

Causal Assessment in California

Southern California Case Studies: San
Diego and Santa Clara Rivers

Bio Objectives Science Advisory Panel October 17, 2012

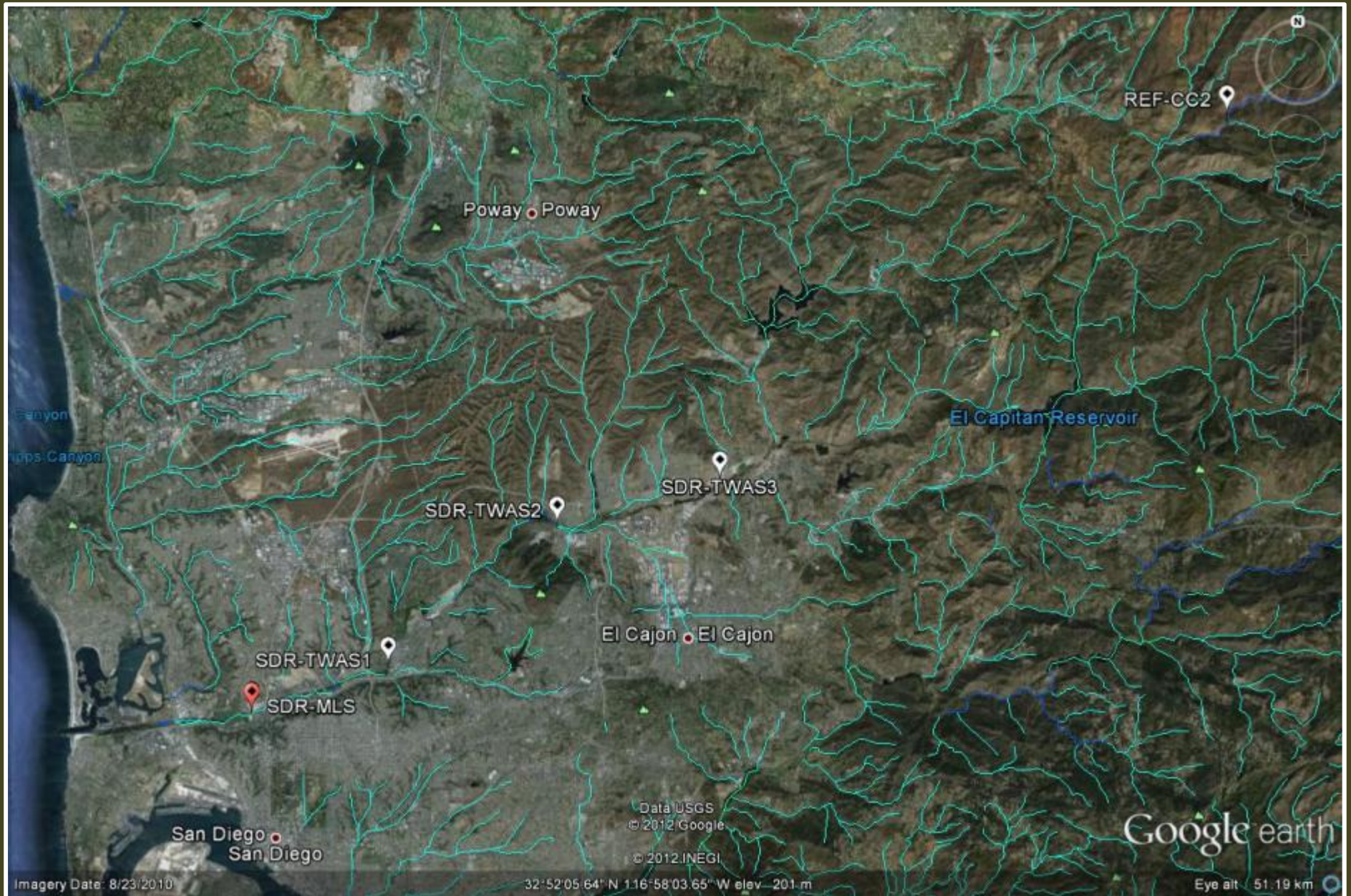


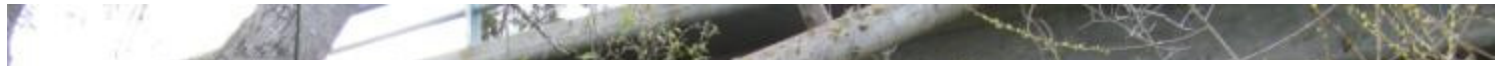
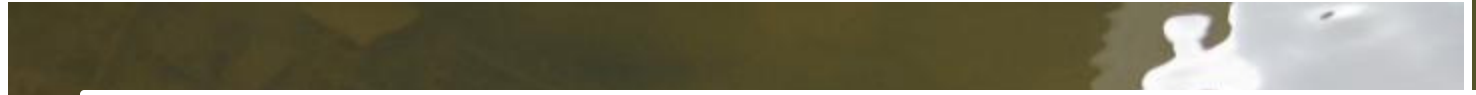
San Diego River



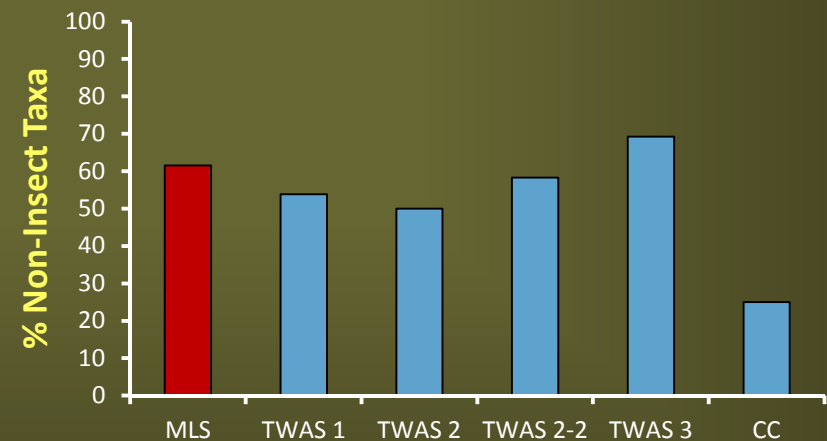
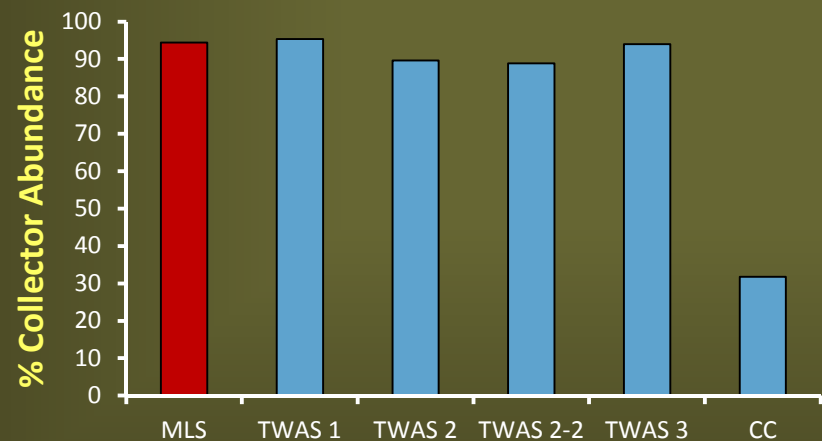
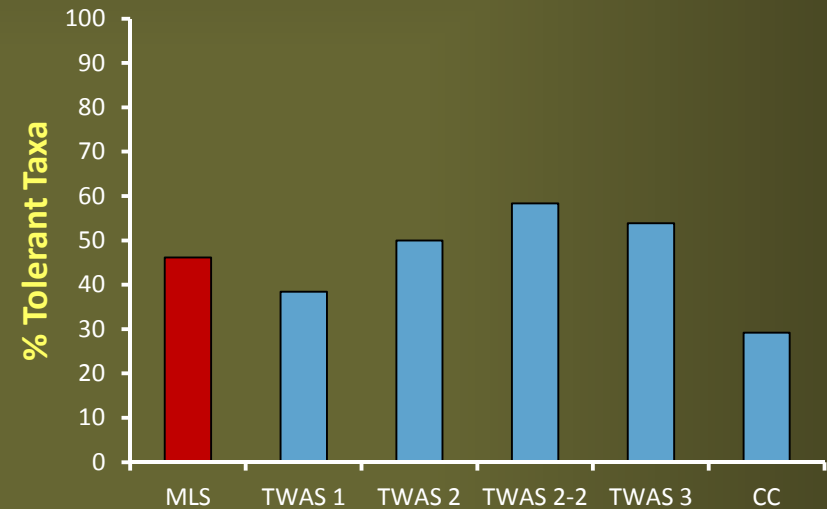
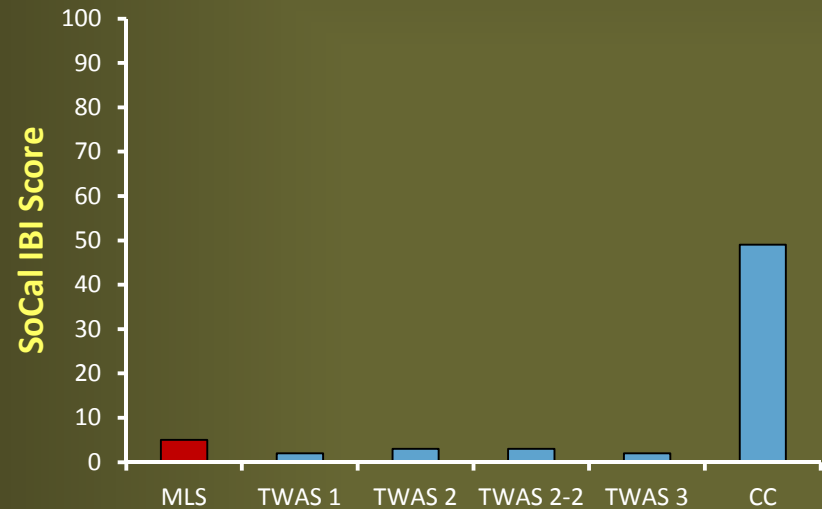
Defining the Case

