2019 Alaska HABS Summary
Report on regional monitoring efforts and results

Compiled by the Alaska Harmful Algal Bloom Network
2020

Background

The Alaska Harmful Algal Bloom Network (AHAB) was formed in 2017 to provide a statewide approach to HAB awareness, research, monitoring, and response in Alaska. AHAB is made up of researchers, outreach specialists, community contacts, and resource managers and coordinates a diverse group of coastal stakeholders to address human and wildlife health risks from toxic algal blooms. For more information about AHAB and HABs in Alaska please visit: https://aoos.org/alaska-hab-network/

About this summary

This document is a compilation of HABS monitoring efforts and results by region for 2019. Regional sections were completed by regional leads and compiled by the Alaska Ocean Observing System (AOOS). AHAB intends to publish an annual summary of this nature on an annual basis.

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Region: Southeast

Organization: Sitka Tribe of Alaska/SEATOR
Contact: Chris Whitehead, chris.whitehead@sitkatribe-nsn.gov

Role with regard to HABs: The Sitka Tribe of Alaska is the coordinator for the Southeast Alaska Tribal Ocean Research Network. This network consists of 17 different tribal governments working together to track changing ocean conditions through HAB observations and subsistence shellfish toxin testing. SEATOR partners monitor more than 40 sites for HABs by collecting and analyzing phytoplankton and subsistence shellfish samples. Phytoplankton samples are categorized on-site by SEATOR partners and shellfish samples are submitted to the Sitka Tribe of Alaska Environmental Research Lab (STAERL) for PSP toxin testing. STAERL issues PSP reports, as often as there are new PSP data to share with stakeholders, PSP reports are issued approximately twice per week during summer months. If PSP levels exceed the regulatory limit of 80 μg of toxins per 100g of tissue, STAERL will also release a Public Service Announcement. SEATOR partners use a tiered messaging approach to ensure that community members are properly informed of the current risk associated with subsistence shellfish collection. SEATOR also operates a website that displays current shellfish and phytoplankton data across all sample sites.

Summary of activities undertaken in 2019: In 2019 SEATOR partners continued their year-round phytoplankton and shellfish monitoring program.

Summary of key findings/highlights from 2019: In 2019 more than 650 phytoplankton observations across 40 sample sites were collected and analyzed by SEATOR partners. These observations act as a first warning for increasing toxins in subsistence shellfish. In 2019 more than 550 shellfish samples were collected and analyzed for PSP. The bloom season of 2019 had more occurrences of PSP and the highest PSP levels throughout the region than any other

year since testing began in 2016. On June 18th a blue mussel sample from Juneau had 4,412 µg of toxins per 100g of tissue. This is the highest SEATOR blue mussel sample STAERL has ever tested and is more than 50 times the regulatory limit. Overall, more than 200 shellfish samples exceeded the regulatory limit in 2019. Only two out of seventeen SEATOR partners did not have samples exceed the regulatory limit during the bloom season of 2019. Samples throughout the region continued to exceed the regulatory limit through October.

Image**:** participants of a water quality training workshop in Sitka with SEATOR partners in May 2019.

Region: Southcentral

Organization: Kachemak Bay National Estuarine Research Reserve (KBNERR)
Contact: Rose Masui, rmmasui@alaska.edu

Role with regard to HABs: Community Monitoring Program Coordinator

Summary of activities undertaken in 2019: During the summer of 2019 over 300 phytoplankton samples were collected looking for the presence of marine HABs from 21 sample locations from Lower Cook Inlet through Prince William Sound. Community monitors join Reserve staff for an annual training every spring. Shellfish samples were collected at just over 10 different sites throughout Southcentral Alaska and were mailed into Alaska Department of Environmental Conservations Environmental Health Lab in Anchorage for toxin analysis. From April through September weekly updates were shared to agency managers, community monitors, resource managers, commercial shellfish harvesters, and tribal partners. Through partnerships with local tribal communities, NOAA, and the Alaska Department of Health and Social Services, Public Service Announcements were developed for Alaskan tribal communities to warn about the potential symptoms of toxic shellfish. In October, KBNERR hosted a HAB Risk Communication Workshop in Homer with partners from 12 different agencies and tribal organizations participating.

Summary of key findings/highlights from 2019: During the summer of 2019, the HAB species of concern were present in samples throughout the summer. However, NO wild shellfish KBNERR tested for saxitoxins came back above the regulatory limit. *Pseudo-nitzschia* dominated in July and August in samples yet no toxins were detected. There were no reports of any potential human illnesses occurring in 2019 in Southcentral Alaska. KBNERR is not a regulatory agency and highly values our partnerships with the Alaska Department of Environmental Conservation and Department of Health and Social Services who partner with the Reserve on toxin testing and public service announcements.

