Scientists study mysterious invader in the Chesapeake Bay's largest underwater grass bed

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Researcher Judy O'Neil dons a wetsuit, a snorkel and goggles, and jumps into one of the Chesapeake Bay's most important ecosystems: the vast underwater grass beds of the Susquehanna Flats.

But O'Neil isn't there to study the grasses, so much as a perplexing invader in their midst called microseira, which is growing more and more prevalent there.

Located offshore of Havre de Grace, Maryland, the Flats lie at the mouth of the Susquehanna River, the bay's largest tributary. Estimated at over 10,600 acres in 2023, the sprawling bed of submerged aquatic vegetation, or SAV, is a key habitat for underwater creatures—and a critical sink for harmful sediments and nutrients rushing down the Susquehanna.

That's what makes it such a key area for research. O'Neil, an associate research professor at the University of Maryland Center for Environmental Science, visited in August with a host of other researchers and summer interns, along with the Maryland Department of Natural Resources. Each team collected data about the grasses, including species like wild celery and water stargrass. But O'Neil was focused on the algae-like mats of microseira, embedded in the sediment beneath the spiny green grasses.

Known by the name lyngbya until a recent change, microseira is a type of cyanobacteria, a photosynthesizing bacteria that grows in clumps on the bottom. And as the season progresses, it grows up onto the grasses, in search of sunlight, and sometimes floats in unsightly mats on the water's surface.

"In Australia, they call it mermaid's hair," O'Neil said. "But we always joke that we don't want to meet that mermaid."

Closely related cyanobacteria appear in tropical environments like Hawaii and Australia. But Maryland researchers first noticed it in the Flats in 2004, after watermen complained that the mats were clinging to their fishing gear. In recent years, its footprint has appeared to increase, O'Neil said, and warming waters due to climate change could add more fuel.

But the impact of the microseira on the Flats remains unclear. For the time being, the cyanobacteria doesn't appear to be slowing the growth of the Chesapeake's largest grass bed.

The recovery of the Flats from near-decimation in the 1970s is an oft-cited success story for the bay, at a time when the restoration effort has fewer items in the win column than bay officials would have hoped when they signed the latest recovery agreement in 2014.

That agreement calls for a total of 185,000 acres of underwater grasses in the bay, but the latest estimate from the Virginia Institute of Marine Science, which tracks the figure annually, indicated there were 82,937 acres in the 2023 season—a considerable improvement compared to 2019's figures, after rainy conditions buried grasses bay-wide, but well short of the goal.

That 2014 bay agreement also came with a 2025 deadline for states surrounding the Chesapeake to reduce their loads of nutrients and sediment runoff into the bay. While some states met their obligations or will come close, others remain far off the mark, meaning the overall effort will fall short.

A committee convened by Chesapeake Bay Program leaders unveiled its recommendations earlier this year for the future of the bay agreement. The committee called on governors of the bay states to recommit to the agreement, as scientists and other stakeholders figure out a new timeline

for some of its goals, and new targets for others.

The latest science, in the form of a comprehensive evaluation released in May 2023, emphasizes the importance of shallow-water habitats like the Flats. In the bay's deep trench, reductions in nutrients and sediments haven't spawned the expected increases in dissolved oxygen levels. Whereas these improvements are arriving faster in shallow areas, particularly when underwater vegetation returns, providing habitat for crabs and fish.

In the Flats these days, that mysterious microseira is hardly difficult to find. Floating amid the grasses, O'Neil ducks underwater with her hand outstretched, and swims for the bottom. Her flippers dangle in the air for a moment, before she reappears, holding a fistful of the muddy, filamentous substance yanked from the grass bed.

Researchers believe the microseira is largely fed by nutrients in the water and legacy phosphorus in the sediment of the Flats.

In other habitats, such as Florida and Australia, similar cyanobacteria has crowded out aquatic vegetation, leading to declines. But the same story doesn't seem to be playing out in the Chesapeake, said Brooke Landry, who focuses on SAV as program chief for living resources assessment at Maryland's Department of Natural Resources.

"By August, there's just a lot of it. It covers hundreds of acres in the bed," Landry said. "It's like: How is this not having a negative impact? And we'll go and we'll look around, and the grass underneath looks bright green and happy."

The health of the Flats could be the reason, O'Neil said. The grasses in the Flats can grow up to 6 feet long, often reaching the surface, so the microseira cannot completely cover the grasses and block the sunlight. In

other environments, such as Florida's, the grasses can't grow as high, sometimes because of hungry marine species such as turtles and manatees, O'Neil said.

But microseira has plenty of weapons in its arsenal, including an ability to "fix" nitrogen—or take in nitrogen from the atmosphere and use it for growth, something that algae cannot do. Therefore, simply reducing the amount of nutrient runoff into the water wouldn't stop the microseira.

"I don't want people to think that keeping nutrients out is not a good idea, because it is," O'Neil said. "But there are other mitigation strategies that have been used in other places to save the seagrass, including harvesting (the microseira)."

In tropical environments like the Hawaiian and Australian shorelines, some types of lyngbya have been a documented cause of "stinging seaweed disease," in humans, causing skin, eye and respiratory irritation because of the toxins they produce.

But the microseira found in the Flats creates different toxins that do not pose the same threat to people, said Cathy Wazniak, DNR's program manager of coastal integrated assessment.

"It's not a human health threat, because you have to ingest these things, and I don't think anybody's making a salad out of that benthic mat," Wazniak said. "But there are animal implications, maybe ecosystem implications."

Scientists are still trying to determine the impacts of the toxins, Wazniak said. They've found one in tiny zooplankton living on the mats, but it remains unclear whether the toxin is passing up the food chain to other organisms, and what effects it may have, Wazniak said.

Globally, cyanobacteria appear to be growing more plentiful, and spreading to new regions, as climate change warms underwater ecosystems, O'Neil said.

"It's not just occurring here. The species that we work with in the marine environment, that used to be confined to Florida, I'm now finding in Cape Cod," O'Neil said.

The microseira research is just one chapter in the evolving history of the Susquehanna Flats.

A pivotal moment came in 1972, when Hurricane Agnes, a generational storm, sent powerful floodwaters rushing down the Susquehanna, wiping out the Flats.

Back then, the storm felt like the "nail in the coffin" for the Flats, said Cassie Gurbisz, associate professor of marine science at St. Mary's College of Maryland.

"The SAV was gone from the Flats for like 30 years—and then all of the sudden, in the early 2000s, it came back," Gurbisz said.

That resurgence was the focus of Gurbisz's dissertation. She determined that several factors came together to make it happen. Nutrient reductions, including from the ban of phosphates in detergent, and a dry spell in the bay region, created a "window of opportunity" for the grasses to regain a foothold at the mouth of the Susquehanna. And once the grasses passed a certain tipping point, the bed's growth was exponential.

"It's kind of like this runaway train. We call it positive feedback," Gurbisz said. "The plants clear up the water, and that means they're getting more light, and then they can grow even more, and clear up the water even more, and get even more light."

The result is a strengthened ecosystem that can better withstand threats, like 2011's Hurricane Lee, 2018's heavy rains and other influxes of nutrient pollution.

For observers, that means a lush underwater meadow, visible from a boat when the waters are shallow, but enchanting from behind a dive mask, surrounded by swaying sprigs of green.

"I harp to my friends and neighbors all the time about how amazing the Chesapeake Bay is, and SAV. But still, their perception of getting in the water in the bay is just like 'ick,'" Landry said. "The fact (is) that there are these beautiful areas where the water is crystal clear."

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