

Assessment of Episodic Streams in the San Diego Region

Raphael D. Mazor¹, Jeff Brown¹, Eric D. Stein¹, John R. Olson², Matthew D. Robinson², and Theresa Clark²

¹*Southern California Coastal Water Research Project*

²*California State University, Monterey Bay*

EXECUTIVE REPORT

Ephemeral streams and intermittent rivers are an important component of watersheds in arid regions, such as Southern California. They face increasing pressure from storm- or wastewater discharges, groundwater extraction, intensive recreation, and other human activities. Watershed managers need tools to assess and manage the impacts of these activities. To this end, the San Diego Regional Water Quality Control Board, the Southern California Coastal Water Research Project, and California State University at Monterey Bay completed a pilot project to develop and evaluate potential indicators of biological condition for use in ephemeral streams during their dry phase. When complete, these tools could support the integration of ephemeral streams into Water Board programs, such as headwater protection, identification of impaired beneficial uses, and evaluation of discharges or spills in these systems. Currently, such activities focus primarily on perennial or long-duration intermittent streams, which comprise only a small portion (~10%) of the San Diego Region's watersheds.

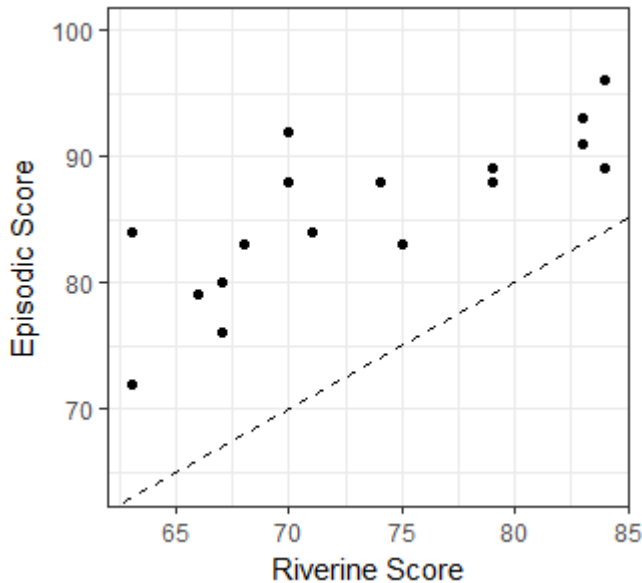


Cold Spring Creek (left), a minimally disturbed site, and Trabuco Creek (right), a highly disturbed site, represent the range of conditions evaluated in this study.

Following the EPA's tiered approach towards wetland assessment, this study evaluated both "Level 2" (rapid, field-based) and "Level 3" (intensive) methods for assessing condition. We evaluated a newly developed "Episodic" module of the California Rapid Assessment Method (CRAM) for ephemeral streams, in comparison to the more traditional Riverine module for intermittent and perennial streams. In addition, we developed protocols and evaluated assessment metrics for two assemblages that inhabit dry streambeds: arthropods (e.g., spiders and insects) and bryophytes (e.g., mosses). Although caution is warranted when interpreting a study of limited size (39 sites, 22 reference sites), we demonstrate that these methods hold promise as tools to assess conditions in ephemeral streams.

Both CRAM modules provide similar information, but selecting a module requires more guidance

The Episodic CRAM module resulted in assessments that were up to 22 points higher (on a 100-point scale) than those realized through the traditional Riverine module, although module scores were typically within 11 points. The differences in scores largely driven by the Episodic module's lower expectations for biotic complexity. In most cases, the differences in scores were small enough that outcomes are unlikely to be influenced by the selection of a module. However, the choice of module could make the difference between a passing and failing score at moderately stressed sites. For regulatory applications, module selection requires transparent guidance that can be easily implemented and standardized among practitioners.



At most sites, the Episodic CRAM module yields higher scores than the traditional Riverine module, although scores were positively correlated with each other ($r=0.79$). The dashed line represents perfect agreement between the modules.

