California's Surface Water Ambient Monitoring Program

Overview of the SWAMP Bioassessment Program and Resources

CABW
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Who is SWAMP?

SWAMP is made up of a Roundtable of monitoring coordinators from the SWRCB and nine RWQCBs, along with scientists from UC, CSU, CDFW, OEHHA, USEPA, and other State agencies

SWAMP Resources

SWAMP has created:

- Standard Operating Procedures (SOPs)
  - BMI, Soft Algae, Diatoms taxa lists
- Reports, Technical Memos, and Fact Sheets
- California Stream Condition Index
  - Interim instructions for calculating the CSCI
- Online Interactive Map

All for providing timely and high-quality information needed to evaluate all surface waters throughout California.

SWAMP resources support bio-integrity/nutrients policy

SWAMP Data available through CEDEN, http://www.ceden.org/

Future Resource – Algae CSCI

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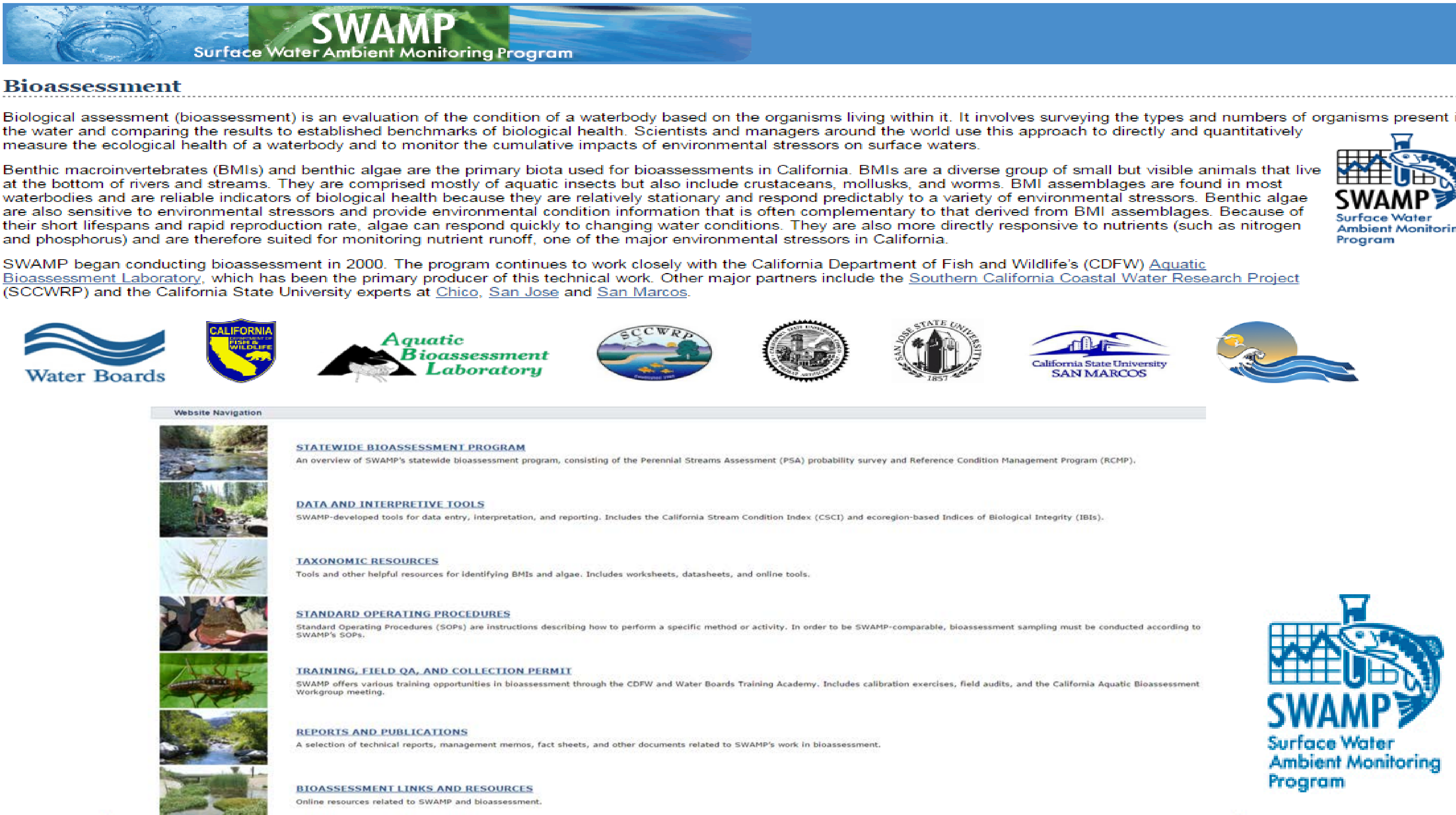
SWAMP Bioassessment Website

