

# Lakes

## UC DAVIS TAHOE ENVIRONMENTAL RESEARCH CENTER

SUMMER 2016

### 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



**GENERAL CREEK** tannins are visible entering Lake Tahoe at the creek outflow during this year's Snapshot Day volunteer water quality monitoring event.

## RESEARCH UPDATES

### SPRING SNOWMELT INTRUSION

By Brant Allen

Does this year's snow pack and cool spring rains mean swimmers will have to delay their summer Tahoe adventures? Not necessarily.

Interestingly, Lake Tahoe's surface water warms at about the same rate each year regardless of the winter snow pack. As solar radiation increases during the longer days of spring, the surface water begins to warm. It may not be inviting enough for a swim in April but the shallow water will already be several degrees warmer than the

water just a few meters below.

When the winter snow pack begins to melt and join the nearest stream, water in that stream becomes very cold—maybe just a few degrees above freezing. As the cold, dense stream water enters the lake, it “plunges” below the warmer surface water, to a depth where the lake water is the same temperature and density.

Though this happens all the time at stream mouths, we rarely get to see it. This spring, UC Davis researchers observed a thin layer of dark brown water suspended midway between the bottom and the surface of the lake while working on a nearshore water

*Continued on Page 3*

## LETTER FROM THE DIRECTOR

I have spent the last week observing the impacts of poor land management, uncontrolled invasive species, and degrading aquatic resources in one of the most unique and idyllic places on earth. I also saw really big crocodiles, so I wasn't at Lake Tahoe. Rather, I was in the Northern Territory in Australia, a region that is starkly different than Tahoe, but sharing many of the same challenges. In the last fifty years this region has been opened up to the world, in the same way that Tahoe was opened up after the Squaw Valley Olympics.

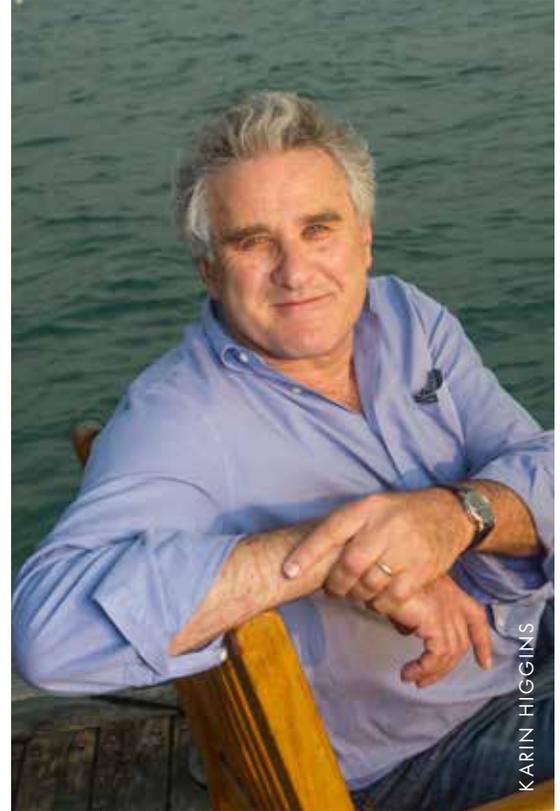
Where Lake Tahoe has outdone the Northern Territory is that it has built on a continuous science presence for over 55 years, with the greatest advances in the last decade. It is hard to believe that it was 10 years ago that the finishing touches were being installed on TERC's new labs and offices at Incline Village. That was an exciting time. After years of getting by in makeshift houses and buildings, we finally had the home we needed: a facility where research, public engagement and the science to guide restoration had a base in the Tahoe basin.

Looking back at all that has been accomplished it becomes clear how monumental an achievement this really was. Over 100,000 people of all ages have walked through the doors to learn about solving Tahoe's challenges. Scores of research grants have launched the careers of young

scientists and helped unravel the lake's secrets. International conferences have brought hundreds of visiting scientists from every continent to help us understand Lake Tahoe and have launched new collaborations on lakes around the world.

