

Lakes

UC DAVIS TAHOE ENVIRONMENTAL RESEARCH CENTER

WINTER 2014-2015

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



PAIUTE SCULPIN found living inside nearshore network sensor at bottom of Lake Tahoe

RESEARCH UPDATES

NEARSHORE NETWORK FOUND BY NEMO

One of the advantages of TERC's new nearshore network is that it allows researchers to study and understand minute-by-minute changes in nearshore water quality in real-time. So when strange, daily increases in water conductivity started occurring at one station in late October, researchers were quick to start trying to explain them. It wasn't raining, so they couldn't be caused by runoff. Were there underwater springs? Was there chemical contamination entering the lake?

The mystery wasn't solved until TERC diver, Brant Allen, inspected

the station and found that a Paiute sculpin, a fish native to Lake Tahoe, had moved into the conductivity cell. The sculpin, now named Nemo, returned to sleep in the cell each afternoon, exactly coinciding with the measured spikes in conductivity.

The nearshore sensors now have mesh covers, stopping Nemo and his friends from taking up residence, but still allowing water to freely flow by. While studying fish behavior is not one of the goals of the nearshore network, this is a great example of how we learn new things in the most unexpected ways.

LETTER FROM THE DIRECTOR

What is written about Lake Tahoe often addresses familiar themes – clarity, climate change, invasive species, and the nearshore. To be sure, these are all important topics. Likewise, measuring progress on the changing state of the lake with respect to each of them provides indications of the effectiveness of actions taken in past years. But is merely tracking the past trends enough? What if those trends start heading the wrong way? Then what?

A science-based approach to the restoration of Lake Tahoe requires more than scientists measuring past trends. It requires a more fundamental understanding of the underlying processes that are driving change – be they physical, biological or chemical processes. It requires taking that understanding and using it to build conceptual and predictive models of how the lake may change in the future. The extent to which those models match the evolving conditions are the truest measure of our understanding, informing us where data gaps exist and where assumptions require rethinking.

TERC and its research partners endeavor to work in precisely this mode. Yet funding such research is difficult. Agencies are often required to fund monitoring to assess broad sets of targets, or compliance of specific water quality standards. Funding for the research to understand the system usually lags and with it the ability for science-based restoration.

In 2014 TERC has made some huge strides toward building the human and equipment infrastructure needed for science-based restoration. In May, UC Davis approved two

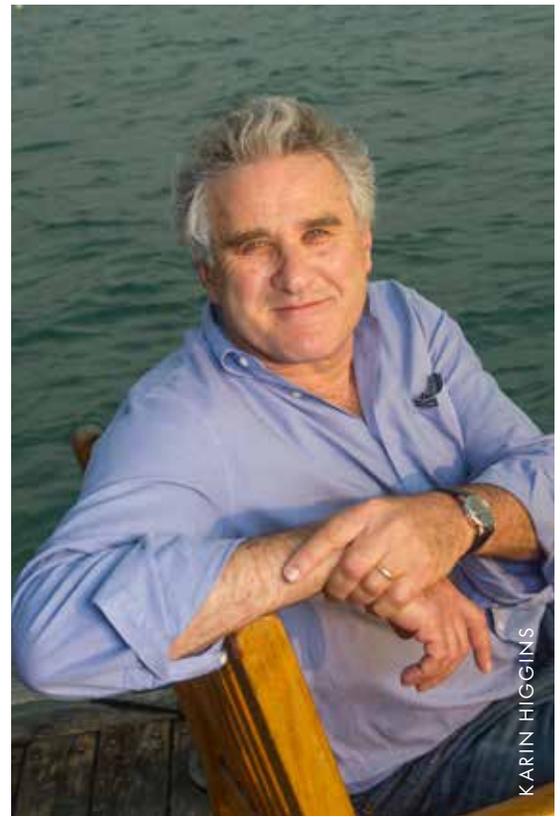
new faculty positions for TERC – one in the area of ecology and the other in area of lake physics. This allows for a new generation of faculty (and students!) to start focusing on Lake Tahoe. The hiring process has already begun.

In July, we launched our Nearshore Network, a system of real-time sensors positioned around the edge of the lake and providing data on changing water quality every 30 seconds. Aside from the new scientific insights this is already providing, it is forming the basis of new educational exhibits and citizen science programs that will help bring scientists and the communities closer together.

Support from donors has underpinned our efforts. It has allowed us to:

- Increase student fellowships, so that students are conducting more of the critical research needed to save the lake.
- Invest in new data collection and modeling technologies that are helping us examine the changes occurring in the nearshore and at all points in the lake.
- Expand our education facilities and programs to empower future stewards of the lake, and to leverage new government funding.
- Enhance our facilities, giving TERC the capacity to host guest speakers, visiting scholars and the world's thought leaders in freshwater research.

