An Introduction to the Algal Stream Condition Index (ASCI)

Susie Theroux (susannat@sccwrp.org)

ASCI development

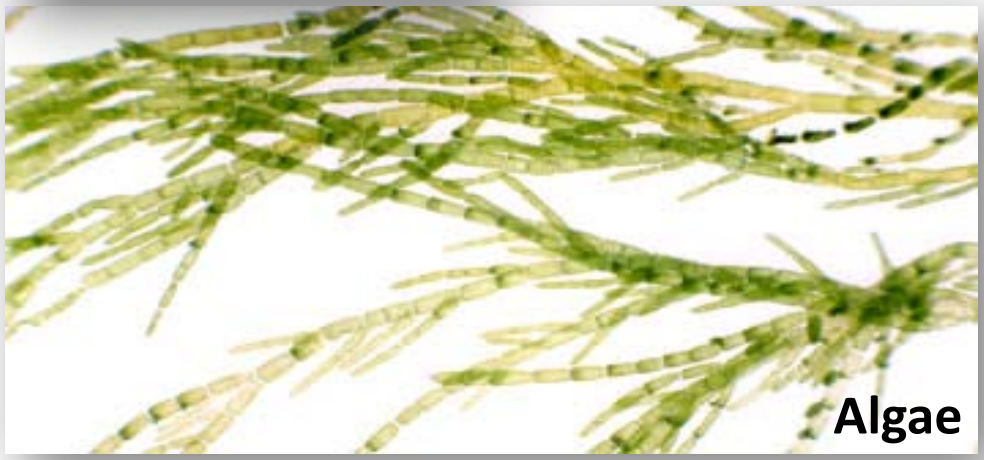
- California's bioassessment toolbox
  - California Stream Condition Index (CSCI)
  - SoCal Algal Index of Biotic Integrity (IBI)
  - Algal Stream Condition Index (ASCI)
- ASCI development: approach
- ASCI development: status and deadlines

CA's ecological indicators

Multiple Indicators – BMIs, algae, fish, riparian vegetation

Multiple waterbody types – large rivers, non-perennial streams, lakes, wetlands

California focus – perennial streams, bugs and algae



California's bioassessment programs

- Over two decades of sample collection
- Standardized protocols and QA/QC
- Annual trainings and audits for all field crews

California stream bioassessment: bioindicators

Benthic macroinvertebrates

- Respond to physical habitat, pollutants, sediment, flow alteration
- Integrate ecological condition over time

Algae

- Direct link to water chemistry and nutrient stressors
- Short life span, rapid growth rate and rapid response to stress

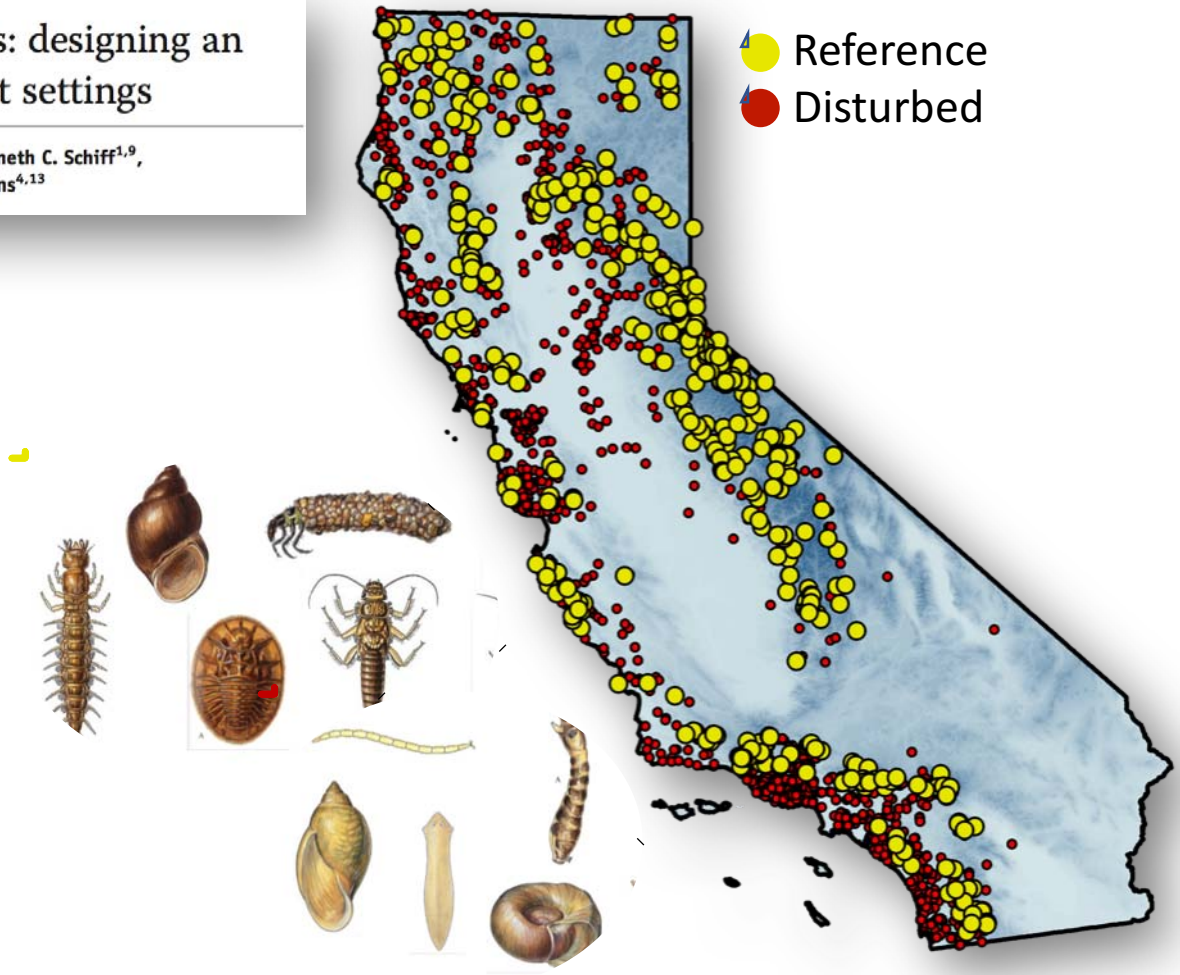
Diatoms
Soft-bodied algae
Cyanobacteria

California Stream Condition Index (CSCI)

