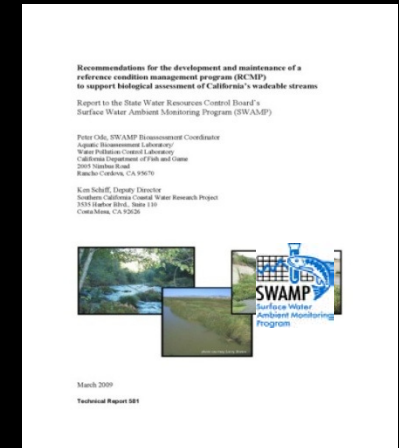
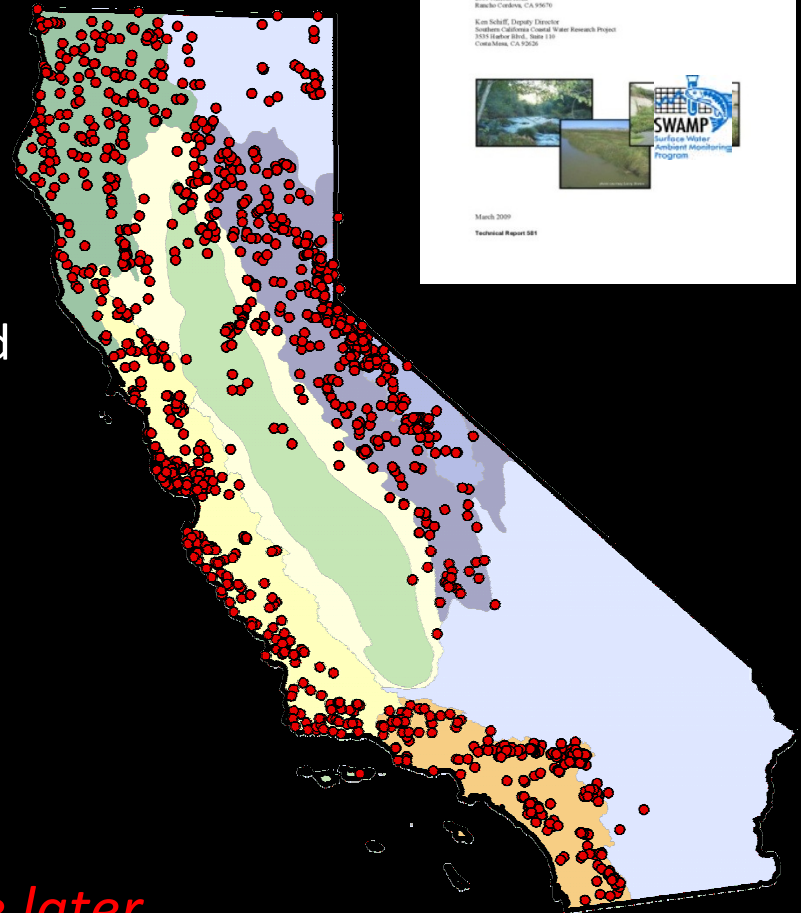
“What should the biology look like at a test site?”



Reference Condition Management Plan

(adopted March 2009)

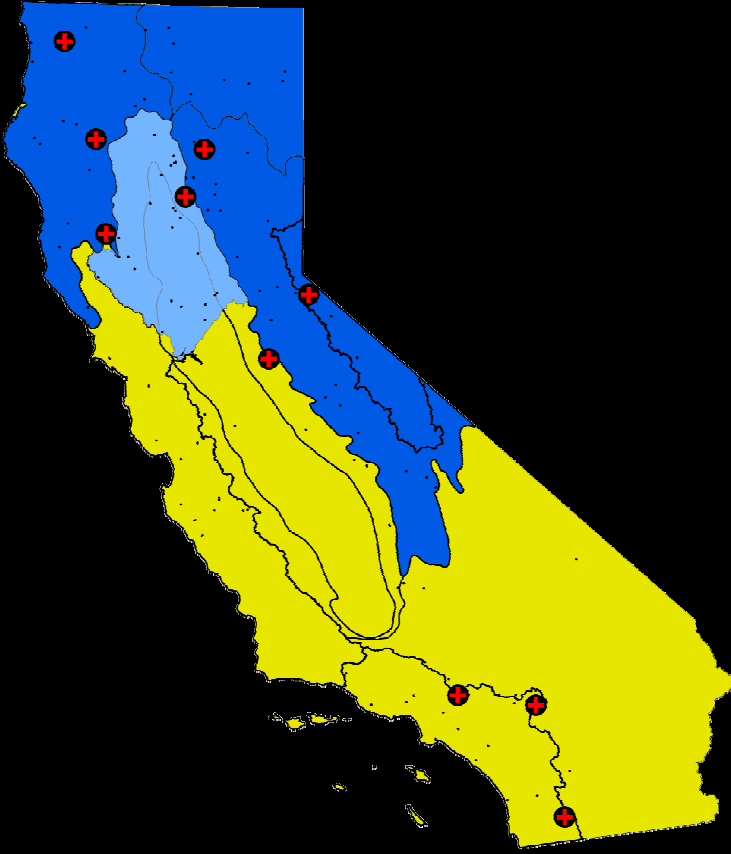
- RCMP is SWAMP's standardized process for identifying & sampling "reference sites" throughout CA
- Now in implementation phase:
 - ✓ Screen existing sites (~1700) with GIS and local data
 - ✓ Identify data gaps and collect bio/chem/hab data where missing
 - ✓ Monitor temporal variability (both inter-annual & intra-annual)



more later ...

Index Period Documentation/ Validation

Index Period: Standardized restriction of sampling period used to minimize effects of seasonal variation in biological communities

