ASSESSMENTS FOR STORMWATER MONITORING AND MANAGEMENT

Eric Stein

Biology Departments

Southern California Coastal Water Research Project (SCCWRP)

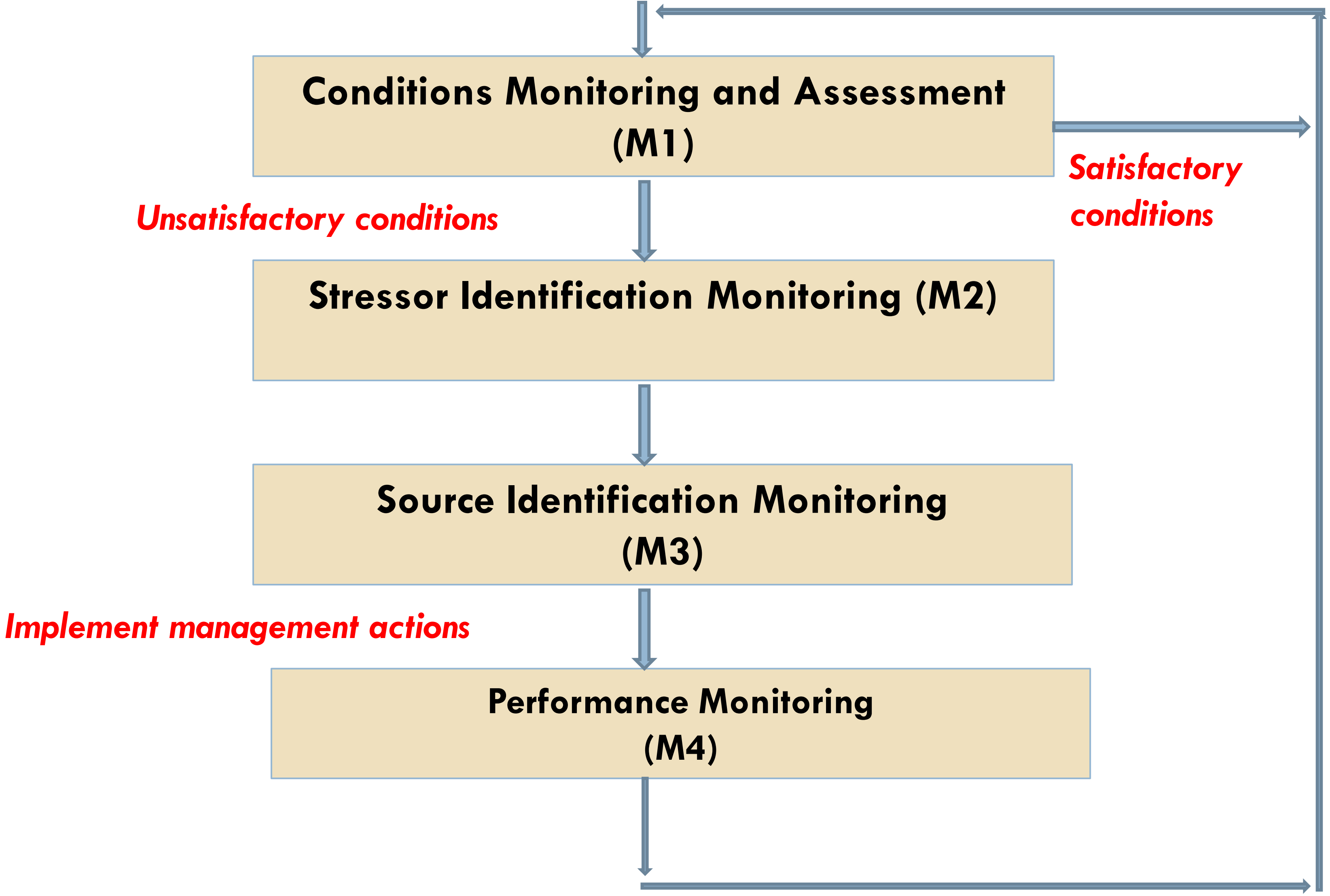
Effects of Stormwater Runoff

Waterbody Impairments

Coliforms, Beach Closures and Pathogens

Stormwater Assessment is Complex

Monitoring and Assessment Framework



Conditions Monitoring and Assessment (M1)

Satisfactory conditions

Unsatisfactory conditions

Stressor Identification Monitoring (M2)

Source Identification Monitoring (M3)

Implement management actions

Performance Monitoring (M4)

Hydromodification

Toxicity

Bioobjectives

Wetland Policy

Nutrient Criteria

Water Quality

Sensitive Species

Don’t Freak Out!

- ☐ Coordination
- ☐ Integration
- ☐ Communication

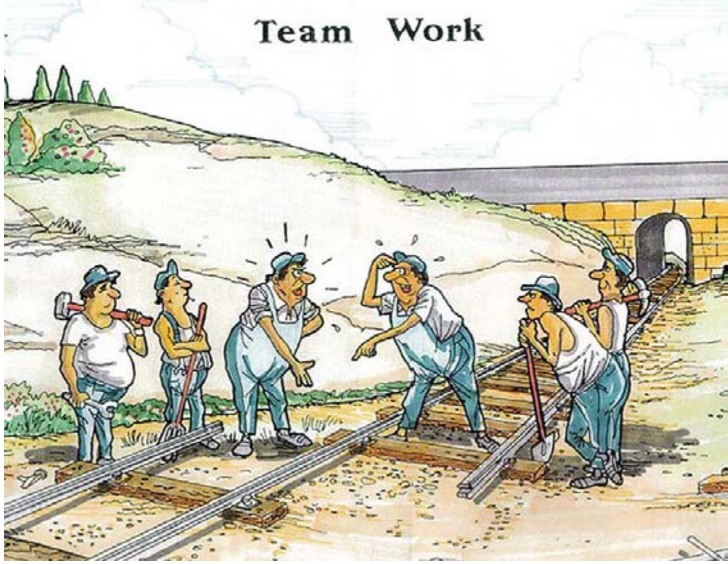
Monitoring Philosophy

- 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

Oh what to do, what to dooo?

Need for Cooperative Monitoring

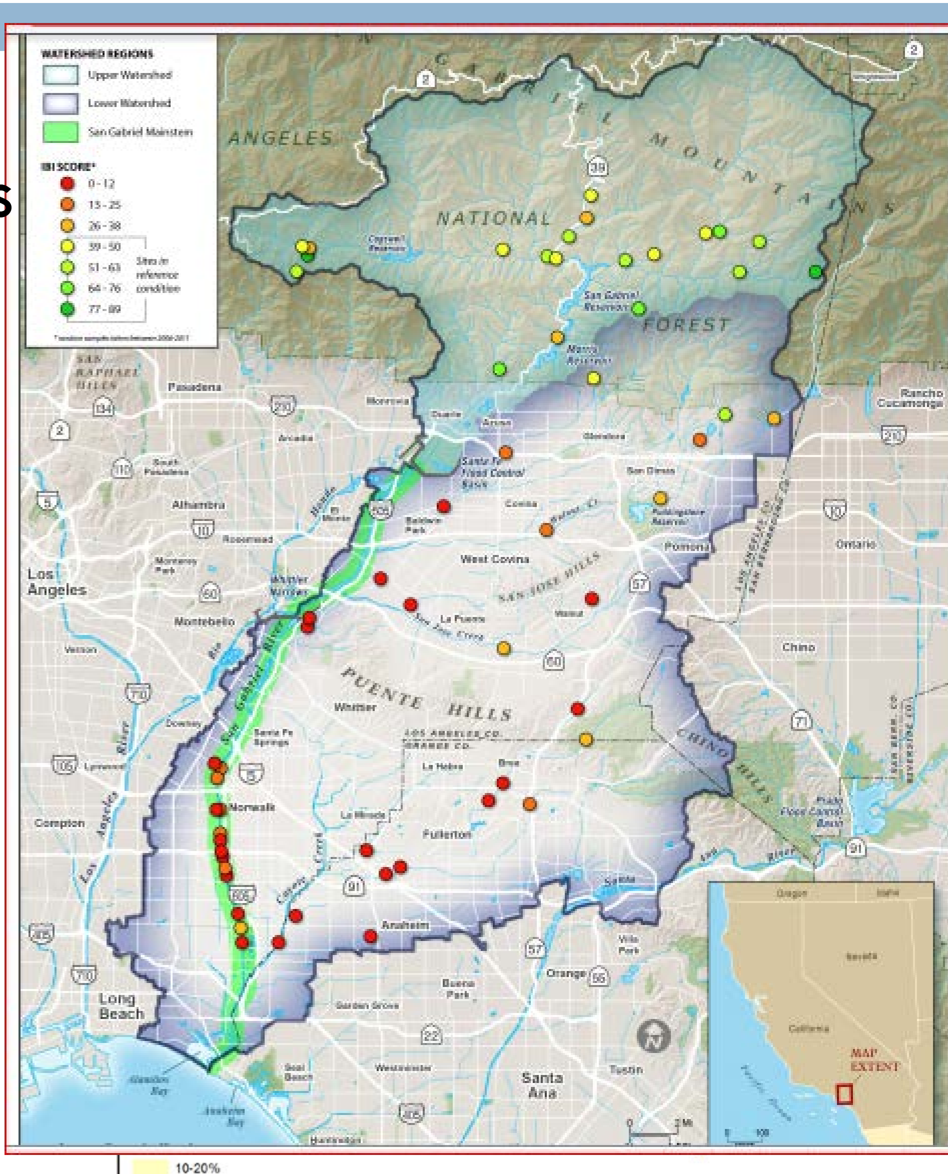
- Leverage resources, knowledge and experience
- Answer regional questions and fulfill mandates
- Provide relevant information that can be readily shared
- Provide a platform for more in-depth studies



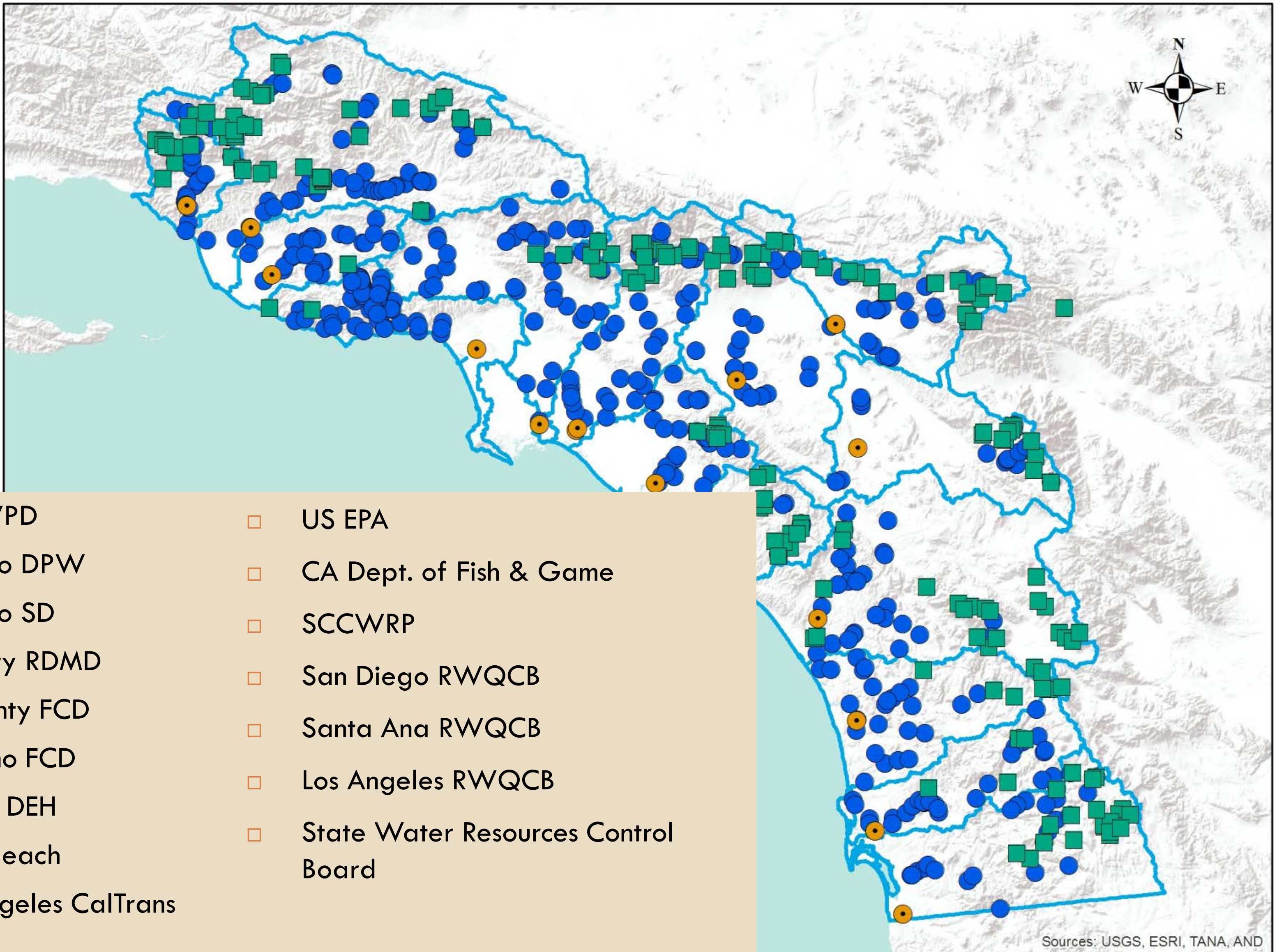
- Standard tools and monitoring design
- Shared information management.
- Nested design to allow local intensification

