The Future of California Bioassessment

or:

"Driving the car as you build it"

~an ABL perspective

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What I've learned so far:

1. Newborns can experience emotional states very similar to those of their parents…

2. The “baby section” contains a new world of useful products…

10 years of CA bioassessment

an ABL perspective

This is my 10th CABW meeting...

When I first came to CA in 1995, very few groups actively working on bioassessment (Jim, SNARL, DWR, USGS, EPA's REMAP) and CABW had just started

CABW's initial efforts focused on introducing biology to WQ programs

This was immensely successful: I used to be shocked by how far CA was behind the rest of the country; now, we're catching up fast and could soon be a leader

At the heart of bioassessment is it's promise an efficient and powerful measure of ecosystem condition

Our goal now is to get the most out of that promise

At first, our work was descriptive: focus on collecting biological data, calculating metrics and making descriptive summaries of BMI communities

Now, our work is more analytical: focus on collecting BMI data as part of a strategy for answering specific WQ questions

To do this right, there is much basic work needed to develop tools and infrastructure …. We see ABL's role as helping the state develop a comprehensive bioassessment program robust enough to withstand regulatory challenges

TODAY's GOAL: Give an overview of how all the pieces fit together and highlight a few examples of recent work in our lab

Three Main Areas of Focus

Developing **technical infrastructure** for measuring biotic integrity

Developing a **research program** for establishing a scientifically defensible framework

Developing **regulatory infrastructure** to integrate biological data into WQ programs

Building a Comprehensive Bioassessment Program for California

Research Program

- Physical Conditions
- Reference Conditions
- Fish and Algae
- Methods Comparisons
- GIS landscape ecology
- Tolerance Values
- Diagnostic Techniques

Special Studies

- Hydro impacts
- Mining impacts
- Intermittent streams
- No reference available

The "Toolbox"

- IBIs
- RIvPACS models
- Tolerance Values
- Physical Condition Index
- Reference Conditions
- GIS Watershed Tools

Bioassessment Applications

- Regulatory Programs
- Condition Assessments
- Enforcement Programs
- TMDLs

Database (CalEDAS/SWAMP)

- **Standardization**
- **Data Reporting**

QC

Numeric Biocriteria
Tiered Aquatic Life Uses

Technical Infrastructure

Regulatory Infrastructure

Distinction between two types of protocols used in a bioassessment program

	Developmental Protocols	Applied Protocols
GOAL:	**Research protocol: Gather data used to develop and support the program, special studies**	**Refined protocol: Samples collected to answer specific regulatory questions**
ASSOCIATED DATA	**Extensive suite of physical/ chemical and local condition data**	**Basic set of "core" condition indicators**
TAXONOMY:	**Species level**	**Genus or Family level**
EXAMPLES:	**EMAP, CMAP, CEC**	**SWAMP, enforcement**

STRATEGY: Use developmental datasets to support applied protocols

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Interdependent Components:
~why we have to build the car as we drive it~

The process of building all of this is complicated because its not a stepwise process; the components are interdependent:

- Need a research program to develop the "toolbox"
- Need tools to answer research questions
- Need to know how data will be used in a regulatory context to direct research and create most appropriate tools
- Need research to determine which measurements should be part of the "core" suite used in regulatory methods

Good news is that bioassessment data is quite robust to variation in methods (*see upcoming talks by Andy Rehn and David Herbst*);
an iterative approach to developing the program works best

Technical Infrastructure:

Toward a Common Database Structure

Database Development (CalEDAS): 6 years and > $250,000 in staff time

- Supports **research**, **enforcement** and **regulatory programs**
- Mechanism for taxonomic standardization (data entry, reporting)
- Full taxonomic QC capabilities (QC Manager)
- Reporting interface (metrics, Monte Carlo, IBIs)
- Support for multiple field and lab methods
- Developing structure for physical habitat and chemistry data

Current Database Coordination Efforts

- SWAMP funding to integrate CalEDAS into SWAMP
- Modification of table structure to use DWR's BDAT datamart

At the core of the database is a key taxonomic table:
"Benthic Master Taxa List", important role for CAMLnet

California Aquatic Macroinvertebrate Laboratory Network

Created in 1996 as a CABW workgroup

Original Mission:

- Set taxonomic effort levels for CSBP
- Provide forum for sharing taxonomic knowledge among labs (e.g. workshops, literature, etc.)

