SWAMP Surface Water Ambient Monitoring Program

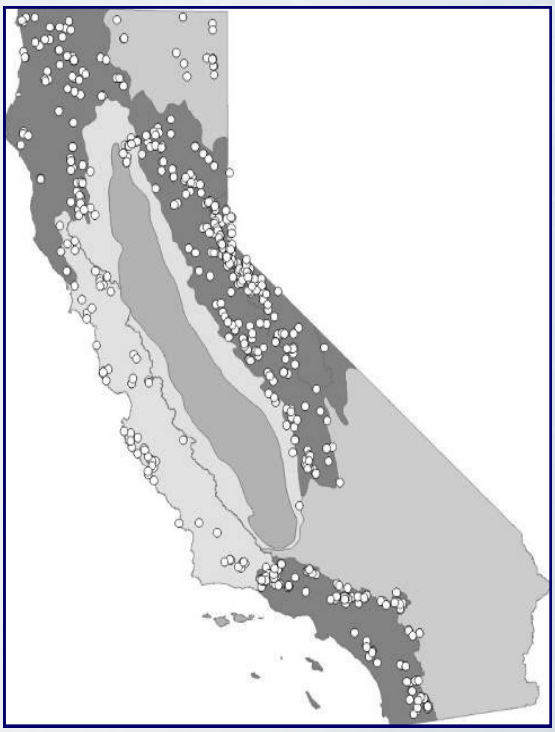
SWAMP Newsletter

Sound science for informed water quality management

2017 | Fall Issue

The Reference Condition Monitoring Program (RCMP): A Network of California's Healthiest Streams

By Andrew Rehn (Andy.Rehn@wildlife.ca.gov)



"Reference sites" are healthy stream reaches that define a benchmark of expected biological, chemical, and physical conditions when human disturbance in the environment is absent or minimal. This benchmark, known as the "reference condition," is the foundation of a strong bioassessment program: it sets the standard for evaluating results from compliance and ambient monitoring, provides meaningful objectives for stream restoration, establishes a framework for protecting our healthiest streams and rivers, and provides a basis for assessing potential effects of climate change on freshwater resources. SWAMP screened more than 2,000 previously sampled sites, and targeted sampling of additional high-quality streams, to establish a statewide network of nearly 600 reference sites that provides crucial support for a diverse range of monitoring objectives (see map at right).

Supporting Development of Biological Indices

California's great physiographic complexity supports a wide variety of natural stream types with dramatically different reference expectations. The broad geographic coverage and representation of diverse environmental settings provided by the RCMP network allowed SWAMP to develop the California Stream Condition Index (CSCI): an index based on benthic macroinvertebrates (BMIs) and the first to have statewide applicability (CSCI fact sheet). Development of a statewide algae index is underway (Algae Fact Sheet).

(Continued on next page)

Decisions about whether study sites support aquatic life beneficial uses, such as protection of native species, are often based on criteria established from the statistical distribution of biological index scores at reference sites. For example, the CSCI can be divided into 4 condition categories, with scores greater than 0.92 indicating a BMI assemblage likely to be intact (Figure 1,). Once established, that attainment "goal" for the CSCI can be related to environmental conditions likely to support it. In Figure 1, the dashed blue arrow shows that, statewide, the 90th percentile of riparian condition index scores observed at sites with "likely intact" biological condition was 1.3, where higher index scores indicate greater riparian disturbance. This indicates that biological condition generally tends to become degraded when riparian index scores exceed the threshold of 1.3.