http://www.waterboards.ca.gov/water_issues/programs/swamp/bioassessment



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Bioassessment

Biological assessment (bioassessment) is an evaluation of the condition of a waterbody based on the organisms living within it. It involves surveying the types and numbers of organisms present in the water and comparing the results to established benchmarks of biological health. Scientists and managers around the world use this approach to directly and quantitatively measure the ecological health of a waterbody and to monitor the cumulative impacts of environmental stressors on surface waters.

Benthic macroinvertebrates (BMIs) and benthic algae are the primary biota used for bioassessments in California. BMIs are a diverse group of small but visible animals that live at the bottom of rivers and streams. They are comprised mostly of aquatic insects but also include crustaceans, mollusks, and worms. BMI assemblages are found in most waterbodies and are reliable indicators of biological health because they are relatively stationary and respond predictably to a variety of environmental stressors. Benthic algae are also sensitive to environmental stressors and provide environmental condition information that is often complementary to that derived from BMI assemblages. Because of their short lifespans and rapid reproduction rate, algae can respond quickly to changing water conditions. They are also more directly responsive to nutrients (such as nitrogen and phosphorus) and are therefore suited for monitoring nutrient runoff, one of the major environmental stressors in California.

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SWAMP began conducting bioassessment in 2000. The program continues to work closely with the California Department of Fish and Wildlife's (CDFW) Aquatic Bioassessment Laboratory, which has been the primary producer of this technical work. Other major partners include the Southern California Coastal Water Research Project (SCCWRP) and the California State University experts at Chico, San Jose and San Marcos.

Water Boards | California Department of Fish & Wildlife | Aquatic Bioassessment Laboratory | SCCWRP | California State University Chico | San Jose State University 1857 | California State University SAN MARCOS

Website Navigation

STATEWIDE BIOASSESSMENT PROGRAM
An overview of SWAMP's statewide bioassessment program, consisting of the Perennial Streams Assessment (PSA) probability survey and Reference Condition Management Program (RCMP).

DATA AND INTERPRETIVE TOOLS
SWAMP-developed tools for data entry, interpretation, and reporting. Includes the California Stream Condition Index (CSCI) and ecoregion-based Indices of Biological Integrity (IBIs).

TAXONOMIC RESOURCES
Tools and other helpful resources for identifying BMIs and algae. Includes worksheets, datasheets, and online tools.

STANDARD OPERATING PROCEDURES
Standard Operating Procedures (SOPs) are instructions describing how to perform a specific method or activity. In order to be SWAMP-comparable, bioassessment sampling must be conducted according to SWAMP's SOPs.

TRAINING, FIELD QA, AND COLLECTION PERMIT
SWAMP offers various training opportunities in bioassessment through the CDFW and Water Boards Training Academy. Includes calibration exercises, field audits, and the California Aquatic Bioassessment Workgroup meeting.

REPORTS AND PUBLICATIONS
A selection of technical reports, management memos, fact sheets, and other documents related to SWAMP's work in bioassessment.

BIOASSESSMENT LINKS AND RESOURCES
Online resources related to SWAMP and bioassessment.

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STANDARD OPERATING PROCEDURES

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SWAMP BMI External Quality Control SOP

Table 2. QACodes associated with taxonomy data. For additional codes contact the OIMA helpdesk.