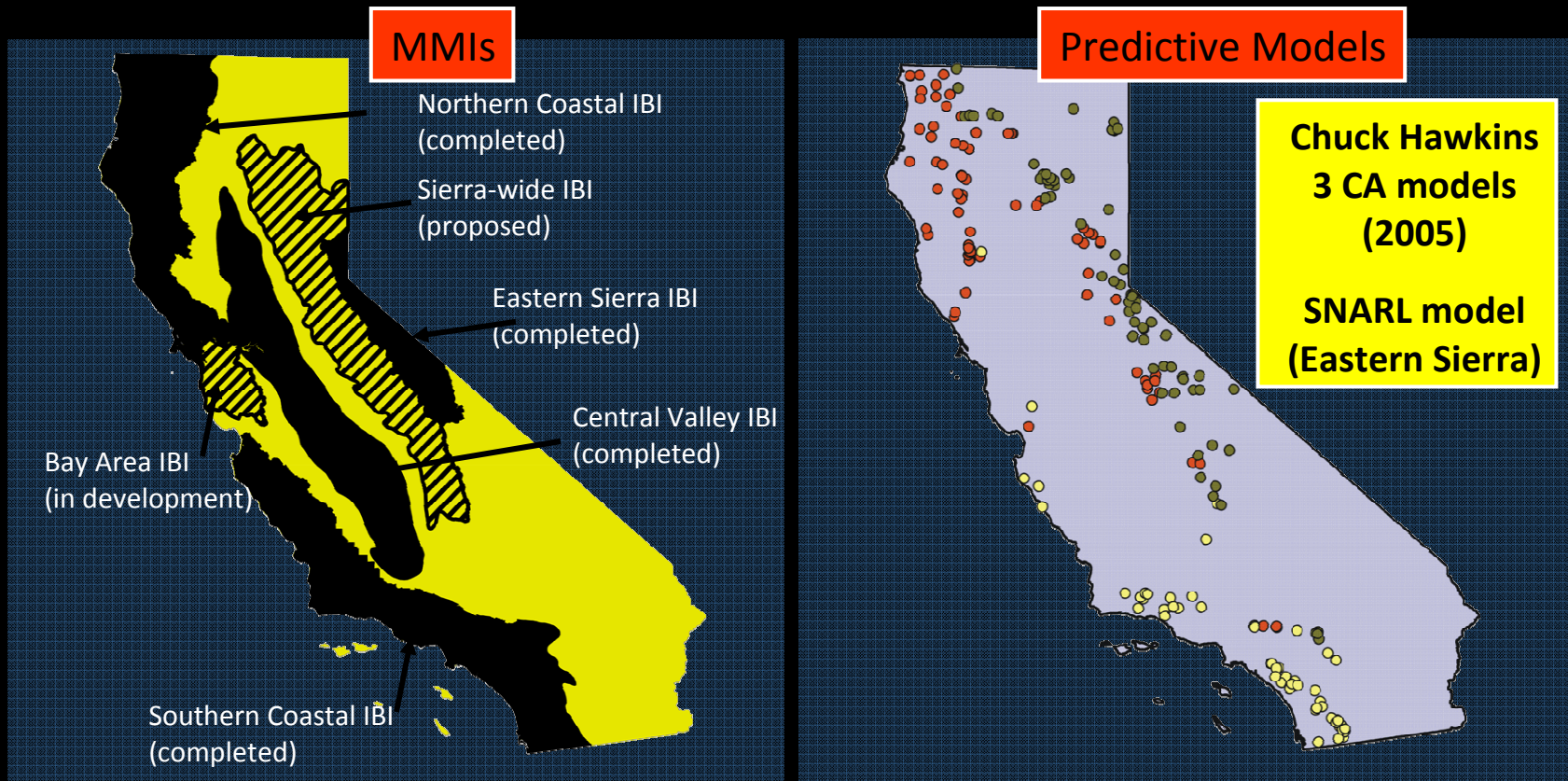


Region	Early	CORE Index Period	Late
Northern Mountains	May	June - September	October
Northern Valley and Chaparral	May	June – August	September
Southern and Central Xeric	April	May – July	August

Scoring Tools: current status

- IBIs are available for several regions of California
- 3 - O/E models cover the entire state

more later.....



QA/QC for Bioassessment

- Many bioassessment programs force their QA/QC into a chemistry model
- SWAMP is developing an approach to QA that better ties monitoring quality objectives to how the data are used



Habitat data:

- Current emphasis on standardizing **training** and **field audit** program
- Ongoing data collection will be used to develop a more comprehensive QA program for habitat data

BMI taxonomy data:

ABL has developed a process for systematic review and documentation of taxonomic data quality. Now working with SWAMP's QA Team and Data Team to develop and store quality control data.

Research Topics



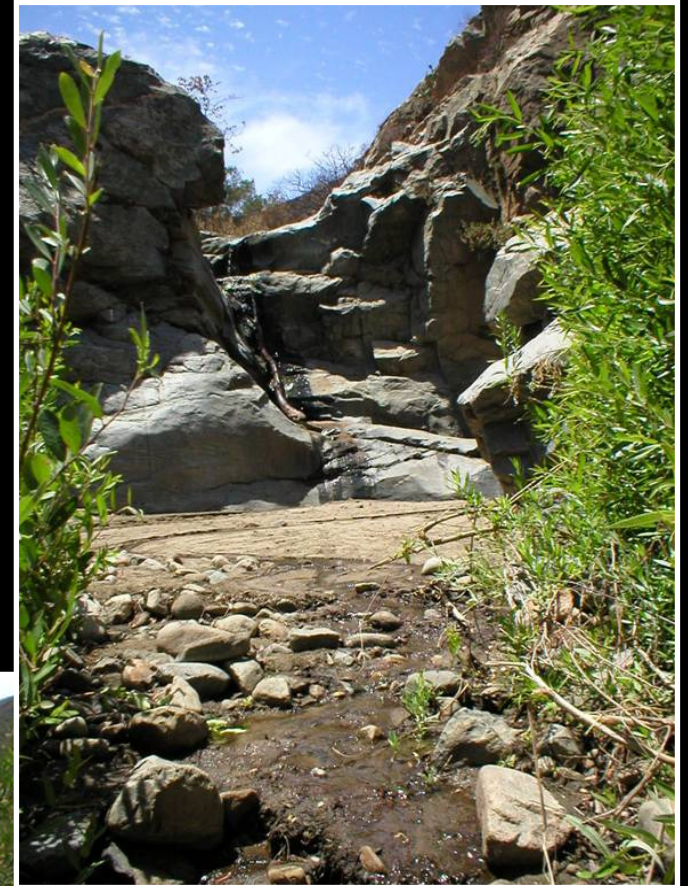
Adapting bioassessment techniques for non-perennial streams

~75% of CA stream length
is non-perennial

NHD+:
perennial 
non-perennial 
canals 

SCCWRP-ABL Non-Perennial Grant

Pilot Objective: Study changes in assemblage structure as streams dry up....
assess implications for bioassessment





Impacts of Fire to Bioassessment

Wildfires are a regular feature of the disturbance regime in many parts of CA

- How do BMI assemblages respond to fires?
- How does this impact interpretation of scoring tools?
- How long to recover?
- Which BMI metrics best describe impacts and recovery?

Lack of vegetation leads to debris flows →
minor to massive changes to stream bed



Reference Conditions

Central Valley Reference Conditions (CVRWQCB/ DPR)

How to set standards for biotic condition where reference streams are hard to find? **more later ...**



Ode, et al. 2005. Adaptation of a bioassessment reference site selection methodology to creeks and sloughs of California's Sacramento Valley and alternative strategies for applying bioassessment in the valley. Report to Central Valley Regional Water Quality Control Board. 33

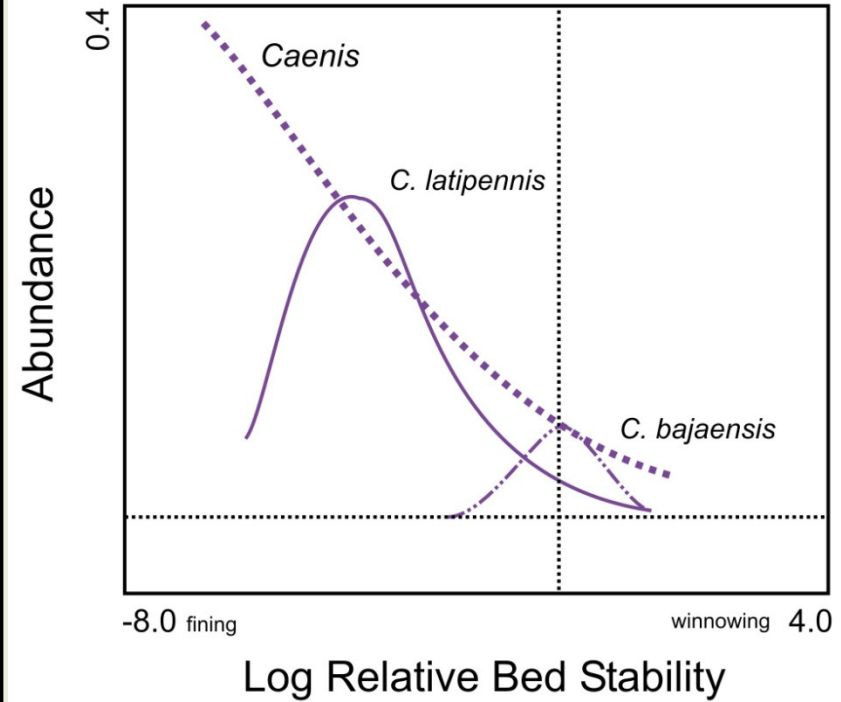
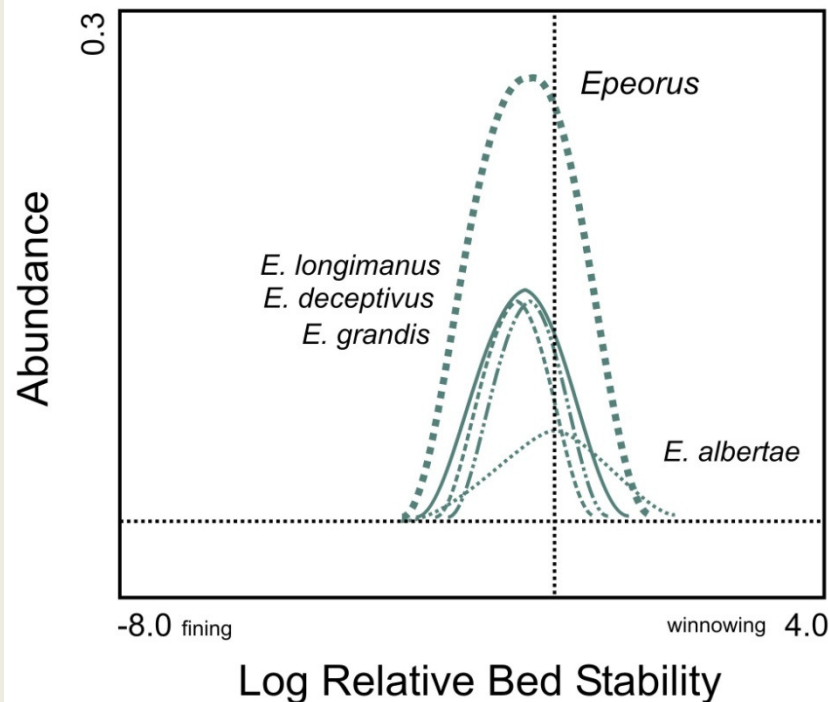
Stressor-specific BMI associations