Bioassessment in complex environments: designing an index for consistent meaning in different settings

Raphael D. Mazor[1,2,5], Andrew C. Rehn[2,6], Peter R. Ode[2,7], Mark Engeln[1,8], Kenneth C. Schiff[1,9], Eric D. Stein[1,10], David J. Gillett[1,11], David B. Herbst[3,12], and Charles P. Hawkins[4,13]

- Predictive index
- Site-specific reference expectations
- Statewide applicability

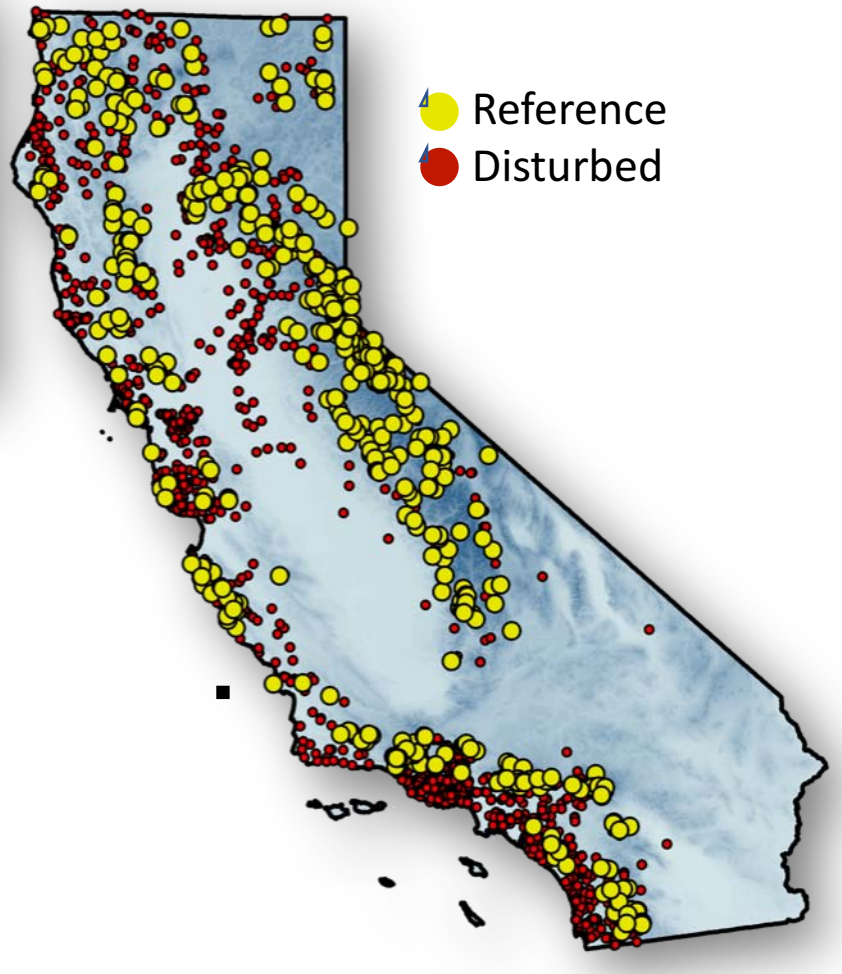


SoCal Algal Index of Biotic Integrity (IBI)

J Appl Phycol (2014) 26:433–450
DOI 10.1007/s10811-013-0088-2

Development and comparison of stream indices of biotic integrity using diatoms vs. non-diatom algae vs. a combination

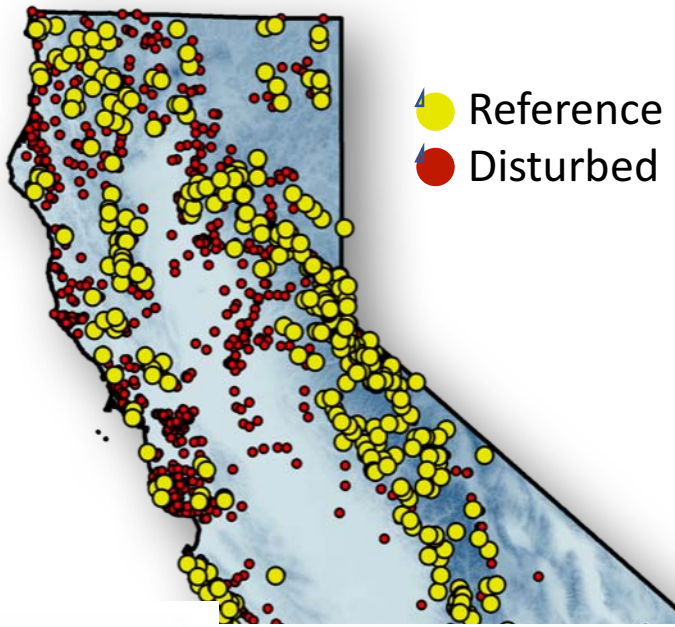
A. Elizabeth Fetscher · Rosalina Stancheva · J. Patrick Kociolek · Robert G. Sheath · Eric D. Stein · Raphael D. Mazor · Peter R. Ode · Lilian B. Busse

