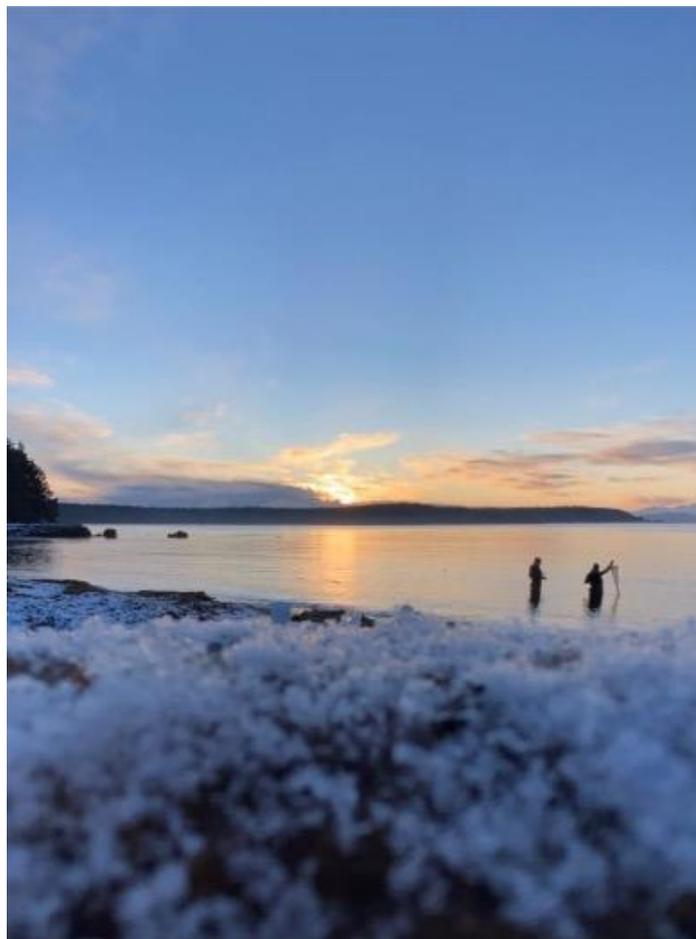


2020 Alaska HABs Summary

Report on regional monitoring efforts and results



*KANA environmental staff conducting a phytoplankton tow during sunrise on Kodiak
Photo credit: Andie Wall*

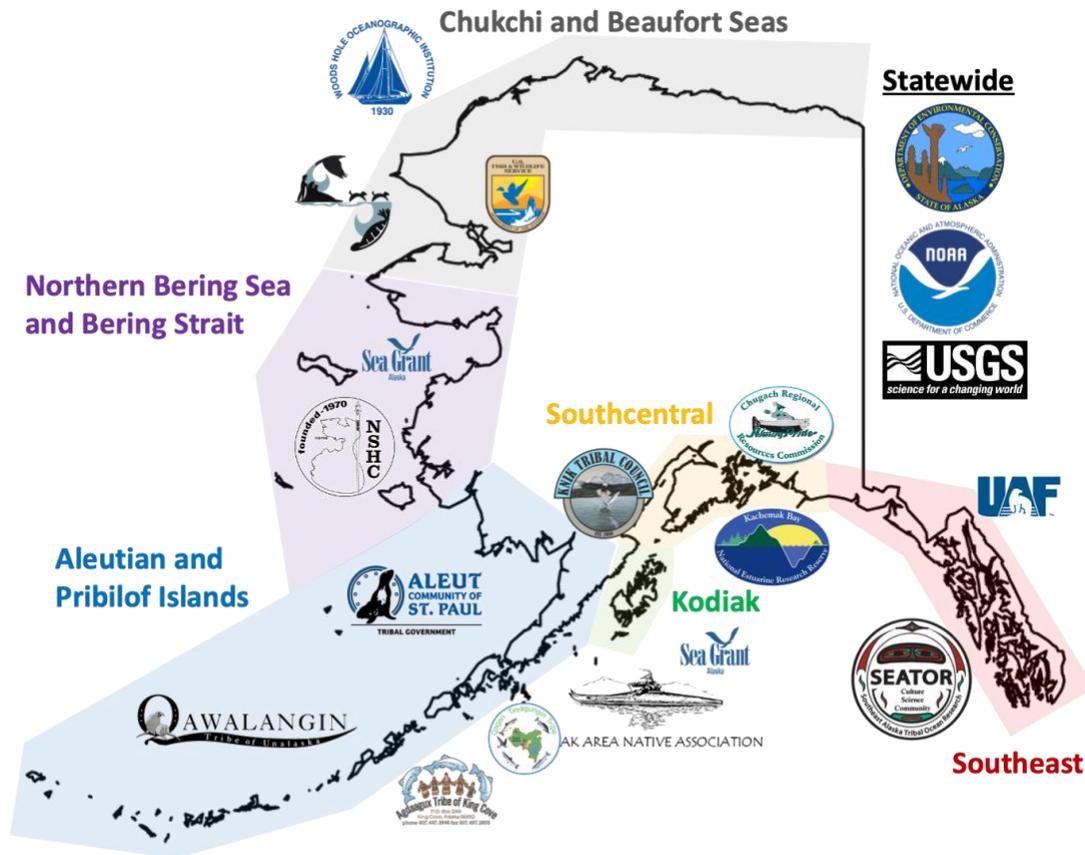
**Compiled by the Alaska Harmful Algal Bloom Network
June 2021**



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://aocs.org/alaska-hab-network/>

This document is a compilation of HAB monitoring efforts and results by region for 2020. Regional sections were completed by regional leads. AHAB intends to publish an annual summary of this nature every year. The focus of this report is on areas and organizations that have established, or are currently establishing, monitoring programs for HAB forming phytoplankton or the toxins from HABs in water samples or organisms like shellfish, fish, seabirds and marine mammals.



The report is broken down into regions, as represented by the map above. Logos from the organizations that are leading the HAB sampling are positioned in the general area where the sampling is taking place.

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Southeast Alaska

Sitka Tribe of Alaska/SEATOR

Kari Lanphier, Naomi Bargmann, Chris Whitehead, Will Peterson, Muriel Reid, Tara Racine, Nicole Filipek

Southeast Alaska Tribal Ocean Research Network (SEATOR): Central Council of Tlingit and Haida Indian Tribes of Alaska, Chilkoot Indian Association, Craig Tribal Association, Hoonah Indian Association, Hydaburg Cooperative Association, Ketchikan Indian Association, Klawock Cooperative Association, Kodiak Area Native Association, Metlakatla Indian Community, Organized Village of Kake, Organized Village of Kasaan, Petersburg Indian Association, Sitka Tribe of Alaska, Skagway Traditional Council, Sun'aq Tribe of Kodiak, Wrangell Cooperative Association, Yakutat Tlingit Tribe

HAB role in Alaska: HAB Monitoring and Baseline Data Collection / Paralytic Shellfish Toxin Analysis / Research / Risk Communication / Education

The Sitka Tribe of Alaska (STA) operates the Sitka Tribe of Alaska Environmental Research Lab (STAERL). STAERL is a research lab that analyzes personal, subsistence and research shellfish and seawater samples for multiple shellfish toxins. STA also does HAB education initiatives with communities, tribal environmental managers, and other stakeholders.