Process	QACode	Description
Lab Sorting/ Taxonomy		
	BZ	Sample preserved improperly
	LST	Sample was lost or destroyed
	BDI	Damaged beyond identification
	BIS	Immature specimen
	BTL	Taxonomist's literature not sufficient
	BBM	Bad Mount
	BOT	Other - see comments
Taxonomy QC		
	BNV	Sample or vial not submitted for analysis
	BLI	Additional sample or vial received than expected
	BLS	Sample or vial labels switched
	BLE	Sample or vial Label and Electronic Data do not match
	BNO	No specimens found in vial
	BPS	Probable sorting error
	BNT	Non-Target taxa identified in sample
	BET	Excluded Taxon
Data Updates		
	BQC	Record underwent QC
	BDC	Data corrected based on QC

SWAMP Laboratory Processing, Identification, and Enumeration of Stream Algae SOP

Natural counting entity (NCE) is each natural occurring form of algae (i.e., each unicell, colony, filament, tissue-like form, coenocyte, tuft, or crust) regardless of the number of cells in the thallus or colony.

The main purpose of using "natural counting entity" is to prevent numerous small cells in a sample with macroscopic forms from dominating a count relative to their actual contribution to the community biomass. It also facilitates the counting of algal forms which have linked cells that may be hard to distinguish.

Laboratory set up for separate analysis of macroalgal and microalgal fractions of the SBA quantitative sample is illustrated in Figure 2 and explained in the Sections 3.1 and 4.1.

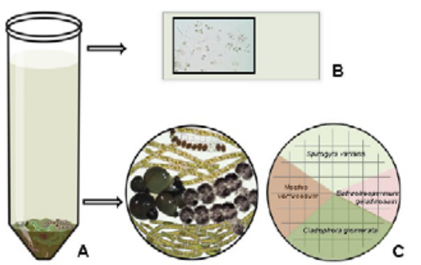

Figure 2. Laboratory set up for separate analysis of macroalgal and microalgal fractions of SBA quantitative sample.

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(OIMA) Office of Information Management & Analysis:
SWAMP Data Management Resources Templates & Documentation

List: OrganismDetailBMILookUp

FinalID	LifeStageCode	LifeStageName	FinalIDAuthority	Source
Abedus	A	Adult	SAFIT	DFG-ABL
Abedus	L	Larva	SAFIT	DFG-ABL
Abedus breviceps	A	Adult	SAFIT	DFG-ABL
Abedus breviceps	L	Larva	SAFIT	DFG-ABL
Abedus herberti	A	Adult	SAFIT	DFG-ABL
Abedus herberti	L	Larva	SAFIT	DFG-ABL
Abedus indentatus	A	Adult	SAFIT	DFG-ABL
Abedus indentatus	L	Larva	SAFIT	DFG-ABL
Abedus ovatus	A	Adult	SAFIT	DFG-ABL
Abedus ovatus	L	Larva	SAFIT	DFG-ABL
Abedus parkeri	A	Adult	SAFIT	DFG-ABL
Abedus parkeri	L	Larva	SAFIT	DFG-ABL
Abedus vicinus	A	Adult	SAFIT	DFG-ABL
Abedus vicinus	L	Larva	SAFIT	DFG-ABL
Ablabesmyia	L	Larva	SAFIT	DFG-ABL
Ablabesmyia	P	Pupa	SAFIT	DFG-ABL
Ablabesmyia annulata	A	Adult	SAFIT	DFG-ABL
Ablabesmyia annulata	L	Larva	SAFIT	DFG-ABL
Ablabesmyia annulata	P	Pupa	SAFIT	DFG-ABL
Ablabesmyia aspera	A	Adult	SAFIT	DFG-ABL
Ablabesmyia aspera	L	Larva	SAFIT	DFG-ABL
Ablabesmyia aspera	P	Pupa	SAFIT	DFG-ABL
Ablabesmyia cinctipes	A	Adult	SAFIT	DFG-ABL
Ablabesmyia cinctipes	L	Larva	SAFIT	DFG-ABL
Ablabesmyia cinctipes	P	Pupa	SAFIT	DFG-ABL
Ablabesmyia mallochi	A	Adult	SAFIT	DFG-ABL
Ablabesmyia mallochi	L	Larva	SAFIT	DFG-ABL
Ablabesmyia mallochi	P	Pupa	SAFIT	DFG-ABL
Ablabesmyia monilis	A	Adult	SAFIT	DFG-ABL
Ablabesmyia monilis	L	Larva	SAFIT	DFG-ABL
Ablabesmyia monilis	P	Pupa	SAFIT	DFG-ABL