- Example of a highly urbanized stream
 - Typical of coastal Southern California
- Partners with San Diego Water Board, City of San Diego, and County of San Diego
- Case centered around May 2010 sampling
 - Presumed to have multiple stressors





Biological Impacts



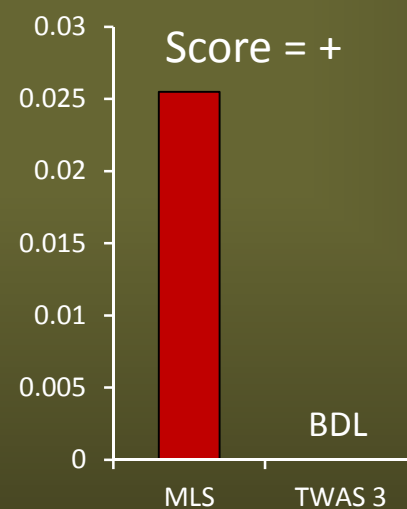
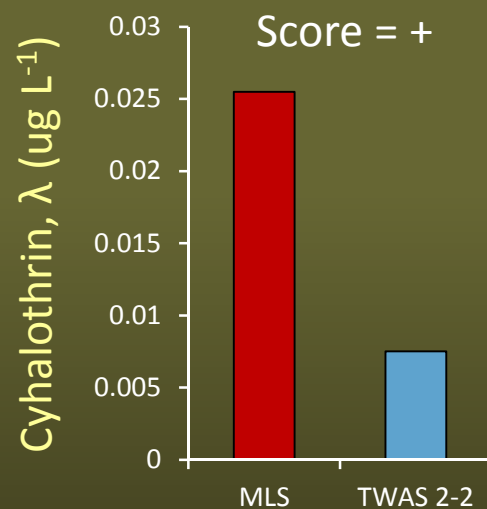
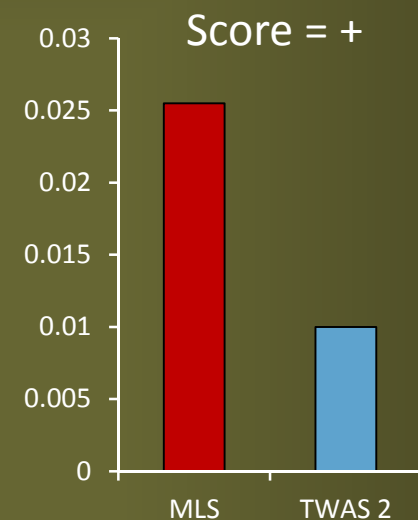
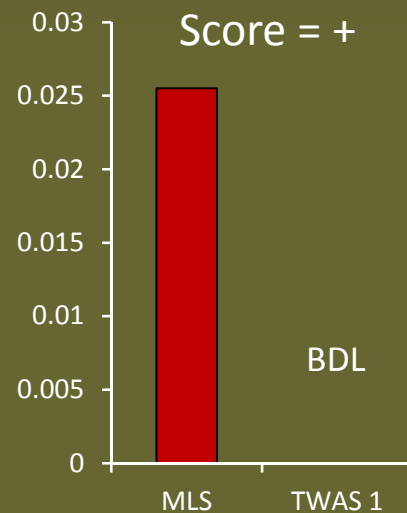
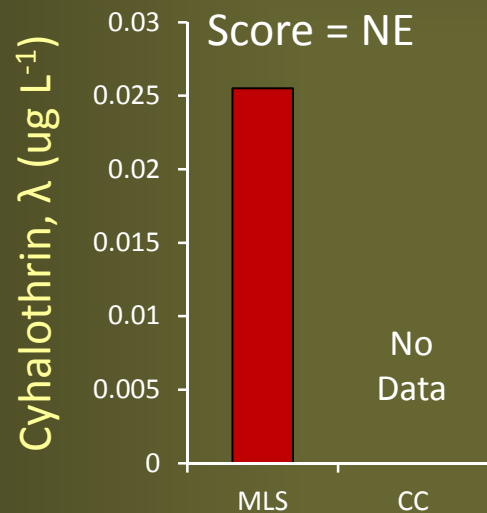
Sites

Sites

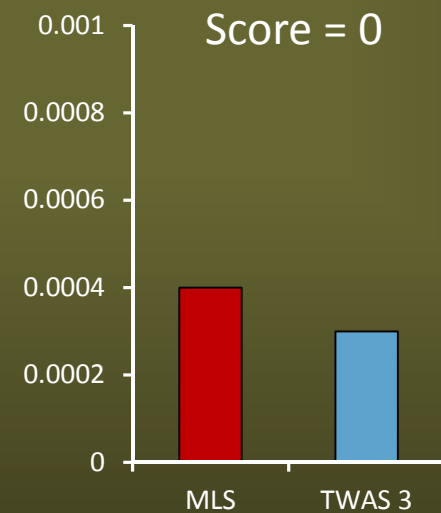
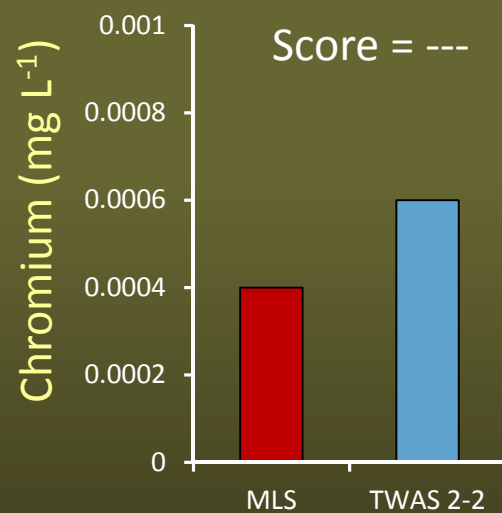
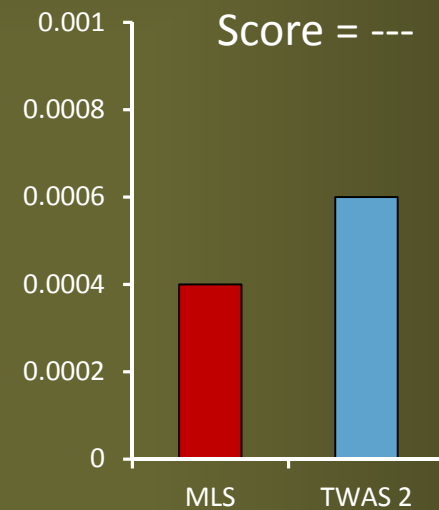
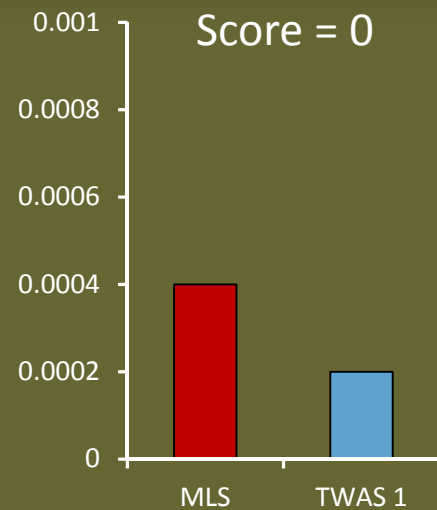
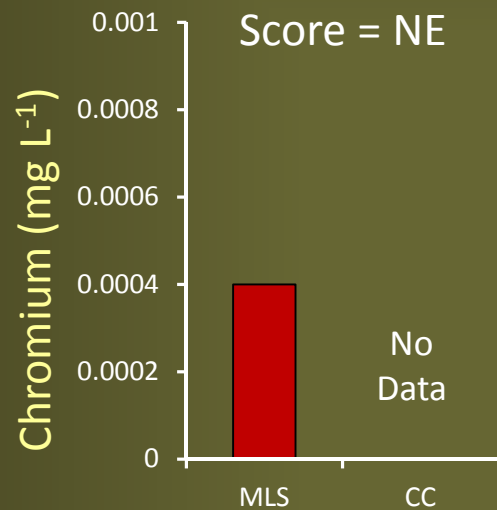
Candidate Causes