STA is the coordinator for the Southeast Alaska Tribal Ocean Research Network (SEATOR). 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 STAERL for Paralytic Shellfish Toxin (PST) testing. STAERL issues Marine Biotoxin Reports, as often as there are new PST data to share with stakeholders. If PST 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 2020:

Sitka Tribe: In 2020, STA started implementing their Monitoring and Event Response (MERHAB) project. This project will increase STAERL's capacity to test shellfish samples for domoic acid and okadaic acid. STA also led multiple education initiatives in 2020 including a HAB workshop at the Alaska Forum on the Environment, implementing high school HAB and climate change curricula, and coordinating and mentoring high school students throughout Southeast on research projects

SEATOR: In 2020 SEATOR partners continued implementing their year-round phytoplankton and shellfish monitoring program.

Summary of key findings/highlights from 2020:

Sitka Tribe: HAB's and shellfish toxicity education and outreach continue to be important objectives. During the multiple education and outreach events STA coordinated or participated in, it was clear that continuing the conversation of risk communication for shellfish toxins is still needed among all stakeholders.

SEATOR: As of September, 2020 more than 500 phytoplankton observations across more than 40 sample sites were collected and analyzed by SEATOR partners. As of September, 2020 more than 800 shellfish samples were collected and analyzed for PSTs. SEATOR partners have been collecting and analyzing shellfish samples since 2016. Overall, the bloom season of 2020 had less samples exceeding the regulatory limit, fewer communities with samples that exceeded the regulatory limit, and had smaller maximum PST values compared to past sampling years.

UAF (Juneau)

Ginny Eckert, Courtney Hart

HAB role in Alaska: Research temporal and spatial patterns of PSP toxicity events in areas where commercial shellfish are grown or harvested. Local monitoring

Summary of activities undertaken in 2020: We finished up our field work down in Ketchikan collecting sediment for cyst mapping. This information will be combined with data from the last two years to make maps of cyst locations. We also started a comprehensive HAB monitoring project with the new oyster farm in Juneau, Salty Lady Seafood. We are working with her to track any PSP blooms at her farm and try to provide information to help her avoid costly shutdowns. We are also collecting OA samples for the UAF OA center to get some baseline data of OA conditions at the farm site.

Summary of key findings/highlights from 2020: There are some areas with extremely high numbers of dormant *Alexandrium* cysts in sediments in close proximity to geoduck harvest areas. Those "hot spots" were most prominent after the summer of 2018 and 2019, but relative cyst number have dropped a lot. There doesn't appear to be a clear pattern between cyst density and geoduck toxicity in the winter but understanding local currents and water flow may help us tease apart some patterns. We just started the work at the oyster farm and don't have any information but plan to continue monitoring for the entire summer.

Southcentral Alaska (Kachemak Bay Lower Cook Inlet)

NOAA Kasitsna Bay Laboratory and Kachemak Bay National Estuarine Research Reserve
Kris Holderied, Dominic Hondolero, Steve Baird, Rose Masui, Jasmine Maurer, James Schloemer

HAB role in Alaska: Research and monitoring

Summary of activities undertaken in 2020: NOAA Kasitsna Bay Laboratory (KBL) researchers conduct monthly monitoring of oceanographic conditions, phytoplankton, and zooplankton in Kachemak Bay and southeast Cook Inlet as part of long-term monitoring under the Gulf Watch Alaska program of the Exxon Valdez oil spill Trustee Council. KBL staff also conduct routine sampling for harmful algal bloom (HAB) phytoplankton species and HAB toxins in shellfish, fish and zooplankton. Sampling was completed throughout 2020, except during April and May 2020 due to COVID-19 restrictions.

Kachemak Bay National Estuarine Research Reserve (KBNERR) researchers collect continuous oceanographic data from stations at the Seldovia and Homer harbors, conduct sampling for HAB toxins in shellfish and lead a community phytoplankton monitoring program in Kachemak Bay which includes tracking of HAB species. KBNERR and KBL routinely collect samples of shellfish species that are commonly harvested for consumption, including butter clams (*Saxidomus giganteus*), littleneck clams (*Leukoma staminea*), and blue mussels (*Mytilus edulis*). Shellfish tissue samples are analyzed for saxitoxins at the Alaska Department of Environmental Conservation Environmental Health Laboratory in Anchorage or Sitka Tribe of Alaska Environmental Research Lab. Since 2012, KBL has used a quantitative method, based on measuring DNA, to monitor abundance of the phytoplankton species (*Alexandrium*) that produce saxitoxins and cause paralytic shellfish poisoning. The molecular method uses quantitative polymerase chain reaction analysis (qPCR) techniques to measure DNA in a water sample and estimate the number of cells per liter. Samples were collected for qPCR analysis in 2020, but analyses are pending the reopening of the NOAA Beaufort Laboratory from COVID-19-related closures.

Summary of key findings/highlights from 2020: Kachemak Bay water temperatures were below normal in January-March 2020 and dropped rapidly in response to a prolonged period of cold winter air temperatures, transitioning from much warmer than normal water temperatures at the end of 2019 (as shown in the monthly water temperature anomaly time series in Figure 1). However, the bay responded quickly to a warmer than normal late spring/early summer and warmer than average monthly water temperatures were observed July-August 2020. The warm water temperatures caused local concern for potential PSP events in Kachemak Bay, since PSP events occurred during marine heat wave of 2016, with high concentrations of *Alexandrium* cells observed in phytoplankton samples (Figure 2) and elevated shellfish toxin levels (Figure 3). Despite 2020 summer temperature anomalies that were similar to those seen in 2016, through August the shellfish toxin levels from Kachemak Bay samples (Figure 3) approached, but remained below, the 80 µg/100g regulatory limit for commercial harvest and safe human

consumption. Data on *Alexandrium* cell abundance for 2020 will be available when COVID-19 laboratory closures are lifted and qPCR analyses can be conducted. HAB species and toxin monitoring will continue into October, since *Alexandrium* blooms can occur in the fall, as other phytoplankton species become less abundant.

