SOUTHERN CALIFORNIA REGIONAL STREAM ASSESSMENT

TOOLS AND COOPERATIVE PROGRAMS

Eric Stein

Biology Departments

Southern California Coastal Water Research Project (SCCWRP)

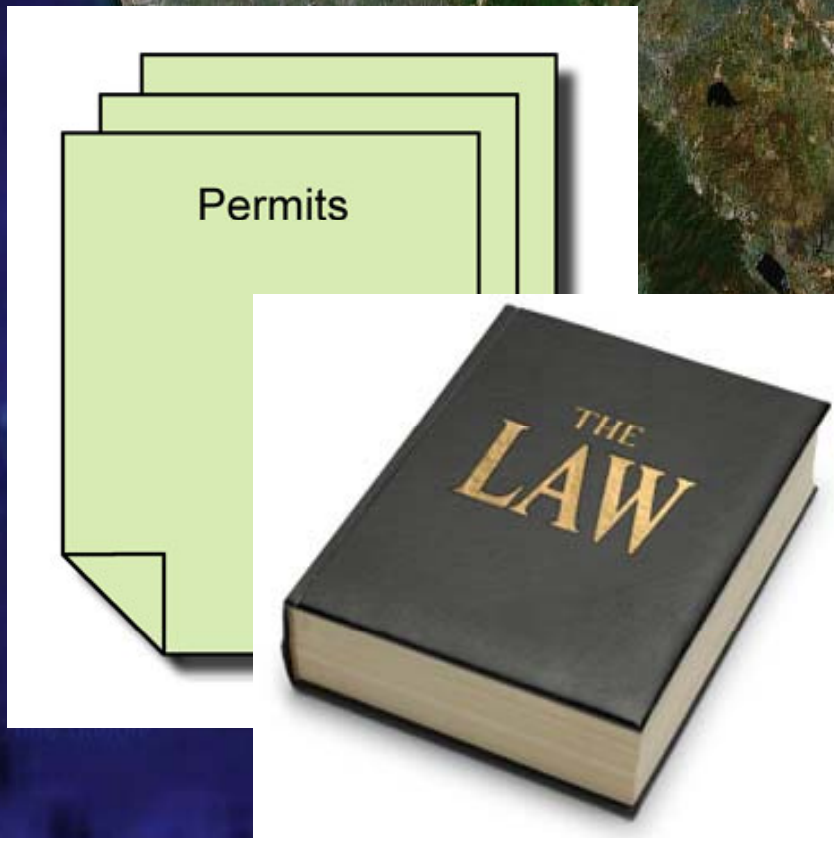
Today's Presentation

- Motivation and Background
- General Design
- Tools
- Status and Preliminary Results
- Future efforts

Opportunities for collaboration

Why do we Monitor?

- Are we making a difference?
- What is the net effect of our actions?
- Are our programs effective?
- Is additional investment justified?

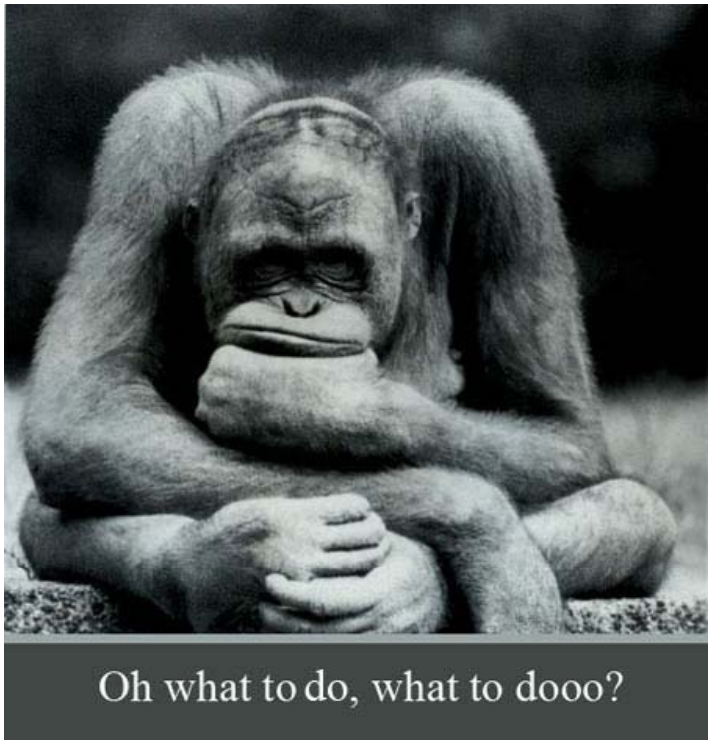


Problems with Existing Monitoring

Lots of existing monitoring, but….

- Programs are not coordinated
  - Limited data comparability
  - Inconsistent methods
  - Lack of coordination
  - No data sharing

- Inefficiencies
  - Redundancies between programs
  - Many areas not monitored

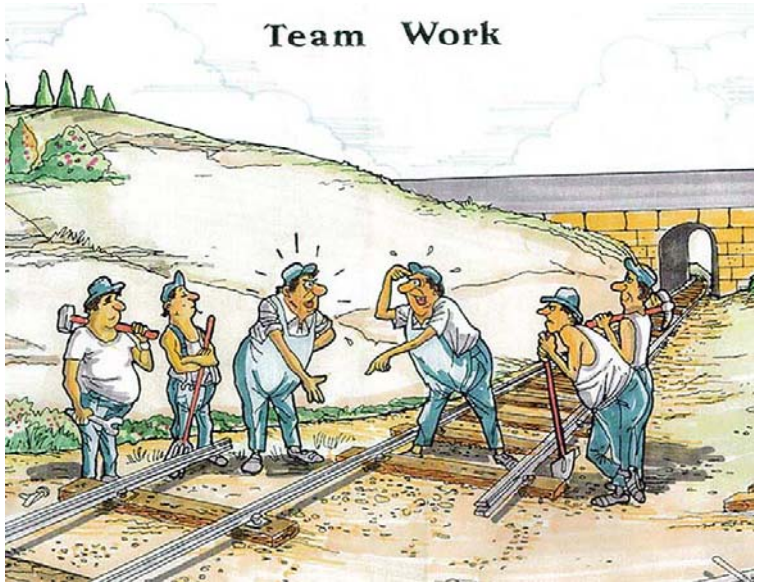


….. Can't answer fundamental questions

Need for Cooperative Monitoring

- Leverage resources, knowledge and experience
- Answer regional questions and fulfill mandates
- Provide relevant information that can be readily shared
- Provide a platform for more in-depth studies

- Stormwater Monitoring Coalition
  - MOU signed in 2001



Stormwater Monitoring Coalition (SMC)

- Ventura Co WPD
- Los Angeles Co DPW
- Los Angeles Co SD
- Orange County RDMD
- Riverside County FCD
- San Bernardino FCD
- San Diego Co DEH
- City of Long Beach
- City of Los Angeles Watershed Protection Division
- CalTrans
- US EPA
- CA Dept. of Fish & Game
- SCCWRP
- San Diego RWQCB
- Santa Ana RWQCB
- Los Angeles RWQCB
- State Water Resources Control Board

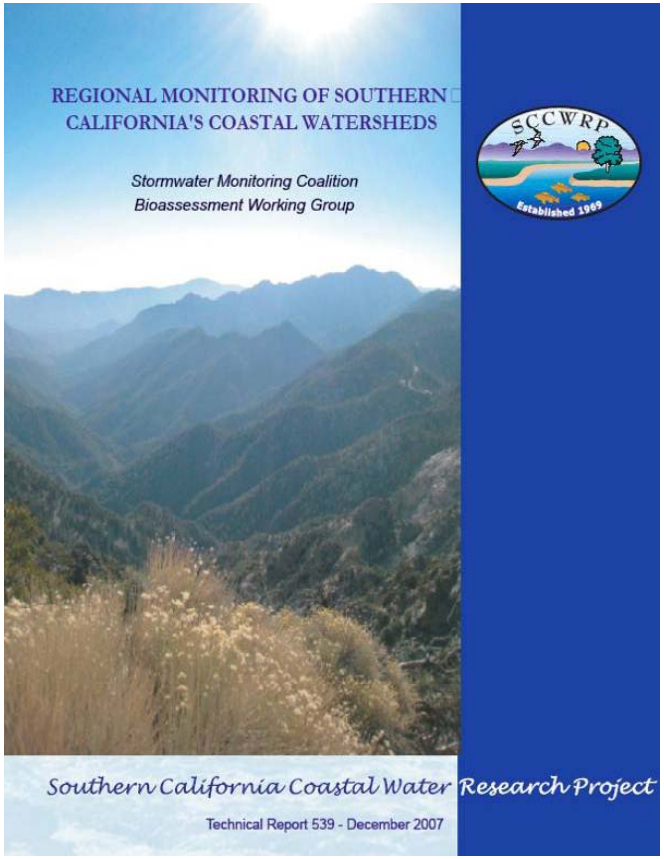
Monitoring Philosophy

- Monitoring data should answer real questions
  - No data collection for data's sake
  - Answered questions should result in management action
- Not enough $$ to answer all questions, so will need to prioritize the most important
- Provide regional context for site-specific monitoring
  - Identify mutual beneficial special studies

Keys to Coordination

- Standard tools and monitoring design
- Negotiated tradeoffs for permit-required monitoring.
  - *NOT* pay-to-play. Each agency generates its own data.
- Regional boards match with similar number of sites
- Nested design allows local intensification

Major Assessment Questions

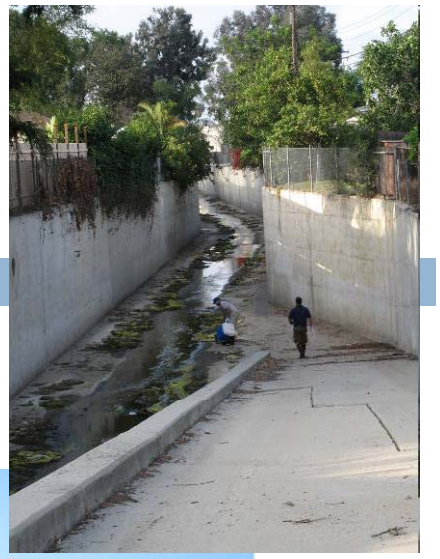


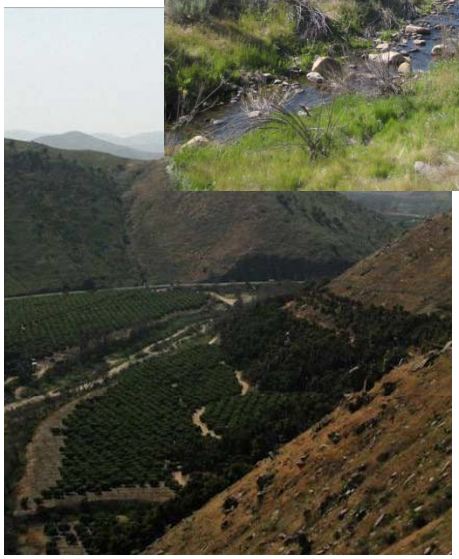
workplan available at *www.SCCWRP.org*

1. What is the condition of streams in our region, and within each land use category?
2. What are the major stressors to aquatic life?
3. Are conditions getting better or worse?

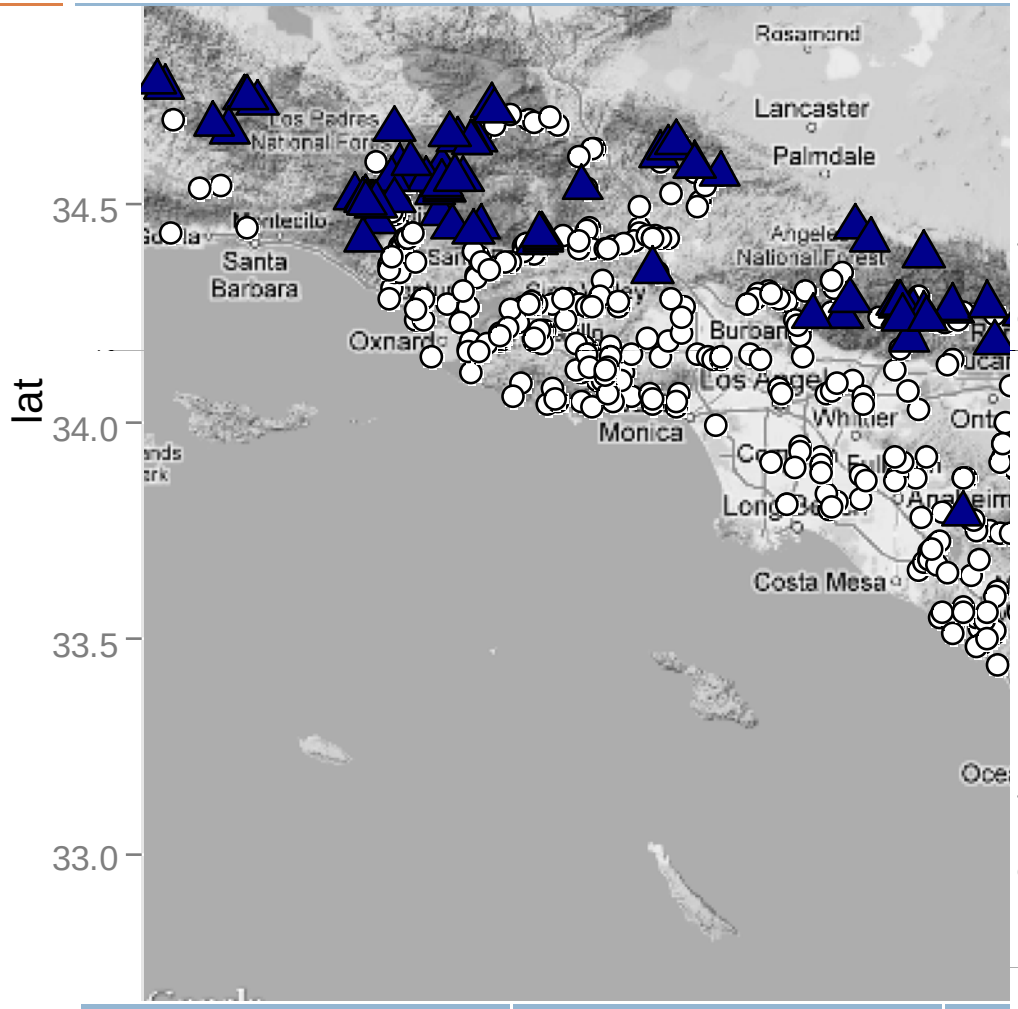
Monitoring Design

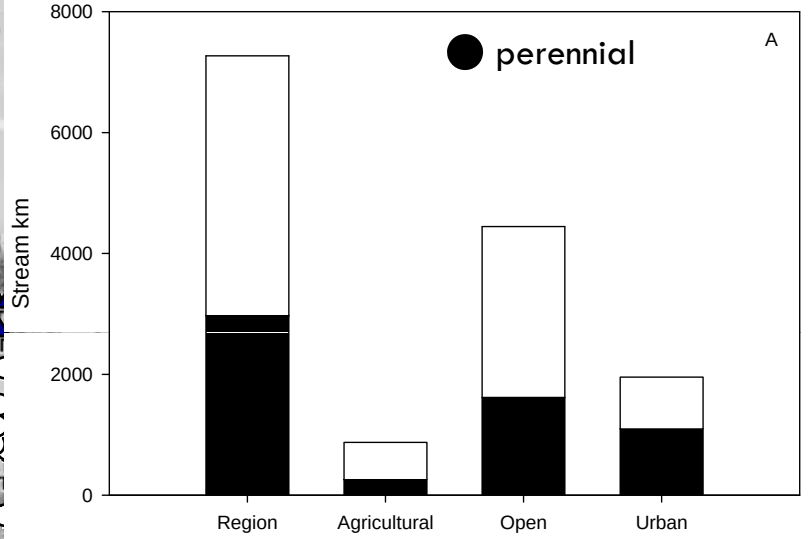
- All coastal draining watersheds in S. CA
  - Perennial wadeable streams
- Hybrid design
  - Probabilistic
  - Targeted (sentinel and reference)
- Stratified
  - Watershed management area
  - Land use type
- Approximately 100 sites/year
- Multiple indicators

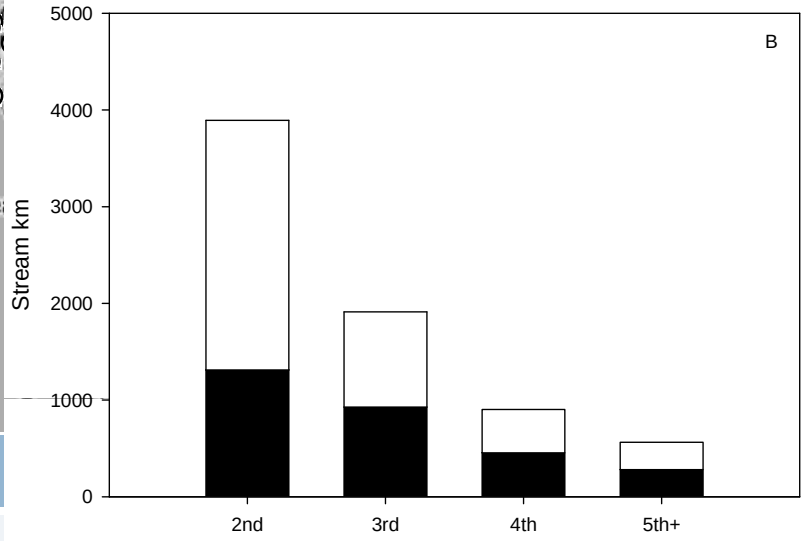




Survey Effort (1999-2012)

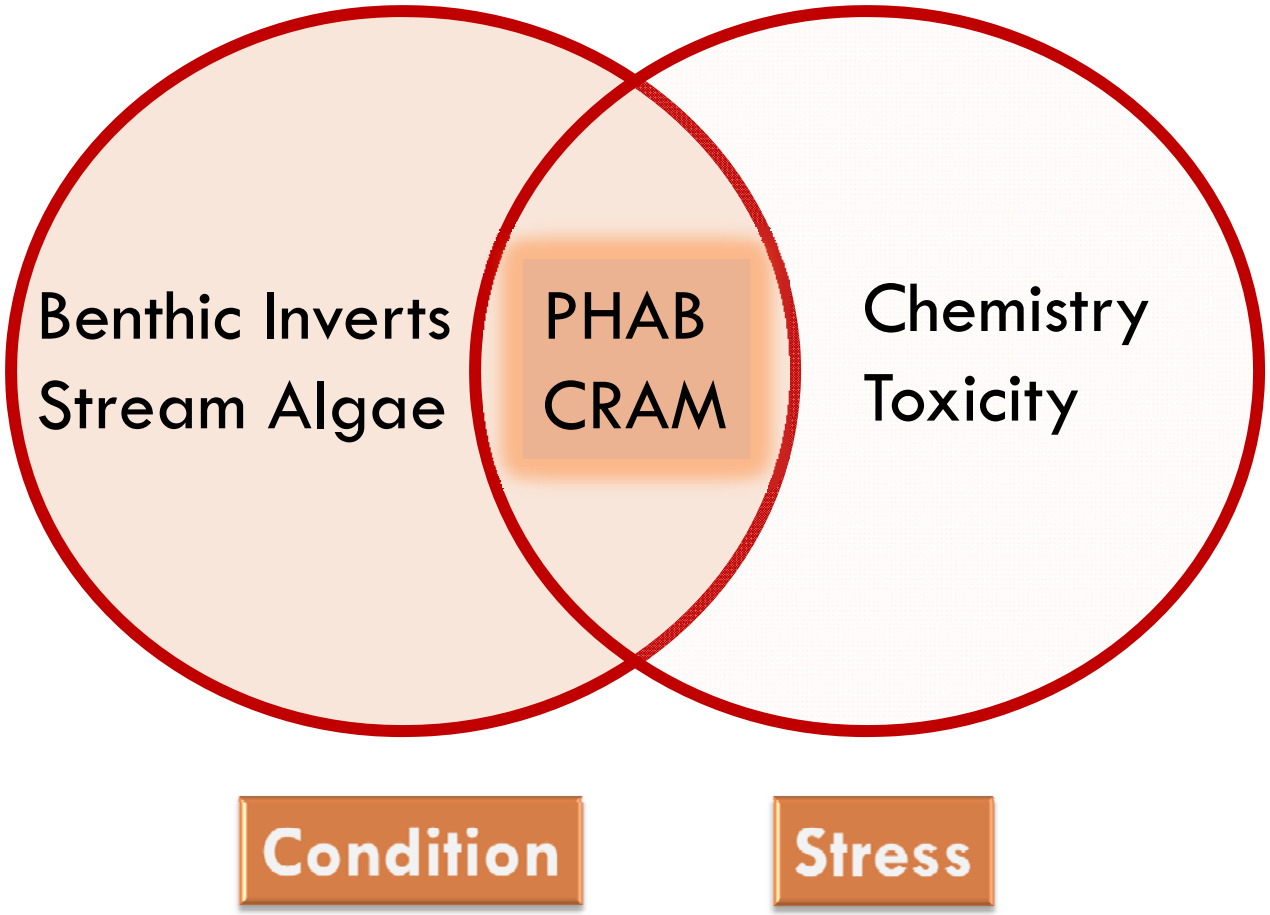






Reference	Nonreference	
119	635	

Stream Indicators



Why use Biossessment?