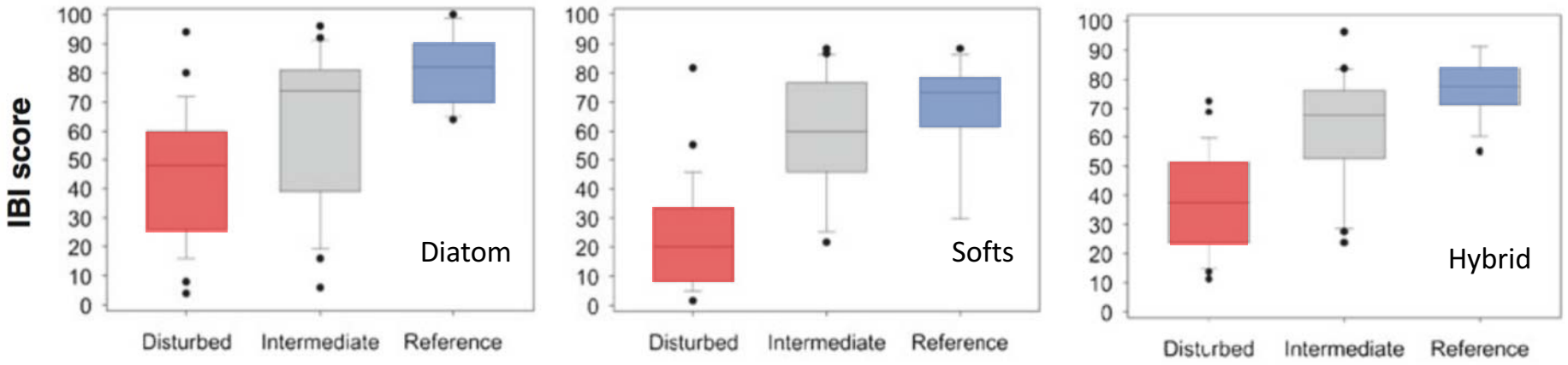


- Traditional (non-predictive)
- Separate indices developed for soft-bodied algae, diatoms, and a hybrid of the two

SoCal Algal Index of Biotic Integrity (IBI)

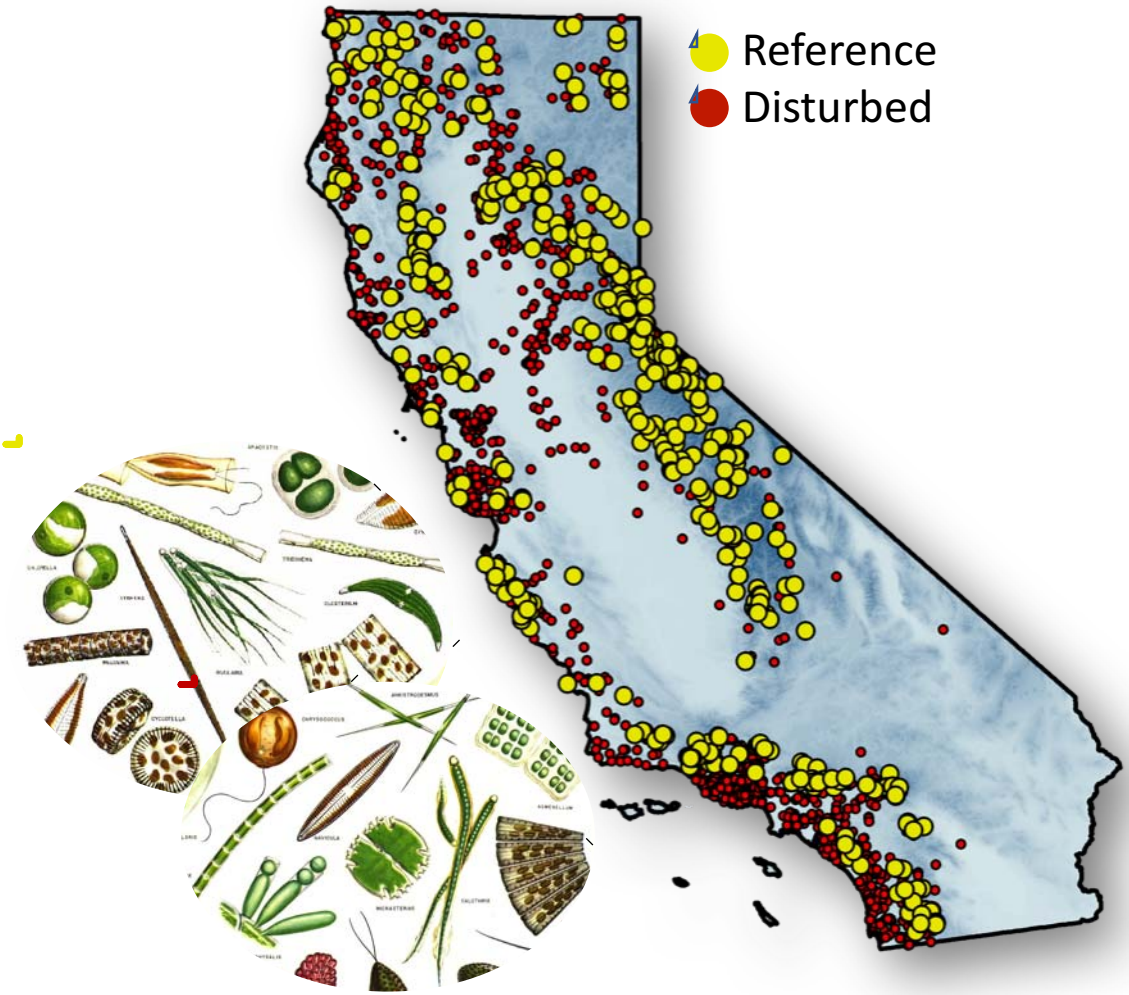
- Algal indices respond strongly to disturbance
- Hybrid index most sensitive