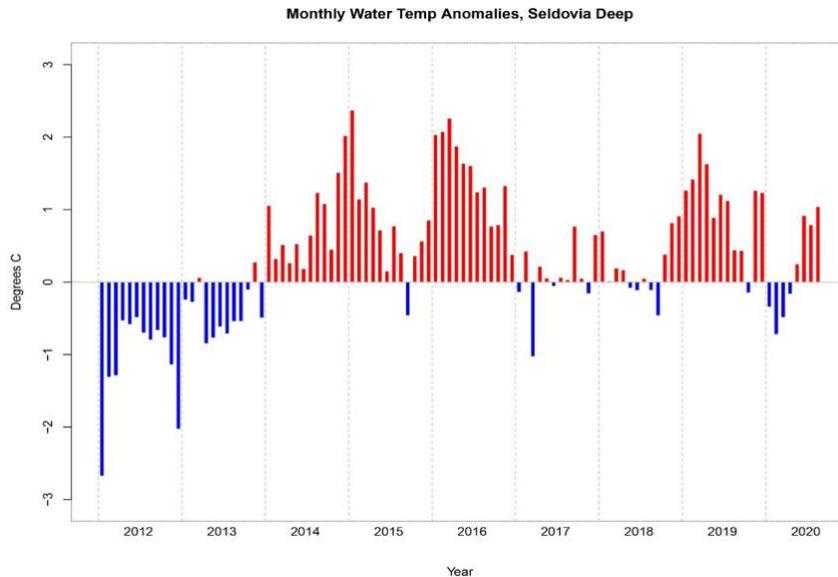


Figure 1. Monthly water temperature anomalies (against 2002-2019 climatology) from KBNERR Seldovia harbor water quality station. Red bars indicate positive anomalies (warmer than average conditions), and blue bars indicate negative anomalies (colder than average conditions).

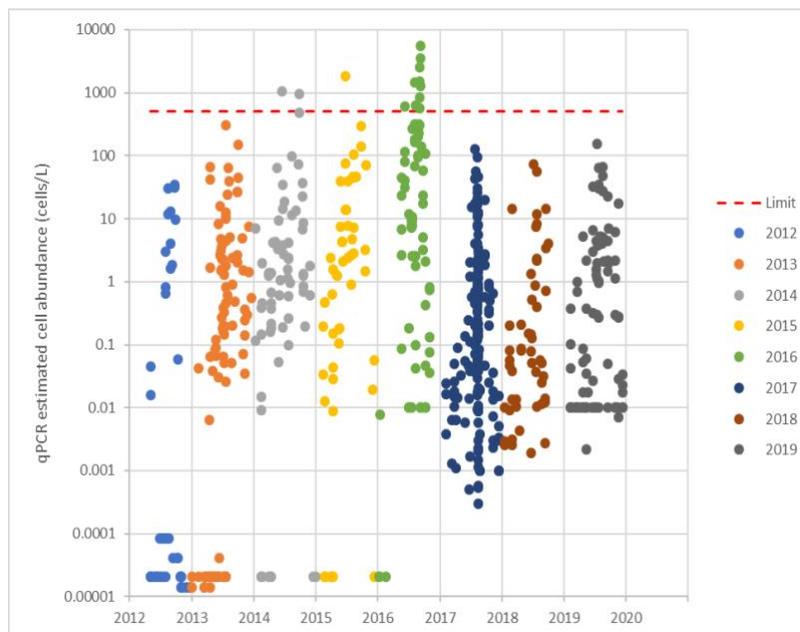


Figure 2. A scatterplot showing estimates of *Alexandrium* cell concentrations from qPCR analysis of phytoplankton samples collected in Kachemak Bay from 2012-2019. The red dashed

line indicates the 500 cells/L concentration at which saxitoxins are expected to start to be elevated in shellfish tissue. Cell concentrations are shown on a logarithmic scale.

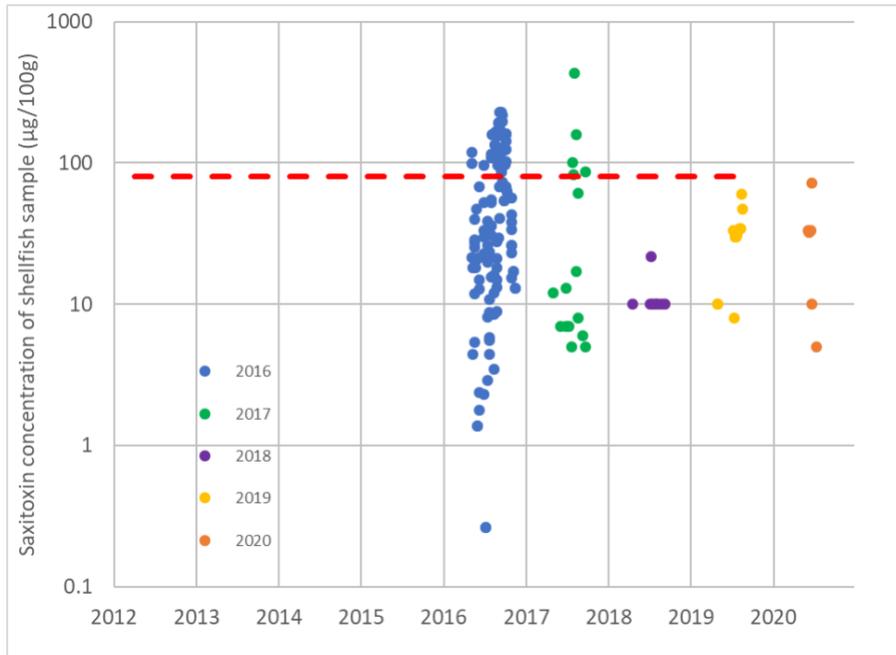


Figure 3. Graph showing saxitoxin concentrations in shellfish sampled from locations in Kachemak Bay from 2016 through August 2020. The red dashed line shows the regulatory limit of saxitoxins for safe human consumption at 80µg/100g of shellfish tissue. Toxin concentrations are shown on a logarithmic scale.

Knik Tribe
Bruce Wright

HAB role in Alaska: Monitoring and research

Summary of activities undertaken in 2020: Knik Tribe has been monitoring PSP with weekly mussel sampling supported with sampling of other species (salmon, amphipods, crab, forage fish and many other species) at 17 locations in 2020. This is part of a 2-year assessment of paralytic shellfish toxins in Alaska (2019-2020).