Most importantly, it has created a permanent home for research and science here in the Tahoe basin. The nature and the complexity of Lake Tahoe and its ecosystem will never stop changing and we need institutional memory, experienced researchers who know what was learned 40 years ago and where the knowledge gaps lie, and new cohorts of students, to keep abreast of these changes and to take on future conditions.

This home for research and science was built through philanthropy. To the many people and foundations in the greater Tahoe community who had the foresight and vision to invest in science when UC Davis launched its campaign for TERC in the 1990s, we once again thank you for your generosity. We hope that on our 10 year anniversary you will again step forward and renew



KARIN HIGGINS

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

your commitment to Lake Tahoe and to science, and help provide the resources we need to sustain independent science.

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



**BRANT ALLEN AND KATIE SENFT**, UC Davis researchers, observed a cold water intrusion in the nearshore of Lake Tahoe in April. The layer of dark water (stained with tannins from fallen leaves) submerged upon entering the lake because it was colder and therefore denser than the surrounding surface water.

quality station. The water was stained with tannins (from fallen leaves), making it visible in Tahoe's clear water.

Back to swimming and what can cause the lake to warm more slowly. Spring storms and especially the strength and duration of the wind, not the associated precipitation, is what keeps the lake cool. Wind adds energy to the lake, mixing cold water from depth back to the surface. It is not uncommon for the lake surface temperature to drop several degrees following a strong spring wind event.

So, if you are one of those Tahoe summer people who long for days in the water, don't curse the big winters and extended snow pack.

That keeps the lake level high. It is the wind that will prolong cold surface temperatures.

### LAKE TAHOE REACHES NATURAL RIM

On Saturday, April 9, Lake Tahoe reached its rim for the first time in 10 months. Surface levels have been below Tahoe's rim of 6223 feet since a five day stretch in mid-June of last year. Prior to that five-day stretch, the lake has been below its rim since October 14, 2014.

Tahoe's surface levels vary throughout the year—falling due to evaporation, outflow, and in-basin withdrawals and rising due to

inflow and precipitation directly on the lake. Rising above the rim is good news for Tahoe's sole outlet, the Truckee River, and for people tired of extremely wide beaches and shallow water. Lake Tahoe is considered full or at maximum storage capacity when surface levels rise to 6,229.1 feet.

### TERC DATA AN IMPORTANT PART OF GLOBAL STUDIES

TERC's unique limnological record for Lake Tahoe traces the response of our ecosystem to over 50 years of climate, land use, and invasive species changes. This record is also important to other lakes around the world, as scientists seek to understand how lakes are changing globally. We also learn about Tahoe as we compare it to these other lakes.

In the last year there have been at least four publications where Lake Tahoe's data has been used as part of a large multi-lake study. This mode of research is likely to increase in the future, as new collaborations are formed and new questions are formulated.

All of TERC's publications are available on our web site at <http://terc.ucdavis.edu/publications/>.

# EDUCATION AND OUTREACH

## LAKE CONDITIONS EXHIBIT COMING SOON

TERC's newest exhibit, Lake Conditions, is set to debut this summer. The interactive exhibit features a 46-inch touchscreen that will display current conditions around Lake Tahoe. Visitors will be able to check on the current weather, snow level, water clarity, wave height as well as recreational opportunities around the Tahoe Basin. The exhibit will also enable visitors to view past conditions of Lake Tahoe as well as future predictions for the lake.

Data collected from TERC's "Citizen Science App" will also be displayed, allowing visitors to explore observations from citizen scientists around the lake. The Lake Conditions exhibit is funded by the Institute of Museum and Library Services, Nevada Department of Environmental Protection, and North Lake Tahoe Resort Association.