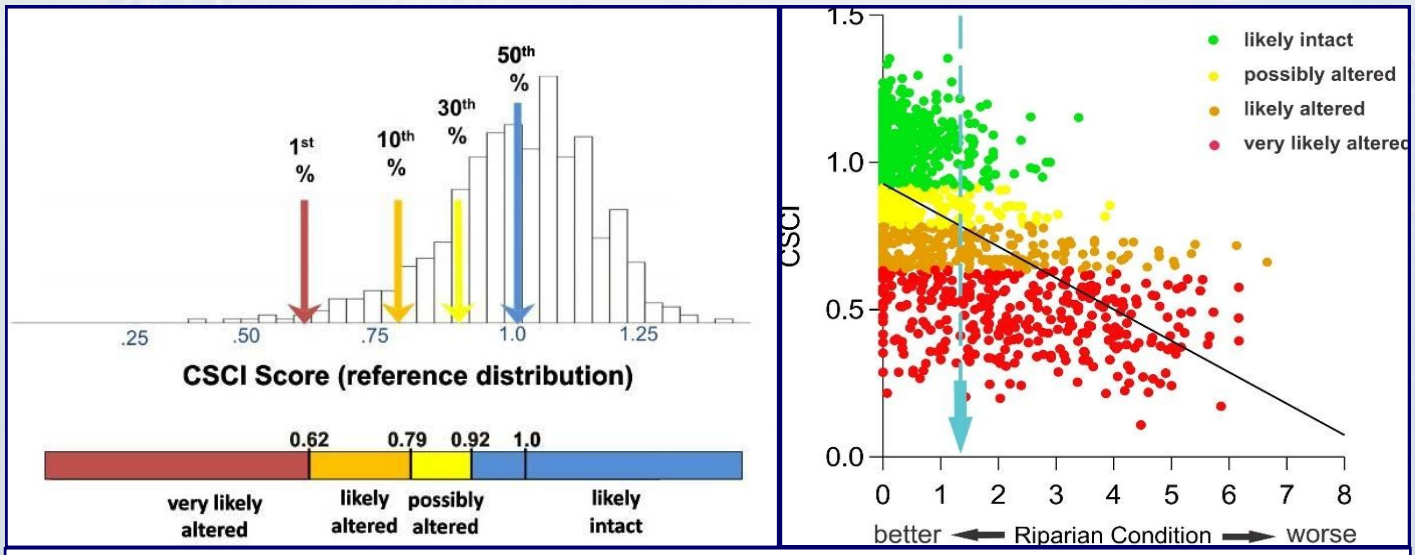


Figure 1. *Left panel: the CSCI was divided into 4 condition categories, with scores greater than 0.92 indicating a BMI assemblage likely to be intact. Right panel: biological condition tends to become degraded when riparian index scores exceed a threshold of 1.3, where higher scores indicate greater riparian disturbance from human activities.*

Providing Context for Monitoring and Restoration

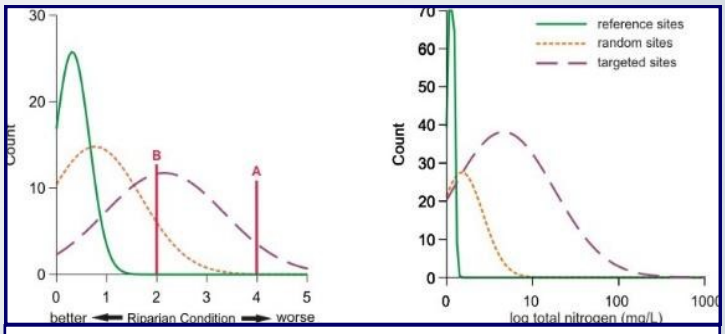


Figure 2. *Examples from the Central Coast region showing how stressor distributions at reference sites provide context for interpretation of results from random and targeted sites.*

Stressor distributions from reference sites provide context for interpretation of results from ambient monitoring of both random sites and targeted sampling at sites of concern, and can help set meaningful restoration and management goals. Riparian restoration at a targeted site may improve its index score from "4" to "2" (i.e., from point A to point B in Figure 2,), but the site would still have more disturbance than 95% of the general population (estimated from random sites), and the entire regional reference pool. The same approach can be used to set targets for nutrients, such as nitrogen, that often have natural concentrations greater than zero, and for which targeted sites commonly have much greater concentrations as compared to random or reference sites (Figure 2).