Watershed Based Monitoring

- ☐ Start with watershed analysis
- ☐ Informs development of monitoring questions
- ☐ Priority locations
- ☐ Opportunities to leverage off existing programs
- ☐ Ability to monitor process indicators over time



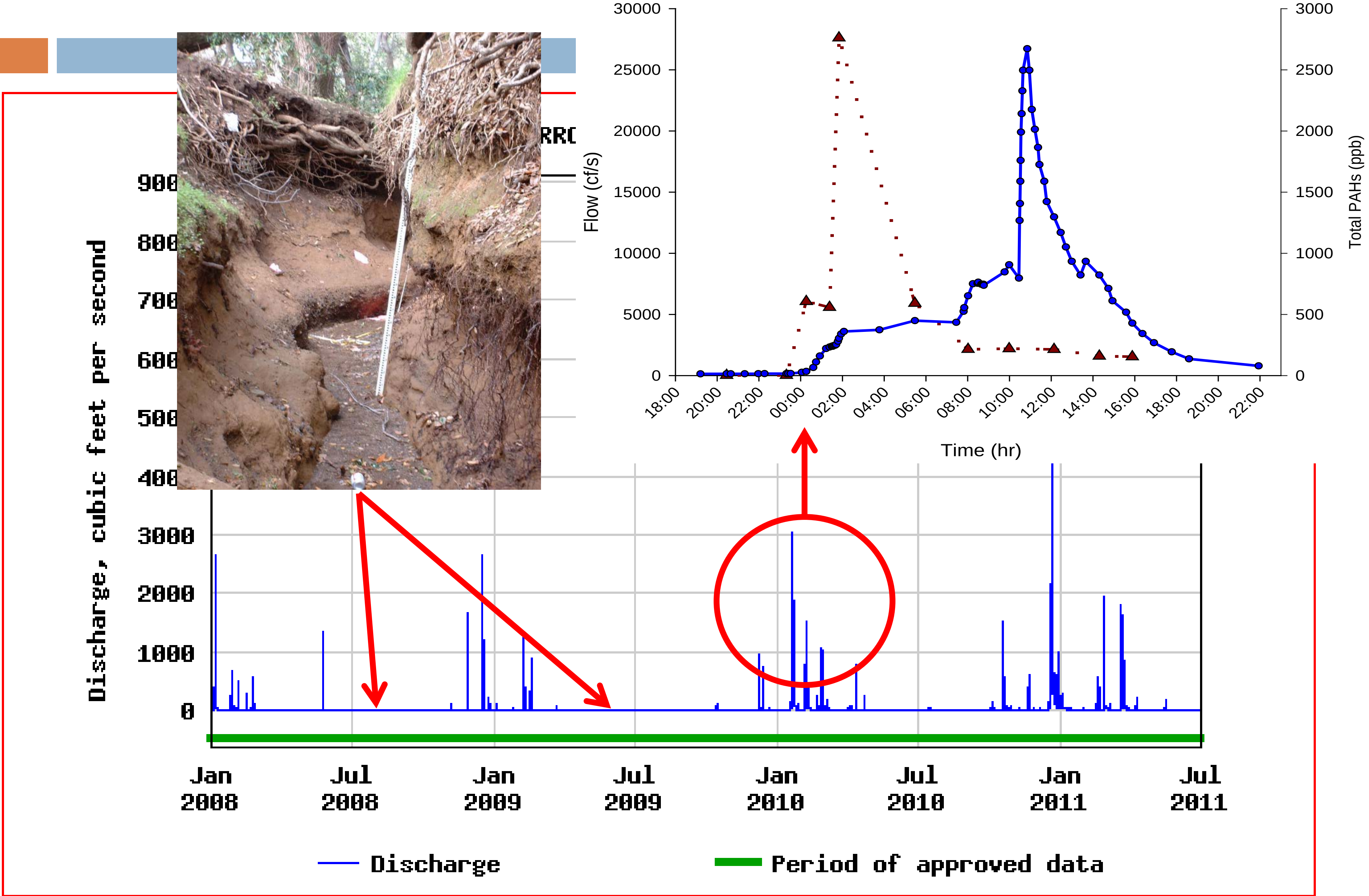
Regional Monitoring Coalitions



Sources: USGS, ESRI, TANA, AND

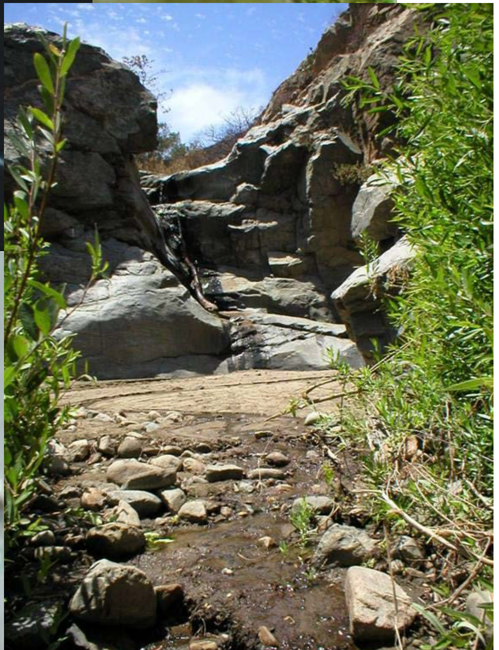
- Ventura Co WPD
- Los Angeles Co DPW
- Los Angeles Co SD
- Orange County RDMD
- Riverside County FCD
- San Bernardino FCD
- San Diego Co DEH
- City of Long Beach
- City of Los Angeles CalTrans
- US EPA
- CA Dept. of Fish & Game
- SCCWRP
- San Diego RWQCB
- Santa Ana RWQCB
- Los Angeles RWQCB
- State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

Wet vs Dry Weather Monitoring

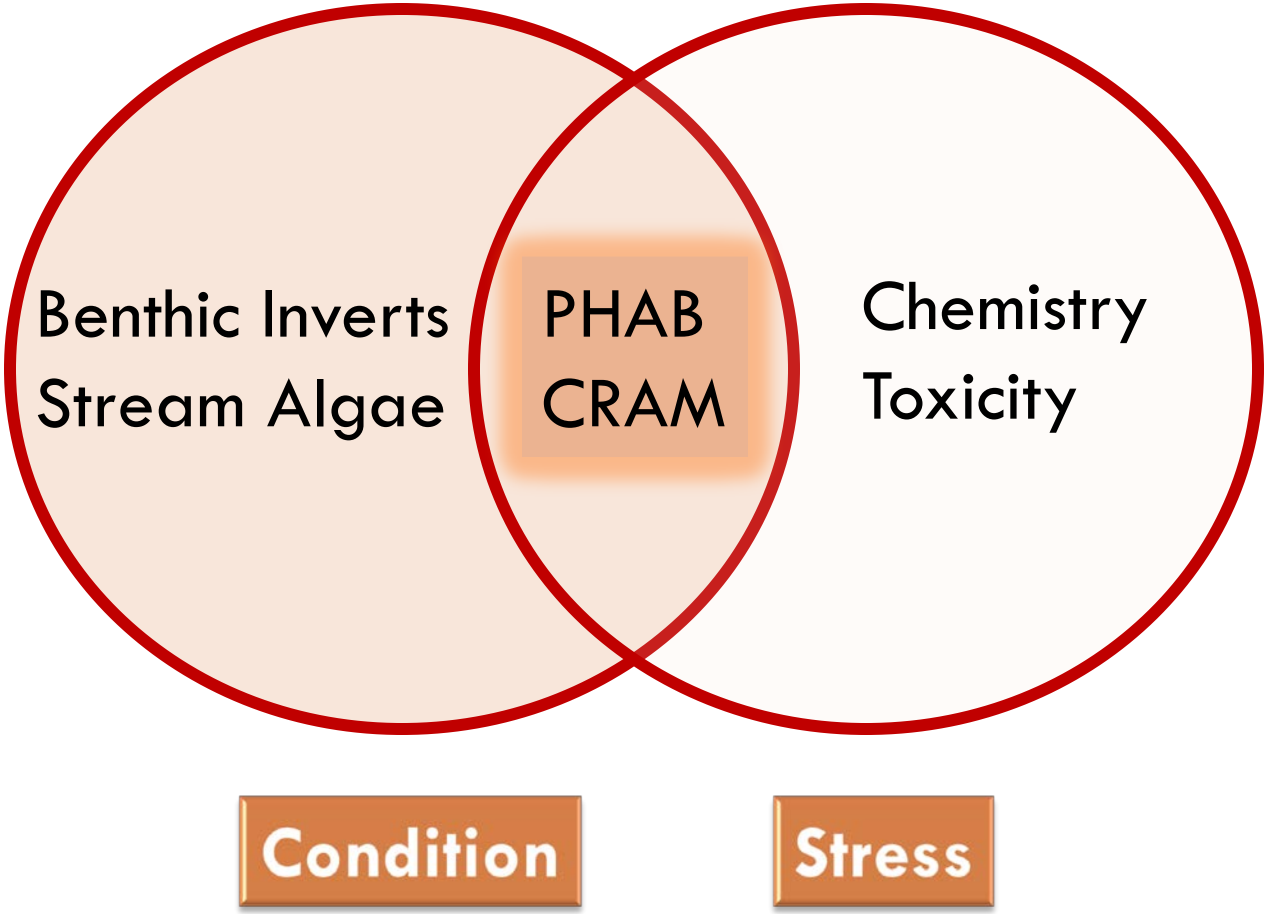


California's Stream Ecological Indicators

- ☐ Instream Biology
  - California Stream Condition Index (CSCI)
  - Algal IBI
- ☐ Physical habitat
  - PHAB MMI
  - Hydromodification
- ☐ General stream condition
  - CRAM