Images: Grace Allan collecting phytoplankton sample in Seldovia, AK (left), and photo of KBNERR October workshop participants in Homer discussing HABs and communication (right).

Region: Kodiak

Organization: Kodiak Area Native Association
Contact: Andie Wall, Andie.Wall@kodiakhealthcare.org

Role with regard to HABs in Alaska:
The Kodiak Area Native Association (KANA), provides health and social services for people in the Kodiak region. KANA's service area includes the City of Kodiak and the six rural villages of Akhiok, Karluk, Larsen Bay, Old Harbor, Ouzinkie and Port Lions. Gathering and assessing the potential toxicity of a traditional food source aligns with our mission due to the threat that PSP poses to the health and wellness of our people.

Summary of activities undertaken in 2019:
Funded through the Bureau of Indian Affairs - Tribal Resilience Program, KANA began monitoring harmful algal species in March 2019, developing new harmful algal bloom (HAB) baseline data for the Kodiak region. This program is a partnership with Sun'aq Tribe of Kodiak, Alaska Sea Grant, and Sitka Tribe of Alaska. Phytoplankton monitoring and identification occurs at four locations on the Kodiak road system and one location off the road system. Tissues samples are collected based on species availability; two locations test butter clams and blue mussels bi-weekly, one location tests blue mussels biweekly, and one location tests butter clams monthly. All tissue samples are shipped to Sitka and analyzed for PSP toxins at The Southeast Alaska Tribal Ocean Research (SEATOR) lab.

The goal of this project is to increase monitoring efforts of PSP and ASP as well as increase knowledge about HABs and biotoxins in Kodiak waters while developing and implementing a strategic HAB action plan to advise residents in the harvesting of shellfish in the Kodiak region.

Summary of key findings/highlights from 2019:
On May 28, we observed the first bloom of Alexandrium and Pseudo-nitzschia. HAB species remained present throughout the summer. In 2019, most butter clam tissue samples tested above the FDA limit, how much above varied on the location of sample collection. At all locations, toxicity in blue mussels followed a bimodal trend. The first peak began at the end of April and continued through June. This was followed by a second larger peak starting in the end of August, which continued through September. The highest butter clam from all locations was collected on May 5th and tested at 359 µg of toxins per 100g of tissue. The highest blue mussel was collected on September 13th and came back at 756 µg of toxins per 100g of tissue. December 11th and 12th, we were able to host the second annual Marine Water Quality Workshop. This was a joint effort with the Environmental Protection Agency (EPA) Indian

General Assistance Program (IGAP). Participants and presenters gathered for the two-day workshop, coming from all over. The first day of the workshop focused on ocean acidification and included marine water sampling training. The second day was dedicated to discussing our current and projected harmful algal bloom monitoring efforts. During the workshop we discussed current harvest methods and gauged interest from tribal members about participating in monitoring efforts. All attendees expressed interest in testing shellfish in their communities. Participation from these communities would significantly increase the program capacity and baseline data for Kodiak region.

Region: Kodiak Archipelago

Organization: Alaska Sea Grant
Contact: Julie Matweyou, jamatweyou@alaska.edu

Role with regard to HABs in Alaska: Principle Investigator, Science Advisor, and Education/Outreach Specialist

Summary of activities undertaken in 2019:
Implementation of Community Based PSP Testing for Subsistence and Recreational Shellfish Harvesting in Southwestern Alaska (Year 3 of 3-year project)
Funding Source: North Pacific Research Board
Principal Investigator(s): R. Wayne Litaker (NOAA), Julie Matweyou (UAF), Patricia Tester (OceanTester) Collaborator: Steve Kibler (NOAA)

Final collection was conducted for the NPRB funded study. Monthly butter clam samples were collected from three sites in the Kodiak region: Shipwreck Beach in Old Harbor; Sourdough Beach in Ouzinkie; and Near Island N. Trident Basin in the City of Kodiak with assistance from the Alutiiq Tribe of Old Harbor, the City of Ouzinkie, and the Sun'aq Tribe of Kodiak, respectively. A minimum of 12 individual butter clams were collected per sample during negative tides from January through December 2019. Clams were shucked following collection and were prepared according to Alaska Department of Environmental Conservation (ADEC) protocol. Shucked tissue samples were labeled and stored archived in the freezer (in the rural villages and at the Kodiak Seafood and Marine Science Center) until opportunity for shipping to the Beaufort NC NOAA laboratory for analysis of PSP toxins by High Performance Liquid Chromatography (HPLC). Samples collected through July 2019 have been analyzed; samples collected after July 2019 have been shipped to Beaufort NC and awaiting analysis. Sample results demonstrate toxins above regulatory level during all months of the year.

