TAHOE

A LEGACY OF RESEARCH, EDUCATION & OUTREACH

Profiles in research
Nevada research contributes to Tahoe science

Alumni profiles
Alumni invest careers in preserving Lake Tahoe

University of Nevada, Reno
Academy for the Environment

DRI
Center for Watersheds and Environmental Sustainability

Compiled by: Mike Collopy, Jim Thomas, Wally Miller and Alan Heyvaert

HARRY REID
NEVADA

MAJORITY LEADER

United States Senate

WASHINGTON, DC 20510–7012

August 2012

Dear Friends:

Lake Tahoe offers unmatched beauty within the Sierra Nevada Mountains and serves as a major source of pride for Nevadans. As stewards of this lake, it is our responsibility to protect and preserve the ecosystem for future generations. The work we have already accomplished has benefited the environment and the economy for Nevadans and Californians alike.

Since 1997, when we held the first Lake Tahoe Summit, incredible strides have been made in restoring the health of the Tahoe Basin. Increased public awareness and federal involvement have been essential to preserve this national treasure. It is critical to reauthorize the Lake Tahoe Restoration Act to continue the great work completed over the past 15 years.

Each August provides us with an opportunity to mark our progress and plan our next steps. The scientists, faculty, and students of the University of Nevada, Reno and the Desert Research Institute produce influential research within the Basin every year. I am proud to see how this hard work is paying off with significant successes at Lake Tahoe.

Our joint efforts have served as a model for how to coordinate efforts of federal, state, and local agencies with the common goal of preserving and protecting this gem of the Silver State. It is vital that we continue to shape conservation efforts to protect the environment and our economy.

My best wishes to you.

Sincerely,

HARRY REID
United States Senator

DEAN HELLER
NEVADA
(202) 224-6244

COMMITTEES:
ENERGY AND NATURAL RESOURCES
COMMERCE, SCIENCE, AND TRANSPORTATION
SPECIAL COMMITTEE ON AGING

United States Senate

WASHINGTON, DC 20510

August 2012

Dear Friends:

The annual Lake Tahoe Summit is always a great opportunity to reflect on past accomplishments and chart future efforts to ensure the long-term health of Lake Tahoe – one of the most spectacular places on earth.

I have the privilege of hosting this year's Summit, which will focus on "***Public-Private Partnerships – Investing in the Future of Lake Tahoe.***" I firmly believe the successes we have enjoyed since the first Presidential Summit in 1997 would not have been possible without the numerous partnerships that started then and have increased in number and scope to this day. These collaborative efforts in both California and Nevada include federal, state, and local governments; private citizens; private businesses; non-profit organizations; and our research partners, including the University of Nevada Reno, Desert Research Institute, and UC Davis. These successful partnerships and working relationships illustrate what can be accomplished when we work toward a common goal.

As we all know, our nation is currently facing economic struggles that demand we do more with less. The infrastructure and established relationships in the Lake Tahoe Basin will play an important part in navigating these difficult times. Remaining vigilant in our fight against invasive species and the threat of wildfire, as well as other environmental challenges, will require continued hard work. I am confident that we will be able to continue to improve the health of the Lake and the surrounding areas by looking to each other to maximize our strengths and resources.

The Lake Tahoe Basin is truly a special place. A dedicated community of citizens, in both the public and private sector, is committed to preserving and improving Lake Tahoe for future generations to enjoy, and I am honored to be a part of it. These annual forums have been instrumental in keeping the challenges facing Lake Tahoe in focus, and I look forward to continuing our work together.

Sincerely,

Dean Heller
United States Senator

President Stephen Wells

President Marc Johnson

Dear Friends,

Since the first Lake Tahoe Environmental Summit in 1997, scientists from the Nevada System of Higher Education's institutions, and, in particular, from the Desert Research Institute (DRI) and the University of Nevada, Reno, have produced an impressive array of research that is today providing the roadmap to a healthy future for one of the world's prized possessions, Lake Tahoe.