Multiple Indicator Approach



Benthic Inverts
Stream Algae

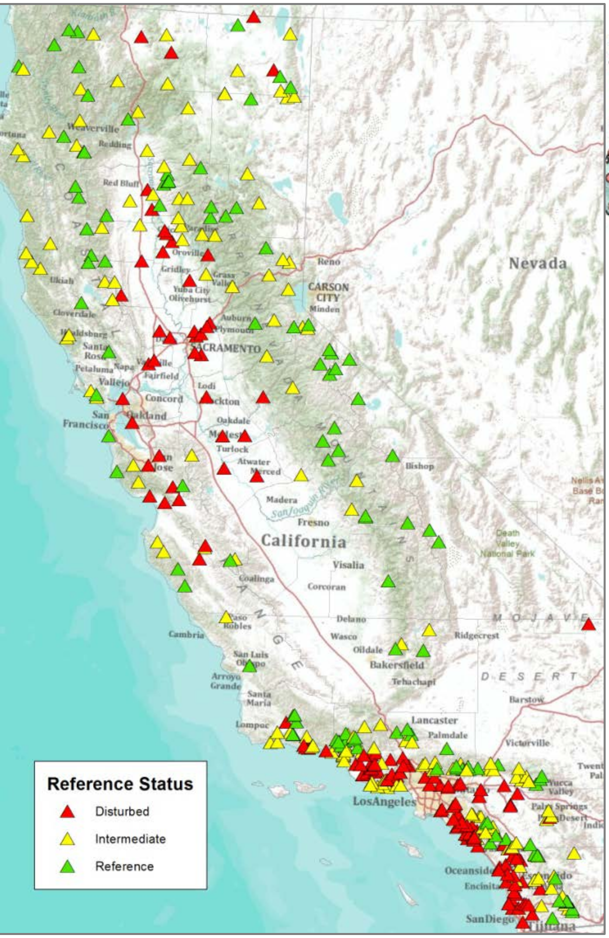
PHAB
CRAM

Chemistry
Toxicity

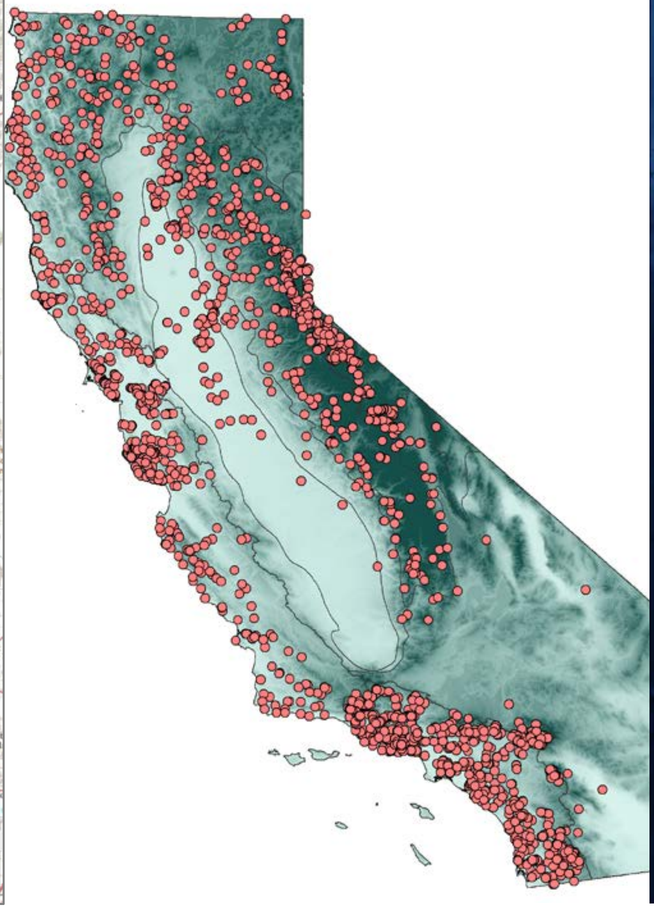
Condition

Stress

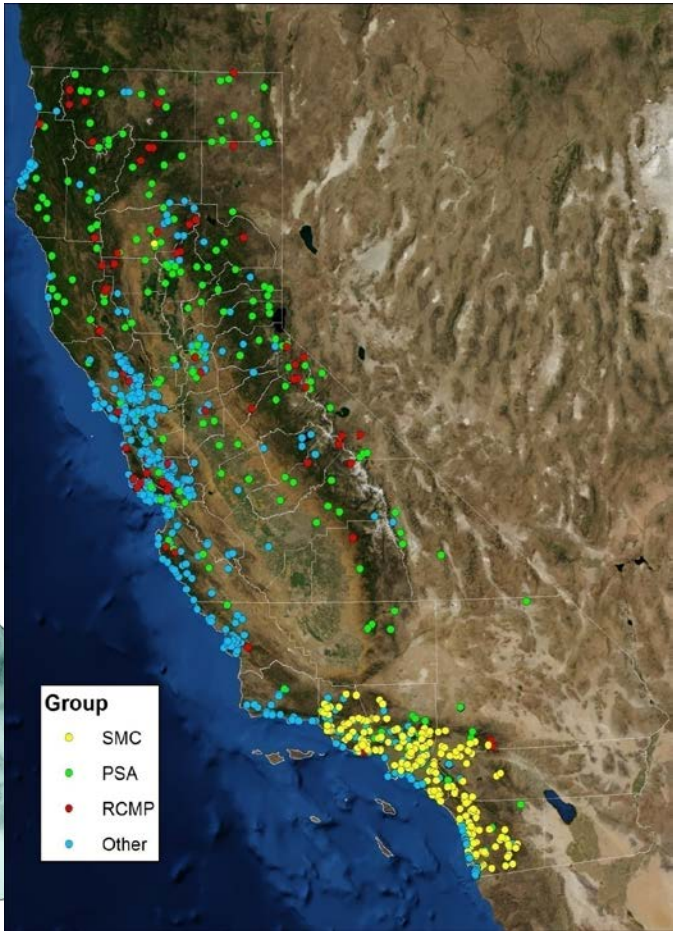
Robust Statewide Monitoring Programs



Algae



Benthic Invertebrates
Physical Habitat



CRAM

Why use Biossessment?

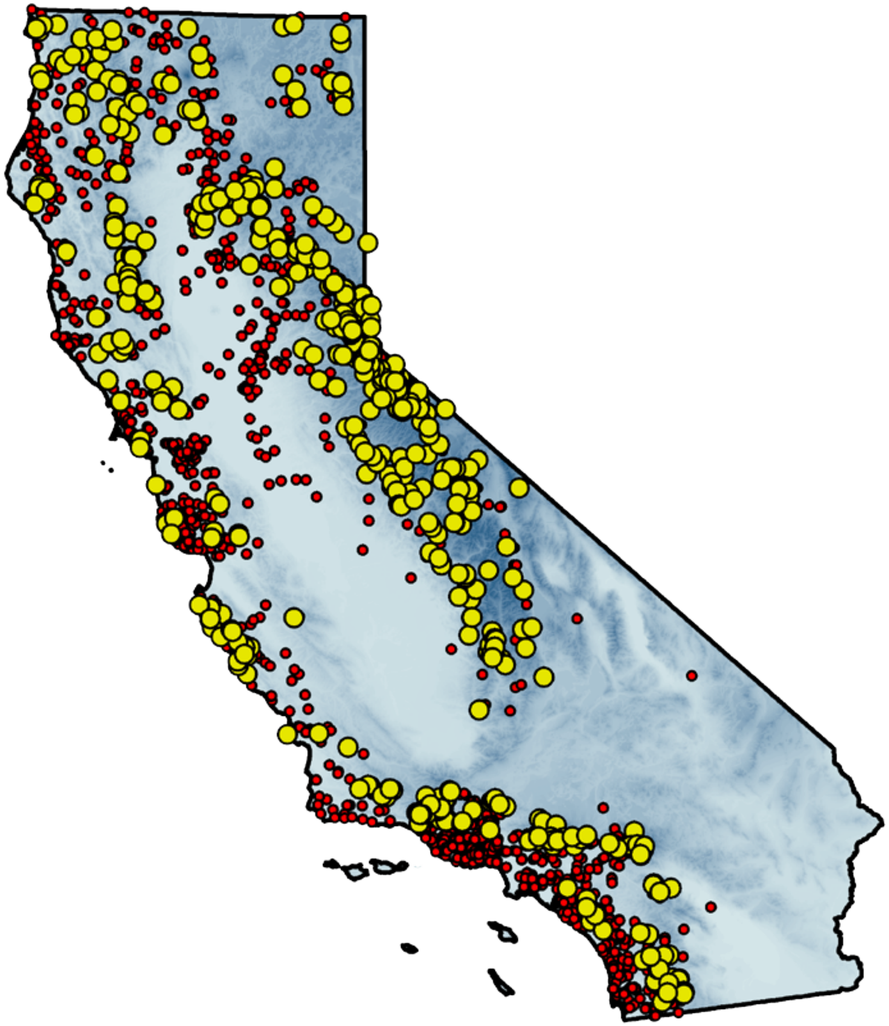
Use species composition to measure overall ecological integrity

- 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

Diverse Reference Network

Screened > 2400 **candidate** reference sites

Selected **586** sites

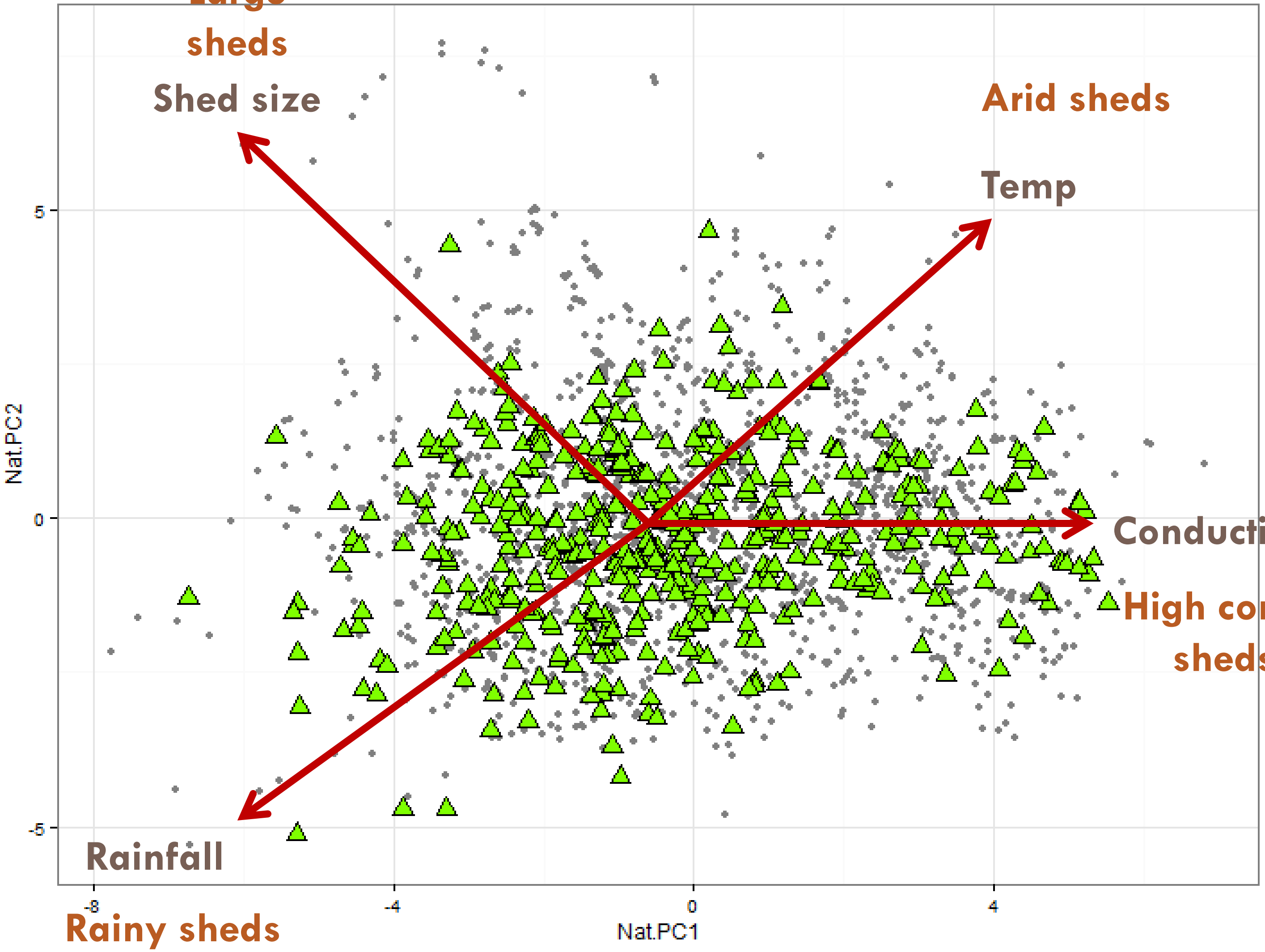


Objectives:

