Lake Tahoe clarity improves, outlook not so clear

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Geoffrey Schladow, director of the Tahoe Environmental Research Center, leads a lake tour for a group of South Korean scientists aboard the center's research vessel. Credit: Gregory Urquiaga/UC Davis

While clarity improved at Lake Tahoe for a second straight year in 2012, long-term trends show that climate change is impacting the Lake Tahoe Basin with drier years, less precipitation, higher lake temperatures and projected lower lake levels.

These conclusions are found within the lake's annual health exam, "Tahoe: State of the Lake Report 2013," released today by the Tahoe Environmental Research Center at the University of California, Davis.

UC Davis researchers have been continuously monitoring Lake Tahoe's clarity, physics, chemistry and biology since 1968. This long-term data set helps inform and measure progress toward Tahoe's restoration goals.

In addition to clarity, algae and weather data, this year's report describes new research that assesses the impact of 21st century climate change trends on the lake; uses an autonomous, underwater glider to examine water quality across the lake; and measures not just clarity, but the quantifiable "blueness" of Lake Tahoe along the color spectrum.

"Every year brings surprises, but with them come new insights," said Geoffrey Schladow, director of the UC Davis Tahoe Environmental Research Center. "In this last year we saw how nature, combined with the results of the many projects that have been completed in the basin, produced an amazing increase in clarity. The real challenge is to be able to sustain the improvements when nature is working against us."

The annual average clarity improved by 6.4 feet over the previous year to 75.3 feet. (Clarity data for 2012 was released in February 2013 and is repeated in this report.) This value is within 3 feet of the interim clarity target of 78 feet. The improvement occurred in both summer and winter. The reasons for the improvement include:

2012 was a dry year for Lake Tahoe, with precipitation 71 percent of the long-term average. Reduced precipitation resulted in fewer pollutants flowing into the lake.

The absence of deep mixing. Each winter, surface waters cool and sink downward, mixing with deeper waters. This brings nutrients to the surface, promoting algae growth, while also moving oxygen to deep waters, promoting aquatic life. A lack of deep mixing can contribute to warmer lake temperatures.

Reduced numbers of tiny Cyclotella algae in 2012. An abundance of the microscopic algae over the past five years has been linked to climate change and coincided with reduced summertime clarity.

Year-to-year fluctuations in lake conditions are normal, which is why TERC researchers note that long-term trends are a better indication of lake health.

Clarity is measured by the depth at which a 10-inch, white Secchi disk remains visible when lowered beneath the water's surface. When the long-term measurement program began in 1968, the Secchi disk could be seen down to 102.4 feet.

While 2012 was not considered an unusual weather year at Lake Tahoe, consequences of climate change could be seen:

- Annual average surface temperature was 52.8 degrees Fahrenheit, the highest ever recorded for Lake Tahoe.
- Snow has decreased as a fraction of total precipitation, from an average of 51 percent in 1910 to 36 percent in 2012.
- A continued long-term trend of fewer days with below-freezing temperatures caused snowmelt to peak on May 4, earlier than historical conditions.
- Lake level experienced a net loss in 2012. It rose by only 1.3 feet during the snowmelt, compared with 3.9 feet in 2011. During summer and fall, lake level fell by 2.3 feet.

The report also describes a study published in the January 2013 issue of the journal *Climatic Change* and co-authored by TERC. The study looked at a range of scenarios to project climate change impacts at Lake Tahoe through 2100. Among the key findings:

- Air temperature increases as high as 10 degrees Fahrenheit;
- Decreased amounts of precipitation falling as snow, which could reduce water storage in the spring snowpack;

- Dramatic increases in flood magnitude;
- Loss of habitat from oxygen depletion caused by extended periods without deep mixing.

In new research, valuable tools are beginning to provide fresh insights into the processes that drive change in Lake Tahoe. An underwater glider that operated in the lake for 11 days in May 2013 provided the first "snapshots" of water quality across an east-west transect. The data confirmed the presence of giant "internal waves" deep in the lake that could move algae and pollutants vertically over 150 feet.

Possibly more important was the installation of a water-quality monitoring station in 360 feet of water off the west shore. Connected to shore by an underwater cable, this station provides data from top to bottom every 30 seconds. This is the first such station in any lake worldwide and is expected to provide a better understanding of climate change impacts on Lake Tahoe.

"Some of the new technologies that are being used at Tahoe, combined with participation from talented collaborators from around the world, are not only providing us with new knowledge of the inner workings of our lake, but also teaching us how to sustain freshwater ecosystems globally," Schladow said.

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Provided by UC Davis

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