- **Conductivity**
 - Conductivity & TDS
- **Heavy Metals**
 - Water, sediment, periphyton-bound metals
- **Pesticides**
 - Synthetic pyrethroids, non-pyrethroids & herbicides in water and sediment
- **Nutrients**
 - Algal mats, low DO, altered food & ammonia
- **Habitat Alteration**
 - Simplified habitat, temperature & changes in food sources

Spatial-Temporal Co-Occurrence



Spatial-Temporal Co-Occurrence



Example Final Score Sheet

TWAS 1

Candidate Cause	Spatial Temporal Co-Occurrence	Stressor Response From Inside the Case			Co-Occurrence From Outside the Case	Stressor Response From Outside the Case			Stressor Response From Laboratory	Continuity
		Collector Abundance	Non-Insect Taxa	Tolerant Taxa		Collector Abundance	Non-Insect Taxa	Tolerant Taxa		
Conductivity	+	0	+	-	+	0	+	+	NE	+ / + / -
Habitat Alteration	---	+	0	0	+	+	0	0	NE	- / - / -
Heavy Metals	+	-	0	-	NE	0	0	0	--	- / - / -
Nutrients	---	0	0	0	NE	-	0	0	NE	+ / + / +
Pesticides	+	-	+	0	NE	NE	NE	NE	--	- / - / -

Results

Most Likely Candidate Causes

Candidate Cause	Evidence & Comments
Conductivity	Elevated conductivity and TDS at MLS compared to in- and outside the case. Consistent stressor response relationship w/ non-insect taxa in- and outside the case
Pesticides	Elevated levels of water column cyhalothrin- λ , fenvalerate, and sediment bifenthrin at MLS compared to inside the case. Stressor response relationship w/ non-insect taxa.

Results

Least Likely Candidate Causes

Candidate Cause	Evidence & Comments
Heavy Metals	Elevated levels of some metals at MLS compared to in- and outside the case, but not at toxic levels. Inverse stressor response relationship from inside the case.

Results

Indeterminate Candidate Causes

Candidate Cause	Evidence & Comments
Habitat Alteration	Mixed levels at MLS compared to inside the case. Inconsistent/indeterminate stressor response relationship in- and outside the case. Some evidence for sands & fines and habitat simplification
Nutrients	Mixed levels of nutrient responses at MLS compared to in- and outside the case.