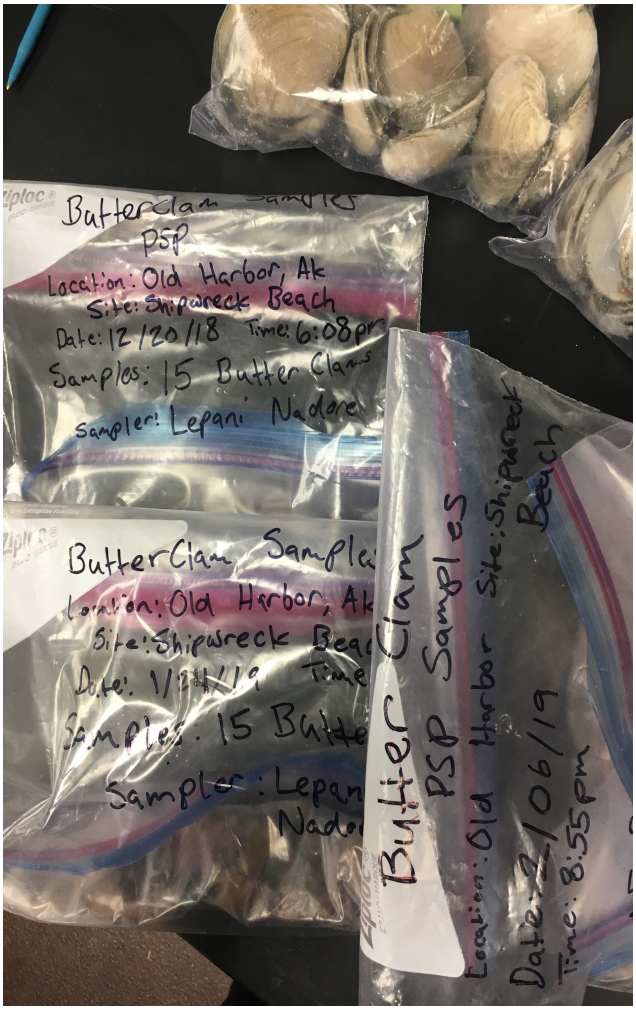


Image: Butter clam samples for testing collected from Old Harbor.

Cooperative Monitoring of Harmful Algal Blooms and Shellfish Toxicity on Kodiak Archipelago: Advancing Tribal Resilience and Subsistence Food Security (Year 1 of multi-year project)
Topical Expert/Scientific Advisor: Julie Matweyou(UAF)
Funding Source: Kodiak Area Native Association

Alaska Sea Grant Marine Advisory Program supports KANA's monitoring efforts by providing local and topical knowledge related to HABs and oversees use and activity at the UAF Kodiak Seafood and Marine Science Center HAB laboratory.

Alexandrium enumeration using qPCR (Year 1 of multi-year project)
Collaborators: Steve Kibler (NOAA) and Julie Matweyou

Whole seawater (collected at the surface using a 5-gallon bucket and concentrated through a 20 micron plankton net) was collected throughout the summer. The concentrated seawater was preserved in lugol's for analysis by qPCR. Samples are pending analysis. Alaska Sea Grant is exploring building capacity for qPCR at the Kodiak Seafood and Marine Science Center.

Application of a quantitative molecular method to characterize abundance and distribution of Alexandrium Cysts for NOAA's HAB Forecasting (Year 1 of 3-year project)
Principal Investigator(s): Cheryl Greengrove (UW), Julie Masura (UW), Julie Matweyou (UAF), Steve Kibler (NOAA)

The primary objectives of the study are to reduce the time and effort required to generate cyst abundance data for NOAA's HAB Operational Forecast System, to increase the accuracy of cyst identification, and to make these methods more widely accessible. The proposed work will help NOAA and its regional partners address MERHAB priorities to mitigate HAB impacts by improving existing methods of monitoring, comparing new and existing monitoring systems and helping to develop forecasting technologies. Kodiak is one of three sites in Alaska for sediment collection.

Summary of key findings/highlights from 2019:
Toxin monitoring at three designated butter clam sites demonstrate toxin levels consistent with the last 6 years of monitoring, with toxin levels generally at or above regulatory levels throughout the year and increased toxins seen in the summer months. However, toxicity in the Kodiak area did not reach extreme levels reported elsewhere in the state.

Image: Principal investigators from UW, UAF and NOAA during a meeting in Seattle.

Region: Aleutians - Akutan, Chignik Lagoon, King Cove, Sand Point and Unalaska (also includes some information for Juneau)

Organization: Knik Tribal Council
Name: Bruce Wright, bwright@kniktribe.org

Role with regard to HABs in Alaska:

1) Quantify PST concentrations in marine forage species.

