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Looking Ahead: Preliminary Examination of Stream Cyanotoxins in Santa Monica Bay and California Watersheds

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4.7 Preliminary Examination of Stream Cyanotoxins in Santa Monica Bay and California Watersheds

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Cyanobacteria ("blue-green algae") are photosynthetic prokaryotes that are nearly ubiquitous in freshwater and brackish habitats. Nuisance cyanobacterial blooms occur commonly (Chorus & Bartram 1999), and are problematic because they can impede the recreational use of water bodies, reduce aesthetics, lower dissolved-oxygen concentrations, cause drinking water taste and odor problems, and sometimes produce toxins (cyanotoxins), the most common of which are microcystins (Butler et al. 2009). Microcystins are powerful hepatotoxins associated with wildlife mortality and liver tumors/cancer in humans (Codd et al. 2005). They have also been implicated in impairment of benthic macroinvertebrate communities, as they can depress bioassessment scores (Aboal et al. 2002). Freshwater harmful algal blooms (HABs, blooms of cyanotoxin-producing cyanobacteria) have been increasing in geographic range, frequency, duration, and severity as a result of various anthropogenic factors, including nutrient enrichment and changes in temperature (Paerl & Huisman 2008, Paerl & Paul 2012, Paerl et al. 2011). Although little data are available on cyanotoxins in the Santa Monica Bay Watershed, based on what data exist, there is currently no indication of a persistent cyanotoxin problem in SMB streams. Nonetheless, toxic cyanobacterial blooms are an emerging issue throughout California, and merit our attention.

Exposure of estuarine and marine biota to high concentrations of microcystins in outflows from impaired freshwater systems has been implicated in the injury or death of marine fish, shellfish, and mammals. The most notable impact in California has been the recent mortality of over 30 federally threatened southern sea otters in and around the Monterey Bay National Marine Sanctuary (Miller et al. 2010, M. Miller pers. comm.). Pinto Lake, a eutrophic lake that experiences frequent cyanobacterial blooms, has been identified as a source of the toxin. Pinto Lake is drained by the Pajaro River, which periodically transports the toxin to Monterey Bay, where it can bioaccumulate in bivalves and ultimately be consumed by the otters (Miller et al. 2010). Microcystins have been shown to be a persistent issue in the major coastal watersheds that flow into the Monterey Bay National Marine Sanctuary (Gibble & Kudela 2014). This phenomenon has been the basis for increasing interest in the transport of cyanotoxins from their source to distant areas via waterways. These toxins can be persistent in the environment, with half-lives spanning weeks to months. Thus, it is important to pay attention to receiving waters downstream from cyanobacterial hotspots, as the experience in Monterey suggests.

Despite the potential importance of cyanotoxin-containing HABs to a wide range of agencies (e.g., those dealing with human and wildlife adverse health effects, or with recreational resources or water supply), the prevalence of cyanobacterial blooms and associated concentrations of

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cyanotoxins are not routinely quantified or monitored in California, hindering the informed development of effective management responses. In an effort to address this data gap, a group of scientists from the Southern California Coastal Water Research Project (SCCWRP), the San Diego Regional Water Quality Control Board, UC Santa Cruz, and CSU San Marcos have begun examining the prevalence of cyanobacteria and cyanotoxins throughout the state. This work has revealed that cyanotoxins (and in particular, microcystins) are widespread throughout Southern California, in every fresh or brackish water body type that has been tested to date (i.e., wadeable streams, depressional wetlands, lakes, lagoons, and estuaries).

In contrast to the region as a whole, only limited cyanotoxin production has been documented within the Santa Monica Bay Watershed, and this is limited to select streams in the Santa Monica Mountains. Although this finding is based on sparse sampling, and few conclusions can be drawn at this time, the low frequency of cyanotoxin production observed in the watershed suggests that future work to examine drivers of toxin production in streams may be able to use the Bay's watershed as a control.

Due to the episodic and ephemeral nature of toxic blooms, in general, the fact that cyanotoxins are widespread throughout the state means that they should be "on the radar" for any watershed monitoring program, as their presence might help explain unexpectedly low bioassessment scores (e.g., the California Stream Condition Index, CSCI, based on benthic macroinvertebrates, see Section 2.2.1 for more on bioassessments) and/or unexplained wildlife mortality (as exemplified by the Monterey Bay sea otter story). Better understanding of what causes toxin production and the potential for effects of cyanotoxins on aquatic life (both upstream and down) will be critical for developing informed management approaches, if and when they are needed.

For more information on cyanotoxin research, contact Dr. Meredith Howard (mhoward@sccwrp.org).

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