(Lester Yuan, Andy Rehn)

Epeorus



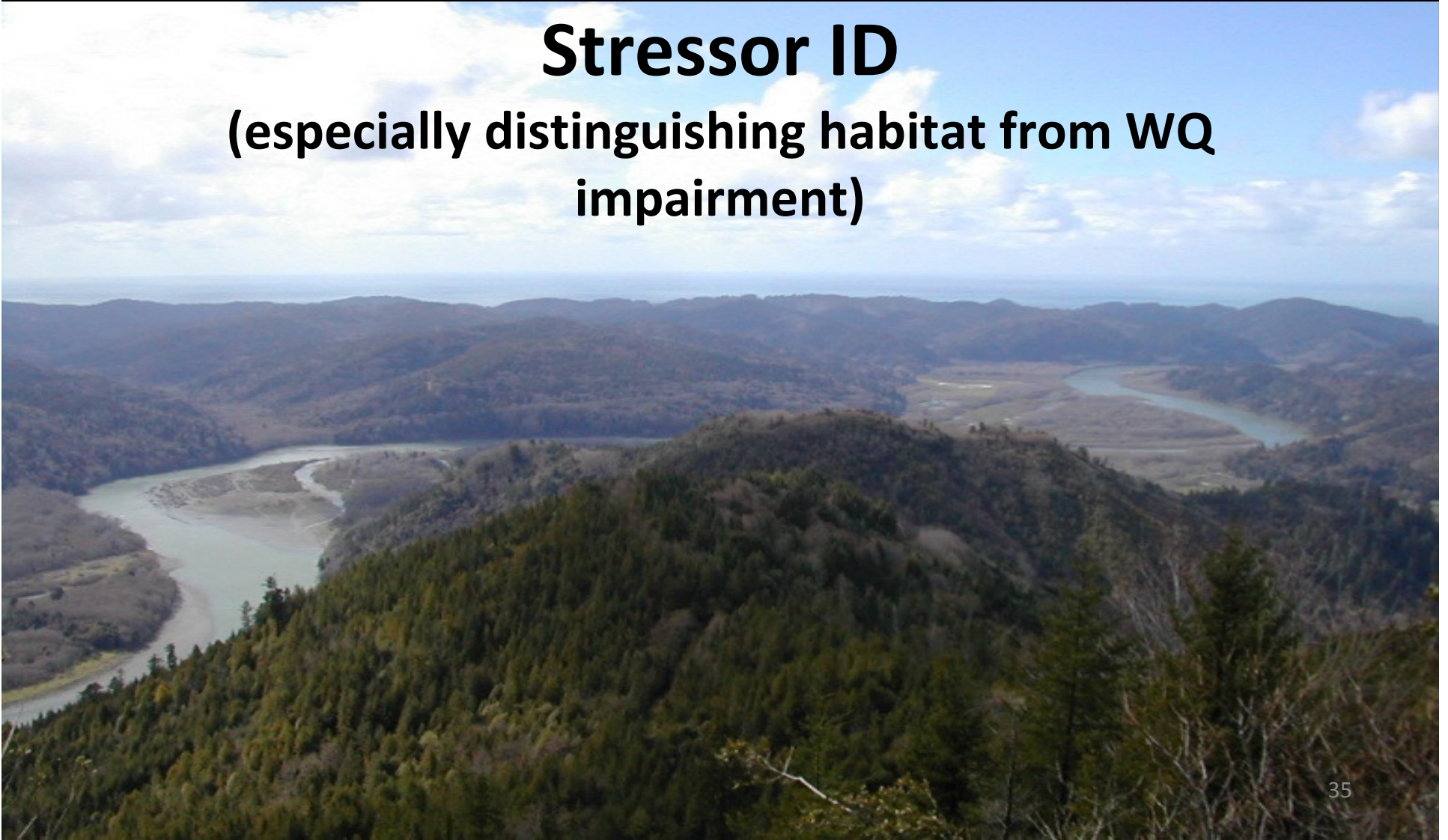
Caenis



Sediment intolerant vs. sediment tolerant

Stressor ID

(especially distinguishing habitat from WQ impairment)

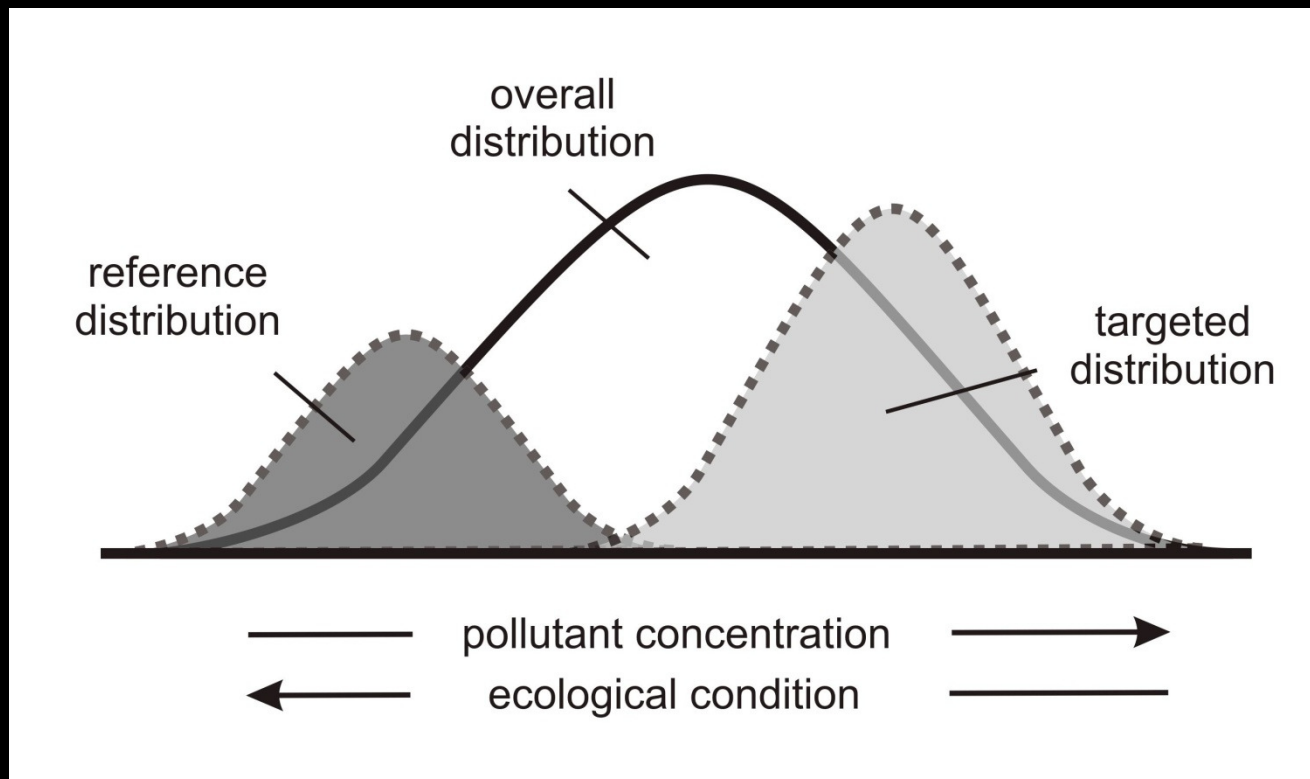


CA Probability Surveys (PSA):