2) Quantify anatomical distribution of toxins in salmon and differences among salmon species.

Summary of activities undertaken in 2019:
The Knik Tribe PSP project sampling began at some locations in the late winter 2018 and early spring 2019 and expanded to additional communities in March 2019 prior to or as spring arrived and PSP blooms began. The Gulf of Alaska marine surface water temperatures were 2-4 degrees C above the long term average and high enough that the PI informed communities in the study area and outside the study area to expect an earlier and more intense harmful algal bloom (HAB) in spring and summer of 2019. Most study locations began sampling in March so to note PST levels prior to the algal bloom. The weekly mussel sampling revealed an early Alexandrium bloom in some locations and recorded the third highest PSP levels in Alaska to date. The results from sampling salmon have been very revealing. Some salmon had detectable levels of PSP in their digestive tracts, kidneys and livers, but the eggs and edible meat had very low or no detectable PSP levels and is considered safe to eat. The lab results from a shipment of samples of small cod, herring and sand lance from a Kodiak to Sand Point survey shows these forage fish species also had measurable levels of PSP.

Summary of key findings/highlights from 2019: see detailed report.

Region: Arctic: Bering, Chukchi and Beaufort research cruises

Organization: Woods Hole Oceanographic Institution
Contact: Don Anderson, danderson@whoi.edu

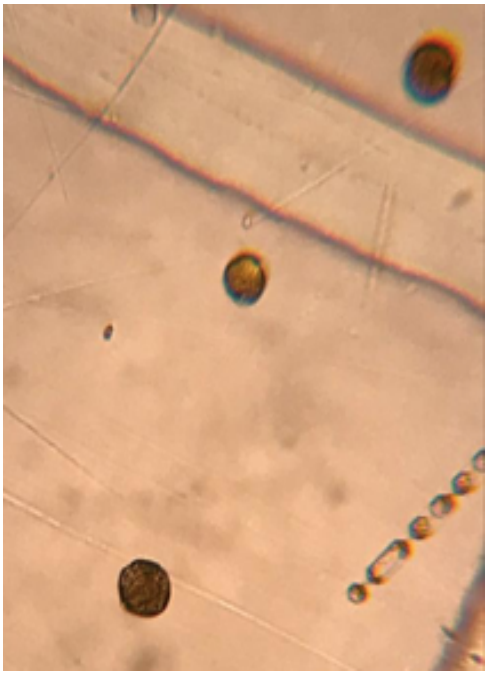
Role with regard to HABs in Alaska: The Anderson Lab is conducting research on the distribution and prevalence of HAB species *Alexandrium* and *Pseudo-nitzschia* in order to develop conceptual models of bloom origin and transport.

Summary of activities undertaken in 2019: Sampling was conducted during HLY1901, the Distributed Biological Observatory cruise, in July-August. This expedition departed from Nome, AK, and included DBO transect lines 1-6 as all as additional sampling on the Chukchi shelf and near Barrow Canyon. This is the second year of this project, and all sampling methods were consistent with protocols used during two cruises in 2018 (HLY1801, August; HLY1803 October-November). Collections included water samples for quantifying *Alexandrium catenella* cell abundance, sediment samples for quantification of *A. catenella* resting cyst concentrations, and filters for *Pseudo-nitzschia* genetic and toxin analysis. Samples collected during the cruise were transported back to Woods Hole Oceanographic Institution for analysis, and used to create maps of *A. catenella* cyst and cell abundance. Cultures established in the laboratory from *A. catenella* resting cysts, isolated from Arctic sediments, will be used for microsatellite and toxin analysis in order to determine population connectivity of this species. *Pseudo-nitzschia* filters are being analyzed by Katherine Hubbard of the Florida Fish and Wildlife Conservation Commission.

Collection of sediment plug from Van Veen grab used for abundance measurements of *Alexandrium* cysts

Summary of key findings/highlights from 2019: Few *Alexandrium* cells were observed in the northern Bering Sea or in the Bering Strait. 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 of U.S. Fish and Wildlife Service). The identity of these cells was confirmed as *A. catenella* after the cruise, with concentrations as high as 8200 cells/L. These levels are more than sufficient to cause dangerous levels of toxicity in shellfish. Vegetative *A. catenella* cells were also detected in bloom concentrations by Barrow Canyon off the coast of Utqiagvik (500-1100 cells/L). Notably, a significant bloom that was detected in the Ledyard Bay region in 2018 was not observed this year. Cells were present, but at much lower concentrations than the year before.

