Update on Benthic Algae IBI for Southern California Streams

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CABW
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Topics of Presentation

- Relationship of our work to California's algae bioassessment initiatives
- Research toward developing a stream algae IBI for southern California
- Progress on resources to build capacity
- New research on toxic stream

Why Algae Bioassessment?

- Advantages over water chemistry alone
  - Integrative over time
  - Direct indication of biological condition (Aquatic Life Uses)
- Information complementary to bugs
  - Different stressors and/or over different ranges of disturbance
  - Weight of evidence
  - Potential for broader range/flexibility in interpretation
- More diagnostic than biomass alone

Building a Stream-algae Assessment Program for California

TECHINCAL TOOLS
- Index of Biotic Integrity (IBI)
- Nutrient Numeric Endpoints
- Biological Objectives

IMPLEMENTATION TOOLS
- Implementation strategy
- Std. Operating Procedures
  - Training workshops
- Database
- QA guidelines

SUPPORT TOOLS TO BUILD CAPACITY
- Regional floras
- Taxonomic ID resources
- Taxonomic standards workgroup

Major Goals of Current Project

- Develop algae-based Index of Biotic Integrity (IBI) for So Cal streams
- Improve taxonomic capacity in (southern) California
- Examine relationships between environmental factors and stream algal nuisance
  - Emphasize correspondence to stream nutrient numeric endpoints (NNE) framework

Guiding Principles in Study Design

Sampling method should be

- Amenable to streams statewide
- Compatible with national programs
- Efficient to integrate into existing practices
- Able to address a broad array of management questions (condition & biomass)

Study design should also provide answers to anticipated implementation questions

Study Design

- Multihabitat (SWAMP-adopted) method + targeted substrates at subset of sites
- Repeat sampling inter- and intra-annually at a subset:
  - 2 years
  - 2 seasons/year (May-June & Oct-Nov)
- Replicate sampling within visits
  - tests patchiness

Data Types Collected

- "Quality" of algal assemblage (taxonomic composition)
- Quantity of algae
  - Lab
    - soft-algal biovolume
    - chlorophyll *a* content
    - ash-free dry mass (AFDM)
  - Field
    - micro & macro algal cover
- Chemical, habitat, and landscape variables

Our Algal Assemblages Include

diatoms

soft-bodied algae (& cyanobacteria)

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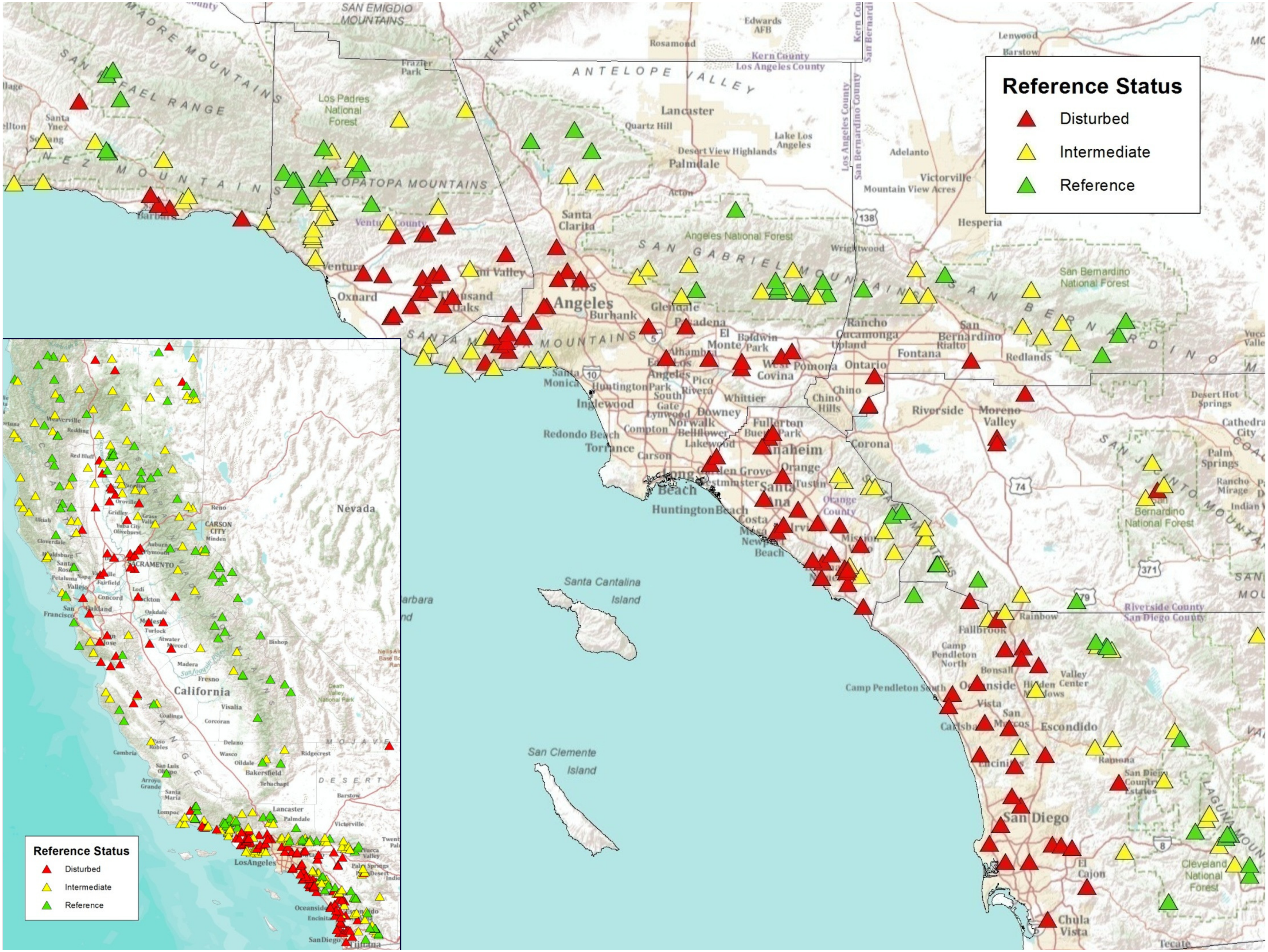
Study Sites

- Data sources:
  - Prop 50
  - Stormwater Monitoring Coalition (SMC)
  - Perennial Stream Assessment (PSA)
  - Reference Condition Management Program (RCMP)
  - Region 9 SWAMP
  - 2007-2009 (N > 400 sites, > 600 samples)
- Sites were assigned to “disturbance classes” based on landscape and local-level stressor data
- “Reference” condition criteria followed bio-objectives