HOWARD UNIVERSITY MIDDLE SCHOOL receives the Augmented Reality Sandbox exhibit from UC Davis and the National Science Foundation

## CITIZEN SCIENCE TAHOE APP

As summer fast approaches, don't forget to bring your smartphone to the beach and become a citizen scientist. TERC researchers are relying on both residents and visitors to send in their observations of the nearshore environment using the

"Citizen Science Tahoe" app. Released last August, users can collect data on algae, wildlife, litter, and add photos and comments using the app. "There are aspects of water and ecological quality that depend solely on the perceptions of individuals. This is what this app is seeking to measure, from everywhere around the lake at all times of year," said TERC Director Dr. Geoff Schladow. "If you want to contribute to science at Lake Tahoe, simply go to the beach."

TERC scientists will compare the citizen collected data with information from a network of real-time sensors to better understand Lake Tahoe's nearshore environment—the region where people spend the most time at the lake but which scientists know the least about. The citizen science data will also be used in the upcoming exhibit, Lake Conditions. The "Citizen Science Tahoe" mobile app is available for download in both Apple iOS and Android at <http://CitizenScienceTahoe.org>.



NEW EXHIBIT COMING SOON shows images, live camera views, activities, weather, lake conditions, and more

## EDUCATION AND OUTREACH, CONTINUED

### PLAYING IN A GLOBAL SANDBOX

TERC's 3D augmented reality (AR) sandbox exhibit, originally developed as part of an NSF grant, has spread far beyond its home in our Tahoe



**PORTABLE AUGMENTED REALITY SANDBOX EXHIBIT** on display at the USA Science and Engineering Festival in Washington, D.C.

Science Center. This spring, a new portable version went to Washington, D.C., where it was featured at the White House Water Forum, the USA Science and Engineering festival, and a Center for National Science Funding event at the Congressional

Rayburn Building.

Its final home was the Howard University Middle School, where it will be a permanent feature in Mrs. Hardeen's sixth grade science class. The handover ceremony was attended by NSF administrators, D.C. education

officials, and the trustees of Howard University. As well as being an exciting new collaboration with a wonderful school, it will be the springboard for TERC's new forays into formalized science education with our partners at the UC Keck Caves and the Concord Consortium.

Since debuting in 2014, the three original AR sandboxes—located at TERC, the Lawrence Hall of Science, and Echo Lake Aquarium and Science Center—have inspired over 120 users across the globe to build their own sandboxes. Used as an educational tool, AR sandboxes can teach students and visitors about geomorphology, topography, hydrology, and landforms. Come to the Tahoe Science Center and experience the 3D AR sandbox in person or visit [www.ARsandbox.org](http://www.ARsandbox.org) to learn more.

## UPCOMING EVENTS

**JUNE 21, 2016:** Stories of Research, with Dr. Charles Goldman

**JUNE 21, 23 & 25:** TERC's Annual Volunteer Docent Training

**JUNE 30:** Chemical Discovered May Be New Tool for Depression Therapy, with Dr. Karen Wagner

**JULY 28:** State of the Lake, with Dr. Geoff Schladow

**JULY 30:** Tahoe Plant Workshop at Demo Garden, Tahoe City: Tahoe Plants = Tasty Teas

**AUG. 6:** Tahoe Plant Workshop at Demo Garden, Tahoe City: Tahoe Arnica Uses

**AUG. 11:** Transforming

Transportation, Finally: How Three Transportation Revolutions are Starting to Disrupt Transportation as We Know It, with Dr. Dan Sperling

**AUG. 13:** Tahoe Plant Workshop at Demo Garden, Tahoe City: Dandelions, weed or feed?

**AUG. 20:** Children's Environmental Science Day at Commons Beach, Tahoe City

**AUG. 25:** Science of Wine (and wine tasting), with Jill Brigham

**SEPT. 1:** Gratitude, with Dr. Bob Emmons

**SEPT. 15:** State of Innovation: The U.S. Government's Role in Technology

Development, with Dr. Fred Block

**SEPT. 29:** A Gut Feeling: How Intestinal Microbes Modulate Mood & Behavior, with Dr. Melanie Gareau

**OCT. 13:** Beer: Simply Splendid Science and the Best of Beverages (and beer tasting), with Dr. Charlie Bamforth

**NOV. 3:** Impact of ocean acidification due to climate change, with Dr. Nann Fangue

**DEC. 8:** Environmental toxicology and chemical stressors, with Dr. Andrew Whitehead

For more information visit <http://terc.ucdavis.edu/events/>.