Summary of key findings/highlights from 2020: An update on the 2-year assessment was published in PISCES Press (see citation below). In 2020, samples started to arrive from the remote sites by mid-September. The 2020 PSP event was delayed due to cooler water temperatures, but by early summer some locations had high PSP levels. The results from sampling salmon have been very revealing. Some salmon had high levels of PSP in their digestive tracts, kidneys and livers, but the eggs and edible meat that was tested had low or no detectable PSP levels and is considered safe to eat. The lab results from a shipment of 2019 and 2020 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. The July 4, 2020 PSP

levels of Chignik Lagoon butter clams was 11,383 µg /100g, the highest PSP levels recorded in butter clams by the Knik Tribe. Figure 4 shows PST levels in blue mussels in King Cove.

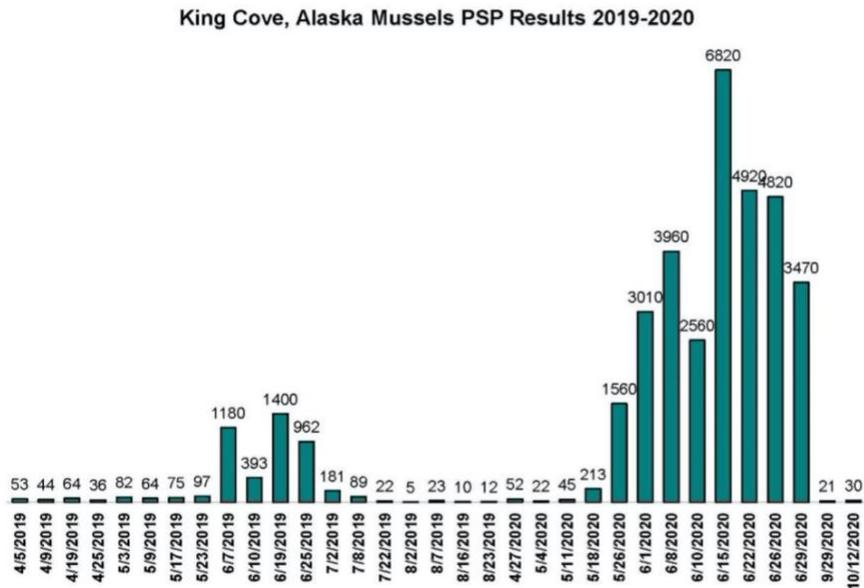


Figure 4. PST levels (µg/100g) of blue mussels at King Cove, Alaska in 2019 and 2020.

Wright, B. (2020). Assessing for paralytic shellfish toxins in Alaskan waters. PICES Press, 28(2), 24-29.

Chugach Regional Resources Commission and Alutiiq Pride Marine Institute
Maile Branson, Jeff Hetrick

HAB role in Alaska: Chugach Regional Resources Commission (CRRC) is a consortium representing seven Tribes in the prince William Sound and Lower Cook Inlet regions of Alaska (Figure 5). CRRC operates the Alutiiq Pride Marine Institute (APMI), located in Seward. CRRC & APMI have recently received funding to conduct monitoring for harmful algae, shellfish biotoxins, and seawater carbonate chemistry across the southcentral region of Alaska through our Chugach Regional Ocean Monitoring (CROM) program.

Summary of activities undertaken in 2020: The current CROM program works with Tribal members in each of our seven communities to conduct ecological and biochemical sampling on a weekly basis. Data are recorded onsite, and physical samples will be sent to APMI for further analysis.

Algae Species Monitoring: Tribal field samplers currently conduct microscopic evaluation of three-minute surface (horizontal) phytoplankton tows for both visual phytoplankton identification and rudimentary counts of cells/mL. This monitoring began in May 2021. Capacity for monitoring

using qPCR analysis for quantitative speciation is also being developed at APMI and is expected to begin as a monitoring effort in April 2022.

Shellfish Biotoxin Monitoring: Tribal field samplers will collect mussels and send them to APMI for analysis using ELISAs beginning April 2022.

CRRC and APMI held its first field sampler training May 3-7, 2021. Sampling began the week of May 10, 2021. APMI is currently working to build in-house laboratory capacity and train our multitude of new staff members in laboratory techniques.

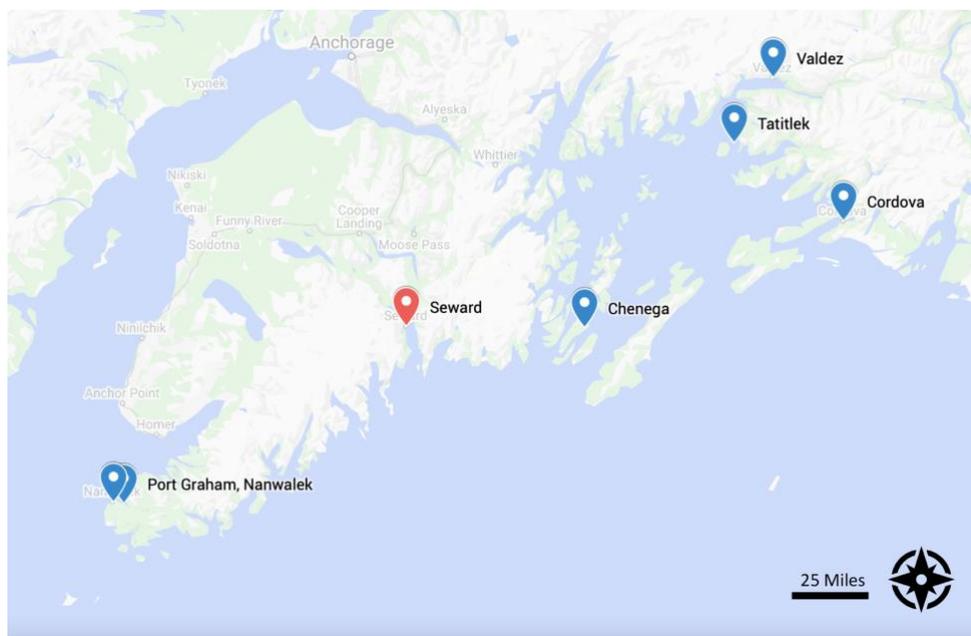


Figure 5. Sample sites represented by each of the Chugach Regional Resources Commission Tribes.

Summary of key findings/highlights from 2020: None yet.

Koniag Region (Kodiak Archipelago)

Kodiak Area Native Association

Andie Wall, Grace Ellwanger

HAB role in Alaska: The Kodiak Area Native Association (KANA), provides health and social services for people who live 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 2020: Funded through the Bureau of Indian Affairs - Tribal Resilience Program, KANA began monitoring harmful algal species in March 2019, developing harmful algal bloom (HAB) baseline data for the Kodiak region. This program is a partnership with Sun'aq Tribe of Kodiak (STK), Alaska Sea Grant, and Sitka Tribe of Alaska. KANA staff collect and analyze phytoplankton activity at four locations on the Kodiak Road System (Road System). Shellfish tissue sampling of butter clams and blue mussels occur bi-weekly at three monitored locations. At the fourth location, STK staff collect butter clam samples monthly. We are working with volunteers and Tribal Environmental Coordinators to extend monitoring sites in village communities where shellfish harvesting occurs more frequently. The Native Village of Port Lions began monitoring butter clams and blue mussels monthly in October 2020.

