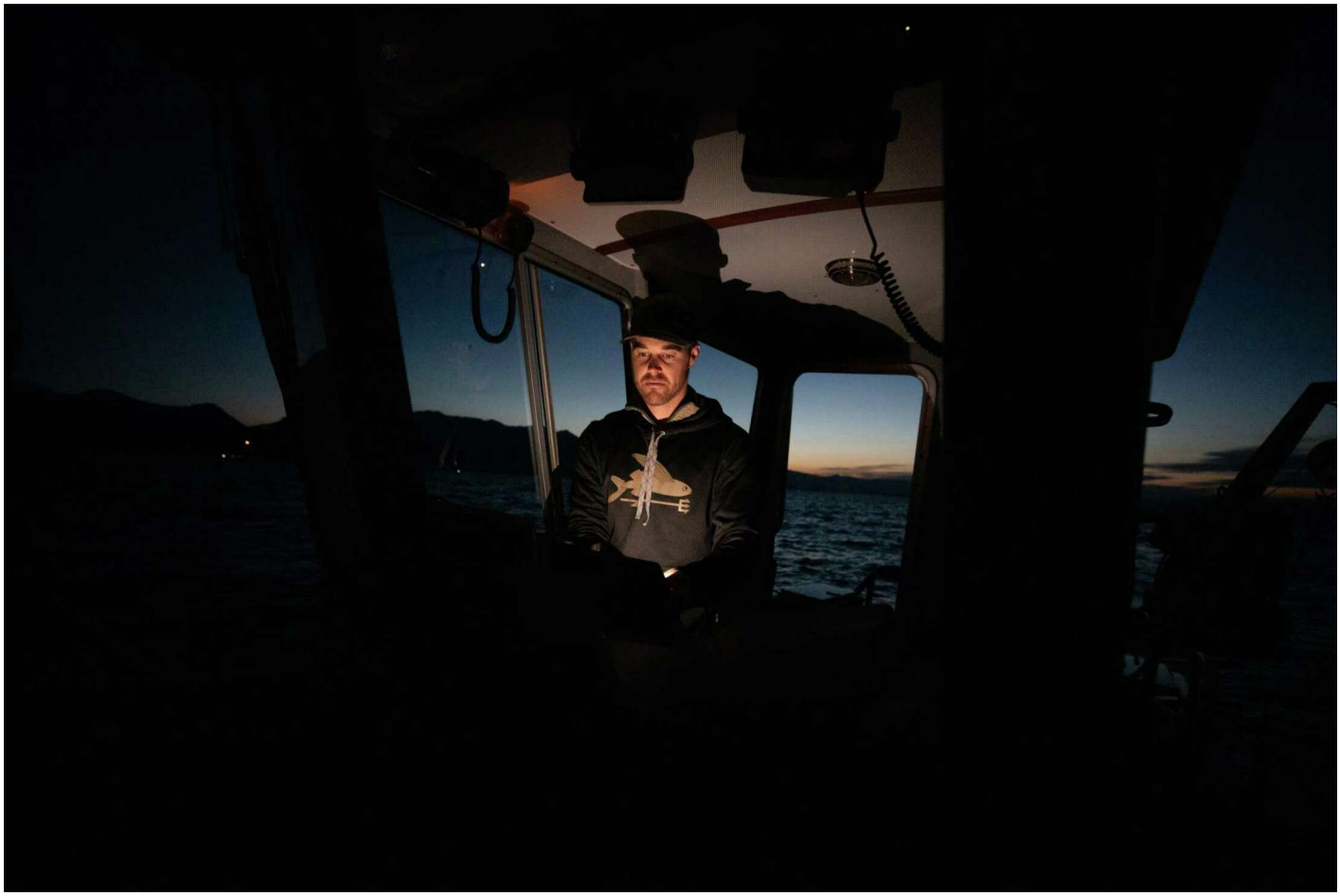
TRAVEL // TAHOE

A stubborn species of shrimp could be clouding Lake Tahoe's crystal-clear waters



Brian Feulner/Special to The Chronicle

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The only boat on Lake Tahoe cruised through the dead of night toward the West Shore. Its pilot throttled down near a GPS marker on his navigation screen, then went aft to lower a long mesh net off the craft's stern to a depth of 300 feet.

After being winched back to the surface, the sock-like net dripped with water, appearing empty. But it wasn't. Its catch had been funneled into a thermos-sized canister at its end. Using headlamps, two biologists aboard in hiking boots and hoodies unscrewed the canister and scoped out their quarry.

"We got shrimps?" asked Erik Young.

"We got shrimps!" Brandon Berry replied.

Young carefully poured the contents — a dozen or so tiny translucent bodies in a few ounces of water — into a sterilized glass jar and then sealed it, marked it, and slotted it among about 20 other vials the researchers had filled that night.

"Catch of the day!" he exclaimed.