Use species composition to measure overall ecological integrity

- Integrate effects of different stresses
  - . . . But . . . exact source of stress may be hard to identify
- Provide a measure of fluctuations of environmental conditions over time.
- Relatively inexpensive
- Direct measure of biological endpoint

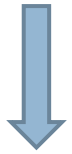
Bioassessment

General Approach

Development of Integrative Indices (e.g. IBI)

1. Classify stream types into classes
2. Select reference sites
3. Select potential metrics
4. Evaluate metrics to select most robust ones
5. Score metrics and combine scores into IBI
6. Assign rating categories to IBI score ranges

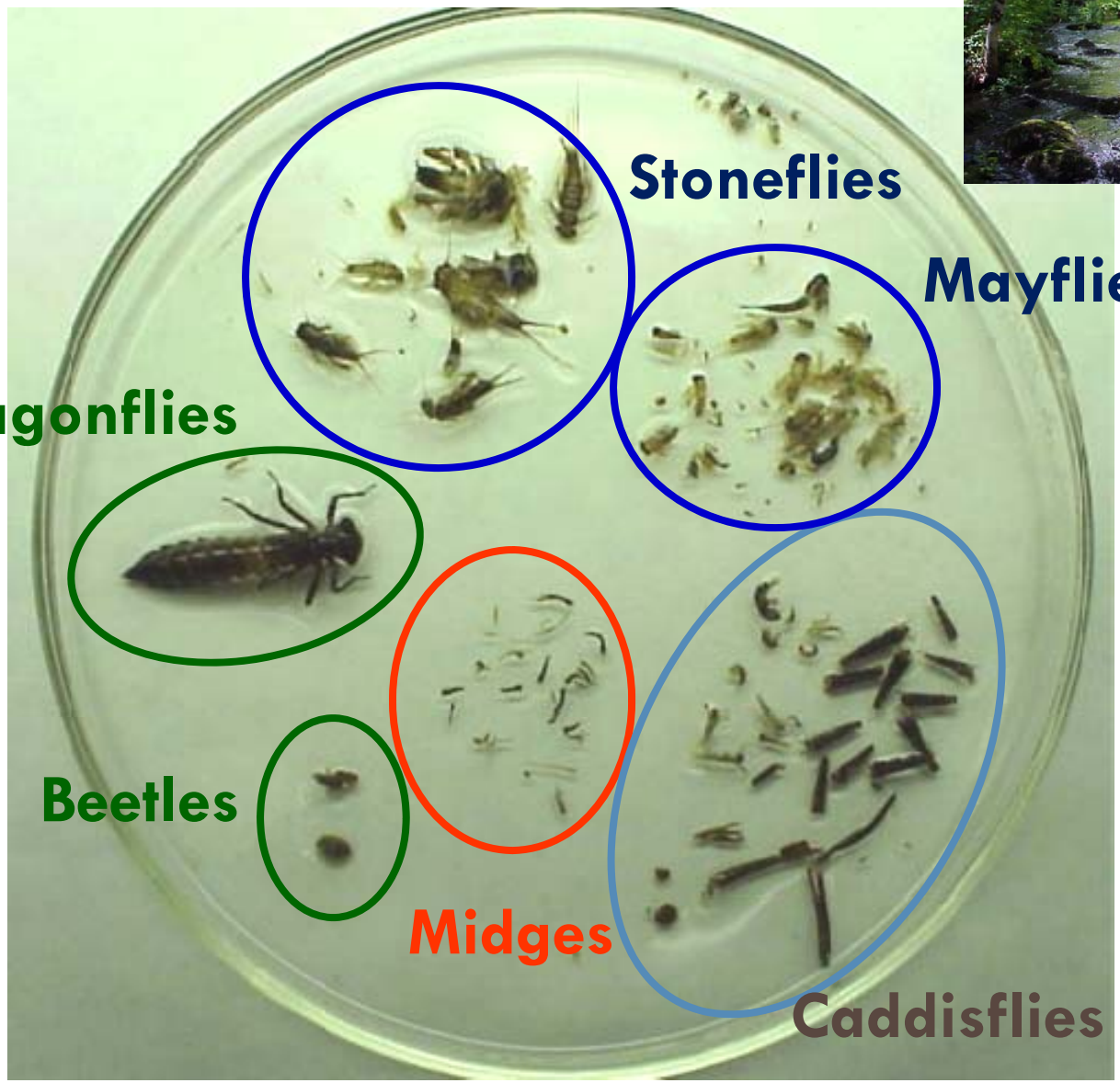
Acari
Baetis
Chironominae
Orthocladiinae
Simulium
Oligochaeta
Tanypodinae



43 (Fair)

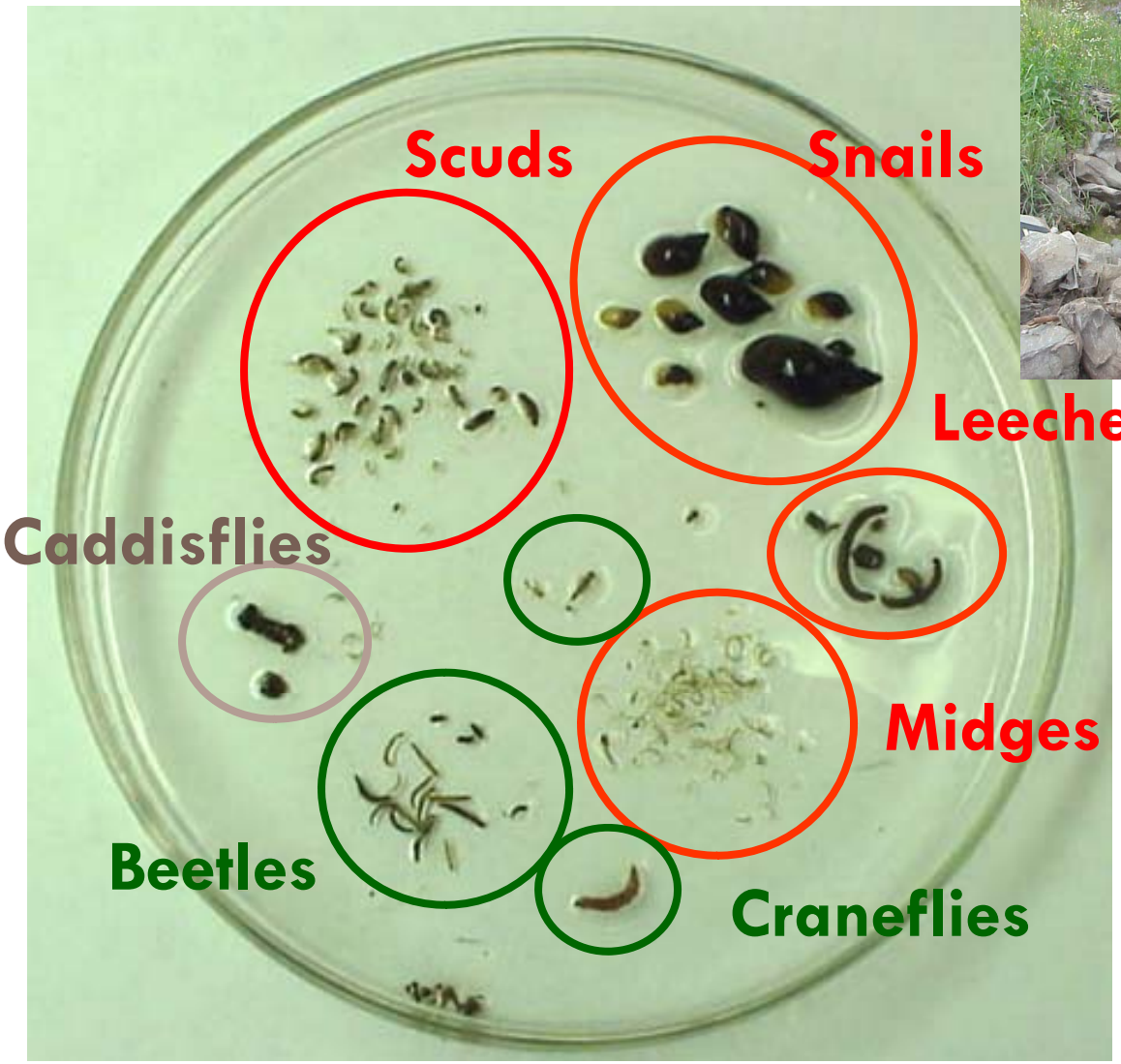
'Sensitive' Groups

Found at High Integrity Sites



‘Tolerant’ Groups

Found at low integrity sites



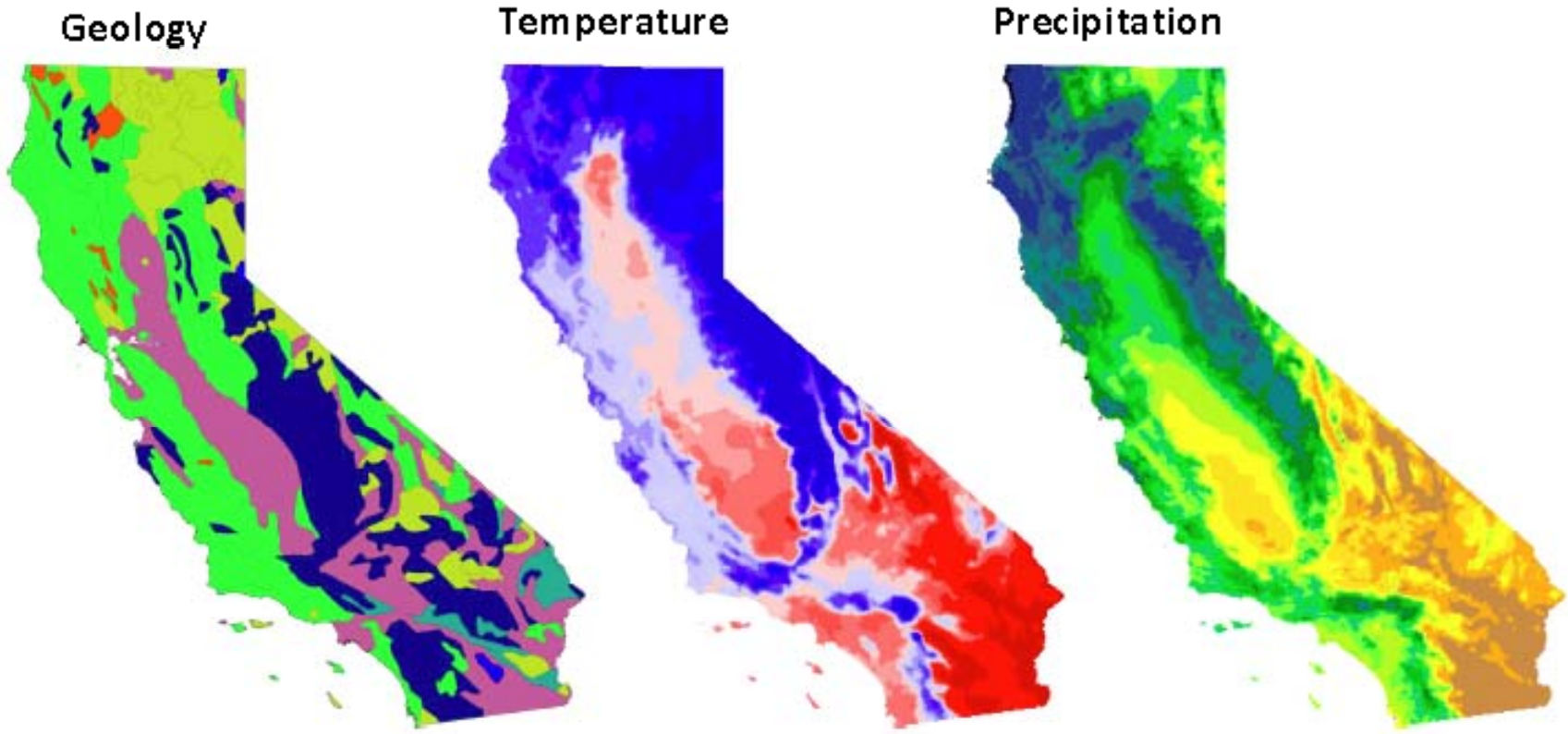
Two Approaches BMI Assessment

- **Taxonomic completeness** (O/E)
  - Compares taxa found at similar reference sites.
- **Ecological structure** (MMI) made up of several metrics (*aka IBI*)
  - Metrics based on functional composition of the site
  - Compares metric values observed to expectations at similar reference sites.

O/E + MMI = CSCI (replaces old IBI)

Challenge of Defining Reference

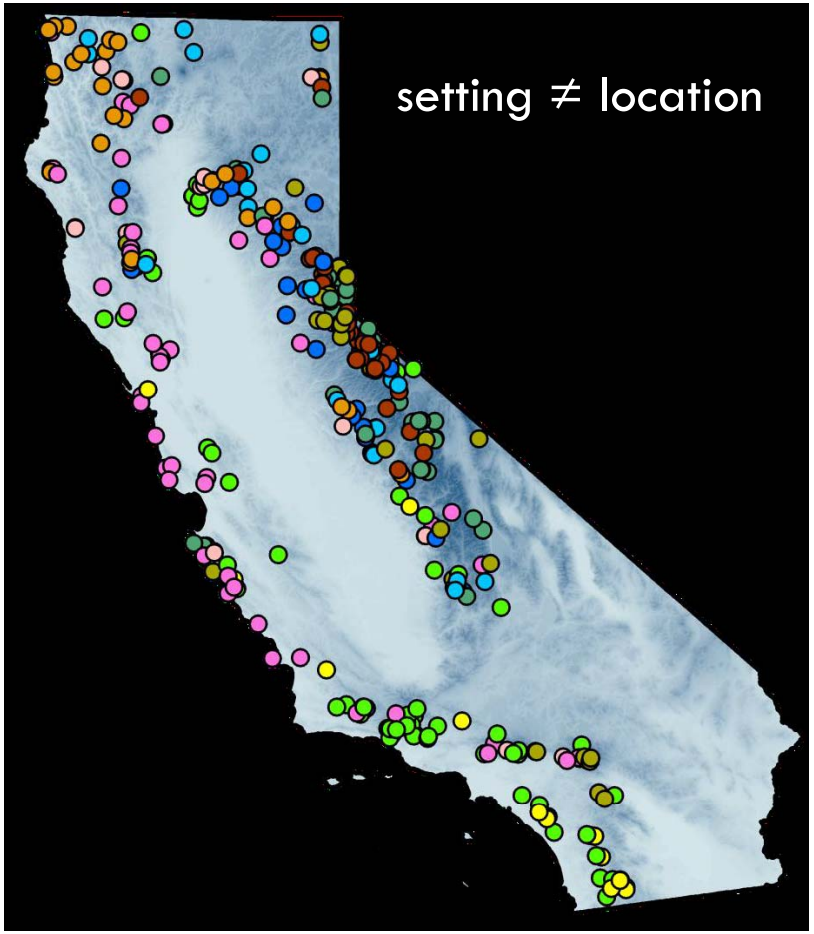
Strong natural gradients result in a large degree of **natural variation** in biological communities