Efforts have been made to increase community outreach and communication. With support from the City of Kodiak and community volunteers, we installed "HAB Hubs" at all monitored locations. HAB Hubs are structural like awnings located at the beaches that are being monitored and where harvesting is occurring. The HAB Hubs display project information, data, and the most recent results.

Through this program, we are offering an adaptation practice for shellfish collecting — "Harvest and Hold." Harvest and Hold is the practice where one chooses a specific location to harvest (shellfish collected no more than 50ft away from each other) and once collection is finished, the harvester sacrifices 6-8 shellfish, about 100g, that they harvested. Then KANA sends the shellfish for testing at Sitka Tribe of Alaska's Environmental Research Laboratory (STAERL). Harvesters wait 2-3 days for results and use these results to make the best management decision. We are actively accepting samples from throughout the Kodiak region.

KANA's Team has also expanded, with two new employees being added to the team at the end of the summer. We established an AmeriCorps Volunteers in Service to America (VISTA) program to help build environmental program capacity and increase outreach for the HAB monitoring program. We also filled a full-time position of the Environmental Technician / Economic Development Program Specialist in November, to be the 'boots on the ground' for HABs monitoring along the Kodiak Road System.

Summary of key findings/highlights from 2020: The first blue mussel sample of the year went above the 80 µg/100g regulatory limit for commercial harvest on May 22nd, 2020. The highest blue mussel PST value came back over five times the regulatory limit at 433 µg/100g on July 22nd 2020. The highest butter clam tested almost six times the regulatory limit at 479 µg/100g in February 21st, 2020. Elevated shellfish toxin levels remained until through August. So far, toxin values are lower compared to last year, our first year of sampling. Kodiak sent 60 samples of butter clams and 76 samples of blue mussels to Southeastern Tribe of Alaska Environmental Research Lab (STAERL) to test for Paralytic Shellfish Toxins.

Alaska Sea Grant
Julie Matweyou

HAB role in Alaska: Research, monitoring and outreach

Summary of activities undertaken in 2020: Although no field work was conducted in 2020, the project team wrapped up an NPRB project (#1616) that resulted in an outreach publication on the butter clam cleaning study (<https://seagrant.uaf.edu/bookstore/pubs/MAB-78.html>). Key findings from the study include: because shellfish retain toxins for months there is a risk of PSP year-round (see figure from the publication below), the distribution and form of the toxins in butter clams change seasonally, and while removal of the black siphon tip and gut content is recommended for removing some of the toxins, the effect is not predictable or a guarantee that the butter clam will be completely safe to consume. It is recommended that harvesters sacrifice some of their clams for testing, and hold the clams until test results are returned before consuming butter clams.

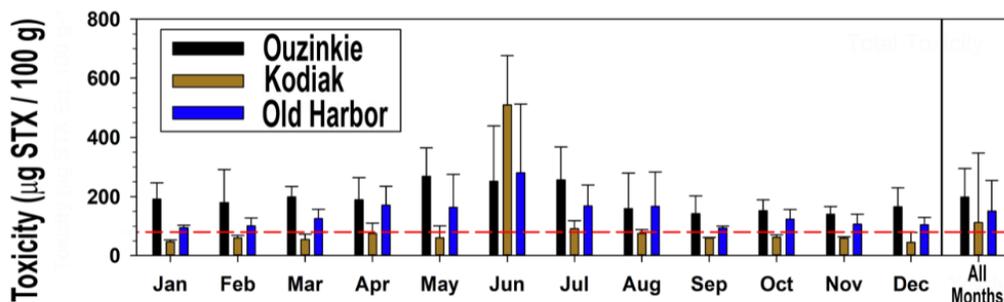


Figure 6. Average monthly toxicity (μg saxitoxin/100g) standard deviation in butter clams collected in 2013-2019 from Sourdough Flats (Ouzinkie), Near Island (Kodiak), and Shipwreck Beach (Old Harbor). The red dashed line is the FDA regulatory limit.

Aleutian and Pribilof Islands

Qawalangin Tribe of Unalaska

Chandra Poe, Environmental Director

HAB role in Alaska: Collection of shellfish for paralytic toxin testing, coordination of shellfish testing and monitoring of HABs in communities around the Aleutians. In process of developing long term program for consistent monitoring of HABs presence Steering Committee member, AHAB.

Summary of activities undertaken in 2020: In summer 2020 our staff completed weekly collection of blue mussels May through September, funded through Knik Tribe (project lead Bruce Wright). These samples were frozen and accumulated throughout the season, with a single shipment and analysis completed in the fall. Additional activities in 2020 included preparation of public outreach materials regarding PSP risk from consuming wild harvested shellfish, in partnership with AK Sea Grant, including flyers distributed in town as well as a radio

PSA written by Missy Good (AK Sea Grant). In July 2020, our community suffered a tragic loss when a community member passed away after consuming wild harvested mussels and snails. Following this event, we worked with the NOAA Event Response team to obtain funding to continue sampling in Unalaska and to expand this sampling to include additional communities. Our collaborators in this sampling effort are Agdaagux Tribe of King Cove (Shankell Mack, Environmental Coordinator), the Aleut Community of St. Paul Island (Lauren Divine, Director of Ecosystem Conservation Office), and Qagan Tayagungin Tribe of Sand Point (Ivy-Jane Jacobsen, Environmental Coordinator). Beginning in late September, these communities are collecting sample of shellfish (butter clams and/or mussels) weekly, bi-weekly, or monthly depending on location. Paralytic shellfish toxin analysis using the PCOX method is being done at the ADEC EHL lab in Anchorage. Results are published at www.qawalangin.com/psp

Summary of key findings/highlights from 2020:

Unalaska results as analyzed by the ADEC EHL lab are shown below (Figure 7). The peak total PST results for blue mussels were from July, at 7,140 micrograms/100g, with levels above USDA recommended limits throughout the sampling period (May thru September). Please note that regular updates for sampling funded through NOAA Event Response for Unalaska, Sand Point, King Cove, and St. Paul Island are available at www.qawalangin.com/psp:

