



# UC DAVIS

## TAHOE ENVIRONMENTAL RESEARCH CENTER

THE TAHOE ENVIRONMENTAL RESEARCH CENTER (TERC) IS DEDICATED TO RESEARCH, EDUCATION AND PUBLIC OUTREACH ON LAKES AND THEIR SURROUNDING WATERSHEDS AND AIRSHEDS. LAKE ECOSYSTEMS INCLUDE THE PHYSICAL, BIOGEOCHEMICAL AND HUMAN ENVIRONMENTS, AND THE INTERACTIONS AMONG THEM. THE CENTER IS COMMITTED TO PROVIDING OBJECTIVE SCIENTIFIC INFORMATION FOR RESTORATION AND SUSTAINABLE USE OF THE LAKE TAHOE BASIN.

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### RESEARCH UPDATES

#### Rim Fire Impact on Sierra Lakes

On August 17, 2013 the largest recorded wildfire in the Sierra Nevada and the third largest in California history started in Stanislaus National Forest. This devastating fire burned more than 250,000 acres and took two months to contain. The effects of the fire on the terrestrial ecosystem will certainly last for years; here at TERC, the question is to what extent were Sierra lakes impacted?

In October TERC researchers received a National Science Foundation - Rapid Response Grant to assess the effects of the Rim Fire on lakes in Northern California. It is a one year study to look at water quality and ecological changes in lakes affected by the wildfire.

TERC is studying two lakes, Cherry Lake and Lake Eleanor, within the heart of the burn area and several lakes to the



TERC research team heading out on Cherry Lake to sample water quality following the Rim Fire near Yosemite



Burned forest is visible behind TERC research team

north that were impacted by smoke during the fire event, including Lake Tahoe, Emerald Bay, and Cascade Lake. Rock

Creek Lake just south of Mammoth will serve as the control lake since it was not impacted by the

Continued on Page 3

## LETTER FROM THE DIRECTOR

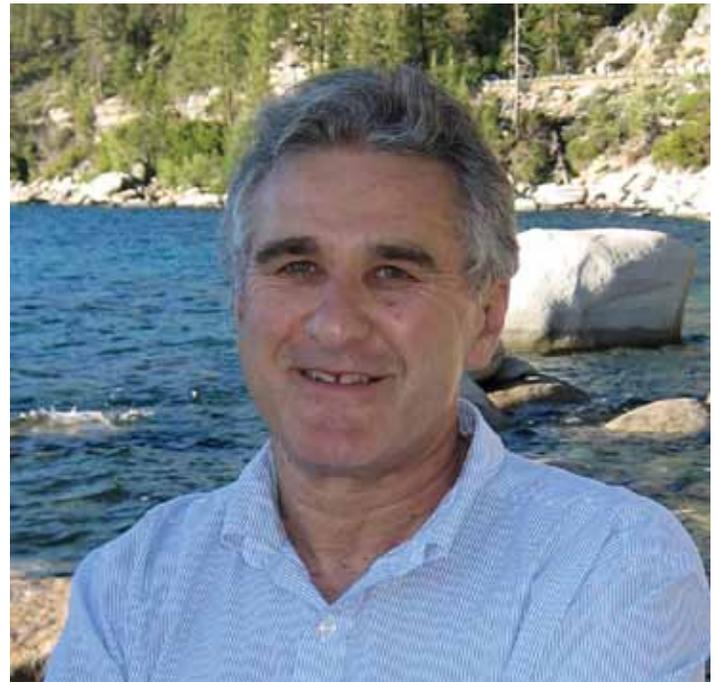
The first snow has fallen at the lake, but it was a cold and dry storm and the water level barely changed. The water level in Lake Tahoe is now at its lowest level in three years, a mere nine inches above the natural rim, and there are predictions for a dry winter ahead. What does this mean for the lake? In all likelihood the lake will fall below its natural rim in 2014, cutting off the major source of water to the Truckee River and extending the shoreline of the lake hundreds of feet from its usual range. Part of the reason for this is the normal fluctuation in our region's hydrology. But part of it is unquestionably linked to the changing climate we are experiencing, and the specter of longer and

more intense drought periods in the coming decades. While the impact of droughts on water level is clear, the impact on the lake ecosystem is something that needs a lot more study.

The long-term data record that TERC has compiled for Lake Tahoe is an invaluable tool in understanding the past and current impacts of climate change here and throughout the Sierra Nevada. Some of that data was summarized in our 2013 Climate Change Report prepared for the Federal Summit in August. However, much more is needed for science to adequately advise policy and decision making at Lake Tahoe.

