

Lakes

UC DAVIS TAHOE ENVIRONMENTAL RESEARCH CENTER

WINTER 2015-16

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.



TERC ADMINISTRATIVE OFFICE

Watershed Sciences Building
University of California, Davis
One Shields Avenue
Davis, CA 95616-8527
Phone: (530) 754-TERC (8372)
Fax: (530) 754-9364

TERC INCLINE VILLAGE LABORATORY

291 Country Club Drive
Incline Village, NV 89451
Phone: (775) 881-7560
Fax: (775) 832-1673

TERC TAHOE CITY FIELD STATION

2400 Lake Forest Road
Tahoe City, CA 96145
Phone: (530) 583-3279
Fax: (530) 583-2417

[HTTP://TERC.UCDAVIS.EDU](http://terc.ucdavis.edu)

SCIENCE TO SAVE THE LAKE



SHOHEI WATANABE takes radiometric profiles regularly to calibrate the buoy sensors

RESEARCH UPDATES

KEEP TAHOE 450 nm: RESEARCHING LAKE TAHOE'S "BLUENESS"

By Shohei Watanabe

Lake Tahoe's deep cobalt blue color is of great ecological and economic value and a focus for lake management strategies. While water clarity has been routinely measured for more than five decades, the blueness of the lake has never been quantified scientifically, until recently.

In collaboration with NASA-JPL and the Université Laval, Québec, TERC has developed the blue water index (B_w) to express Lake

Tahoe's blueness. This objective measurement of water color enables us to conduct continuous monitoring of Lake Tahoe's color as well as the color of other oligotrophic lake waters.

The color monitoring from 2012 to 2014 revealed that Lake Tahoe's iconic blueness is most closely related to algae, not fine inorganic sediments which are directly correlated to lake clarity.

The general assumption that lake clarity is tied to blueness has driven advocacy and management efforts in the Lake Tahoe Basin for decades. But these findings show that at times of the year when clarity increases, blueness decreases, and vice versa.

Continued on Page 3

LETTER FROM THE DIRECTOR

It seems that every conversation about Lake Tahoe this year made reference initially to the ongoing drought, and more recently to El Niño. What is certain is that we are in a long and historical drought. What is also certain is that there exists a band of very warm water across the equatorial Pacific Ocean - the condition known as El Niño. Whether the El Niño conditions will have a significant impact on the drought, particularly in the northern Sierra, is largely unknown.

Historical precedents are relatively few in number, and the data are divided between El Niño years when the northern Sierra received above average precipitation and years of below average precipitation. More certain is the likelihood that temperatures will be above average, increasing the chances of rain at the expense of snow, whatever the total precipitation may be.

What does all this mean for the lake? This year the lake fell to more than 18 inches below its natural rim. While that does not seem very much, the very low slopes in some parts of the lake meant that the water's edge receded many hundreds of yards exposing brown mud and rocks, and shrubs started growing and flowering in previously submerged areas. With the lack of nutrients and erosion products washing into the lake, it has also been far clearer and bluer during the drought.

Will the lake refill this year? With an average precipitation year, the lake will rise slightly above the natural rim next spring, and the Truckee

River will flow once more. With summer evaporation, however, the lake level will fall and the flow will cease. It will take more than one wet year to overcome the consequences of the drought.

Extreme events such as droughts can teach us a lot about our efforts to restore Lake Tahoe. During this period we have seen how many feet of clarity improvement are achievable in a single year; that the lake's blueness is reflected in our ability to control nutrients; and that the attached algae on rocks has fallen to relatively low levels. While scientific measurements are recording these changes, it is the detailed research that we undertake that provides the understanding of what is driving change, and that understanding allows us to construct predictive tools that can guide future restoration. That understanding does not always come quickly or easily, but through the efforts of many we are moving forward.

To all who have contributed to 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



KARIN HIGGINS

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

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.

