SWAMP Surface Water Ambient Monitoring Program

# SWAMP Newsletter

*Sound science for informed water quality management*

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## Using Innovative Technology to Monitor Freshwater Cyanobacteria Harmful Algal Blooms in the North Coast Region

By Katharine Carter, Lisa Bernard, and Rich Fadness (Katharine.Carter@waterboards.ca.gov)

Cyanobacteria, commonly known as blue-green algae, are natural components of healthy fresh water ecosystems. However, under certain water quality conditions they can multiply causing nuisance blooms. Blooms containing toxin-producing species are termed Cyanobacteria harmful algal blooms (CyanoHABs), and pose health risks to domestic animals, wildlife, and humans. CyanoHABs are occurring with increased frequency and severity around the world, including in the North Coast Region. Efforts to more effectively manage HABs and their public health consequences will require improved monitoring, assessment, and increased educational outreach. The North Coast Regional Water Board established a Cyanobacteria and Harmful Algal Bloom Monitoring and Response Program (CyanoHAB program) in early 2015 to fulfill these objectives.

Benthic blooms originating on the substrate of North Coast Rivers are very different from planktonic (floating) blooms that originate in lentic (still) waters of lakes and reservoirs (Figure 1). HABs in lentic waters are caused by free-floating, planktonic cyanobacteria cells. Measuring HABs and their associated toxins in this environment poses fewer challenges and uncertainties than sampling within streams and rivers. In lakes and reservoirs, the water column is relatively stable and the location of nuisance blooms is more easily identified. Planktonic HABs are readily analyzed using grab water column sample collection, and researchers have been studying planktonic HABs for many years since they are common throughout the United States and the world.

***Figure 1.*** *Left panel – benthic bloom; Right panel – planktonic (floating) bloom*

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Conversely, relatively little research has been conducted on benthic blooms. Understanding benthic HABs and the associated public health risks involves layers of complexity not applicable to planktonic HABs. Factors of complexity include:

- Multiple species of cyanobacteria often colonize a specific reach of a river
- Each species may be capable of producing various toxins
- Grab water samples provide only a snapshot in time of water moving through the system
- Timing and precursors to the release of toxins from benthic cyanobacteria is not well understood

Since 2015, the North Coast Regional Water Board has focused on monitoring for the protection of public health while collecting data to further understand the habitat, growth, toxin production, exposure routes, and risks of benthic cyanobacteria found in North Coast rivers. The traditional method of HAB toxin sampling involves taking a grab water sample at a particular location and specific point in time. This type of sampling captures "free" toxins in the water column (extracellular toxins-released from the cells), and free-floating cyanobacteria cells including toxins that remain bound within the cells' walls (intracellular toxins). Benthic cyanobacteria cell colonies attached to the substrate are much less likely to be free-floating in the water column and, thus, less likely to be captured in a traditional grab water sample. To capture intracellular toxicity potential, Regional Water Board staff collect benthic cyanobacteria mat grab samples. This consists of physically removing cyanobacteria mat material from the stream substrate and placing it in a sample bottle for laboratory analyses. A third method used to sample cyanobacteria toxins is the deployment of passive, time-integrated samplers called Solid Phase Adsorption Toxin Tracking (SPATT) bags. These mesh bags contain a synthetic resin which adsorbs toxins as the water flows through them.