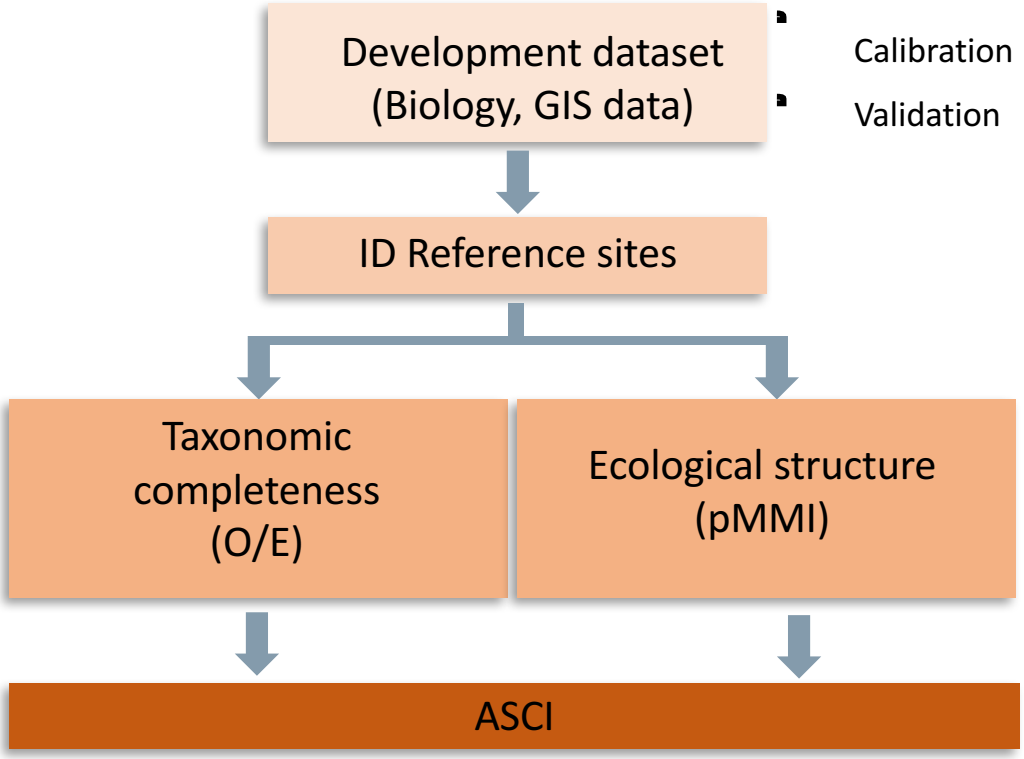
Algal Stream Condition Index (ASCI)

- Predictive index
- Consistent tool to use across state
- Landscape setting informs site-specific reference expectations
- Large dataset spans California ecoregions



ASCI: Development approach

Mirrors CSCI development approach



ASCI: Development approach

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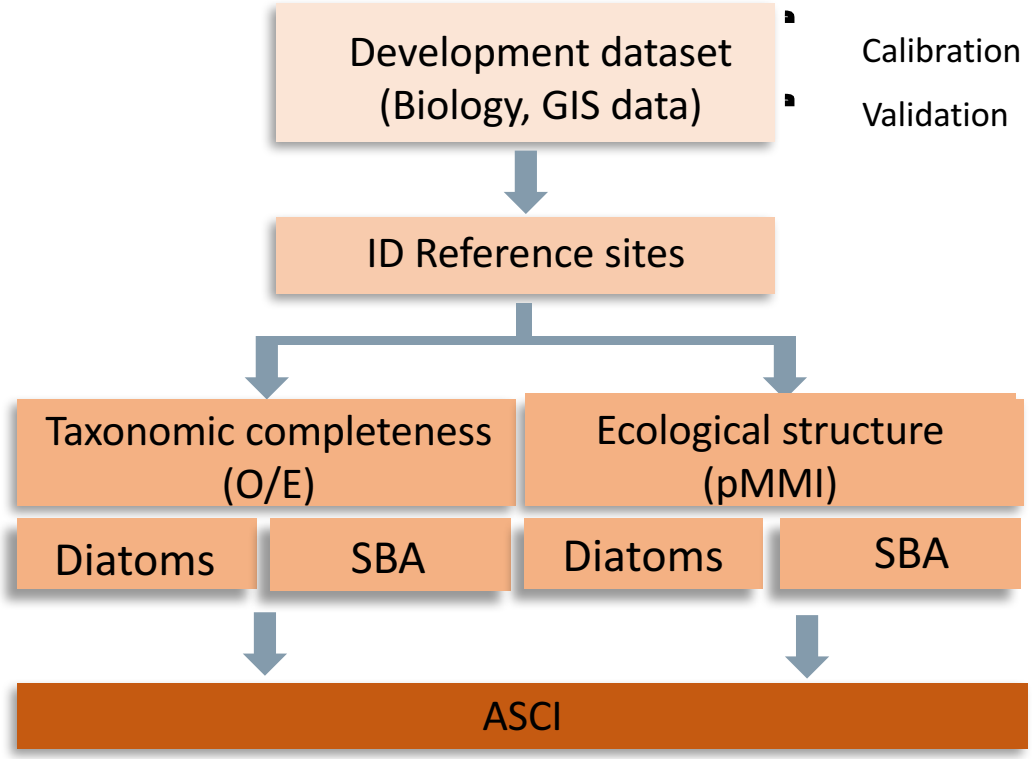
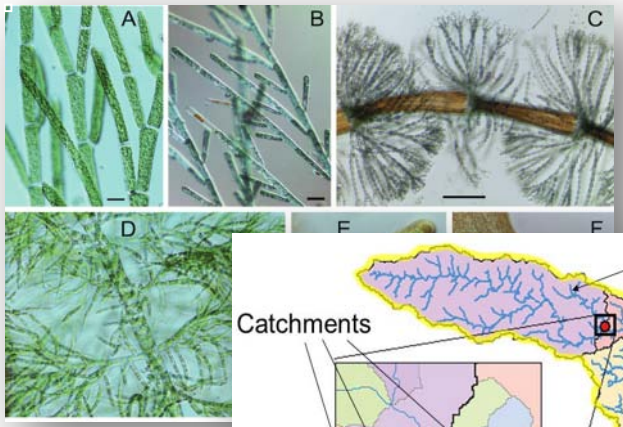