With database consolidation comes a new role:

- Maintain Benthic Master Taxa List
- Define standard taxonomic effort levels for bioassessment
- Develop process for making official changes to the taxa list

The Research Program

GOAL: Provide scientific foundation for defensible regulation

SOME CURRENT PROJECTS:

- Filling the "bioassessment toolbox":
  - Developing regional IBIs (SoCal IBI, NorCal IBI, *see Bay Area IBI -Matt Cover*)
  - Exploring RIvPACS-type models
  - Developing tools for measuring physical integrity

- Standardizing procedures for selecting and maintaining reference sites
- Measuring and improving precision and accuracy of bioassessments

EXAMPLES:

- Developing stressor-specific tolerance values (*see Phil Larsen's talk*)
- Developing GIS tools for landscape ecology/ watershed analysis

Research Program: Stressor-Specific Tolerance Values

(see Phil Larsen's/ Dave Peck's presentation)

BIOASSESSMENT's PREMISE: Since different organisms have unique tolerances to stressors you can tell a great deal about WQ from the assemblage of organisms found at a site

PROBLEM: Current tolerance values are based on response to generalized stress and are poorly supported by data

SOLUTION: Develop tolerance values for specific stressors from associations between BMI taxa and physical/ chemical conditions

- Need good database full of BMI, physical habitat and WQ data

BENEFIT: Better tolerance values have potential for producing more meaningful metrics and even for providing diagnostic signals

ABL currently working on sediment tolerance values (*Andy and Natalia*)

Research Program: GIS-based Watershed Analysis

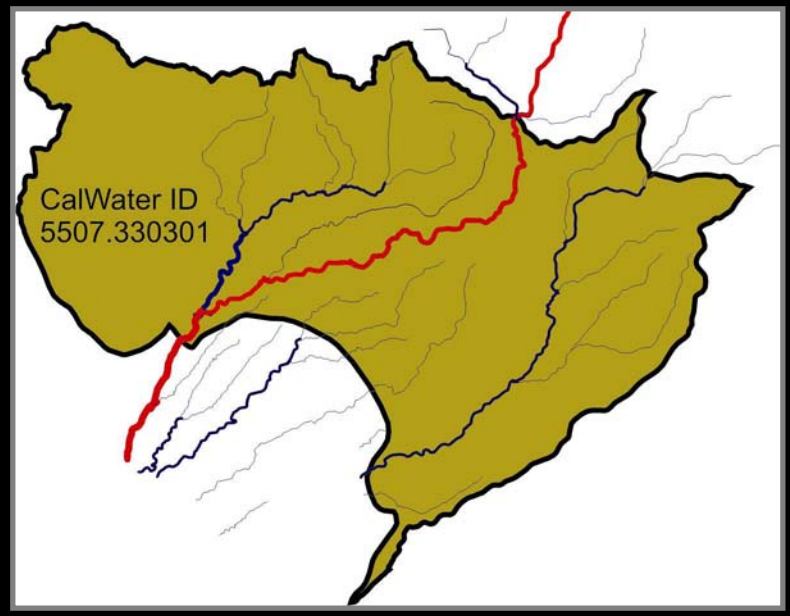
- Using GIS to summarize landuse activities in watersheds and predict stressor loads on stream reaches

- Using GIS to find reference watersheds

Toolbox Example: Creating TRUE Watersheds
(collaboration with CSU Chico, Geographic Information Center)

