

Lakes

UC DAVIS TAHOE ENVIRONMENTAL RESEARCH CENTER

SUMMER 2017

THE TAHOE ENVIRONMENTAL RESEARCH CENTER (TERC)

is a global research leader providing the science for restoring and sustaining Lake Tahoe and other treasured lakes worldwide for over 50 years.

TERC educates the next generation of leaders and inspires environmental stewardship in thousands of students, community members and visitors annually through its outreach centers in Incline Village, Nevada and Tahoe City, California.



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SCIENCE TO SAVE THE LAKE



CHINOOK ROV commencing a descent near Rubicon Bay, Lake Tahoe

RESEARCH UPDATES

IMPROVING THE VIEW OF THE BOTTOM OF THE LAKE

TERC researchers Alex Forrest, Geoff Schladow, and graduate student Jasmin McInerney launched a Chinook class Remotely Operated Vehicle (ROV) in April in Lake Tahoe to view an underwater canyon off Rubicon, periphyton growth in the nearshore region, Mysis shrimp populations, and the deepest parts of the lake. These maneuvers provided a test for manufacturer Seamor Marine Ltd. to assess this ROV system for future operations in Lake Tahoe and elsewhere around the world.

GLIDER OPERATIONS IN LAKE TAHOE

UC Davis civil engineering professor and TERC researcher Alex Forrest and graduate student Jasmin McInerney are interested in studying how Lake Tahoe responds to wind and storms. To do this, they are planning on deploying an autonomous underwater glider, named Storm Petrel, in the lake this summer. The glider propelled using changes in its buoyancy, can explore the lake for months at a time, periodically uploading data via satellite. Storm Petrel, whose maiden voyage was in Antarctica in

Continued on Page 3

LETTER FROM THE DIRECTOR

What a difference a year makes! After a long drought, we have finally dug out from under one of the most extreme winters on record. There is good news – the lake is near full. There is not such good news – the beaches have largely disappeared, with water taking the place of sand.

Many of the less obvious impacts of the winter are still unknown. By the end of May, stream runoff to the lake was continuing to increase, so it will be many months until we know the total loads of nutrients and fine particles that were washed into the lake. Likewise, the periphyton distribution around the lake was still being assessed, although early indications are for a heavy year.

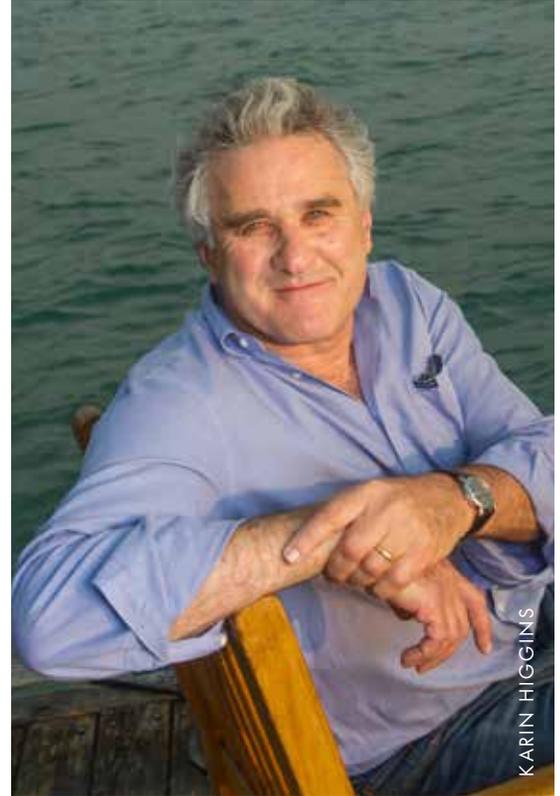
From the perspective of science, the last three years represent a perfect experiment that nature has provided for us. Those three years in the Tahoe basin were an extreme drought year, an almost perfectly average year, and finally an extreme wet year.

The scientific equipment that has been installed in the lake over the last few years, through public and private partnerships, is now giving us a unique opportunity to take advantage of nature's capriciousness. Every 30 seconds water quality data have been collected at stations all around the perimeter of the lake. At the same interval, data have been collected from instruments extending from the lake's surface to its deepest point. Through our

collaboration with NASA's Jet Propulsion Lab, we also have a wealth of remotely sensed data, providing high-resolution imagery of the entire lake and watershed. This is unprecedented for Tahoe and unparalleled for any lake in the world.

For the rest of this year, we will be working to tease apart the differences between each of those years, to learn what a future that is likely to be dominated by extreme events may have in store. Why? This is scientifically very interesting and there is an urgent need to plan public and private investments in the future. Whether it is making our forests healthier and safer, weighing options for maintaining a marina or even rethinking Tahoe's transportation options, all require the best information on what future conditions are likely to be.

