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2022 Bering Sea Algal Bloom Was One Of The Largest, Most Toxic Ever Observed Nationwide

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Last July, researchers detected high concentrations of a toxin-producing algae offshore in the Bering Strait region.

Residents were urged to use caution when consuming marine foods like clams—and new research suggests that caution was justified.

Not only was the algal bloom highly concentrated, it also contained highly potent toxins, according to new analyses from the lab of Don Anderson, a senior scientist at Woods Hole Oceanographic Institution in Massachusetts.

"This was one of the largest and most toxic Alexandrium blooms ever observed in the United States and the world," Anderson told the Nugget. "It did turn out to be largely composed of the most potent toxins that that organism can produce. That's sort of a worst-case scenario. That bloom—and it could well be a very different case next year or the year after that—was nearly as toxic as it could be."

He added that if this bloom had occurred in a region with heavy shellfish resources and harvesting, the situation could have been much more threatening.

"It is safe to say that eating clams from the area of the bloom would have been very dangerous, not only for humans, but for walrus and other animals that eat clams," Anderson said.

There were no reports of anyone getting sick from eating subsistence foods, but there was at least one close call. One family collected a six-inch butter clam from the bloom area just north of Savoonga in late August. They wanted to eat it, but, because of the regional advisories, they turned it in for toxin testing. When the results came back a month later, the clam had saxitoxin levels five times above the limit for human consumption.

"If they didn't send in that clam, that potentially could have been a life lost," said Emma Pate, the training coordinator and environmental planner in the Office of Environmental Health at Norton Sound Health Corporation.

Because of that incident, Pate said she wasn't surprised to learn the samples Anderson tested had such a potent mix of toxins. Still, she said the results were "concerning" and more proof that the region needs better ways to monitor and test marine resources.

"Nobody's going to stop eating or gathering subsistence food—it's a way of life," Pate said. "We need to learn how to adapt to this."

Scientists from Anderson's lab were aboard the Norseman II research vessel last summer. It

sailed through the northern Bering Sea, Chukchi Sea and Beaufort Sea as part of a National Science Foundation-funded project. The researchers were looking for a single-celled algae called Alexandrium catenella, which can produce toxic blooms, and their study subject quickly turned into a public health concern. The scientists found such high concentrations of Alexandrium cells in the water that they got in touch with Norton Sound Health Corporation and other partners on land to issue a series of risk advisories as they followed the bloom north.

Algae like Alexandrium are critically important as the base of the marine food web. But the right combination of conditions like temperature, sunlight and excess nutrients can cause their numbers to explode. When this happens, the toxins that are naturally found in Alexandrium can become dangerous. They can build up in the tissues of certain marine species, such as clams and crabs, and can cause paralytic shellfish poisoning, or PSP, in humans who consume those foods.

The toxin can be transferred and accumulated throughout the food web, causing illness and death in wildlife, even animals that don't consume shellfish.

In most of the world, the main concern with Alexandrium is shellfish. Clams and mussels, which filter the water around them, can accumulate toxins rapidly, and retain it for fairly long times. But in the Alaskan Arctic, many other food resources have the potential to be dangerous. "Animals like walruses and some sea birds that do eat shellfish are very much at risk, just as humans are," Anderson said. He added that some forage fish can also accumulate toxins, putting their predators at risk, too.

Researchers have started looking for where those dangers lie in the larger food web. NOAA research biologist Kathi Lefebvre, has been measuring toxin presence in stranded and subsistence harvested marine mammals. Lefebvre has also been leading research to track Alexandrium toxins through the Arctic food web to learn what animals—and specifically what tissues in those animals—are safe or unsafe to eat. For example, crab legs might be safe to eat during a bloom, but crab guts might contain high levels of toxin.

Meanwhile, a team from the U.S. Geological Survey, or USGS, in Anchorage, has been trying to figure out how seabirds might be affected by harmful algal blooms. They have examined species like common murres, black-legged kittiwakes, northern fulmars, short-tailed shearwaters and Arctic terns. In a Strait Science presentation last month, they explained that they don't often find algal toxins in tissue samples from these birds. When they do, the toxin level has been below the human consumption limit of 80 micrograms per 100 grams. While they are still trying to understand how various doses of algal toxins can impact the birds' health, so far they haven't found a strong link between recent die-offs and these toxins.

"There are a few isolated die-offs that are linked to saxitoxin exposure," Matt Smith, a USGS geneticist, said during the lecture. "But there are also many additional compounding factors, ecosystem changes, and changes in food availability that could account for these die-offs more than algal toxin poisoning."

There's another challenge for researchers trying to understand how algal toxins affect the food web. Alexandrium does not just produce one toxin. It produces a family of toxins. Some, such as saxitoxin and GTX1/4, are much more potent than others. That means each Alexandrium bloom will have its own distinct fingerprint of toxin combinations. Because some toxins in the saxitoxin family are as much as 50 times more potent than others, some blooms can be far more toxic than others. Half a year after the research cruise, Anderson and his colleagues have had more time to analyze the water samples in their lab. They've learned that the 2022 bloom had high percentages of the most potent toxins that produce paralytic shellfish poisoning in humans.

Alexandrium cells clump together, forming cysts that sink to the seafloor. These can lay dormant for many years, or even centuries. Recent scientific observations suggest the Chukchi Sea and the Gulf of Anadyr contain some of the largest accumulations of Alexandrium cysts in the world. While cold water limited how much these colonies could grow, now under warming conditions, these cyst beds could fuel harmful blooms in the future. Anderson's team has been taking sediment samples where these cyst beds are located on the U.S. side of the treaty line. They have been germinating those cells, establishing cultures and looking at the different toxin fingerprints. But there's no clear match with the toxin fingerprint of last summer's bloom.

“It doesn’t match the vast majority of the cultures we have as a baseline,” Anderson said. “We need more data, but we believe this population came from the western waters of the northern Bering Sea, in Russian waters.” The researchers have several reasons to suspect this, but they’re missing toxin fingerprint data that could help make the connection.

Anderson’s team had a collaboration with Russian colleagues that was funded through the National Park Service Shared Beringian Heritage Program. That program was intended to foster collaboration on issues affecting both sides of the Bering Strait. Anderson said his colleagues in Vladivostok were going to collect samples along the Russian coast, both from the seafloor sediment and water column to get information on Alexandrium.

“As you can imagine, this came to a halt because of the Ukraine conflict,” he said. “They’re still trying to collect samples and analyze them. But they were going to come to my lab and work on common techniques and common analysis, and that hasn’t happened. We are left trying to put a complicated story together with only half of the information we need.”

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