Origin and Fate of Harmful Algal Blooms in the Warming Chukchi Sea

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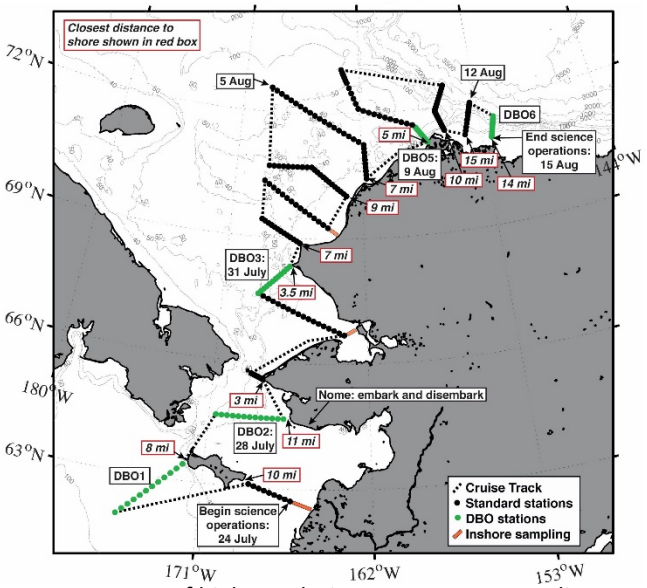
https://www2.whoi.edu/site/andersonlab/current-projects/arctic-habs/

Project Objectives: Our project is a joint physical-biological field program to study the relationship between harmful algal bloom (HAB) species distribution/dynamics and the physical environment of the Chukchi Sea region. The overall goal is to determine how extensive HAB cell distributions are across the shelf, what their origins and dynamics are, and how long they have been in the region. The hypothesis is that HABs in Alaskan Arctic waters are not only advected from the south through Bering Strait but are now originating locally on the Chukchi shelf due to warming temperatures, circulation features, and water mass structure that influence bloom magnitude, duration, toxicity, and recurrence. In July-August 2020 we will conduct a 25-day cruise on the USCGC *Healy*, sampling from the northern Bering Sea to the western Beaufort Sea (see the Figure). This will be the first-ever field program undertaken in the Pacific Arctic dedicated to the study of HABs. For broader impacts, the cruise will include an outreach component with a writer, photographer, and teacher-at-sea, as well as multiple visits to indigenous communities to communicate project results.



Keywords: Harmful algal blooms; Cyst seedbeds; Circulation; Water masses; Alexandrium; Pseudo-nitzschia; saxitoxin; domoic acid; paralytic shellfish poisoning; PSP; amnesic shellfish poisoning; ASP

Progress to Date/Future Plans: The cruise will embark/disembark from Nome, AK. The tentative plan is to occupy a set of high-resolution transects proceeding south to north (see the Figure). This includes occupation of four Distributed Biological Observatory (DBO) lines. We will collect physical, chemical, and biological measurements of the water column using a CTD package, net tows, and underway systems. Benthic sampling will be done with van Veen grabs, box cores, and gravity cores. We will do adaptive sampling if/when HAB blooms are encountered, and using *Healy's* small boat we will extend several of the transects close to shore.

Highlights or Expected Outcomes: We expect to (1) document the prevalence of HAB species throughout the study region; (2) characterize the connectivity and fate of *A. catenella* and *Pseudo-nitzschia* populations using toxin profiling and molecular markers; (3) determine cyst deposition histories in sediments using radionuclide tracers; and (4) develop a conceptual model of the origin, transport, and fate of HABs in the Chukchi Sea region, emphasizing linkages to the flow pathways and characteristics of the different water masses.

NNA Community Collaboration and Research Coordination: We are accommodating numerous ancillary projects on the cruise, including: a study of mezoplankton and larval fish; a multi-tracer biogeochemical component; ocean acidification; nitrogen dynamics; sea bird and marine mammal observers; a study of atmospheric ice-nucleating particles; and deployments of floats and drifters. We will have an indigenous observer on the cruise who will interface between the science party and coastal communities along our sampling route. We also hope to benefit from cruises in the region conducted by other NAA projects. This would allow us to get water column and sediment samples that would complement the ones to be collected during our project. Note that we have only a single cruise scheduled for our project, but would benefit greatly from data from ships of opportunity in other years to sustain this important database of HAB species distribution and abundance.

Advice for Overcoming NNA Project Challenges: We suggest identifying platform/timing requirements early in the process.