ASCI: Development dataset

~2000 stations, 3800 taxa

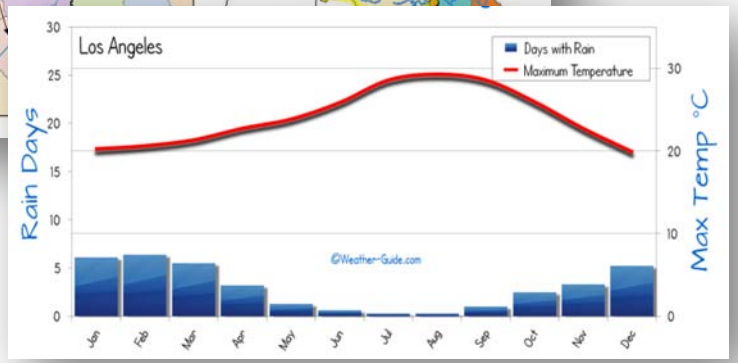
- Years 2008-2016
- Stormwater Monitoring Coalition (SMC)
- Perennial Stream Assessment (PSA)
- Reference Condition Management Program (RCMP)
- Regional Monitoring Coalition (RMC)

Algae taxonomy



Spatial data

Weather

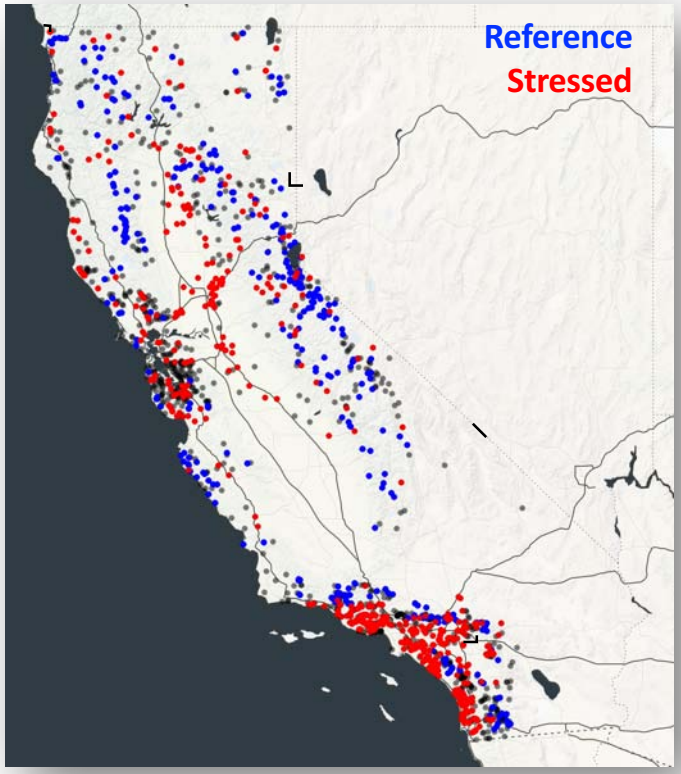


Defining reference expectations

What should the biology look like at a test site?

