

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



TERC researcher Katie Senft preparing the drone for flight

RESEARCH UPDATES

DONATION TO TERC CHANGES THE WAY RESEARCHERS SEE THINGS

This summer TERC received a generous donation from Mt. Rose Ski Tahoe for the purchase of an unmanned aerial vehicle, more commonly known as a drone. While many view drones as nuisance toys or invaders of privacy, drones can also be extremely powerful scientific tools.

The TERC drone is equipped with a high resolution camera, obstacle avoidance technology, and the ability to stay aloft for thirty minutes. When this technology is coupled with mapping software, the

opportunities to view and quantify the landscape of Tahoe changes dramatically. TERC researchers are excited to use the 3D mapping ability of the drone in forest and nearshore projects.

A submarine canyon lies just off the north shore of Tahoe. Over thousands of years, water currents cut through consolidated volcanic ash (tuff) forming a complex substrate resembling a coral reef. This feature was mapped last summer using high-resolution side scan sonar. By capturing drone imagery of the same area,

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LETTER FROM THE DIRECTOR

Another year has come and gone at Lake Tahoe, and it was no ordinary year. We had one of the most extreme winters of snow on record. Lake levels came up 7 feet in a few months and thin ribbons of sand replaced the wide beaches of the last few years. Long forgotten seasonal springs re-emerged on hillsides and wildflowers seemed to last all summer.

Other things about the lake were different too. While the annual record is still being collected and analyzed, early indications are that we are experiencing conditions not seen before, be it high lake temperature or different floating algae. What is science doing to understand and control the changes in the lake and in the forests?

Two new projects in 2018 are aimed precisely at addressing these changes. A pilot project in Emerald Bay is looking at restoring Lake Tahoe's native food web by locating and removing the invasive Mysis shrimp using new, sophisticated echo sounding equipment. Earlier research has shown that Mysis removal can lead to a return of native zooplankton, a restoration of clarity, and improved fish health in one year. But the changes at Tahoe are not just restricted to the lake. A new project to restore sugar pine trees in areas of the north shore that have suffered high tree mortality due to prolonged drought and associated pine beetle activity is also commencing in 2018.

These projects that go to the heart of restoring Lake Tahoe have been made possible through a combination of funding. This includes funds from the California Tahoe Conservancy,

the Nevada Division of Environmental Protection, the Tahoe Fund, UC Davis, and individual community members. This broad base of support is essential, and makes it possible to attract the best scientists and students and to apply the newest technological approaches. Even though Tahoe has been studied for half a century, the challenges we are experiencing are evolving and the science needs to evolve even faster.

While we hope these two projects will achieve their goals, hope is not a strategy. To that end, we continue to work on the essential task of understanding, at a fundamental level, how the Lake Tahoe Basin is changing. From underwater robotic vehicles that silently track the motions of the water, to measurements on the exchanges of carbon that occur in the forests, to high school programs that train and spark the imagination of future scientists, we are embarking on the science that will be needed to save the lake.

To all who have contributed to our achievements this year, my heartfelt thanks. This includes our dedicated staff, our amazing volunteer docents, the students and interns that work at TERC, our partners in other research



Geoffrey Schladow, Ph.D., Director,
UC Davis Tahoe Environmental Research Center

institutes and our colleagues in the various Tahoe agencies, those who visit our education centers, and those of you who have supported our research and education programs and partnered with us in unique ways.

My very best wishes for a safe and peaceful holiday season. I look forward to working together again in 2018.

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

researchers can begin to experiment with merging the two technologies to create a virtual “street view” of this region of Lake Tahoe.

JASMIN MCINERNEY, ACCIDENTAL LIMNOLOGIST

Jasmin McInerney, a Ph.D. student at UC Davis in Civil and Environmental Engineering and a self-described “accidental limnologist,” is applying her background in ocean engineering to study lake systems. Her continued work with Alex Forrest and the TERC research team is yielding interesting results on the physics of the lake and water clarity. The team uses a buoyancy-driven, autonomous glider, Storm Petrel,



Drone image of Cascade Lake with TERC underwater nearshore sensor station circled in red



Alex Forrest and Jasmin McInerney with Storm Petrel aboard TERC Research Vessel John LeConte

carrying various instruments to study water quality variables and their seasonal variability. Glider missions began with east-west transects and recently switched to north-south transects. The benefit of using an autonomous robot is that

tests are precisely repeatable and can be completed over long periods of time and under weather conditions that would be unsafe for human-run measurements.