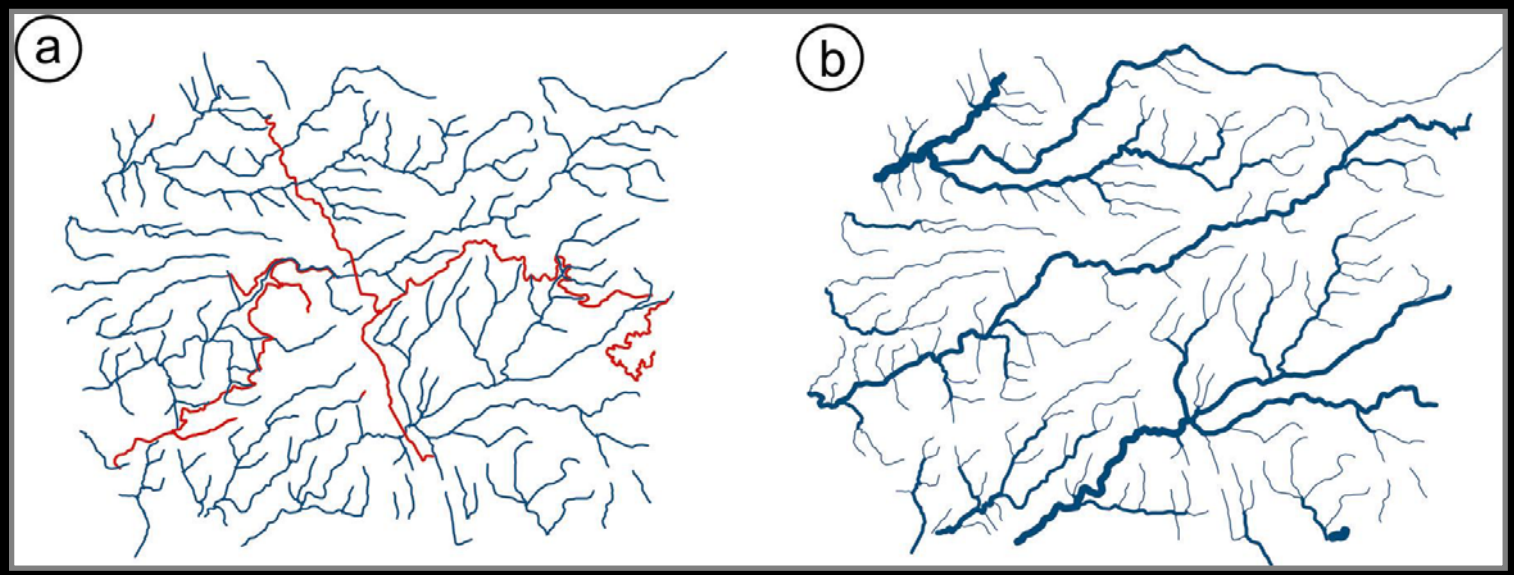
Watershed GIS coverages available for California (CalWater 2.2) are inadequate for bioassessment research:

- Smallest units (PWAs) do not reflect true watershed boundaries
- Often contain multiple portions of unconnected watersheds