Algae List

FinalID	CommonName	Phylum	Subphylum	Superclass	Class	Subclass	Superorder	Order
Actinastrum		Chlorophyta			Trebouxiophyceae			Chlorellales
Actinastrum cf hantzschii		Chlorophyta			Trebouxiophyceae			Chlorellales
Actinastrum hantzschii		Chlorophyta			Trebouxiophyceae			Chlorellales
Actinotaenium		Charophyta			Zygnematophyceae			Desmidiales
Actinotaenium colpopelta f minus		Streptophyta			Zygnematophyceae			Zygnematales
Anabaena		Cyanobacteria			Cyanophyceae	Nostocophycideae		Nostocales
Anabaena aequalis		Cyanobacteria			Cyanophyceae	Nostocophycideae		Nostocales
Anabaena californica		Cyanobacteria			Cyanophyceae	Nostocophycideae		Nostocales

Diatom List

FinalID	CommonName	Phylum	Subphylum	Superclass	Class	Subclass	Superorder	Order	Suborder	Superfamily	Family
Achnanthaceae		Heterokontophyta			Bacillariophyceae			Achnanthales			Achnanthaceae
Achnanthales		Heterokontophyta			Bacillariophyceae			Achnanthales			
Achnanthes		Heterokontophyta			Bacillariophyceae			Achnanthales			Achnanthaceae
Achnanthes acares		Heterokontophyta			Bacillariophyceae			Achnanthales			Achnanthaceae
Achnanthes biasolettiana var subatomus		Heterokontophyta			Bacillariophyceae			Achnanthales			Achnanthaceae
Achnanthes brevipes		Heterokontophyta			Bacillariophyceae			Achnanthales			Achnanthaceae
Achnanthes brevipes var intermedia		Heterokontophyta			Bacillariophyceae			Achnanthales			Achnanthaceae
Achnanthes cf acares DWB		Heterokontophyta			Bacillariophyceae			Achnanthales			Achnanthaceae

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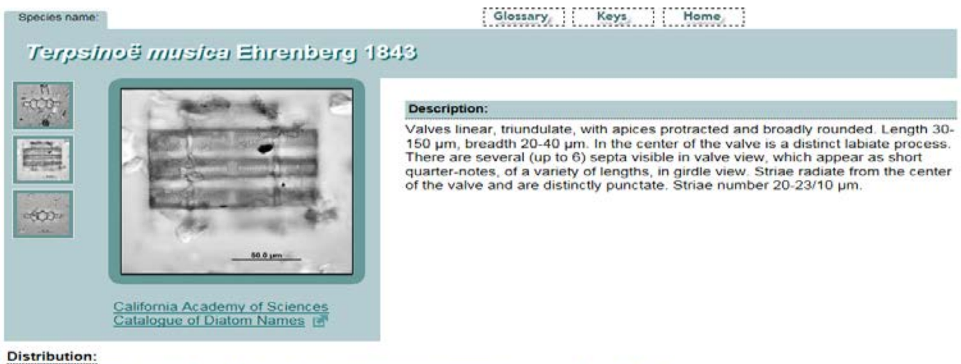
TAXONOMIC RESOURCES

Tools and other helpful resources for identifying BMIs and algae. Includes worksheets, datasheets, and online tools.

ORDER	HABITUS PHOTO	DISTINGUISHING CHARACTERISTICS
Ephemeroptera (mayflies)		Three "tails" or cerci, with gills on abdomen (either dorsal or lateral, usually plate-like) and one tarsal claw.
Odonata (dragonflies, damselflies)		Mask-like labium; gills are internalized within the abdomen (Dragonflies) or external on the end of the abdomen (Damselflies).
Plecoptera (stoneflies)		Two "tails" or cerci; gills (either plumose or finger-like) present on thorax, or on thorax and first few abdominal segments, two tarsal claws.
Hemiptera (true bugs)		"Half wings" – first set of wings half membranous and half sclerotized (looks like an "X"); piercing-sucking mouthparts
Megaloptera (alderflies, dobsonflies, fishflies)		Well-developed mandibles, four-segmented antennae. Head and abdomen are patterned; the head is also quadrate. Two claws on thoracic legs. Segmented lateral gills on abdomen.
Neuroptera (spongeflies)		Long antennae, slender legs with single claws. Transparent gills on ventral side of abdominal segments. Mouthparts elongate and unsegmented.
Trichoptera (caddisflies)		No "tails," just anal prolegs with claws; thorax partially or fully sclerotized, membranous abdomen. May have a "case" built of various materials
Lepidoptera (moths, butterflies)		Head is distinct with a ring of simple eyes. Thorax and legs are segmented. Prolegs and anal prolegs present on abdominal segments.
Coleoptera (beetles)		No anal prolegs but possibly claws.Bodies of larvae may be completely sclerotized; adults have a hardened first pair of wings ("elytra").
Diptera (true flies)		Head may be sclerotized (and visible) or reduced. Legs are not sclerotized. Body fleshy (possibly with clawed prolegs) with various types of breathing structures on the tail end.
Non-Insects		Various characteristics, please see non-insects page.