Multiple surveys produce a large and valuable dataset

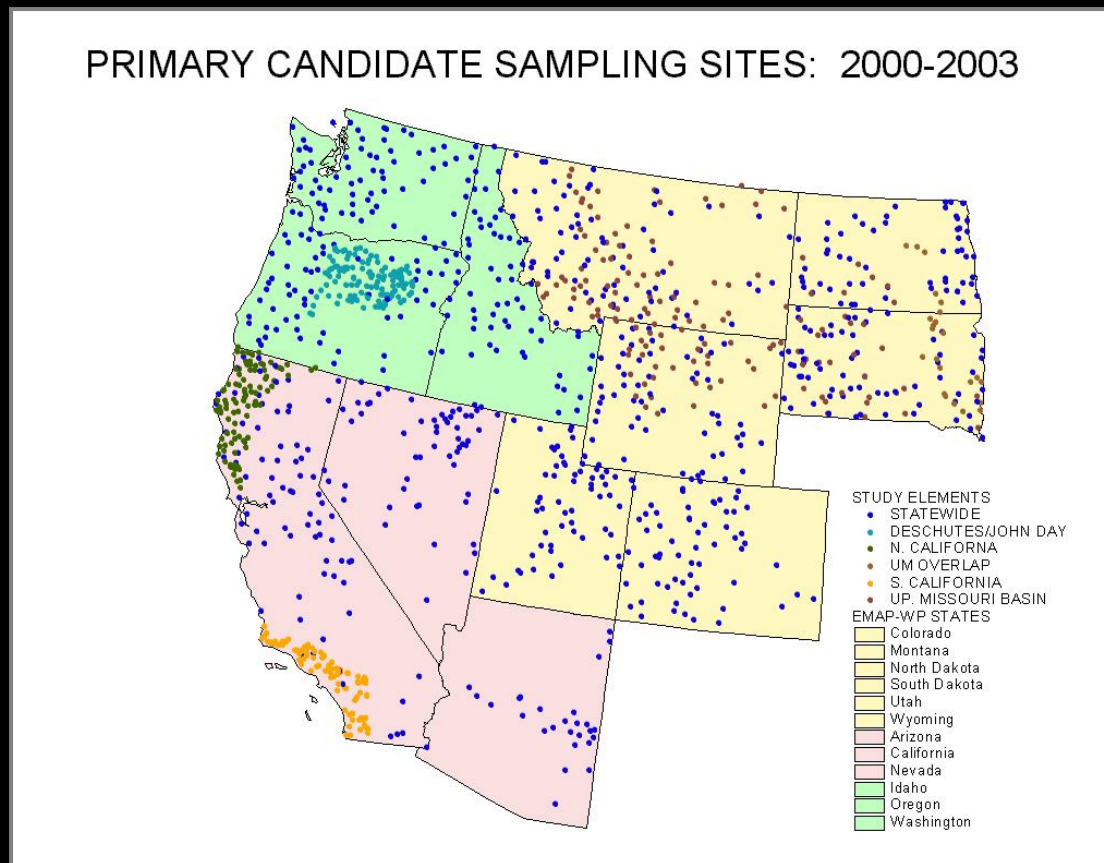


Why adopt probability surveys?



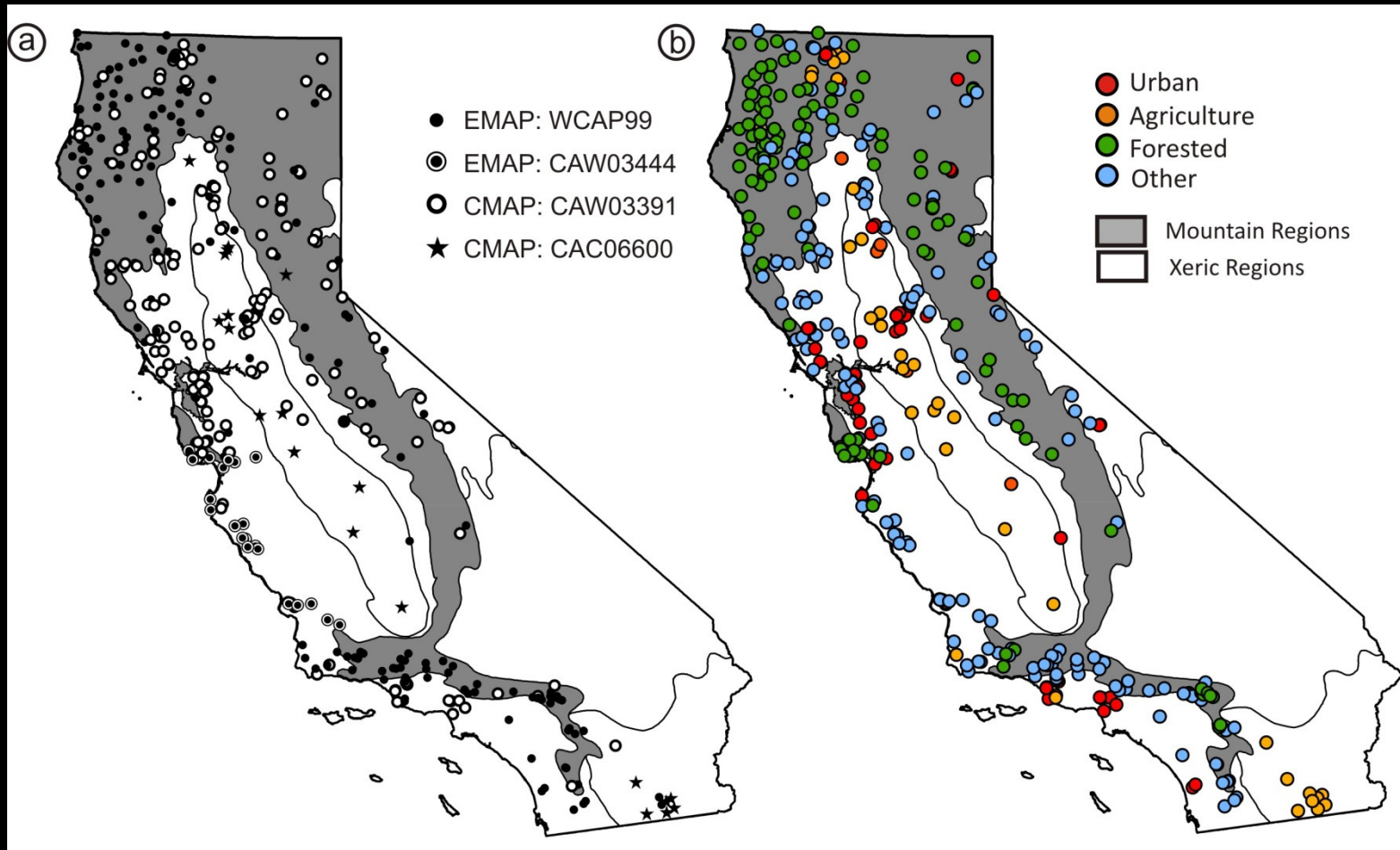
- Provide **objective descriptions of patterns** with limited funds
- Produce an extremely **versatile dataset** with many applications

Western EMAP Pilot (2000-2003):



- 200 sites in CA
- northern CA and southern CA intensification areas
- CA added another 30 in central coast in 2003