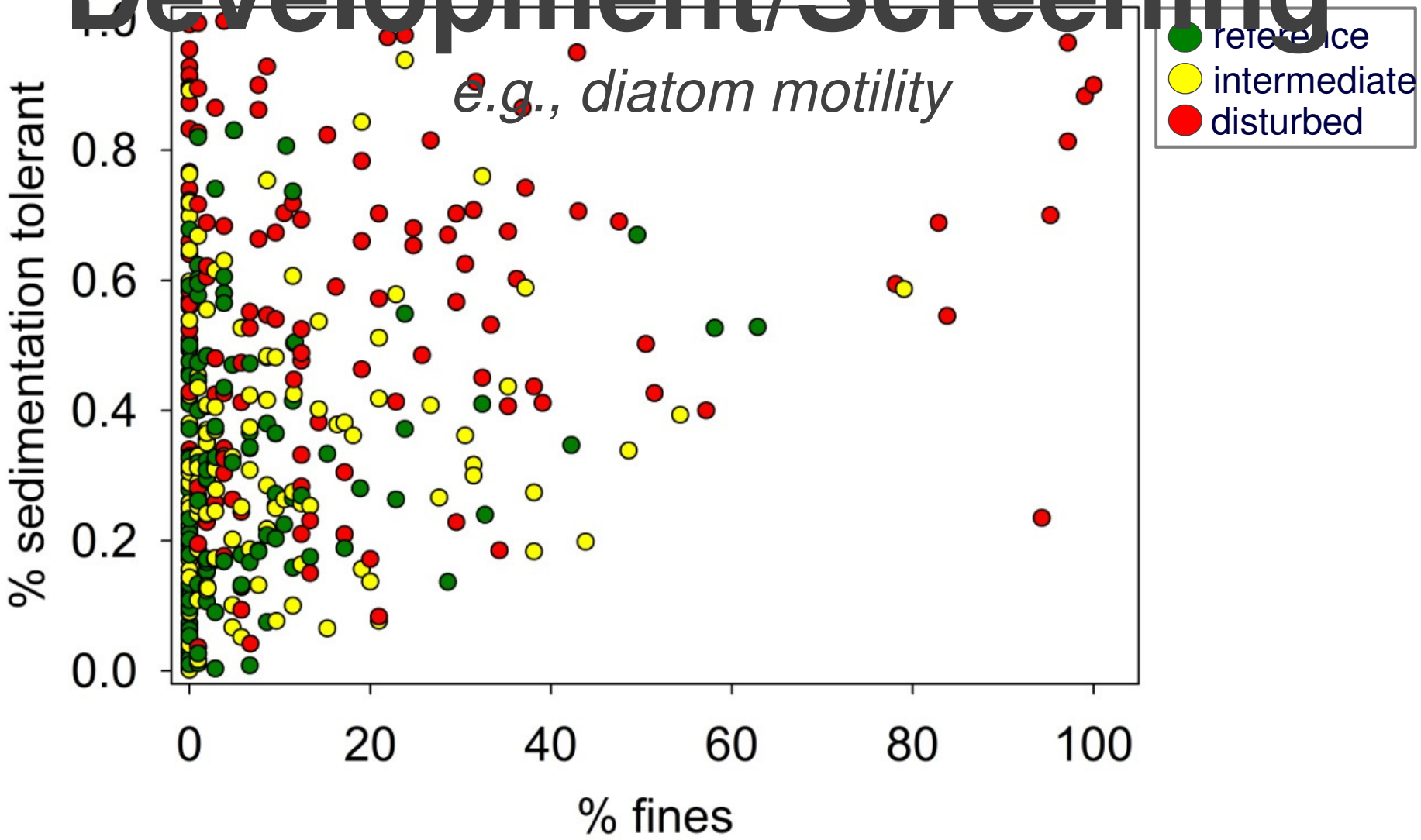

Reference Status
Disturbed
Intermediate
Reference
Los Angeles
San Diego
Santa Cantalina Island
San Clemente Island
Los Padres National Forest
Angeles National Forest
San Bernardino National Forest
Cleveland National Forest
TOPATOPA MOUNTAINS
SAN GABRIEL MOUNTAINS
ANTELOPE VALLEY
Nevada
California
Reference Status
Disturbed
Intermediate
Reference

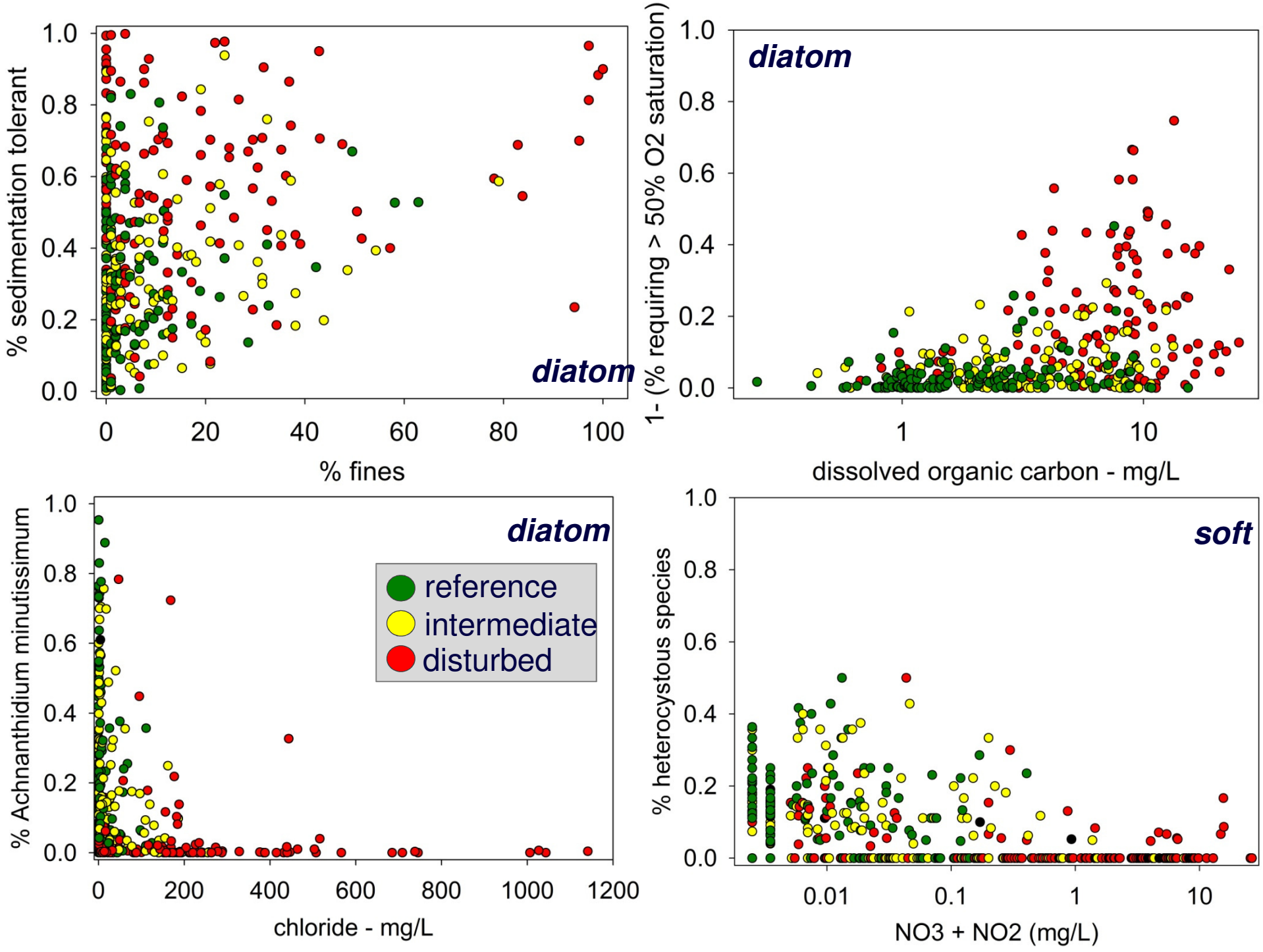
IBI Development Stages - Progress

- Divide data into "calibration" & "validation" subsets
- Develop, scale, screen candidate metrics (N >100)
- Combine metrics into candidate IBIs
- **Validate** response to stress, confirm low mean correlation of metrics, test for indifference to non-anthropogenic factors
- Assess min. detectable diff.; divide into classes