Although this record of research has been vital, it should be noted that both DRI's and the University of Nevada, Reno's scientific work and research at Lake Tahoe dates back longer than 15 years. For several decades, our institutions have placed Lake Tahoe among our highest research and environmental priorities. We have taken to heart words spoken by the pioneering Tahoe scientific figure James Edward Church, considered the father of modern snow science. It was Dr. Church, along with several other collaborators, who helped establish a weather observatory on the summit of Mount Rose in 1906. Church's observatory became one of the first enclaves of Tahoe science, where data were recorded on snow deposits, wind, and runoff. Years later, Dr. Church reflected on the value of his work. "At the end of the rainbow," he said, "I sought snow and found friendship."

So it has been for DRI and the University of Nevada, Reno. Researchers from both institutions, working in concert, have provided comprehensive studies that have led to a better understanding of Tahoe's sky, land and water. Along the way, there has been the creation of another key asset: teamwork. Our talented cadre of scientists has developed a model of collaboration that through its highly cooperative, productive and ongoing research agenda, has had a dramatic impact on Lake Tahoe's future.

We are proud of the work of our researchers in finding a sustainable future for Lake Tahoe. And, as this publication so vividly illustrates, this effort in finding solutions has, along the way, helped foster a research culture at Lake Tahoe firmly based on collaboration, professional respect, and friendship. The vivid rainbow that is Lake Tahoe has not only inspired all of us to action, it has, in the words of the legendary Dr. Church, brought out the very best in our scientific community.

Sincerely,

STEPHEN WELLS
President
Desert Research Institute

MARC JOHNSON
President
University of Nevada, Reno

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Alan Gertler

Air quality worsens in the Tahoe Basin

By Deanna Hearn

Many people don't realize Lake Tahoe's air quality affects its water clarity, and the air quality is getting worse.

Alan Gertler, a Desert Reseach Institute (DRI) scientist for 33 years, studies air quality around the globe. According to Gerler, the Tahoe Basin is suffering from elevated ozone levels. "The increased ozone has both human and environmental consequences. It doesn't violate the federal standard, but it does violate the California standard and is one of the few areas in California where ozone is getting worse."

Photographs by Quincy Shanks

Involved in two current ongoing studies at the lake, Gertler and other researchers from DRI, the U.S. Forest Service and St. Mary's College in California are trying to get a better handle on the sources of ozone in the basin. A combination of measurements and modeling are underway during the high summer season to help guide regulators on how to mitigate and control the ozone problem.

"People relate to water clarity and visibility. In studying air quality we're more interested in particulate matter and ozone because they have health consequences," said Gertler. "However, our work has shown that both pollutants contribute to the decline in water quality as well as the degradation of visibility in the Tahoe Basin."

There are three major contributors to the decline in water clarity in the basin according to Gertler; nitrogen, phosphorus and particulates. Nitrogen and phosphorus contribute to the growth of algae and particulates get deposited in the water and scatter light.

"Nitrogen comes from many different sources," said Gertler, "including a great deal from cars, trucks and boats. More than 50 percent of the nitrogen deposited in the basin comes from the atmosphere. Our work has shown that most nitrogen comes from sources within the basin. Particulate matter, which doesn't transport far because it is larger, also primarily comes from inside the basin.

"We've gotten quite far in understanding the sources of pollution and how much is from within the basin versus out of the basin. The next step is to work with the people in the basin to find effective strategies to manage growth and development while minimizing the effects of the pollution."

Through his work in mega cities throughout the world, Gertler sees some of the most unhealthy, polluted places on the planet. "It's a pleasure to work at Tahoe in an area with such natural beauty. It motivates me to work there because we have the opportunity to preserve something so beautiful. In most of the places I work the pollution is so unbelievably bad, the best we can do is try to minimize the risks to people and the environment."

Photographs by Quincy Shanks

Alan Gertler
examines air quality and its effect on Lake Tahoe's water quality.

Photograph by Quincy Shanks

Peter Weisberg

Satellites and computer models help study forests

By Deanna Hearn

Photographs by Scott Hinton

Peter Weisberg, associate professor in Natural Resources and Environmental Science at the University of Nevada, Reno, and his graduate students are actively studying the forests in the Tahoe Basin.