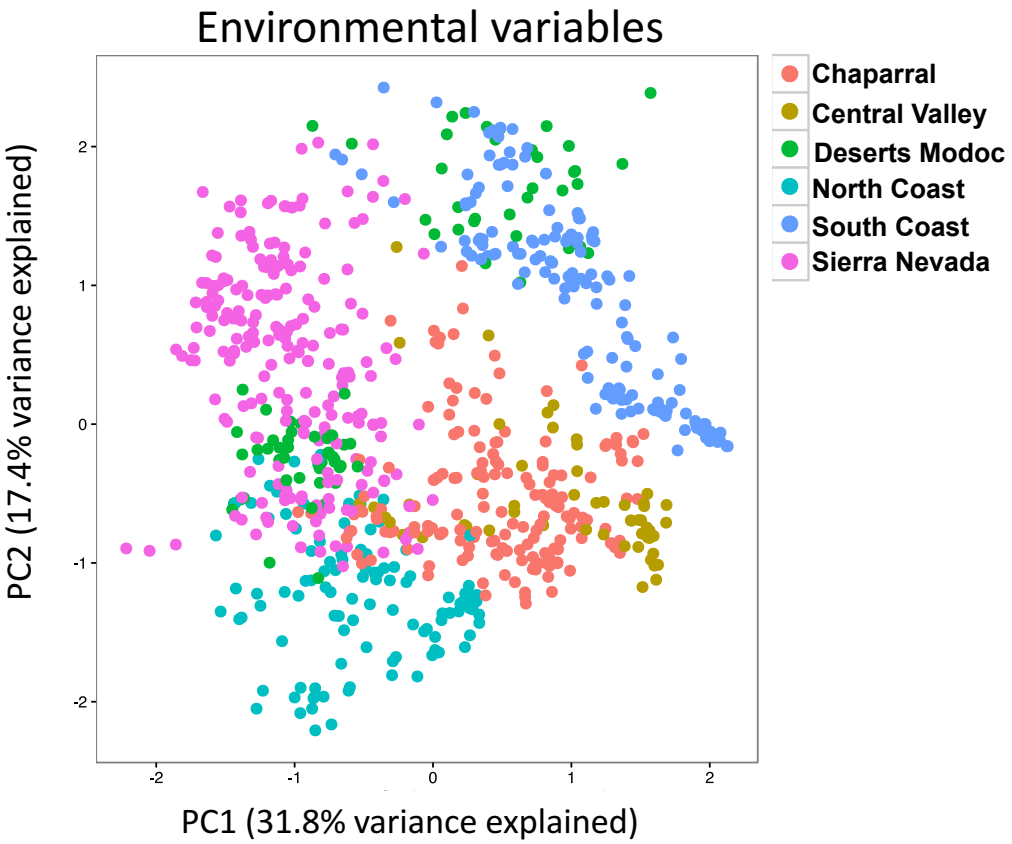
ASCI: Reference site selection criteria

Metric	Scale	Threshold	Unit
% agriculture	1k, 5k, WS	3	%
% urban	1k, 5k, WS	3	%
% agriculture + % urban	1k, 5k, WS	5	%
% Code 21 (developed veg)	1k, 5k, WS	7, 10	%
Road density	1k, 5k, WS	2	km/km2
Road crossings	1k, 5k, WS	5, 10, 50	crossings
Dam distance	WS	10	km
% canals and pipelines	WS	10	%
Producer mines	5k	0	mines
W1_HALL (rip. anthro. disturbance)	site	1.5	-

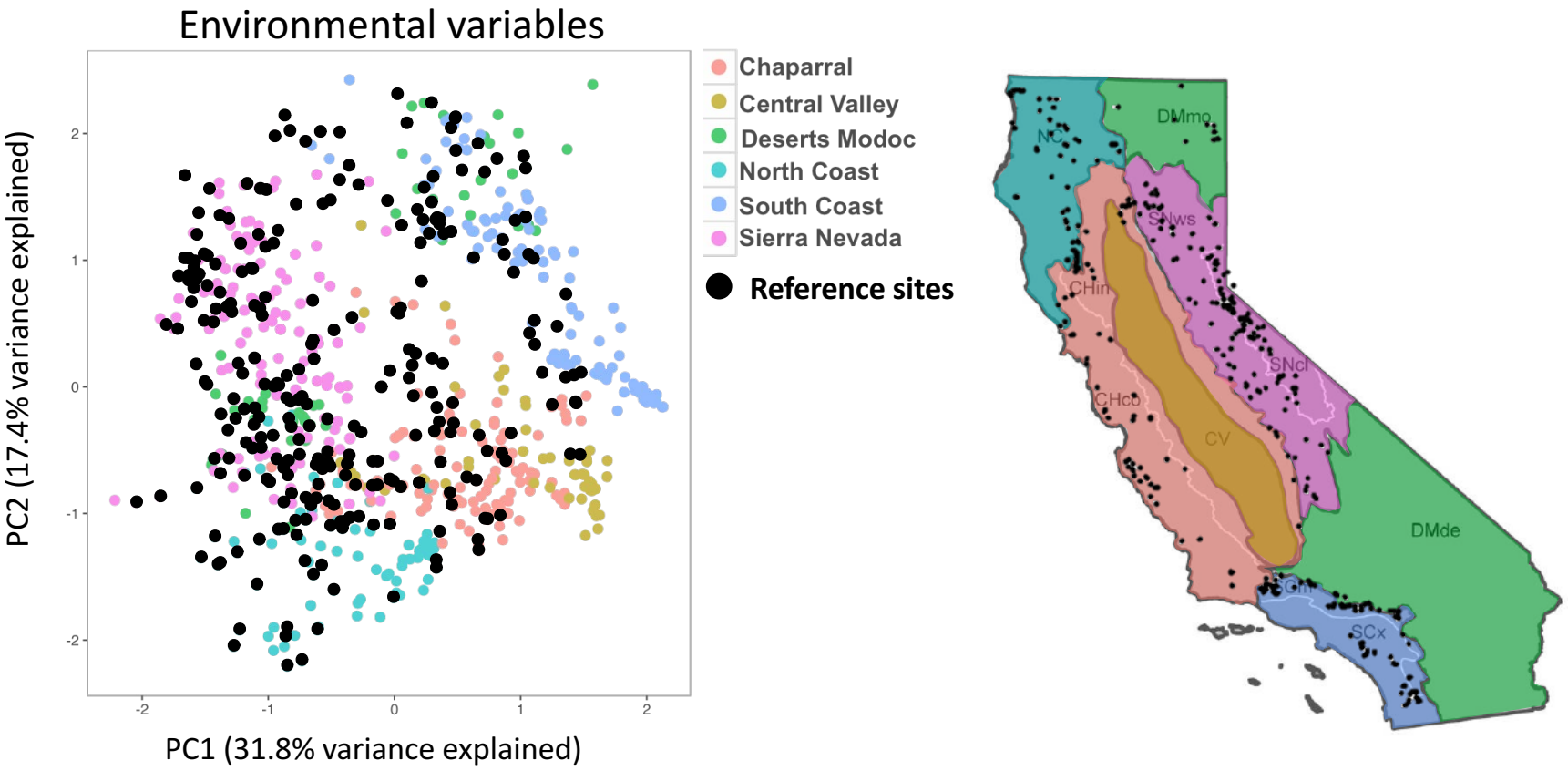


http://rpubs.com/stheroux/devdata

Dataset spans ecoregions in California



Reference sites capture geographic gradients



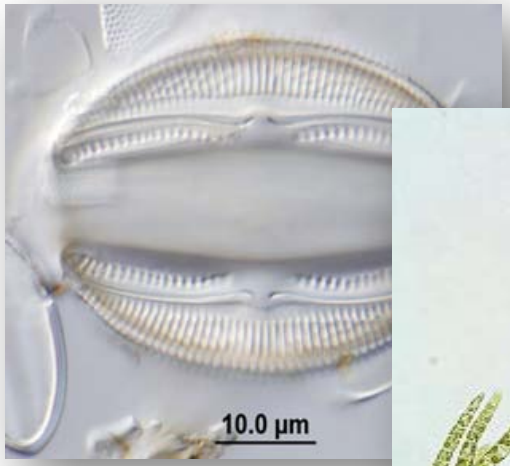
Reference sites by region

	All sites	Reference Sites
Central Lahontan	125	53
Central Valley	79	1
Coastal Chaparral	353	55
Deserts Modoc	87	26
Interior Chaparral	84	30
North Coast	168	60
South Coast Mountain	236	39
South Coast Xeric	621	26
West Sierra	148	66

ASCI: two component index

Observed vs. Expected taxa (O/E)

Diatoms



Softs

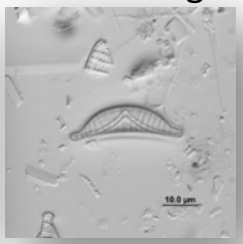
Who is there?