Metric Development/Screening

e.g., diatom motility

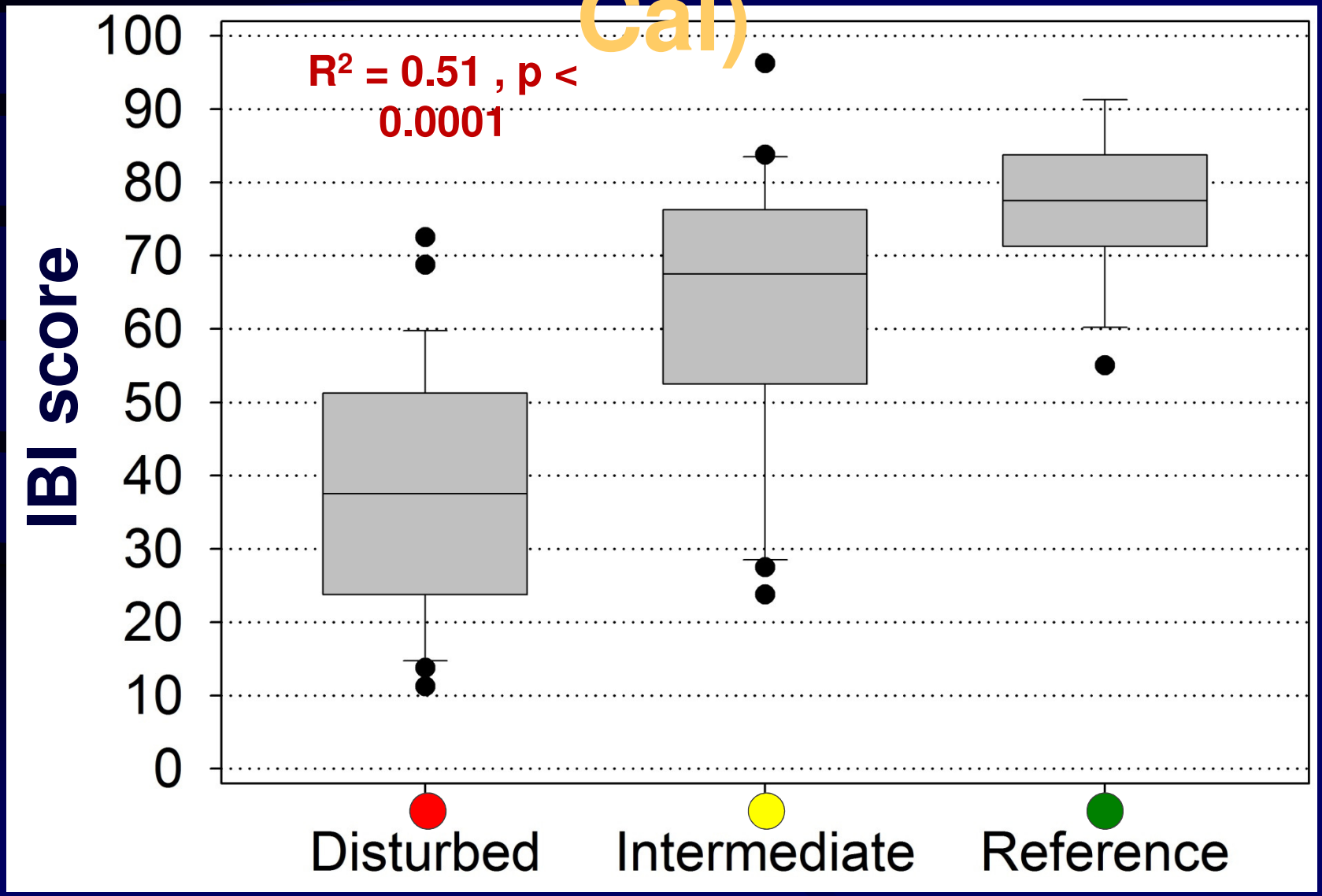



% sedimentation tolerant
% fines
diatom
1- (% requiring > 50% O2 saturation)
dissolved organic carbon - mg/L
diatom
% Achnanthidium minutissimum
chloride - mg/L
diatom
reference
intermediate
disturbed
% heterocystous species
NO3 + NO2 (mg/L)
soft

Component Metrics: *Candidate* Algae IBI for So Cal

1. proportion sedimentation tolerant (incl. highly motile)
2. proportion low-nitrogen indicators (incl. N fixers)
3. proportion halobiontic
4. proportion nitrogen heterotrophs
5. proportion requiring > 50% saturation DO
6. proportion of organic-associated spp
7. proportion of copper-associated spp
8. proportion of low-phosphorus-associated

Draft IBI – *Validation* Data (So Cal)