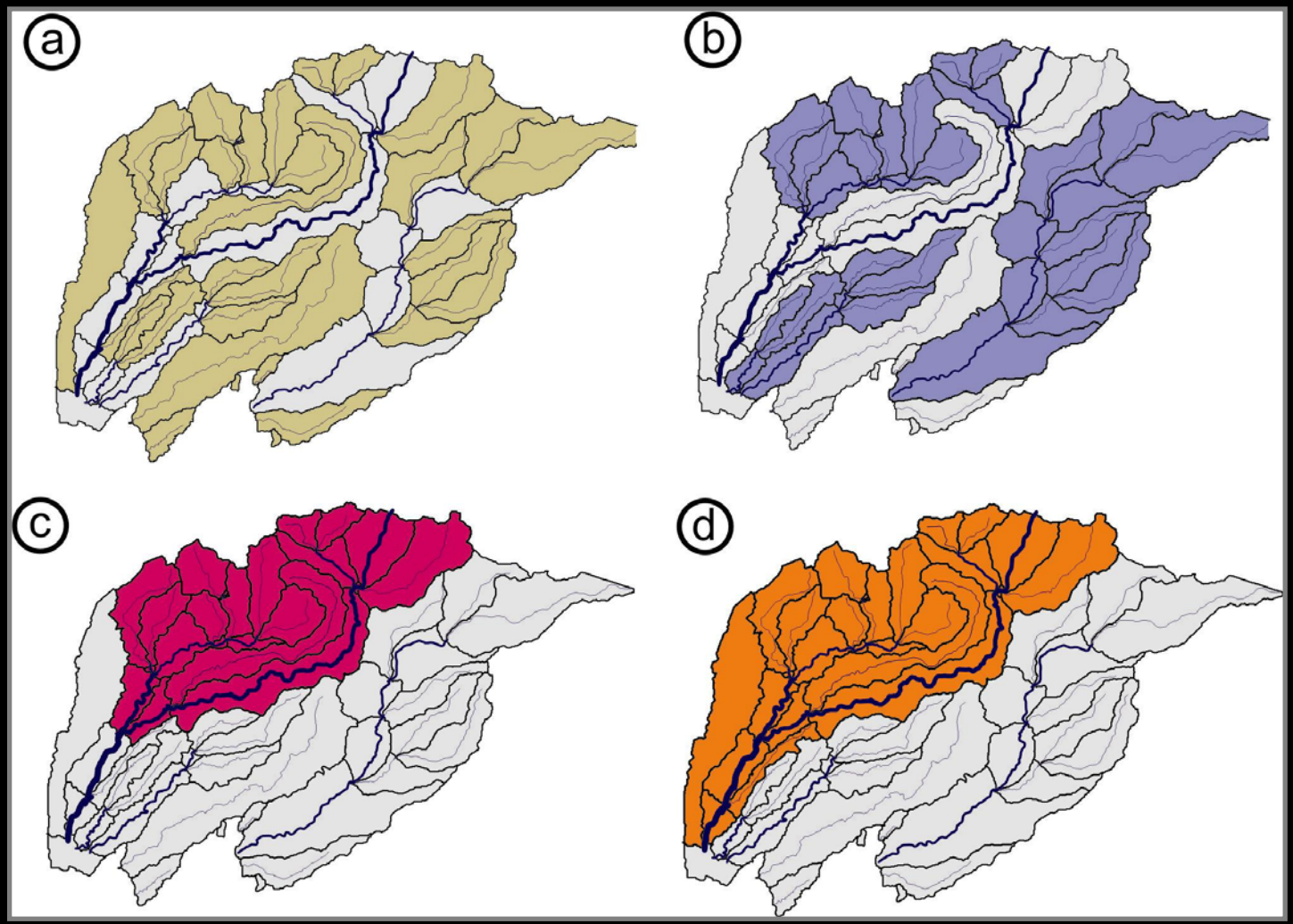


We developed a procedure to create “true” watershed coverages (Chuck Nelson, Jason Schwenkler, Chico GIC):

1. Clean up existing stream layers (NHD):
   - remove extraneous features
   - connect segments
   - flow direction
2. Assign stream orders to all stream segments
3. Prepare DEM elevation layers for analysis
4. Delineate watershed boundaries
5. Create new GIS watershed shapefiles



“True” watersheds allow us to analyze landuse data in spatial units that relate directly to hydrology