1. Reference pool represents CA stream diversity

2. Biological at reference sites is minimally influenced by stress

Reference Sites Cover Key Gradients



Large sheds

Shed size

Arid sheds

Temp

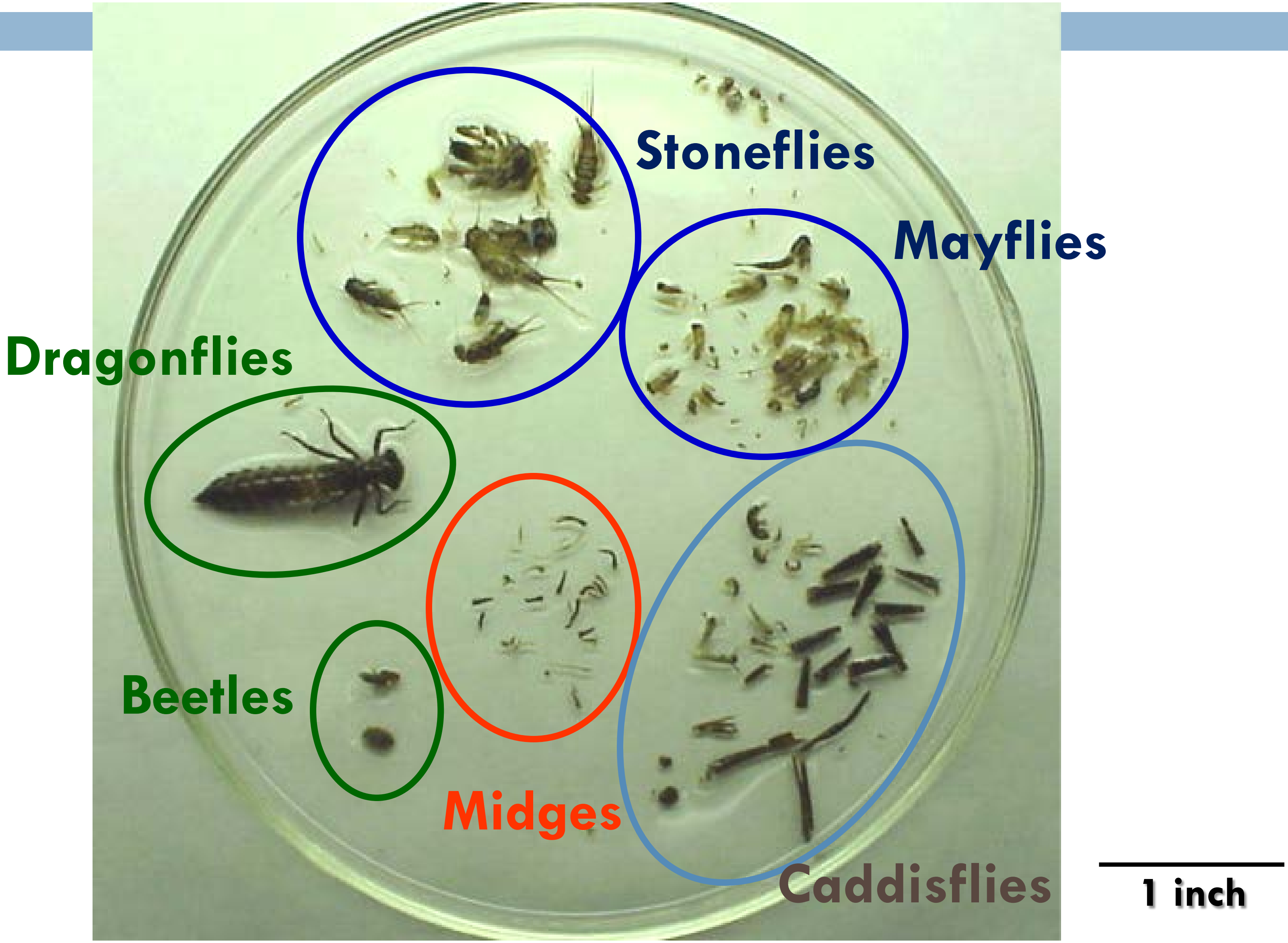
Conductivity

High cond. sheds

Rainfall

Rainy sheds

Converting Taxa to a "Score"



California Stream Condition Index (CSCI)

Part A: Ecological Structure Component (pMMI)

Part B: Taxonomic Loss Component (O/E)

BMI Species List from Sample

Taxon	Count
Mayfly species 1	43
Mayfly species 2	12
Mayfly species 3	2
Beetle species 1	1
Beetle species 2	1
Midge genus 1	65
Midge species 1	3
Midge species 2	10
Midge genus 2	3
Dragonfly species 1	2
Stonefly species 1	1
Stonefly species 2	14
Worm species 1	9
Worm species 2	2

Ecological Function Metrics

- # mayfly taxa
- # predator taxa
- % sediment tolerant taxa
- % non-insect taxa

Species Loss Component

E = 8 taxa O = 3 taxa

Scores are adjusted to account for major natural gradients

- Elevation
- Latitude
- Longitude
- Conductivity
- PPT, Temp
- Mineral Content

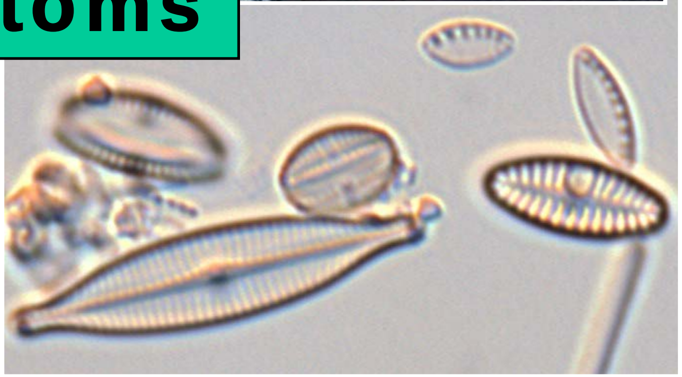
- Both components adjust for environmental setting
- CSCI is a simple average of the two scores

How does the CSCI Compare to 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

Benthic Algae IBIs

diatoms

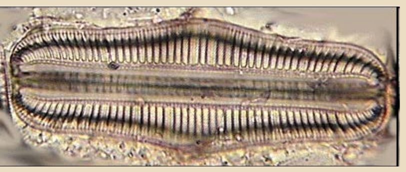


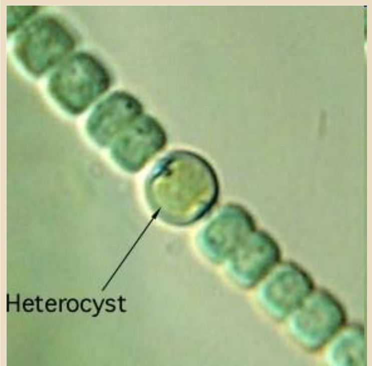
soft-bodied algae (& cyanobacteria)

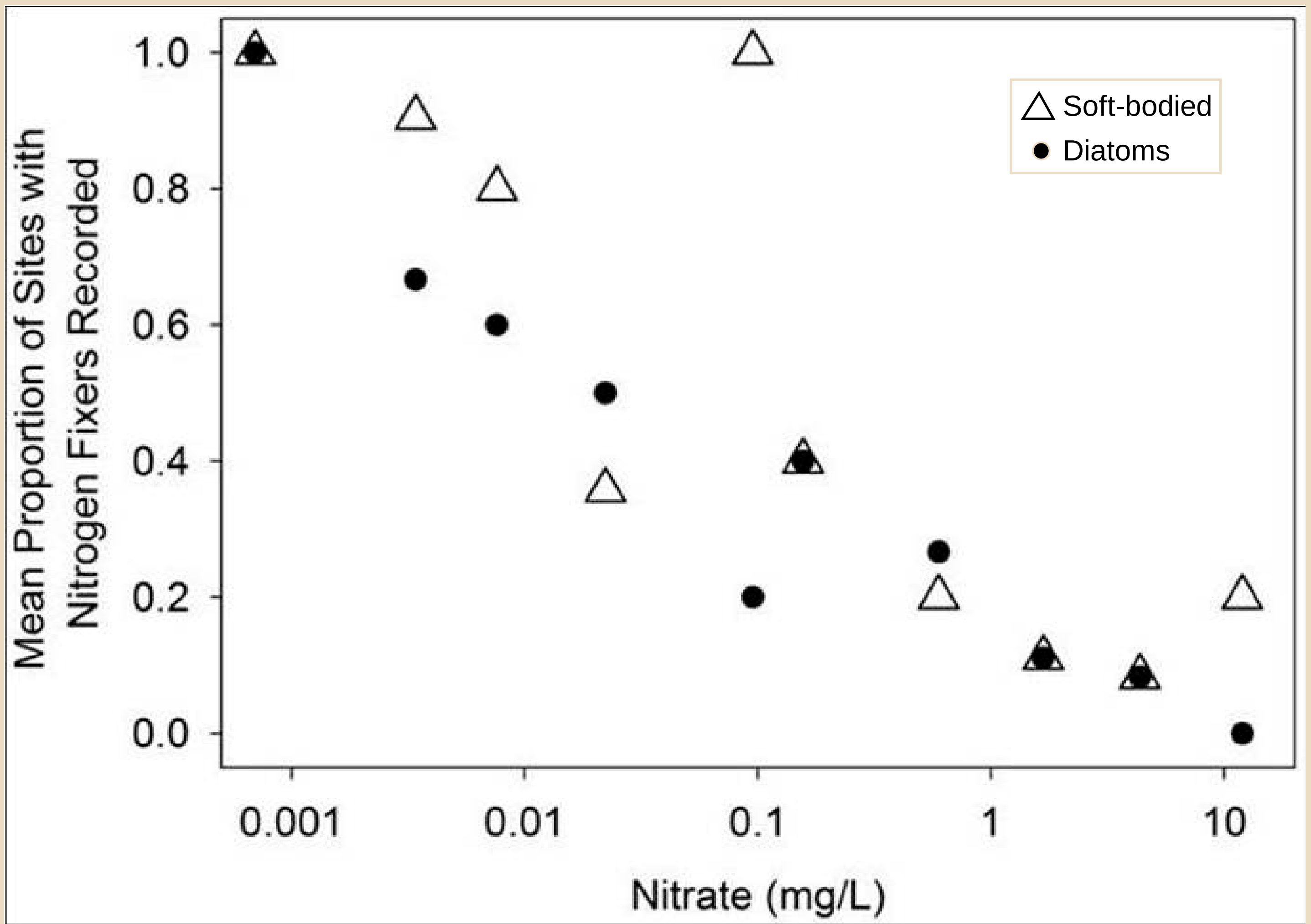
Why Add Algae to Bioassessment?