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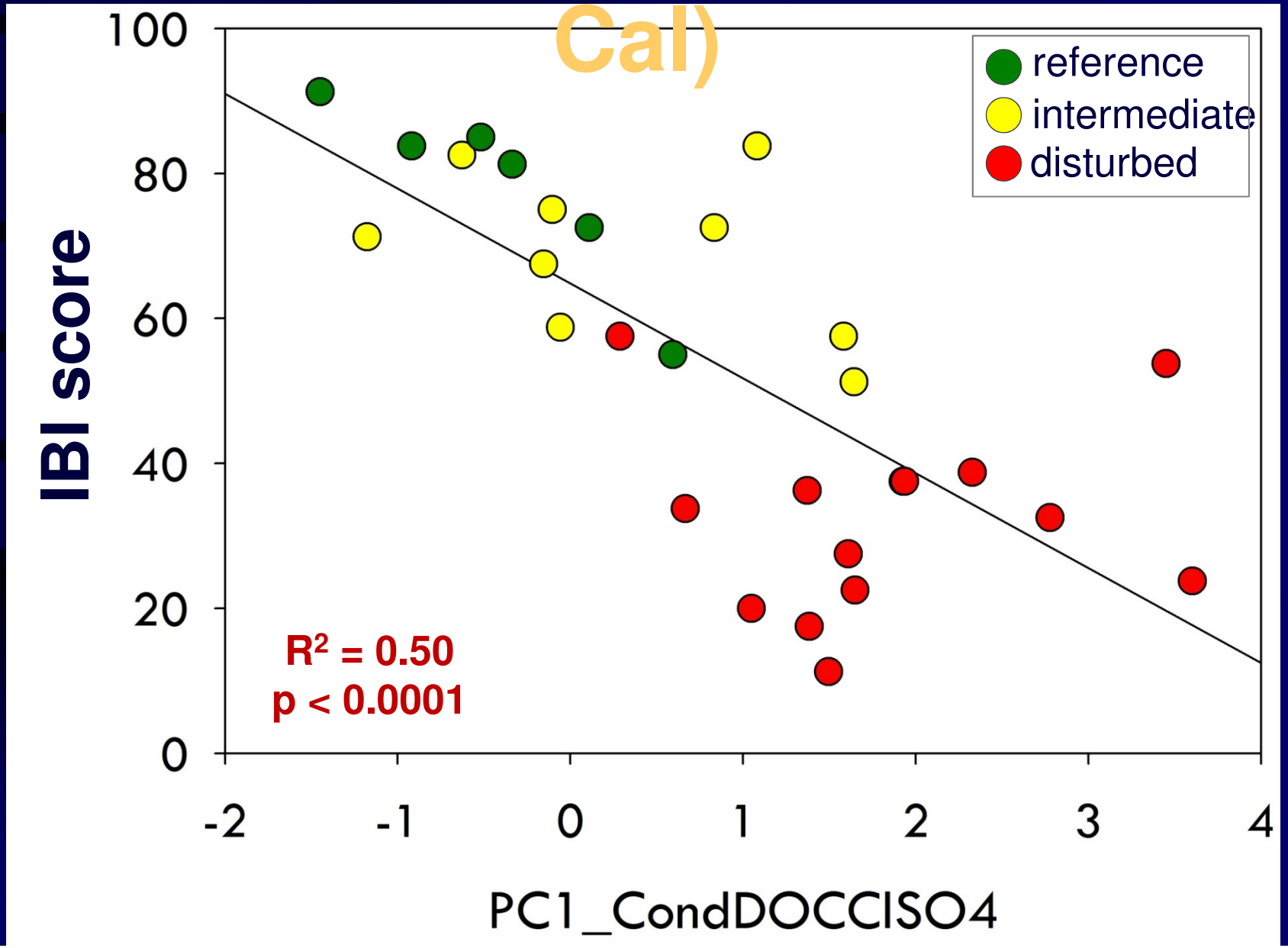
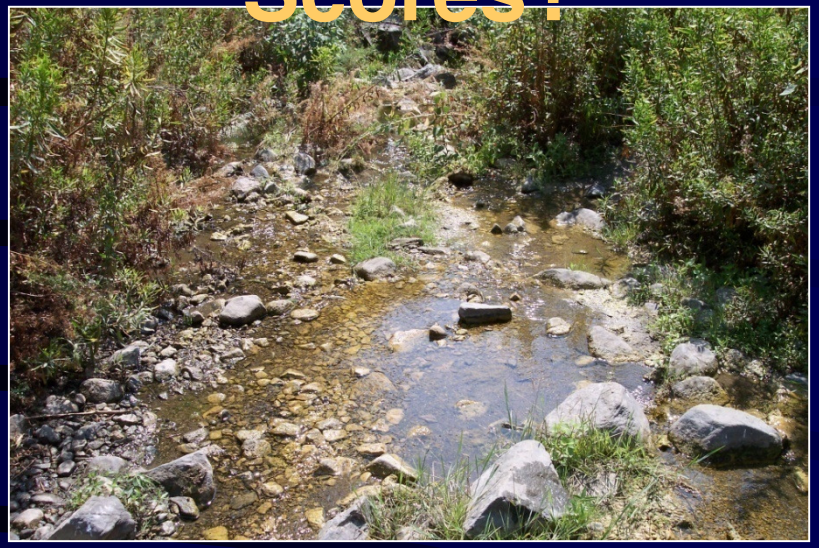
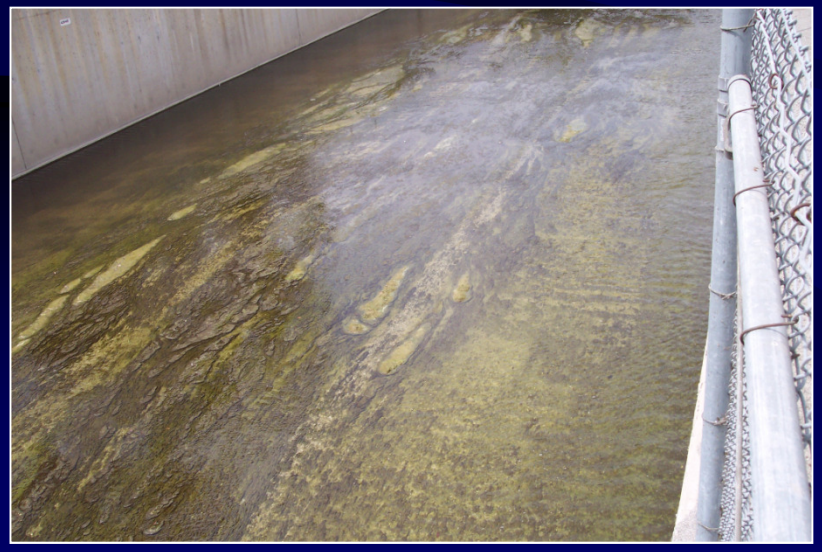
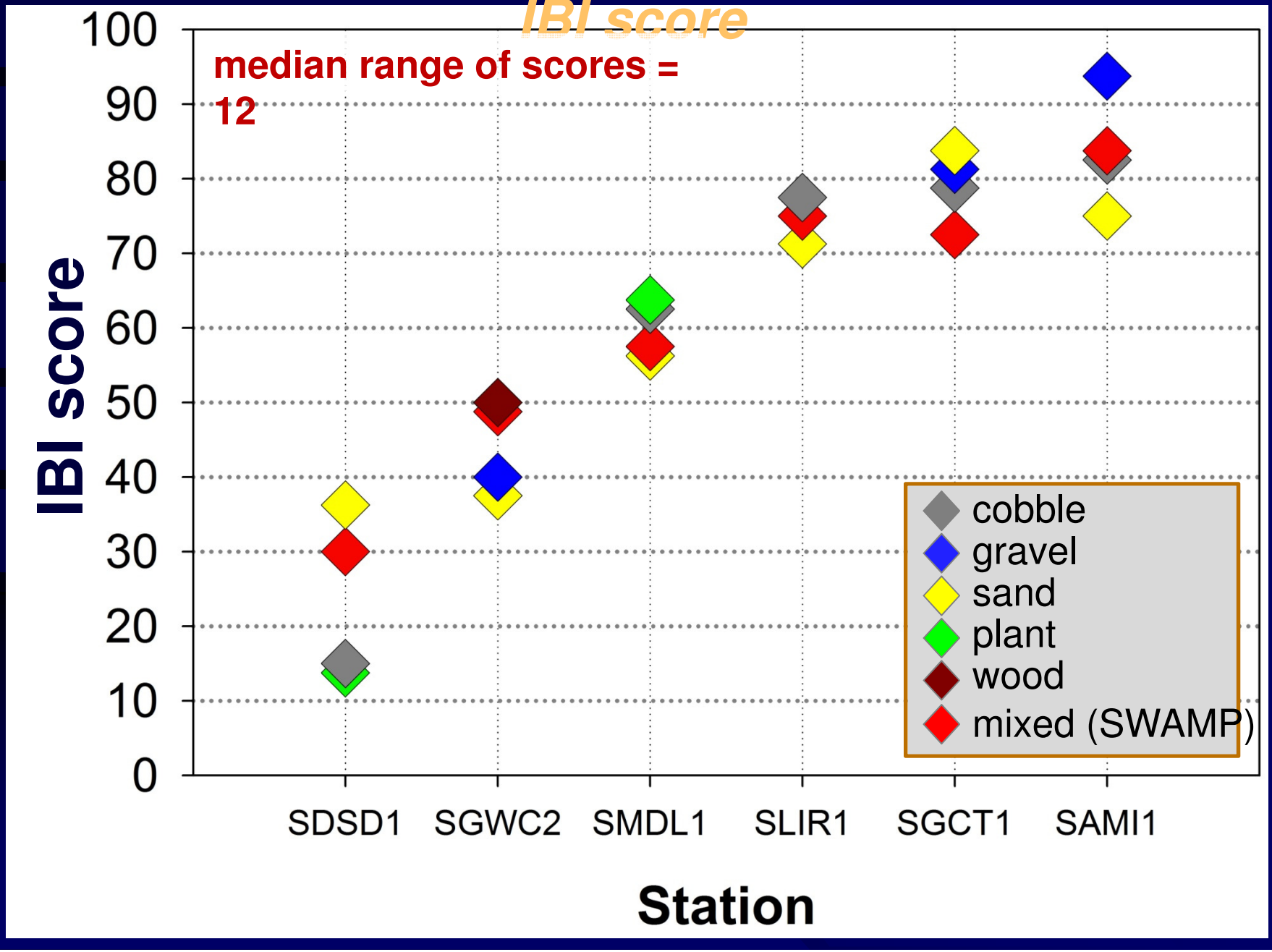