(Continued on next page)

Assessing Potential Effects of Climate Change

Climate change is predicted to increase average temperature and decrease average precipitation across California in coming decades. Many streams with permanent flows may shift to long periods of summer drying with declines in endemic, montane-adapted taxa and an increase in widespread, resilient taxa.

Figure 3. *Cosumnoperia hypocrena, a California stonefly endemic to headwater streams of the Cosumnes River basin that could experience loss of habitat and extinction under predicted climate change.*

Regulatory programs depend on reference sites to define standards for assessing the biological integrity of our streams and rivers. If reference conditions decline or become more variable as climate warms, our ability to define ecological degradation as a departure from the reference condition becomes diminished.

Long-term data loggers that continuously record temperature and water depth have been deployed at more than 40 "sentinel" reference sites statewide. These sites are sampled annually for BMIs, algae, water chemistry, and habitat conditions in order to improve our understanding of how natural flow and temperature regimes influence native fauna, identify habitats and species most vulnerable to the effects of climate change, and develop a management framework that supports resilience and protection of our most vulnerable stream types.

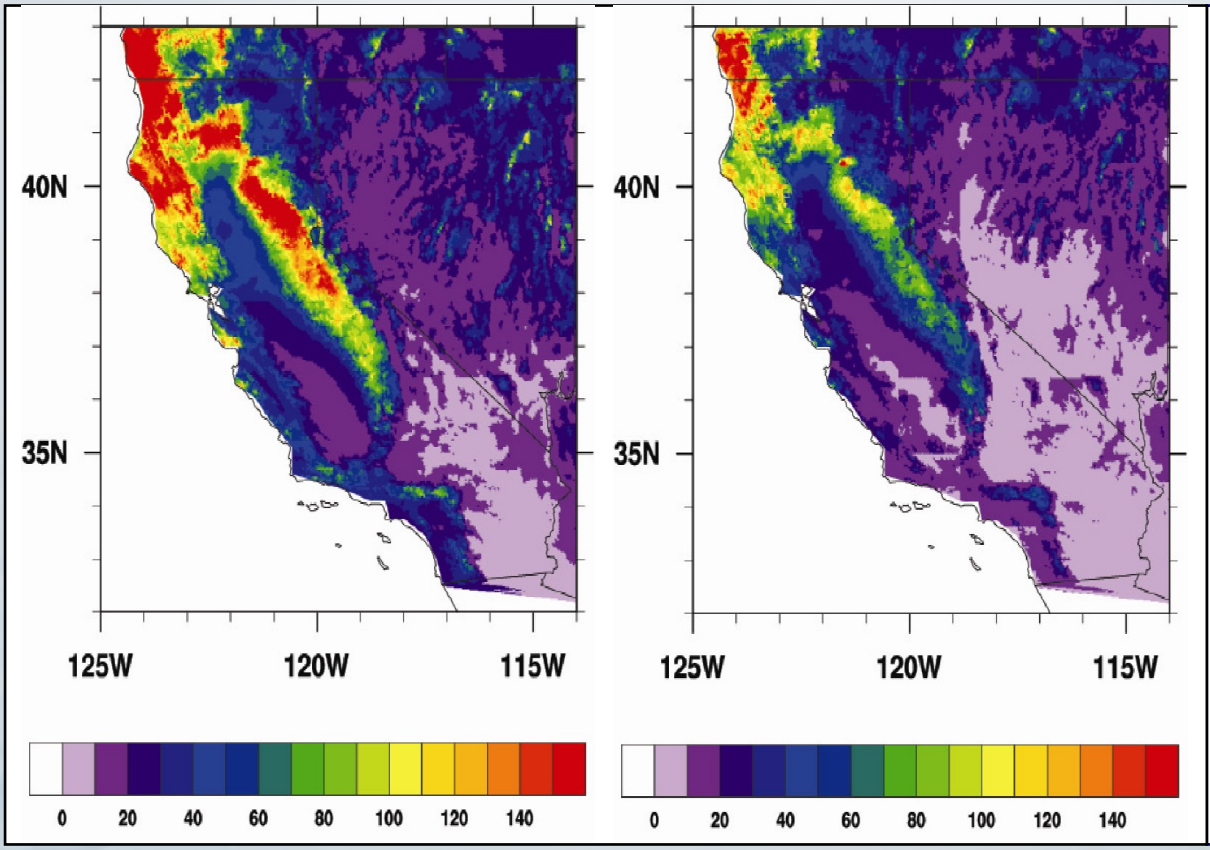


Figure 4.

