

LOCAL AGRICULTURAL RUNOFF'S EFFECT ON BOLINAS HARMFUL ALGAL BLOOMS

ELLA MILLER-HODGE

Background

“Harmful algal blooms (HABs) pre-date human encroachment on marine systems. However, there is growing evidence that the incidence, severity, and composition of HABs have changed because of human activities.” (Maddonald, Robbie, Brain, Morton and Sophia Johannessen, 2003). There is a lack of research on how the local agricultural operators of Bolinas located on the cliffs directly above the beach, are affecting the harmful algal blooms off Bolinas beach. It is vital that we gather this data because “HABs affect marine ecosystems in many ways. HABs that produce toxins can greatly disrupt an ecosystem as the effects of the toxins are passed up the food chain.” (McGaraghan, Kudela, Negrey, Gibble, 2017)

Objectives

- I predict that there will be a positive correlation between runoff events from local agricultural operations and the harmful algal blooms off Bolinas beach.
- Harmful algal blooms by definition have a negative impact on wildlife ecosystems and populations. By establishing a connection between agricultural runoff and harmful algal blooms in Bolinas specifically, we can set protocol to adjust agricultural practices to help mitigate the intensity and therefore impacts of the algal blooms on the ecosystem.

Methods/Approach

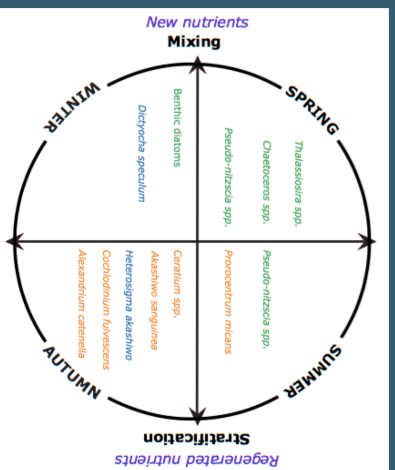
- This will be an observational study of the algal bloom's relationship to runoff from the agricultural operation located on the cliffs above the beach
- Sampling protocol: A water sample will be taken approximately 300 feet off shore at intervals of one mile for five miles via boat along the coast of Bolinas. At each sampling location a sample will be taken from both the water surface and a depth of 5 meters. Samples will be collected weekly. This sampling method is modeled from an observational study of similar nature conducted in a different location (Tatters, A. O., Howard, M. D., Nagoda, C., Busse, L., Gellene, A. G., & Caron, D. A., 2017)
- The major variables analyzed will be algal species observed (quantitative) and algal biomass observed (qualitative, measured in chlorophyll a amount)(USEPA). Fluctuations in these numbers will be compared to rainfall/runoff events and distance from the agricultural operation. In order to determine the relationship between these variables. The timeline for this study will be five years, which is based off the first study (conducted by Stanford) successfully linking agricultural runoff to algal blooms, in which it took five years to properly conclude causation. (Mark Schwartz, 2004)



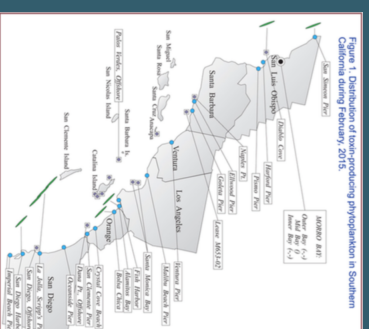
This graphic shows how human factors, as well as biological, chemical and physical properties of marine environments, all contribute to algal bloom and harmful algal bloom formation. Image: A. Joyner, UNC-CH Institute of Marine Sciences

Expected Benefits, Management Implications or Greater Impact

- If the study finds that there agricultural runoff of Bolinas does have a significant impact on harmful algal blooms off Bolinas beach, we can use this information to make changes to the agricultural operations to lessen their impact, and therefore the intensity of these blooms.
- Some changes that could be implemented are the addition of riparian buffers around the cliff and streams and limiting the use of land directly next to the cliff and streams to certain times of year with relation to rainfall/runoff events. Both of these actions could help to mitigate the nutrient runoff from these areas at minimal cost to farmers.
- It is important to mitigate the affects of local agricultural runoff on the harmful algal blooms off Bolinas beach because Bolinas beach and Duxbury reef are home to a vast amount of ecological diversity vital to the health of the ecosystem. In addition many locals make their living off of fishing, crabbing, etc. Finally, Bolinas beach is a popular recreational area for surfers, swimmers, etc. As a Bolinas resident for the last 20 years myself, I can tell you this firsthand.
- One anticipated setback of new management policies is resistance from the local farmers because less land will be in production. We hope to combat this through education on the importance of the topic as well as considering offering incentives to the farmers for making these changes.



A simplified scheme of the succession of main phytoplankton groups, varying with nutrient availability and mixing of the water column. Green are diatoms, orange are dinoflagellates, and blue are “other”. Image: “A Primer on California Marine Harmful Algal Blooms” 2017.



This figure shows the distribution of toxin-producing phytoplankton in southern California (2015) and demonstrates a lack of data on Northern California harmful algal bloom distribution. Image: “A Primer on Marine Harmful Algal Blooms” 2017

Literature Cited:

Tatters, A. O., Howard, M. D., Nagoda, C., Busse, L., Gellene, A. G., & Caron, D. A. (2017). Multiple stressors at the land-sea interface: Cyanotoxins at the land-sea interface in the southern California bight. *Toxins*, 9(3), 95.

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