McInerney’s focus is on internal waves and understanding how the

waves affect the lake’s thermal structure, mixing, and nutrient and gas cycling. Unlike waves caused by wind, internal waves are caused by velocity variations deep within the lake. In Lake Tahoe, they typically occur at the thermocline – the interface between the warm upper



Storm Petrel initiating a dive in Lake Tahoe

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

layer of water that sits atop the colder denser water. These waves, which can be 10 meters high in Lake Tahoe, are slow moving. The shortest wave period occurs in about 18 hours, while the longest can be up to 125 hours. Understanding internal wave properties is giving McNerney and the TERC team a better idea of how internal waves can interact with the bottom of the lake. Disturbances in the water may lead to erosion around structures such as piers, pipelines, and cables. Additionally, internal waves can promote lake mixing, a process that is beneficial for cycling nutrients and gases, but can also contribute to particle resuspension.



Storm Petrel initiates a dive into Lake Tahoe to begin east-west transects

TRACKING CHANGES IN TAHOE'S FORESTS

Camille Jensen, along with the TERC forest ecology research team, has been studying changes in Tahoe forest health since 2008. On their initial inventory, the team established 84 plots (28 sites at 3 elevations), assessed every tree within the plot, and noted information such as, tree species, diameter, damage due to insects, disease and fire, cone production, and measures of canopy condition. The results of the 2008-09 inventory showed the forests were healthy with a fair amount of diversity. Researchers did not see a lot of landscape-level damage, although mountain pine beetle, mistletoe, root diseases, and white pine blister rust were present in many locations, causing mortality.

Nine years later, the team is back at the same plots to look for changes in forest health and mortality rates, primarily due to insects and diseases. Some plots had no mortality while others had up to 10%. Mortality is most prevalent on the rocky, south-facing slopes of the north shore where mountain pine beetle outbreaks are widespread. Jensen likens it to a weakened immune system. Following the long drought period, trees were no longer able to defend themselves and this stress on the forest led to increased mortality.

Forests around lake level have seen impacts due to mountain pine beetle and drought, whereas high elevation forests have seen slow, creeping continuous damage due to white pine blister rust. Mountain



Forest ecology research team checks restoration plantings on Rifle Peak above Crystal Bay

pine beetle, although a native insect, can kill trees within a year, while white pine blister rust weakens the tree and may take 30+ years to cause mortality. "I find it fascinating to watch different organisms interact with each other, whether it's a parasitic mistletoe surviving in the tree canopy or a root disease creeping underground into the trees' root system," Jensen stated.



Aaron Vanderpool analyzes greenhouse gas emissions from soils

EDUCATION AND OUTREACH

CHANGING FORESTS EXHIBIT

Visit the new forest health exhibit in the Tahoe Science Center to learn more about the research and see beetle specimens. This new exhibit, funded by the Tahoe City Rotary Club, highlights the history of Tahoe's forests, climate change, tree mortality, and the AlertTahoe camera system.

AlertTahoe is a fire camera system that is built upon an emergency information platform already in use for earthquake monitoring and response. Fire cameras are located throughout the region on mountaintops and other key locations, streaming real-time images to firefighters and other emergency management personnel, as well as the public. Visit <http://www.alertwildfire.org/tahoe/firecams.html> to learn more or come into the Tahoe Science Center to see the camera views on our touchscreen exhibit.