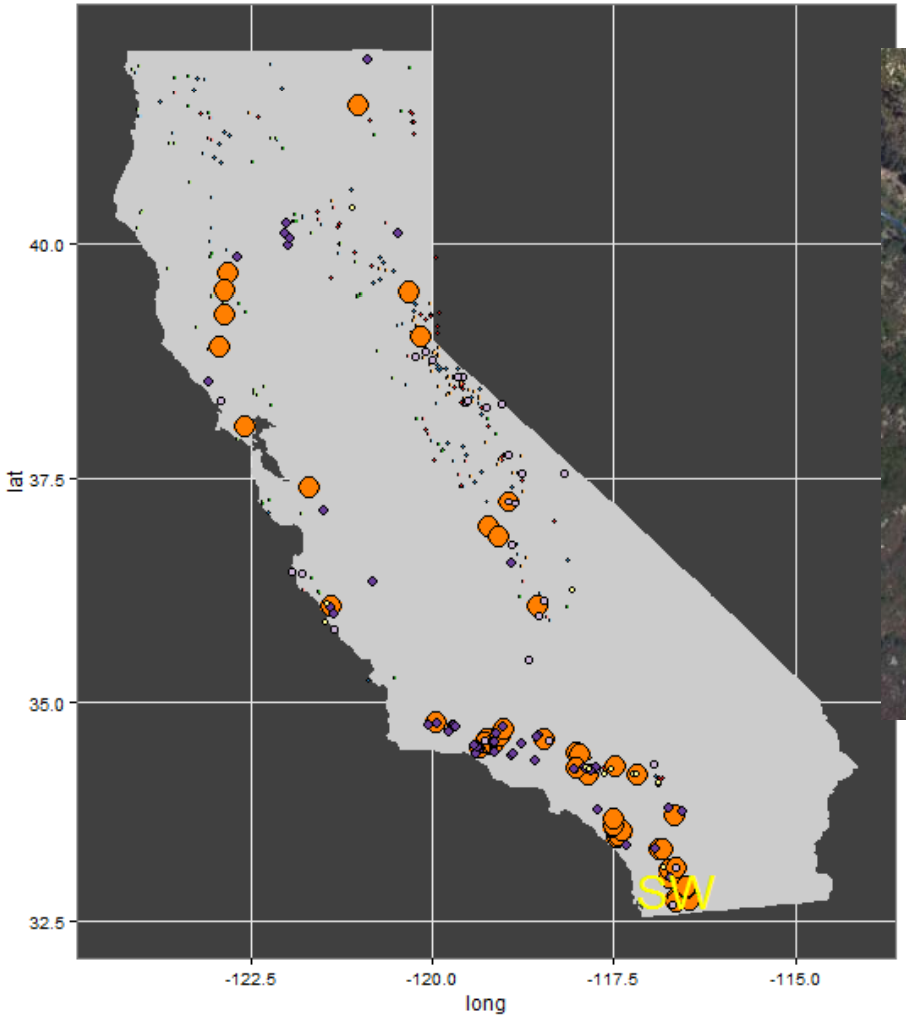
Predictive Metrics

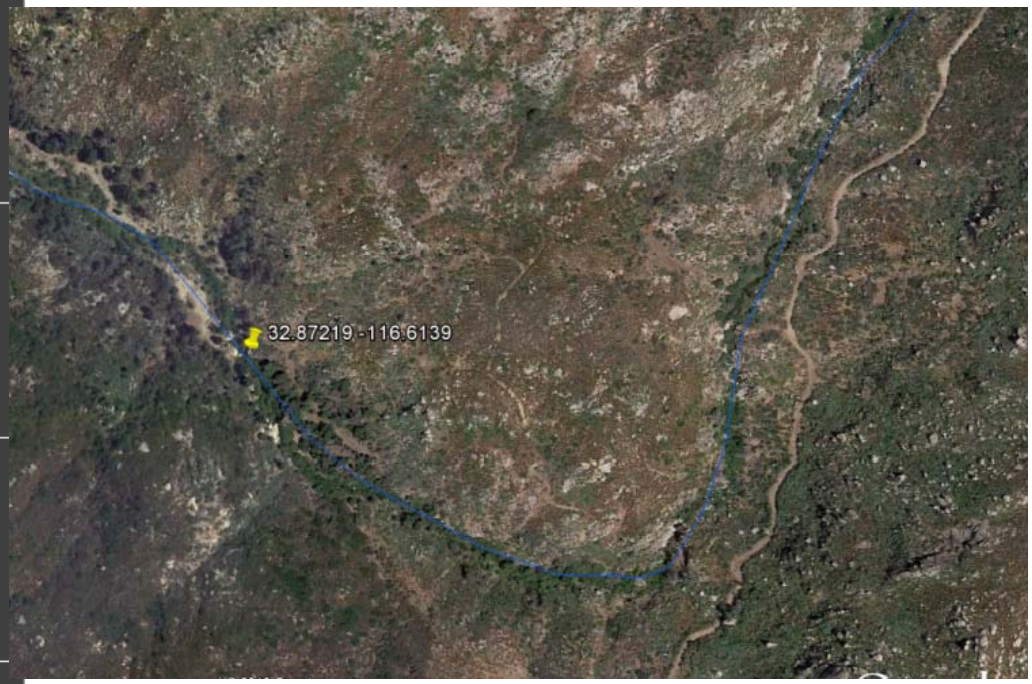
- Test sites are compared to groups of similar reference sites to determine which taxa to "expect"
  - Location – elevation, latitude
  - Watershed size
  - Climate – precipitation, temperature
  - Geology – mineral content, soils

- Expectations based on physical characteristics
  - Major influences on bug community
  - Unaffected by most human activity



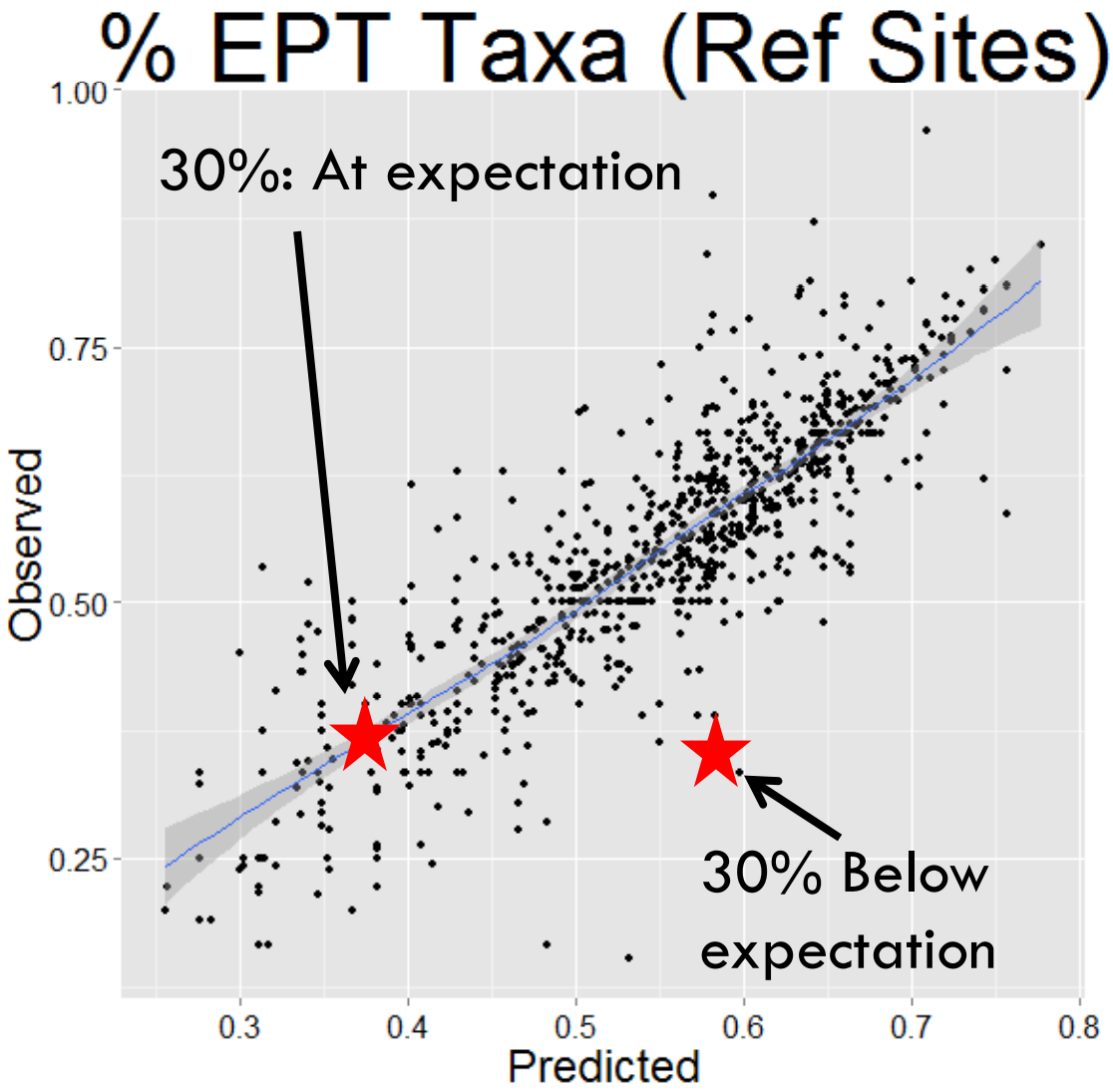
Reference Sites Based on Environmental Setting





Sweetwater River: S. CA Xeric Region

Modeled Expectations at Reference Sites



Much of the variability attributed to environmental factors.

Environmental "noise" removed by models.

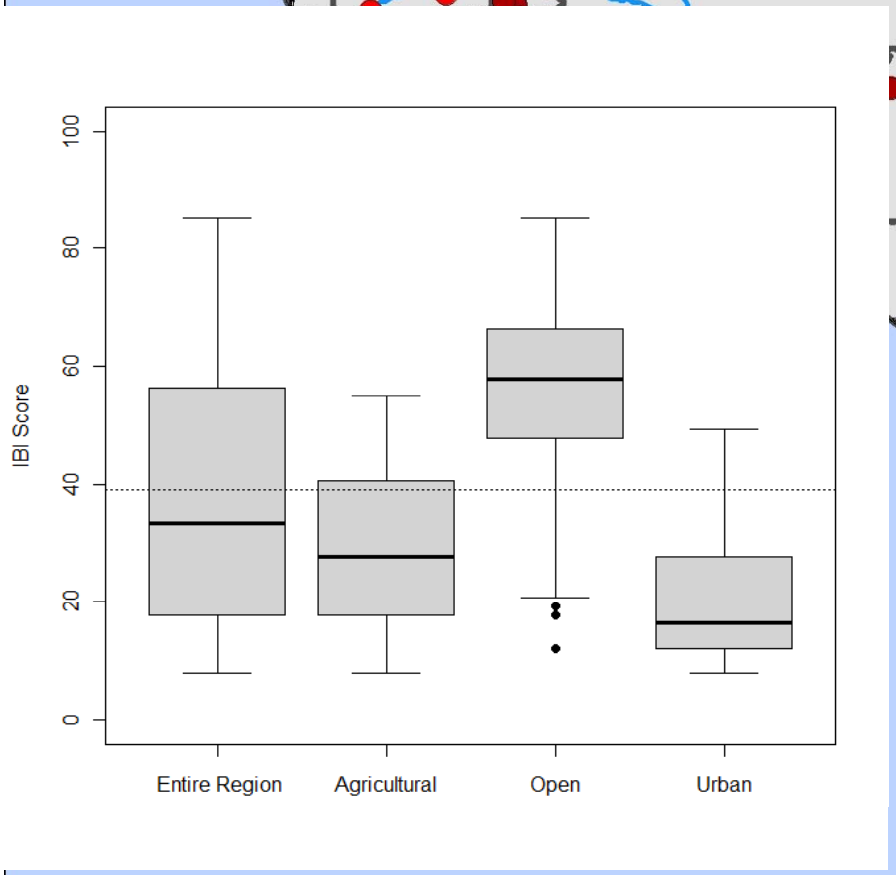
Score depends on the *environmental setting*, not just metric value.

Less reliance on local reference

How is the CSCI Better than Previous Indices?

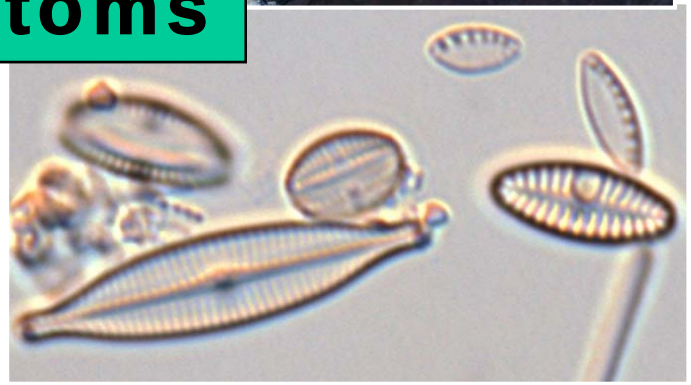
- ***Much better reference*** data set
  - Bigger, broader, and more rigorously screened
- ***More comprehensive*** assessment of biological integrity
- ***Statewide applicability***, without regionalization
  - Nearly all perennial wadeable streams can be assessed
  - Formal tests of applicability are possible
- ***More lines of evidence*** than most indices
- ***Site-specific expectations*** means that your site is held to appropriate standards

Biological condition

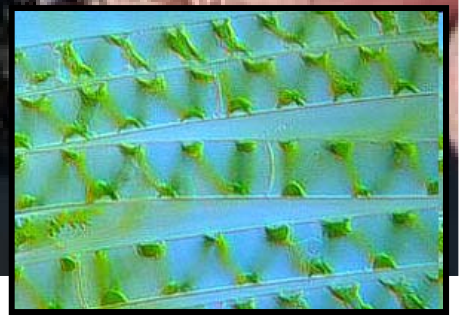


Benthic Algae IBIs

diatoms



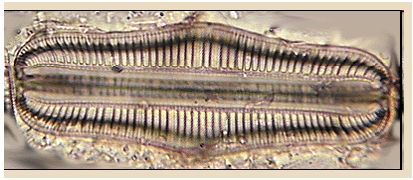
soft-bodied algae (& cyanobacteria)

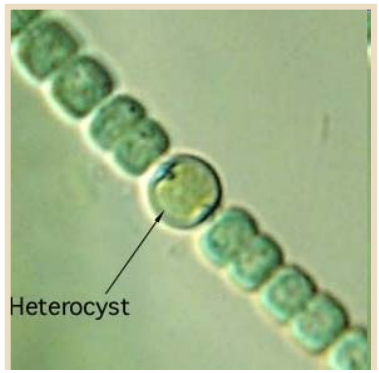


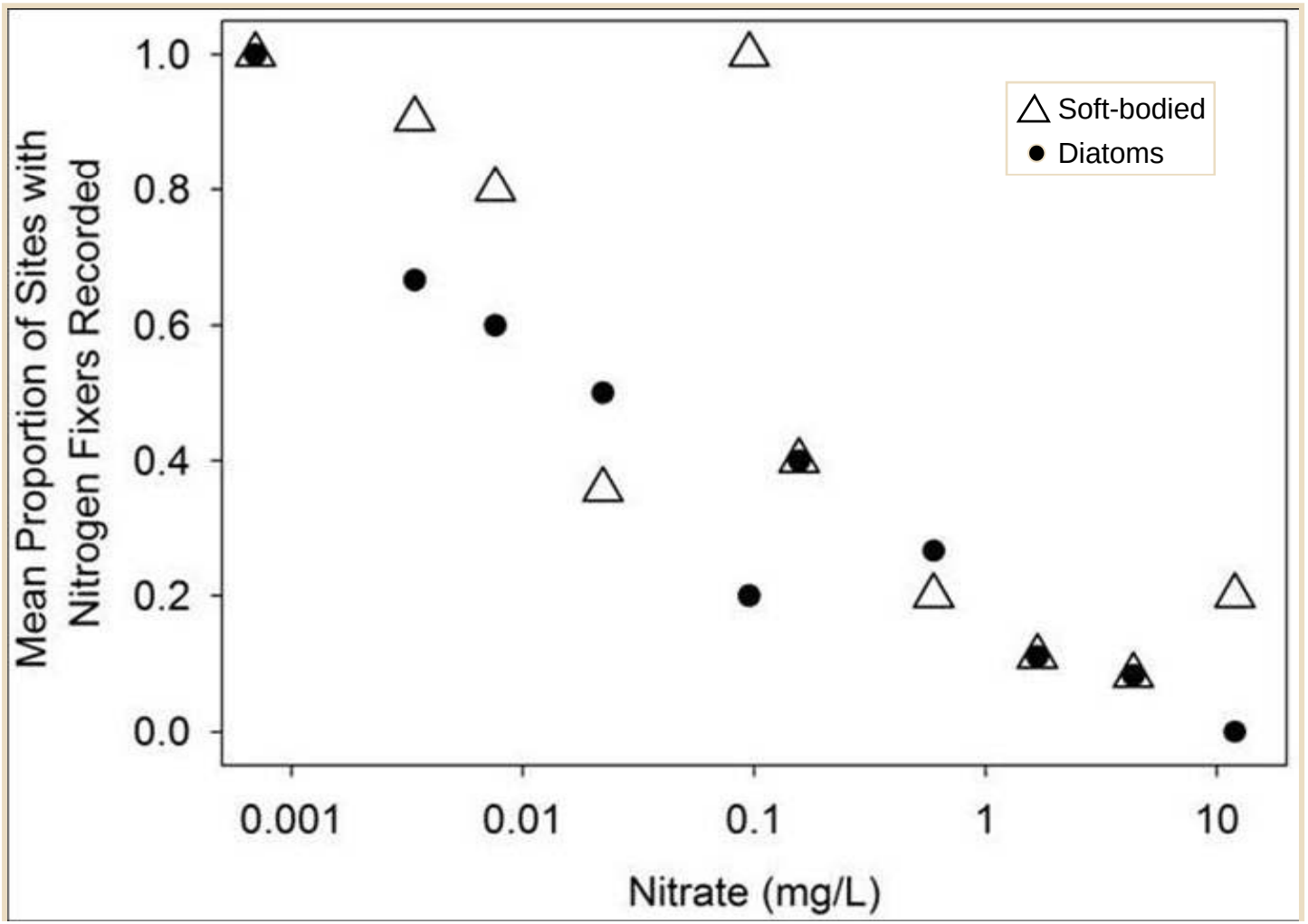
Why Add Algae to Bioassessment?