Locations of *Terpsinoë musica* Ehrenberg 1843

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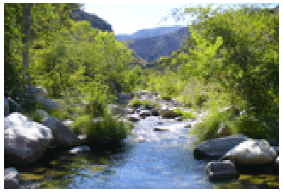
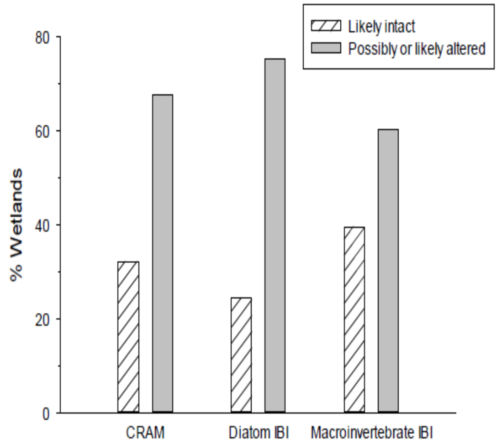


REPORTS AND PUBLICATIONS

A selection of technical reports, management memos, fact sheets, and other documents related to SWAMP's work in bioassessment.

Application of Macroinvertebrate, Diatom and Overall Condition Indices for Assessing Southern California Depressional Wetlands

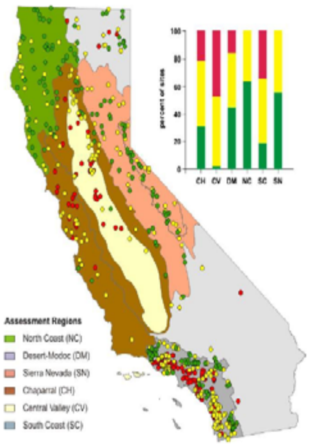
Figure ES-1. Proportion of wetlands considered "likely intact" according to the three indicators measured in this study.



Multiple Biological and Habitat Condition Indices Technical Memorandum

Table 4. Summary of agreement and disagreement between CSCI, $CRAM_{bio-phys}$ and H20 at 628 statewide probability sites sampled 2008-2012, and land use characteristics of those sites.

Condition	*n*	Ag	Urban	Forest	Other	Reference	Moderate-activity	High-activity
All 3 degraded	159	24	108	0	27	0	20	139
All 3 not degraded	185	0	2	67	116	77	98	10
Sites w/ disagreement	284	16	78	40	150	34	141	109



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DATA AND INTERPRETIVE TOOLS

SWAMP-developed tools for data entry, interpretation, and reporting. Includes the California Stream Condition Index (CSCI) and ecoregion-based Indices of Biological Integrity (IBIs).

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]

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[2]Aquatic Bioassessment Laboratory, California Department of Fish and Wildlife, 2005 Nimbus Road, Rancho Cordova, California 95670 USA
[3]Sierra Nevada Aquatic Research Laboratory, University of California, 1016 Mt. Morrison Road, Mammoth Lakes, California 93546 USA
[4]Department of Watershed Sciences, Western Center for Monitoring and Assessment of Freshwater Ecosystems, and the Ecology Center, Utah State University, Logan, Utah 84322-5210 USA