There are still many ways in which we could use your help. If you see something unusual at your favorite beach, you could take a photo and upload it through our Citizen Science Tahoe app. We are still in need of sites for weather stations



GEOFFREY SCHLADOW, Ph.D., Director,
UC Davis Tahoe Environmental Research Center

and nearshore water quality stations. Or if you have a desire to combine your life experiences with your love of Lake Tahoe, consider joining our volunteer docent program.

RESEARCH UPDATES, CONTINUED *(Continued from Page 1)*

February (<https://www.ucdavis.edu/news/beneath-ice-antarctica>), collects data on the temperature, chlorophyll and dissolved oxygen content of the water. All of these parameters help researchers at TERC understand changes in the lake over time. Similar work was initiated by TERC director Geoff Schladow in 2013 in collaboration with the University of Minnesota.

ANTARCTICA: UNDERWATER ROBOTS HELP PREDICT HOW AND WHEN ICE SHELVES COLLAPSE

To outer space and the deep ocean, add “beneath the ice” to the list of rarely charted frontiers of science exploration.

There have been very few expeditions where robots have



ALEX FORREST with the recovered underwater glider after its seven-day mission in Terra Nova Bay, Antarctica

ventured beneath polar ice shelves to characterize and measure them. UC Davis civil engineering professor and TERC researcher Alex Forrest recently returned from one of them.

Forrest led a six-member robotics team on the Western Ross Sea and Terra Nova Bay in Antarctica as part of an international expedition funded by the Korea Polar Research Institute. The team spent nearly two months aboard the South Korean icebreaker R/V Araon.

Their mission? Deploy two autonomous underwater vehicles. One to dive beneath the sea ice to map the bottom of the Nansen ice shelf, from which two Manhattan-sized icebergs broke last year. The other, the glider Storm Petrel, to patrol the front of the ice shelf for 10 days, looking for evidence of freshwater intrusions. Why? Ultimately, to better predict how — and when — ice shelves collapse.

“Ice shelves are melting,” Forrest said. “But we don’t know how fast



ROV image of rock formations near Rubicon Bay



MYSIS SHRIMP swimming deep in Lake Tahoe

they’re melting. To actually make on-site measurements is the next step. We’re trying to get a baseline understanding of what changes are happening in the Antarctic. As a global community, we don’t really understand what we’re losing.”

[Read the full multimedia story at <https://www.ucdavis.edu/news/beneath-ice-antarctica> to learn how the robots are expanding their range to the Arctic and even Lake Tahoe.]

RESEARCH UPDATES, CONTINUED *(Continued from Page 3)*

BIG WINTER MAY MEAN MORE ALGAE GROWTH

Kayakers, paddle boarders, and swimmers enjoying Lake Tahoe's shoreline may see more algae this summer than in the past several years.

Algae are small microscopic plants that utilize the sun's energy and nutrients (nitrogen and phosphorus) in the lake to grow. Algae are found both in open water (phytoplankton) and attached to rocks, piers, boat hulls or other hard surfaces (periphyton).

Record winter storms and spring snowmelt have brought nutrient-laden runoff into the lake. Nutrients are an essential ingredient for algal growth.

UC Davis researchers have already observed thick, luxuriant growths of white and tan-colored algae on submerged rocks at depths below about 2-3 feet. In addition, a zone of lighter growth is also being seen in the shallowest waters right below the surface this year. This is likely a consequence of the rapid rise in lake level. The algae in very recently submerged areas have had little time to develop a thick growth.

The type of algae causing the heavier growth, diatoms, produce a white stalk, which attaches to the rock or becomes entangled with other stalks, eventually coating the rocks in a thick mat. Later in the season, pieces of the periphyton mat often detach from the rocks and float on the surface. Carried by wind and currents these mats can end up on the shoreline where they decay in the bright sun. Encountering smelly algae along a Tahoe beach stands in stark contrast to the image most visitors have of this clear, pristine mountain lake.



UC DAVIS RESEARCHERS Scott Hackley measures periphyton growth April, 2017



THICK, FURRY GROWTH of attached algae coating submerged rocks near Tahoe City

You can help UC Davis scientists track algae growth using the Citizen Science Tahoe app. Download the app onto your Android or iPhone by visiting <https://citizensciencetahoe.org/> or from the iTunes store. By taking a few minutes to enter what you see at the beach you are helping the science of Lake Tahoe. Each observation automatically records the user's location and the date and time. Users can also add photos and their own comments.