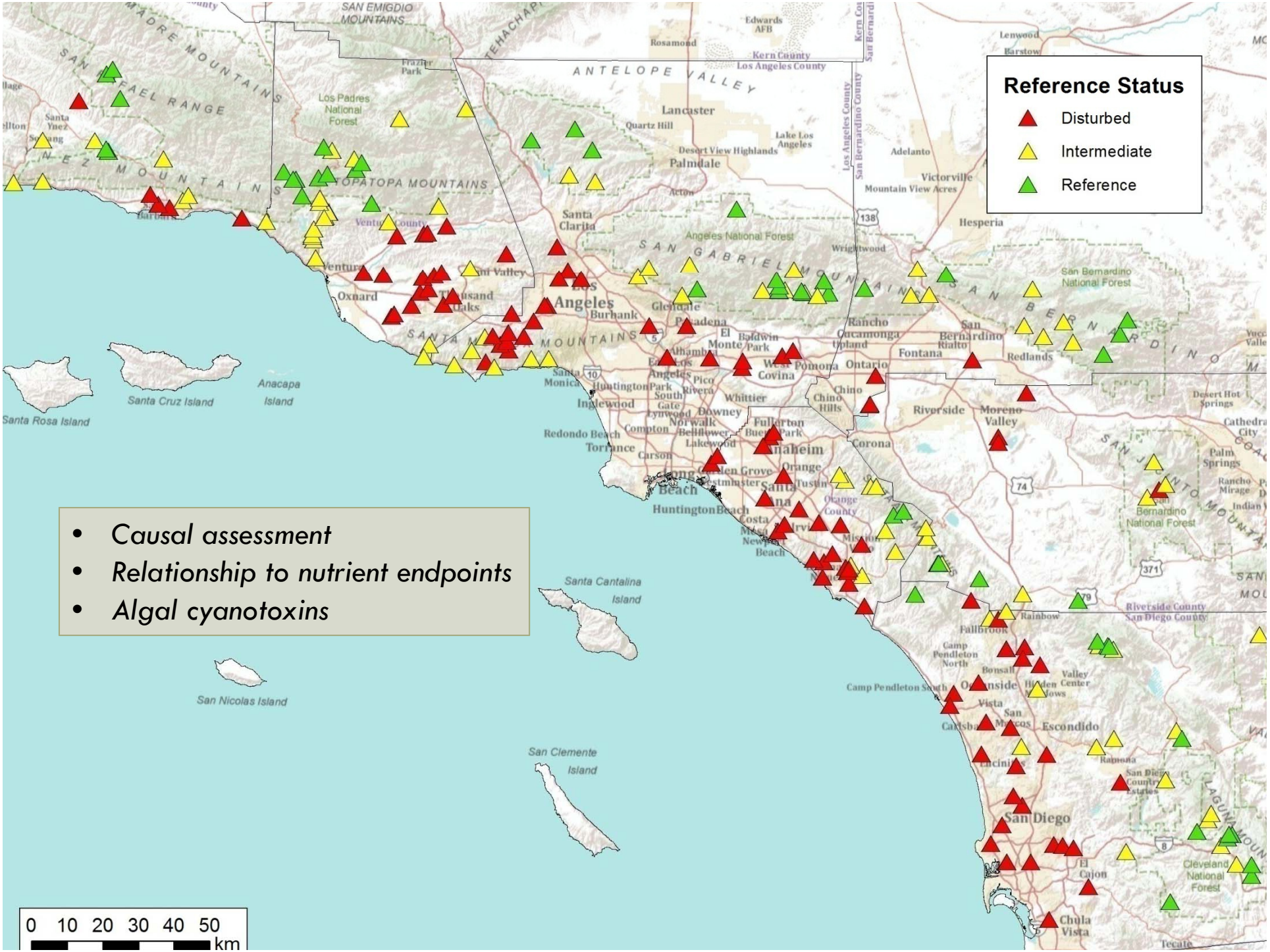
- Information complementary to bugs
  - Response to different stressors
  - Strongest responses evident over different ranges of disturbance
- Weight of evidence
- Potential for broader range/flexibility in interpretation of results
  - Applicability on different substrate types

Diagnostic Assessments





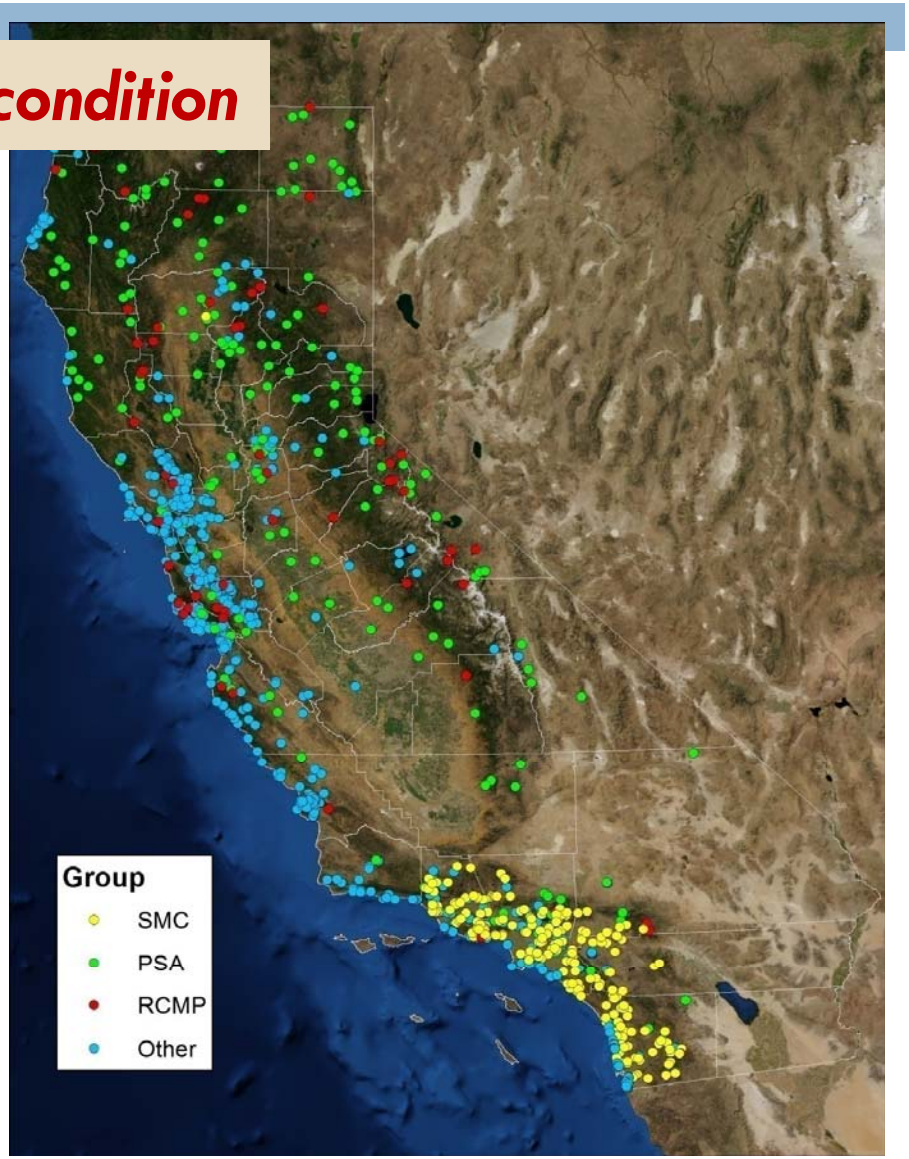



Reference Status
Disturbed
Intermediate
Reference
• Causal assessment
• Relationship to nutrient endpoints
• Algal cyanotoxins
0 10 20 30 40 50
km

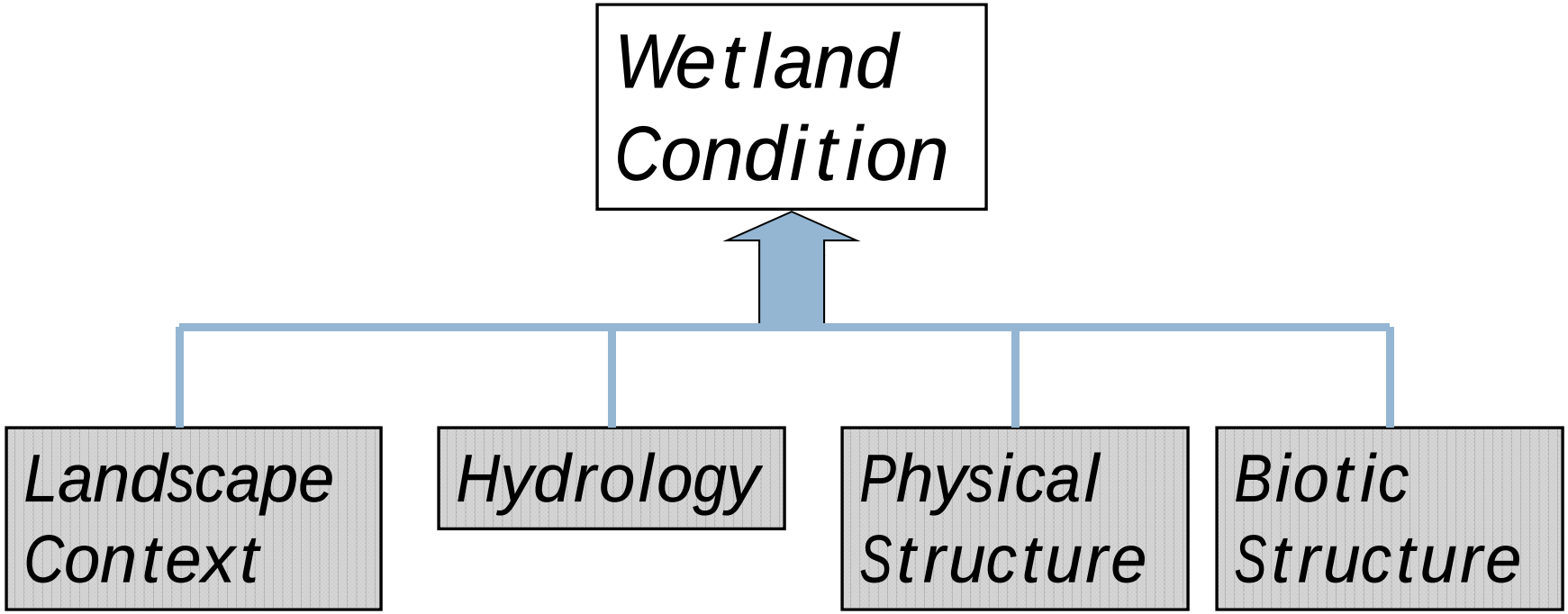
California Rapid Assessment Method (CRAM)

Field-based, rapid tool to assess condition

- Applicable to all wetland types, including streams
- Based on readily observable field indicators
- Evaluates broad suite of conditions
- Validated with more intensive measures of condition

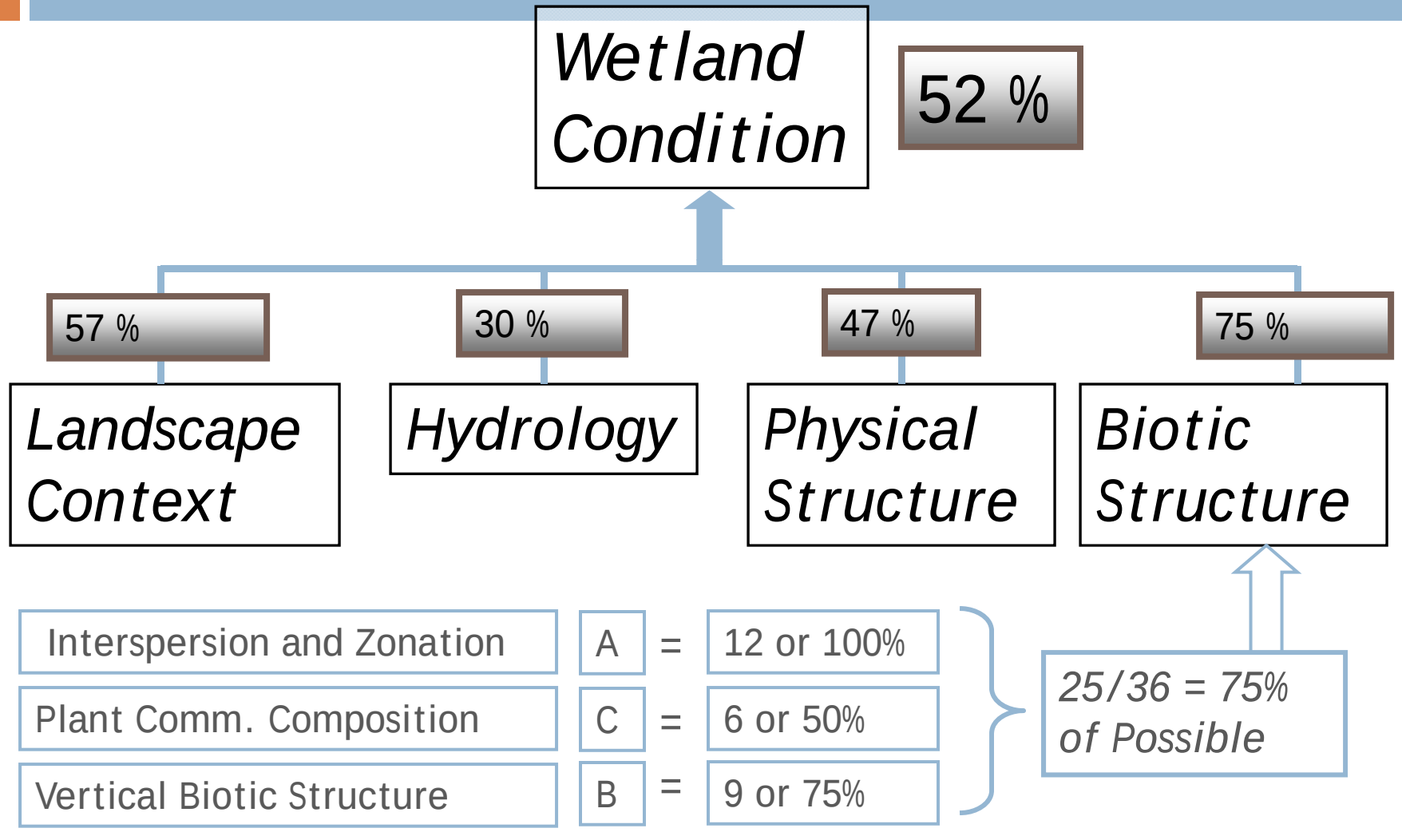


CRAM Design

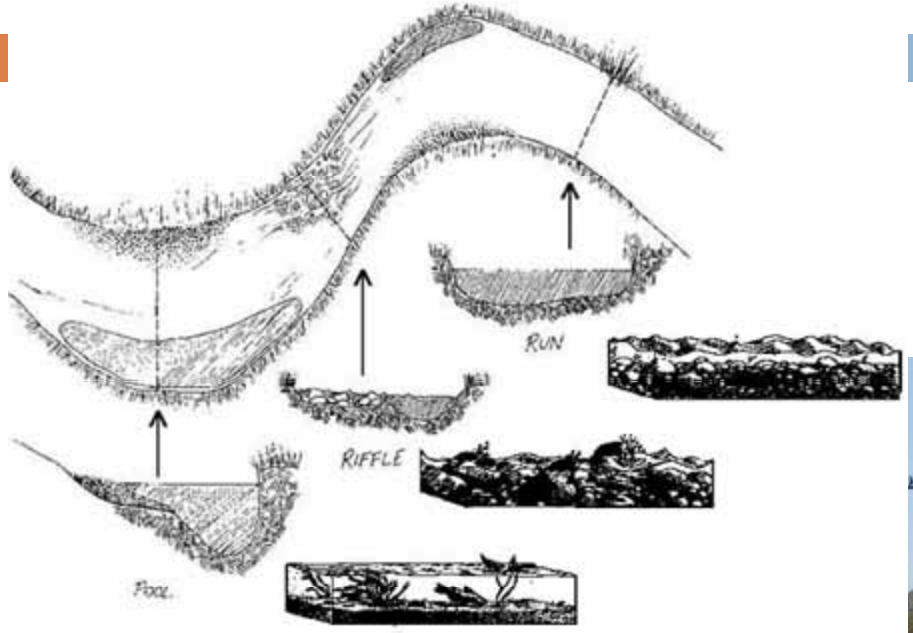


- CRAM recognizes four attributes of wetland condition
- Each attribute is represented by 2-3 metrics, some of which have sub-metrics.

CRAM Scoring



Physical Habitat (PHAB) MMI



Habitat Assessment Field Data Sheet
Low Gradient Streams

Stream Name	
Station #_____ Rivermile _____	
Lat _____ Long _____	
Storet #	
Form Completed By	Date _____ Time _____ AM PM

Habit Parameter				
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover, mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30 - 50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10 - 30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	

Using PHAB Data

- Lots of data collected in the field
- Lack of overall metrics or index make interpretation difficult

- Develop predictive models to develop reference expectations for metrics
  - Create a predictive MMI
  - Use the same candidate predictors as CSCI.

- Index of habitat condition
  - Describes natural variability in stream types
  - Quantifies stress

PHAB MMI Metrics

Condition Categories

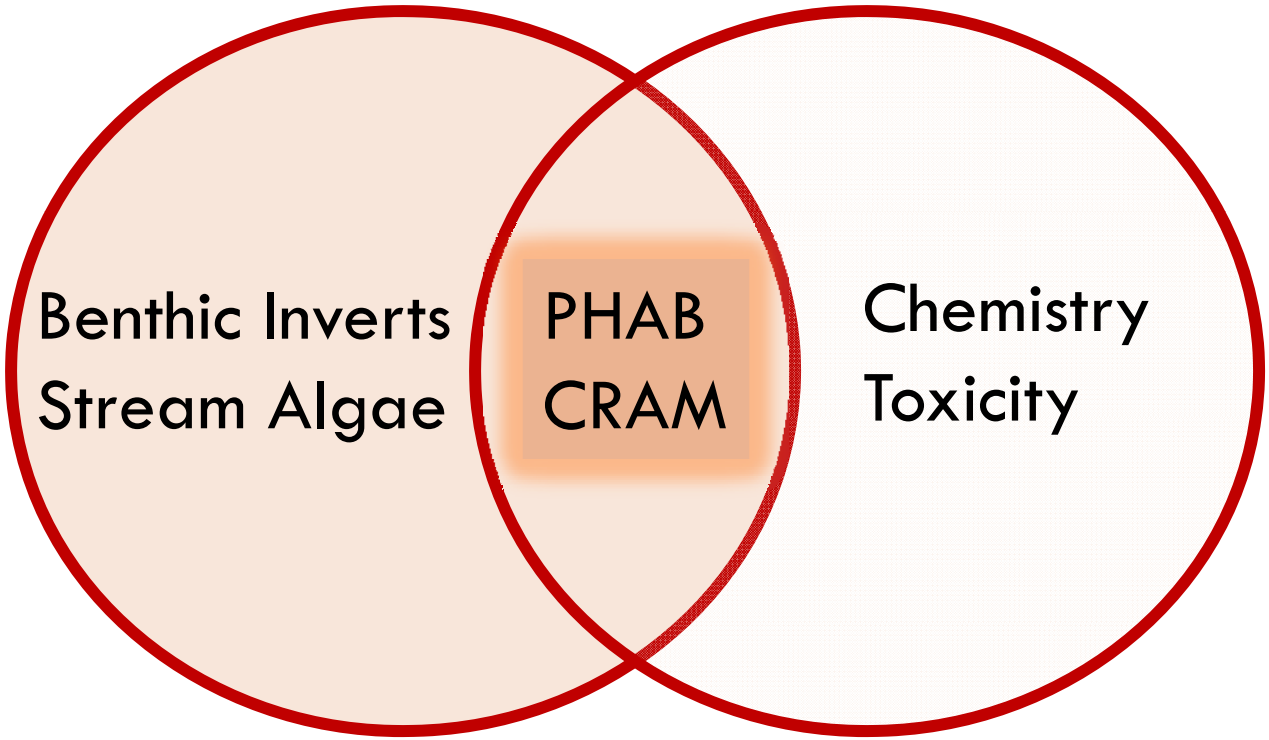
- Riparian condition
- Substrate condition
- Productivity
- Channel equilibrium
- Riparian condition