- 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

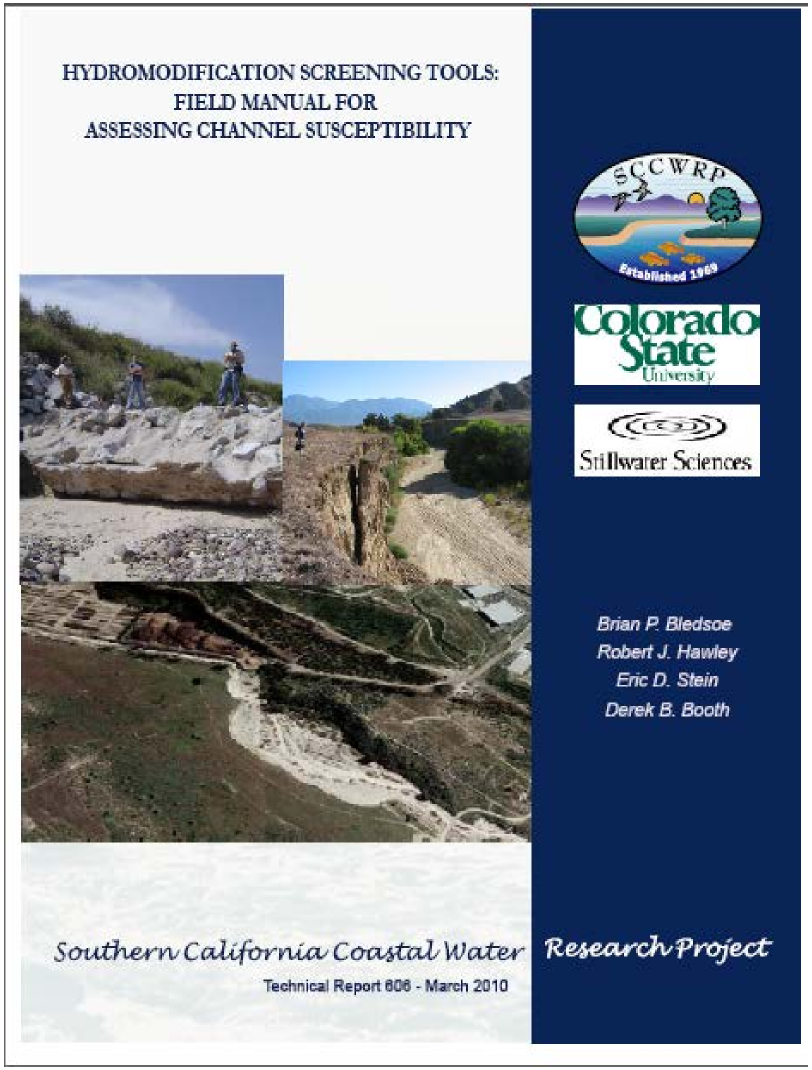






Hydromodification Field Screening Tool

- Classify streams by:
  - Likely severity of response
  - Likely direction of response
- Decision trees
  - Clear endpoints – *very high, high, medium, low*
- Simple to apply field metrics
  - Does not rely on complex field measures
- Locally calibrated
- Rapid - < 1 day in office + 1 day in field



HYDROMODIFICATION SCREENING TOOLS:
FIELD MANUAL FOR
ASSESSING CHANNEL SUSCEPTIBILITY

SCCWRP
Established 1969

Colorado State University

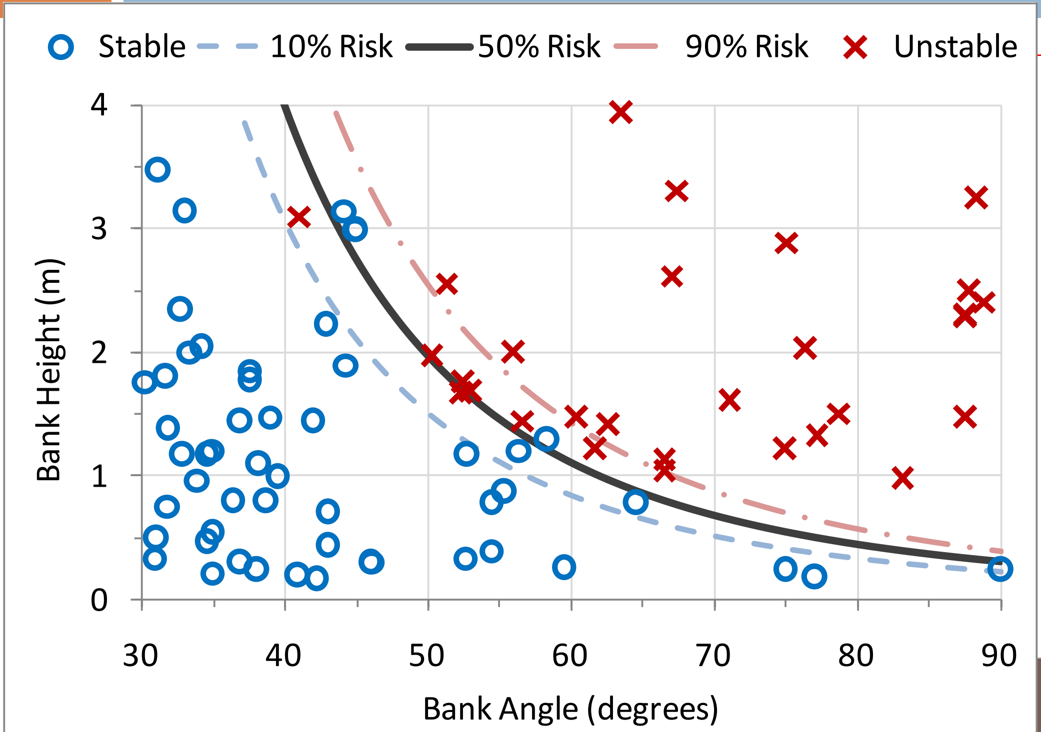
Stillwater Sciences

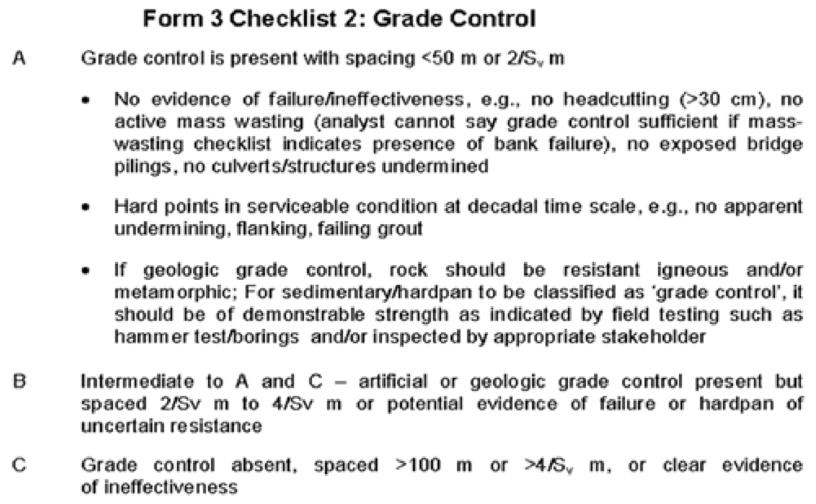
Brian P. Bledsoe
Robert J. Hawley
Eric D. Stein
Derek B. Booth

Southern California Coastal Water Research Project

Technical Report 606 - March 2010

Field Indicators + Empirical Relationships





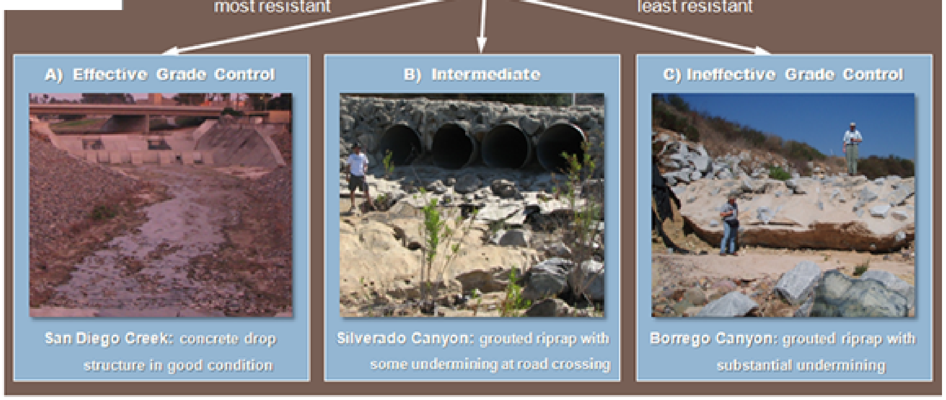
Form 3 Checklist 2: Grade Control

A Grade control is present with spacing <50 m or $2/S_v$ m

- No evidence of failure/ineffectiveness, e.g., no headcutting (>30 cm), no active mass wasting (analyst cannot say grade control sufficient if mass-wasting checklist indicates presence of bank failure), no exposed bridge pilings, no culverts/structures undermined
- Hard points in serviceable condition at decadal time scale, e.g., no apparent undermining, flanking, failing grout
- If geologic grade control, rock should be resistant igneous and/or metamorphic; For sedimentary/hardpan to be classified as 'grade control', it should be of demonstrable strength as indicated by field testing such as hammer test/borings and/or inspected by appropriate stakeholder

B Intermediate to A and C – artificial or geologic grade control present but spaced 2/Sv m to 4/Sv m or potential evidence of failure or hardpan of uncertain resistance

C Grade control absent, spaced >100 m or $>4/S_v$ m, or clear evidence of ineffectiveness



GRADE CONTROL

most resistant

least resistant

A) Effective Grade Control

San Diego Creek: concrete drop structure in good condition

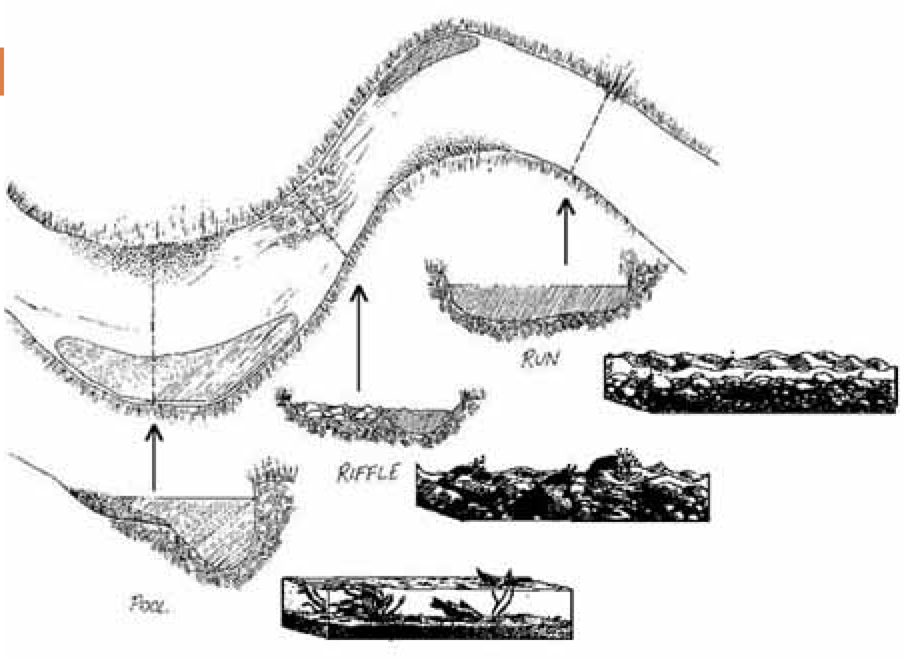
B) Intermediate

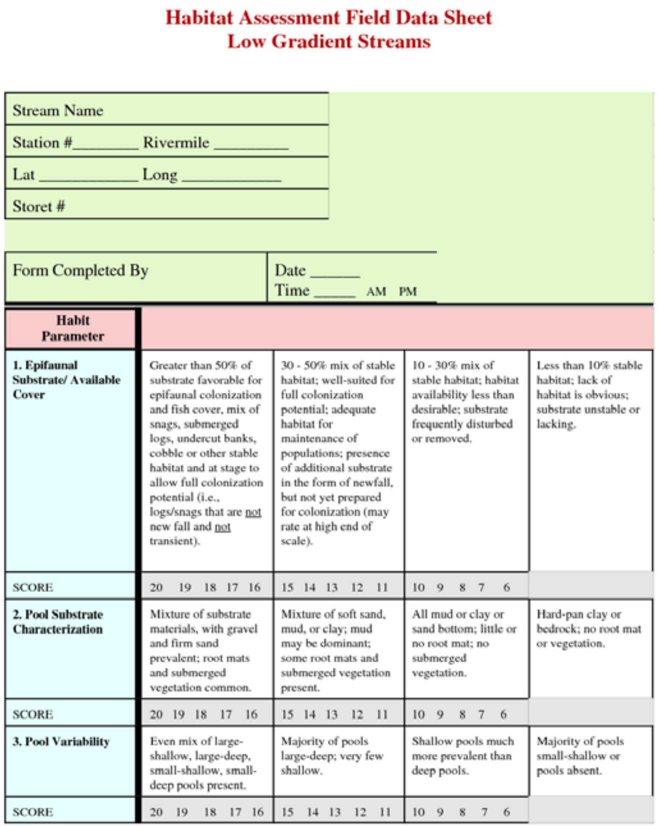
Silverado Canyon: grouted riprap with some undermining at road crossing

