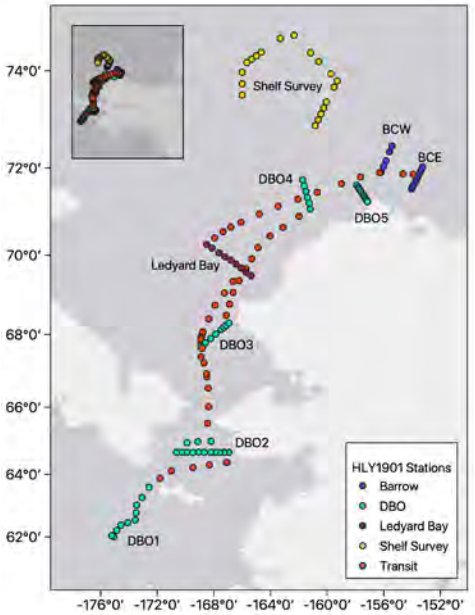
Distribution and Prevalence of Harmful Algal Blooms in Arctic Waters

Don Anderson, Woods Hole Oceanographic Institution

2019 Progress Report

Multiple HAB toxins are present in the Arctic food web, evidenced by observations of toxins and toxic cells in the region (through this project and its predecessor) as well as high prevalence of algal toxins in harvested and stranded marine mammals. Warming ocean temperatures and decreasing ice cover will likely expand the spatial and temporal window for HABs in the Arctic. **The objective of this research is to provide baseline data on the distribution and dynamics of HAB organisms *Alexandrium catenella* and *Pseudo-nitzschia* in the Arctic in order to develop conceptual models of origin and transport and to guide strategies for mitigating impacts.**

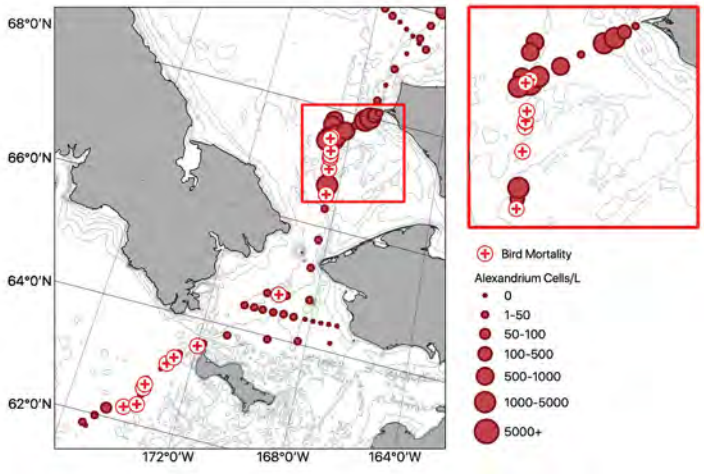
- Sampling conducted during Healy 1901 (July - Aug 2019), 137 locations sampled
- Water collection from surface, 10m and Chl max niskins
  - Filtration for *Pseudo-nitzschia* DNA and toxin analysis
  - Phytoplankton samples preserved for *A. catenella* enumeration
- Surface sediments collected for *A. catenella* cyst abundance
- Additional sediments collected for culture establishment for genomic and toxin analysis
- **Underway observation and sample collection conducted through the shipboard underway seawater system**
  - High concentrations of *Alexandrium*-like cells were observed concurrently with a bird mortality event off of Point Hope (bird observation data provided by Charlie Wright, Linnaea Wright, and Kathy Kuletz U.S Fish and Wildlife)
  - The identity of these cells was confirmed as *A. catenella* after the cruise, concentrations were as high as 8200 cells/L, more than sufficient to cause toxicity



Sampling locations for Healy 1901.

A. Catenella Whole Cell Samples	*Pseudo-nitzschia* samples	Sediment Samples
277	430 filters 241 Lugol's	56 surface plugs 107 germ.