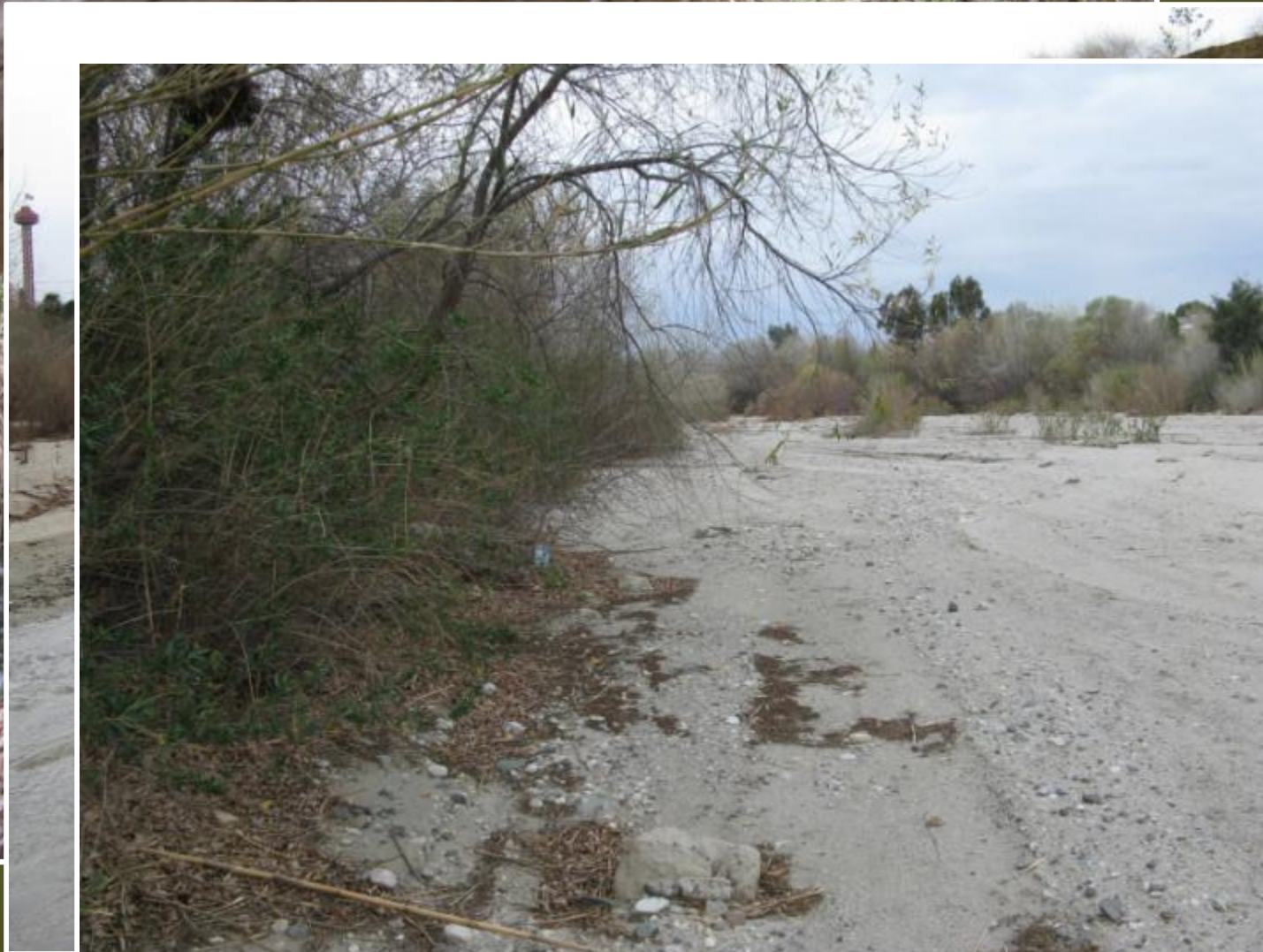
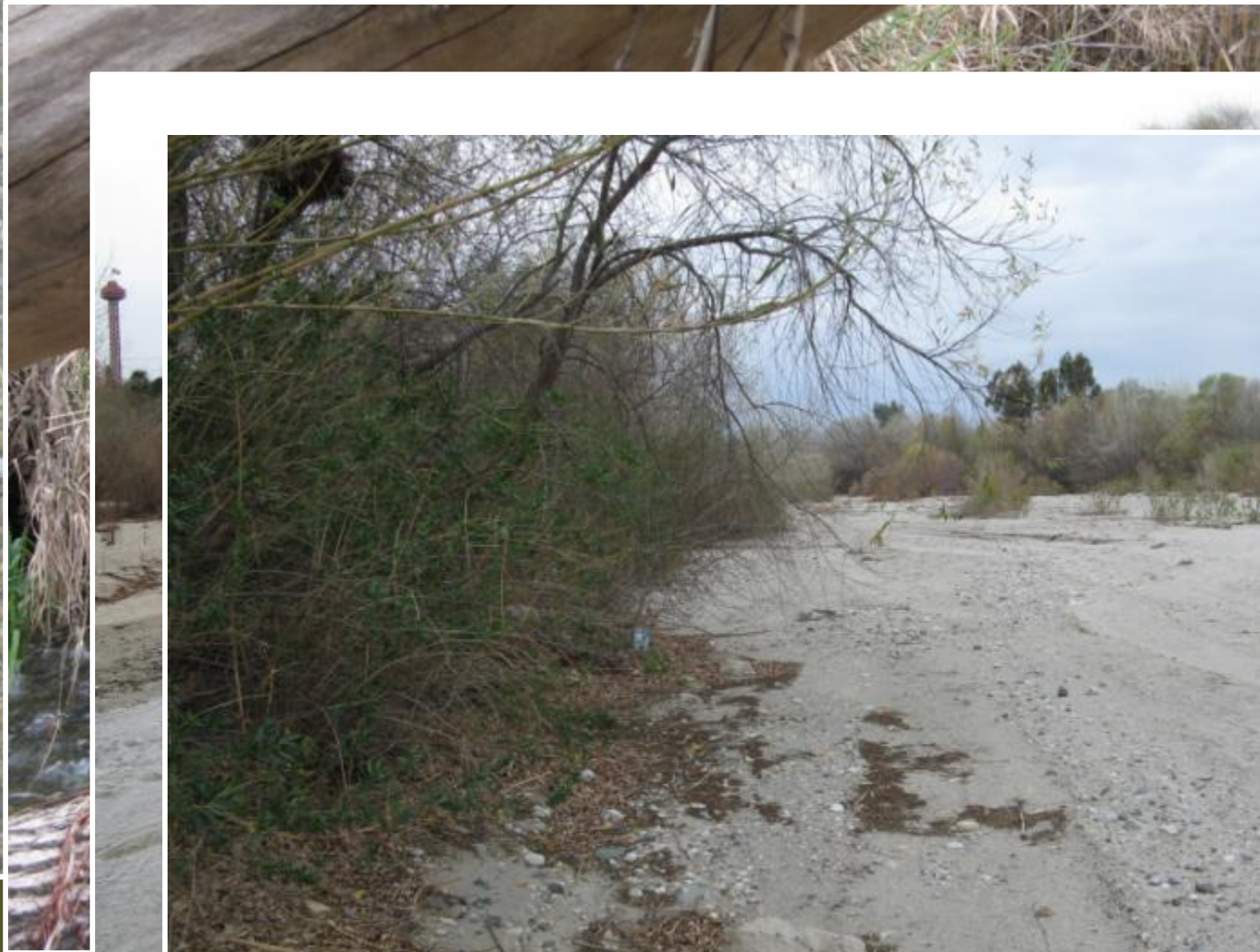
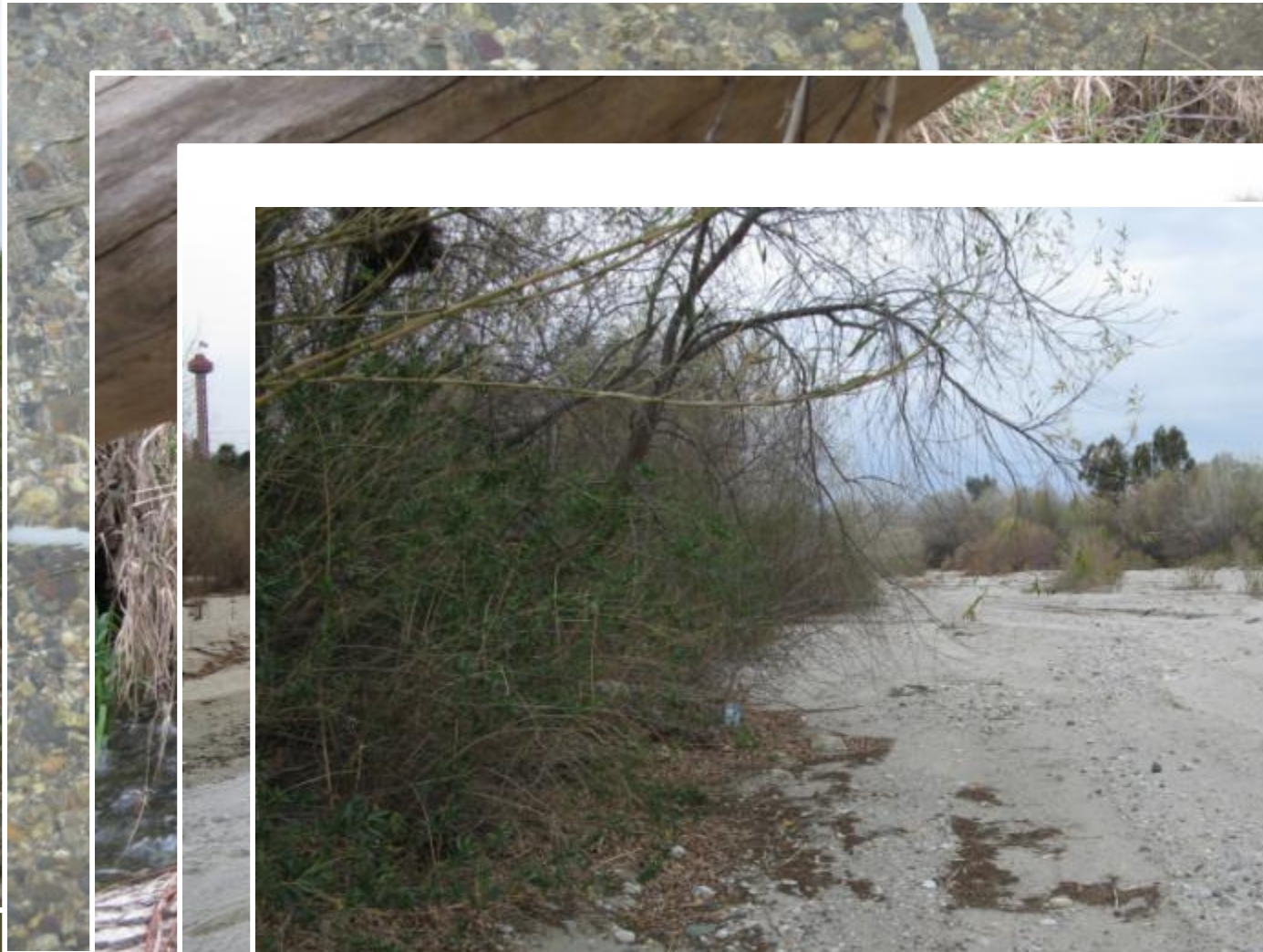
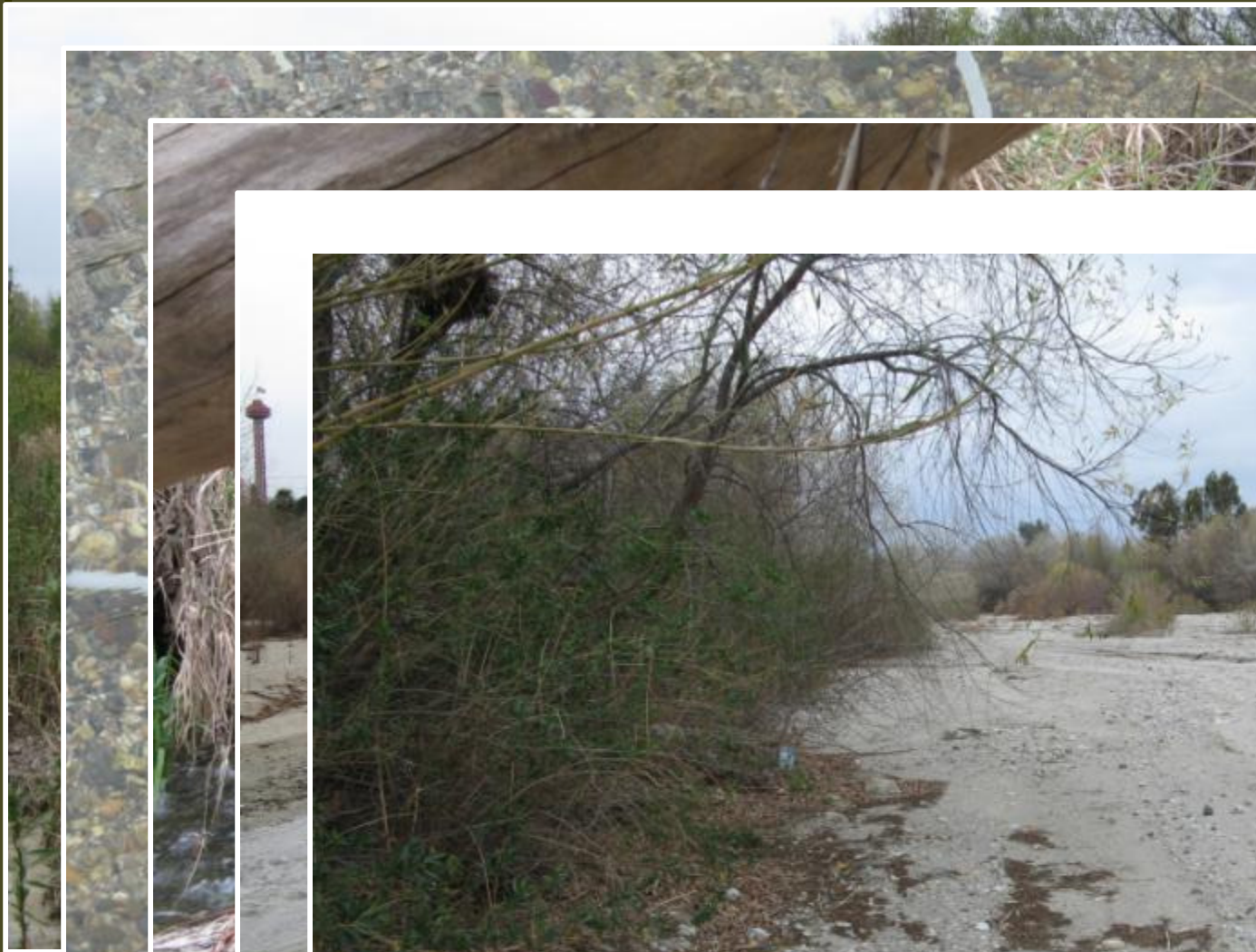
Santa Clara River