This perceptual data will help lake researchers better understand Lake Tahoe's fragile nearshore. Scientists will compare this data to that obtained from a network of real-time sensors to gain a larger scientific view. As the number of citizen science observations increases, new information and trends will be discovered.

"There are aspects of water and ecological quality that depend solely on the perceptions of individuals," said Geoff Schladow, director of the UC Davis Tahoe Environmental Research Center. "That is what this app is seeking to measure from everywhere around the lake at all times of year. If you want to contribute to science at Lake Tahoe, simply go to the beach".



YOU CAN HELP with the Citizen Science Tahoe app Version 2

RESEARCH

EXPERIMENTAL GARDEN

TERC forest and conservation biologist and associate director Patricia Maloney has set up an experimental garden at the



EXPERIMENTAL GARDEN growing conifers to study genetic and environmental factors influencing adaptation

University of Nevada-Reno (UNR) Greenhouse Complex in collaboration with UNR's Dr. Tom Parchman and Dr. Beth Leger.

Research in the common garden will be evaluating patterns of local adaptation for three long-lived conifers of the arid West (Great Basin bristlecone pine, limber pine, and foxtail pine). Dr. Maloney is growing these trees to determine how genetic and environmental factors influence local adaptation and how they respond to drought and insects.

EDUCATION AND OUTREACH

VISIT THE UC DAVIS TAHOE SCIENCE CENTER

Have you visited yet? Come discover the UC Davis Tahoe Science Center (<http://tahoesciencecenter.com>). Uncover the Tahoe Basin's ecological challenges through 3-D movies and interactive exhibits. Family-friendly fun for kids ages 8 and up. Drop-in tours are Tuesday through Friday from 1-5 p.m. and Saturdays from Memorial Day through Labor Day.

For school groups, we offer inquiry-based field trips. Check out our list of monthly lecture series on various scientific topics below. To learn more about the Tahoe Science Center and TERC, visit tahoesciencecenter.com or ucdavis.edu. The science center is located at 291 Country Club Dr., Incline Village, Nevada. Call us at 775-881-7566.

UPCOMING EVENTS

JUNE 15, 19, 20 & 24: Docent Training. Become a Lake Tahoe expert and share your love of Tahoe with locals and visitors alike. Participate in a four-part training program to develop your local Lake Tahoe presentation skills. Training covers Tahoe-specific topics including environmental issues, geology, history of research, state of the lake, and ecology and food webs.

JUNE 21, 2017: Living With Wildlife, because co-existence is a community effort. Learn how to protect your pets, home, and property from wildlife from mice to

bears and mountain lions. Featuring Rebecca Dmytryk the founder of Human Wildlife Control Association and Madonna Dunbar, resource conservationist for IVGID.

JUNE 27, 2017: Tracking Studies of Sharks, Sturgeon, and Trout, with Dr. Pete Klimley from the College of Biological Sciences at UC Davis.

JULY 27, 2017: State of the Lake Report with Dr. Geoff Schladow, director of the UC Davis Tahoe Environmental Research Center.

AUG. 24, 2017: The History of Protecting Lake Tahoe with retired TRPA executive director and author

Bill Morgan.

SEPT. 21, 2017: Stinging Things in the Sierra, with Dr. Lynn Kimsey, Professor of Entomology. This talk will explain yellow jacket diversity and biology, pest species and how to distinguish them from other wasps, the effects and treatment of stings, and how to prevent outbreaks.

OCT. 12, 2017: Forest Health and Tree Mortality with Dr. Patricia Maloney, Associate Director of the UC Davis Tahoe Environmental Research Center.

For more information visit <http://tahoesciencecenter.com/events/>.

FACULTY AND STAFF HIGHLIGHTS

A WINTER FOR THE AGES

The winter of 2016-17 was a very wet one with Tahoe Basin precipitation the highest since 1982 with precipitation exceeding the high amount measured in that water year (NRCS May 1, 2017 Water Supply Outlook Report, see: <https://www.nrcs.usda.gov/wps/portal/nrcs/main/nv/snow/>).

The exceptionally high precipitation has nearly filled the lake increasing by over 6 feet from a low of 6,222.47 feet in October 2016 to a current high of 6,228.55 feet. The lake is now more than 5 feet above the natural rim. (In the last 20 years the lake has shown rises of over five feet in two other water years: 2005-06 and 2010-11).

The U.S. Water Master's office has been releasing water from Lake Tahoe since Feb. 22 to prevent the lake level from rising too high with the spring snowmelt. The amount of water released has been changed in stages since February, with flow out of the dam reaching over 2,000 cubic feet per second near the end of April 2017. These high flows have resulted in some flooding downstream along portions of the bike path (see photo).