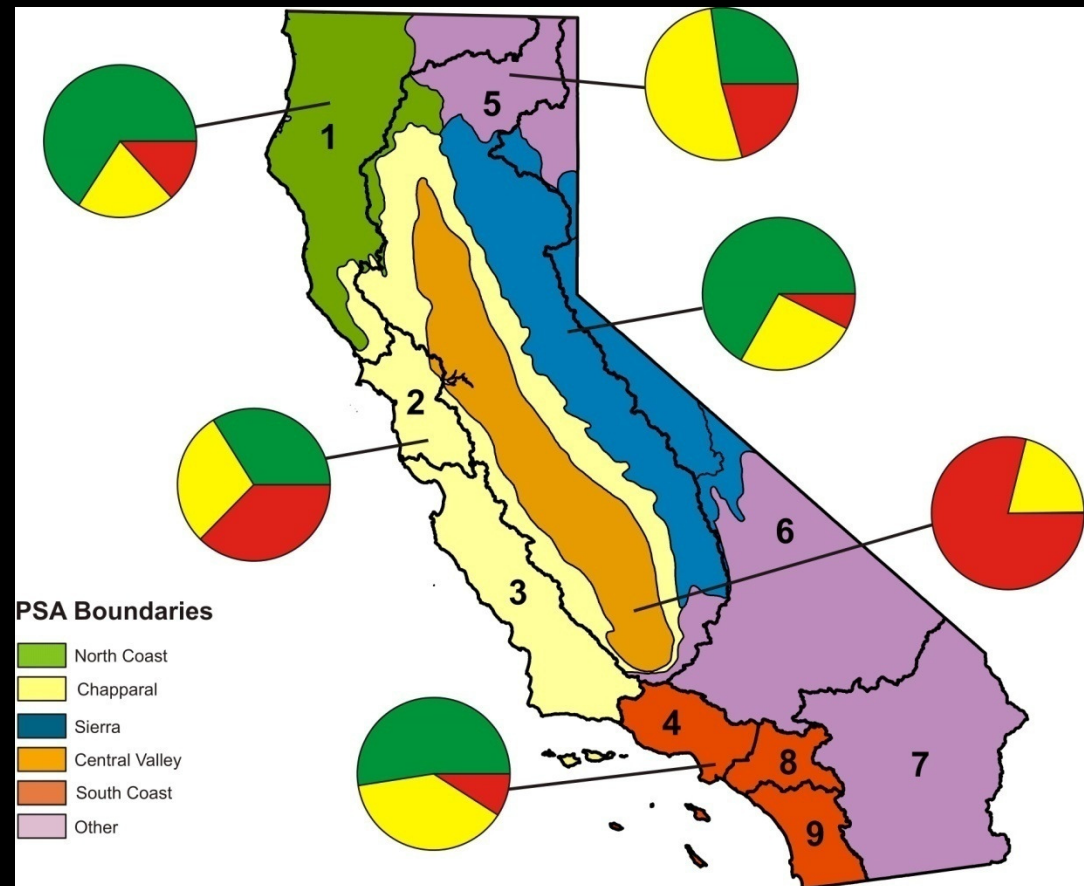
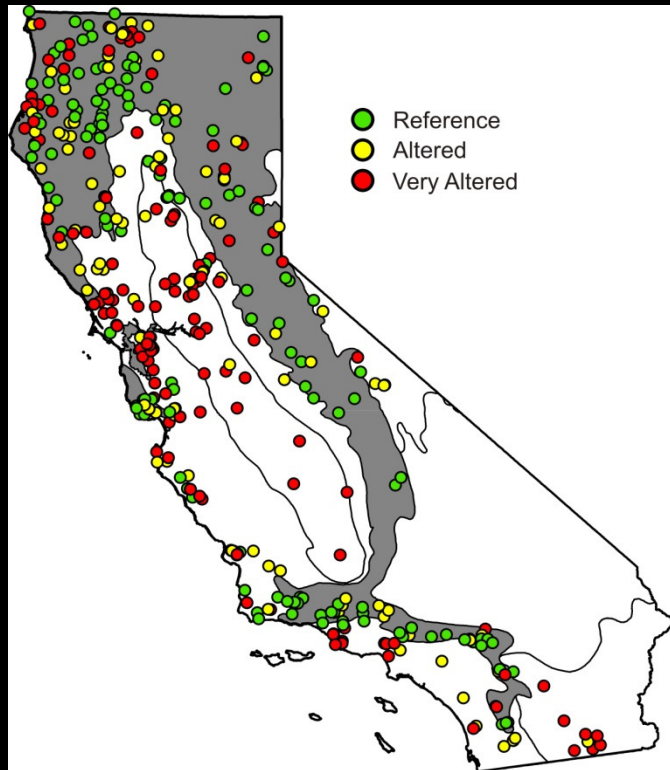
California EMAP (CMAP, 2004-2007)



- Sponsored by NPS program
- ~ 200 new sites
- explicit stratification by landuse class (AG, URBAN, FOREST, OTHER)

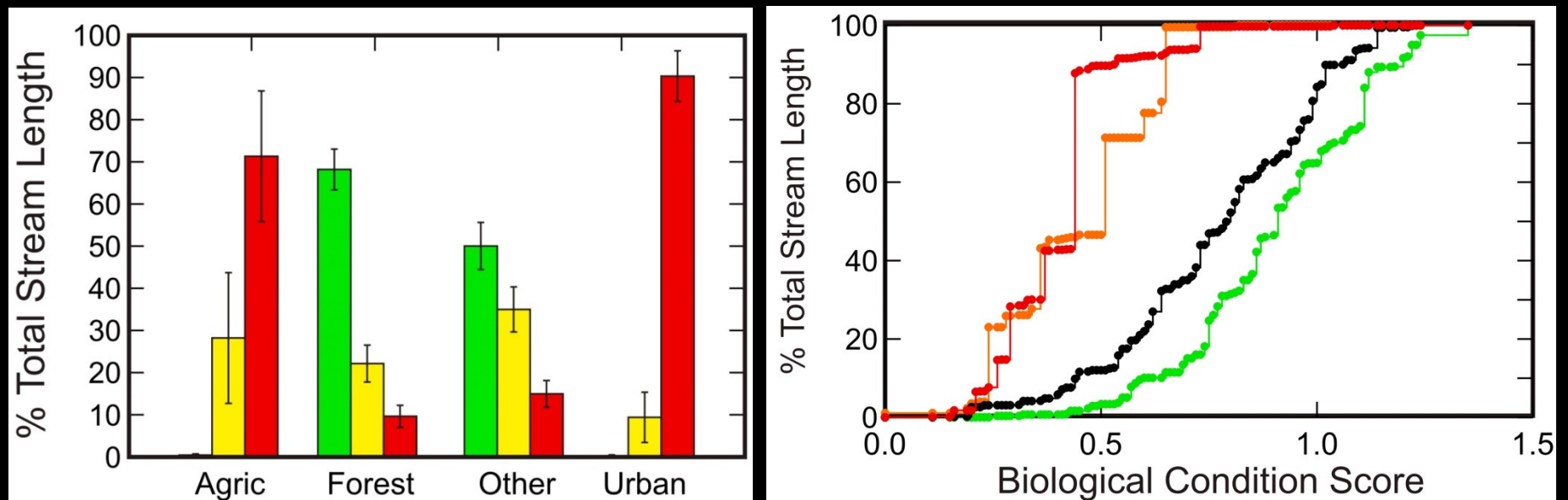
Condition Assessments by Region (8 years)

(thanks to Tom Kincaid and Tony Olsen)