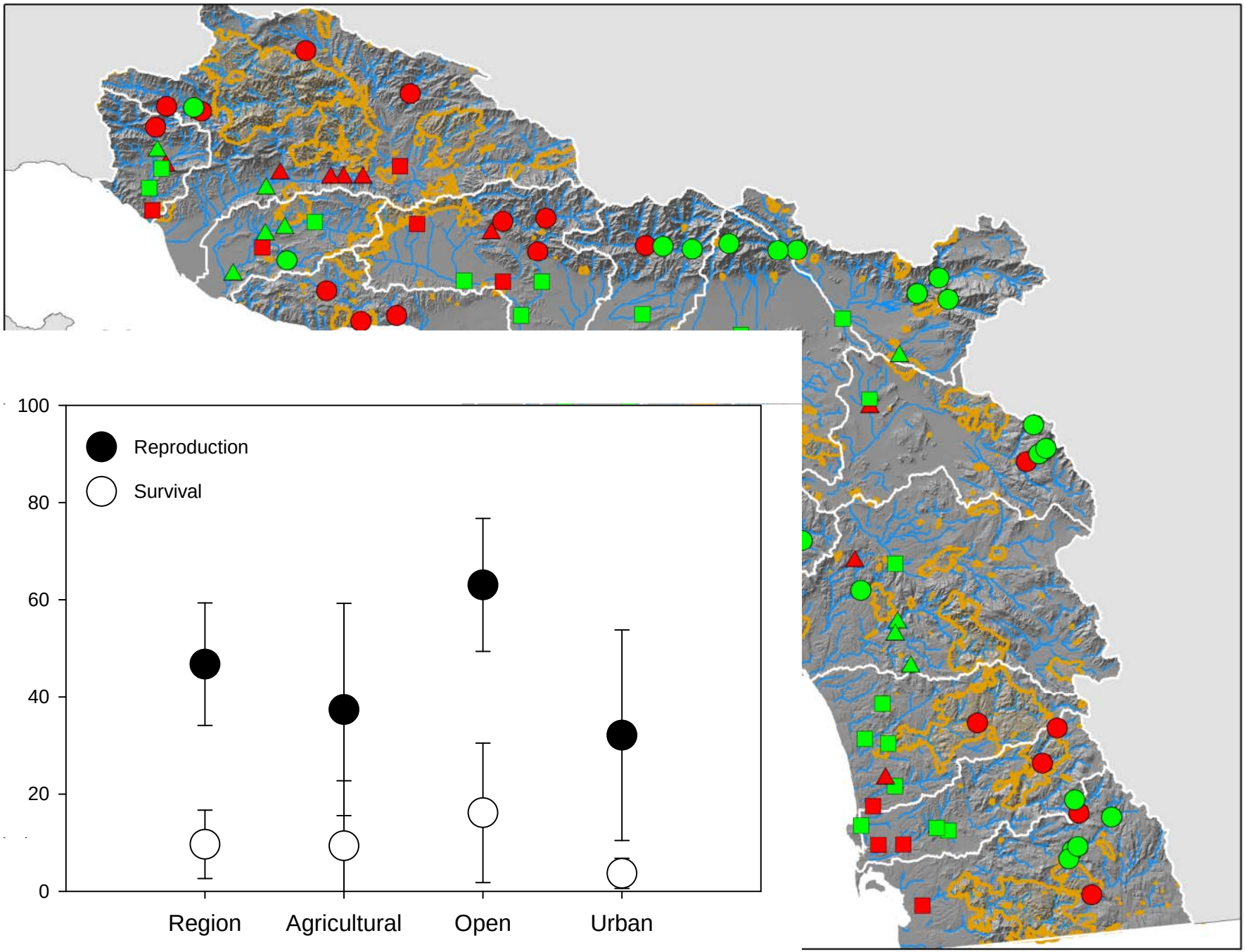
Candidate Metrics

- Percent Presence of Macroalgae
- Percent Stable Banks
- Percent Fast Water of Reach
- Natural Shelter cover - SWAMP
- Mean Mid-Channel Shade
- Canopy cover
- Riparian Vegetation All 3 Layers
- CPOM Presence
- Particle Size Median (d50)
- Percent Substrate <2 mm

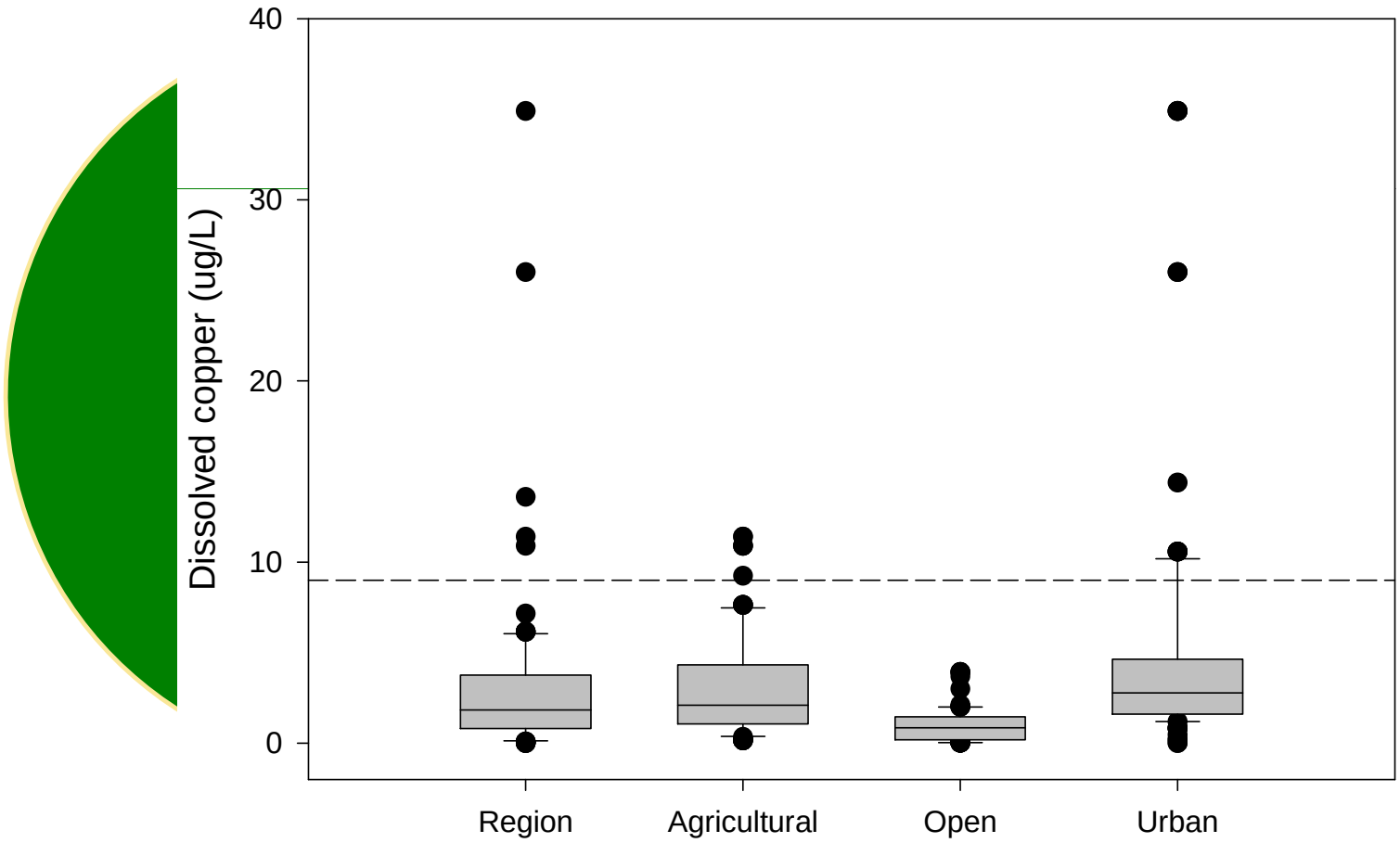
Index under development

What About Stress?




100
80
60
40
20
0
% Stream Length
Reproduction
Survival
Region
Agricultural
Open
Urban

Regional Copper Concentrations

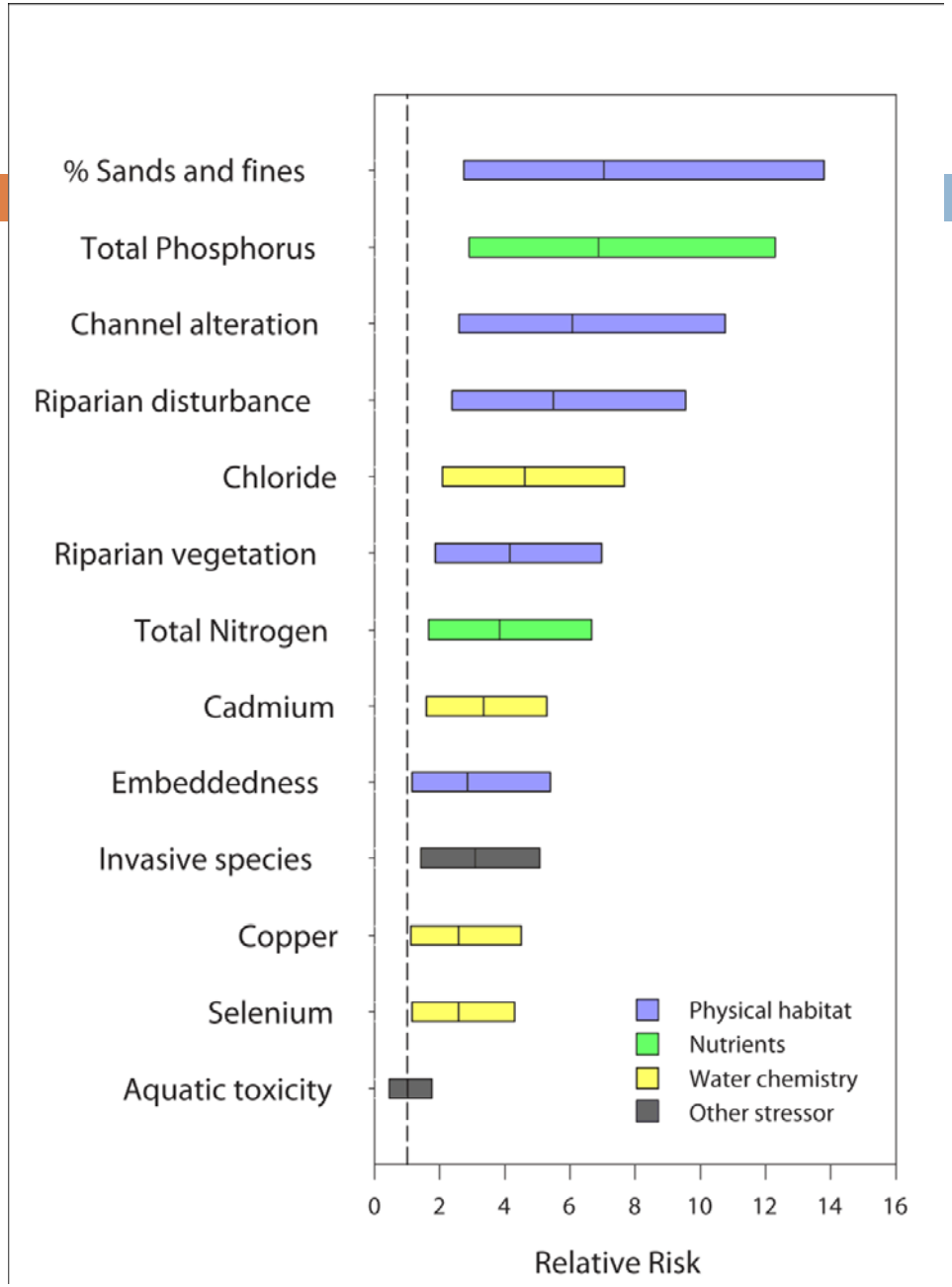


ug/L)

ug/L)

*assuming hardness of 100 mg/L

Risk Factors



Higher risk:

- Habitat degradation
- High nutrients

Lower risk

- Conventional toxicants

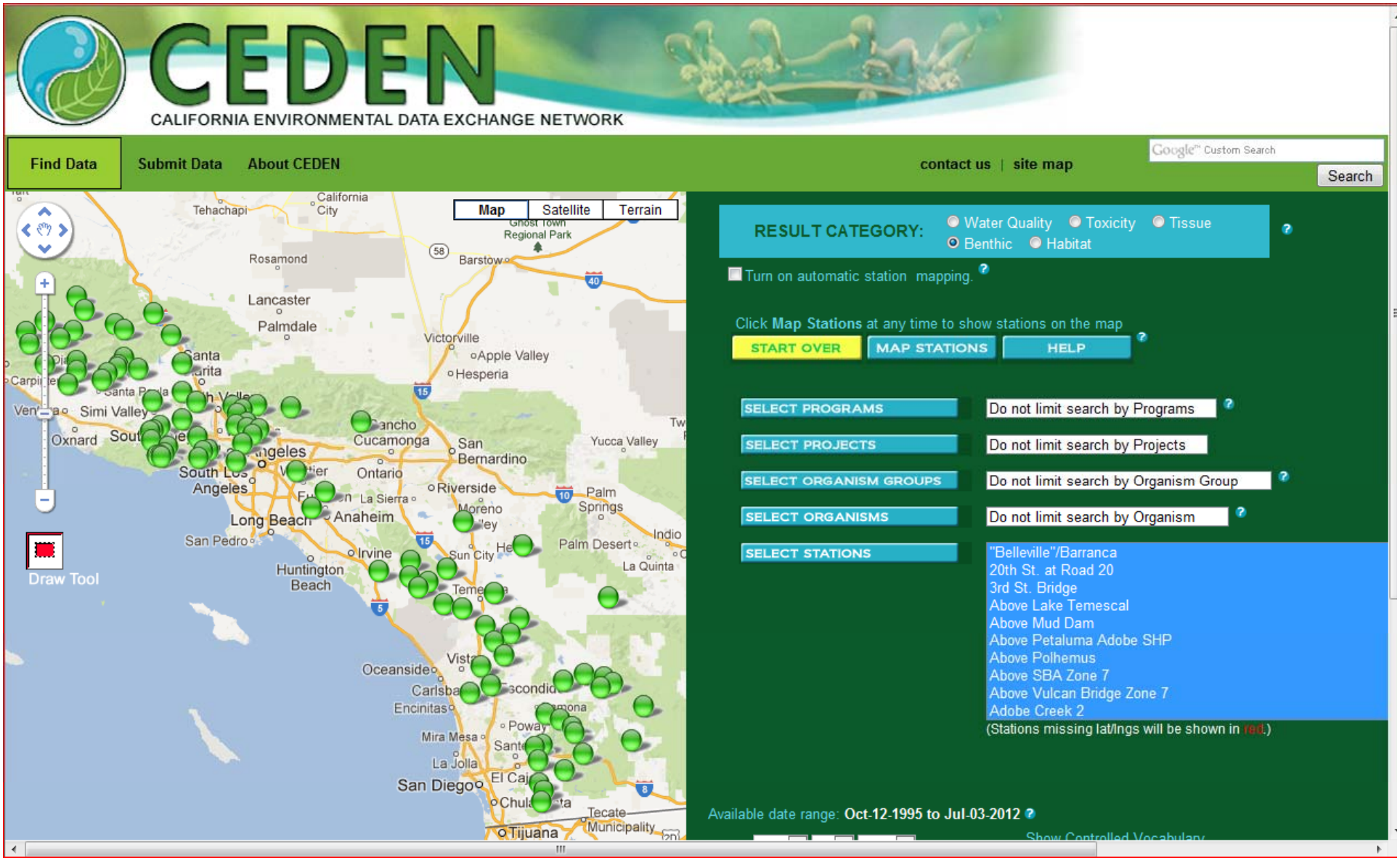
Aalyses show correlation, not causation

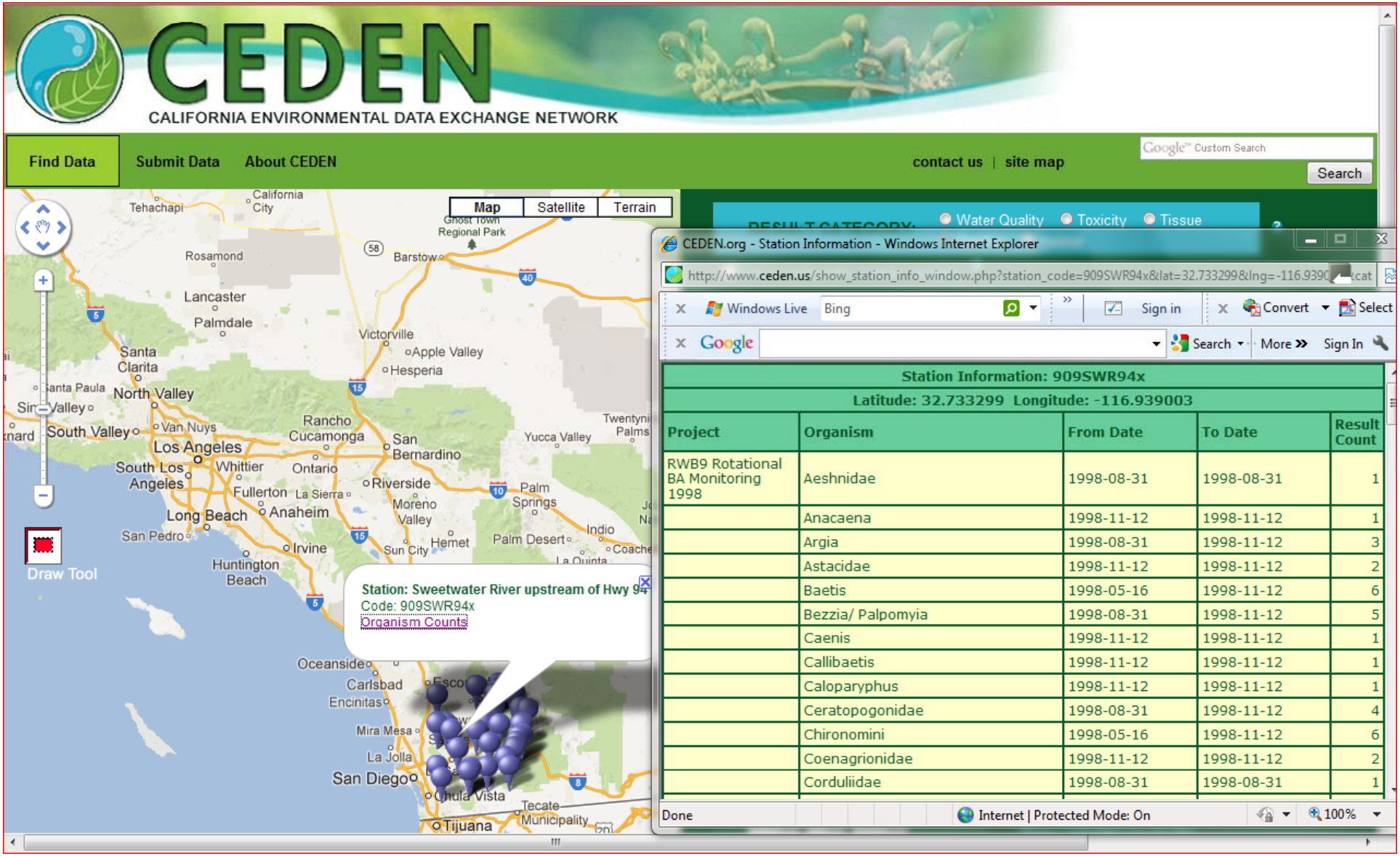
Working on integrated assessment

How Can You Access the Data

Benthic invertebrates, Algae, Chemistry, Toxicity

CRAM, Chemistry, Toxicity, Hydromod (Future) + Project info


CEDEN
CALIFORNIA ENVIRONMENTAL DATA EXCHANGE NETWORK
Find Data
Submit Data
About CEDEN
contact us | site map
Google™ Custom Search
Search
Map
Satellite
Terrain
Draw Tool
RESULT CATEGORY:
Water Quality
Toxicity
Tissue
Benthic
Habitat
Turn on automatic station mapping.
Click Map Stations at any time to show stations on the map
START OVER
MAP STATIONS
HELP
SELECT PROGRAMS
Do not limit search by Programs
SELECT PROJECTS
Do not limit search by Projects
SELECT ORGANISM GROUPS
Do not limit search by Organism Group
SELECT ORGANISMS
Do not limit search by Organism
SELECT STATIONS
"Belleville"/Barranca
20th St. at Road 20
3rd St. Bridge
Above Lake Temescal
Above Mud Dam
Above Petaluma Adobe SHP
Above Polhemus
Above SBA Zone 7
Above Vulcan Bridge Zone 7
Adobe Creek 2
(Stations missing lat/lngs will be shown in red.)
Available date range: Oct-12-1995 to Jul-03-2012
Show Controlled Vocabulary