Analysis of sediment samples reveals a massive cyst bed present in the Chukchi Sea which extends at least 200 km offshore. This appears to be a persistent feature, and was detected in both 2018 and 2019 with highest concentrations (~17000 cysts/cc) along the Ledyard Bay transect line. Bottom and surface water temperatures recorded during both years in this region were well within the ranges that support relatively rapid *A. catenella* cyst germination and cell growth. These data, plus the cruise observations of vegetative cells north of Bering Strait suggest that Arctic blooms may be derived from both advected as well as in situ populations (e.g., cyst germination as an inoculum). Cyst concentrations were relatively low in the northern Bering Sea and in the Bering Strait, but appeared to increase moving west towards Russian waters.



In 2019, a secondary cyst seedbed was identified near Barrow Canyon with cyst concentrations of over 14,000 cysts/cc. The location of this secondary seedbed is significant because it lies at the entrance to the Beaufort Sea, where cyst presence was low or undetected in 2018. Given the high bottom temperatures observed on the shelf, it is possible that cysts could germinate locally and be transported east into the Beaufort Sea, allowing the population to expand in geographic range.

While *Pseudo-nitzschia* sample analysis from 2019 is still underway, samples collected during 2018 reveal the presence of several domain acid producing *Pseudo-nitzschia* species. Nearly all samples collected in August 2018 were dominated by *P. delicatissima,* a weakly toxic species. Highly toxic *P. australis/P.seriata* temperate species were detected from the Bering Strait to the Chukchi Sea in October/November 2018. Many of the *Pseudo-nitzschia* detected in the Beaufort Sea at this time were unidentified species or strains, and their toxicity is unknown.

Image above: Microscope image of *Alexandrium* cells collected off of the coast of Point Hope in August 2019 (photo by Piper Bartlett-Browne, PolarTREC).

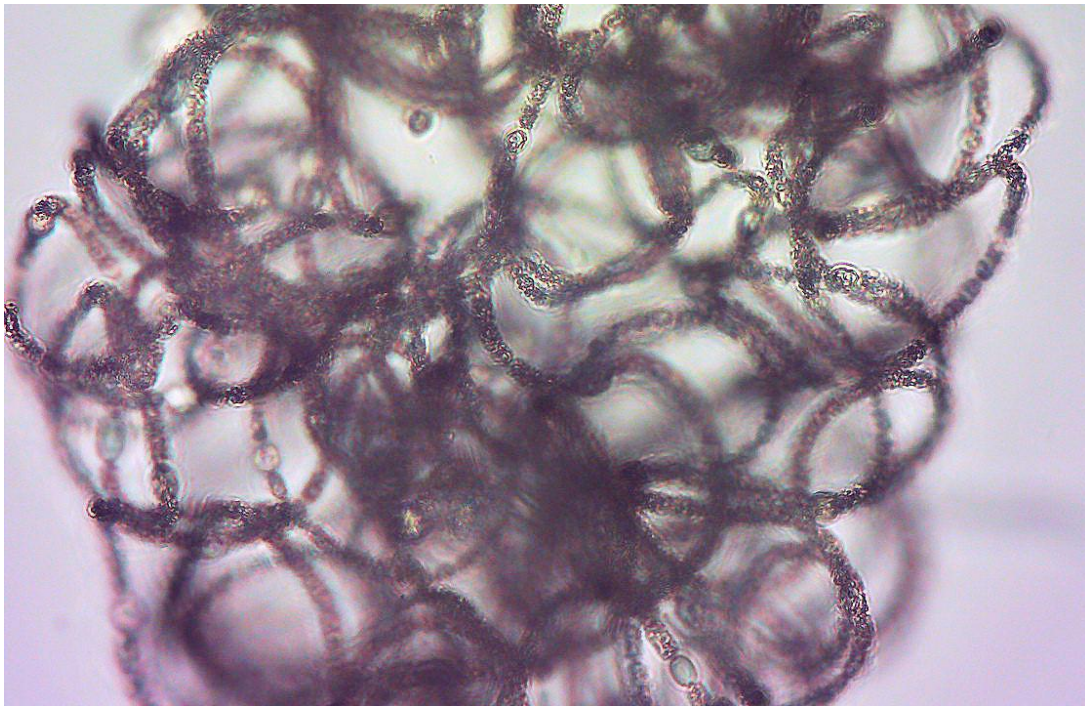
Region: Arctic - Kotzebue Sound

Organization: Native Village of Kotzebue
Contact: Alex Whiting, alex.whiting@qira.org

Role with regard to HABs in Alaska: Principal Investigator

Summary of activities undertaken in 2019: Sampled locations near Kotzebue for the presence of HAB's, nutrients, and toxins in collaboration with Ajit Subramaniam of Columbia University (HABs/nutrients) and Astrid Schnetzer of North Carolina State (SPATT toxins). This included deploying SPATT bags for the first time and phytoplankton ID and counts with Ed Carpenter of San Francisco State University which was also the first time this activity has been undertaken near Kotzebue. In addition, Ajit, Ed and Alex submitted a cyano/nutrient project proposal to NSF under the NNA opportunity.