Support from the public is helping us get to where we need to be. This year we have been able to:

- Increase student support, so that more graduate and



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

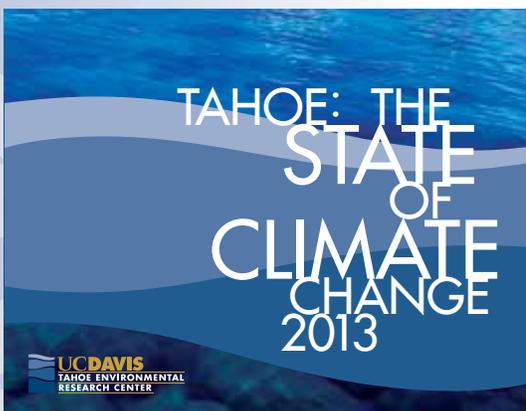
undergraduate students are having the opportunity to conduct the critical research needed to save the lake.

- Invest in new technologies that are helping us learn more about the lake and surrounding environment.
- Expand our education and outreach programs to empower future stewards of the lake, by inspiring curiosity in K-12 students and promoting scientific literacy for all.
- Enhance our facilities, giving TERC the capacity to host students, visiting scholars and the world's thought leaders in freshwater research.

Many people have contributed to our accomplishments this

year, and for that I am truly grateful. They range from our incredibly dedicated 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 seeing you in 2014.

A handwritten signature in black ink, appearing to read "Geoff".



Read "Tahoe: The State of Climate Change 2013 on the TERC website at <http://terc.ucdavis.edu>

## RESEARCH UPDATES, CONTINUED

Continued from Page 1

fire or smoke. UC Davis is collaborating in the study with Miami University, Ohio; Stony Brook University, New York; University of Nevada, Reno; and UC Santa Barbara.

Initial assessment of the water quality and zooplankton community was completed in late October, prior to the first snow. The science team will return following a weather event that causes dramatic runoff, or during the spring snowmelt.

The research is focused on how the lakes respond to the organic compounds contained in the smoke from wildfires. The results will have importance to the entire west, with expectations for increases in wildfires due to climate change.

### Expected Impact of Climate Change on Lake Tahoe

The 21st century climate is expected to continue to impact the air temperature, amount and type of precipitation, stream discharge, sediment and nutrient loading, lake temperature, lake mixing, water quality, biodiversity and aquatic invasive species. Potential effects include:

- Snow declining as a fraction of total precipitation
- Extended droughts
- More extreme streamflow events
- Increased algal growth
- Increased threat from aquatic invasive species

- Impact on tree mortality and risk of wildfire
- “Tahoe: The State of Climate Change 2013” highlights and summarizes some of the key findings drawn from the “Tahoe: State of the Lake Report 2013.” The research conducted to date has highlighted the huge changes that future climatic conditions may exert on our freshwater ecosystems.

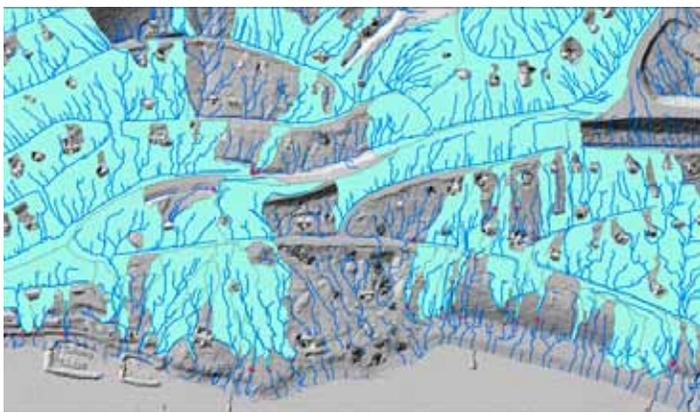
Read more at <http://terc.ucdavis.edu/stateofthelake/StateOfClimateChange2013.pdf>.

### Distributed Stormwater Detention Basins

Ever wondered about the route snowmelt takes to get to the lake? That was the question that led to a research collaboration between Geoff Schladow and two colleagues at the University of Granada, Juanfran Reinoso and Carlos Leon. Using a new Lidar data set, which provides extremely fine scaled and accurate estimates of the exact shape of the land surface throughout the Tahoe basin, the team has produced maps that show the exact flow paths that water takes within the



“Climate Rules!” is just one of the posters presented at the Tahoe Summit and included in the “Tahoe: The State of Climate Change 2013”



Pale blue shows areas in a section of Incline Village where urban stormwater could be captured by a system of small, distributed detention basins. Dark blue lines show the paths taken by the stormwater.

urban areas surrounding the lake. The maps are being used to identify small, natural depressions in the landscape that can be used to cheaply trap the runoff and allow it to infiltrate into the ground rather than running off into streams and the lake. It is estimated that less than 1% of the available infiltration potential is currently being used. TERC is partnering with Tahoe agencies to build and test prototypes in 2014. While not a silver bullet, this new approach to trapping urban stormwater is likely to be a large part of efforts to restore the lake’s clarity and health.