Will Different Dominant Substrata Affect IBI Scores?

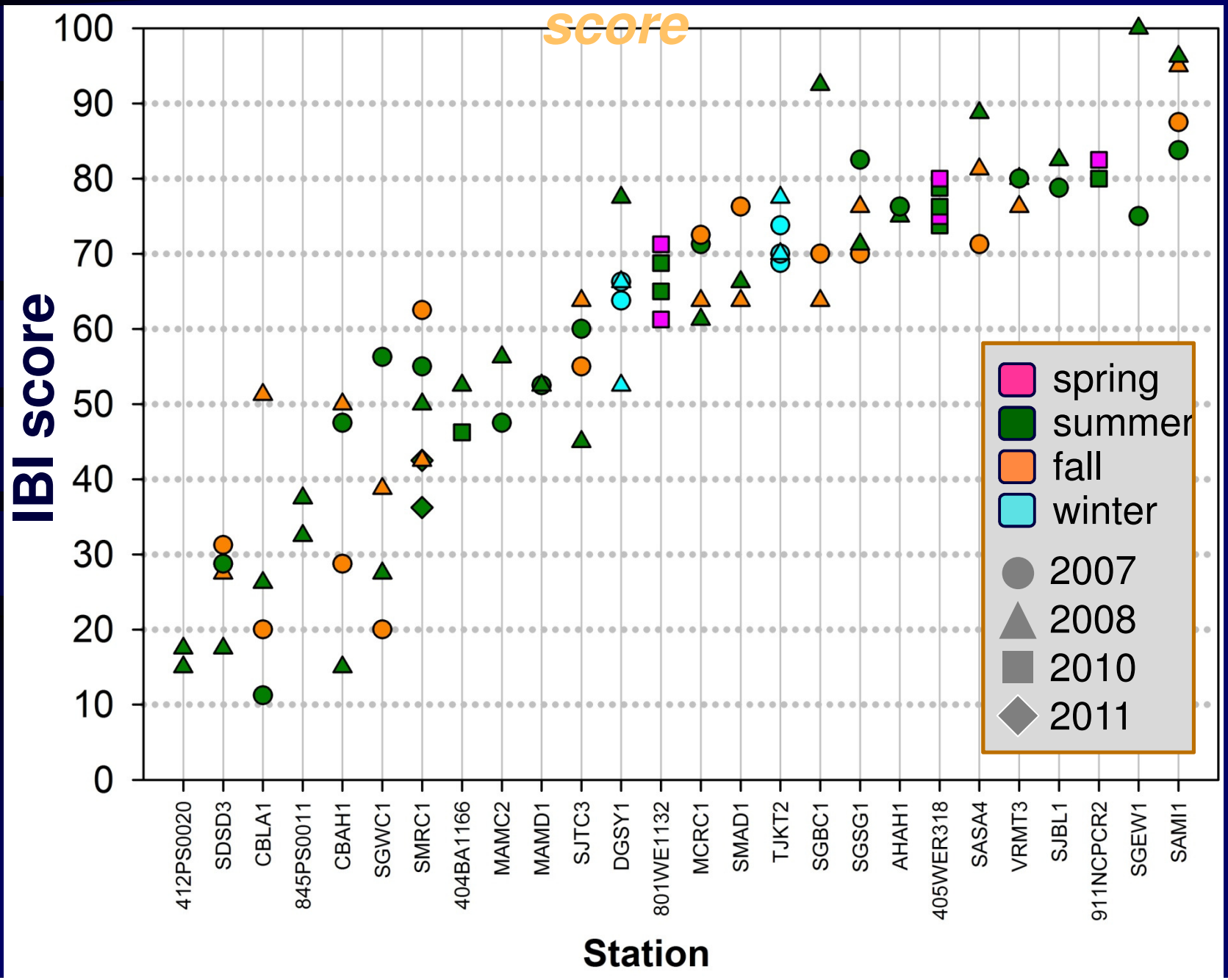




Substratum Type: *No consistent influence on Draft IBI score*



Season/Year: *No consistent influence on Draft IBI score*



Summary: So Cal IBI Development Progress

- >100 metrics developed and screened
- Several potential IBIs tested
- Draft IBIs for So Cal exhibit expected relationships with stress
- Apparent substratum & seasonal effects are unbiased and fairly minimal
- Pros and cons of diatom/soft only *vs*. different types of “hybrid” IBIs are being explored in depth
- Draft IBI for So Cal finished next month