To all who have contributed to



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

our accomplishments this year, I am truly grateful. This includes our incredibly hard-working staff, our volunteer docents, the many students and interns that work at TERC, our partners in other research institutes and our colleagues in the various Tahoe agencies, those who visit our education centers, and those of you who have helped fund our research and education programs and partnered with us in unique ways.

I wish you all a safe and peaceful holiday season, and look forward to sharing many more success stories in 2015.

FURTHER LEVERAGING TERC RESEARCH

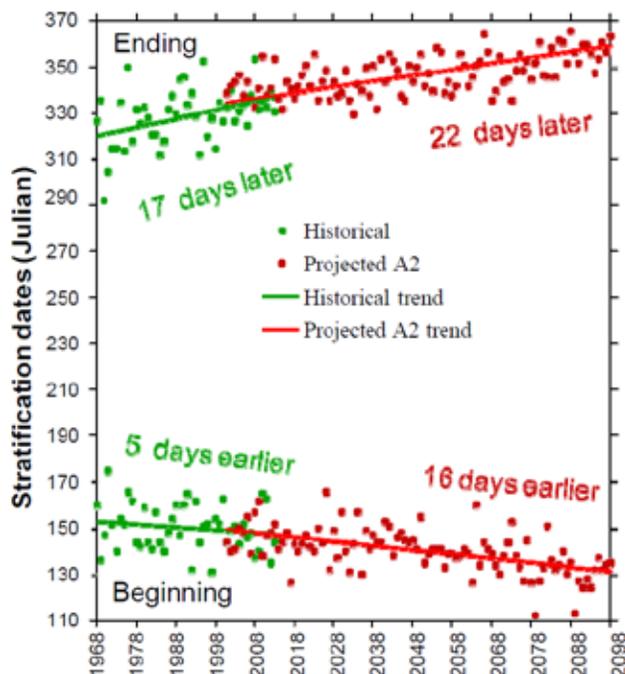
TERC staff is making use of an additional outlet for its research findings provided by the UC Davis Policy Institute for Energy, Environment, and the Economy (<http://policyinstitute.ucdavis.edu/>).

The Policy Institute provides support for the development and distribution of Policy Briefs: two-page documents that provide a concise summary of research conducted by scientists across the UC Davis campus. Covering a wide range of topics, these briefs highlight the policy relevance of the world-class research conducted at the university.

TERC staff recently produced a policy brief describing new research on the potential effects of climate

change on Lake Tahoe (see excerpt below). Over time we expect to develop more policy briefs on a variety of topics, with the overall aim of helping government agencies to better understand the policy implications of the research we do.

To obtain the full policy brief, visit <http://policyinstitute.ucdavis.edu/informing-policy-3/policy-briefs/>.



INCREASING LAKE STRATIFICATION: The day of the year when water column stratification begins (spring) and ends (fall) in Lake Tahoe. Both measured (historical) and modeled (projected) values are shown. Day 150 is May 30. Day 320 is November 16.

POLICY BRIEF SUMMARY

CLIMATE CHANGE AT LAKE TAHOE: WHAT DOES THE FUTURE HOLD AND WHAT CAN WE DO?

ISSUE: Monitoring shows increasing trends in air and water temperature, as well as increases in the portion of the year with warm conditions. Increasing the duration of warm conditions translates into less vertical mixing of water, which is the primary way dissolved oxygen is delivered to the bottom of Lake Tahoe. This mixing process is critical to the survival of deep-water fish and other aquatic organisms. Chronic oxygen depletion also can lead to chemical changes in the lake bottom, triggering nutrient releases from bottom sediment, and reductions in water quality.

POLICY IMPLICATIONS:

Science suggests a greater emphasis is needed on policies and management strategies that reduce the influx of nutrients from all sources to help preserve and restore Lake Tahoe's clarity under a changing climate.

RESEARCH FINDINGS:

A characteristic of lakes is that they thermally stratify during the warm part of the year. The warmer, lighter water at the surface floats on top of the cooler, denser water below. When this occurs the supply of oxygen to the deeper parts of the lake is cut off because stratification inhibits vertical mixing. Scientists at the Tahoe Environmental Research Center have measured and modeled temperature stratification in Lake Tahoe for the past and the future, respectively (see above).