## FACULTY AND STAFF HIGHLIGHTS

### TWO NEW TAHOE FACULTY

We are very excited to announce that UC Davis has hired two new faculty members to work on Lake Tahoe and other freshwater systems around the world. Both were hired as part of the Provost's Hiring Initiative Program, and highlight the University's ongoing commitment to Lake Tahoe.

From lakes to oceans, Dr. Alex Forrest has over a decade of experience working with autonomous robotics as data collection platforms to address environmental issues. With a background in Civil and Environmental Engineering, his research examines the influence lakebed and seafloor features have on localized hydrodynamic flow and uses acoustic mapping techniques and environmental fluid mechanics to interpret the dynamics of a system.



**ALEX FORREST** joins UC Davis as Assistant Professor in Civil and Environmental Engineering

Alex is excited to apply his expertise to issues affecting water quality and ecosystem health in Lake Tahoe and other Sierra lakes (e.g. sedimentation, invasive species, etc). The main focus of his teaching at UC Davis will be environmental fluid mechanics at the undergraduate and graduate level.

As a limnologist and ecosystem ecologist, Dr. Steve Sadro is interested in how physical, chemical, and biological factors interact to regulate aquatic ecosystems. He uses observational, comparative, and experimental approaches to understand ecological processes in habitats ranging from coastal streams to alpine lakes. Much of his focus in the last decade has been on hundreds of small lakes located throughout the Sierra, where he has been exploring processes such as carbon and nutrient cycling, terrestrial – aquatic linkages, and food web dynamics. By understanding the factors that regulate aquatic ecosystems, Steve hopes to improve our ability to predict how Sierra lakes will respond to climate change and other anthropogenic effects. He is enthusiastic about bringing his ecosystem approach to bear on environmentally important questions in the Tahoe basin. Steve will quite literally begin dipping his toes in the waters of Tahoe when he starts teaching limnology courses through the Department of Environmental Science and Policy at UC Davis. Favoring an experiential field-based teaching approach, he plans to have students out on the lake as often as possible.



**STEVE SADRO** joins UC Davis as Assistant Professor in Environmental Science and Policy

### THANK YOU KELLY CARNER AND GEORGE MALYJ

TERC's program manager George Malyj and UC Davis Financial Analyst Kelly Carner are set to retire this year. We wish George and Kelly all the best in their retirement and thank them for their work.

Kelly Carner is retiring at the end of June. Originally hired in 1978, Kelly has now worked at UC Davis for almost 37 years. Kelly has been an integral part of JMIE's Administrative Staff, playing a pivotal role as Office Manager/Financial Analyst. She has provided excellent service to our unit and has enjoyed working with students, her colleagues and academia throughout her time here.

George Malyj is also retiring this year. Since the late 1970's George has been an integral part of UC Davis at Lake Tahoe. As often stated by Charles Goldman, "my greatest gift to Lake Tahoe is George Malyj." George has not only managed TERC's financial

## FACULTY AND STAFF HIGHLIGHTS, CONTINUED

affairs, he has been the institutional memory of every step (and misstep) that TERC and the TRG has made. His gentle, compassionate nature, together with his mindset for detail, make him impossible to replace but inspirational to live up to. Combined with his vast knowledge of wine, cheese, and the Golden State Warriors, George will be sorely missed but has promised to continue to stay on as a volunteer for a few more years.