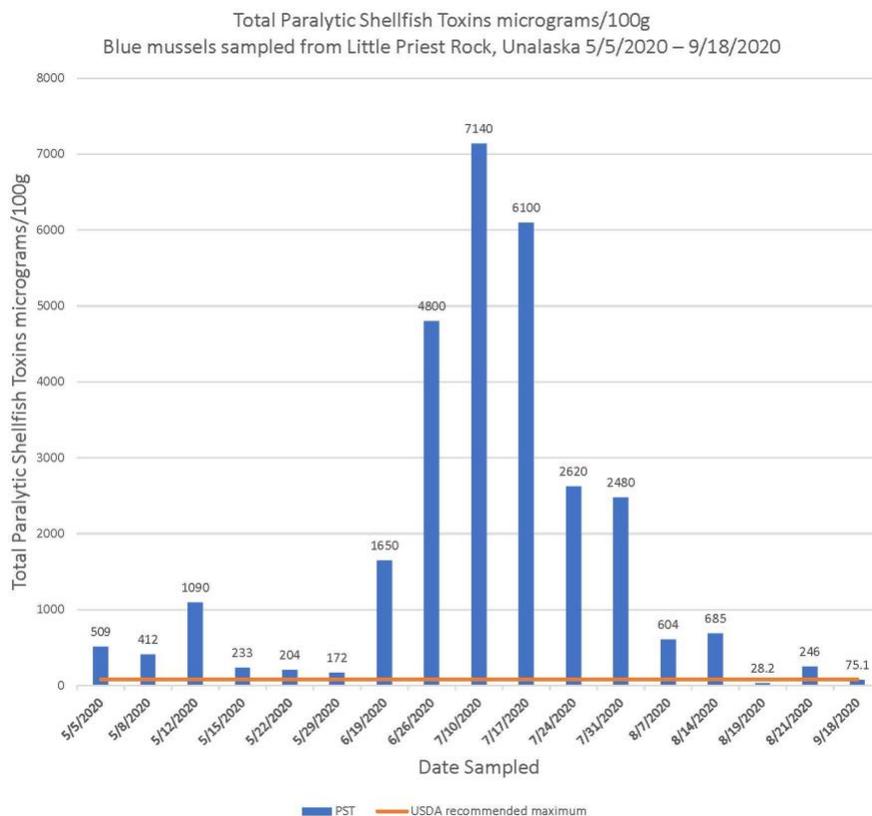


Figure 7. Total PST ($\mu\text{g}/100\text{g}$) from blue mussels sampled at Little Priest Rock, Unalaska in 2020.

Northern Bering Sea and Bering Strait

UAF/Alaska Sea Grant

Gay Sheffield

HAB role in Alaska: Facilitate HAB research, outreach, and education throughout the Bering Strait region. Provide general HAB info as well as research results; liaison between media, communities, researchers, and others; facilitate collaborative outreach education/outreach HAB documents available electronically worldwide.

Summary of activities undertaken in 2020: ECOHAB project funded. Coordinated/Collected fecal / gastrointestinal samples from >70 animals including:

- Marine mammals (n=8): bearded seal, ringed seal, and walrus
- Fish (n=25): King and chum salmon, sculpin, starry flounder, and an arctic cod
- Seabirds (n=43): Crested auklets, murres, puffins, shearwaters, as well as a fulmar, a brant, and a shoveler duck. Birds were collected intact and provided to USGS/USFWS .
- Krill (euphausiids) from eastern Norton Sound
- Sample locations included Diomede, Nome, Savoonga, Shishmaref, and Unalakleet as well as the northern Seward Peninsula.

Responded to a USCG concern regarding multiple dead stranded walrus along the N. shore of the Seward Peninsula during September.

Summary of key findings/highlights from 2020:

Sheffield, G. 2019. 2018/2019 Bering Strait / Chukchi Sea: *Alexandrium* Algae, Saxitoxin, and Clams, Alaska Sea Grant, University of Alaska Fairbanks, MAB-75, 2 pp.

<https://doi.org/10.4027/aascbscs.2019>

Trainer, V., R. Thoman, and G. Sheffield. "Where the Sea Ice Recedes, So Does an Alaska Way of Life". *New York Times*, 25 Sep. 2019, Op-ed.

<https://www.nytimes.com/2019/09/25/opinion/climate-change-ocean-Arctic.html>

Sheffield, G. 2019. Bering Strait: Walrus and Saxitoxin, late summer/fall 2017, UAF Alaska Sea Grant, Nome, Alaska. MAB-74. 2pp. 10.4027/bsws.2017

<https://doi.org/10.4027/bsws.2017>

Norton Sound Health Corporation

Emma Pate

HAB role in Alaska: Monitoring for HABs and toxins in the Norton Sound Area.

Summary of activities undertaken in 2020: Preparation to begin sampling.

Summary of key findings/highlights from 2020: No results yet.

Little Diomede

Opik Ahkinga, Chris Whitehead

HAB role in Alaska: Phytoplankton monitoring and baseline data on PSTs and DA in subsistence blue king crab.

Summary of activities undertaken in 2020: Preparation to begin sampling.

Summary of key findings/highlights from 2020: No results yet.

Chukchi and Beaufort Seas

Native Village of Kotzebue / Selawik National Wildlife Refuge

Alex Whiting, Bill Carter

HAB role in Alaska: Alex Whiting is the Environmental Director of the Native Village of Kotzebue, specifically interested in the cyanobacteria blooms that occur in Kotzebue Sound during the summer. Bill Carter is a fish biologist with the USFWS Selawik National Wildlife Refuge and is participating in deploying sensors in Kotzebue Sound.

Summary of activities undertaken in 2020: The Native Village of Kotzebue is facilitating a US Arctic Research Commission project that will methodically monitor the water in Kotzebue Sound for harmful blooms and the associated toxins. The project is just now getting underway, and sensors have been purchased to monitor the water conditions in the Sound during the summer.

Summary of key findings/highlights from 2020: None yet.

Woods Hole Oceanographic Institute

Don Anderson, Evie Fachon

HAB role in Alaska: Research on the offshore phytoplankton and HAB community, both in the water column and in the sediment. Work focuses primarily on the Chukchi and Beaufort seas but also includes stations in the Bering sea.

Summary of activities undertaken in 2020: Despite complications due to the ongoing covid-19 pandemic, offshore sampling for HAB species was conducted during three cruises in 2020 (Figure 8, Table 1). The earliest, a DBO Cruise aboard the Oscar Dyson (NOAA-operated vessel), took place in September 2020 and occupied DBO lines 1-5 in the northern Bering and Chukchi Sea. Water samples were collected by NOAA personnel from surface CTD bottles as well as from the underway seawater system. These samples were concentrated and preserved with Lugol's iodine solution and analyzed for planktonic presence of *Alexandrium* and *Pseudo-nitzschia* using a combination of microscopy and genomic techniques. An additional DBO cruise took place aboard the R/V Norsemann II in October 2020 and also occupied DBO lines 1-5. Personnel from the University of Maryland Center for Environmental Science collected

sediment plugs for enumeration of *Alexandrium catenella* resting cysts from a total of 29 stations.