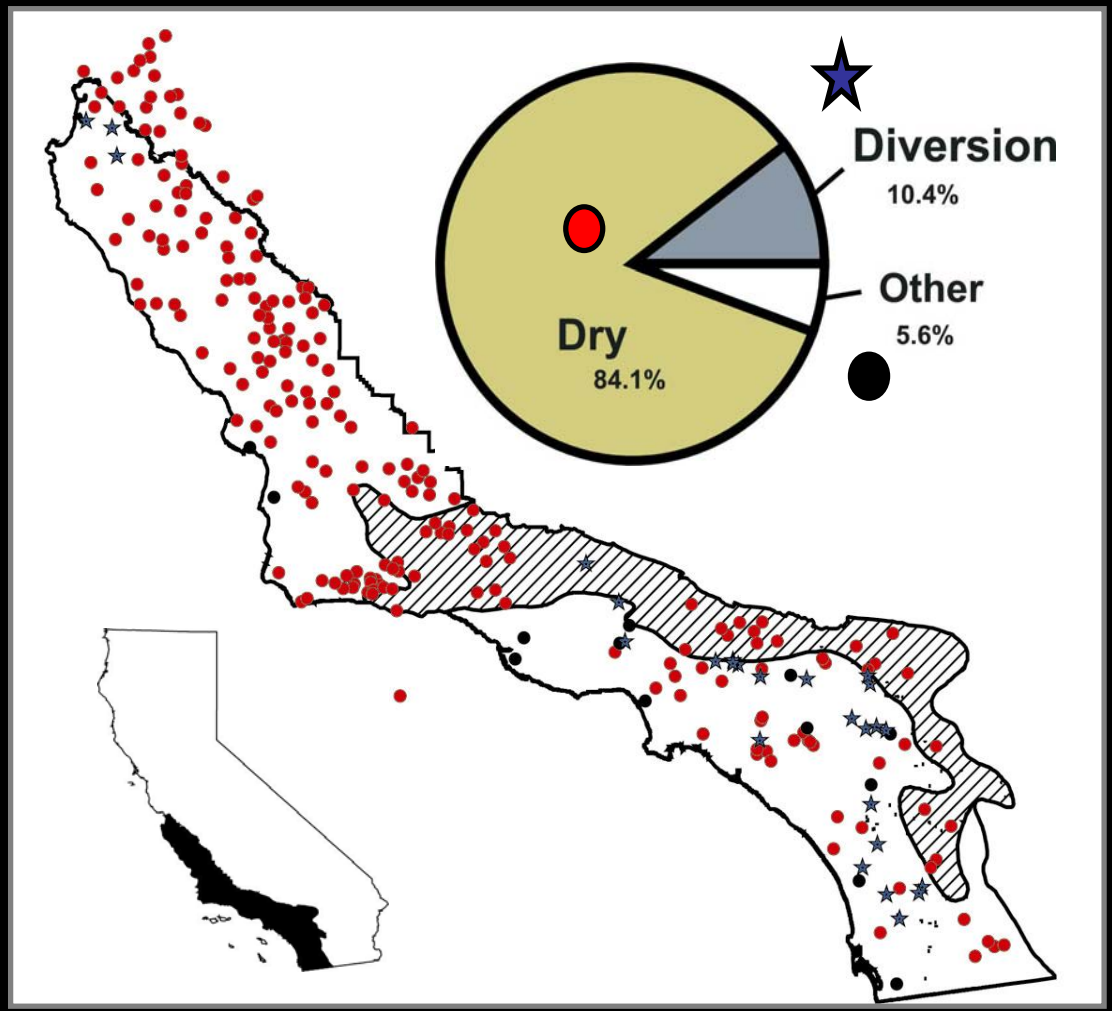
Special Studies

California Energy Commission: Developing bioassessment tools for measuring impacts of hydroelectric dams

Central Valley Reference Conditions (CVRWQCB, DPR): How to set standards for biotic condition where reference streams are hard to find?

Intermittent Streams: How to set standards for biotic condition in non-perennial streams?

Bioassessment for Intermittent Streams in the Arid West



<u>Results of EMAP Survey:</u>
65% of stream miles indicated as "perennial" on USGS 1:100K maps were dry

Traditional bioassessment methods were developed for perennial streams

WQ regulators need to be able to define standards for non-perennial streams

Need basic research on best measures of biotic integrity for non-perennial streams

~SCCWRP?