Abstract: Regions with great natural environmental complexity present a challenge for attaining 2 key properties of an ideal bioassessment index: 1) index scores anchored to a benchmark of biological expectation that is appropriate for the range of natural environmental conditions at each assessment site, and 2) deviation from the reference benchmark measured equivalently in all settings so that a given index score has the same ecological meaning across the entire region of interest. These properties are particularly important for regulatory applications like biological criteria where errors or inconsistency in estimating site-specific reference condition or deviation from it can lead to management actions with significant financial and resource-protection consequences. We developed an index based on benthic macroinvertebrates for California, USA, a region with great environmental heterogeneity. We evaluated index performance (accuracy, precision, responsiveness, and sensitivity) throughout the region to determine if scores provide equivalent ecological meaning in different settings. Consistent performance across environmental settings was improved by 3 key elements of our approach: 1) use of a large reference data set that represents virtually all of the range of natural gradients in the region, 2) development of predictive models that account for the effects of natural gradients on biological assemblages, and 3) combination of 2 indices of biological condition (a ratio of observed-to-expected taxa [O/E] and a predictive multimetric index [pMMI]) into a single index (the California Stream Condition Index [CSCI]). Evaluation of index performance across broad environmental gradients provides essential information when assessing the suitability of the index for regulatory applications in diverse regions.

Key words: bioassessment, predictive modelling, predictive multimetric index, reference condition

Evaluating the adequacy of a reference-site pool for ecological assessments in environmentally complex regions

Peter R. Ode[1,7], Andrew C. Rehn[1,8], Raphael D. Mazor[1,2,9], Kenneth C. Schiff[2,10], Eric D. Stein[2,11], Jason T. May[3,12], Larry R. Brown[3,13], David B. Herbst[4,14], David Gillett[2,15], Kevin Lunde[5,16], and Charles P. Hawkins[6,17]

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[4]Sierra Nevada Aquatic Research Laboratory, 1016 Mount Morrison Road, Mammoth Lakes, California 93546 USA
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[6]Western Center for Monitoring and Assessment of Freshwater Ecosystems, Department of Watershed Sciences, and the Ecology Center, Utah State University, Logan, Utah 84322-5210 USA

Abstract: Many advances in the field of bioassessment have focused on approaches for objectively selecting the pool of reference sites used to establish expectations for healthy waterbodies, but little emphasis has been placed on ways to evaluate the suitability of the reference-site pool for its intended applications (e.g., compliance assessment vs ambient monitoring). These evaluations are critical because an inadequately evaluated reference pool may bias assessments in some settings. We present an approach for evaluating the adequacy of a reference-site pool for supporting biotic-index development in environmentally heterogeneous and pervasively altered regions. We followed common approaches for selecting sites with low levels of anthropogenic stress to screen 1985 candidate stream reaches to create a pool of 590 reference sites for assessing the biological integrity of streams in California, USA. We assessed the resulting pool of reference sites against 2 performance criteria. First, we evaluated how well the reference-site pool represented the range of natural gradients present in the entire population of streams as estimated by sites sampled through probabilistic surveys. Second, we evaluated the degree to which we were successful in rejecting sites influenced by anthropogenic stress by comparing biological metric scores at reference sites with the most vs fewest potential sources of stress. Using this approach, we established a reference-site pool with low levels of human-associated stress and broad coverage of environmental heterogeneity. This approach should be widely applicable and customizable to particular regional or programmatic needs.

Key words: reference condition, bioassessment, environmental heterogeneity, performance measures, benthic macroinvertebrates

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, et al.

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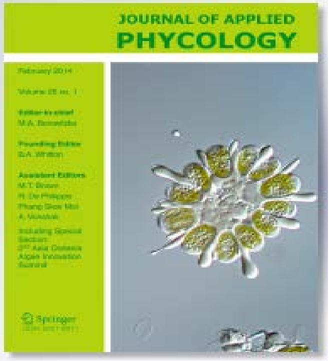

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DATA AND INTERPRETIVE TOOLS

SWAMP-developed tools for data entry, interpretation, and reporting. Includes the California Stream Condition Index (CSCI) and ecoregion-based Indices of Biological Integrity (IBIs).