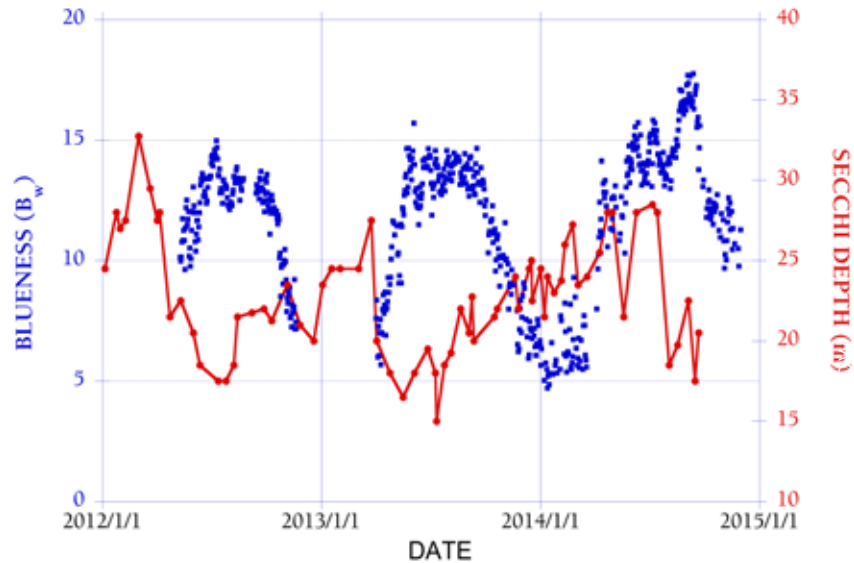
I wish you all a safe and peaceful holiday season, and look forward to hearing how the lake refilled far quicker than I predicted.

RESEARCH UPDATES, CONTINUED (Continued from Page 1)

This is due to the seasonal interplay of sediment, nutrients and algal production as the lake mixes.

Development of models estimating lake water blueness from the input of water quality data is currently underway. The models will help us determine past and future lake colors that reflect changing environmental conditions of the region.

Additional details are available in *2015 Tahoe: State of the Lake Report*.



ATTACHED ALGAE IN THE NEARSHORE: PERIPHYTON AND METAPHYTON

By Scott Hackley

Throughout the year, TERC researchers monitor attached algae, or periphyton, in the nearshore zone. The monitoring is done for the Lahontan Regional Water Quality Control Board and occurs at multiple sites around the lake. For spring 2015, we found that the amount of periphyton was low—similar to 2014 levels. This low amount of periphyton is likely from reduced nutrient input and low lake levels from the continuing drought.

Over the past summer, researchers began a pilot study to evaluate ways to monitor a different type of algae, metaphyton. Metaphyton are aggregations or clumps of green filamentous algae hovering or tumbling along the bottom in shallow sandy areas. During summer and fall, metaphyton can accumulate

BLUENESS index shows that Lake Tahoe's iconic blueness is more strongly related to the lake's algal concentration than to its clarity



NEARSHORE ALGAE monitoring conducted by Katie Webb

along the south and southeast shores and eventually lead to smelly accumulations of decaying algae. TERC will continue to evaluate methods to monitor metaphyton,

which include using digital photo to assess algal coverage and collecting algae biomass along transects near shore.

EDUCATION AND OUTREACH

CITIZEN SCIENTISTS REPORT THEIR FINDINGS

New app allows lake visitors to add photos, observations to database

Winter isn't when you typically visit the beach. However, that's exactly what TERC scientists are hoping to change—for people to hit the beach this winter and record what they see using the "Citizen Science Tahoe" mobile app.

Released in August, the "Citizen Science Tahoe" app enables users to collect data in an easy and intuitive way. Users record things like algae, wildlife, and litter, and can add their own photos and comments.

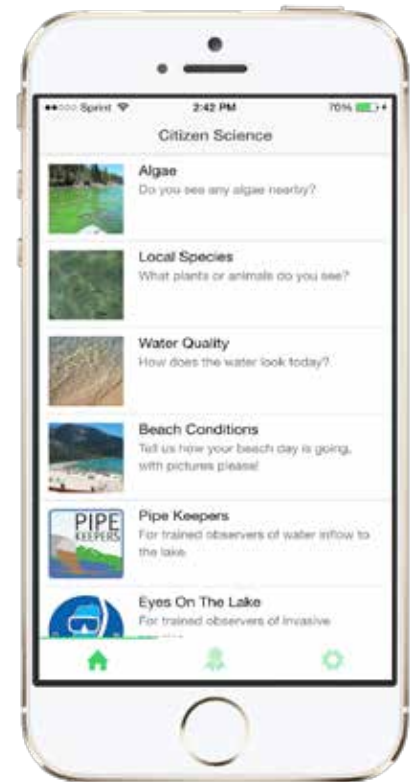
"There are aspects of water and ecological quality that depend solely on the perceptions of individuals. This is what this app is seeking to measure, from everywhere around the lake at all times of year," said TERC Director Dr. Geoff Schladow. "If you want to

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 an upcoming, interactive exhibit, "Lake Conditions." The exhibit will allow visitors to explore how things like lake level, temperature, clarity, color, and algae content change over time and at different locations around the lake. A working beta version of this is currently available at <http://citizensciencetahoe.org/data>.

The "Citizen Science Tahoe" mobile app is available for download in both Apple iOS and Android at <http://CitizenScienceTahoe.org>.



CITIZEN SCIENCE TAHOE mobile app



WINTER may not be beach weather, but UC Davis scientists need people to record what they see at the lake year-round on the Citizen Science Tahoe app.