Guidance in selecting between the Riverine and Episodic modules in the CRAM field books emphasizes map-based indicators, such as geographic location, stream order and mean annual rainfall. In contrast, we found that field-based indicators, such as dominant vegetation type and channel morphology, can be helpful. Moreover, we found that there are certain sites where either module may be appropriate. Guidance in the CRAM field books needs to be updated to help practitioners select an appropriate module.

Bioassessment in ephemeral streams is feasible, and likely to be successful

We developed sampling protocols for two potential bioindicators in ephemeral streams: terrestrial arthropods (such as insects and spiders) and bryophytes (mosses). For the two indicators, we calculated 130 metrics expected to respond to human activity. Sampling effort is

comparable to effort required to sample benthic macroinvertebrates in flowing streams, although arthropod sampling requires overnight deployment of traps, and therefore two consecutive site-visits. Capacity of labs to perform taxonomic analysis is likely high in the case of arthropods, but could be limited for bryophytes. However, molecular tools may be worth evaluating eventually as a means to obviate taxonomical expertise for that group.

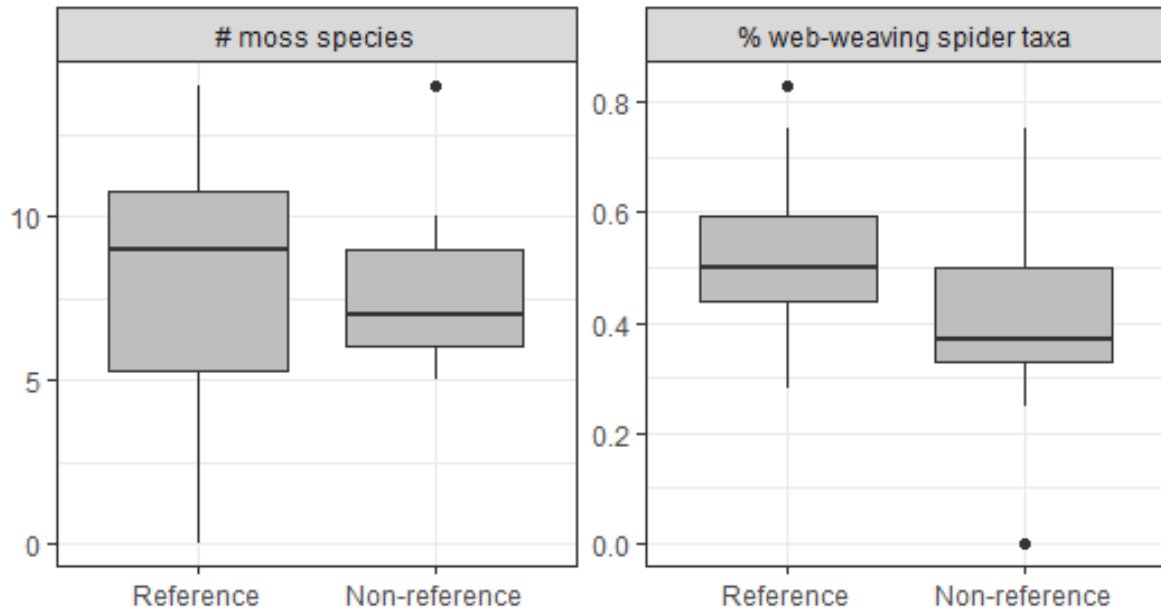


Arthropods are sampled by deploying “ramp” traps overnight (left), while bryophytes (right) are sampled through time-limited searches.

A number of metrics exhibited significant relationships with measures of human activity, suggesting that they could be used in an index of stream condition. Some metrics, such as the number of moss species, or the percent of web-weaving spider taxa, characterize sedentary components of the stream community, which may be more vulnerable to frequent physical disturbance (like active recreation or grazing). Others may reflect trophic structure or feeding strategies. For example, the relative numbers of predatory versus fungus-eating beetles may reflect a change in food sources associated with eutrophication or dumping of trash. Further investigation of the life histories of bryophyte and arthropod species could yield useful bioassessment metrics that provide insight into ecosystem function, and will be pursued through literature reviews in planned research projects.