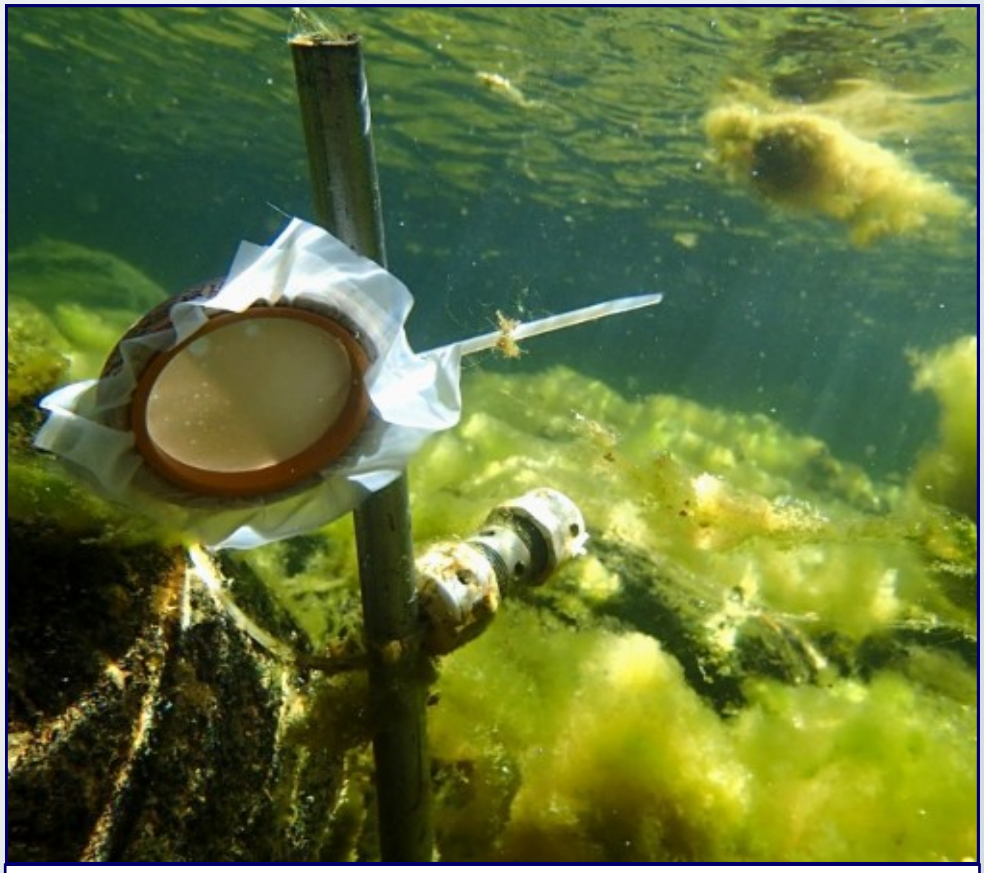

***Figure 2.*** *Solid Phase Absorption Toxin Tracking (SPATT) Bags. Photo Courtesy of Kieth Bouma-Gregson*

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Monitoring results have documented the importance of collecting algal mat grab samples when monitoring in water bodies with benthic blooms. As reflected in the table below, simply measuring cyanotoxins present in the water column may result in underestimating the potential health threat. Algae mat grab sample results provide insight into toxin levels; specifically, those toxins that are bound within cells at risk of release into the water column. These toxin-rich cyanobacteria mats are especially dangerous to dogs, which are often exposed to high levels of toxins through ingestion which can result in death.

| Sample Method | Anatoxin (Neurotoxin) |
|---|---|
| SPATT | 5.062 ng/g |
| Water Grab | Non Detect |
| Algal Mat Grab | 217 ug/L |

***Table 1.*** *Sample results from the Russian River near Cloverdale Airport—10/3/2016*

In 2017, the North Coast Regional Water Board continued to implement multiple monitoring methods in an effort to better understand toxin dynamics, exposure routes, and the risks of benthic blooms in our river systems. In combination with U.S. Geologic Survey instream telemetry data (temperature and dissolved oxygen), Regional Water Board staff assessed biostimulatory indicators, visual observations, and both water column and algal mat toxin results to determine CyanoHAB risks. When monitoring conditions indicated a potential threat to public health, Regional Water Board staff in cooperation with the local Public Health Agencies initiated the posting of signs alerting recreational users to take precautions at key public access points to the affected water bodies.

The North Coast Regional Water Board continues to collaborate with the California Cyanobacteria and Harmful Algal Bloom (CCHAB) Network and the Freshwater CyanoHABs (FHABs) Program to further research and continue the development of effective monitoring tools and strategies. Additional resources and information can be found at the North Coast Regional Water Board's website, as well as the websites maintained by the CCHAB and FHAB.