Left panel: Mean monthly precipitation (in inches) in California in 1999. Right panel: Modeled (predicted) mean monthly precipitation in 2090. Courtesy of Dr. Charles P. Hawkins, Utah State University.

(Continued on next page)

Setting Minimum Flow Requirements

California has more dams and water diversions than any other state. Hydrologic alterations typically associated with dams and diversions include reduced instream flows and lack of seasonal fluctuation, with associated changes in physical habitat, temperature regime, nutrient loading, food webs, and resident biota. Natural flow characteristics at reference sites like the Clavey River, including the timing, frequency, and magnitude of peak storm events, can be used to establish minimum flow requirements at sites that experience modified flows, like Silver Creek below Camino reservoir (Figure 5).

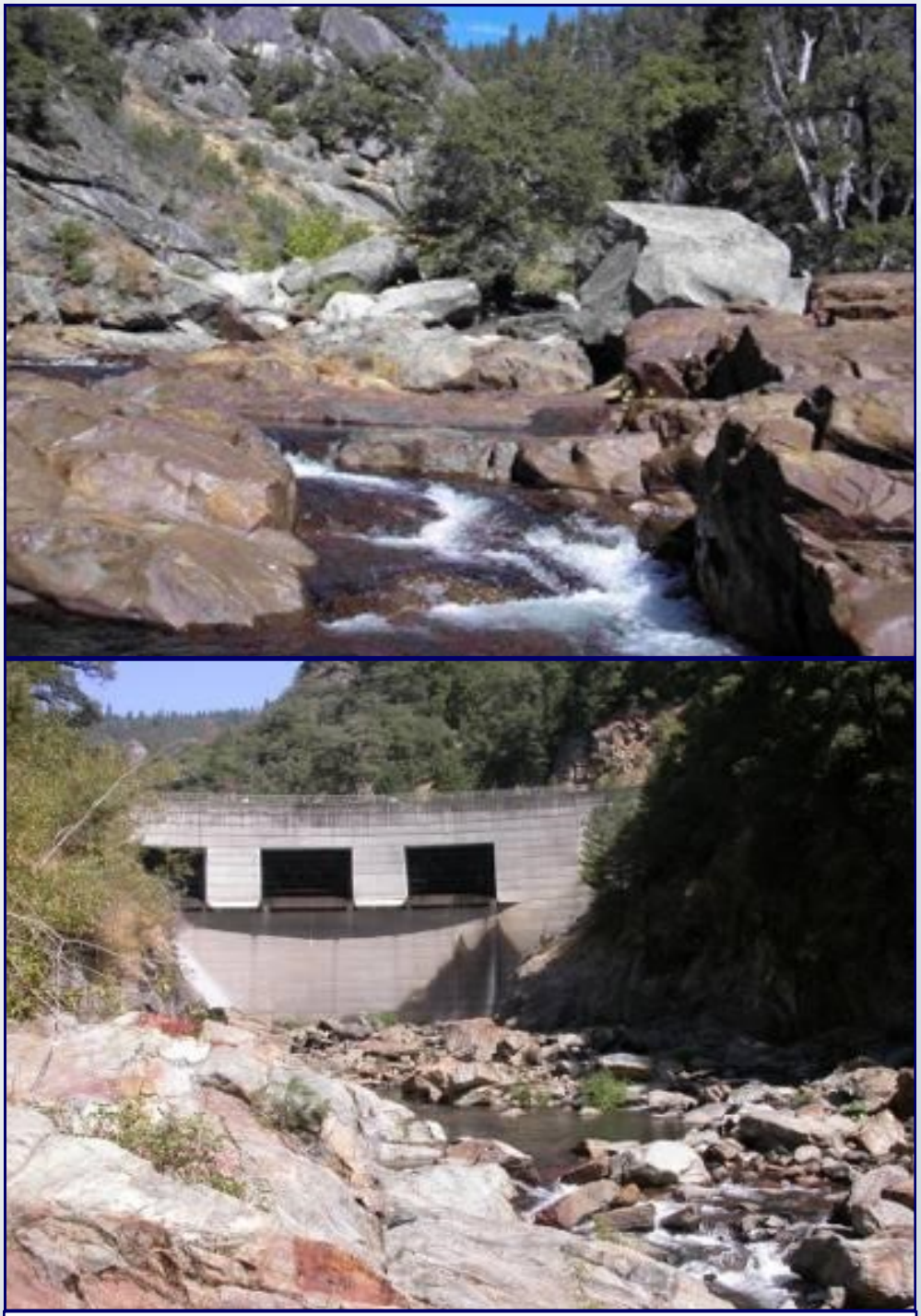


Figure 5. *Top—The Clavey River; Bottom—Silver Creek below Camino Reservoir.*

Moving Into Nonperennial Streams

The RCMP has recently expanded its scope to include streams that go dry for a few weeks to a few months each year (i.e., nonperennial streams). Nonperennial streams are an important interface between land-use activities and downstream impacts and support a wide variety of aquatic life uses, including habitat for aquatic and terrestrial wildlife, processing nutrients, transporting sediment, and provide an array of other services. These streams may be especially vulnerable to the effects of warming climate and prolonged drought.