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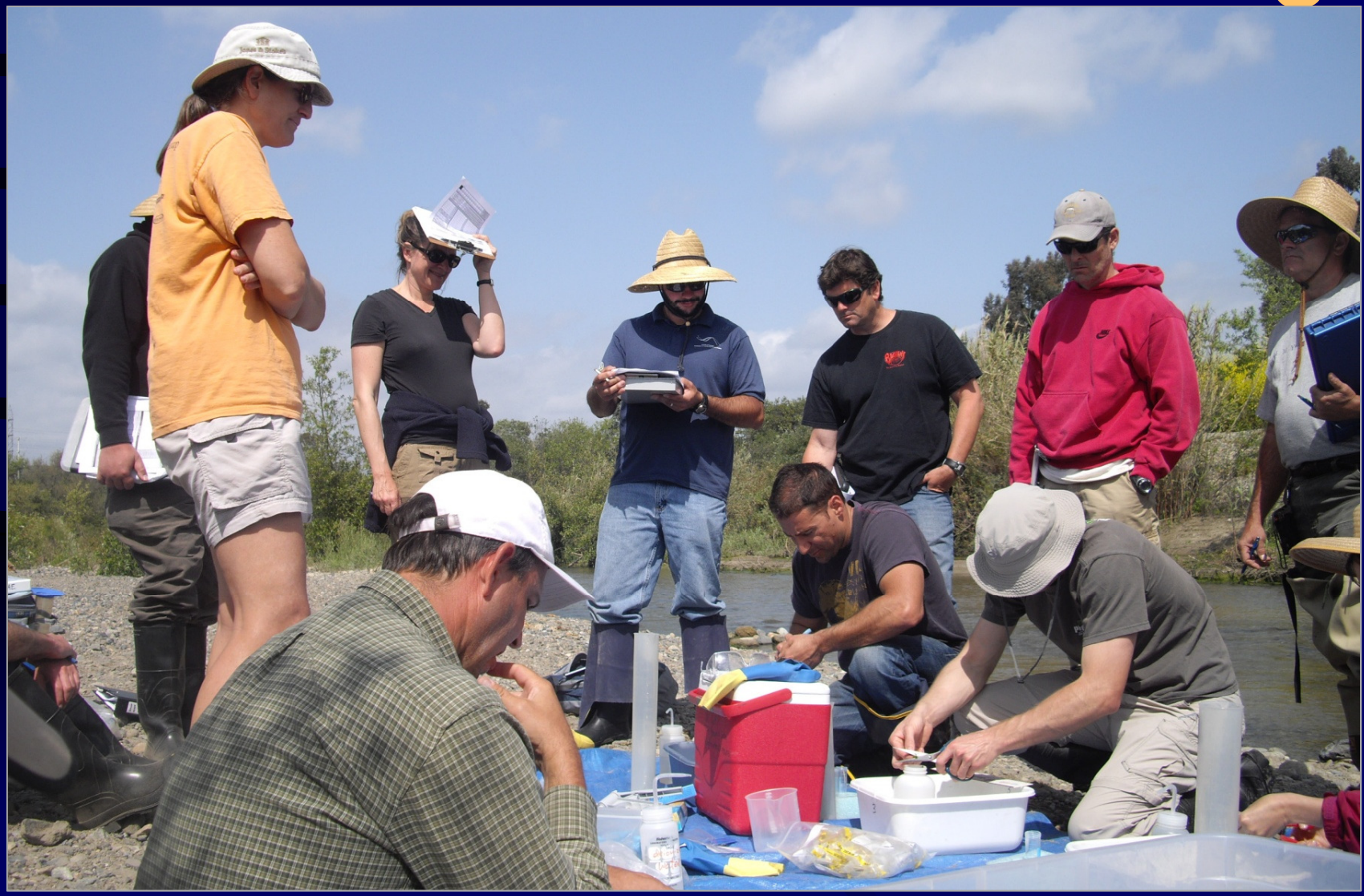
Sampling Method Standardization and Training



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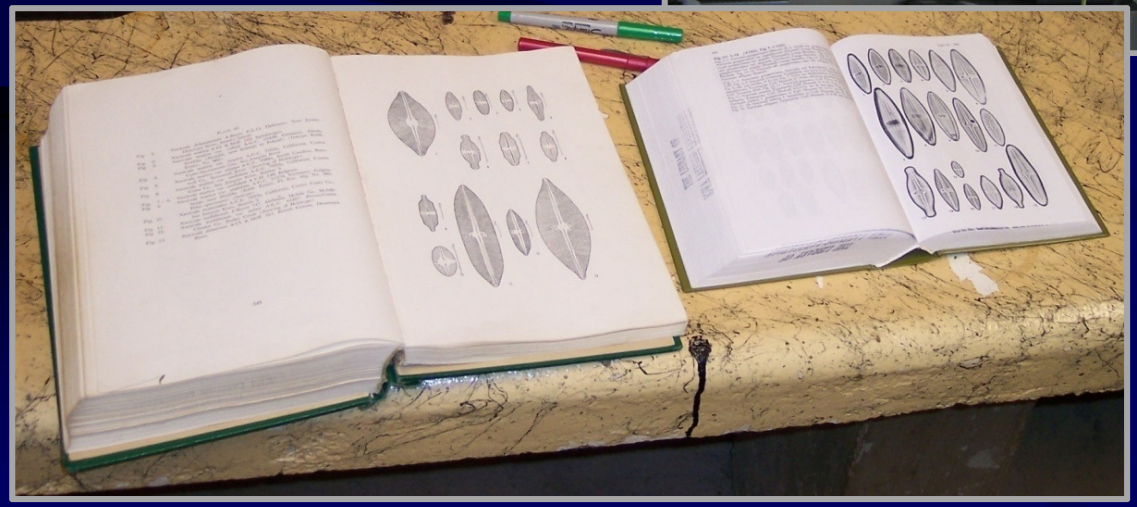
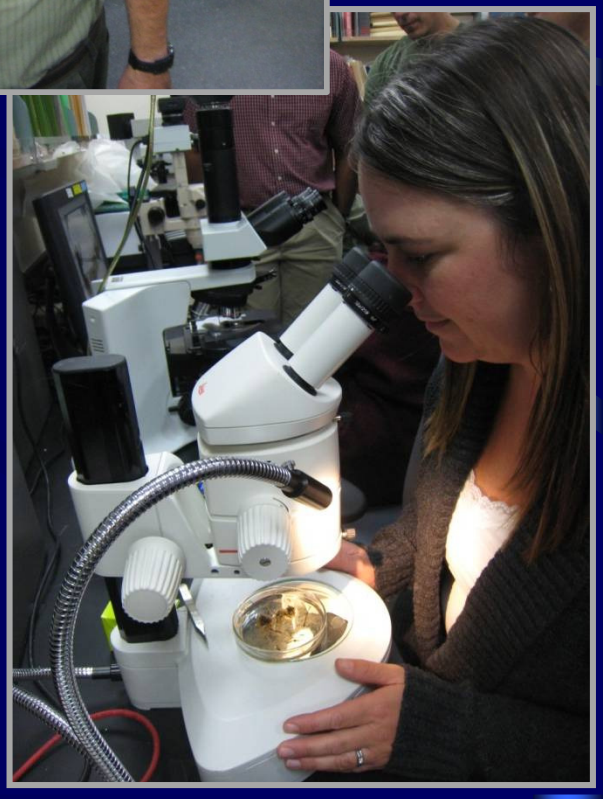
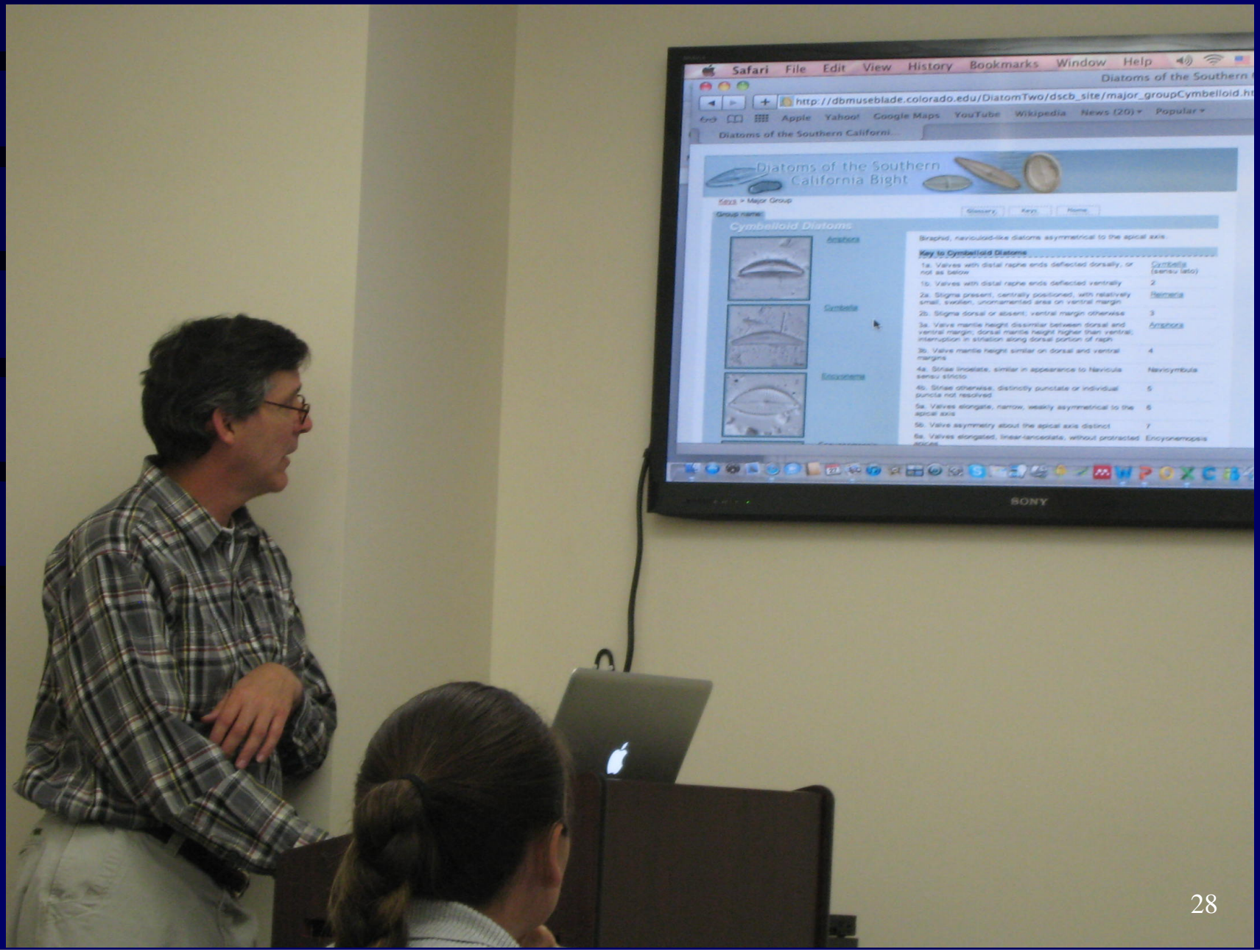
Addressing the Need for Algae Taxonomic Resources for California