Special Studies: San Diego Fires

In October 2003: large areas of southern CA burned

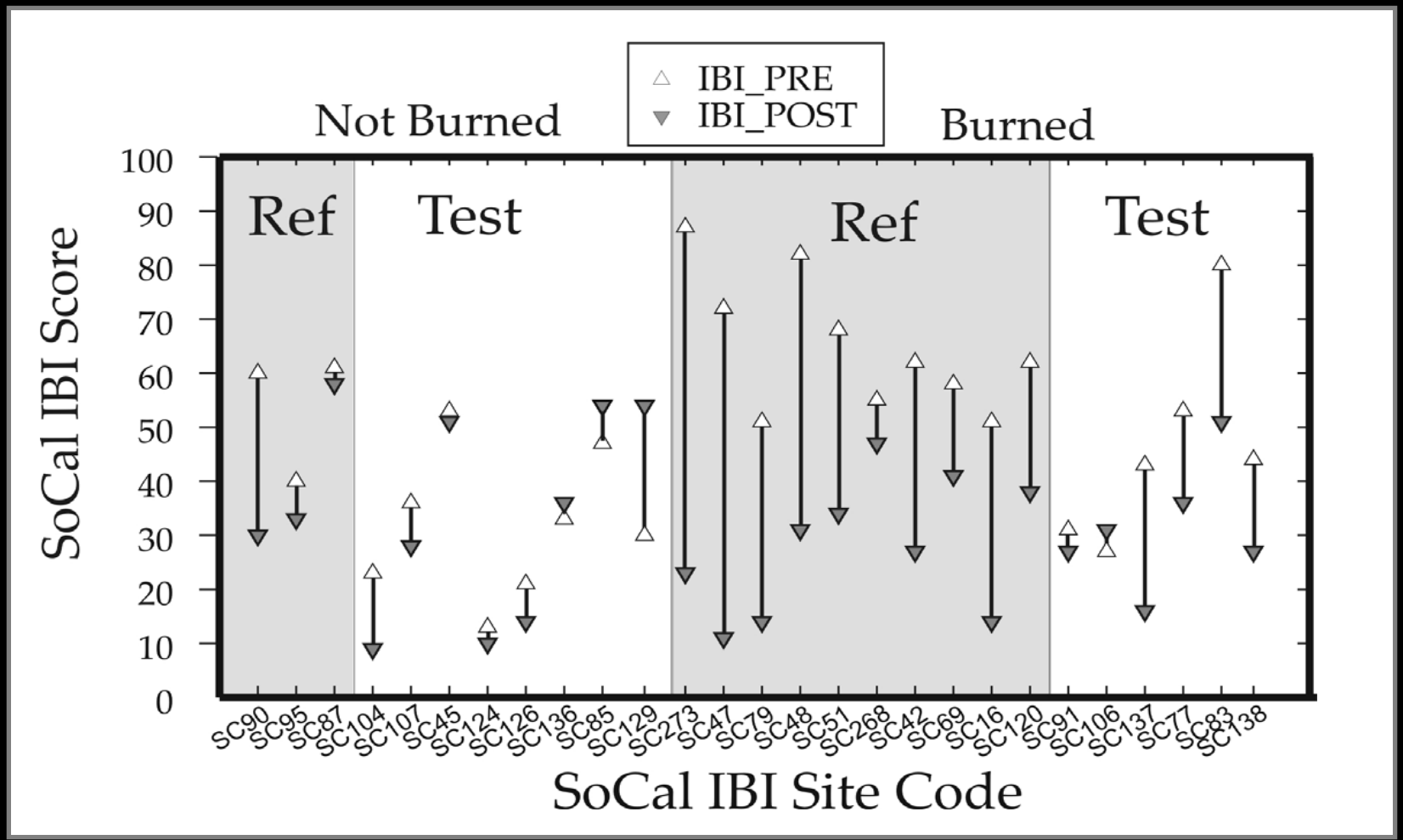
Because of our previous work in the region, we had a lot of data from reference sites in burned and unburned areas

<u>Natural experiment:</u>

- How do BMI assemblages respond to large sediment pulses?
- How long does it take to recover?
- What is the effect of a large natural disturbance on IBI scores?
- Which BMI metrics best describe impacts and recovery?