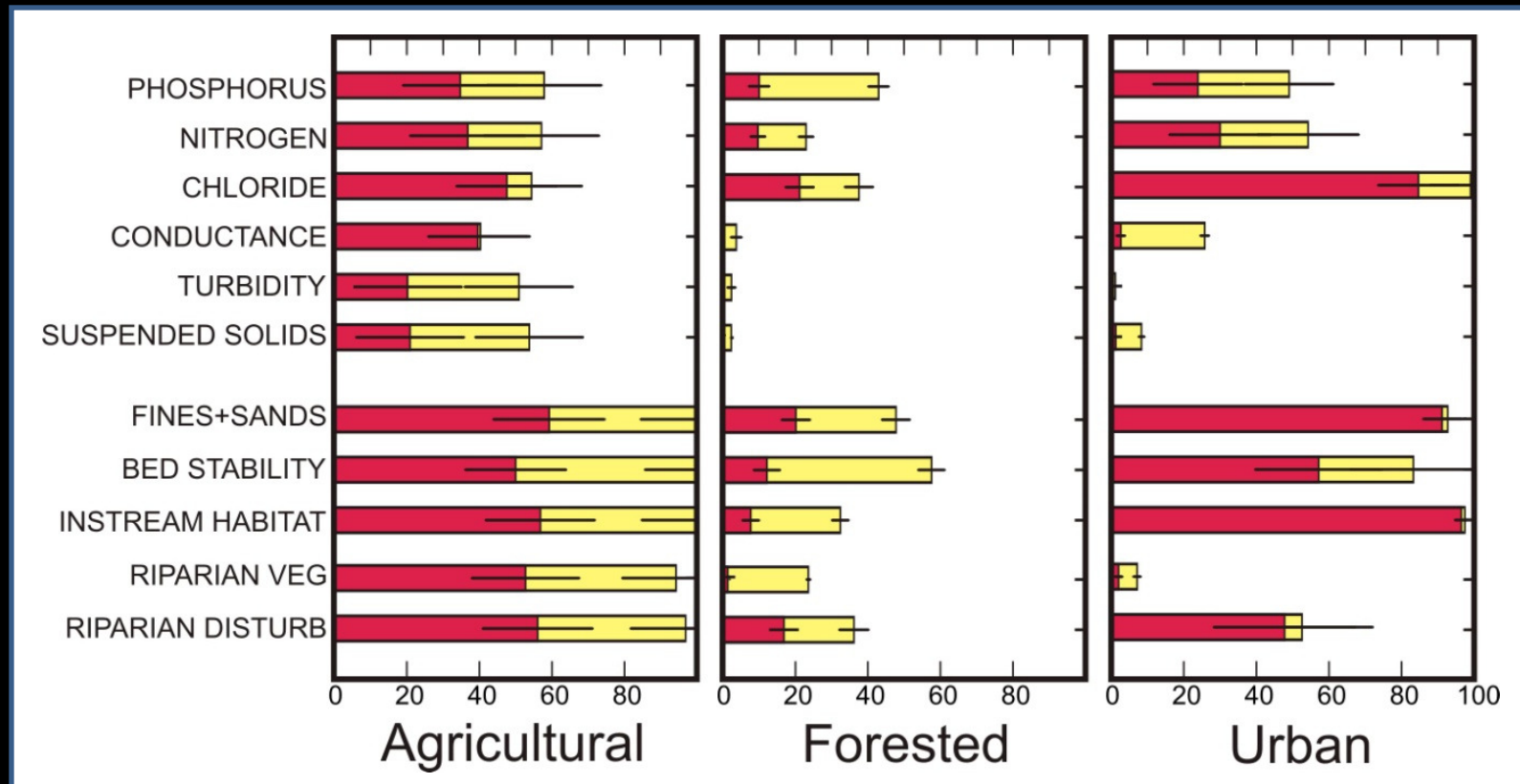


Statewide: ~50% of stream length with impaired biology
~22% with very impaired biology