A. catenella cell densities displayed with bird mortalities observed in the Bering Strait and off of Point Hope >>



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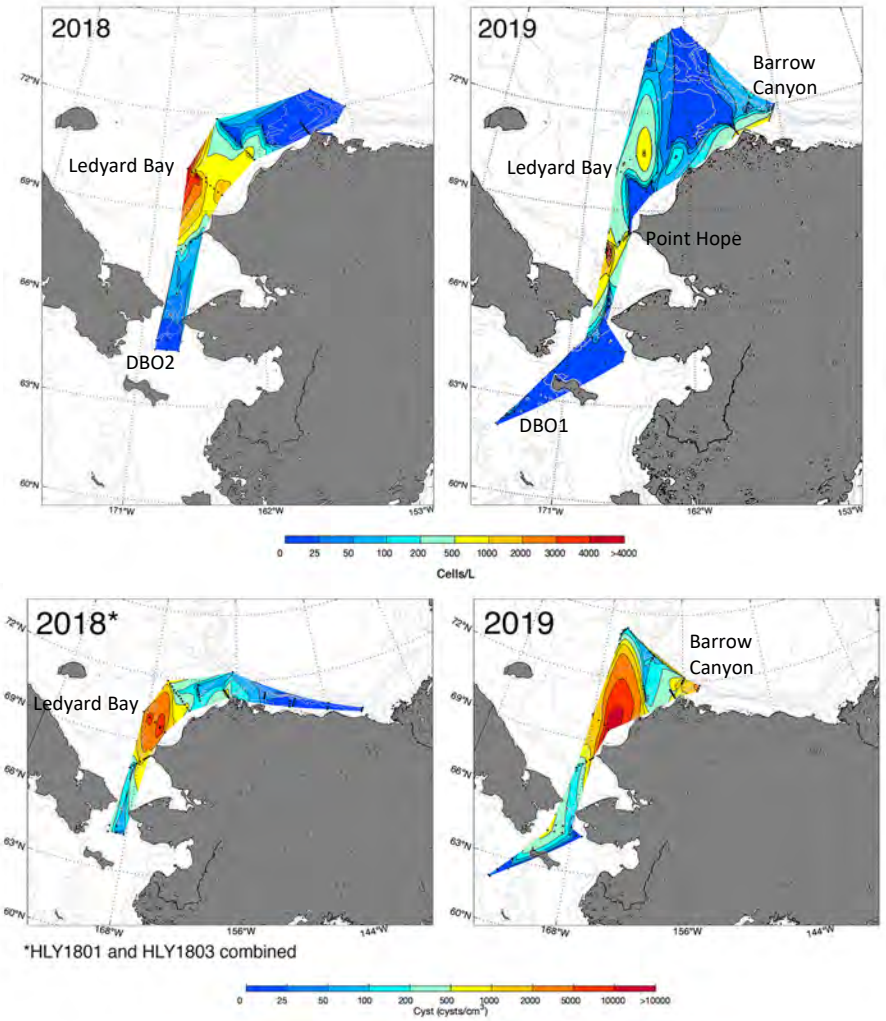
Vegetative *A. catenella* cells were detected at dangerous concentrations near Point Hope and by Barrow Canyon off of the coast of Utqiagvik in 2019.

- Few cells were observed in the northern Bering Sea (DBO1/DBO2) or in the Bering Strait in either sampling year
- Cell concentrations of 500-1100 cells/L near Barrow Canyon in 2019; these occurred with high water temperatures on the shelf (~9°C)
- A bloom that was present in Ledyard Bay in 2018 (max concentrations ~5000 cells/L) was absent in 2019

A massive cyst bed is a persistent feature in the Chukchi Sea. This "seedbed" extends at least 200 km offshore and 600 km alongshore.

- Maximum concentrations of *A. catenella* cysts were observed on the Ledyard Bay transect (~17000 cysts/cm^3). This is the highest ever observed for this species globally.
- A secondary cyst seedbed was identified in 2019 near Barrow Canyon at the entrance to the Beaufort Sea (max ~14000 cysts/cc)
- Relatively low cyst abundance south of, and within the Bering Strait, but concentrations appear to increase moving west towards Russian waters
- Water temperatures recorded in high cyst-density areas are conducive to germination and bloom development
- Cultures established from these sediments will be used for toxin composition and microsatellite analysis to enhance understanding of bloom origin and population connectivity



Above top: Vegetative *A. catenella* surface concentrations (cells/L) during summer 2018 and 2019. *Above bottom: A. catenella* cyst concentrations (cysts/cm^3) in surface sediments measured in 2018 and 2019.