UC Davis researcher Brandon Berry holds up a sample of "mysis" shrimp while searching for the crustaceans in Lake Tahoe. Top of page: Berry pilots a research boat toward sampling areas in the lake.
Brian Feulner/Special to The Chronicle

The researchers, hailing from UC Davis Tahoe Environmental Research Center, plumb Tahoe's depths on midnight missions every month for one simple and astounding reason: because they believe the fate of the lake's famously crystal-clear water is tied to the life cycles of a species of small, stubborn shrimp.

Since TERC scientists began measuring the lake's clarity in 1968, they have observed a decades-long clouding trend. In the 1970s, the water was clear to depths between 85 and 99 feet. By the 1990s, it decreased to 72 feet, on average. Clarity has plateaued since the turn of the century, hovering at an 23-year average of 69.5 feet between 2000 and 2022, a victory attributed to smarter building and environmental regulations in the basin that have helped prevent harmful pollutants and sediment from entering the lake.

Lake Tahoe's depth of clarity, on average

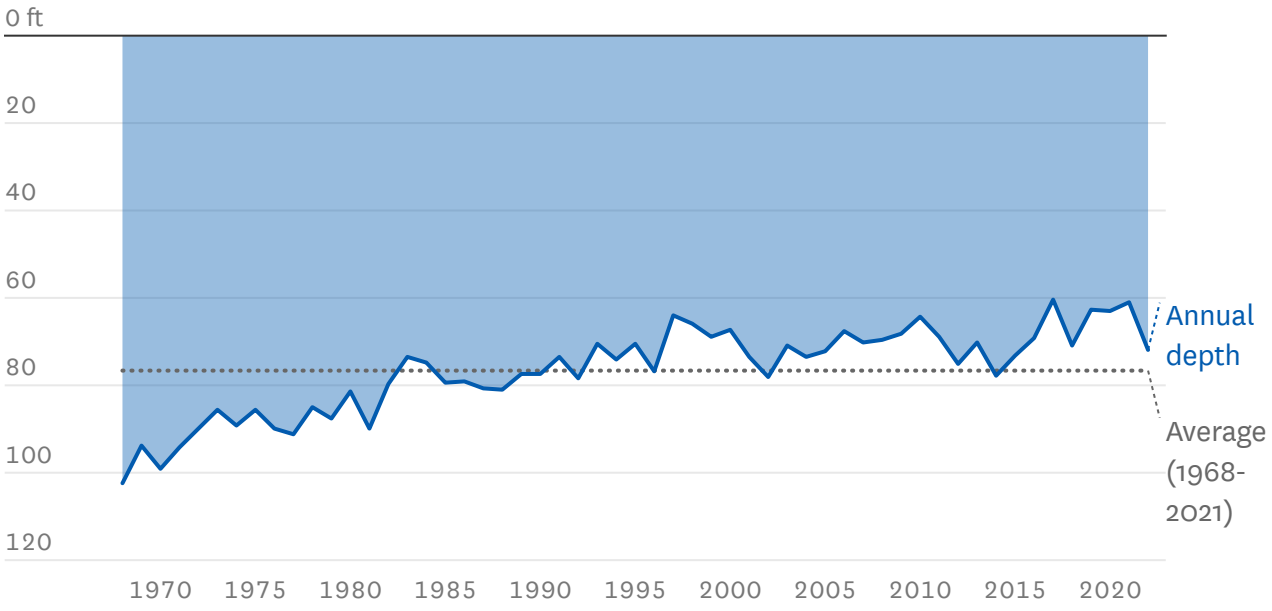

Chart: Sriharsha Devulapalli / The Chronicle · Source: Tahoe Environmental Research Center

Reversing the long-term trend and improving clarity hinges on the so-called "mysis" shrimp, according to TERC. The crustaceans feast on key species of microscopic zooplankton, called daphnia, that specialize in consuming tiny algae and silt particles that muck up Tahoe's water column — operating like tiny Hoover vacuums.

The broader community of scientists studying Tahoe isn't convinced that the shrimp are the main culprit of Tahoe's clarity woes; however, there is consensus that the creatures are a contributing factor. But TERC Director Geoffrey Schladow says his team's research clearly shows that more shrimp mean fewer daphnia, which in turn means a cloudier lake.

Top, a specimen of a mysis shrimp at a lab in Tahoe City, where researcher Katie Senft works, above. The mysis shrimp were introduced to feed trout stocked for recreational fishing at Lake Tahoe decades ago. Photos by Brian Feulner/Special to The Chronicle

contaminants out of the lake shouldn't be continued. But there's something missing from those efforts, and that is the mysis (shrimp) and the food web."

A proliferation of creatures

On appearance, Tahoe's clear blue water gives the impression of a pristine environment. But scientists see it differently.

For a century the lake has been subject to human behaviors that have disrupted its natural order. They include antiquated waste disposal and building practices but also, notably, the introduction of non-native flora and fauna.

Today, the lake is the happy home of invasive bullfrogs, goldfish, crayfish, catfish, clams, smallmouth bass, pondweed, mudsnails and other prolific newcomers. Some of these creatures were purposely inserted to facilitate one environmental outcome or another; others quietly piggybacked in on the hulls of dirty boats,

announcing their presences in population explosions that have altered the lake's ecology.

