

Monitoring Monday – Let's look at benthic algae and periphyton.

Join us each Monday as the Clean Water Team shares information and resources on water quality monitoring. Today we will look at biomonitoring algae and periphyton.

Biological assessment is a method in which living organisms are used to determine the situation of the environment. For aquatic ecosystems, the United States Environmental Protection Agency recommends the utilization of multiple bioindicators that will facilitate a “weight-of-evidence” approach to the interpretation of biomonitoring results. For many biomonitoring programs algae are one of those bioindicators.

The term "algae" covers many different organisms capable of producing oxygen through photosynthesis (the process of harvesting light energy from the sun to generate carbohydrates). These organisms are not necessarily closely related. However, certain features unite them, while distinguishing them from the other major group of photosynthetic organisms: the land plants.

Algae lack true roots, stems and leaves, and a vascular system to circulate water and nutrients throughout their bodies. They also occur in a variety of forms and sizes. They can exist as single, microscopic cells; they can be macroscopic and multicellular; live in colonies; or take on a leafy appearance as in the case of seaweeds such as giant kelp. Picoplankton are between 0.2 to 2 micrometers in diameter, while the fronds of giant kelp are as large as 60 meters in length. Algae are found in a range of aquatic habitats, both freshwater and saltwater.

Benthic algae (periphyton or phytobenthos) are primary producers, and an important foundation of many stream food webs. These organisms also stabilize substrata and serve as habitat for many other organisms. Because benthic algal assemblages are attached to substrate, their characteristics are affected by physical, chemical, and biological disturbances that occur in the stream reach during the time in which the assemblage developed. They can also serve as habitat for many other organisms.

Algae can colonize virtually any stream substratum; thus, algal assemblages can be monitored throughout the diverse range of stream types found in California. Algal taxa tend to have high dispersal rates, growth rates, and relatively short generation times (on the order of days, for many taxa), thereby allowing rapid response to changes in their environment. Consequently, they can provide a temporal window for assessment that is complementary to (shorter than) that for other common bioindicators and may be valuable for application in streams with short flow durations (i.e., intermittent streams and some ephemeral streams). As primary producers, algae are the most directly responsive of the common bioindicators to nutrients and have been very valuable for assessing nutrient impairment.

Diatoms in particular are useful ecological indicators because they are found in abundance in most lotic ecosystems. Diatoms and many other algae can be identified to species by

experienced algologists. The great numbers of species provide multiple, sensitive indicators of environmental change and the specific conditions of their habitat. Diatom species are differentially adapted to a wide range of ecological conditions.

Periphyton is a complex mixture of algae, cyanobacteria, heterotrophic microbes, and detritus that is attached to submerged surfaces in most benthic habitats, including algae, bacteria, protozoa, and invertebrates. Periphyton are considered early warning systems for contamination detection and their ability to reveal effects of pollutants have led researchers to propose a variety of methods to detect and assess the impact of pollutants and use on rivers.

METHODS

Incorporating Bioassessment Using Freshwater Algae into California's Surface Water Ambient Monitoring Program (SWAMP) -

www.waterboards.ca.gov/water_issues/programs/swamp/docs/reports/563_periphyton_bioassessment.pdf

Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers: Periphyton, Benthic Macroinvertebrates, and Fish - [Second Edition](#)

- [Chapter 6: Periphyton Protocols](#)

Standard Operating Procedures for the Collection of Field Data for Bioassessments of California Wadeable Streams: Benthic Macroinvertebrates, Algae and Physical Habitat (May 2016) -<https://drive.google.com/file/d/0B40pxPC5g-D0MS1zMjNacnJZOEk/view>

- [SWAMP Field Methods Course](#)

Standard Operating Procedures (SOP) for Laboratory Processing, Identification, and Enumeration of Stream Algae (November 2015)

www.waterboards.ca.gov/water_issues/programs/swamp/bioassessment/docs/sop_algae_lab_101315.pdf

Tahoe Environmental Research Center - [Periphyton Monitoring](#)

Watershed Academy Web: Rapid Bioassessment Protocols -

https://cfpub.epa.gov/watertrain/moduleFrame.cfm?parent_object_id=1019

TAXONOMY TOOLS

- [Diatoms of the Southern California Bight Identification Tool](#) - An online tool that utilizes SWAMP data collected from southern California streams. Hosted by the University of Colorado, Boulder.
- [Soft-Bodied Stream Algae of California Identification Tool](#) - An online tool that utilizes SWAMP data collected from over 1,500 streams throughout California. Hosted by the University of Colorado, Boulder.

- [Diatoms of North America](#) - Diatoms of North America is a collaborative effort to document the diversity of diatom species in North America. We aim to provide accurate information on diatom identification, ecology and distribution.

Taxonomic identification of algae (morphological and molecular): species concepts, methodologies, and their implications for ecological bioassessment -
<https://pubmed.ncbi.nlm.nih.gov/26988316/>

Technologies for Plankton Identification and Monitoring (FlowCam - Flow Imaging Microscopy Blog)
<https://blog.fluidimaging.com/blog/technologies-for-plankton-identification-and-monitoring>

VIDEOS

Bugs, Fish and Algae, oh my...California's Bioassessment Program (Video) -
www.youtube.com/watch?v=BleOpwOMOS0

Algae Corner: What are Algae? - www.youtube.com/watch?v=uhZLswAB6ec

Diatoms: Tiny Factories You Can See from Space - www.youtube.com/watch?v=Ygty9HxhFK4

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