The California Stream Condition Index (CSCI):
Interim instructions for calculating scores using GIS and R

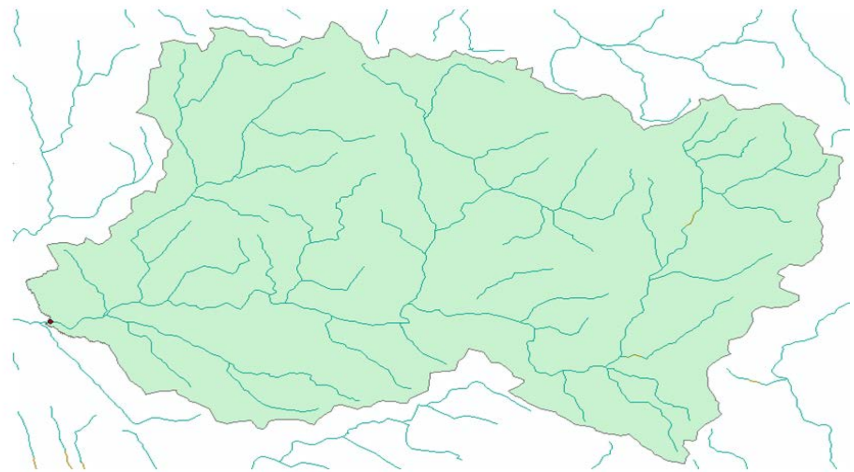
Raphael Mazor[1,2] (raphaelm@scccwrp.org), Peter R. Ode[2], Andrew C. Rehn[2], Mark Engeln[1], Tyler Boyle[3], Erik Fintel[3], Steve Verbrugge[3], Calvin Yang[4] (calvin.yang@waterboards.ca.gov)

THE OFFICE OF INFORMATION MANAGEMENT & ANALYSIS

BROWN BAG SEMINAR

Overview of Calculating California Stream Condition Index (CSCI) Scores using GIS and R

Using GIS to Calculate Environmental Predictors



Count	Number_(	Number_(	Pcnt_Amb	Pcnt_Amb	E	Mean_O	OoverE	OoverE_P	MMI	MMI_P[illegible]rc	CSCI	C[illegible]
608	20	20	2.138158	5.555556	9.125335	11	1.205435	0.86	0.906353	[illegible]3	1.055894	

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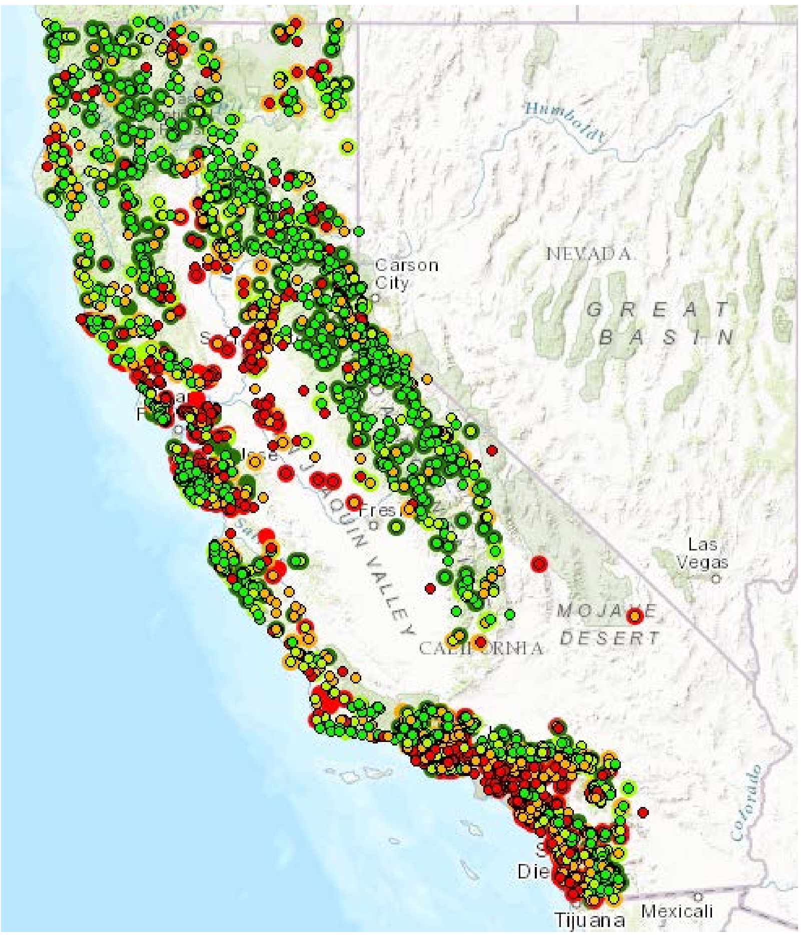