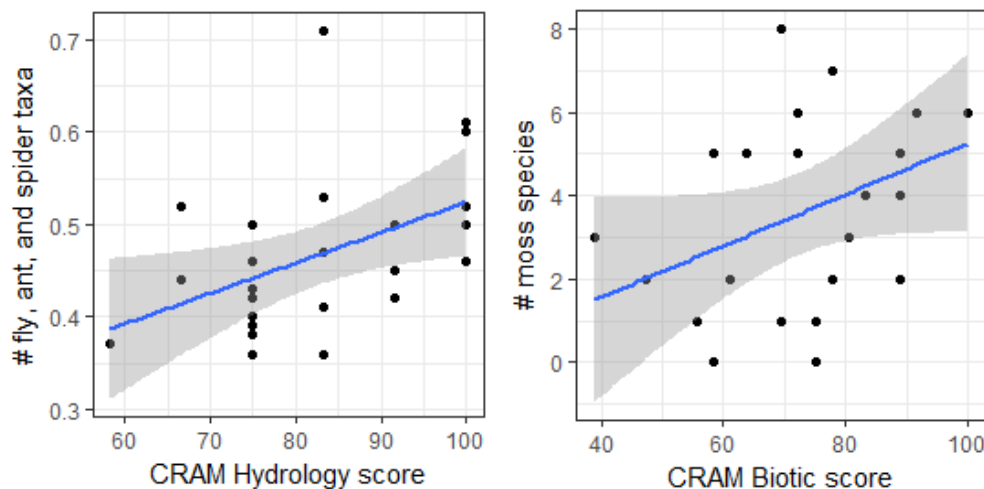
Samples are identified under a microscope to identify taxa, such as darkling beetles (left) and Fissidens moss (right).



Several metrics decline with increasing human activity. For example, the number of moss species, as well as the percent of web-weaving spiders, were both higher at reference sites (22 sites) than non-reference sites (17 sites).

Bioassessment metrics demonstrate the validity of rapid assessment methods

Many bioassessment metrics showed a strong relationship with the CRAM index and attribute scores, demonstrating the validity of these rapid methods. For example, the number of fly, ant, and spider taxa increased with CRAM scores, as well as measures of hydrologic and physical structure; similarly, the number of moss taxa in the streambed was positively correlated with the biotic CRAM attribute.



Both arthropod and bryophyte metrics are correlated to CRAM scores.

Recommendations for assessing conditions of ephemeral streams

This study demonstrates the feasibility of assessing ephemeral streams and including them in Water Board programs from which they are presently excluded. However, some additional steps may facilitate this integration. These steps may be beyond the scope of the Regional Board to pursue on its own; therefore, identifying collaborators with similar interests, both within the region (e.g., the Stormwater Monitoring Coalition [SMC]), in other parts of California (e.g., State Water Board and other Regional Water Boards), and in other states (e.g., regulatory agencies in Arizona or Nevada) should be a priority.

- *The Episodic CRAM module may be used now*, but additional guidance is necessary to help practitioners select between this and the Riverine module.
- *More work is needed to use arthropods or bryophytes as assessment tools*. Collect additional samples from both reference and stressed sites to validate results and assess temporal variability. Explore (and generate, if necessary) life history information to identify assessment metrics that provide meaningful insight into stream condition. Use these data to develop indices that provide a standardized, repeatable measure of biological condition.
- *Implement sampling protocols now* in programs or studies that need to assess the condition of ephemeral streams (e.g., the stream survey of the SMC). Although indices are not yet available, protocols are suitable for application to many monitoring programs.
- *Improve infrastructure* required to conduct assessments of ephemeral streams. In particular: conduct trainings and audits for practitioners in the region; refine quality assurance steps for both lab and field analyses; and create a standard taxonomic effort for both bryophyte and arthropod assemblages. Explore the utility of molecular methods to improve capacity to analyze bryophyte samples.

Full text:

http://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/1011_BioIndicatorAssessCondSD_IRES.pdf