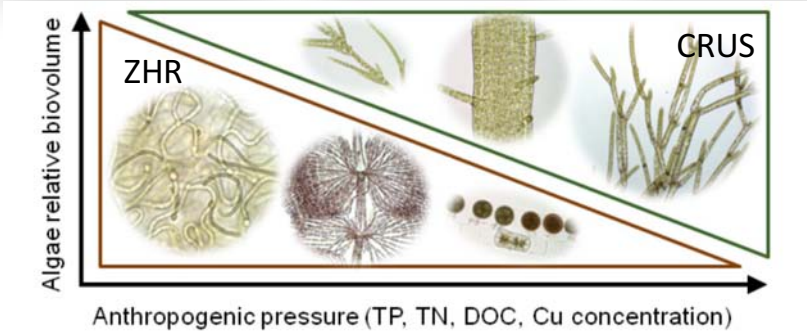
Predictive Multi-Metric Index (pMMI)

% motile taxa

% Cu tolerant

% N-fixing





What are they doing?

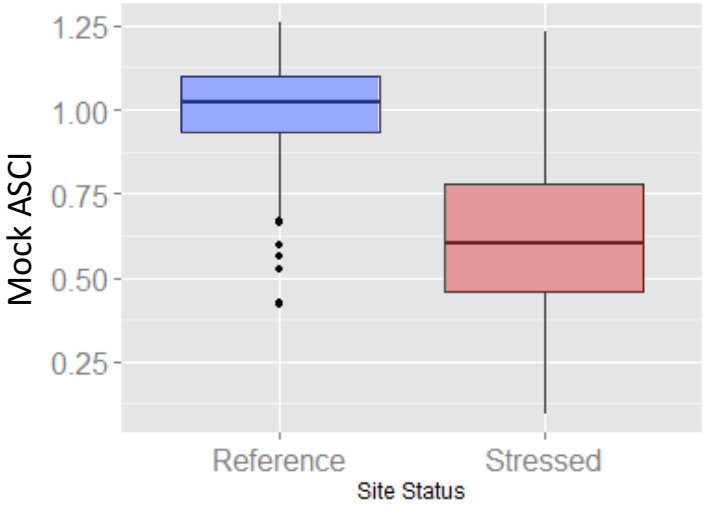
How are we making predictions?

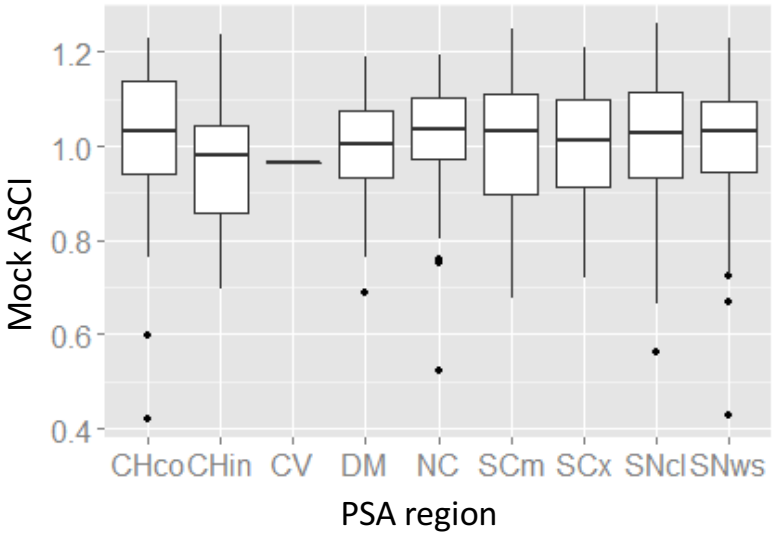
- Use environmental variables to predict species assemblages (O/E) and metric values (pMMI)
- Candidate predictors (partial list):

Location	Topography	Long-term climate	Soils	Minerology
Latitude	Watershed area	Catchment precip	Bulk density	MgO content
Longitude	Elevation range	Local precip	Erodibility	CaO content
Elevation		Local temp	Permeability	S content