Summary of key findings/highlights from 2019: Toxins, nutrients and fixed water samples yet to be processed. The ID and count work is completed, and results are linked here.



Anabaena sp. sampled from Kotzebue beach during bloom on July 16, 2019. Image and sample by Alex Whiting.

Region of Alaska: Arctic - northern Bering Sea/Bering Strait region

Organization: Alaska Sea Grant
Contact: Gay Sheffield, ggsheffield@alaska.edu

Role with regard to HABs in Alaska: Facilitate HAB outreach and education throughout the Bering Strait region regarding general HAB info as well as research results; liaison communications between media and researchers; facilitate a collaborative outreach education/outreach HAB document available electronically worldwide.

Summary of activities undertaken in 2019:
A two-day HAB workshop was held in Nome in July 2018 with HAB experts, public health experts from the State of Alaska Department of Epidemiology, tribal representatives, Norton Sound Health Corporation healthcare providers, and local stakeholders.

A collaborative effort led by Alaska Sea Grant along with Woods Hole Oceanographic Institution, NOAA Fisheries Wildlife Algal Research and Response Network (WARRN-West), Kawerak Inc., AOOS / Alaska Harmful Algal Bloom Network (AHAB), and the SOA Section of Epidemiology resulted in the production of an outreach flier disseminating saxitoxin research results from seawater and biological specimens collected during the August 2019 cruise of the USCG Icebreaker HEALY. Research results included the first documentation of clams from the northern Bering Sea and Chukchi Sea at two locations (70 miles north of Saint Lawrence Island and 50 miles north of Cape Lisburne) with saxitoxin levels above the USDA seafood safety regulatory limit. This one page double-sided flier entitled "2018/2019 Bering Strait / Chukchi Sea: *Alexandrium* Algae, Saxitoxin, and Clams" was provided to all tribal offices within the Bering Strait region and was made available to the general public via the Alaska Sea Grant Bookstore. Additionally, this outreach material was translated into Russian and shared for dissemination throughout Chukotka, Russia.

As a result of the public distribution of the flier, the Nome Nugget newspaper ran a front page article in their 21-Nov-2019 newspaper edition entitled "Researchers Find Algal Toxins in Clams in Chukchi Sea". Lastly, KNOM Radio recorded an interview Sheffield for an upcoming comprehensive radio story on HABs in western and northern Alaska which ran Nov 27, 2019.

Sheffield organized and facilitated a presentation at the Strait Science Series on August 23 in Nome by Bob Pickart (Woods Hole Oceanographic Institution) entitled "Chukchi Sea Research: An update". Dr. Pickart provided an overview of recent research focusing on influences to the Arctic ecosystem in the Northern Bering and Chukchi seas. Research efforts include monitoring ocean currents, fish, and krill in Bering Strait region. He also presented new results regarding harmful algal toxins in Alaskan Arctic waters. The Nome Nugget News (September 5, 2019

edition) provided a region-wide story “USCG Healy takes scientists to study biological hot spots” of the research efforts and his HAB results.

Participants at the Bering Strait Algal Toxins workshop in July 2019 listen to USGS researchers present recent findings on seabirds.

Region: Statewide

Organization: USGS Alaska Science Center
Name: Caroline Van Hemert, cvanhemert@usgs.gov (with Matt Smith, Sarah Schoen, Mayumi Arimitsu, and John Piatt)

Role with regard to HABs in Alaska: Our lab tests bird tissues, forage fish, and other samples for STX and DA. Our research efforts include working with partners to respond to bird die-off events, investigating HAB toxins in the food web, and assessing the relevance of HAB toxins to Alaskan seabird populations.

Summary of activities undertaken in 2019: We tested samples from birds submitted to the National Wildlife Health Center to determine whether STX or DA may have contributed to seabird mortality events observed during 2019. We received samples from the Chukchi Sea, Bering Sea, and southeast Alaska. We also collected food web and seabird samples in the Gulf of Alaska to better understand sources of exposure and trophic transfer of STX.

Summary of key findings/highlights from 2019:
Analyses are still underway but results to date indicate below detection levels of STX and DA in birds associated with 2019 die-off events, except among Arctic Terns collected near Juneau, Alaska. These samples had elevated levels of STX and saxitoxicosis was suspected as cause of death in this localized mortality event involving both nestlings and adults at their breeding colony. Forage samples collected near Juneau during the same time period, when a known *Alexandrium* bloom event was occurring, also showed relatively high levels of STX.