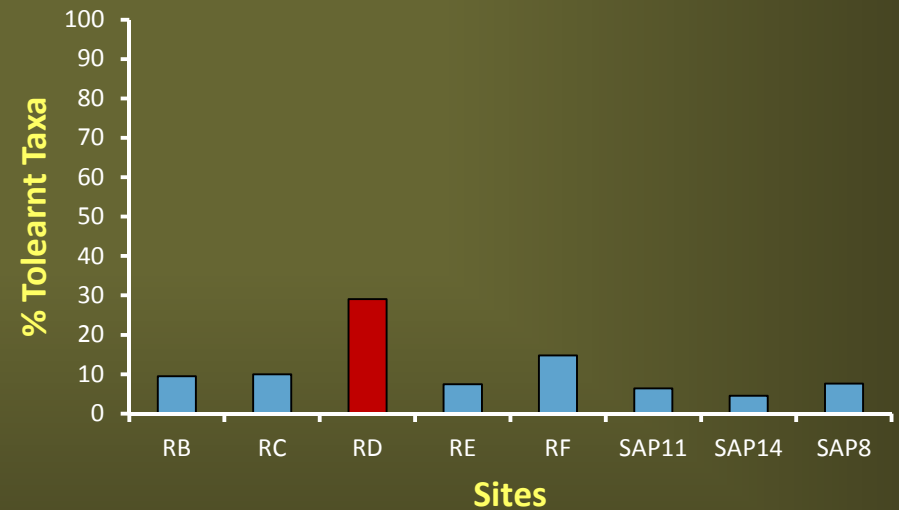
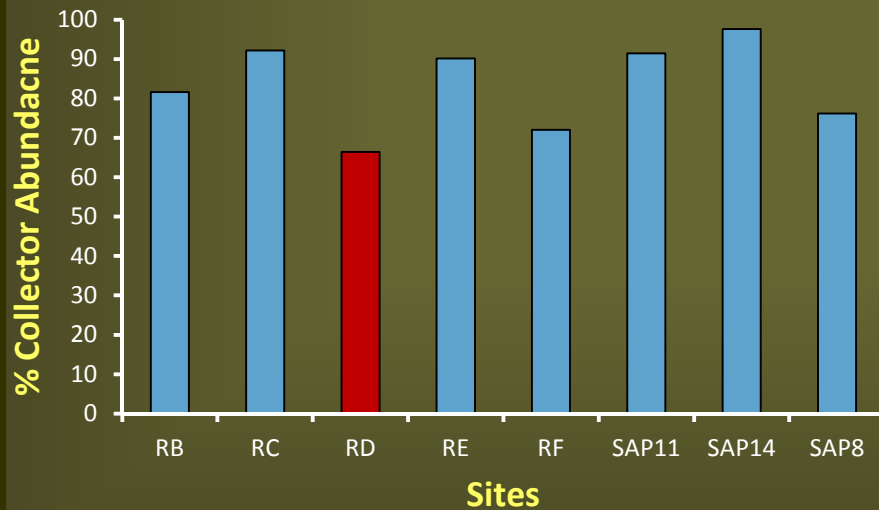
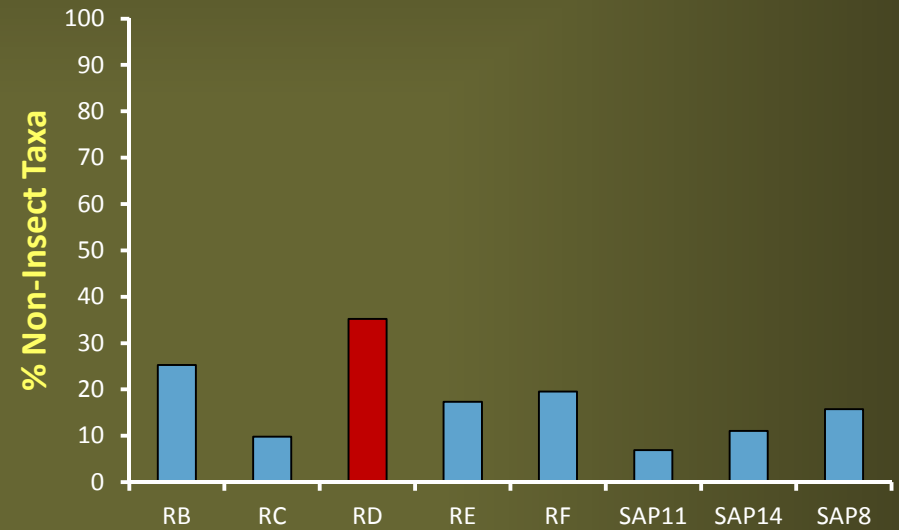
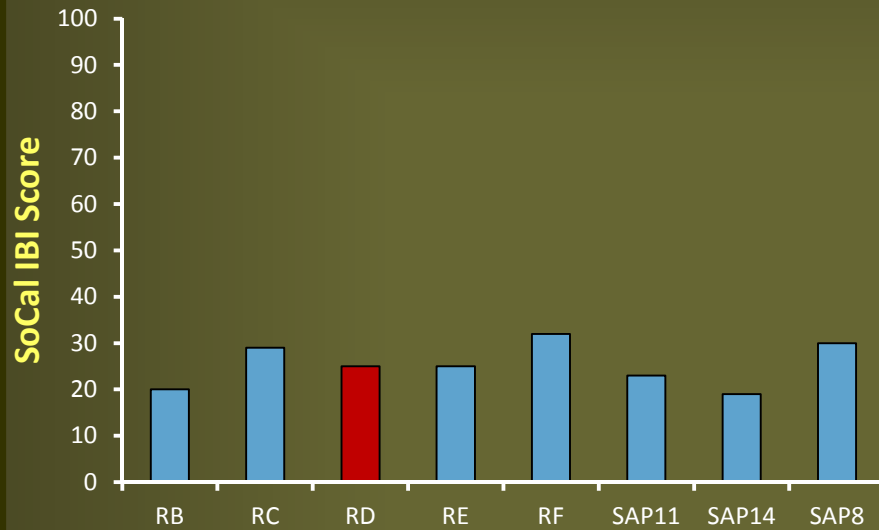
Defining the Case

- Example of an urbanized/suburbanized stream
 - Typical of Southern California
- Partners with Region 4 Water Board and LA County Sanitation District
- Case centered around October 2006 and 2007 sampling
 - Presumed to have multiple stressors