Table 1. 2020 cruise summary including number and type of locations occupied during each expedition

Vessel	Sample Timeframe	Water Locations	Sediment Locations
Oscar Dyson	9/4 – 9/18/2020	36	-
R/V Norsemann II	10/5 - 10/19/2020	-	29
R/V Sikuliaq	10/18/20 – 11/19/20	123	47

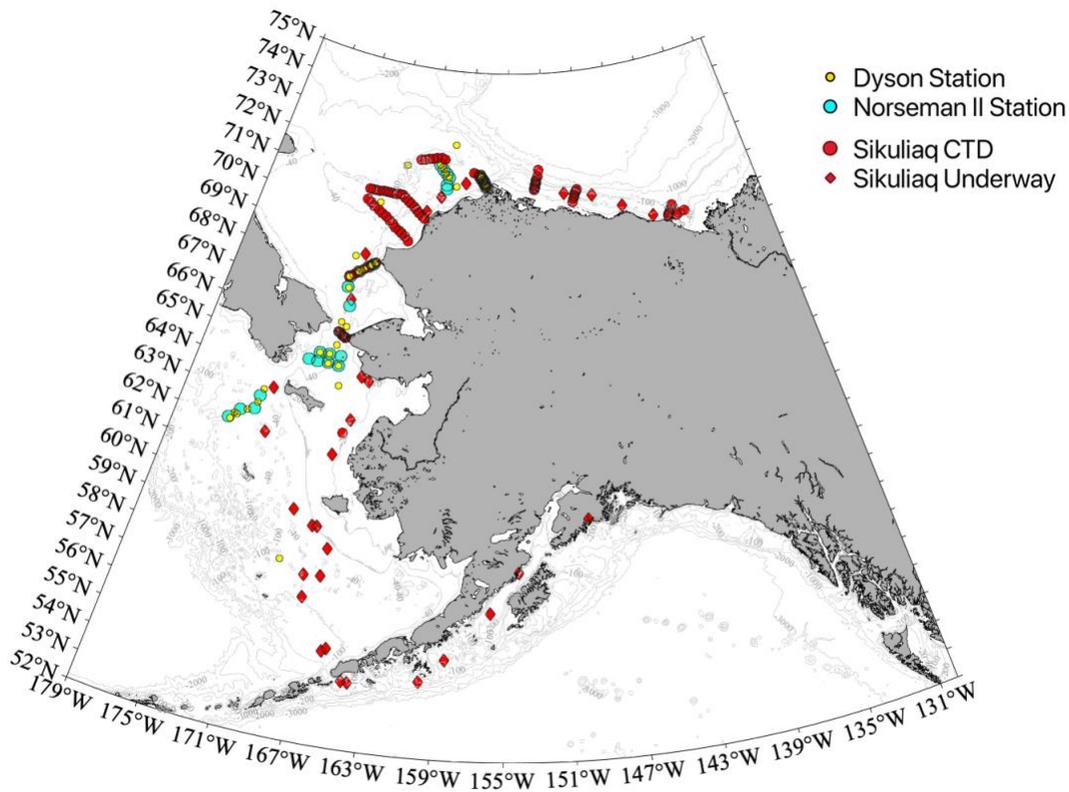


Figure 8. Offshore locations sampled for HAB species during cruises in 2020

Offshore samples were collected aboard the R/V Sikuliaq by Woods Hole Oceanographic Institution personnel in late October and November 2020; this cruise departed from Seward, AK and included extensive sampling in the Chukchi Sea and western Beaufort Sea (including DBO lines 3, 5 & 6). Collections included filtration of both CTD and underway water for *Pseudo-nitzschia* genomic analysis, sediment sampling for *Alexandrium* cyst enumeration, and preservation of benthic invertebrates for toxin analysis. Additionally, an Imaging FlowCytobot (IFCB) was configured to sample from the underway seawater system for the duration of the cruise. This instrument captures images of phytoplankton at a rate of 8-10 images per second, generating hundreds of thousands of pictures per day. While few *Alexandrium* vegetative cells

were observed this late in the season, *Pseudo-nitzschia* chains were observed throughout the cruise track (Figure 2), even under the sea ice in the Beaufort Sea. Since *Pseudo-nitzschia* are nearly impossible to identify to the species-level using IFCB images alone, analysis of filters collected will provide insight into the species that were present. The IFCB data from this cruise are available here:

<https://ifcb-data.whoi.edu/timeline?dataset=arctic>

*Note: at the time of this writing, this dataset has not yet been georeferenced

Summary of key findings/highlights from 2020: Initial microscopic analysis of surface water samples collected aboard the Oscar Dyson revealed relatively sparse presence of *Alexandrium* and *Pseudo-nitzschia* cells in the northern Bering and Chukchi Seas in early-mid September 2020 (Figure 9). The maximum count for *Alexandrium* was 97 cells/L observed off the coast of Utqiagvik (DBO5); this is much lower than levels seen one week earlier in the region in 2019. The highest concentrations of *Pseudo-nitzschia* were seen at one station on DBO1 (709 cells/L) with a second patch observed at DBO2 (140 cells/L). Forthcoming genomic analysis will allow an identification of which *Pseudo-nitzschia* species were present.