Project	Organism	From Date	To Date	Result Count
RWB9 Rotational BA Monitoring 1998	Aeshnidae	1998-08-31	1998-08-31	1
	Anacaena	1998-11-12	1998-11-12	1
	Argia	1998-08-31	1998-11-12	3
	Astacidae	1998-11-12	1998-11-12	2
	Baetis	1998-05-16	1998-11-12	6
	Bezzia/ Palpomyia	1998-08-31	1998-11-12	5
	Caenis	1998-11-12	1998-11-12	1
	Callibaetis	1998-11-12	1998-11-12	1
	Caloparyphus	1998-11-12	1998-11-12	1
	Ceratopogonidae	1998-08-31	1998-11-12	4
	Chironomini	1998-05-16	1998-11-12	6
	Coenagrionidae	1998-11-12	1998-11-12	2
	Corduliidae	1998-08-31	1998-08-31	1

EcoAtlas HOME ABOUT CONTACT DATA REGIONS

South Coast : Map | Projects | Summaries

Interactive Map

Layers Legends Bac

Project Information

Wetland Projects

Existing Aquatic Reso

Drainage Features

Transparency

Fluvial

Tidal

Wetlands

Transparency

Estuarine and Coastal

Estuarine Intertidal

Southern California Wetlands Mapping Project

Home | Project Organization | Study Area | Draft Data | Publications | Meetings | Historical Ecology | Contact

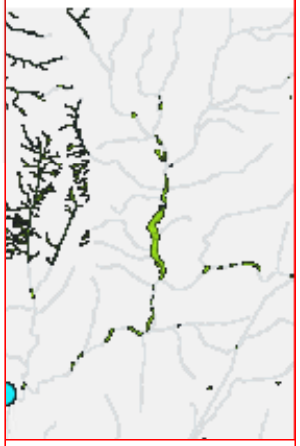
http://www.socalwetlands.com

Southern California Wetlands Mapping Project

Welcome to the Southern California Wetlands Mapping Project website. This project is funded by the State Water Resources Control Board under the Proposition 50, Coastal Nonpoint Source Pollution Control Program. The project funding was awarded to the Southern California Coastal Water Research Project with California State University, Northridge's Center for Geographic Studies as the primary sub-contractor.

The goal of this website is to disseminate publication materials, draft wetland maps, and provide stakeholders with any information they need about our project. Please feel free to contact us (Contact Info.) if you have any specific questions. Our Meetings page will detail any upcoming stakeholder meetings or presentations. Don't hesitate to let us know if you would like for us to give a presentation at your organization or if you have any questions about our project.

Name	File Type	Submitted On	Submitted By	Includes
Coastal Conservancy Staff Recommendation	Other	06/30/2008	Christopher Solek, Southern California Coastal Water Research Project	
Fish Survey	Dataset	06/30/2008	Christopher Solek, Southern California Coastal Water Research Project	
Initial Project Concepts and Alternatives	Other	06/30/2008	Christopher Solek, Southern California Coastal Water Research Project	Map
October 2002 Pollutant Source and Sedimentation Analyses	Monitoring Report	06/30/2008	Christopher Solek, Southern California Coastal Water Research Project	Map
October 2003 Sediment Characterization Study	Monitoring Report	06/30/2008	Christopher Solek, Southern California Coastal Water Research Project	Map
Plant Species by Habitat Type	Dataset	06/30/2008	Christopher Solek, Southern California Coastal Water Research Project	
Project Cost Estimates	Dataset	06/30/2008	Christopher Solek, Southern California Coastal Water Research Project	
Terrestrial Wildlife Species Occurrence by Habitat	Dataset	06/30/2008	Christopher Solek, Southern California Coastal Water Research Project	

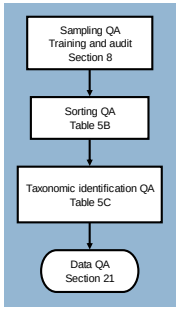


Search

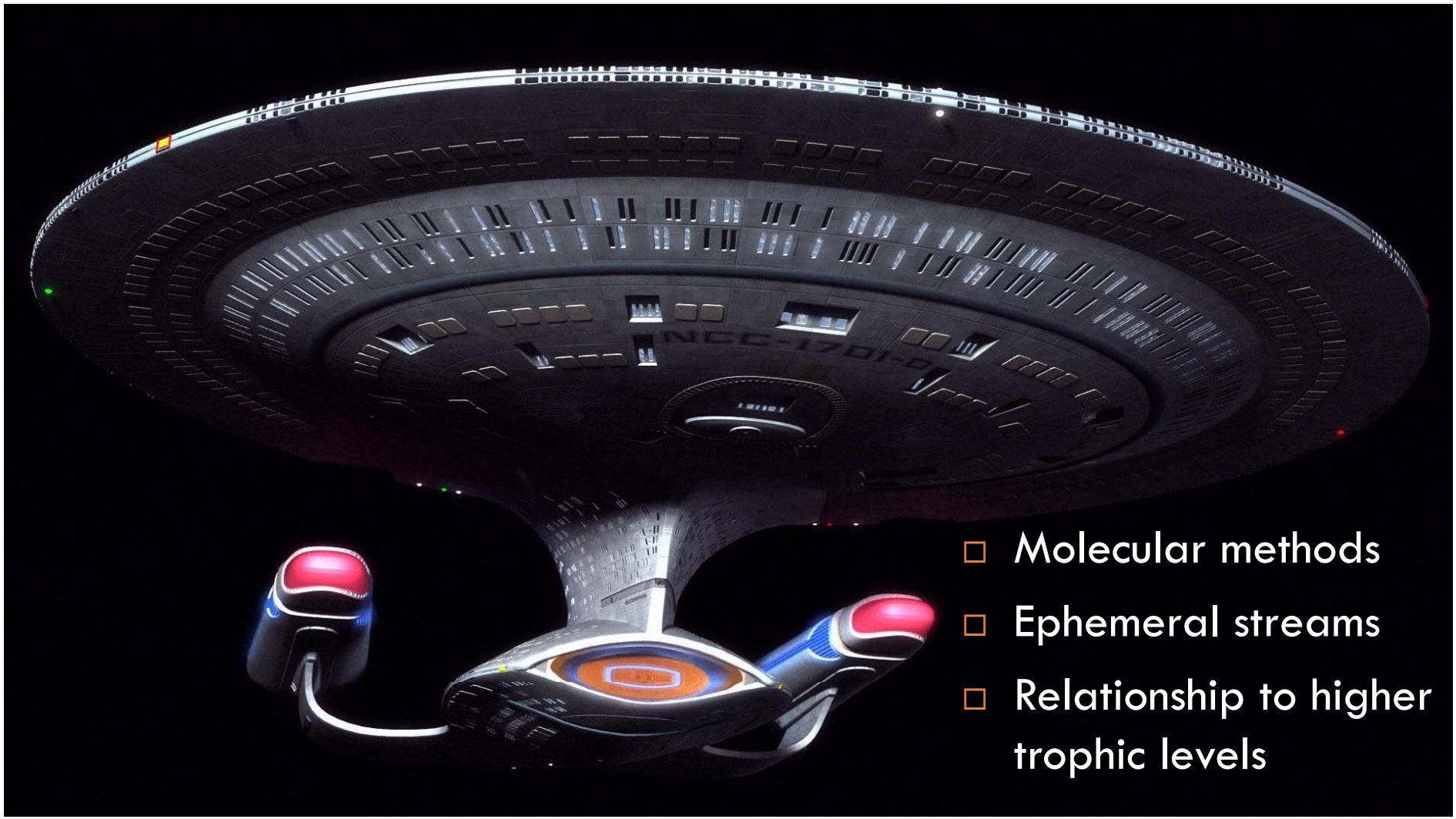
			3.6
			0.64
			16.6
Balboa Marina Dock Replacement Project Other	Construction in-progress	Orange	0.34
Ballona Wetlands Restoration Planning Performance Criteria Prepared Map Map Other	Construction in-progress	Los Angeles	600
Bolsa Chica Wetlands Restoration Map	Construction completed	Orange	939
Bristol Cove Dredging Other	Construction completed	San Diego	0.91
Buena Vista Creek Acquisition, Sherman Parcel Prepared Map Map Other	Construction completed	San Diego	133.8
Buena Vista Lagoon State Ecological Reserve Restoration Planning - Phase II Dataset Monitoring Report Prepared Map Map Other	Construction in-progress	San Diego	225.71

Benefits of Cooperative Program

- Consistency of approaches
  - Improved ability to share information
- Improved quality controls
  - Well developed protocols
  - Training and auditing
- Information sharing
  - Mapping of local and regional resources
  - Common data analysis
  - Data sharing protocols
  - Common data repository
- Improved cost effectiveness

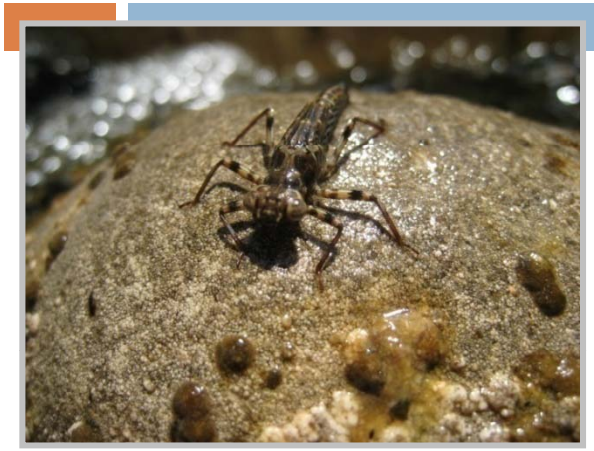


What Next?



- Molecular methods
- Ephemeral streams
- Relationship to higher trophic levels

Challenges of Traditional Taxonomy

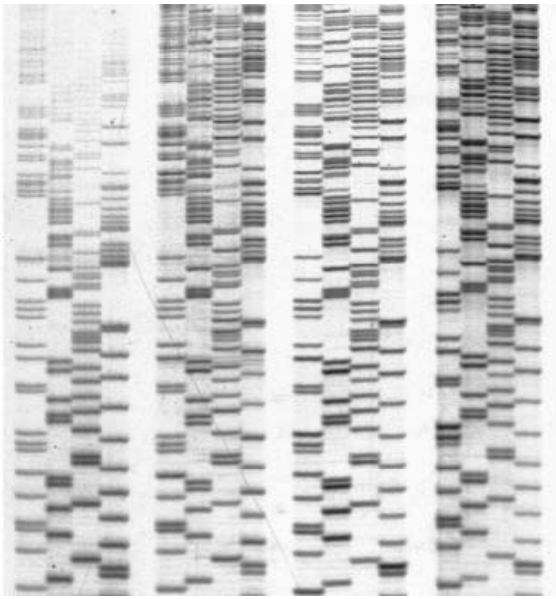


- Time required to get results
- Expense of detailed taxonomy
- Taxonomic capacity
- Unpredictable quality of specimens
- Difficult identifications
  - Rare and cryptic species
  - Morphology of various life stages
  - Sexual dimorphism

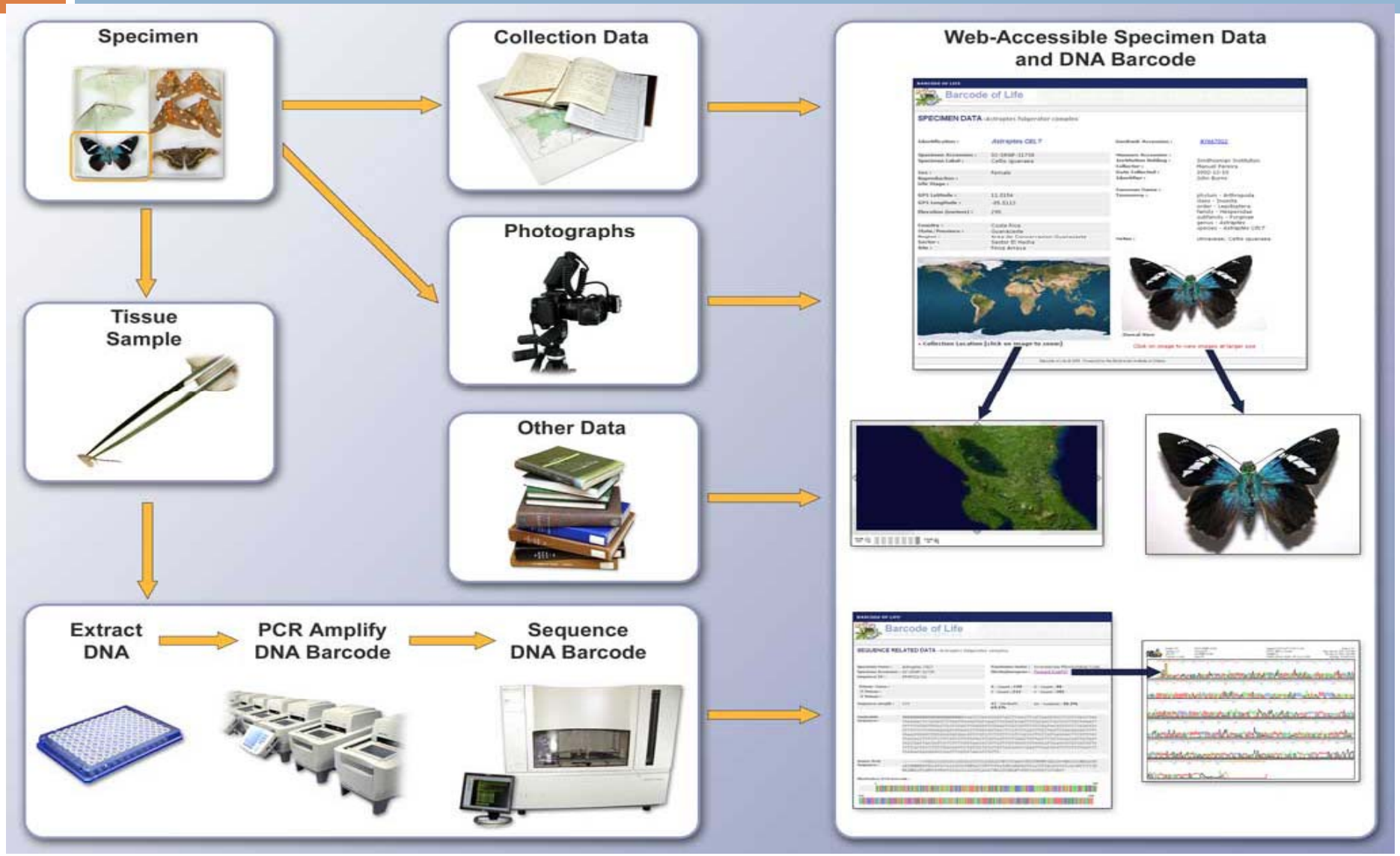
DNA Barcoding is Part of the Solution

A DNA barcode is a short gene sequence taken from standardized portions of the genome, used to identify species.

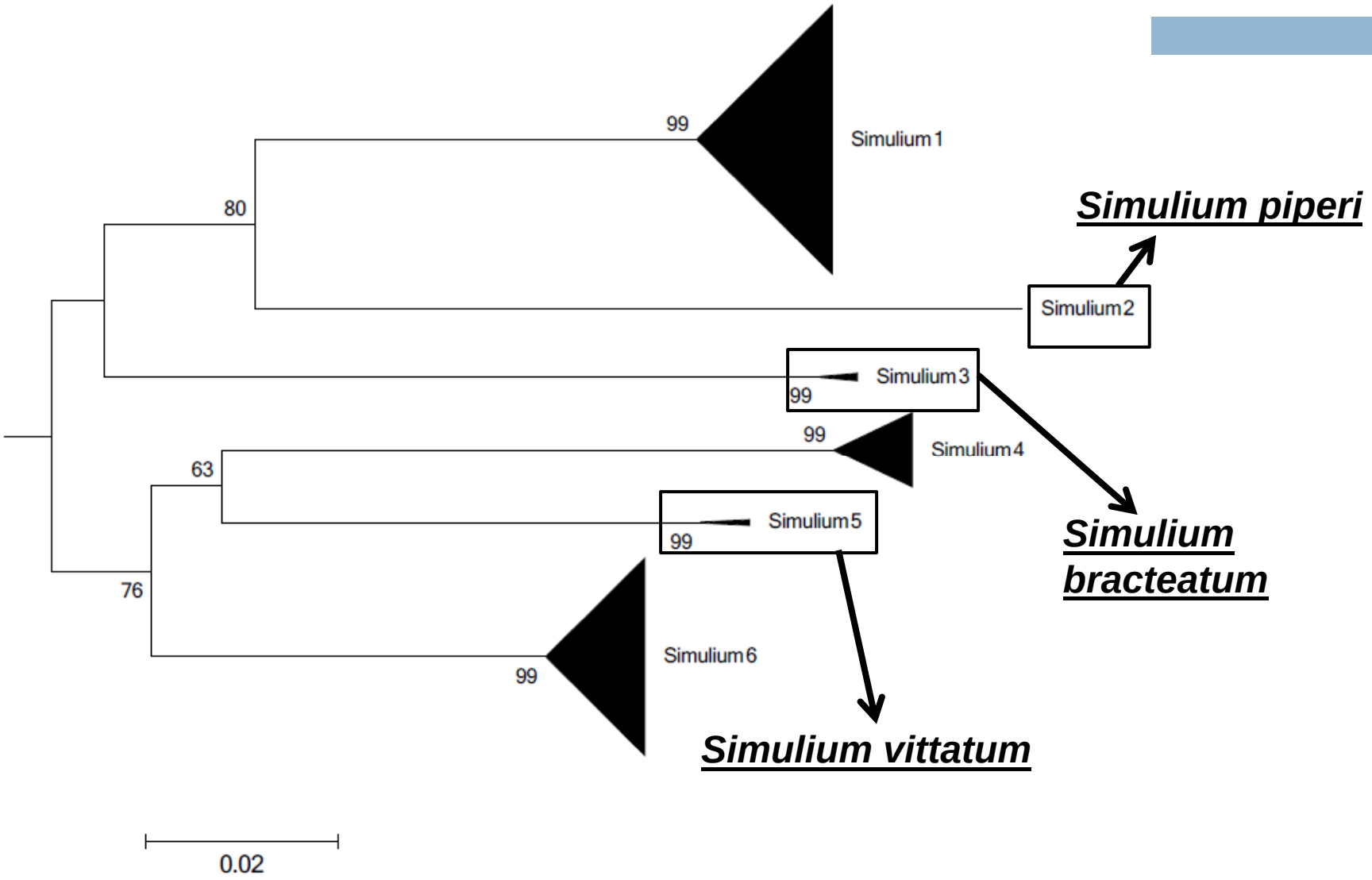
Similar to the UPC, DNA barcodes provide a universal system of unique tags for each species.