## EDUCATION AND OUTREACH

### “Lake Tahoe: Can We Save It?”

UC Davis Tahoe Environmental Research Center is featured prominently in the KQED QUEST documentary “*Lake Tahoe: Can We Save It?*” The documentary covers environmental issues affecting Lake Tahoe and what TERC researchers and other organizations around the lake are doing to protect it.

Lake Tahoe’s famously blue waters – which make it the clearest lake of its size in the United States – attract three million visitors to California and Nevada each year. But decades of development, and now climate change, threaten this national treasure. This QUEST half-hour documentary takes you behind the scenes with the scientists working to keep the lake pristine and protect it

for generations to come.

The 26-minute video is available free online at <http://science.kqed.org/quest/video/lake-tahoe-can-we-save-it/>.

### Education Team visits UC Berkeley Lawrence Hall of Science and Exploratorium for Curriculum and Hands-on Exhibit Development

In November the education team visited the Lawrence Hall of Science (LHS) to meet with curriculum developers about new exhibits and lesson plans for the Tahoe Science Center. LHS is a partner on the NSF-funded grant that resulted in the interactive “Shaping Watersheds” sandbox exhibit, several new 3D visualizations and new hands-on science



Warmer temperatures are nice for visitors, like these at Lake Tahoe’s Sand Harbor, in Nevada. But they could lead the lake to move away from its famous indigo blue and more towards green.

activities currently under development. The next idea in development is a Lakes of the World 3D viewer and complementary interactive activities.

### Upcoming Events

- Jan. 28, 2014: Radon: What You Don’t Know Could Hurt You with Eric Matus of the Nevada Radiation Control Program, 5:30 p.m. at Tahoe Center for Environmental Sciences
- Feb. 6, 2014: Music, Memory and Psychology with Dr. Petr Janata of UC Davis Center for Mind and Brain, 5:30 p.m. at Tahoe Center for Environmental Sciences
- March 17-20, 2014: Science Expo, featuring Earth and Space Science. Volunteers needed! Contact Kylee Wilkins at [knwilkins@ucdavis.edu](mailto:knwilkins@ucdavis.edu)
- April 10, 2014: Social History of Chocolate with Dr. Louis Grivetti of UC Davis Department of Nutrition, 5:30 p.m. at Tahoe Center for Environmental Sciences
- May 29, 2014: California Black Bear with Mario Klip of California Department of Fish and Wildlife, 5:30 p.m. at Tahoe Center for Environmental Sciences
- June 17, 2014: Lake Ecosystem Changes Worldwide, with Dr. Charles Goldman, 5:30 p.m. at Tahoe Center for Environmental Sciences
- June 17, 19 & 21,



TERC Education Team at UC Berkeley Lawrence Hall of Science (Kristen Reichardt, Kylee Wilkins, Alison Toy and Kelsey Poole)

Continued on Page 5

## EDUCATION AND OUTREACH

Continued from Page 4

- 2014: Docent Training Program. Interested in being a TERC docent? Contact Kristen Reichardt at kereichardt@ucdavis.edu
- July 17, 2014: Positive Psychology with Alison Ledgerwood, UC Davis, 5:30 p.m. at Tahoe Center for Environmental Sciences
- July 31, 2014: State of the Lake, with Dr. Geoff Schladow, UC Davis, 5:30 p.m. at Tahoe Center for Environmental Sciences
- August 9, 2014: Children's Environmental Science Day, 1 to 4 p.m. at Tahoe Center for Environmental Sciences



KATIE WEBB

Kokanee salmon as viewed underwater using the new GoPro 3D camera set-up

## NEW 3D MOVIE PRODUCTION UNDERWAY

### Researchers Brant Allen and Katie Webb Go Underwater for the New “Let’s Go Jump in the Lake” 3D Movie

TERC researchers Brant Allen and Katie Webb (see also Page 7), along with 3D movie specialist Steve Andersen, script writer Sharon Wood, and the entire TERC Education Team, are working hard to bring the Tahoe Science Center another 3D movie.

This new film will let visitors virtually dive under the water and learn about the ecology and physics of the lake using actual 3D video footage from under the surface of Lake Tahoe. Imagine being able to see the kokanee salmon swimming under water, algae growing, and researchers diving, all in 3D!