INTERACTIVE STATE OF THE LAKE EXHIBIT COMING SOON

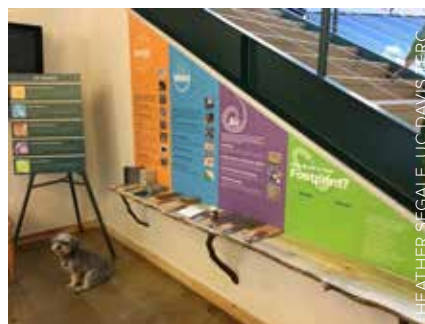
TERC is working with app developer Arborglyph to develop a new State of the Lake iPad interactive exhibit that will highlight information about lake clarity, changing lake level, climate change, forest health, and provide a visitor survey. It will replace the existing iPad app.



Fire in Lake Tahoe's Forests exhibit now includes actual beetles and beetle galleries... can you follow the path of the adults and larvae?

GREEN BUILDING EXHIBIT

TERC recently installed a new green building exhibit to highlight the Tahoe Center for Environmental Sciences (TCES) building LEED-Platinum features. Hands-on displays and an interactive touch-screen monitor highlight the innovative components that increase the efficiency and sustainability of the building. Check it out next to the stairway in the UC Davis Tahoe Science Center.



Green building exhibit showcases the LEED Platinum building features

YOUTH SCIENCE INSTITUTE ACCEPTING APPLICATIONS

The Youth Science Institute (YSI) is now accepting applications. YSI is an after-school program that enables high school students in grades 9-11 to interact with scientists and engineers. From dissections to building robots, students gain hands-on experience and learn about potential careers in different Science, Technology, Engineering, and Math (STEM) fields. This outstanding program will benefit any college-bound student. Information and applications are available at <http://tahoe.ucdavis.edu/ed-outreach/ed-programs/ysi.html>. Applications are due Friday, January 12, 2018. Contact Christine Limon at cjlimon@ucdavis.edu for details.

SCIENCE EXPO 2018 TO FOCUS ON LIFE SCIENCE AND HEALTH

The annual Science Expo event increases student excitement and interest in science through interactive, hands-on activities, games, and demonstrations. Science Expo includes five days of hands-on science activities in North Lake Tahoe and four days in South Lake Tahoe for third-, fourth-, and fifth-grade students from the greater Lake Tahoe and Truckee Region. Evening public events for families and lovers of science available at both locations. This year's theme is Life and Health Science with activities focused on Inheritance and Adaptation, Organisms and Ecosystems, and Health and Nutrition. Volunteers are needed!! Contact Liz Bronson at lbronson@ucdavis.edu to learn more.

FACULTY AND STAFF HIGHLIGHTS

GEORGE MALYJ TRIBUTE

It was with great sadness that the TERC family lost our friend, co-worker, mentor, confidante and most human of humans, George Malyj, on October 1, 2017. George had been battling liver cancer and though he defied the odds for several years, his final days descended upon him quickly—far, far quicker than any of us thought.

George touched so many people in so many ways over his 35+ years at UC Davis. From day-to-day management of the Tahoe and Castle Lake program, to his role as supervisor of our laboratory staff, to his constant care and listening ear for all who studied and worked with our Center. His passion for astronomy was put to use for many years in our stargazing events on the lake. Likewise, his knowledge and passion for wine made him TERC's sommelier-in-chief.

In George's honor, the former "Blue House," that has housed generations of students and researchers, will be renamed "Malyj Manor."

BLUE HOUSE BECOMES "MALYJ MANOR"

Malyj Manor, formerly called the "Blue House" (because of its bright blue color), was originally built in the 1880s to serve as the Tahoe City sheriff's residence before it became the California Department of Fish and Game Deputy Superintendent's residence. In 1975, control was transferred to UC Davis and the house has become a temporary home for scores of graduate students, visiting professors, and researchers.



George Malyj viewing the eclipse

Historically, funding for maintenance and upkeep of the house has been limited; however, in 2016 the house was approved for many desperately needed upgrades. Besides donning a fresh coat of green

paint, the house got a new roof, new flooring and windows, deck repairs, heating, upgraded wiring, and LED lighting, among many other improvements. Please consider giving a gift to help us improve the Malyj Manor interior and purchase new furnishings (<https://give.ucdavis.edu/JMIE/TERCGFT>).