EDUCATIONAL EXHIBITS

Come check out our three new interactive iPad exhibits in the Tahoe Science Center: 1) DIY Lakes allows visitors to investigate lakes ecosystems and how they change throughout the seasons, 2) Healthy/Unhealthy Lakes explores how various activities can impact a lake's health and functioning, and 3) State of the Lake lets visitors learn about the most important factors affecting Lake Tahoe's health from TERC's annual State of the Lake report.

EDUCATION AND OUTREACH, CONTINUED

SANDBOX EXHIBIT

Using sand and some innovative technology, TERC's augmented reality (AR) sandbox exhibit has enabled visitors to build watersheds complete with contour lines, colorful

elevation gradients, and virtual water flowing downhill to create streams and lakes.

The interactive sandbox exhibit comes from the joint efforts of the UC Davis KeckCAVE, ECHO Lake Aquarium and Science Center, the

Lawrence Hall of Science, and TERC. Since debuting in 2014, the three original AR sandboxes have inspired educational institutions across the globe to build their own sandboxes. There are now over 60 installed around the world.



SANDBOX EXHIBITS developed under the NSF grant are located at more than 60 locations around the world.

YOUTH SCIENCE INSTITUTE

We are pleased to announce that our Youth Science Institute (YSI) is now accepting applications. YSI is an after-school program where high school students interact with scientists and engineers. From fish dissections to building robots, students gain hands-on experience and learn about potential careers in different Science, Technology, Engineering, and Math (STEM) fields. This is an outstanding program that will benefit any college-bound student. Information and applications are available at http://terc.ucdavis.edu/education_outreach/educationprograms/youthscienceinstitute.html.

Applications are due January 15, 2016.

UPCOMING EVENTS

People's quest for knowledge at Lake Tahoe seems to be growing. As the last two TERC monthly lectures have been fully booked, we are now requesting online reservations through Constant Contact. It is fast and easy! Click on the "Register" link and add your name to the list.

JAN. 28, 2016: Exploring Mars with Curiosity, with Dr. Dawn Sumner

FEB. 18: Physics of Snow, with Dr. Bernhard Bach

MARCH 14-18: Science Expo, with public event March 16

APRIL 7: Pollinators - Bees and Butterflies, with Ellen Zagory

MAY 3: Tree mortality in the Lake Tahoe Basin - Causes and Consequences, with Dr. Patricia Maloney

MAY 19: The Deepwater Horizon Oil Spill: Behind the Headlines and the Lessons Learned, with Dr. Ronald Tjeerdema

JUNE 21: History of research at Lake Tahoe, with Dr. Charles Goldman

JUNE 21, 23, AND 25: Docent training

JULY DATE TBD: State of the Lake, with Dr. Geoff Schladow

AUG. DATE TBD: Children's Environmental Science Day

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

SEPT. 15: Mapping the U.S. Innovation System Today, with Dr. Fred Block

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

NOV. 10: 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.

Dr. Alex Forrest, a former TERC post-doc, is returning from three years at the University of Tasmania. Alex's expertise is in physical and chemical processes in lakes and oceans, and in the use of autonomous underwater vehicles and other remote instruments.

Dr. Steve Sadro, currently a post-doc with UC Riverside, will be joining UC Davis as an ecologist, to build on the work of Dr. Charles Goldman. Steve has been studying small lakes throughout the Sierra Nevada as part of his research, looking at impacts of atmospheric deposition and climate change.

THANK YOU PATTY ARNESON

After 36 years with the Tahoe Research Group and TERC, our esteemed data analyst and archivist **Patty Arneson** is leaving. Not one of our data points has ever been released without Patty first ensuring that it had undergone all the appropriate checks and protocols and that it met her standards for excellence. It was this attention to detail and meticulous record keeping

that contributed to Lake Tahoe's ecological data set being one of the most valued in the world. Hopefully her retirement will be free of spreadsheets and log books.

GRADUATE STUDENT NEWS

Welcome **Perrine Ratouis**, a visiting graduate student from Switzerland's École Polytechnique Fédérale de Lausanne (EPFL). During her seven-month stay, Perrine has been working with Geoff Schladow and Simon Hook (NASA-JPL) to complete her master's thesis on nearshore convection movements in Lake Tahoe. To study these movements, Perrine has installed a thermal infrared camera to observe temperature patterns on the nearshore water surface. Her next steps are developing models to better understand how pollutants move in the nearshore.

Welcome to our newest graduate student, **Karen Atkins**. Karen previously spent a year working as a SNAP AmeriCorps member with the Sierra Fund in Nevada City.