Our investigation of the role of HAB toxins in the large-scale die-off of Common Murres in 2015-16 has been completed and is currently in press with *Harmful Algae*. Saxitoxin was present in multiple tissue types of both die-off (36.4%) and healthy (41.7%) murres and healthy kittiwakes (54.2%). Saxitoxin was also common in forage fish (20.3%) and marine invertebrates (53.8%). Although results from this study do not support the hypothesis that acute exposure to STX or DA played a primary role in bird mortality, additional information about the sensitivity of murres to these toxins is needed before we can discount their potential role in the die-off. The widespread occurrence of STX in seabirds, forage fish, and marine invertebrates in the Gulf of Alaska indicates that algal toxins should be considered in future studies of seabird health, especially given the potential for greater occurrence of HABs in the future.

Additional work funded for upcoming years includes continued diagnostic support for die-off events, captive study of sublethal STX exposure in Common Murres, food web dynamics of HAB toxins, and a broad-scale survey of HAB toxins in Alaskan seabirds.

See manuscript: **Algal toxins in Alaskan seabirds: Evaluating the role of saxitoxin and domoic acid in a large-scale die-off of Common Murres**

Region: Statewide

Organization: NOAA/Northwest Fisheries Science Center/Wildlife Algal-toxins Research and Response Network (WARRN-West)
Contact: Kathi Lefebvre, kathi.lefebvre@noaa.gov

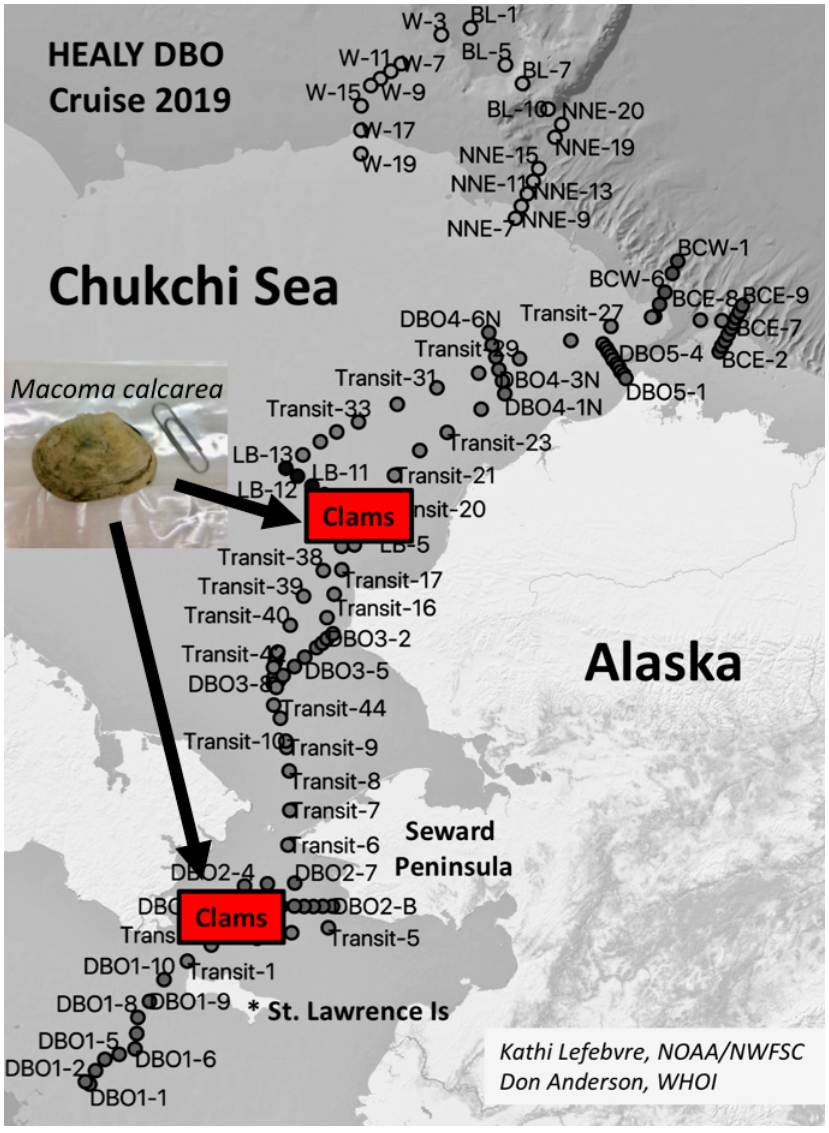
Role with regard to HABs in Alaska: The Lefebvre laboratory in collaboration with multiple WARRN-West partners are conducting a long term study to : 1) quantify toxic algal cell densities (*Pseudo-nitzschia* and *Alexandrium*), 2) quantify corresponding toxin concentrations (DA and PSTs/STXs) in phytoplankton, zooplankton, shellfish, finfish and marine mammals, 3) define trophic transfer pathways via stomach content analyses in fish and marine mammals, 4) document health impacts in marine mammals and fish in relation to toxin concentrations and bloom densities using behavioral observation reports by fishers and subsistence hunters as well as detailed pathology examinations in opportunistically-collected fresh stranded marine mammals, and 5) use the environmental and observational data generated from objectives 1-4 to develop toxin - trophic transfer models for algal toxin accumulation, biotransformation, and impact in specific food webs under multiple bloom scenarios and to predict future animal mortality events.