C) Ineffective Grade Control

Borrego Canyon: grouted riprap with substantial undermining

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 <u>not</u> new fall and <u>not</u> 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	

PHAB MMI Metrics

Condition Categories

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

Index under development

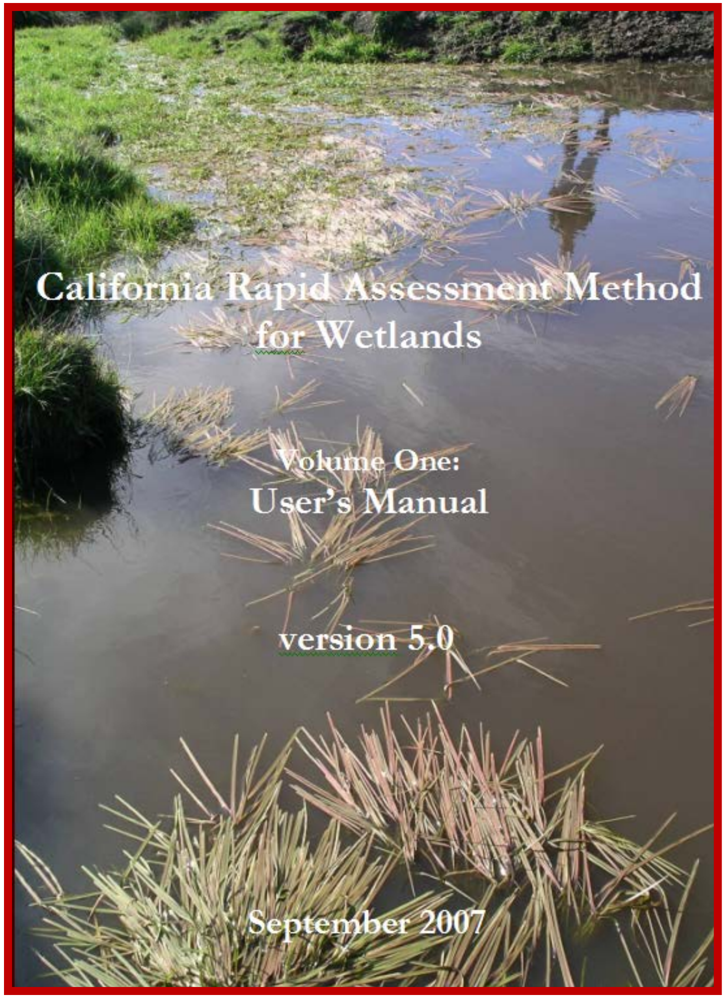
Candidate Metrics

- 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

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



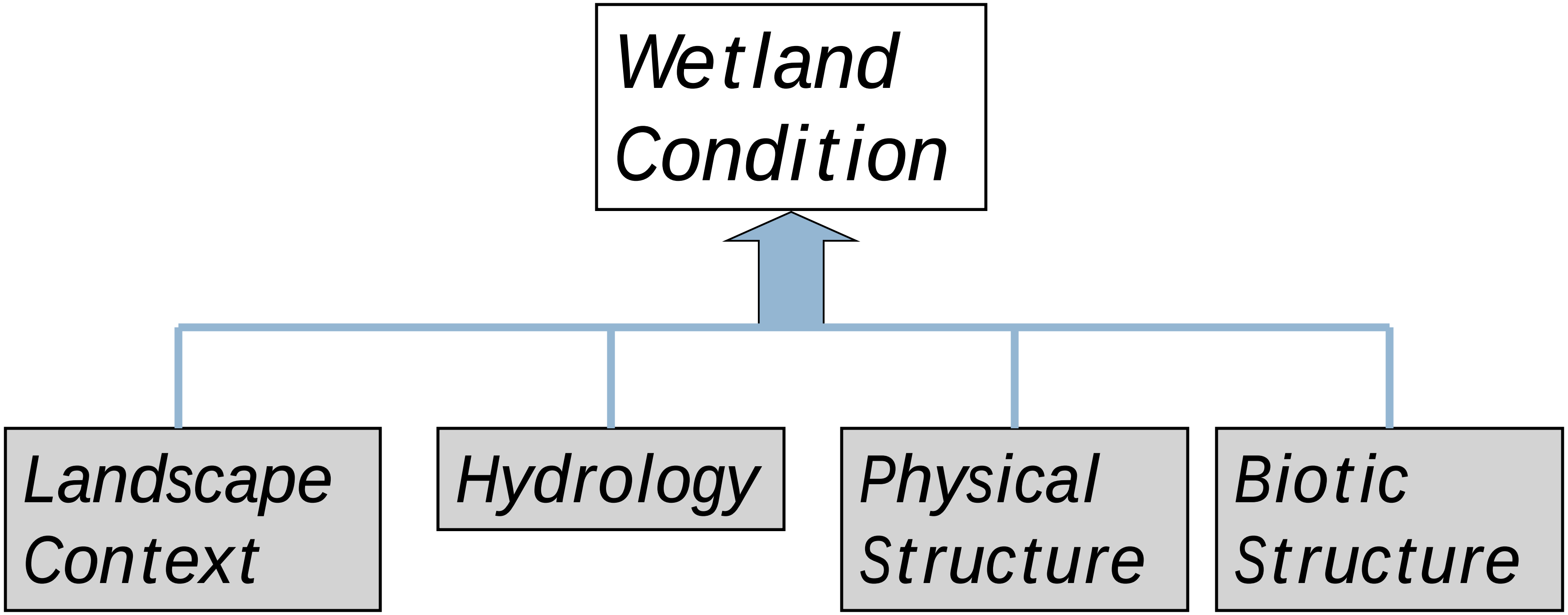
California Rapid Assessment Method for Wetlands