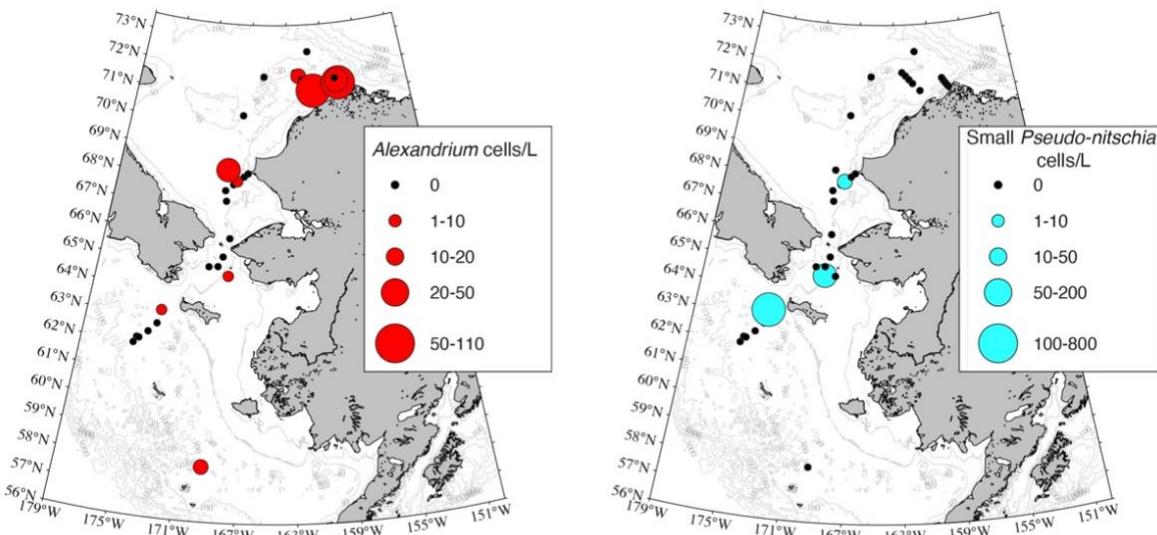


Figure 9. Cell concentrations of *Alexandrium* and *Pseudo-nitzschia* collected in surface waters from 9/4/20 – 9/18/20 (Oscar Dyson Cruise).

Statewide

Alaska Department of Environmental Conservation

Patryce McKinney, Kim Stryker, Carol Brady

HAB role in Alaska:

The Alaska Department of Environmental Conservation tests bivalve shellfish harvested from classified shellfish growing areas meant for commercial market for marine biotoxins including paralytic shellfish toxin (PST) in all bivalve shellfish and domoic acid (DA) specifically in razor clams. The Environmental Health Laboratory (EHL) is the sole laboratory in the state of Alaska certified by the FDA to conduct regulatory tests for commercial bivalve shellfish. The EHL also does testing for research, tribal, and subsistence use.

Summary of activities undertaken in 2020:

The EH performed the following marine biotoxin analyses in 2020:

	Commercial	Non-commercial
Domoic Acid	0	606
MBA	719	47
PCOX	0	540

The sole commercial razor clam fishery in Alaska did not operate in 2020 as a result of the Covid-19 pandemic and no regulatory tests for DA in razor clams were conducted.

Summary of key findings/highlights from 2020:

There was one farm closure in 2020 due to PST levels at 123 µg/100 g of tissue. This area remained in the closed status to harvesting until 6/18/2020 when the reopening criteria was met: three consecutive PST tests taken at least four days apart spanning at least 14 days must be below 80 µg/100.

USGS Alaska Science Center

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HAB role in Alaska: Our lab tests bird tissues, forage fish, and other samples for STX and DA. Our research efforts include 1) working with partners to respond to bird die-off events, 2) conducting experimental trials to assess sensitivity of seabirds to STX, 3) investigating HAB toxins in the food web, and 4) tracking the occurrence of HAB toxins in seabirds throughout Alaska.

Summary of activities undertaken in 2020: We tested liver and gastrointestinal samples from 18 birds submitted to the National Wildlife Health Center (NWHC) to determine whether STX or DA may have contributed to seabird mortality events observed during 2020. We received die-off samples from the Chukchi Sea, Bering Sea, and Gulf of Alaska. We also tested bird and forage samples collected in the Gulf of Alaska as part of a pilot food web study initiated in 2019. In collaboration with the Alaska Sea Life Center, we conducted a pilot study of Common Murres to validate research and husbandry protocols; this effort will support our 2021 project to evaluate behavioral and physiological effects of STX on seabirds. Many 2020 activities were postponed

or cancelled due to COVID-19 but our lab is operational again and we are currently planning for the 2021 field season.

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.

For more information about USGS Alaska Science Center HABs research, see:

<https://www.usgs.gov/centers/asc/science/harmful-algal-bloom-toxins-alaska-seabirds>

Summary of key findings/highlights from 2020: None of the 2020 die-off birds submitted to the NWHC had quantifiable levels of STX; testing for DA is still in progress. Samples from a pilot study of food web dynamics in the Gulf of Alaska have been analyzed and results will be forthcoming soon.

Our investigation of the role of HAB toxins in a multispecies die-off in the Bering and Chukchi seas in 2017 is currently in press with *Journal of Wildlife Diseases* (Figure 10). Saxitoxin was present in 60% of all individuals tested, and in 88% of Northern Fulmars at concentrations equivalent to those reported from other STX-induced bird die-offs. Although direct neurotoxic action could not be confirmed and starvation appeared to be the proximate cause of death, STX was implicated as a potential factor in the die-off. This effort included a diverse group of partners, including the NWHC, Alaska Sea Grant, Aleut Community of St. Paul Island, USFWS, NOAA, and University of Washington COASST. Sample collection was made possible by local residents and volunteers in western Alaska and the Bering Strait region.



Figure 10. Map showing locations and numbers of carcasses tested for saxitoxin (STX) during a 2017 multispecies die-off in the Bering and Chukchi seas. Solid (red) indicates individuals with detectable levels of STX (n=15); empty (white) indicates individuals with no detectable STX (n=10). (From Van Hemert et al. 2021)

Van Hemert, C., Dusek, R.J., Smith, M.M, Kaler, R., Sheffield, G., Divine, L.M., Kuletz, K.J., Knowles, S., Lankton, J.S., Hardison, D.R., Litaker, R.W., Jones, T., Burgess, H.K., Parrish, J.K. 2021. Investigation of algal toxins in a multispecies die-off in the Bering and Chukchi seas. *Journal of Wildlife Diseases*, 57(2): 399-407.
<https://meridian.allenpress.com/jwd/article/doi/10.7589/JWD-D-20-00057/449937>.

NOAA/NWFSC/WARRN-West
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HAB role in Alaska: The role of the Wildlife Algal-toxin Research and Response Network (WARRN-West) at NOAA's Northwest Fisheries Science Center is to provide surveillance for the presence of algal toxins in stranded and subsistence harvested marine mammals collected from the entire West Coast of North America. In addition, an Alaska focused ECOHAB-funded project entitled "Trophic transfer and effects of HAB toxins in Alaskan Marine Food Webs" combines WARRN-West and multiple partners with the priority of determining the trophic transfer of algal toxins within food webs and the impacts of toxins on individual organisms and food webs. The scientific objectives of the study are 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 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.

Summary of activities undertaken in 2020: Food web sampling began in 2019 with collections on over 10 research cruises in Arctic and subarctic regions. In 2020, most cruises were cancelled, but we were able to get some benthic clam samples throughout the Bering, Chukchi, and Beaufort Seas.

Summary of key findings/highlights from 2020: Preliminary results reveal that 2020 samples had similar patterns of toxin presence in clams as in 2019 even though over-lying bloom densities were lower in 2020 than in 2019 (see section above by WHOI/Anderson).