Algae Laboratory Workshops – Nov 2011



Taxonomy Website: Diatoms



Taxonomy Website: Soft Algae

Soft-Bodied Stream Algae of California: Clastridium rivulare - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://home.comcast.net/~rpglam/storage/algae_site_draft/c_rivulare.html

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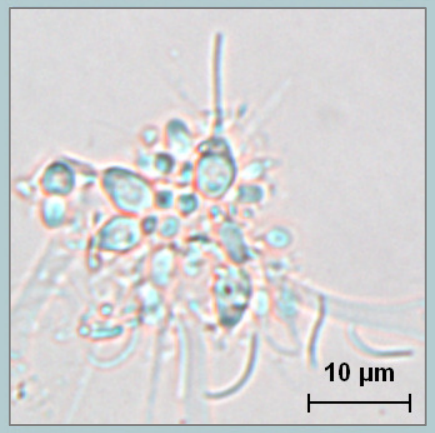
Soft-Bodied Stream Algae of California

Keys > Major Group > Genus > Taxon Description

Species name:

Home

Clastidium rivulare (Hansg.) Hansg.



External reference link 1

Description:

Cells in dense gelatinous groups joined to the substrate by their widened bases; cells shortly ovoid to slightly pear-shaped, pale grey-green, sometimes yellowish, 3.2-4.1 µm wide, up to twice as long as wide. Mucilaginous hair slightly thickened towards the basis up to 30 µm long. Sheath thin, firm, colorless, not clearly visible.

Distribution:

New Research on Toxic Cyanobacteria in Wadeable Streams

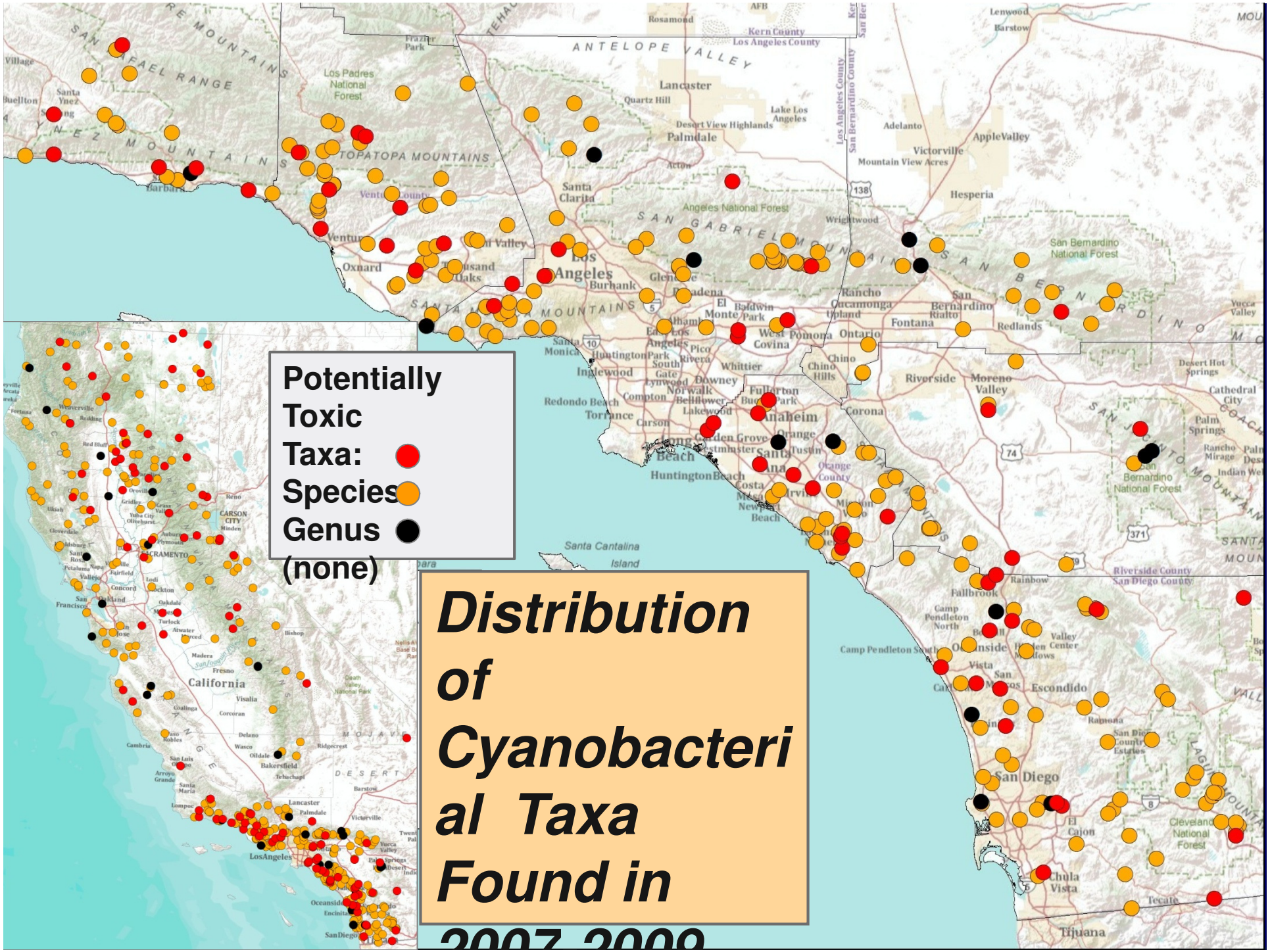
Survey of Toxic Cyanobacteria (incl. Benthic) in California Streams