Volume One:
User's Manual

version 5.0

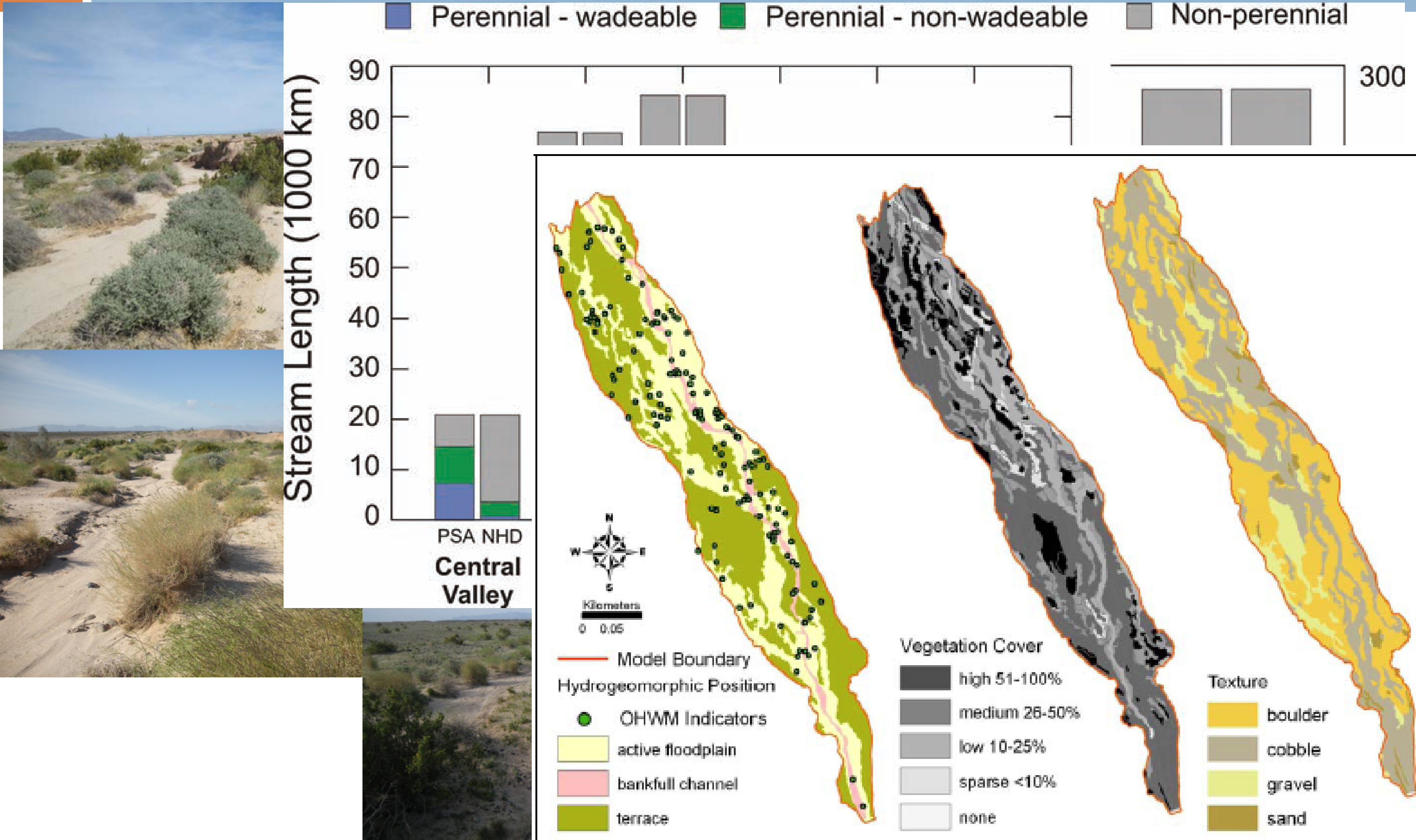
September 2007

CRAM Attributes

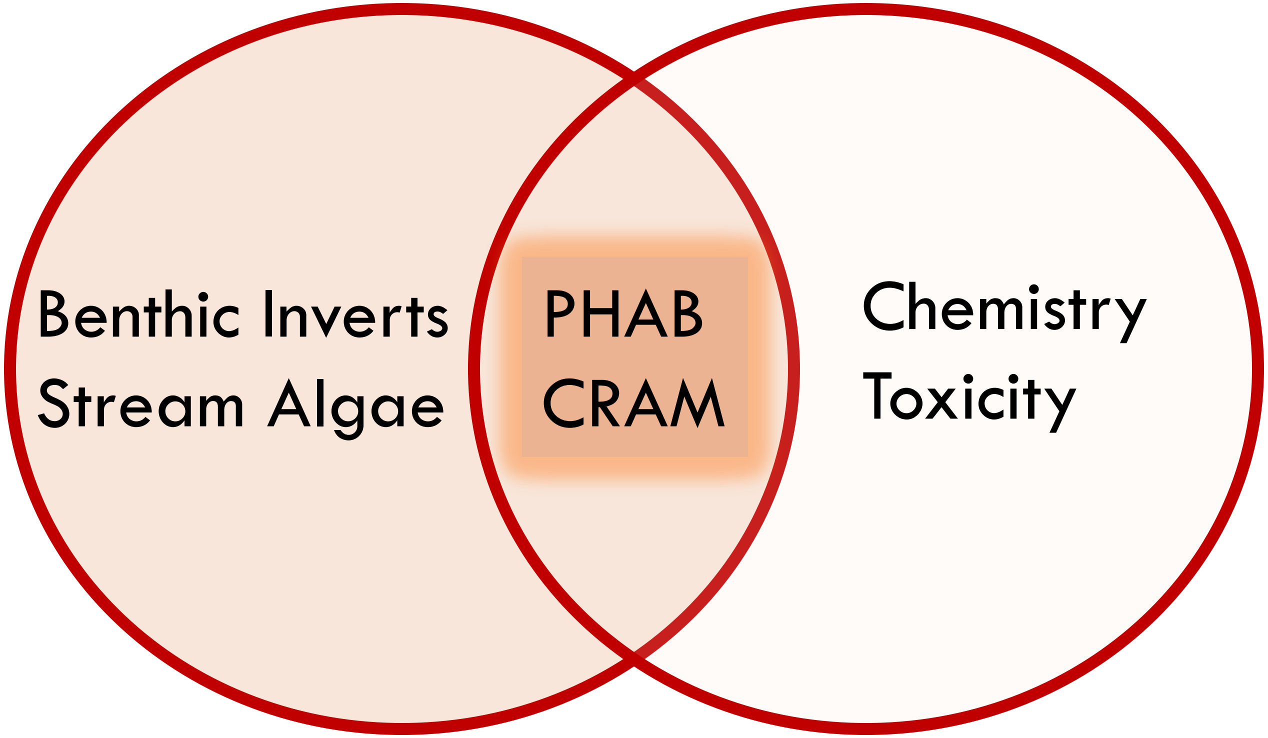


- CRAM recognizes four attributes of wetland condition
- Each attribute is represented by 2-3 metrics, some of which have sub-metrics.

Emerging Indicators for Non-perennial Streams



What About Stress?



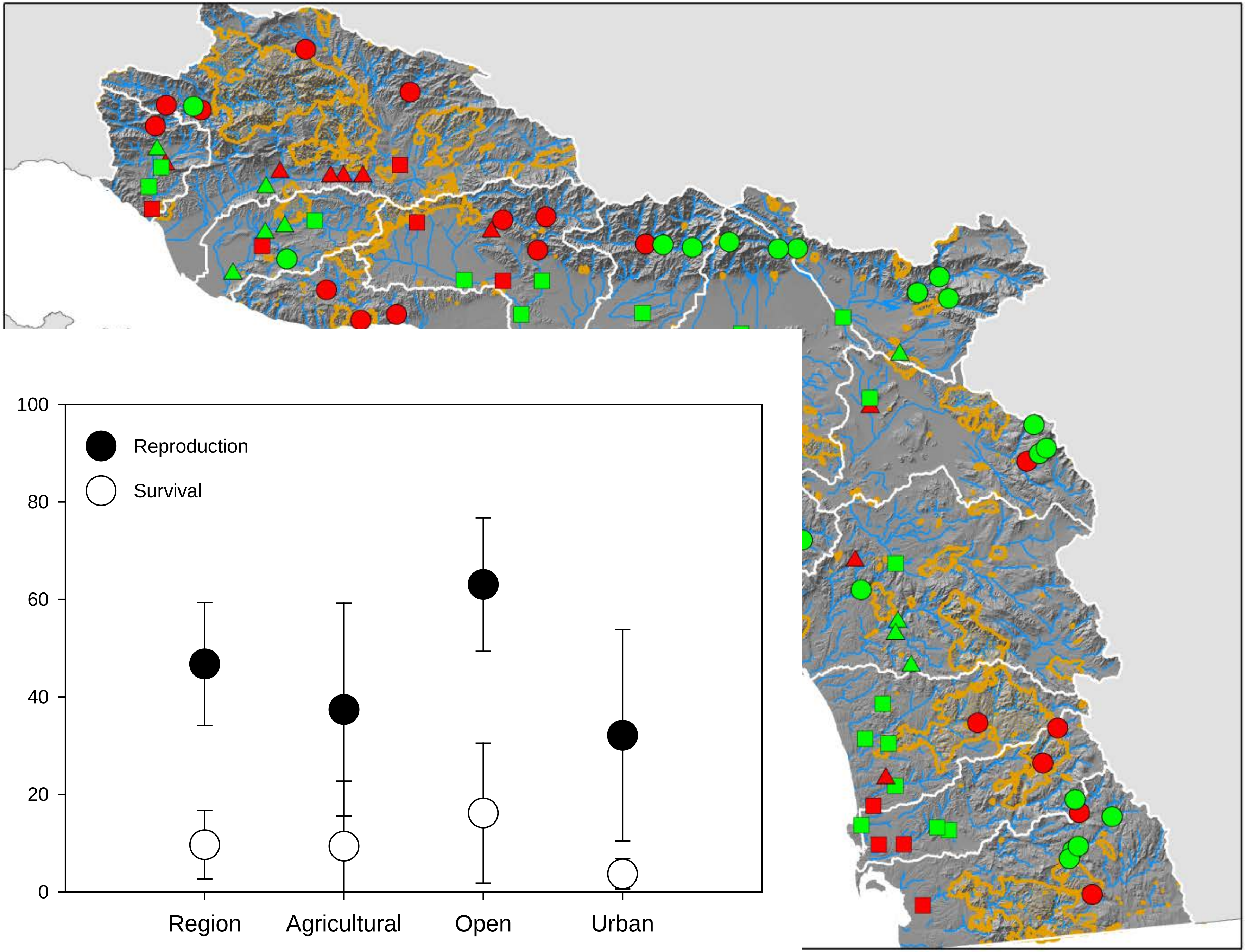
Benthic Inverts
Stream Algae

PHAB
CRAM

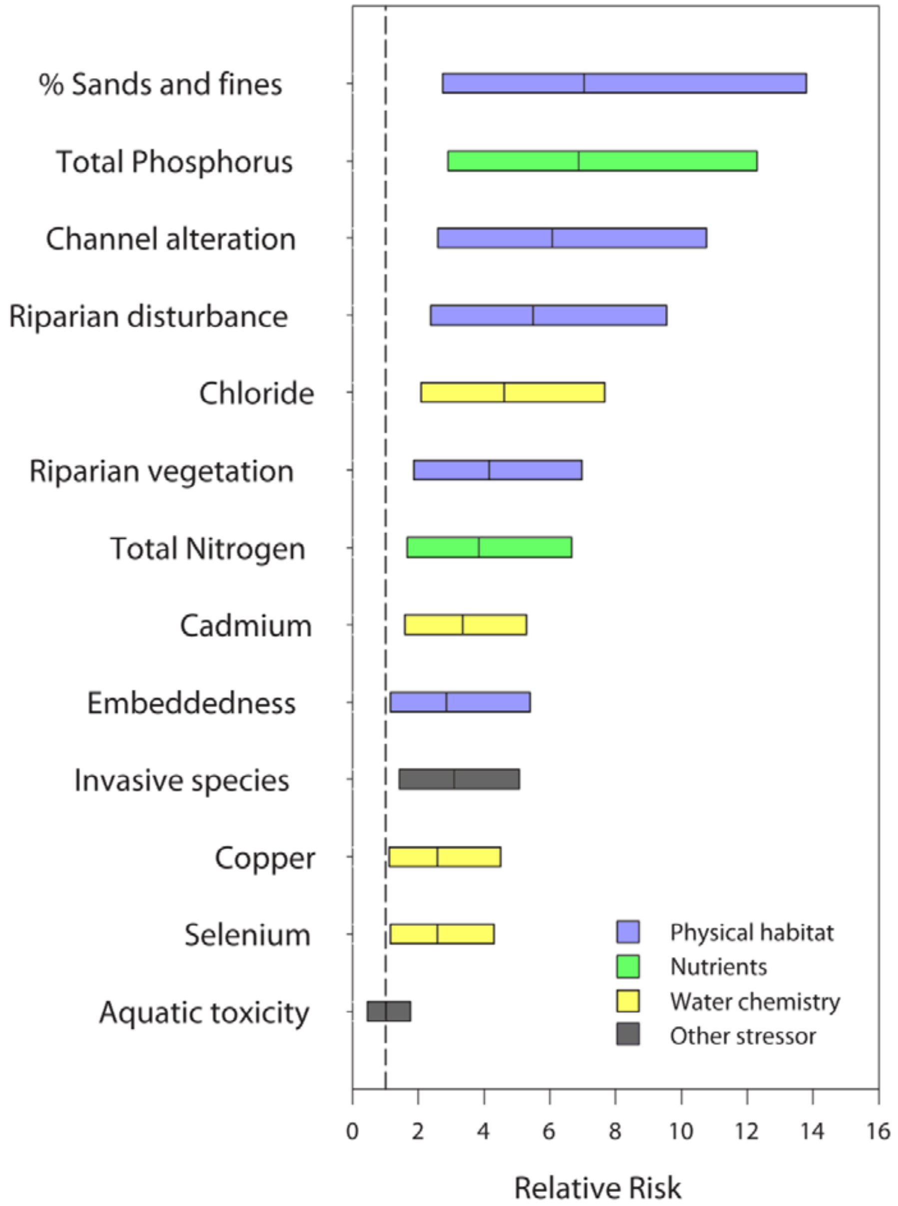
Chemistry
Toxicity

Condition

Stress


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

Risk Factors



Higher risk:

