Science Needs Assessment

Harmful Algal Blooms

Conservation Issue

Harmful algal blooms (HABs) are naturally occurring events that can be triggered or exacerbated by human activities such as non-point source discharge of fertilizers. In the last 30 years, HABs have increased in both frequency and intensity on the West Coast, including Monterey Bay National Marine Sanctuary (MBNMS). HABs can be toxic to marine wildlife, cause hypoxia, lower coastal pH, alter phytoplankton communities, threaten human health, and cause economic losses to fishing and tourism. Beyond immediate effects, there is the potential for long-term shifts in the function of the coastal ecosystems, from diatom-dominated upwelling to more pronounced fall blooms of dinoflagellates, which could alter the diatom-krill-fish trophic structure.

Description

Recent evidence suggests that HABs are escalating in both frequency and duration. While anthropogenic influences likely play a role, these trends may also result from better documentation due to more rigorous and abundant surveys or changing natural cycles in HAB dynamics. Recent HABs are also exhibiting new strains of algae not recognized on the west coast until the early 1990s, such as *Pseudo-nitzschia australis*, a diatom that produces the toxin domoic acid, or the dinoflagellate *Cochlodinium* (renamed to *Margalefidinium*), which was first reported as causing a HAB in 2004 and is a known to cause fish kills in the western Pacific. Studying the population structure of these potentially toxic species can improve understanding of the mechanisms that control the distribution and toxicity of HABs.

Data and Analysis Needs

1. Trends in the magnitude, frequency, duration, and effects of different types of HABs in MBNMS and causes of these trends
2. Reliable indicator species for the presence of HAB toxins (e.g., *Emerita* spp., *Mytilus* spp.)
3. Effects of HABs on local species, including the California sea lion and southern sea otter
4. Toxin purging and recovery rates for shellfish and other market organisms (e.g., rockfish, flatfish, bait fish) after a HAB event has ended
5. Natural and anthropogenic factors influencing HABs
6. Other, non-filter-feeding pathways by which HABs impact the ecosystem, such as through contamination of flatfish or bait fish
7. Effects of prolonged, low-level exposure to HABs in marine organisms such as the California sea lion and southern sea otter
8. Roles of agricultural versus urban nutrients in the development of HAB events (to supplement existing data from the Central Coast Wetlands Group and Central Coast Long-term Environmental Assessment Network [CCLEAN])
9. Impacts of freshwater organisms that make their way to the marine environment through surface waters or wastewater
    1. Methods for wastewater surveillance of human pathogens

2. Length of time freshwater organisms are able to survive in the marine environment and their potential effects on marine animals
3. Conditions under which freshwater HAB toxins accumulate in the marine environment

10. Relationships between climate-related variables (e.g., temperature and pH) and the magnitude, frequency, and duration of HABs
11. Baseline (non-bloom) concentrations of marine toxins in shellfish and other market organisms
12. Mechanisms that control the distribution and toxicity of HABs

Potential Products

- Maps of habitat distribution and HAB threat levels posed by proximity to fishing grounds and tourist areas
- Maps of water bodies frequently affected by HABs
- Integrated maps of fish and invertebrate distributions to determine proximity and vulnerability to HABs
- Characterization of the relationship between biological communities, oceanographic conditions, and anthropogenic influences that may cause HABs
- Enhanced notification systems to increase public awareness of HAB events and potential consequences
- Documentation of private and public sources of effluent that might contribute to HABs (to supplement existing work in Monterey and Watsonville)
- Criteria for selecting and prioritizing habitats vulnerable to HABs
- An effective prevention program for known effluent pathways that cause HABs
- An assessment of ecological and economic impacts of HABs in MBNMS

Suggested Scientific Approach and Actions

- Include HAB metrics in a long-term regional monitoring program to determine causes and effects of HABs, including: water quality analysis of effluent, indicator species, and strains of algae
- Identify habitats where recurring HABs appear
- Evaluate temporal and spatial scales of HAB presence and, in particular, the relationship to contamination of recreational and commercial fisheries and impacts on marine populations
- Utilize integrated watershed water quality data to assess the impact of the watershed on non-point effluent that might cause HABs

Key Partners

University of California at Santa Cruz, Monterey Bay Aquarium Research Institute, Central Coast Regional Water Quality Control Board, California Department of Fish and Wildlife, California Department of Public Health, CCLEAN, Central Coast Wetlands Group