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

Bed changes associated with dramatic changes to BMI communities



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Regulatory Infrastructure:
Application of Bioassessment Data

Eventual Goals:

1. Biotic integrity fully integrated into WQ management programs (*lots of examples tomorrow*)
2. Fully implemented numeric biocriteria

An Integration Framework:

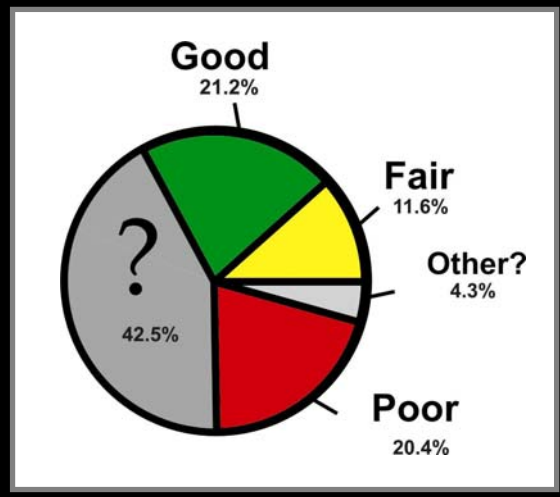
Tiered Aquatic Life Use (TALU) framework

(*see Jerry Diamond's presentation*)

Bioassessment Application: Condition Assessments (EMAP/ CMAP)

Objective: Use of probabilistic surveys to answer basic WQ questions:

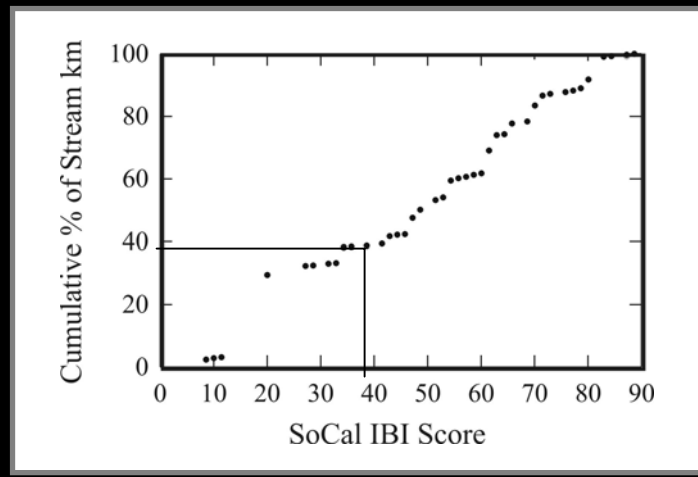
- What is the biotic condition of the state's streams?
- Is it getting better? Is it getting worse?
- Are we allocating $$$$ wisely?



Condition Assessments: SoCal, NorCal, statewide

CMAP: also apply these questions to non-point source (NPS) stressor categories:

- Agriculture, Urban, Forested, Other



Appoximately 270 sites collected under EMAP and an additional 200-250 will be collected under CMAP

Helpful framework for setting statewide funding priorities

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"An ABL Perspective"

There's still much work to be done, but because of all the work that's been done so far, we're sitting on a large amount of data that can be mined to support research and develop tools

"An ABL Perspective" because this is only part of CA bioassessment and there are many ways to think about how it all fits together

We're not doing this in a vacuum; we have many partners in this work and we couldn't have gotten very far without the efforts of:

- University Researchers: SNARL, UC Berkeley, UCD-ATL
- Federal Agencies: USGS, USFS, EPA
- State and Regional Water Boards,
- Citizen's groups

There are many different perspectives on the best approaches, but we share a belief that biological data have tremendous potential for California WQ…