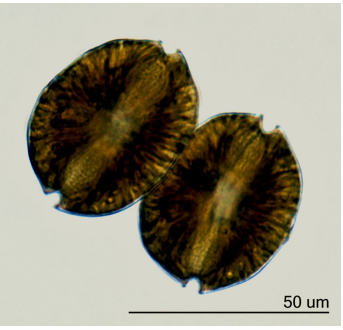

Tracking and Forecasting Algal Toxins in Alaska:

Working with Partners in the Southcentral and Southwest

Alexandrium blooms in Alaska

Alexandrium catenella is a toxic microalga that blooms seasonally in the coastal waters of Alaska. This bloom-forming dinoflagellate produces a suite of potent neurotoxins commonly known as paralytic shellfish toxins (PSTs) that can accumulate in the body tissues of bivalve shellfish, including clams, oysters, and mussels, when they ingest *Alexandrium* present in the surrounding seawater. PSTs are also transferred through other parts of the marine food web through zooplankton, planktivorous fishes, predatory fishes, invertebrates and higher level predators like seabirds and marine mammals.

Paralytic Shellfish Toxins

Paralytic shellfish poisoning (PSP) is a potentially fatal human illness caused by the ingestion of shellfish containing high levels of PSTs produced by *Alexandrium*. The effects of PSP in mammals include severe gastrointestinal symptoms (nausea; vomiting; diarrhea); neurological effects (headaches; weakness; numbness in the extremities, lips and tongue); and severe effects such as muscle paralysis, asphyxiation and death. Collectively, PSTs are a risk to human health and through trophic transfer, are a threat to the health and survival of marine fauna throughout the marine food web.

Tracking PSTs in Marine Fishes

Although PSTs are commonly known from shellfish toxicity outbreaks, these compounds are readily transferred to a wide array of other marine fauna during *Alexandrium* blooms. Field data collected during blooms show these toxins are present from zooplankton to predatory fish in months when *Alexandrium* blooms are most prevalent. PSP toxins were quantified in Alaskan salmon, cod, and halibut collected from samples across southern Alaska to assess potential risks to coastal communities, the fitness of commercially important species, and to the Alaskan fishing industry.

Forecasting PSTs

Coastal residents in Alaska depend on shellfish resources for subsistence and longstanding cultural traditions. PSP is a severe and potentially preventable risk to coastal Alaskan communities. Due to the large Alaskan coastline and limited resources for shellfish monitoring, advanced notification and forecasts of elevated PSP risk would allow resource and shellfish managers, including Alaska Department of Environmental Conservation (DEC), Department of Health and Social Services (DHSS), and regional Tribal organizations, to better focus their monitoring and testing resources to reduce PSP risk.

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PST Levels in Ecologically Important Fishes

Field data were collected across southern Alaska in the spring, summer, and fall when *Alexandrium* blooms occur using various nets or obtained from sport, subsistence, and commercial fishers, as well as fish processing facilities.

PSTs were present in zooplankton that feed on *Alexandrium* (e.g. copepods, krill, and fish larvae); in many important forage fishes (e.g., sand lance, herring, juvenile cod); in commercially important predatory fishes (salmon [Chinook, Coho, Pink, Sockeye and Chum], cod, halibut); and in a variety of invertebrate species (e.g., snails, chitons, urchins). Data also show toxins levels in these biota reach the greatest levels in locations with high shellfish toxicity, such as the Kodiak Archipelago, the Alaska Peninsula and the Aleutian Islands.

PSP toxins sometimes reach high levels in Alaskan salmon species and Pacific Cod, with lower levels in Pacific Halibut. Overall, toxins are highest in the digestive and excretory organs, with lower levels present in muscle tissue and gonads. High toxin levels in forage fish species also indicate these important prey represent a primary trophic transfer pathway to seabirds and marine mammals.

It is not known how the observed body burdens may affect health and fitness of important prey species like Sand Lance and Herring, as well as juveniles of commercially important fishes like Pacific Cod and salmon. This information is critical to estimate the physiological cost of PSTs on fish health, fitness, and susceptibility to predators.

Predicting and Forecasting PSTs in Alaska

To predict how PSTs are transferred up the food web, we are working toward a trophic transfer model for Arctic and Subarctic food webs using empirical data on the abundance of toxin-producing *Alexandrium*, corresponding toxin levels in multiple trophic levels, health and behavioral assessments, and observational data for fish and marine mammals. We are also developing a forecast that incorporates shellfish toxicity observations, *Alexandrium* bloom information, environmental monitoring data, biophysical and circulation models, and satellite derived imagery to predict annual Alexandrium bloom severity along the Alaskan coastline. Initial efforts are focused on southwestern and south-central Alaska due to the availability of observational data. Subsequent forecast products will focus on other parts of the state as data becomes available.

RESOURCES

- For more information see project summaries for the prevalence of PSP toxins and trophic transfer of HAB toxins in Alaska marine food webs funded through NOAA's Monitoring and Event Response for HABs and Ecology and Oceanography of HABs programs as well as PSP toxin tracking funded by the North Pacific Research Board.
- Results from scientific publications include: Kibler et al. 2022, Lefebvre et al. 2022, and Vandersea et al. 2018.
- For additional information about HABs see the NOAA NCCOS webpage.

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