Supplementary Information

Impacts of HABs on Marine Mammals
National Analytical Response to Harmful Algal Bloom–Related Marine Animal Mortality Events
California Harmful Algal Blooms (HABs) Portal
California HABMAP
Central and Northern California Ocean Observing System: Harmful Algal Blooms
California Department of Public Health: Marine Biotoxin Quarantines and Health Advisories

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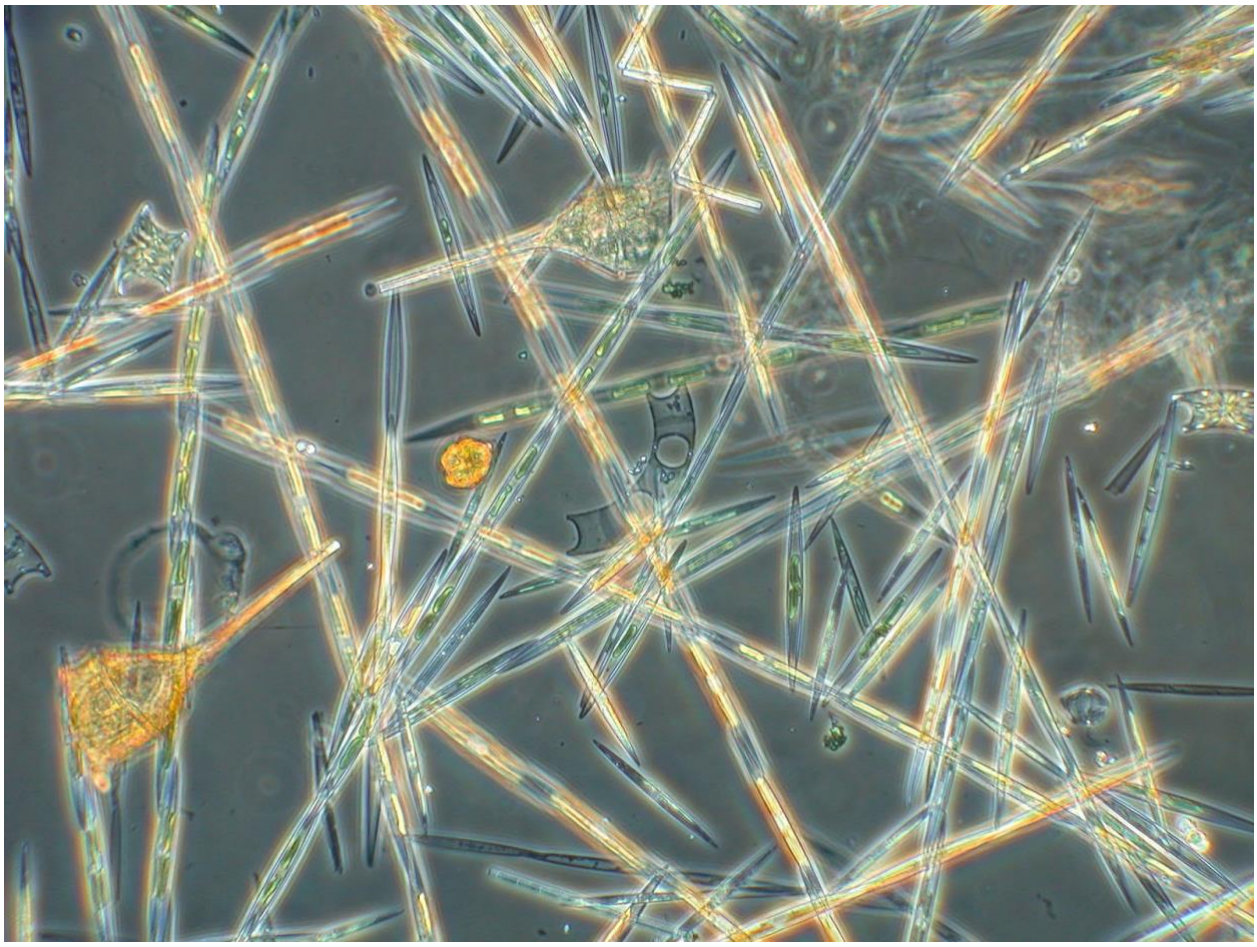

The algae *Pseudo-nitzschia australis*, a strain of algae that was previously unknown on the West Coast, harbors the toxin domoic acid. Photo: CeNCOOS; HABMAP; Kudela Lab/University of California Santa Cruz