Getting these shots is not easy. In order to get 3D footage the videographer needs two cameras set up for the “left” and “right” eye. On top of that, the cameras must be waterproof, stable, and timed to perfection. Filming in 3D takes a lot of precision and control—two things that are hard to come by diving deep under the surface in Lake Tahoe. Often shots are hard to film because of sediment and organic material being stirred up by diver’s flippers or the wind. TERC is using cameras and waterproof housing donated by GoPro to capture all the action from the boat and underwater.

Not only are Brant and Katie certified research divers and scientists, they now are amateur

filmmakers. So far, they have been filming their underwater research for TERC. Since the script is not yet finalized Brant and Katie are taking shots that they think will work well and that everyone would love to see. This movie will allow visitors to see the lake from a diver’s or a

fish’s point of view, a rare and beautiful way to see the lake. There is so much to see and learn under the surface of Lake Tahoe, and soon the Tahoe Science Center will be able to show visitors this unique perspective. The tentative completion date for the new film is summer 2014.



BRANT ALLEN

Research diver Katie Webb is also capturing 3D video footage while underwater in Lake Tahoe for the new 3D movie

## AN INCONVENIENT BOOTH AT TAHOE SUMMIT 2013

TERC staff created “An Inconvenient Booth” to present the latest information on climate change at Lake Tahoe (see Climate Change at Lake Tahoe on Page 3) at this year’s Tahoe Summit held on August 19, 2013 at Sand Harbor.

Since the first Presidential Forum in 1997, federal, state and local leaders have come together annually at Lake Tahoe. In 1997, then-Vice President Gore was instrumental in gathering stakeholders and bringing much needed attention to the problems

facing the Lake Tahoe Basin. At this year’s event, former Vice President Al Gore presented “A Clean Lake Legacy: Preserving Tahoe and the Environment for Future Generations” and provided recommendations for applying Tahoe’s environmental management approach worldwide to an audience of almost one thousand.

Other speakers at the Summit included Senators Harry Reid and Diane Feinstein and Governors Jerry Brown and Brian Sandoval. TERC’s “An

Inconvenient Booth” received a lot of attention,

including a mention by Gore.



Professor Charles Goldman presents former Vice President Al Gore a copy of his newest book “Climatic Change and Global Warming of Inland Waters: Impacts and Mitigation for Ecosystems and Societies”



TERC Education Team hosts “An Inconvenient Booth” about climate change impacts at Lake Tahoe at the Tahoe Summit on August 19, 2013



TERC Education and Outreach Director Heather Segale and Nevada State Lands Lake Tahoe Coordinator Liz Harrison meet Al Gore

## STAFF HIGHLIGHT: KATIE WEBB

**K**atie Webb is a research diver with TERC who spends many days out on the research vessel studying Lake Tahoe. To her, this is more than a dream job.

Katie grew up in Reno, Nevada and went to University of Nevada, Reno. She studied Lake Tahoe during her time at UNR in the aquatic ecosystem lab.

Her love for limnology continued to grow after she graduated from UNR; she took a job at the Castle Lake Limnological Research Station.

Following that study she headed abroad to Mongolia, where she studied megafish in

collaboration with both TERC and UNR scientists. After that adventure she made her way back home to Lake Tahoe and worked as the TERC education program AmeriCorps member. Katie was then offered a position with TERC and has since been promoted to staff as a research diver.

Long days and even long nights on the boat are a regular occurrence for Katie. She often comes into the office red-cheeked from a cold day out on the boat. She said her coldest day diving was when the water was 34 degrees Fahrenheit! Even a sealed dry suit cannot keep that cold out—she feels the sensation of



Katie Webb prepares for research dive into Lake Tahoe

having an “ice cream headache” after taking a dip. Even with the cold days, Katie still loves her job and loves to learn more everyday about the lake and research diving.

When the snow has melted and the water is warm again, diving is her favorite part of the job! She gets to see the lake the way only a few have, deep under the surface steadily breathing from an oxygen tank and doing work to help protect the lake she loves.



Researchers Brant Allen and Katie Webb prepare for a cold water dive off the Research Vessel Bob Richards

# GIVING TO THE TAHOE ENVIRONMENTAL RESEARCH CENTER

Charitable gifts to the Tahoe Environmental Research Center provide crucial support for research, teaching and public outreach that helps promote understanding and conservation of the Lake Tahoe Basin and other lake

systems. Your gift helps ensure the Center's continued excellence in restoring Lake Tahoe and other lakes around the world - now and for generations to come. 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.

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