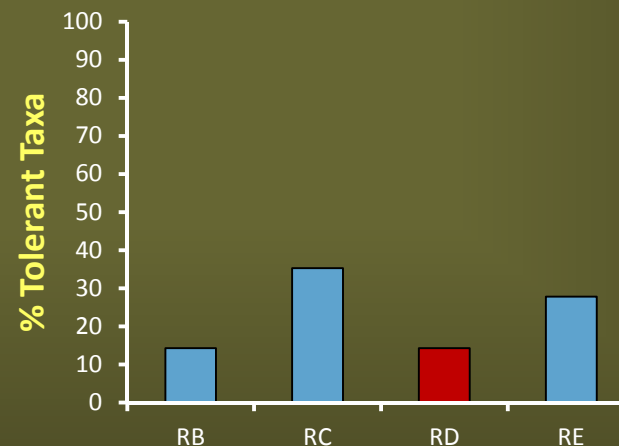
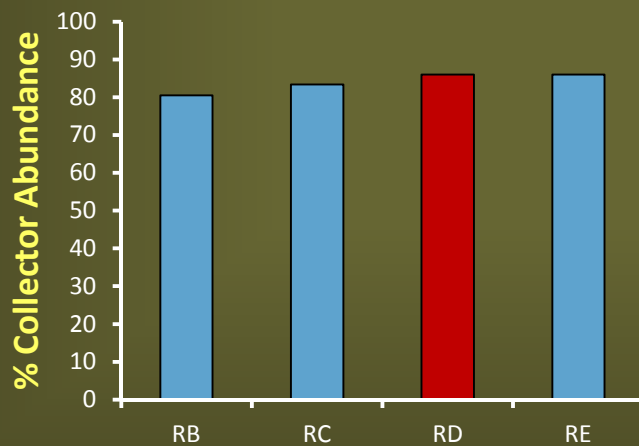
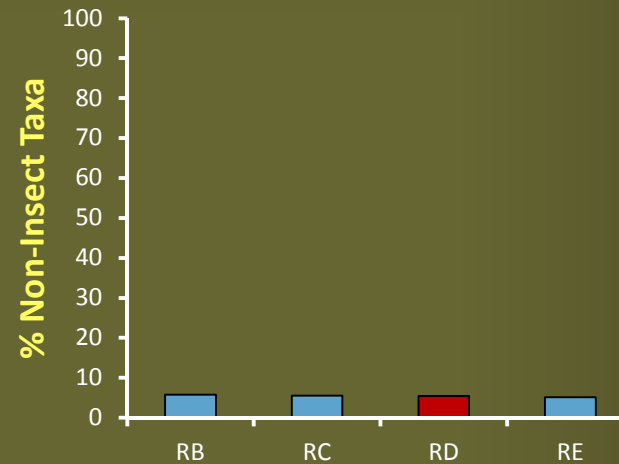
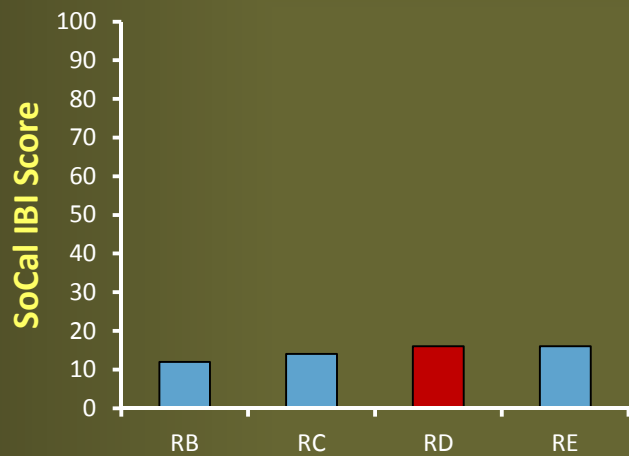


Biological Impacts



2006

Biological Impacts



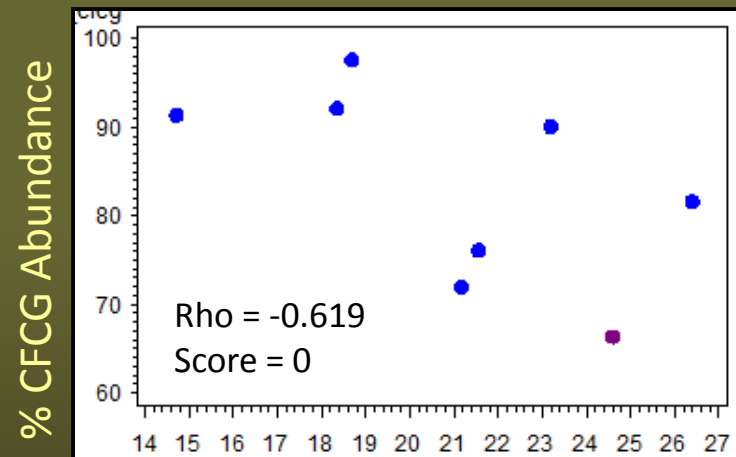
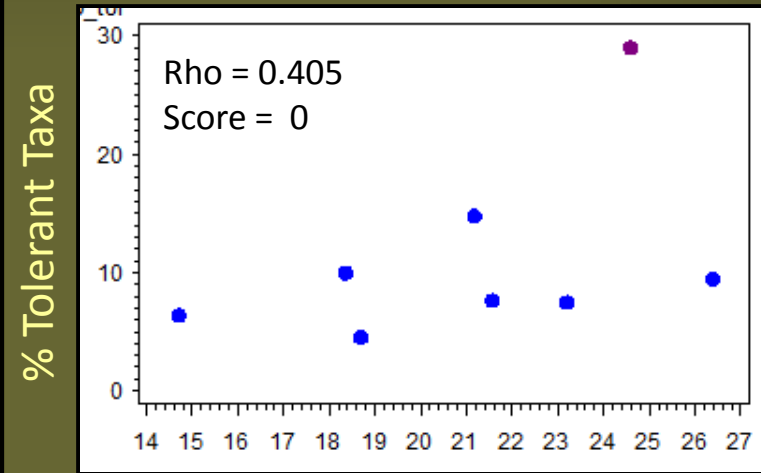
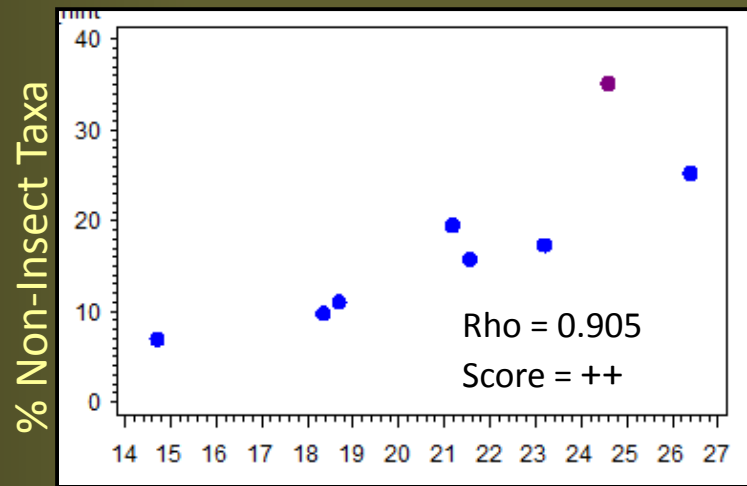
Sites

Sites

Candidate Causes

- **Conductivity**
 - Conductivity & TDS
- **Heavy Metals**
 - Water, sediment, periphyton-bound metals
- **Pesticides**
 - Synthetic pyrethroids, non-pyrethroids & herbicides in water and sediment
- **Nutrients**
 - Algal mats, low DO, altered food & ammonia
- **Habitat Alteration**
 - Simplified habitat
- **Habitat Discontinuity**
 - Altered food, lack of wood, lack of recruits
- **Temperature**

