Scientists: Lake Tahoe is regaining legendary clarity

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At midnight, researchers aboard the vessel John Le Conte—an old 37-foot diesel-powered salmon trawler—dropped a net into icy cold waters.

What was surprising wasn't what they caught. It's what they didn't: Invasive shrimp, which have long held sway over America's most famous

alpine lake, upsetting its balanced ecosystem.

In a rare piece of environmental good news, the harmful predators are almost gone. In their place are helpful creatures who are safely returning to eat algae and other fine particles. Scientists say this mysterious shift may be restoring the lake's legendary clarity.

Lake Tahoe's average visibility has increased from 52.8 feet deep to a stunning 71.7 feet in the past three years, although this summer's runoff has created some temporary murkiness. That's like seeing seven stories underwater. In the last five months of 2022, the visibility increased to 80.6 feet, a level not seen since 1988, when it was 81 feet.

"We haven't had this level of clarity since the 1980s," said Geoffrey Schladow, director of the UC Davis Tahoe Environmental Research Center

To study the dramatic restructuring of Lake Tahoe's food web, the Center's research vessel counts the presence of three different populations: algae; the predatory shrimp, called Mysis; and a slew of beneficial native species of algae-eating zooplankton, especially Daphnia and Bosmina, which are harbingers of good water quality.

In the past, the nighttime netting would capture 100 to 150 of the nocturnal shrimp, which rise to the surface of the lake in darkness.

Now it's catching just two or three. "You can name them!" joked Schladow.

The lab is also monitoring lake clarity by measuring the depth to which a 10-inch white plate, called a Secchi disk, remains visible when lowered into the water. While 2023 data isn't yet available, the lake's average clarity jumped 10 feet between 2021 and 2022.

Scientists say the lake is clearest when the zooplankton Daphnia and Bosmina, which had once almost vanished, are most abundant.

"Biologically, things are changing," said Schladow. "Things that weren't in the lake before, suddenly they're there. Things that were in the lake—they've disappeared. It's very interesting, and we're trying to piece it together."

The mountain-ringed lake, which straddles the Nevada/California border in the Sierra Nevada, has long been considered a natural wonder.

Awed by its crystalline waters, writer Mark Twain proclaimed it "so singularly clear…that the boat seemed floating in the air. The water was not merely transparent, but dazzlingly, brilliantly so." The lake owes its clarity to surrounding granite. Additionally, it has a relatively small watershed and is largely free of agricultural pollutants.

But in recent decades, the lake's waters had grown increasingly cloudy—losing their world-famous clarity at a rate of nearly a foot and a half a year.

Lake Tahoe seemed destined to someday look like any other lake: a murky muddle in the mountains.

Alarmed, management agencies in the region have taken steps to reduce runoff from roads, gardens, golf courses and the construction of new multimillion-dollar homes. They report that more than 500,000 pounds of fine sediment and other clarity-harming contaminants are being kept out of the lake every year through roadway maintenance and erosion-control projects.

But a natural culprit also emerged: the non-native Mysis shrimp.

The shrimp's introduction was an idea gone terribly wrong. In the early 1960s, the California and Nevada Departments of Fish and Game imported it from the Great Lakes, believing the shrimp would provide food for Lake Trout, which was Tahoe's primary sport fish.

But the shrimp are sensitive to light—and once in the lake's clear waters, they spend their days on the dark deep lake bottom. Every night, they undertake an enormous vertical migration to the surface.

Most fish are "sight feeders," and don't occupy the same water column during the day, said Katie Senft, the Center's staff research associate. So the shrimp aren't eaten. And with few predators, they flourished.

Voracious consumers of zooplankton, the shrimp annihilated the Daphnia and Bosmina, she said. By 1971, those two important species largely disappeared from the lake.

But now something new is happening.

Starting in 2012, just a few Mysis shrimp were found in samples from the lake's Emerald Bay. In work that is now being expanded to other lake locations, Daphnia and Bosmina have reappeared in large numbers.

"For 50 years, Mysis ruled. Then they disappeared. Gone," said Schladow. "We didn't know why."

Microscopic study at the Center's modern lab, tucked in the tall pines of Incline Village, is revealing a possible cause: The shrimp are starving.

Once populations of Daphnia and Bosmina plummeted, the shrimp shifted their diet to a different type of zooplankton, called copepods. And those copepods are dying from fungal infections, the lab suspects.

Magnified, the dead copepods look as fuzzy as a chia pet. To better understand if the fungus is the underlying cause for the current population crash, Center intern Katie Fielder is scanning historic water samples.

There is likely always some fungus in the lake, and the Center has seen these "fuzzy" copepods in the past, but never at such density. It's not known why so many are dying now, said Senft.

All these years, Daphnia and Bosmina have patiently laid in wait. Their eggs can sit dormant in lake sediment for up to a century, said Senft. Now the eggs are hatching—and, free of predators, they're flourishing.

"They're very, very, very efficient feeders," said Schladow. The lake's cleanup crew, "they just shovel things into their mouths—and the food they eat, the algae and very fine particles, are what impact the lake's clarity the most."

Swimming underwater in the lake's Sand Harbor over the July 4 weekend, "it was serene. Crystal clear. Little minnows were doing something in the water, although it was so cold I'm not sure my brain was working," said A.J. Kohn, visiting from Minneapolis.

"Absolutely beautiful," said paddleboarder Heather Pratt of El Dorado Hills.

Darcie Goodman Collins, CEO of The League to Save Lake Tahoe, welcomed the research, saying that "learning more about this system can help us really understand the 'trigger points' and can help us make management decisions…But better annual averages doesn't mean that the lake is doing better, overall. It's not time to take a victory lap yet."

"It's highly unlikely that the shrimp population is going to be the only

component to clarity improvements or clarity loss," Collins said. "A lot of the impacts are coming from our urban landscape, and could have a significant impact on our ecology, including the Mysis shrimp and our native populations of Daphnia."

The lake's clarity is expected to grow over 2023, and may return to 1970s levels, despite the expected large runoff from this year's record snowpack. California and Nevada lake management agencies dream of someday restoring up to 90 feet of visibility.

Sadly, nature's food web is a tale of ebb and flow. Mysis will start eating the newly emerged zooplankton and re-establish itself, scientists predict, returning the lake to its perturbed and more clouded status.

"It's temporary," said Schladow. Once introduced, "you can never get rid of things completely."

But the discovery could support strategies to deliberately remove the shrimp, which could be captured while hovering in its tight 50-foot-deep nocturnal band. While it may not be eliminated, numbers could be held in check.

"If we can get the lake back into some balance, then the system is pretty resilient," said Schladow. "And that gives us hope."

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