This team has submitted an ECOHAB (Ecology and Oceanography of Harmful Algal Blooms) proposal entitled, ***Trophic Transfer & Effects of HAB toxins in Alaskan Marine Food Webs***. The objectives for the proposed Alaska-based regional ECOHAB food web study will be addressed in all oceanic waters bordering Alaska including the Beaufort and Chukchi Seas, NE and SE Bering Sea and the Gulf of Alaska (GOA) via sample collection on cruises of opportunity including NSF-funded and NOAA's Ecosystem Monitoring and Assessment yearly Bering Arctic Subarctic Integrated Surveys (BASIS) cruises. Coastal regions in Barrow, Nome, Bristol Bay, St. Lawrence and Aleutian Islands, Kachemak Bay, Prince William Sound, Sitka and SE GOA will also be included via established regional HAB monitoring programs and newly-developed community-based sampling by Alaska Native Villages. Marine mammals will be obtained via the AK Marine Mammal Stranding Network, US Fish & Wildlife, AK Fish & Game and AK subsistence harvest communities. All data will be compiled into a central database and used for the development of models for quantifying toxin exposure and effects in Alaskan food webs.

Photo of WARRN-West Team at NOAA's Northwest Fisheries Science Center: Emily Iversen, Maryjean Willis and Kathi Lefebvre (left to right).

Summary of activities undertaken in 2019: In 2019 the **ECOHAB Alaska Food Web Team** was able to sample multiple levels of the food web on the following cruises: USCGC Healy (Beaufort, Chukchi, and Bering Seas; August 4th-23rd), Arctic IERP (Beaufort, Chukchi, and Bering Seas; August 1st - October 3rd; Three legs), NBS (North Bering Sea; two legs; August 27th - September 20th), SECM (Southeast Coastal Monitoring; Southeast Alaska inland waters; August 20th - 26th), Western GOA (Gulf of Alaska; two legs; August 14th - September 11th), and the Go-West Ice Edge Cruise (Northern Arctic; November 7th - December 2nd). Samples are still being processed and analyzed for the presence of algal toxins. The team is waiting to hear if funding will be approved to maintain the chemistry technician and hire the quantitative modeller for the research. Additionally, marine mammal samples were collected as part of the WARRN-West network from all regional partners of Alaska, including: North Slope Borough, Alaska Marine Mammal Stranding Network, Alaska Sea Grant, University of Alaska, Fairbanks, USGS, Alaska Fish and Wildlife, and Alaska subsistence harvest communities. These samples are still being analyzed.

Summary of key findings/highlights from 2019: The WARRN-West team was able to collect, receive and properly store all food web samples collected from the nine cruises listed above for 2019. In addition, the collection methods and sample processing for algal toxin quantification in krill, copepods, clams, worms, and fish was proved to work and this validation is critical for all future sampling and analyses. The team was able to process about 40% of the samples collected in 2019 focusing on the Chukchi and Bering Seas. Highlights from this work were described above and will be repeated here: Research results included the first documentation of clams from the northern Bering Sea and Chukchi Sea at two locations (70 miles north of Saint Lawrence Island and 50 miles north of Cape Lisburne) with saxitoxin levels above the USDA seafood safety regulatory limit (see map image).



This double-sided flier entitled "2018/2019 Bering Strait/Chukchi Sea: Alexandrium Algae, Saxitoxin, and Clams" was provided to all tribal offices within the Bering Strait region and was

made available to the general public via the Alaska Sea Grant Bookstore. Additionally, this outreach material was translated into Russian and shared for dissemination throughout Chukotka, Russia.

As a result of the public distribution of the flier the Nome Nugget ran a page 1 news article entitled “Researchers Find Algal Toxins in Clams in Chukchi Sea.” On Nov 21, 2019.