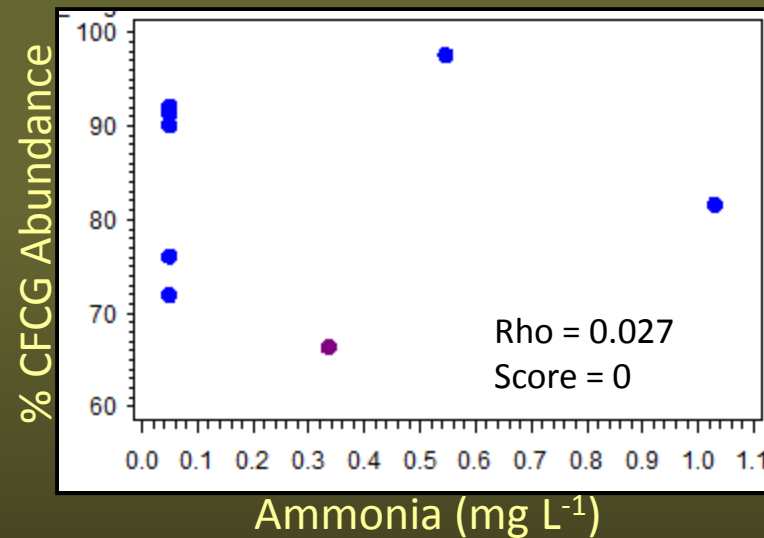
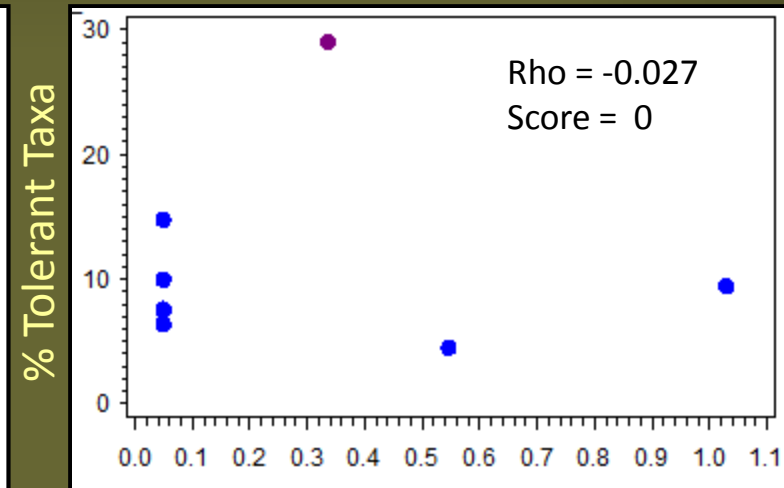
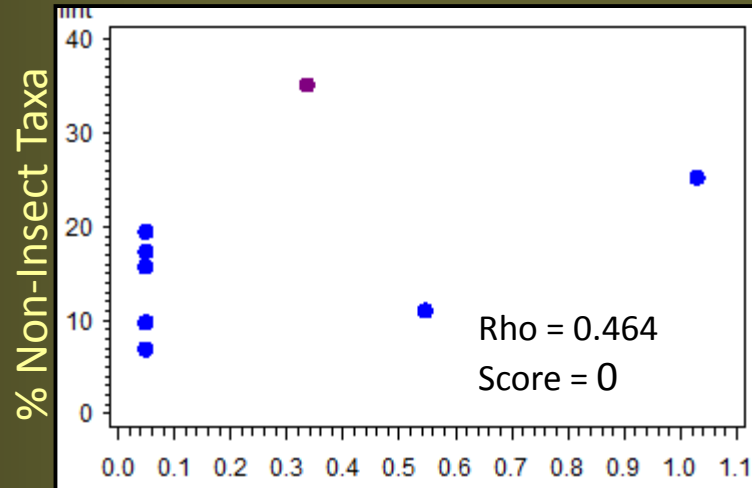
Stressor Response



TDS (mg L⁻¹)

Sites ● ● ● Other ● ● ● RD

Stressor Response



Sites ● ● ● Other ● ● ● RD

Example Final Score Sheet

RC 2006

Candidate Cause	Spatial Temporal Co- Occurrence	Stressor Response			Co-Occurrence From Outside the Case	Stressor Response From Outside the Case			Stressor Response From the Laboratory	Continuity
		Collector Abundance	Non- Insect Taxa	Tolerant Taxa		Collector Abundance	Non- Insect Taxa	Tolerant Taxa		
Metals	+	+	+	+	NE	0	0	0	--	-/-/-
Conductivity	---	+	-	0	+	+	+	+	NE	-/-/-
River Discontinuity	0	0	0	0	NE	0	+	+	NE	0/0/0
Habitat Alteration	0	0	0	0	-	-	+	+	NE	+/-/-
Nutrients	---	-	-	-	NE	NE	NE	NE	NE	+ / + / +
Pesticides	---	--	--	--	NE	NE	NE	NE	-	+ / + / +
Temperature	+	-	+	0	NE	NE	NE	NE	NE	- / + / 0

Results

Most Likely Candidate Causes

Candidate Cause	Evidence & Comments
Conductivity	Elevated conductivity and TDS at RD compared to outside the case. Consistent stressor response relationships in- and outside the case
Temperature	Elevated mean temperature and reduced range compared to inside the case. Stressor response relationship w/ non-insect taxa inside the case.

Results

Least Likely Candidate Causes

Candidate Cause	Evidence & Comments
Heavy Metals	Levels of some metals at RD similar or below to inside the case sites, but supporting stressor response relationships. All concentrations at non-toxic levels.
Pesticides	All measured pesticides and herbicides were below detection limit. Pyrethroids were not measured.
Nutrients	Consistent inverse stressor responses and lower nutrient responses at RD compared to inside the case sites.

Results

Indeterminate Candidate Causes

Candidate Cause	Evidence & Comments
Habitat Simplification	Lower/indeterminate levels at RD compared to in- and outside the case. Inconsistent stressor response relationship in- and outside the case.
River Discontinuity	Lower/indeterminate levels at RD compared to inside the case. Inconsistent stressor response relationship in- and outside the case.

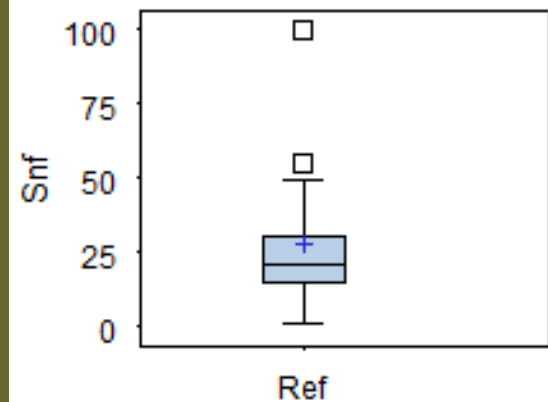
New Tool Exploration

- Could we expand the use and importance of “data from outside the case”?
 - Use the large reference/non-reference dataset available in CA
- Develop approaches for co-occurrence and stressor response
 - Contextualization of stressors and biology at the site

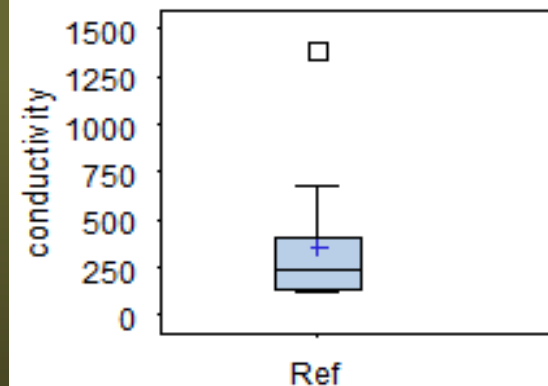
Co-Occurrence Outside the Case

- Use a subset of reference sites
 - Select sites by environmental parameters
- Used slope and elevation
 - 36 samples from 24 sites

Sands and Fines



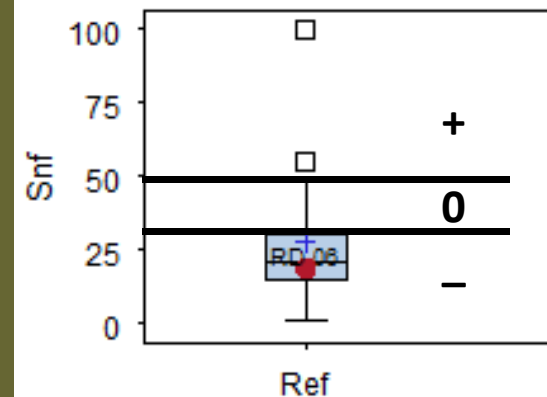
Conductivity



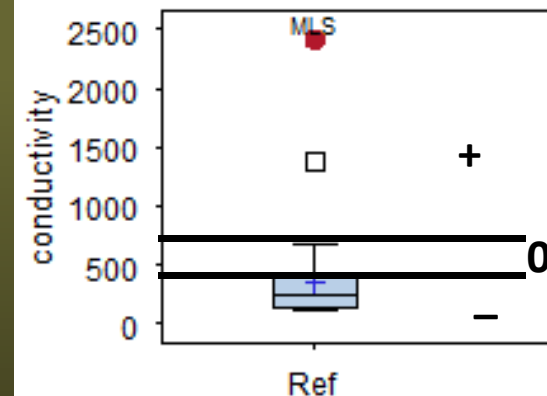
Co-Occurrence Outside the Case

- Use a subset of reference sites
 - Select sites by environmental parameters
- Used slope and elevation
 - 36 samples from 24 sites