Species

- *Geitlerinema splendidum*
- *Lyngbya aestuarii*
- *L. martensiana*
- *Oscillatoria limosa*
- *Phormidium chalybeum*
- *P. cortianum*
- *P. uncinatum*

Genera

- *Anabaena*
- *Anabaenopsis*
- *Geitlerinema*
- *Hapalosiphon*
- *Leibleinia*
- *Lyngbya*
- *Microcoleus*
- *Microcrocis*
- *Microcystis*
- *Nodularia*
- *Nostoc*
- *Oscillatoria*
- *Phormidium*
- *Pseudoanabaena*
- *Schizothrix*
- *Tychonema*


Potentially Toxic Taxa:
Species
Genus
(none)
Distribution of Cyanobacterial Taxa Found in 2007-2009

Why Should We Care?

- Potential explanatory factor for lab toxicity in streams with no obvious anthropogenic influences
- Spain study → potential negative effects on beneficial uses (e.g., macroinvertebrates)
- Possible Contributing Factors
  - Nutrient enrichment (incl. atmospheric deposition)
  - Hydromodification
  - Loss of riparian habitat

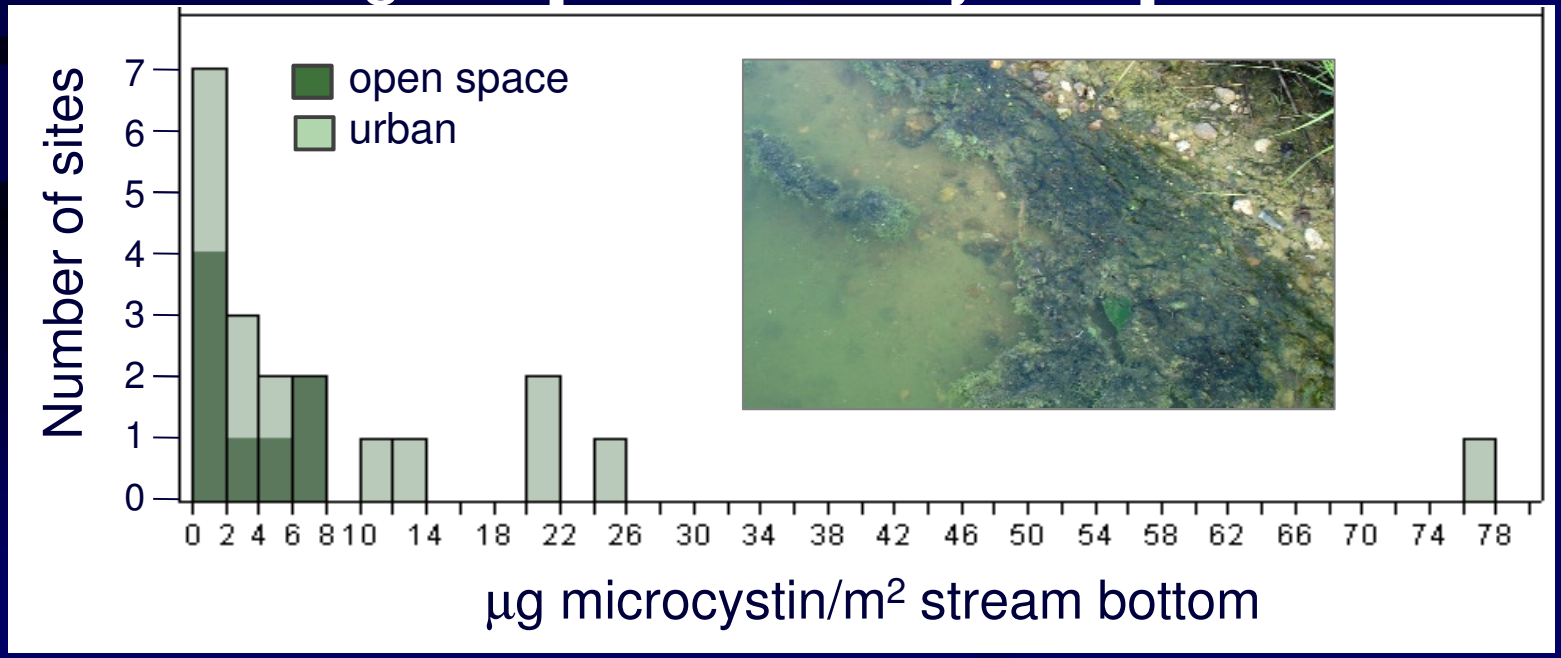
Pilot Study: Toxin Production by Benthic Cyanobacteria in Southern California Wadeable Streams

Basic design

- SCCWRP, ABC Labs, Council for Watershed Health, UCSC
- Crews collected benthic algae per SWAMP protocol at19 sites across the LA/SG (7 open-space, 12 urban)
- Liquid chromatography–mass spectrometry (LCMS) used to analyze for several microcystin species and anatoxin

Stream Cyanotoxins – Pilot Results

- Cyanotoxin hits at **75%** of urban sites, **57%** of open
- Of these, [urban] > [open]
- 4 microcystin species detected; no anatoxin
- MCY-LA most common overall
- 30-fold range in [total microcystins] across sites



Stream Algae Research – Next Phases

- Toxic stream algae (cyanobacteria) extent & effects
- Finish recommendations for a So Cal IBI
- Stressor-responses mechanisms
- Tool validation in a variety of applications
  - algae IBI
  - NNE

So Cal Algae IBI
Core Project Team & Funding

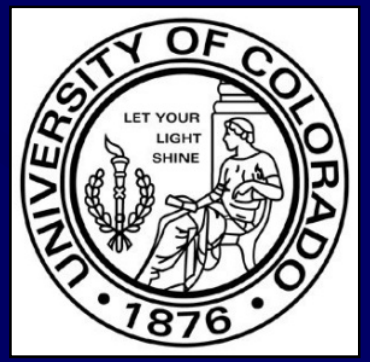
Collaborating institutions on grant:

- SCCWRP
- CSU San Marcos (R. Sheath, R. Stancheva)
- University of Colorado, Boulder (J.P. Kociolek)

Funding:

CA State Water Board:

- Consolidated Grants Program (Prop
- SWAMP Program



Acknowledgements