WELCOME 2015-16 AMERICORPS MEMBERS

TERC welcomes our three new AmeriCorps members for the 2015-2016 year! The Sierra Nevada AmeriCorps Program (SNAP) is supported by the Sierra Nevada Alliance and we are incredibly grateful to have new energy and enthusiasm for the science education program.



2015-16 AMERICORPS MEMBERS Evan Portier, Emily Frey and Bree Lewis on the NASA Buoy on Lake Tahoe

Emily Frey grew up in the majestic Redwoods of Humboldt County. She eventually found herself on the sandy beaches of UC Santa Barbara and earned a B.S. in Biological Sciences. She currently lives in Truckee and has worked as a biological technician in the past.

Bree Lewis is native to New Hampshire, but has called Tahoe home for the past year. She spent her college years at the University of Colorado, Boulder, completing a B.S. in Environmental Sciences. She is an avid skier and loves to cook and read in her free time.

Evan Portier hails from Los Angeles and graduated with a degree in Environmental Science from UC Berkeley. He has had positions in Tennessee, New Mexico, Colorado, and Puerto Rico, before returning to California. He is a proud owner of a 74 VW Bug and 75 VW Bus.

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

RESEARCH UPDATES, CONTINUED

RESEARCH BUOYS ON LAKE TAHOE

By Brant Allen

UC Davis has been conducting lake research with NASA's Jet Propulsion Lab (JPL) for the past 16 years. The research has focused on four buoys anchored in the center of the lake. JPL uses the buoys to collect precise measurements of the lake's surface temperature in order to calibrate satellites which provide the thermal images of earth processes such as the El Niño conditions in the central Pacific.

The buoys have evolved over time. The original catamaran style rafts couldn't handle the winter waves Lake Tahoe generated. With limited funding, used buoys were originally purchased from the National Oceanographic and Atmospheric Administration (NOAA). These proved themselves in Tahoe's rough choppy waters for over a decade. This past summer, staff from UC Davis and JPL replaced the two oldest buoys. The new 5,000 pound buoys were deployed in 1,500 feet of water with 3,000 pound anchors. These buoys have been equipped with the necessary instrumentation and are once again recording the lake's surface temperature and weather conditions.

It is on one of these NASA buoys that Dr. Watanabe conducted his recent research on the blueness of Lake Tahoe. Without a permanent structure in the deep water of Lake Tahoe this type of research would not be possible. As researchers discover new ways to assess changes in the lake, the new buoys will continue to serve as reliable platforms.

URBAN STORMWATER MONITORING

By Raph Townsend

Stormwater monitoring is an ongoing effort at Lake Tahoe. In cooperation with partners around Lake Tahoe, TERC provides expertise in the construction, design and maintenance of stormwater monitoring sites. The sites are located within three counties—Placer, El Dorado, and Washoe—and are placed with water quality improvement projects. TERC partners with the Tahoe Resource Conservation District to provide the personnel to operate the sites and manage the data.

Each stormwater monitoring site is different and requires unique equipment configurations. Most sites utilize automated water sampling equipment and turbidity and flow sensors. However, some sites have inflow and outflow monitoring equipment that measure the



NASA-JPL BUOYS being assembled prior to deployment on Lake Tahoe

effectiveness of a specific treatment. Other sites are located at the outfall of a treated area and collect pre- and post-improvement water quality data.

HOW CAN YOU SUPPORT TERC?

- **Charles Goldman Endowed Fund:** To honor Goldman's many contributions and dedication to Lake Tahoe, this fund creates an endowment for graduate student support.

- **Direct donations to TERC:** Support can be for research, education, or the area of greatest need. Send check payable to "UC Regents" directly to TERC using the "Giving" information on the back of this newsletter or online <https://give.ucdavis.edu/Donate/YourGift/TERCGFT>.

- **Give Back Tahoe:** As we enter the holiday and giving season, UC Davis Tahoe Environmental Research Center is pleased to be one of the featured non-profit organizations for Tahoe Truckee Community Foundation's Give Back Tahoe. Starting Dec. 1 and running through the end of the month supporters can donate online via Give Back Tahoe's website at <https://www.giveback-tahoe.org/#npo/uc-regents>.

- **Parasol Tahoe Community Foundation:** Donate to the "Lake Tahoe Science Fund" online anytime at <https://www.parasol.org/index.php/donate-now>.

- **Honor a special friend, a special occasion or simply support science to save the lake** at <https://give.ucdavis.edu/Donate/YourGift/TERCGFT>.

- Thank you for your support.

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.

Name: _____

Spouse/Partner: _____

Address: _____

City, State, Zip: _____

Phone: _____

Gift Amount: _____

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 giving.ucdavis.edu/ways-to-give/disclosures.html

TERCGFT

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