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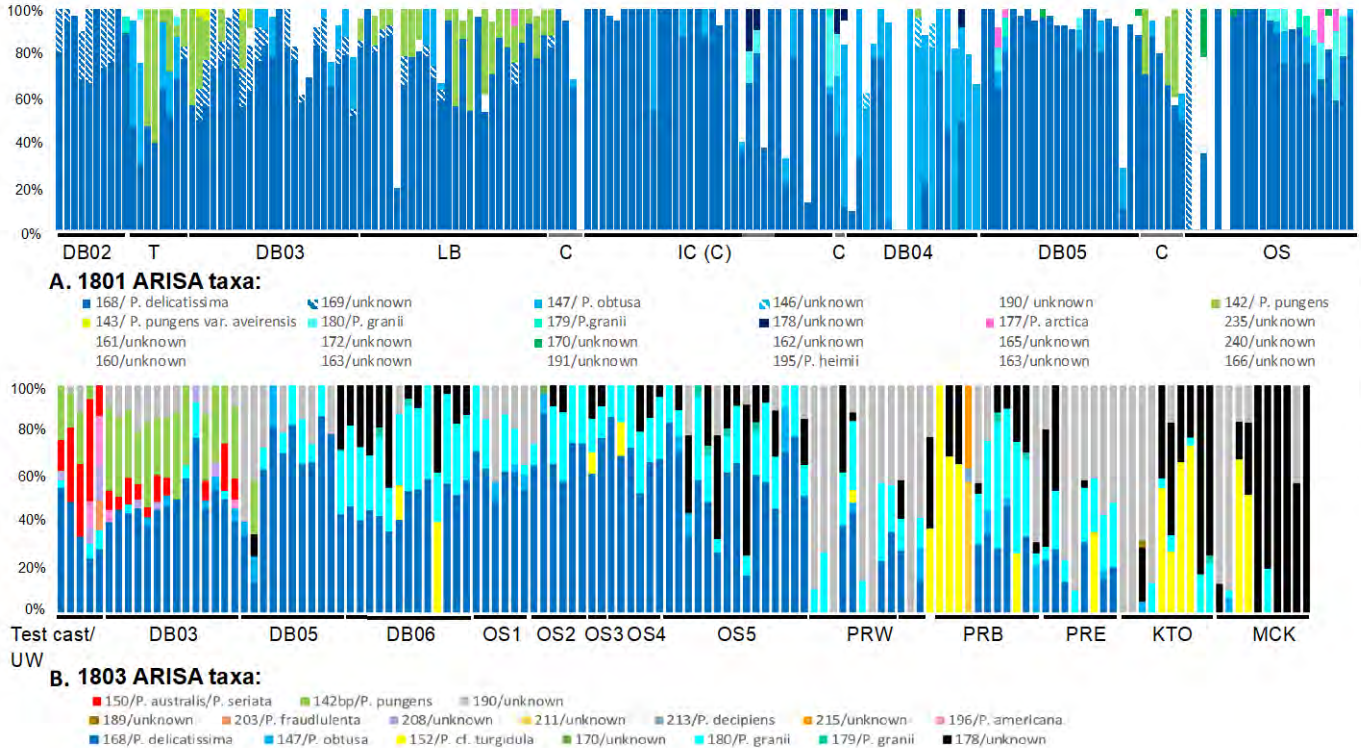
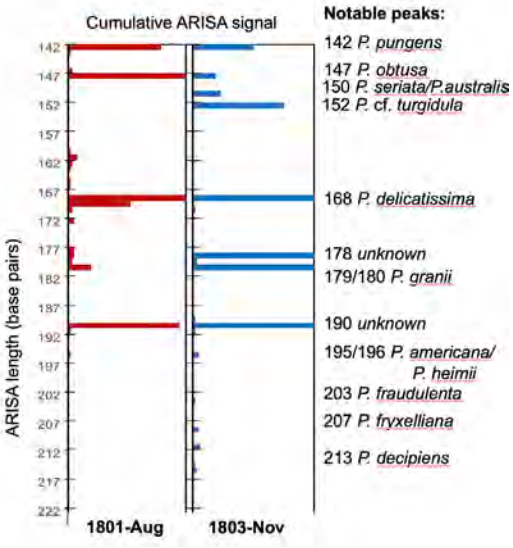
- 32 unique amplicons were detected, including at least 11 known species and up to 19 unidentified species or strains
- 10 amplicons were observed during both surveys, including *P. pungens, P. obtusa, P. granii, P. delicatissima, P. heimii/P. americana,* and four unknowns
- Several weakly toxic species were detected along much of the coast (*P. delicatissima* - blue; *P. obtusa* - aqua)
- Highly toxic *P. australis/P. seriata* (red) and other "temperate" species (*e.g., P. pungens* - green*)* detected from Bering Strait to Chukchi Sea during HLY1803
- A relatively large proportion of unidentified species (black, grey) were observed in the Beaufort Sea during HLY1803





Left: Pseudo-nitzschia strains detected by ARISA, arranged by transect along the Alaskan coast from south to north-east
Above: Cumulative peaks detected by ARISA across all samples for each cruise