TERC ADVISORY BOARD

TERC formed an advisory board this year! The Board is comprised of full and part-time residents who share an appreciation for the role of science in guiding environmental stewardship of the Lake Tahoe basin. Together with our staff, the Board helps us achieve our mission of restoring and sustaining Lake Tahoe through new philanthropic and community engagement opportunities. If you are interested in learning more about our board, please contact Jennifer Prahla at jlprahl@ucdavis.edu.



Malyj Manor (formerly the "Blue House") has provided lodging for graduate students and visiting researchers for decades and recently received several major upgrades by UC Davis Facilities

FACULTY AND STAFF HIGHLIGHTS, CONTINUED

WELCOME 2017-2018 AMERICORPS MEMBERS

TERC welcomes our three new AmeriCorps members for the 2017-2018 year! Bre Harris, Liz Bronson, and Christine Limon will serve as Education Program Assistants and help with science education and programming at TERC.

Bre's main tasks include Field Trip Coordinator, Eriksson Education Center Coordinator, and Aquarium and Exhibit management. Bre was born and raised in Missoula, MT, and obtained her Bachelor of Science in Biology at Western Washington University in Bellingham, Washington. Bre spends her free time mountain biking, skiing, backpacking, and studying botany. Bre is excited to get involved in a new community and to share her passion for the environment as an educator.

Liz's main tasks include marketing, special events, and

writing and editing. She was born in Pittsburgh, PA, but recently moved to Tahoe from Billings, MT. She graduated with a Bachelor of Science in Athletic Training from Ithaca College and is now working on a master's degree in Resilient and Sustainable Communities from Green Mountain College. Liz enjoys climbing, hiking, biking, and almost anything else outside.

Christine grew up in the heart of south Texas where her summers were spent on the beach or tubing down the river. She was born and raised on a countryside home where she had many chickens, a few goats, and a horse. After graduating from the



Welcome 2017-18 AmeriCorps Members Bre Harris, Liz Bronson, and Christine Limon

University of Texas at San Antonio with a B.S. in Environmental Science with a concentration in Chemistry, she moved to the beautiful Lake Tahoe area in hopes to expand on her educational background. Some of her hobbies include Ballet Folklorico dancing, hiking, and playing various instruments.

UPCOMING EVENTS

Jan. 12, 2018: Last day for Youth Science Institute applications

Jan. 24, 2018: Youth Science Institute begins

Jan. 18, 2018: Memory: How the Brain Remembers and How to Make Memories Stick with Dr. Charan Ranganath, UC Davis Department of Psychology

Feb. 2, 2018: Science of Cocktails Special Event. Tickets are limited. Reserve your space at <https://tinyurl.com/ScienceOfCocktails>

Feb. 8, 2018: Dark Side of the Universe with Dr. Marusa Bradac, UC Davis Department of Physics

March 12-16, 2018: North Tahoe Science Expo for students in grades 3-5. Volunteers needed.

March 14, 2018: Family Night Science Expo in Incline Village

April 3-6, 2018: South Lake Tahoe Science Expo for students in grades 3-5. Volunteers needed.

April 5, 2018: Family Night Science Expo in South Lake Tahoe

April 26, 2018: The Psychology of Humor, with Dr. Kim Bateman, Sierra College.

May TBD, 2018: Managing Forests for Fire and Drought, with Malcolm North, forest ecologist with the Forest Service Pacific Southwest Research Station

June 14, 2018: Little Known Stories from Tahoe's Past, with Bill Morgan

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

GIVING TO THE TAHOE ENVIRONMENTAL RESEARCH CENTER

Private Support is critical to continuing the Tahoe Environmental Research Center's legacy of ground-breaking 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
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All gifts are tax deductible. UC Davis is committed to providing excellent donor stewardship. To learn more about the University's gift policies, please visit <http://giving.ucdavis.edu/ways-to-give/disclosures>.

Science Sustainer

There are two easy options for giving:

- 1) Make a secure online gift at <http://give.ucdavis.edu/TERC>
- 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.

Name: _____

Spouse/Partner: _____

Address: _____

City, State, Zip: _____

Phone: _____

Gift Amount: _____

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