

Regional lake study points to faster warming

Matt Weiser, Sacramento Bee, 12-27-09

Lake Tahoe, Clear Lake and four other large lakes in Northern California and Nevada are warming faster than the surrounding atmosphere, suggesting climate change may affect aquatic environments faster and sooner.

The findings are reported in a new study led by researchers at NASA's Jet Propulsion Laboratory in Pasadena.

They used 18 years of temperature data from satellite sensors. It is believed to be the first time data have been dissected to reveal lake surface temperature over a period that long.

The other lakes in the study are Lake Almanor and Mono Lake in California, and Pyramid Lake and Walker Lake in Nevada.

Results show that the surface water temperature of the lakes rose two times faster, on average, than the regional air temperature.

"It was a big surprise to see that," said Philipp Schneider, the study's lead author and a post-doctoral research scientist at the NASA lab.

"If it turns out they're actually changing faster than the air temperature, then there's a whole new phenomenon going on here," he said. "The lake ecosystems are going to be very much affected, especially because the trend we observed seems to be quite rapid."

The study was published in the November issue of *Geophysical Research Letters*, a peer-reviewed science journal.

Schneider said more research, such as comparing water temperature with local air temperature changes at each lake, is needed before lake warming can be attributed to climate change.

For this study, that comparison was done at Lake Tahoe. For the rest of the lakes, results were compared with regional air temperatures across the California-Nevada study area.

Tahoe's surface waters warmed 3.7 degrees Fahrenheit from 1992 to 2008 – a mean annual increase of 0.23 degrees. During the same period, air temperature recorded at Tahoe City increased 0.10 degrees annually.

Mono Lake and Lake Almanor showed the largest overall increase, warming 4.3 degrees from 1992 to 2008. Five of the lakes saw a mean annual temperature increase of about two-tenths of a degree; Clear Lake warmed half as fast.

Such increases may explain some dramatic changes documented at many water bodies in the region.

An invasive clam, *Corbicula fluminea*, appeared at Lake Tahoe in 2002 in spotty numbers. But in the past two years, densities of the inch-long clam have jumped 100-fold. Waste from the clams, in turn, has helped trigger blooms of bright green algae.

The clean, pure sand at some beaches along Tahoe's southeast shore is now covered with invasive clam shells, and blooms of algae discolor the water in summer. Neither of these problems has been seen historically at Tahoe.

John Reuter, associate director of the University of California, Davis, Tahoe Environmental Research Center, said warmer water along the lakeshore is thought to help clams thrive and breed.

"The warmer it gets, the less likely these things are to go away," he said. "It's creating an environment, I think, where these invasive species can thrive."

Another problem is circulation. Historically, Tahoe's warm surface layer mixes with colder, deeper water about every four years. This mixing, triggered by strong winds, is vital to circulate oxygen and nutrients to support the aquatic environment.

Because the temperature difference between surface and deep waters is widening, in the future it will take a bigger wind event to mix them, one likely only every 20 to 30 years, Reuter said.

"Certain fish then can't live there. Certain biological processes change," he said. "That, to me, is a big deal."

The basic principle at work in the study is the same one that makes a hot cup of coffee or tea so enjoyable on a winter day: Water holds heat longer than air.

The air above a tea kettle heats up only fleetingly before escaping into the room. But turn off the stove, and the water will stay too hot to touch for a long time.

"These lake temperature records can give us a pretty good indication of how regional climate changes," Schneider said.

Clear Lake also has seen explosive algae blooms. The lake has always been warmer and more nutrient-rich than Tahoe, and it has always had algae blooms.

But this year a new type of algae suddenly took over at Clear Lake, one that had been rare in the past, said Tom Smythe, Lake County water resources engineer.

Called Lyngbya, the algae formed a thick gray-green carpet on the surface that smelled foul, alarming the lake's tourism industry.

Also this year, rooted underwater plants began to thrive along the shore, annoying swimmers and boaters.

Smythe said rooted plants can grow because Clear Lake has become clearer.

The change began in 1991, and the greatest clarity ever recorded at the lake occurred in May: a white test disk could be seen 20 feet down. In the 1970s, the disk vanished from sight at half that depth.

The change does not appear related to erosion controls adopted by the county, Smythe said, because nutrient levels in the lake have been stable.

Rooted plants can grow because sunlight now reaches more of the lake bottom. Plants die back in the fall when days get shorter. Unfortunately, dying plants then provide nutrients for another algae bloom.

It's unknown if warmer water is to blame for these changes. But Smythe said Lake County has hired UC Davis scientists to study temperature records to see if warming is a factor.

"Something has changed in the lake, and we don't know what it is," he said. "It's a very dramatic change."