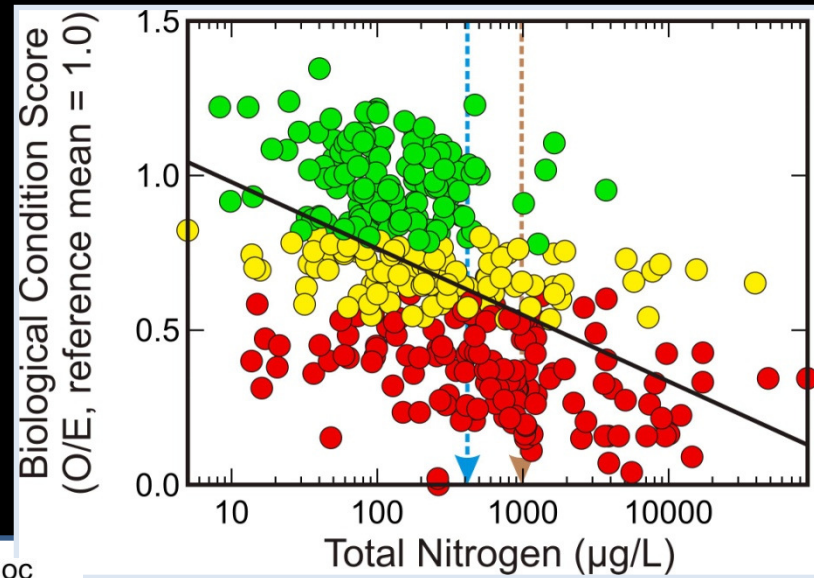
Condition Assessments by Landuse



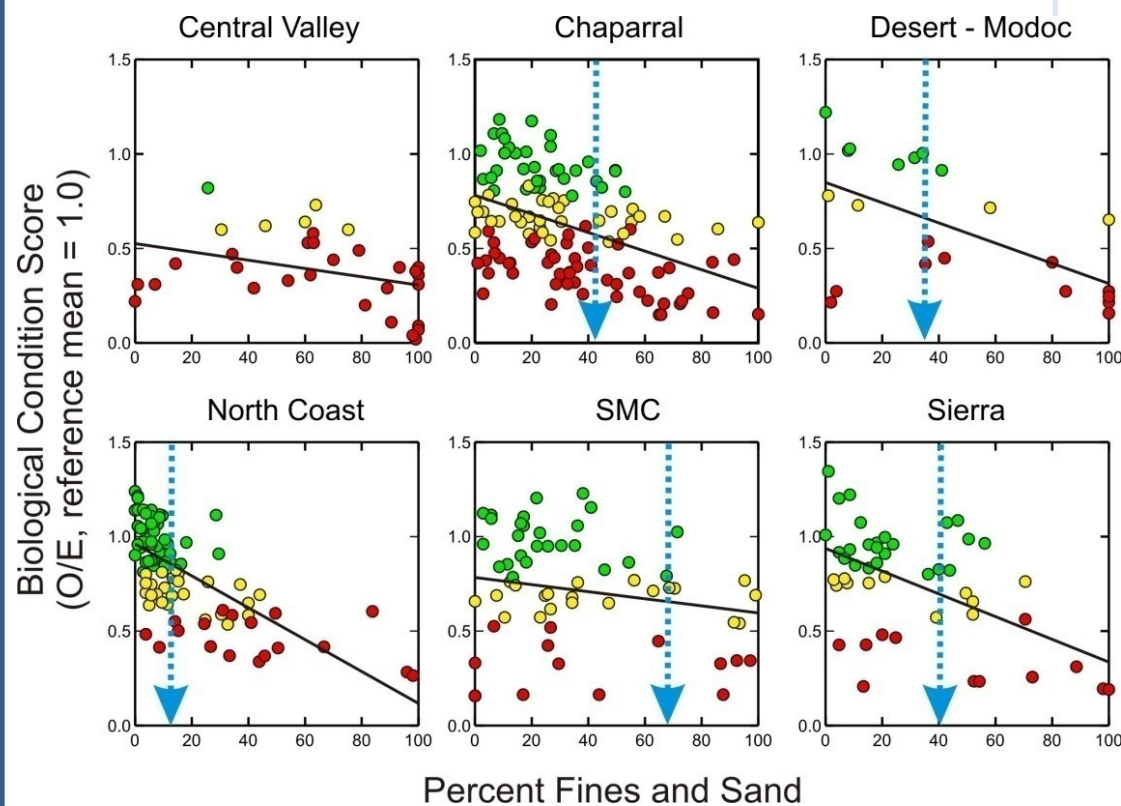
Stressor Extent Estimates by Landuse



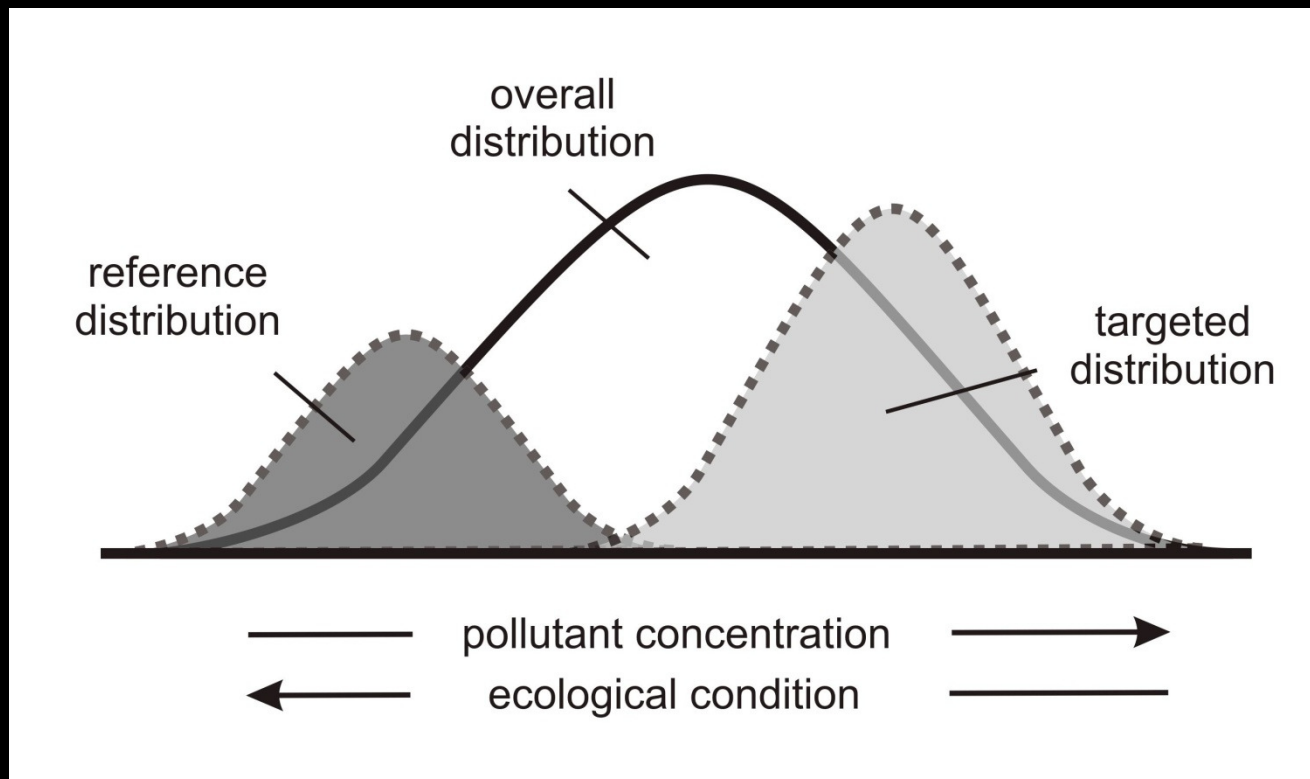
Beyond condition assessments...



Biology-based stressor thresholds



Beyond condition assessments...



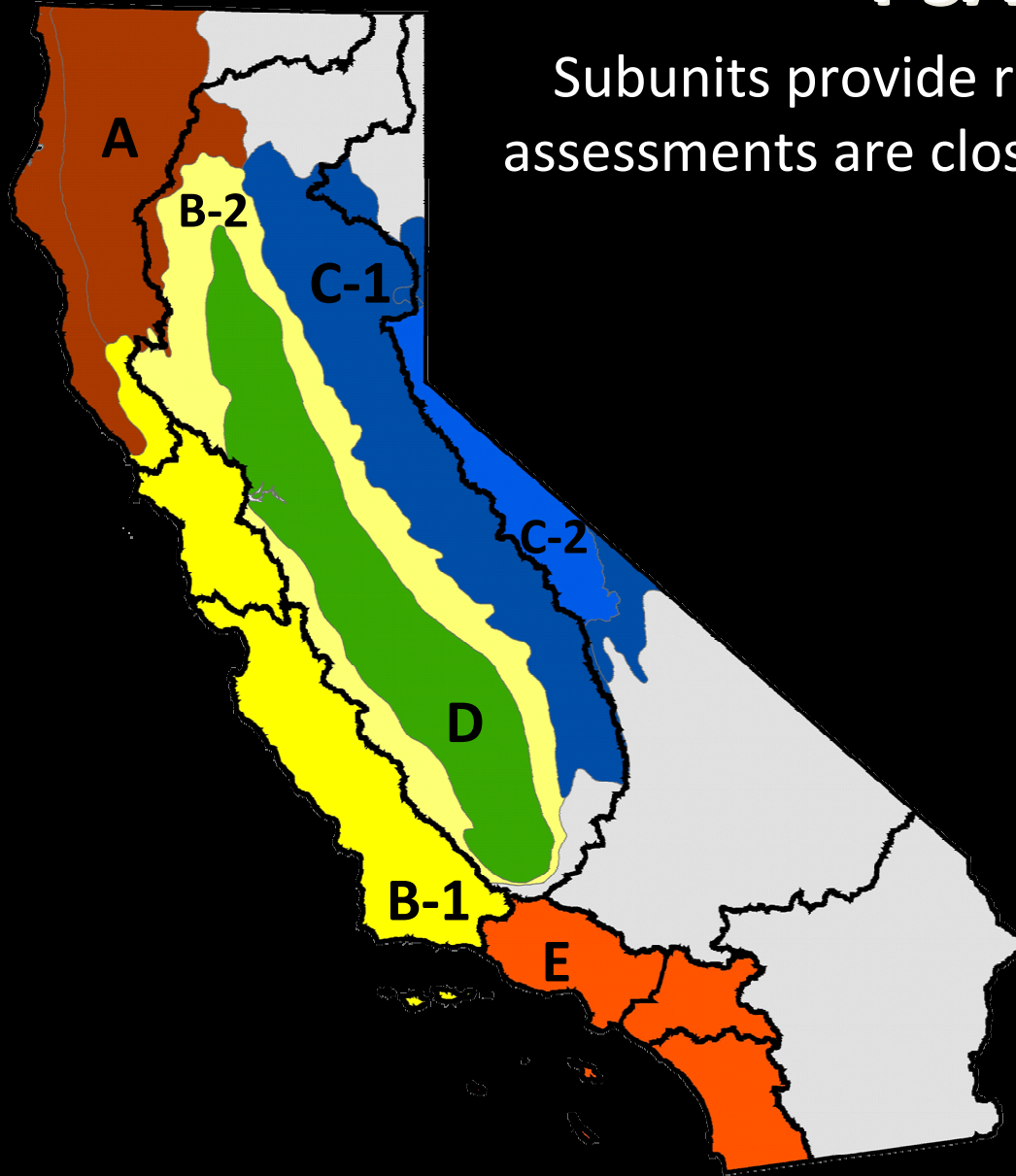
Integrating probability perspective into WQ
management programs

New Surveys: SWAMP's Perennial Streams Assessment (PSA)

- PSA combines all prior statewide surveys (2010 sampling season was PSA Year 11)
- Sampling intensity ~ 75 sites/year (~15/region)
- Increased weights of AG, URB sites (~25% of total)
- Current design has 6 major CA subregions (PSA Regions)

PSA Regions

Subunits provide regional perspectiveand 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)

