Scientists test cutting-edge technology for underwater mapping at Tahoe basin

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A borrowed boat, a small mountain lake and the inaugural run of a half-a-million dollar state-of-the-art multi-beam sonar system made history this month with the successful high-definition mapping by University of Nevada, Reno, and Scripps Institution of Oceanography researchers of the bottom of Fallen Leaf Lake, a tributary lake just upstream from Lake Tahoe. Credit: Photo by Mike Wolterbeek, University of Nevada, Reno

A borrowed boat, a small mountain lake and the inaugural run of a half-a-million dollar state-of-the-art multi-beam sonar system made history this month with the successful high-definition mapping of the bottom of Fallen Leaf Lake, a tributary lake just upstream from Lake Tahoe.

"The clarity of the images we produced is unmatched in detail," said University of Nevada, Reno Seismology Lab Director Graham Kent and co-lead investigator of the project. "We can clearly see 1,000-year-old

trees standing upright under 100 feet of water and remnants of earthquake activity along the West Tahoe Fault line. This is a valuable tool for a number of scientific pursuits."

What the scientists can see:

- Fault mapping such as the West Tahoe Fault which runs through Fallen Leaf Lake - it's a magnitude 7.3 capable normal fault that's approaching the end its characteristic earthquake cycle (almost overdue)

- The effects of drought, including the Medieval Warm Period (approximately 950-1250 AD); features include: old shorelines at 80- to140-feet underwater; and standing, rooted trees at 110-foot level below the lake's current surface

- Substrate identification that has potential uses for biohabitat mapping of various aquatic species, both native and invasive

"The centerpiece of the system comes from rocket technology, with an inertial guidance/gyro system, which allows image stability even as the boat rocks back and forth in the waves," said Kent, also a professor in the University's College of Science. "It's also positioned with a phased GPS array and sound velocity corrections to align or properly register lake-floor pixels. It's a half-million dollar acoustic system, but mo st of the cost is in the guidance system."

While there are many commercial applications of this type of mapping, this system is owned by only a handful of academic institutions worldwide. The technology allows for several centimeter depth resolution (with less than one-meter spatial resolution), giving definition similar to airborne lidar.

"This system helps document the best estimate of how severe the Medieval Warm Period drought was, with perhaps 40 percent less precipitation than we get today, for more than two centuries," Kent said. "It's disturbing to think it could happen again. This is possibly the best estimate of medieval drought anywhere in the Sierra."

Kent and his colleagues from Scripps Institution of Oceanography in San Diego, Calif., geophysicists Jeff Babcock and Neal Driscoll, have been studying the glacially carved lake bottom in conjunction with seismic studies at Lake Tahoe for nearly a decade, and they are excited to use the new tool they have developed to continue and enhance those studies.

Graham Kent, University of Nevada, Reno's seismological lab director and professor of geological sciences and engineering leads a team of researchers in mapping the bottom of Fallen Leaf Lake with new high-definition multi-beam sonar system in on-going research in the Lake Tahoe basin. Credit: Photo by Jean Dixon, University of Nevada, Reno.

"Not only are we using this cutting-edge system to map the geologic substrate but we can use this, for example, to quickly find potential

habitat for invasive species at Lake Tahoe such as the Asian Clam," Kent said.

These expeditions also provide an ideal environment to train the next generation of research scientists; two graduate students, one from the University and one from SIO, participated in the mapping. The team has also been joined by Emeritus Professor John Kleppe from the University's College of Engineering, who was one of the first to document the submerged trees beneath Fallen Leaf, and his involvement has been significant in both the science and educational aspects of this project.

The Fallen Leaf Lake area was the largest unmapped region of the Tahoe Basin. The lake is three miles long and one mile wide, and the surface is about 150 feet higher in elevation than Lake Tahoe. The lake is about 415 feet deep at its deepest point.

The team has mapped lakes and shallow-seas such as Pyramid Lake, Lake Tahoe, Salton Sea and the Great Salt Lake to name a few of their latest endeavors.

Provided by University of Nevada, Reno