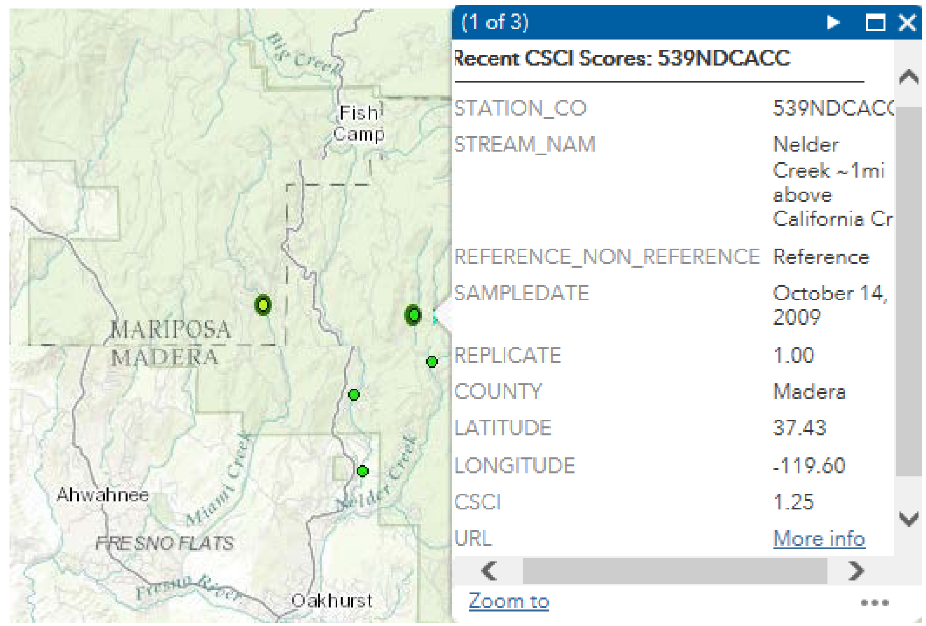

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CEDEN
CALIFORNIA ENVIRONMENTAL DATA EXCHANGE NETWORK

Find Data | Submit Data | About CEDEN

CEDEN: Data Retrieval								
Program	StationCode	TargetLati	TargetLon	SampleDa	Collection	FinalID	LifeStageName	BAResult
Surface Water Ambient Monitoring Program	539NDCACC	37.4249	-119.596	5/5/2009	18:00	Leptolyngbya foveolarum	Not Recorded	2
Surface Water Ambient Monitoring Program	539NDCACC	37.4249	-119.596	5/5/2009	18:00	Achnanthidium minutissimum	Not Recorded	33
Surface Water Ambient Monitoring Program	539NDCACC	37.4249	-119.596	5/5/2009	18:00	Adlafia minuscula	Not Recorded	2
Surface Water Ambient Monitoring Program	539NDCACC	37.4249	-119.596	5/5/2009	18:00	Aulacoseira crenulata	Not Recorded	6
Surface Water Ambient Monitoring Program	539NDCACC	37.4249	-119.596	5/5/2009	18:00	Cocconeis placentula var euglypta	Not Recorded	2
Surface Water Ambient Monitoring Program	539NDCACC	37.4249	-119.596	5/5/2009	18:00	Eunotia implicata	Not Recorded	5
Surface Water Ambient Monitoring Program	539NDCACC	37.4249	-119.596	5/5/2009	18:00	Gomphonema parvulum	Not Recorded	27
Surface Water Ambient Monitoring Program	539NDCACC	37.4249	-119.596	5/5/2009	18:00	Kolbesia suchlandtii	Not Recorded	6
Surface Water Ambient Monitoring Program	539NDCACC	37.4249	-119.596	5/5/2009	18:00	Planothidium lanceolatum	Not Recorded	26

Download Data

Excel file - This table contains the sites that have CSCI scores and/or H20 scores that populates the Bioassessment Scores Map. It contains information for station code, stream names, sample dates, county, field replicate, reference status, latitude/longitude, CSCI score, and H20 score.

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Thank You

http://www.waterboards.ca.gov/water_issues/programs/swamp/bioassessment

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