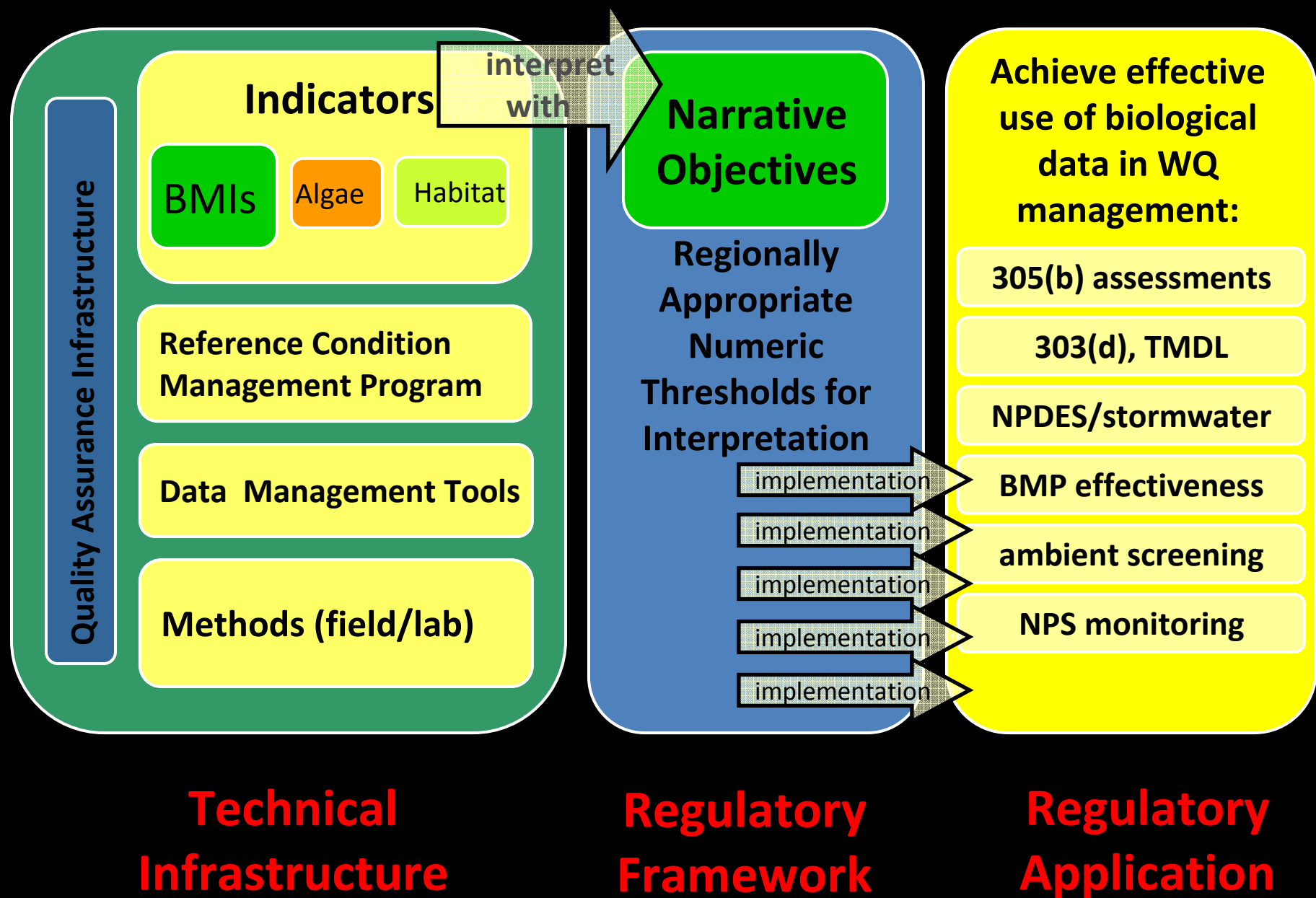
Other:

- Modoc Plateau
- Deserts

Integrating Statewide and Regional Surveys

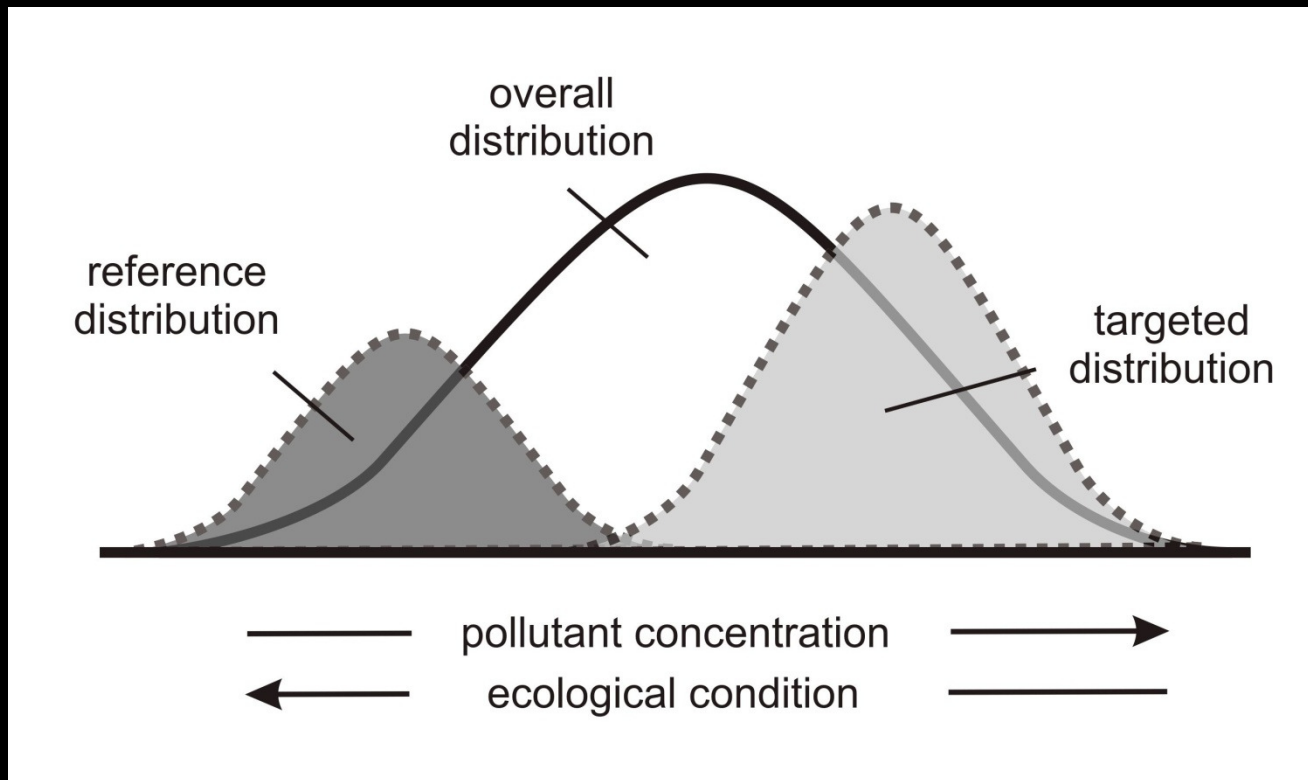
Program	Number of Sites	Geographic Distribution	Notes	Design Elements
EMAP	230	Statewide	Western EMAP	
CMAAP	200	Statewide	California EMAP	Landuse
PSA	220	Statewide	Perennial Streams Assessment	Weighted landuse
NRSA	61	Statewide	National Rivers and Streams Assessment	
SMC	200	SoCal coast	Coalition of regional boards and regulated stakeholders	Landuse + watersheds
SoCal (other)	100-200	SoCal coast	Multiple designs and scales	
USFS	40	Sierra Forests		
Garcia River	90	Garcia River	The Nature Conservancy	
TRPA	75	Tahoe Basin	Tahoe Regional Planning Agency	Urban/Non

New analyses will integrate multiple surveys, both statewide and regional (> 600 statewide sites + > 500 regional sites)



from Bioassessment to Bio-objectives

Goal has been to **assimilate** biological integrity monitoring into California's state and regional WQ regulatory programs



Biological endpoints and probability surveys have potential to transform WQ management in CA

Omernik Ecoregions (Draft 2 2010)

Level III – 13

Level IV - 189