How Does Barcoding Work?



Match Unidentified Specimens to Existing Libraries



Improved Taxonomic Resolution

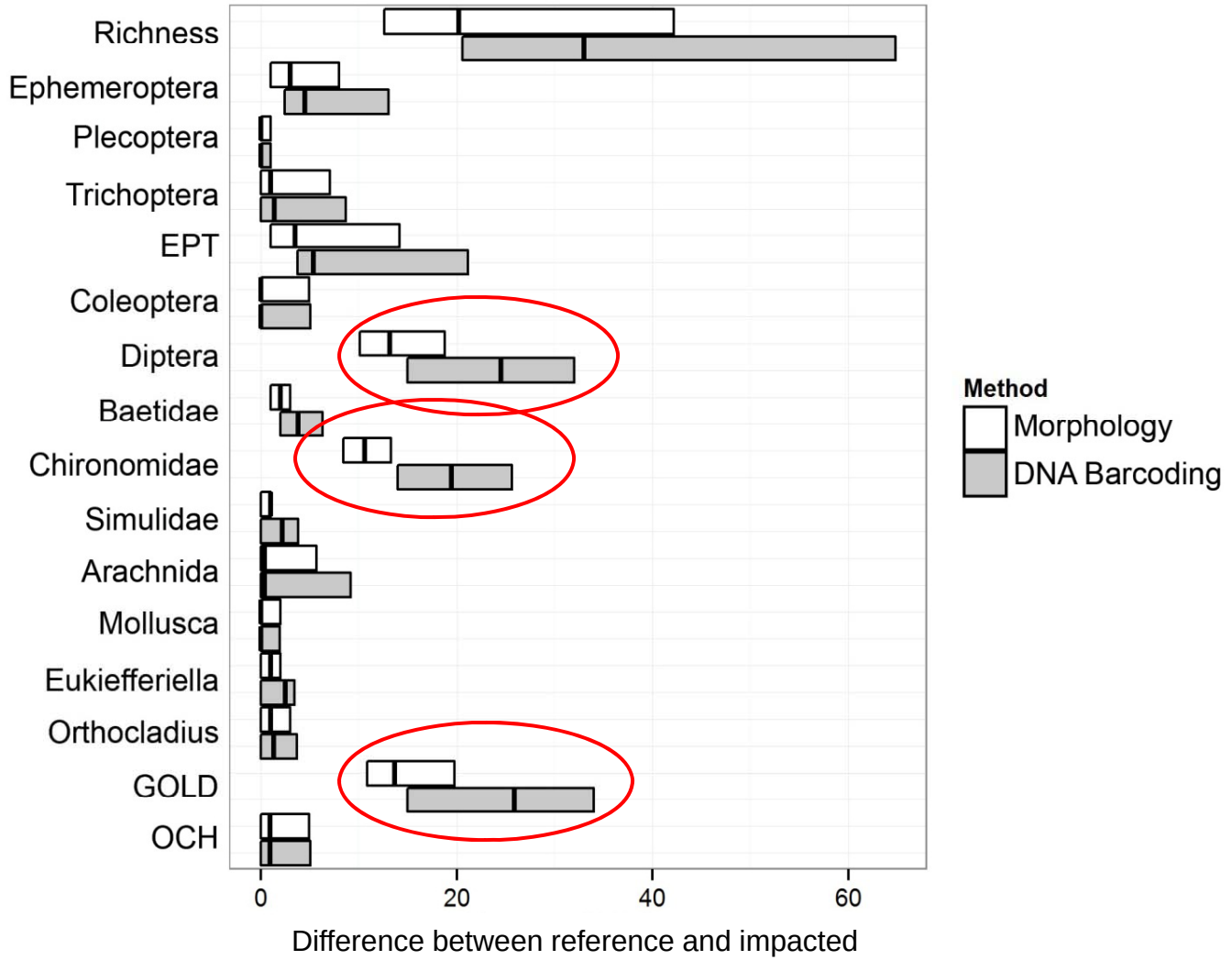
Simulium piperi

- High quality sites
- Cool water
- Good vegetated margins

Simulium vittatum

- Tolerant species
- Extreme temperature
- Low oxygen
- Often associated with agriculture

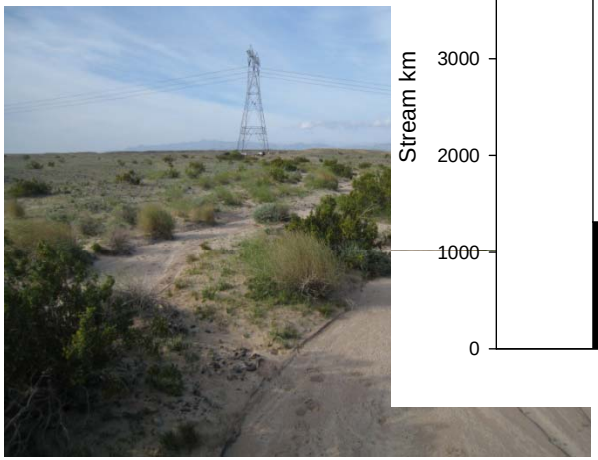
Some Barcode Derived Metrics are More Sensitive

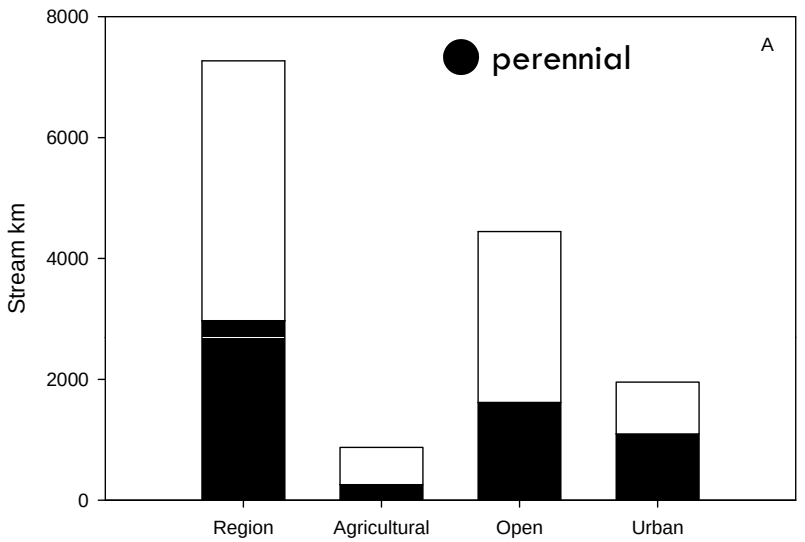


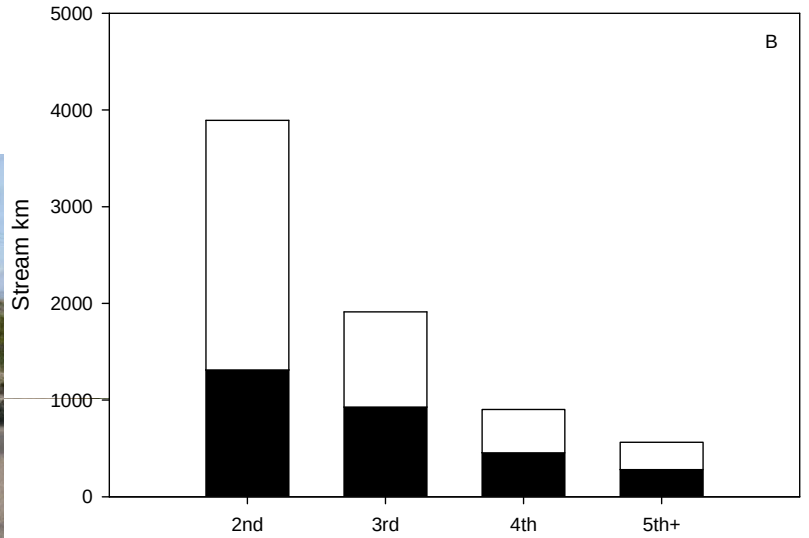
Sampling with Environmental DNA (eDNA)

- DNA released from an organism into the water column
- Persists for 7-21 days depending on conditions
- Can be used for detection
  - Future application to community analysis

Sampling in non-perennial streams



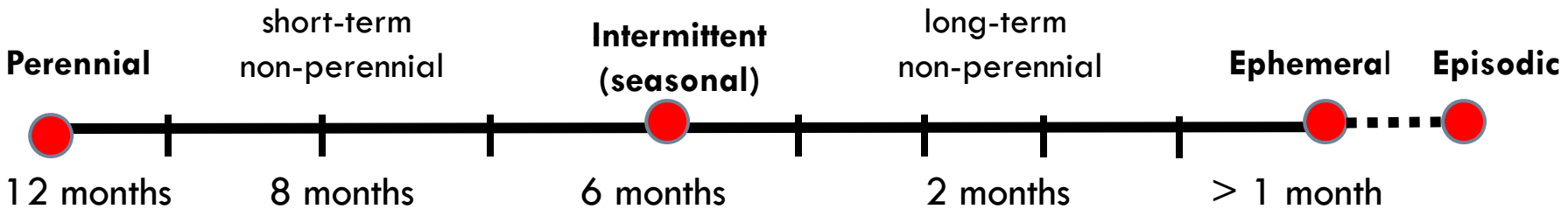




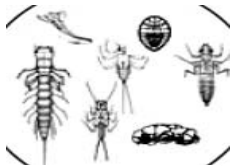
Gradient of Hydrologic Permanence

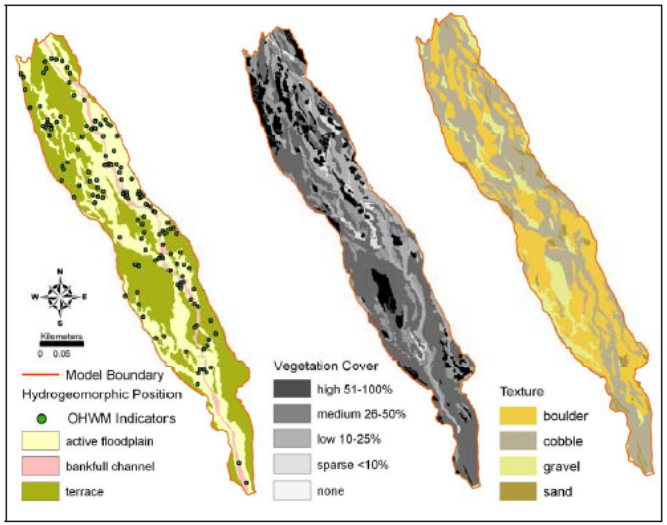






Typical flow duration

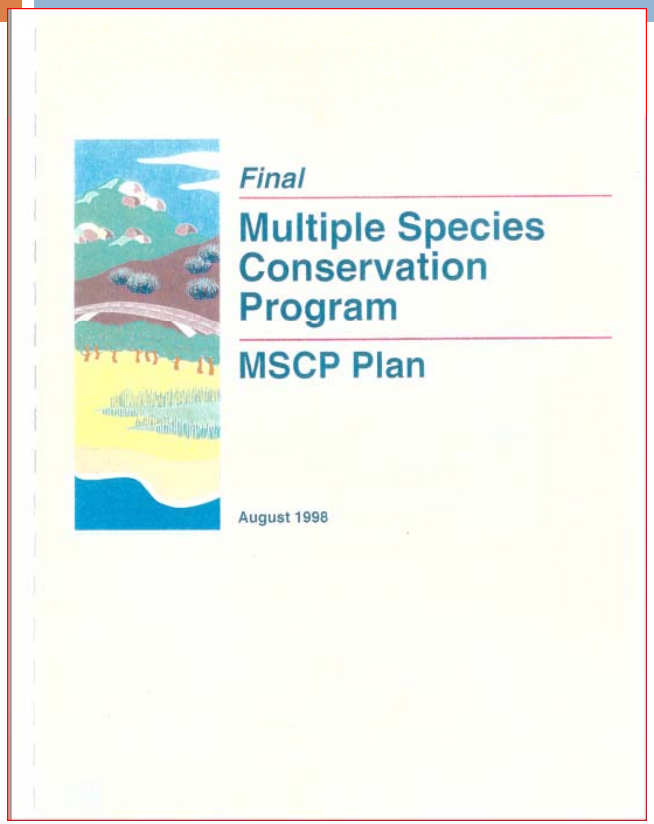


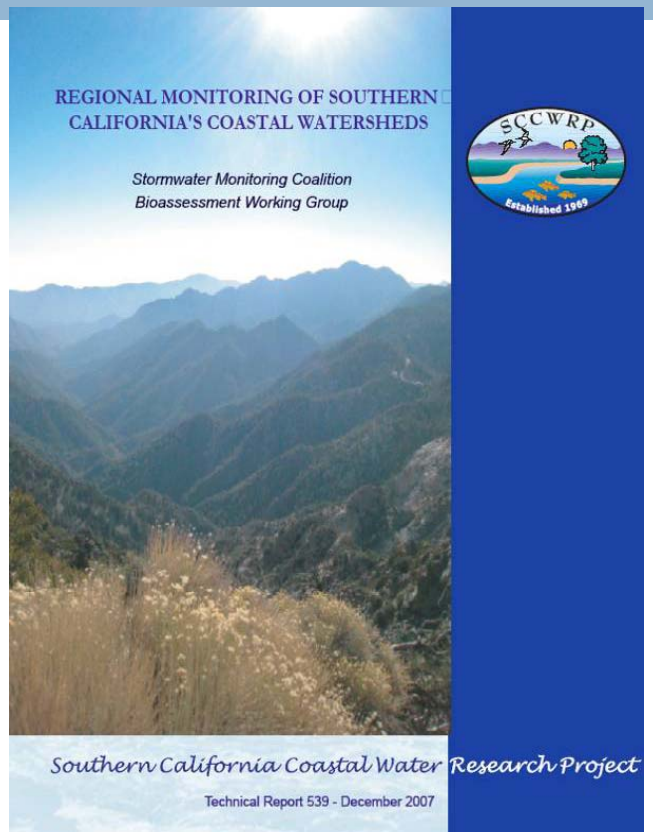


Relating Water Quality Indicators to Higher Trophic Level Functions

- Do relationships exist between biological indicators (e.g bugs), contaminant levels, and higher trophic levels?
  - Common stressors
  - Food chain effects

Opportunities for Collaboration





RESOURCES AGENCY CALIFORNIA DEPARTMENT FISH & GAME

US Army Corps of Engineers ®
Sacramento District

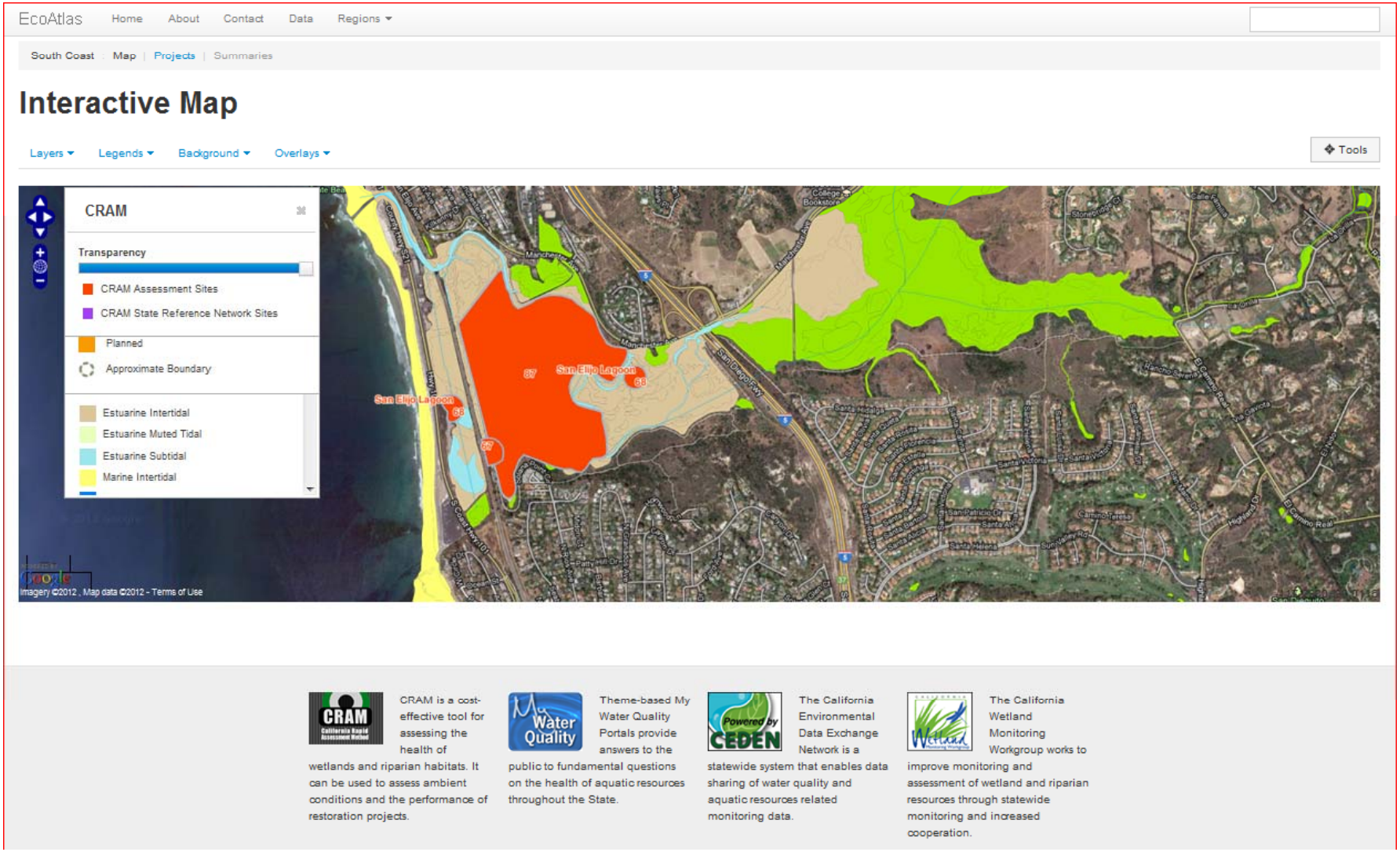
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