(Continued on next page)

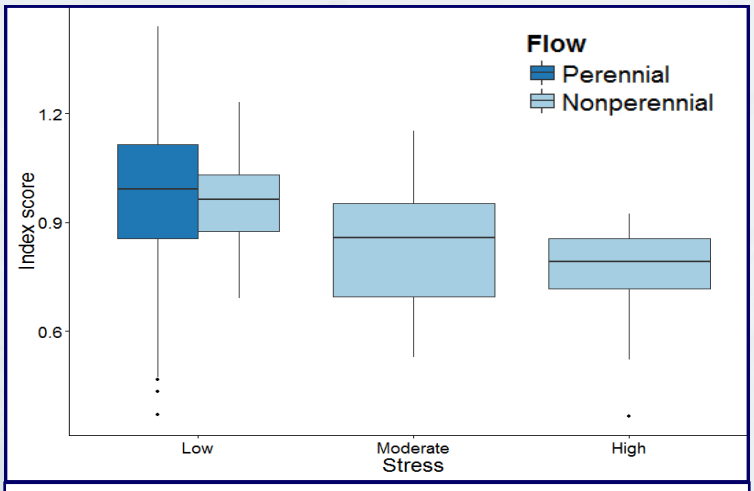


Figure 6. *Nonperennial reference streams like Bell Canyon in southern coastal California have CSCI scores similar to regional perennial reference streams, and the CSCI responds similarly to stressor gradients in both nonperennial and perennial streams*

The majority of stream length in many regions of the state, (e.g., the central and southern coasts and the Sierra foothills) is nonperennial and even wet regions have a large proportion of non-perennial streams. However, these important habitats are often neglected by resource managers, largely because little is known about them. A practical need of resource managers is to know whether existing biological indices are applicable in these systems. Encouraging preliminary results from southern California and the Bay Area indicate that nonperennial reference streams score similarly to regional perennial streams, but we don't yet know how well these patterns apply in other parts of California (Figure 6).

For more information: *Visit the SWAMP Bioassessment Program website for publications, field sampling protocols, interpretive tools and other bioassessment resources:* *http://www.waterboards.ca.gov/water_issues/programs/swamp/bioassessment/*

Download Data: Bioassessment Scores Map