- Habitat degradation
- High nutrients

Lower risk

- Conventional toxicants

Analysis show correlation, not causation

Working on integrated assessment

Common Data Platforms

CEDEN

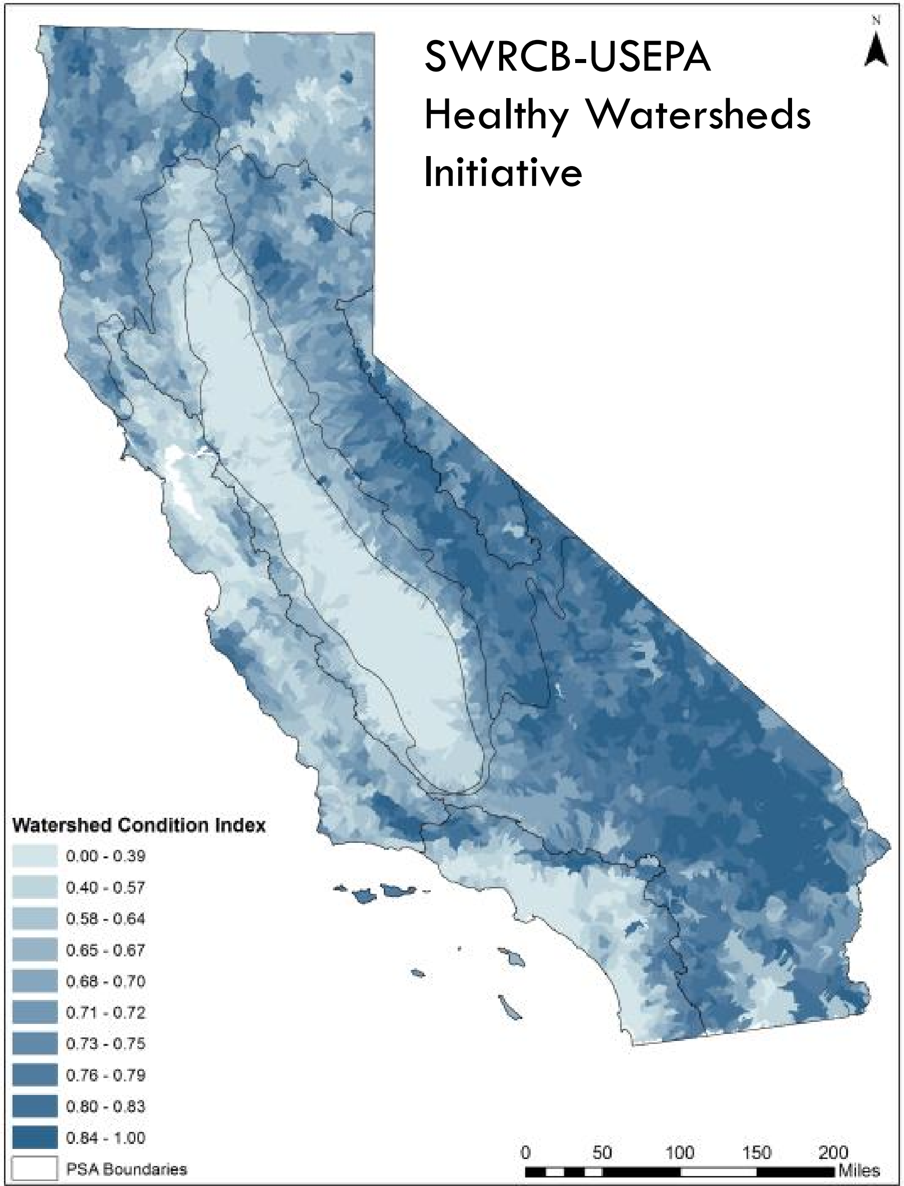
CALIFORNIA ENVIRONMENTAL DATA EXCHANGE NETWORK

Benthic invertebrates, Algae, Chemistry, Toxicity

EcoAtlas

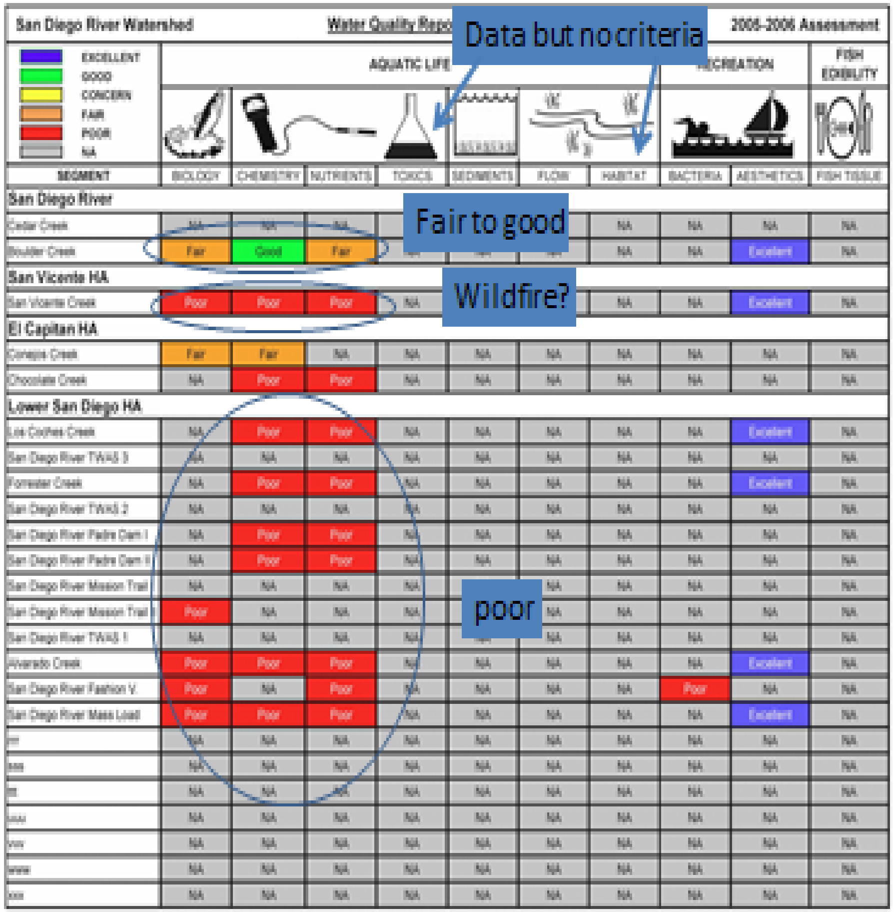
CRAM, Chemistry, Toxicity, + Project info

Communication



SWRCB-USEPA
Healthy Watersheds
Initiative

2005-2006



San Diego River Watershed — Water Quality Repo — **2005-2006 Assessment**

🟦 EXCELLENT
🟩 GOOD
🟨 CONCERN
🟧 FAIR
🟥 POOR
⬜ NA

	AQUATIC LIFE							ECREATION		FISH EDIBILITY
SEGMENT	BIOLOGY	CHEMISTRY	NUTRIENTS	TOXICS	SEDIMENTS	FLOW	HABITAT	BACTERIA	AESTHETICS	FISH TISSUE
San Diego River										
Cedar Creek	NA	NA	NA	[illegible]	[illegible]	[illegible]	NA	NA	NA	NA
Boulder Creek	Fair	Good	Fair	NA	NA	NA	NA	NA	Excellent	NA
San Vicente HA										
San Vicente Creek	Poor	Poor	Poor	NA	[illegible]	[illegible]	NA	NA	Excellent	NA
El Capitan HA										
Conejos Creek	Fair	Fair	NA	NA	NA	NA	NA	NA	NA	NA
Chocolate Creek	NA	Poor	Poor	NA	NA	NA	NA	NA	NA	NA
Lower San Diego HA										
Los Coches Creek	NA	Poor	Poor	NA	NA	NA	NA	NA	Excellent	NA
San Diego River TWAS 3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Forester Creek	NA	Poor	Poor	NA	NA	NA	NA	NA	Excellent	NA
San Diego River TWAS 2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
San Diego River Padre Dam I	NA	Poor	Poor	NA	NA	NA	NA	NA	NA	NA
San Diego River Padre Dam II	NA	Poor	Poor	NA	NA	NA	NA	NA	NA	NA
San Diego River Mission Trail	NA	NA	NA	NA	[illegible]	NA	NA	NA	NA	NA
San Diego River Mission Trail I	Poor	NA	NA	NA	[illegible]	NA	NA	NA	NA	NA
San Diego River TWAS 1	NA	NA	NA	NA	[illegible]	NA	NA	NA	NA	NA
Alvarado Creek	Poor	Poor	Poor	NA	NA	NA	NA	NA	Excellent	NA
San Diego River Fashion V.	Poor	NA	Poor	NA	NA	NA	NA	Poor	NA	NA
San Diego River Mass Load	Poor	Poor	Poor	NA	NA	NA	NA	NA	Excellent	NA
rrr	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
sss	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ttt	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
uuu	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
vvv	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
www	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
xxx	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Data but no criteria

Fair to good

Wildfire?

poor

E:\Regional Board Work\SWAMP\report cards\SDR report cards\detailed report cards\report card by year\SDR 2005_2006
10/3

Hydromodification

Toxicity

Bioobjectives

Wetland Policy

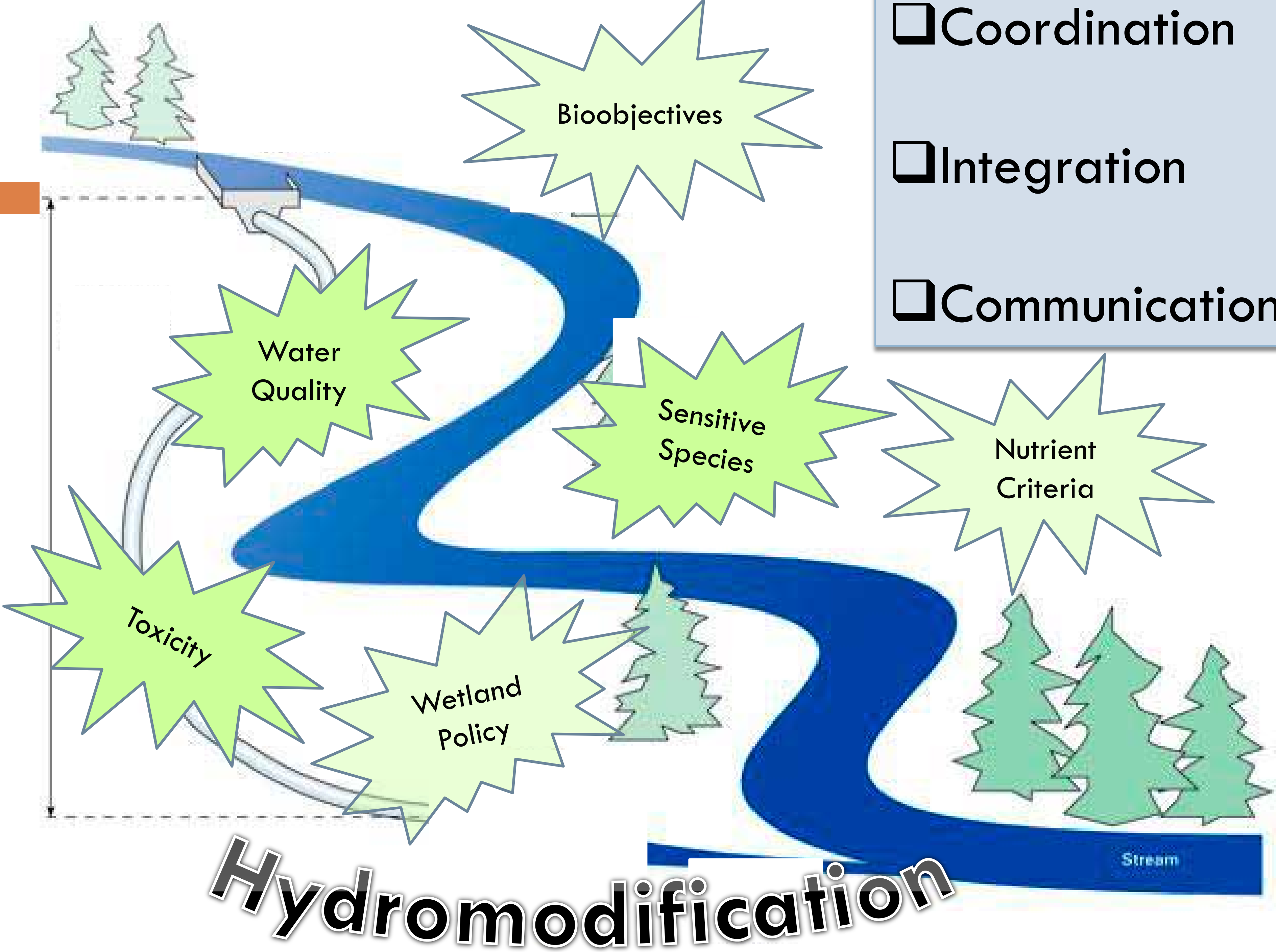
Nutrient Criteria

Water Quality

Sensitive Species

Hydromodification

- ☐ Coordination
- ☐ Integration
- ☐ Communication



Biobjectives

Water Quality

Sensitive Species

Nutrient Criteria

Toxicity

Wetland Policy

Final Thoughts

- Questions drive monitoring
- True benefits will only be realized over the long-term
    - Need long-term implementation mechanisms
- Monitoring data contributes to new knowledge
    - Data must be made broadly available

Thank You

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