Long-term records of air and water temperature in Lake Tahoe show an increasing trend in both due to the effects of climate change, leading to the expectation that the period of lake stratification also will increase. The results show that since 1968, stratification has increased by 22 days, starting 5 days earlier in the spring and ending 17 days later in the fall. By 2100 the duration of stratification is expected to increase by an additional 38 days, 16 more in the spring and 22 more in the fall. This overall lengthening in the stratification season from 6 months in 1968 to 8 months in 2100, due to climate change, is anticipated to have substantial impacts on the lake's water quality and ecology, including chronic deep-water depletion of dissolved oxygen.

EDUCATION AND OUTREACH

THANK YOU 2013-14 AMERICORPS MEMBERS

Kelsey Poole, Kristen Reichardt and Kylee Wilkins were education program assistants and “got things done” (the AmeriCorps motto) for TERC. We will miss their laughter and enthusiasm and wish them all the best in their future endeavors. We are incredibly grateful to all three of them for their service.

WELCOME 2014-15 AMERICORPS MEMBERS

TERC welcomes our three new AmeriCorps members for the 2014-2015 year.

Laynie Saidnawey is part of the Incline Village-based Parasol AmeriCorps program, while Diana Hitchen and Carley O’Connell are with the Sierra Nevada AmeriCorps Partnership program.

Laynie is from Belmont, Massachusetts and earned



KARIN HIGGINS

STUDENT FIELD TRIPS are signing up now for Water on Earth, Food Web Ecology, Geology and Plate Tectonics, Landforms, Tahoe Systems, Earth Systems Science and Environmental Detectives

her Bachelor of Science in Environmental Conservation from the University of New Hampshire. She spent a semester in New Zealand working on an environmental restoration project, her primary area of interest.

Diana grew up in Berkeley, California and studied at UC Davis, completing a B.S. in Anthropology this past spring. The program explores science, human culture, and their relationship, themes that are very relevant to TERC’s work at

Lake Tahoe.

A local to Truckee, California, Carley recently completed a B.S. in Environmental Sciences from UC Berkeley. As a high school graduate from TERC’s Youth Science Institute and former TERC lab intern, Carley has a long and active history with TERC.

Please join us to welcome our new AmeriCorps members onto the TERC Education and Outreach Team!



ALISON TOY

FAREWELL 2013-14 AmeriCorps members Kylee Wilkins, Kelsey Poole, and Kristen Reichardt



ALISON TOY

WELCOME 2014-15 AmeriCorps members Diana Hitchen, Carley O’Connell, and Laynie Saidnawey

EDUCATION AND OUTREACH

GRANT FUNDS NEARSHORE EXHIBIT AND CITIZEN PERCEPTUAL APP

The Institute of Museum and Library Services awarded \$150,000 to TERC to create a new, interactive public exhibit at the Tahoe Science Center, located in Incline Village. The exhibit will merge the results of citizen science with TERC's new, real-time monitoring network that is being installed around the lake to understand and improve the clarity and health of Lake Tahoe's shoreline.

The new exhibit, scheduled to open in 2015, will encourage visitors and residents to participate in hands-on learning about the lake and other watersheds, resulting in increased awareness and active environmental stewardship.

The exhibit will rely upon data collected via TERC's new nearshore monitoring network – the first of its kind – that is measuring changes to water quality in the area of the lake

people experience most. Collected data will include water temperature, cloudiness and algal concentration. This information will be coupled with TERC's existing data on weather, dissolved oxygen, stream contaminants and water currents to provide insight into how climate change, invasive species and other factors impact the lake.

The exhibit will also incorporate data from a new citizen science mobile app that TERC is developing. Members of the public will be able to go to places such as Kings Beach and use their phone to easily send TERC data and photos of nearshore conditions. Moments later, those citizen scientists can visit TERC's Tahoe Science Center, where the new exhibit displays the results collected from both citizens and the nearshore monitoring network.

"We are grateful to the Institute of Museum and Library Services for their vision to inspire hands-on learning and civic engagement in