The large accumulated snowpack will contribute to higher than average stream flows during the spring and early summer. The net inflow to Lake Tahoe from streams during May and June is anticipated to be over 200% of average.

This extraordinary winter and spring has placed an inordinate

burden on TERC and USGS scientists who monitor streams to quantify the loads of sediments and nutrients entering the lake – critical information for evaluating the performance of lake restoration measures. Basin agencies were able to secure extra funding to allow the very long and extreme runoff season to be fully measured.

NEW TERC POST-DOC: ADRIANNE SMITS

Dr. Adrienne Smits is an ecosystem ecologist interested in how climate and landscape features influence food webs and biogeochemistry in freshwaters. She received her PhD from University of Washington in 2016, where she studied carbon cycling and food web energy pathways in boreal Alaskan streams.

As a post-doctoral researcher at UC Davis, she will investigate how lake and watershed morphology



TRUCKEE RIVER overflowing onto the bike path between Tahoe City and Squaw Valley during release of 2,000 cubic feet per second

mediate the role of snowmelt in high-elevation lake thermal regimes and carbon cycling in the Sierra Nevada.

A better understanding of how snowmelt influences lake temperature and chemistry will help efforts to predict lake responses to decreasing snowpack in the Sierra Nevada.

She also plans to use the long term ecological datasets collected at Lake Tahoe and Castle Lake to ask how species interactions influence food web resilience to stressors such as climate change, eutrophication, and invasive species introductions.

Dr. Smits is working with Dr. Steven Sadro (UC Davis) and Dr. Sudeep Chandra (University of Nevada, Reno).

FACULTY AND STAFF HIGHLIGHTS, CONTINUED

KUDOS TO TERC STAFF: BRANT ALLEN AND SCOTT HACKLEY

Congratulations to Brant Allen and Scott Hackley, who both received Individual Staff Awards from the UC Davis Staff Assembly for their outstanding contributions to research. With over 60 years of Tahoe experience between them, they have been at the front line of unraveling Tahoe's mysteries. Scott is responsible for the stream sampling and analyzing periphyton data. Brant is responsible for sampling the lake and is our local research dive master.

Brant also received the campus Safety Star Award for his efforts in ensuring that TERC's field, boating and diving operations are conducted to the highest safety standards. We are proud of our unblemished safety record both in the field and in the lab.

GRADUATE STUDENT NEWS

Derek Roberts is using Nearshore Network data to quantify the frequency and the effects of waves around the entire perimeter of Lake Tahoe. Derek is also using these data to explore seiching (rocking of the lake surface) and snowmelt effects on nearshore water quality. Quantification of each of these processes represents an important step in piecing together what is driving change in Tahoe's nearshore zone. The Nearshore

Network is funded through partnerships between lake front property owners, private donors, the State of California and TERC. A new Tahoe City station was just completed, and two south shore stations will be installed in July.

For the past year, Amelia Jones has been using continuous dissolved oxygen measurements at multiple depths in the lake to estimate lake metabolism. Lake Tahoe is unusual in that algae can grow as deep as 300 feet.

Karen Atkins has been working on analyzing downscaled climate models as part of a project to understand the impacts of extreme events in the coming decades. She will apply these results toward understanding periphyton (algae attached to rocks) growth patterns under future climate regimes.

Sean Trommer has recently started modeling water quality changes in Pyramid Lake. With funding from the Pyramid Paiute Tribe, Sean is exploring the role that future nutrient loads from the Truckee River may have on this lake.

Jasmine McNerney and Kyungwoo Lee are both working on using the glider, Storm



DAMIEN GUIHEN, UNIV. OF TASMANIA

"STORM PETREL" GLIDER makes its maiden voyage in Antarctica



DAMIEN GUIHEN, UNIV. OF TASMANIA

"STORM PETREL" GLIDER being recovered in Terra Nova Bay, Antarctica

Petrel, in Lake Tahoe. (See article on Page 3 for additional details.)

GIVING TO THE TAHOE ENVIRONMENTAL RESEARCH CENTER

PRIVATE SUPPORT is critical to continuing the Tahoe Environmental Research Center's legacy of groundbreaking work in restoring and sustaining Lake Tahoe. Gifts at every level support research, education and outreach, and give the flexibility to address emerging needs and opportunities. Every gift makes a difference and there are many ways to give. Thank you!

- YES, I wish to support the Tahoe Environmental Research Center with the gift amount shown below.
- Please contact me about how I can make a deferred or estate gift to UC Davis.
- I wish this gift to remain anonymous.

Mail to: *UC Davis Tahoe Environmental Research Center*
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Please make checks payable to UC Regents.

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