### GRADUATE STUDENT NEWS

Congratulations to our graduate students Karen Atkins and Amelia Jones. Karen was the recipient of a Boyd Tahoe Fellowship during Spring quarter, 2016. Both Karen, and incoming graduate student Amelia, will be working at Tahoe all summer with the support of the inaugural Loury Scholarships.

Derek Roberts will be in Bath, UK, in July to attend the Physical Processes in Natural Waters Conference. Derek will be reporting on Tahoe's unique Nearshore Water Quality Network.

This year TERC will have several new graduate students. Amelia Jones, who graduated from Carnegie Mellon University in Pittsburgh in May, will be starting her research this summer. Mr. Kyungwoo Lee, a graduate student from South Korea will be joining us in August. Mr. Lee is being fully supported by a scholarship from the Korean water agency, K-Water. TERC and K-Water signed an MOU for student training in 2014, and

Mr. Lee is the first student to attend this program. Finally Mr. Min Chen, a doctoral student at the State Key Laboratory of Hydraulics and Mountain River Engineering, Sichuan University, will be a visiting student for 18 months under a prestigious Chinese Scholarship Council award.

### LIDIA TANAKA STUDIES PHYTOPLANKTON COMMUNITY OF LAKE TAHOE

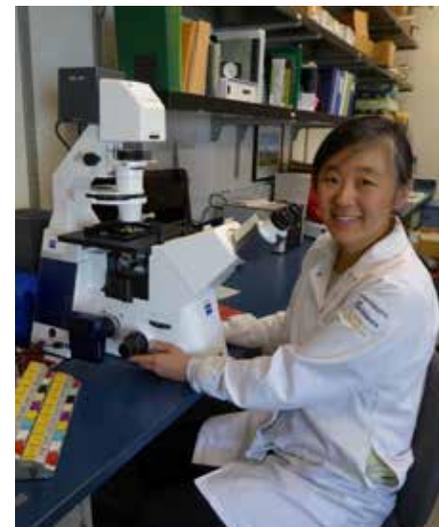
Lidia Tanaka started working for TERC in 2015 and is responsible for identifying and classifying the tiny floating algae that constitute the phytoplankton community of Lake Tahoe. Much of her work is the microscopic analysis of phytoplankton and includes identifying, counting, and calculating the volume of collected samples. Identifying phytoplankton relies on recognizing minute morphological differences and character between species. The process can take from minutes to hours under a microscope.

Phytoplankton represent a diverse, broad group of floating plants (algae) that are not visible to the naked eye. However, when observed under a microscope, they often reveal amazing and strange looking shapes and forms. While these organisms are tiny, they play a huge role in aquatic systems like Lake Tahoe as they are the base of the entire food web.

Since 1967, TERC researchers have monitored Lake Tahoe's phytoplankton, drawing samples

from two stations on the lake at up to 6 discrete depths monthly. We have found that Lake Tahoe's phytoplankton communities have been historically dominated by large sized diatoms. In recent years, the species composition and diatom community structure has shifted to small-sized species, such as *Cyclotella* sp., and are being found at shallower water depths.

Why is it important to keep looking at phytoplankton in such detail? Phytoplankton have short lives and respond quickly to environmental changes in the lake. They can therefore give us an early warning of short term events such as sewage spills or introduced chemicals, or long term events such as invasive species introductions, climate change, or clarity declines.



**LIDIA TANAKA** identifies and classifies the phytoplankton (algae) in Lake Tahoe

# 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*  
*Watershed Sciences Building*  
*One Shields Avenue*  
*Davis, CA 95616-8527*

## SCIENCE SUSTAINER

There are two easy options for giving:

- 1) Make a secure online gift at <https://give.ucdavis.edu/JMIE/TERCGFT>
- 2) Fill out the information below and mail with a check payable to UC Regents

**Enclosed is my tax-deductible contribution.**

Please make checks payable to UC Regents.

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