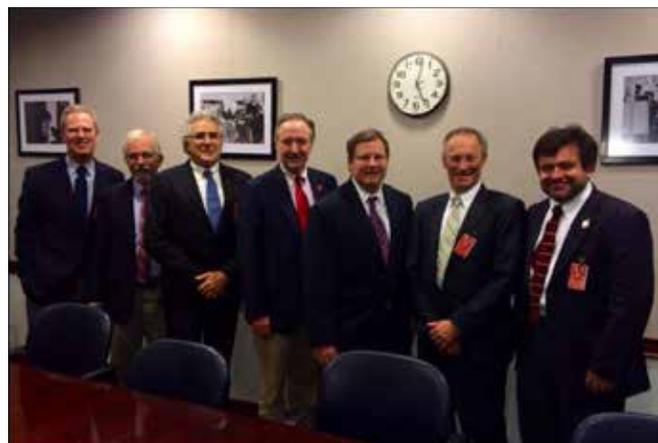
the Tahoe Basin. This will benefit both the residents and the three million visitors that come each year to enjoy the lake's extraordinary beauty," said UC Davis TERC director Geoffrey Schladow. "This generous award builds on our philanthropically-funded Nearshore Network and demonstrates the power of collaboration and leverage. It opens the door to a new era of broad-scale citizen science that can lead to Lake Tahoe becoming the clearest and 'smartest' large lake in the world."

"Our grants are highly competitive," said IMLS director Susan H. Hildreth. "The Institute of Museum and Library Services enlists hundreds of library and museum professionals throughout the United States to review grant applications and make recommendations on projects most worthy of funding. Receiving a grant from IMLS is a significant achievement, and we congratulate UC Davis TERC for being among the 2014 IMLS museum grantees."

INTERNATIONAL PARTNERSHIPS

Geoff Schladow was part of the UC Davis delegation led by Provost Ralph Hexter to Santiago, Chile. Here the group is seen with US Ambassador Mike Hammer at the US Embassy. From left to right: Professors Tu Jarvis, Graham Fogg, Geoff Schladow, Alan Bennett, Ambassador Mike Hammer, Provost Ralph Hexter, and Jorge Rojas.

Prior to the Santiago meetings, Geoff was the guest of the Universidad Austral de Chile in Valdivia, where he was establishing new collaborative agreements.



DIRECTOR GEOFF SCHLADOW (shown third from left) was part of a UC Davis delegation to Santiago, Chile

STAFF HIGHLIGHT: **FAYE-MARIE PEKAR**

If you find yourself dodging burned logs on forest service roads in remote areas of Yosemite National Park, you might just run into Faye-Marie Pekar and the TERC Team. The hard-working research team spent the past 18 months assessing the impacts of the 2013 Rim Fire on lake ecosystems in the Sierra Nevada.

While some may enjoy the comforts of a warm office and comfy desk chair, Pekar prefers the unpredictable, problem-solving aspects of field work, and the equally dynamic team she has worked alongside on the project. “Katie and Brant showed me the ropes and shared their excellent fieldwork skills. They were great guides who chose career opportunities based on their own life experience.”

Pekar began her work with the UC Davis Tahoe Environmental Research Center in May of 2013 as a Junior Research Specialist. After obtaining her research diver certification in

August of 2013 at the UC Davis Bodega Bay Marine Laboratory, she was able to help monitor aquatic invasive species in Lake Tahoe, an ongoing effort to preserve the native populations and clarity of the lake. Her team helped monitor Asian clam barriers, conduct clam surveys for potential infestations, clean off buoys, and retrieve instruments from the bottom of Emerald Bay.

Faye-Marie says that choosing UC Davis was one of the best decisions she’s made thus far. She wanted to experience field research on the front line and be a role model for women to get more involved in science, and was able to do this with her various research projects. Pekar has recently moved on from

TERC to work with the Tahoe Resource Conservation District as a storm water technician, and will be continuing to do inspirational and important work for the Lake Tahoe Basin and other California watersheds and ecosystems.



FAYE MARIE PEKAR working in the TERC Chemistry Lab

ALUMNI SIGHTINGS

Alumnus John Coil stopped by the TERC lab for a science center and lab tour in October 2014. John received



UC DAVIS Tahoe Research Group alumnus John Coil visits the TERC lab

his M.S. from UC Davis in Ecology in 1971 studying productivity and nutrients at Star Harbor (following a summer monitoring program of the Tahoe Keys in 1969). He received his Ph.D. from UC Davis in Ecology in 1978 studying spatial variability of nitrate in Lake Tahoe.

For 20 years John was an environmental scientist with Bechtel reviewing hydroelectric projects in the Pacific Northwest and Environmental Impact Analysis of the “Big Dig” in Boston. From 1988 to 1994, John was vice president of a small environmental consulting firm in

Santa Barbara – mostly working with the oil and gas industry. From 1994 on he has worked as an independent environmental consultant, including nine years in Sakhalin Island, Russia doing monitoring and impact analyses of offshore pipeline construction, and 4 years in Western Australia doing impact analyses and studies for dredging a new marine terminal.

Now semi-retired, John is waiting for the “right project”! It is very gratifying to hear first hand the impact that a research education at Lake Tahoe has had in so many places around the world.