CALIFORNIA Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

U.S. FISH & WILDLIFE SERVICE

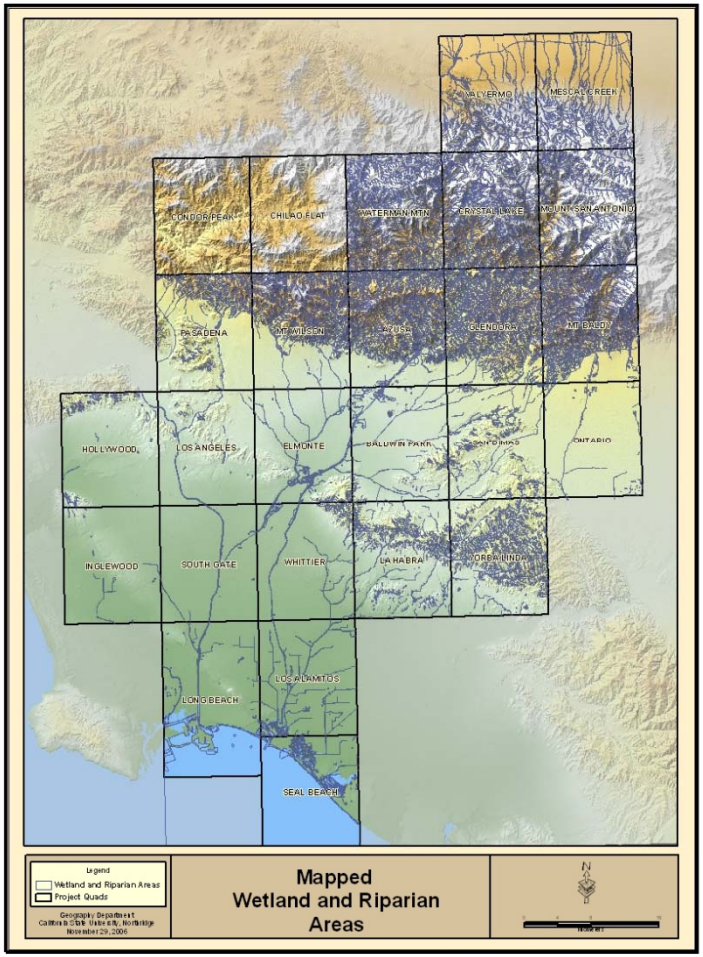

Thank You
Eric Stein
714-755-3233
erics@sccwrp.org

Wetland and Riparian Basemap

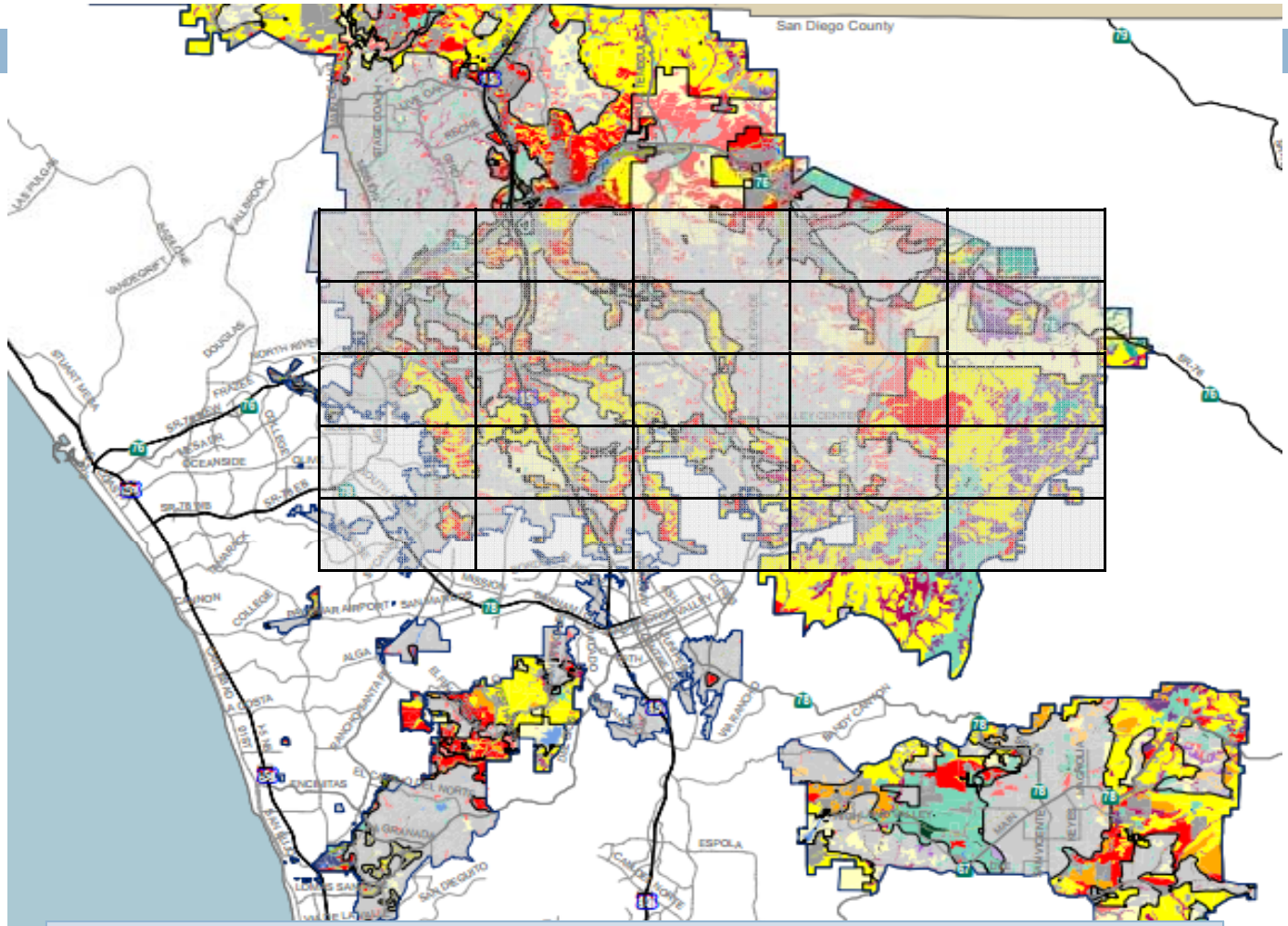


California Aquatic Resource Inventory (CARI)

- Comprehensive map of wetlands and streams across California
  - Will include riparian
- Standard mapping protocols and classification
- More accurate and current than available wetland/stream maps
- Can accommodate different resolutions/level of detail



Application to HCPs



Map all habitats within each plot

Can act as a sample frame for ambient condition assessment

S. Ca. Stream and Wetland Mapping

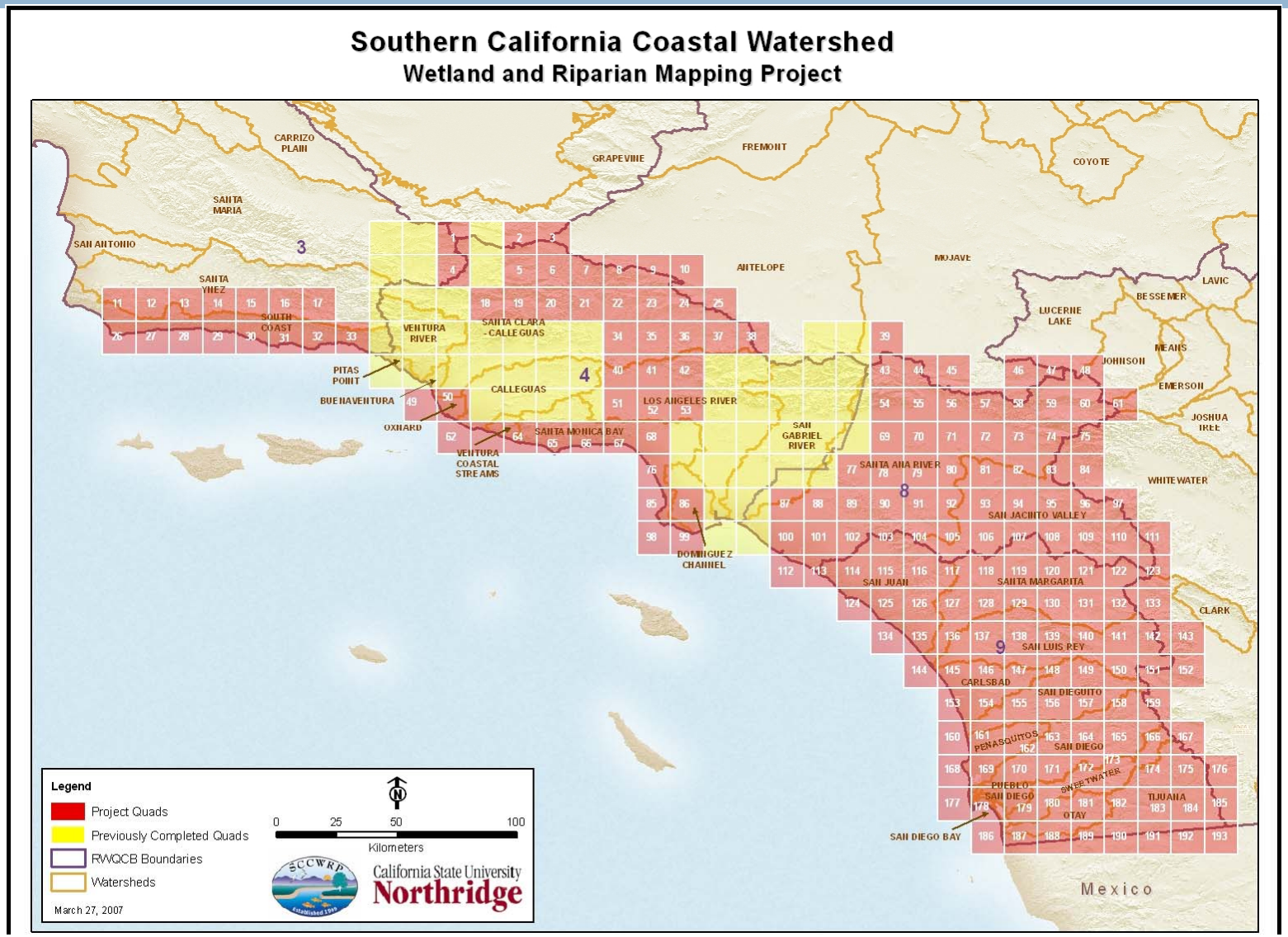
- All wetlands a
  streams in S. C
- High resolutio
  aerial photo-
  interpretation
- 2005 imagery
  newer
- Cowardin and
  CARCS

http://www.socalwetlands.com

Southern California Wetlands Mapping Project

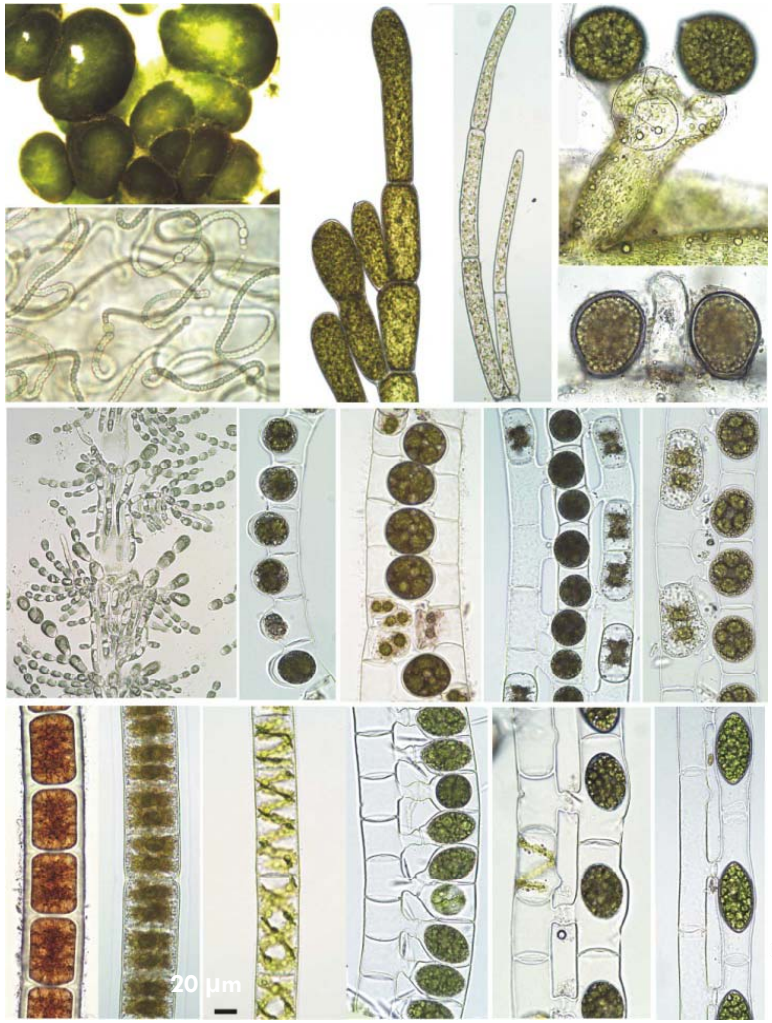
Welcome to the Southern California Wetlands Mapping Project website. This project is funded by the State Water Resources Control Board under the Proposition 50, Coastal Nonpoint Source Pollution Control Program. The project funding was awarded to the Southern California Coastal Water Research Project with California State University, Northridge's Center for Geographic Studies as the primary sub-contractor.

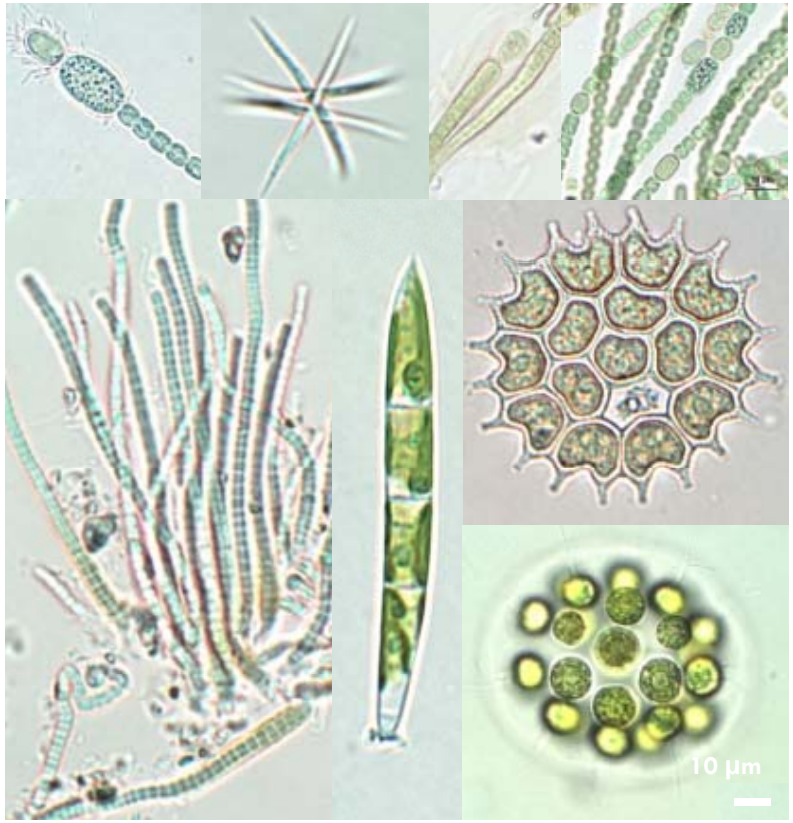
The goal of this website is to disseminate publication materials, draft wetland maps, and provide stakeholders with any information they need about our project. Please feel free to contact us (Contact Info.) if you have any specific questions. Our Meeti page will detail any upcoming stakeholder meetings or presentations. Don't hesitate to let us know you would like for us to give a presentation at your organization or if you have any questions about project.


Southern California Coastal Watershed
Wetland and Riparian Mapping Project
CARRIZO PLAIN
GRAPEVINE
FREMONT
COYOTE
SANTA MARIA
SAN ANTONIO
SANTA YNEZ
ANTELOPE
MOJAVE
LAVIC
BESSEMER
LUCERNE LAKE
JOHNSON
MEANS
EMERSON
JOSHUA TREE
WHITEWATER
CLARK
SOUTH COAST
VENTURA RIVER
SANTA CLARA - CALLEGUAS
CALLEGUAS
LOS ANGELES RIVER
SAN GABRIEL RIVER
SANTA ANA RIVER
SAN JACINTO VALLEY
SAN JUAN
SANTA MARGARITA
SAN LUIS REY
CARLSBAD
SAN DIEGUITO
SAN DIEGO
PENASQUITOS
PUEBLO SAN DIEGO
OTAY
SWEETWATER
TIJUANA
SAN DIEGO BAY
PITAS POINT
BUENAVENTURA
OXNARD
VENTURA COASTAL STREAMS
SANTA MONICA BAY
DOMINGUEZ CHANNEL
Mexico
3
4
8
9
Legend
Project Quads
Previously Completed Quads
RWQCB Boundaries
Watersheds
March 27, 2007
0 25 50 100
Kilometers
SCCWRP
California State University Northridge

Types of Waterbodies

Algae Come in a Variety of Shapes/Sizes…





same scale!

Component Metrics

1. proportion sedimentation tolerant (incl. highly motile)
2. proportion low-nitrogen indicators (incl. N fixers)
3. proportion haplobiontic
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 spp

Sample Application: Sweetwater

Taxonomic Completeness

Observed	Missing
Acari	Bezzia
Baetis	
Chironominae	
Orthocladiinae	
Simulium	
Oligochaeta	
Tanypodinae	

low taxa richness at Sweetwater, but hardly anything missing.

Index/Component	Sweetwater
CSCI	1.04
MMI	0.96
O/E	1.13

Ecological Structure

Metric	O	E	Score
Shannon Div	2.3	1.6	1.0
% Intol Taxa	0.06	0.23	0.3
Tol Value	6.2	5.8	0.7
Shredder Taxa	0	0.8	0.6
Clinger Taxa	5.6	6.5	0.7
Coleo Taxa	5.1	3.1	1.0
% Noninsect Taxa	0.2	0.2	0.9
Collector Taxa	12.2	9.4	1.0

Ambient Data Provides Context for Decisions