The mysis shrimp is one of the former. A native of the Great Lakes, the centimeter-sized crustaceans were dumped into Tahoe in the 1960s as bait food for lake trout — which, themselves, were stocked in the lake in the early 20th century for recreational fishing.

"But there were unintended consequences," explained Katie Senft, a staff research associate with TERC.

The fish don't, in fact, eat the shrimp, Senft said. Because of the shrimps' unique behavioral pattern — the mysis sink to the lakebed during the day to avoid light, then rise to the surface at night — they are all but undetectable to sight-feeding trout. By 1970, having settled into a comfy niche, the shrimp had become a self-sustaining presence in the lake.

UC Davis researchers Erik Young (left) and Berry inspect water samples taken from Lake Tahoe during their search for mysis shrimp.
Brian Feulner/Special to The Chronicle

The role of tiny shrimp

In the decades after the shrimp arrived, the lake became murkier, TERC's records show.

The dynamic is observable on a more granular level too, TERC researchers say. In 2012, low shrimp numbers in Emerald Bay, situated at Lake Tahoe's only inlet, appeared to allow a resurgence in daphnia there as well as better clarity, according to TERC.

A similar cycle may be occurring there right now: According to TERC's latest research, Emerald Bay is experiencing both a dearth of shrimp and deeper clarity.

"When you restore the native food web you start to see improvements in clarity," Senft said. "I feel like this is the missing piece to the clarity puzzle."

That's not the consensus theory among other scientists studying Tahoe. A wide range of variables affects the Tahoe environment — building regulations, runoff, wildfire smoke, watershed restoration, the lake's occasional mixing — and, at most, the relationship of shrimp to clarity is one of correlation, not causation, some say.

"What they're proposing is not scientifically credible. Their data is insufficient," said John Melack, an aquatic ecologist and limnologist at UC Santa Barbara who has studied Sierra lakes since the 1980s. Melack and Schladow both sit on the Tahoe Science Advisory Council, a bi-state effort to integrate science into management decisions concerning the lake.

Top: A depth gauge indicates how far down a sampling apparatus descends into the waters of Lake Tahoe. Above: Researcher Berry lowers a net to take water samples. Photos by Brian Feulner/Special to The Chronicle

Melack believes there hasn't been enough consistent sampling of shrimp and daphnia on the lake, and points out that TERC's research hasn't been validated by peer review. He also says the boom and bust cycles of the shrimp and daphnia don't adequately align to explain the timing of observed swings in clarity.

"I take exception to that," Schladow said of the claim. "There is a causal connection."

Darcie Goodman Collins, CEO of the League to Save Lake Tahoe, said TERC "has been instrumental in our efforts to keep Tahoe blue" for decades and that its research "will be important to understand the full picture" of lake ecology. She said the shrimp-daphnia link "could be a key component" of lake clarity but cautioned that attributing it as a main driver would be a "rash assumption."

"The data doesn't clearly support that bold of a claim," Collins said. If it did, it could mean changing how Tahoe is managed. "We need to be sure what's really going on."

To eat and eradicate?

Schladow said TERC is finalizing a research paper on its shrimp theory that he hopes to submit for peer review later this summer. Melack said he welcomes such a move and is working with other scientists on a responsive analysis of TERC's self-published findings — "not to rebut the TERC clarity report but to get new eyes on the data set."

Eradicating the shrimp to boost Tahoe's clarity isn't practical, Schladow said. "You'll never get rid of them all." But he says their numbers need to be controlled to bring more balance to the food web.

Berry holds a net used for taking water samples. The research missions are conducted at night to catch the shrimp closer to the surface; during the day the shrimp sink to the lakebed to avoid light.
Brian Feulner/Special to The Chronicle

In 2018, hoping to test their hypothesis, TERC researchers spent months trawling Emerald Bay to remove as many shrimp as possible, thinking they might facilitate a spike in clarity. The plan, they say, was inherently flawed — they towed around a small net behind a research vessel rather than enlist a professional fisher.

During the course of netting hundreds of pounds of the little crustaceans that year, the researchers brainstormed how harvested shrimps might be put to use. They tried eating them — first raw, then sauteed in a frying pan.

"It was gross," Berry said. "They tasted awful."

"Very fishy and very oily," Senft said.

Through a connection at UC Davis, a business student launched a small venture to grind the shrimp — which are high in Omega-3 fatty acids, Senft said — into dog treats. That venture, called Shrimply Blue, would help fund regular trawling but is on hiatus until a plan comes together, Senft said.

Schladow agrees with Melack that there isn't enough data on the mysis shrimp. But he said he believes there is enough evidence to fund more frequent sampling around the lake to accumulate such data.

"If we care about Tahoe and we're spending all these tens of millions of dollars to protect it and we potentially have part of the solution, why aren't we spending to answer this question?" Schladow said. Because of the population dip in Emerald Bay, he said, "There's probably not a better time to get to it."

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