STUDENT HIGHLIGHTS

Congratulations to **Tom Mathis**. Tom is the inaugural Boyd Fellow at Tahoe, an award he received for the work he is conducting on analyzing data that NASA has collected from the famous yellow buoys on Lake Tahoe. Tom's work will help us understand processes that occur at the very surface of the lake, and provide a benchmark for comparing data collected by the Nearshore Network.

Derek Roberts has received a GLEON Fellowship. GLEON, the Global Lake Ecological Observatory

Network, is a grassroots consortium of lake researchers. The Fellowship allows Derek to participate in three week-long training workshops to exploit the rich information content of large and diverse data sets, to operate effectively in diverse international teams, and to communicate outcomes to a broad range of audiences.

Kristin Reardon presented a paper at the 13th International Water Association Specialized Conference on Watershed and River Basin Management in San Francisco in September.

The paper was on sediment resuspension in Lake Tahoe's nearshore, which Kristin studied as part of her Ph.D. research. Also, congratulations are due for Dr. Kristin Reardon, who will submit her Ph.D. dissertation on December 18. Kristin, who recently moved to Alaska with her family, will be greatly missed.

Heather Sprague attended the Women in Engineering Conference in San Diego in November. Heather has been a staunch advocate and mentor for women in engineering.

TERC VISITORS

Francisco Bellido, an undergraduate from the University of Granada, Spain, is studying and working at UC Davis for one year using the three-dimensional lake hydrodynamic model, Si3D, developed at UC Davis for use at Lake Tahoe. He is using it to model Lake Tanganyika to understand the ways in which climate change will impact the lake and its fisheries.



NSF DIRECTOR FRANCE CORDOVA (second from right) visited the Keck CAVES at UC Davis in May 2014 specifically to see the 3-D visualizations of Lake Tahoe

UPCOMING EVENTS

JANUARY 8, 2015: Monthly Lecture: AlertTahoe: A 21st Century Approach to Firefighting in the Tahoe Basin, with Graham Kent, UNR Nevada Seismological Laboratory.

JANUARY 15, 2015: Monthly Lecture: Stem Cell Treatments for Inflammatory and Traumatic Diseases, with Dori Borjesson, UC Davis Vet Med: Pathology, Microbiology, Immunology.

JANUARY 28—MAY 20, 2015: Youth Science Institute after-school program for high school students.

FEBRUARY 19, 2015: Monthly Lecture: Choosing a Pet: Breed Selection, Gender Selection, Neutering Concerns, Behavioral Issues, and Welcoming a New Pet Into Your Home, with Benjamin Hart, DVM, UC Davis School of Veterinary Medicine.

MARCH 16—20, 2015: Science Expo and Kids' Health Fair for third-, fourth- and fifth-grade students is sponsored by UC Davis, Tahoe Expedition Academy, and Rotary

Club of Tahoe-Incline.

MARCH 18, 2015: Science Expo evening event is open to the public.

APRIL 9, 2015: Monthly Lecture: The World Food Center: Agriculture, Food, & Nutrition: from Local to Global, with Josette Lewis, UC Davis World Food Center.

MAY 21, 2015: Monthly Lecture: The bacterial world within: diet and health from babies to adults, with Dr. Bruce German, UC Davis Department of Food Science & Technology.

JUNE 11, 2015: Monthly Lecture: Your Gut Microbiome, Nutrition, and Disease, with Carolyn Slupsky, UC Davis Department of Nutrition.

AUGUST 8, 2015: Children's Environmental Science Day

SEPTEMBER 17, 2015: Monthly Lecture: Using LiDAR imagery to re-examine faulting and geologic history of western Nevada, with Courtney Marie Brailo, Nevada Seismological Laboratory.

RESEARCH PHOTOS



RESEARCHERS Brant Allen, Sam Urmy, Faye-Marie Pekar, Katie Webb, Raph Townsend and Shohei Watanabe at Lake Eleanor inside the Rim Fire burn area



KATIE WEBB studies Kokanee salmon found spawning in Eagle Creek in Emerald Bay and other alternative locations due to low lake levels



CHEMIST Veronica Edirveerasingam and intern Lindsey Saunders perform nutrient analysis on water samples from streams and storm water



RESEARCH DIVERS Faye-Marie Pekar and Katie Webb in the middle of Lake Tahoe preparing for a dive beneath the NASA buoy



SCOTT HACKLEY conducts a bioassay experiment to determine nutrient limitation in Lake Tahoe's waters



SHOHEI WATANABE on the NASA buoy uses hyperspectral radiometric measurements to measure the color of the lake

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