Sands and Fines

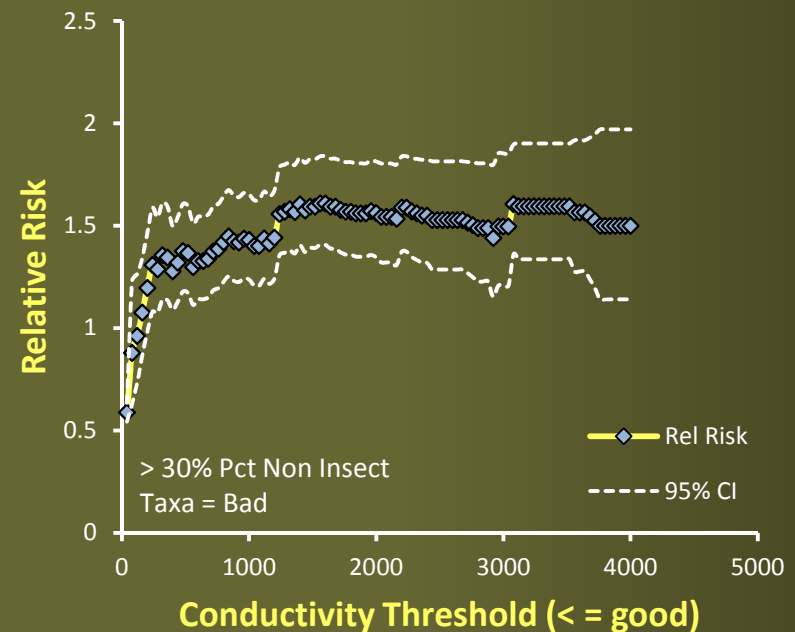


Conductivity



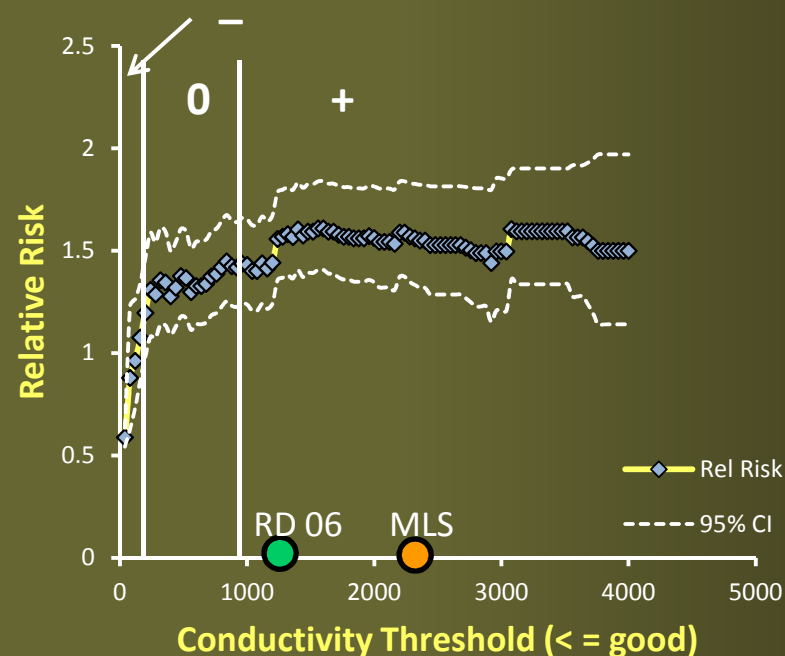
Stressor Response Outside the Case

- Use a relative risk approach to evaluate probability of stressor–biology relationships
 - Subset sites again
- Set biological threshold and incrementally change stressor threshold



Stressor Response Outside the Case

- Use a relative risk approach to evaluate probability of stressor–biology relationships
 - Subset sites again
- Set biological threshold and incrementally change stressor threshold



Conclusions From Southern CA

- Both case studies were moderately successful
 - At a minimum, certain stressors could be ruled out
- As an organizational and communication tool, CADDIS shows good promise for California
- There is some room for modification and improvement

Lessons Learned

- Stakeholder involvement is critical
 - Data and local knowledge contributions
- Selection of biological endpoints is important for the stressor diagnosis
 - How will this be linked to bio-objectives?
- Spatial/temporal constraints in defining the case not conducive to systemic and chronic problems
 - How to select comparator sites?
 - Develop standardized techniques for detangling multiple stressors

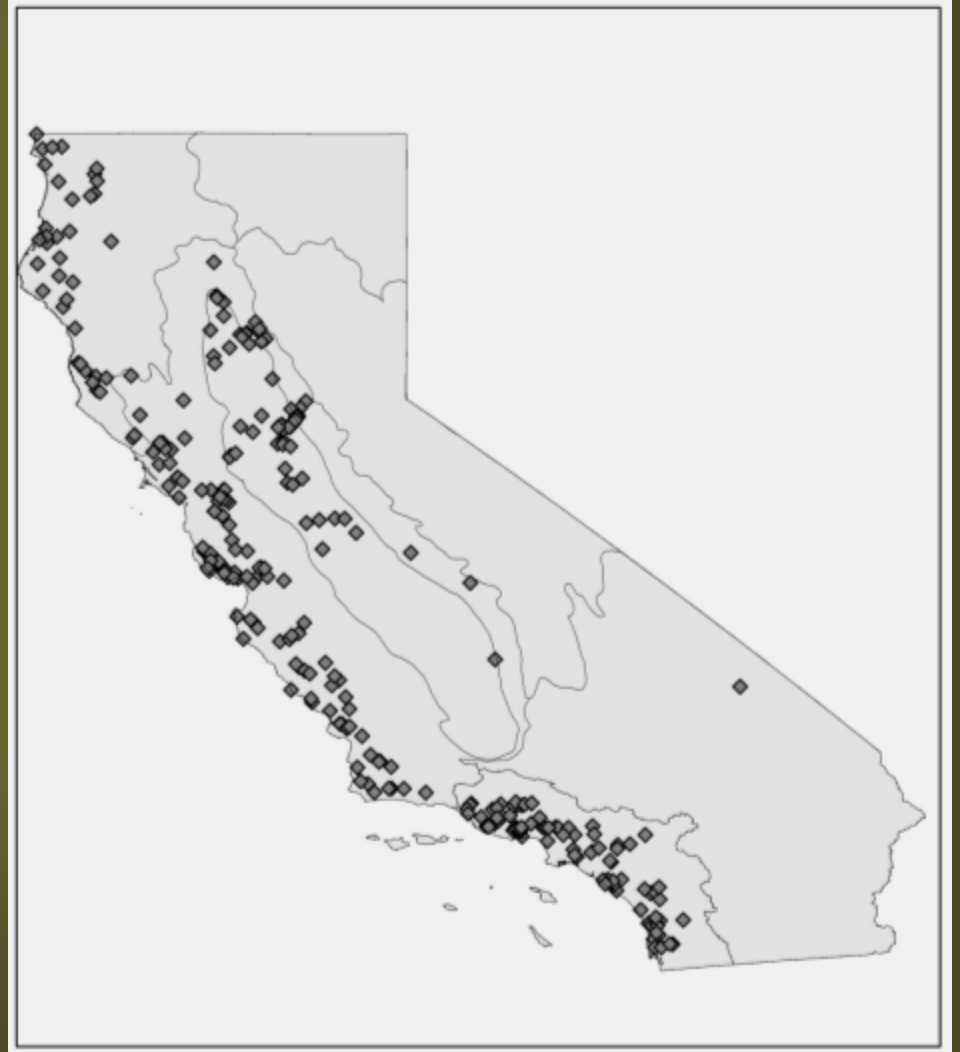
Reference Sites

- Used in Spatial–Temporal co-occurrence from elsewhere
- 36 samples across 24 sites



Non-Reference Sites

- Used in Stressor Response from elsewhere
- 540 samples across 515 sites



Spatial-Temporal Co-Occurrence “Rules”



Score= +



Score= 0



Score= ---



Score= ---



Score= ---