ASCI: evaluate performance

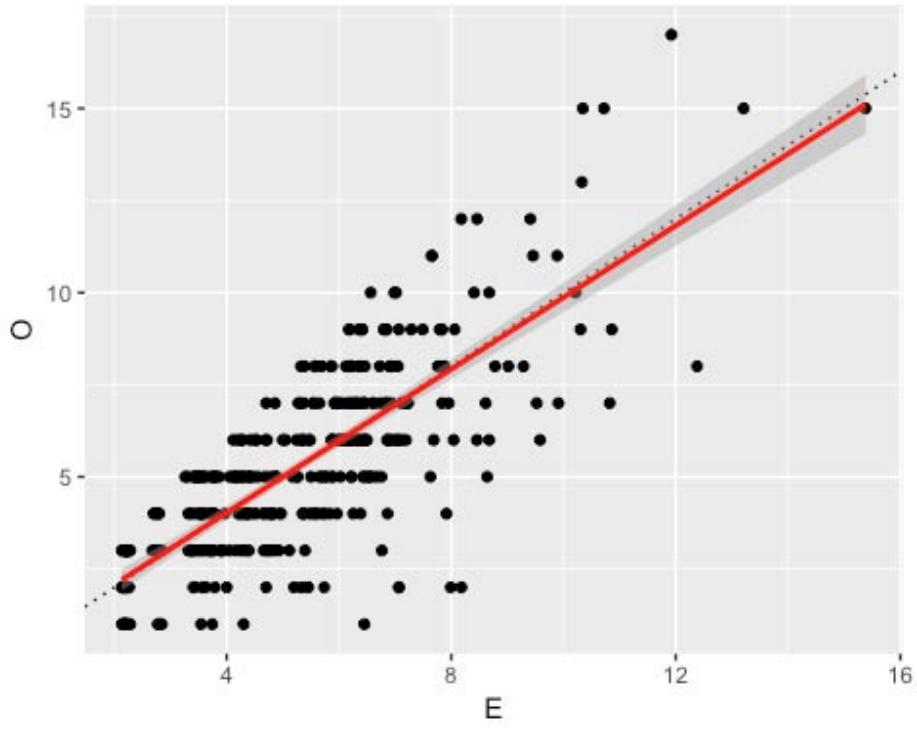
Performance aspect	How do we measure?
Sensitivity	Big differences between reference and stressed
Precision	Low SD for reference sites
Accuracy	Validation reference sites
Bias	No bias from natural gradients





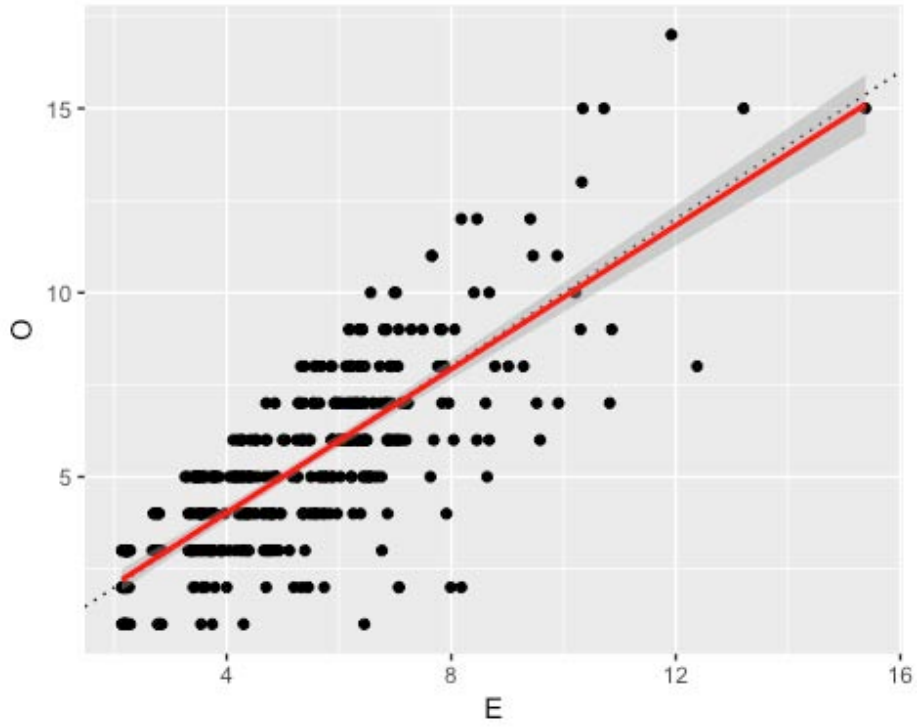
Status of ASCI: draft O/E

1. Biological characterization ✓
2. Predict cluster membership and capture probabilities for each taxon ✓
3. Selection of expected taxa
4. Combining of taxa into an index



Status of ASCI: pMMI in progress

1. Calculate metrics ✓
2. Predict metric values at reference sites ✓
3. Screen metrics
4. Select metrics
5. Combine metrics into an index



Status of ASCI: pMMI in progress

Metrics we have calculated (partial list):

Autoecological	Community structure	Ecological guild	Tolerance/Intolerance
N uptake metabolism	*Achnanthidium minutissimum*	High motility	ISA: most sensitive
Saprobic class	CRUS taxa	Low motility	ISA: most tolerant
Oxygen requirement	ZHR taxa	Nonmotile	Sediment tolerant

BCG derived metrics:

BCG Levels	BCG id'ed taxa of interest
Level 1 taxa	*Achnanthidium minutissimum; Hannaea arcus*
Level 3/4 taxa	*Planothidium* sp.*; Surirella* sp.*; Pleurosira* sp.
Level 6 taxa	*Cyclotella meneghiniana, Gomphonema parvulum, Nitschia inconspicua*

Timeline

Description	Estimated Date
Index development - Graphs and tables summarizing O/E model, MMI model and ASCI model and validation	6/2017
Oral presentation on comparison of ASCI performance to other indices	6/2017
Graphs and tables summarizing ASCI use in context of other bioindicators	9/2017
Draft final report	9/2017
Final report	12/2017

Summary: ASCI applications

- Algal Index will leverage years of algae taxonomy and environmental data
- ASCI will be integrated into in State and Regional ambient wadeable stream bioassessment toolkit
- Provide complementary information to CSCI and other biointegrity measures
- Support State Water Board combined biostimulatory and biointegrity amendments

Questions?

susannat@sccwrp.org

Reference sites have few sources of human stress

- **Infrastructure**: roads, railroads
- **Population density**
- **Hydromodification**
  - manmade channels, canals, pipelines
- **Landuse**
  - Ag/Urban development
  - Timber Harvest, Grazing
- Fire history, dams, mines
- 303d list, known discharges
- Water chemistry