Doctoral student Sarah Karam is using computer modeling to study nutrient cycling as the result of changes in forest management. This includes a historical perspective from the clear-cut during the Comstock mining boom in the 1800s to modern day fire exclusion and fuel treatments to reduce fire risk.

"Sarah's model assesses the flows of nitrogen and phosphorous on a given piece of ground," said Weisberg. "The fire volatilizes nitrogen but also changes nutrient cycling in complicated ways that are difficult to predict without modeling. We measure a lot of things, but we can't go back to before the forest was influenced so much by logging and fire suppression. A model is valuable in better understanding natural processes over time in areas as large as the Tahoe Basin."

"The literature has been dominated by nutrient cycling in wet forests," said Karam, "but the effects of fire on nutrient cycling in drier forests have been less explored. In the semi-arid Tahoe Basin, fire is more important in moving nutrients through the system. Nutrients are either burned up or leached into the soil and moved into the water.

"Fire had a nearly 50 percent larger effect than the leaching processes before European settlement because of the frequency and severity of the fires. With fire exclusion we're not replicating the burn up of nitrogen so there is an increased buildup of nutrients. We know historically in dry environments that fire is important in regulating nutrients in the watershed. With fire exclusion and fire treatments, we have more than doubled the amount of nutrients in the terrestrial ecosystem."

"Even though removing brush is intended to restore forest structure," said Weisberg, "the modeling suggests it might not be effective in restoring historic nutrient cycling. It has an effect on reducing fire risk and restoring what we can see in the forest, but not for reversing the effects of increased nutrient loads. This has implications for the clarity of the lake."

Jane Van Gunst is a master's student studying the changes in Tahoe Basin forest mortality from 1985 to 2010, which includes wet and dry periods. "I'm looking at what drives tree mortality such as density, climate, differences between pines and firs, differences in location, and the interaction between stand structure and drought."

"Jane studies the health and mortality of the forest canopy using satellite imagery," said Weisberg. Using one image of her study area taken every September to show how much of the forest canopy has died in every part of the basin. By analyzing the images, she's developed an algorithm to estimate tree mortality from year to year around the basin.

Preliminary conclusions show that tree density increases the risk of forest mortality particularly at lower elevations and especially during dry years. The increasing frequency of drought years could lead to a continuing increase in the number of trees dying.

Graduate student Yuanchao Fan worked on a study funded by the Nevada Department of Transportation with Weisberg and Professor Robert Nowak using remote sensing to determine how road salt has affected tree mortality. Fan found that tree mortality is greatest near roads, particularly following wet winters when more de-icing compound is used. However, the damage extends only to a narrow belt of forest about 100 feet from the road.

Research assistant professor Jian Yang has developed a statistical model to look at the number and distribution of ignitions for forest fires. Using climate change forecasts, the model is based upon environmental and human variables including road density and population centers.

"He's taken different models of climate change, downscaled them to the Tahoe Basin, then extrapolated fire patterns into the future assuming that the fire maintains relationships with climate as it has in the past," said Weisberg. "His model predicts there could be up to three times more fire ignitions by the end of the century, and the location and number of fires will change. If that comes to pass, the forest and entire landscape may be greatly altered."

Peter Weisberg
studies forests in the Tahoe Basin utilizing landscape modeling.

Photograph by Quincy Shanks

Rick Susfalk

Peering into the nearshore's shallow waters

By Guia Del Prado

Most of Lake Tahoe's visitors swim and play along the lake's 72 miles of shoreline. That's also where most pollutants enter, and where a degradation in water clarity is most apparent.

While other scientists study Lake Tahoe's water clarity in deeper waters, Rick Susfalk, an associate research scientist from the Desert Research Institute (DRI), peers into the shallow depths of the lake's nearshore area to learn more about how pollutants are affecting where visitors play everyday.

"When we start seeing degradation, we'll see it first in the shallower nearshore area," Susfalk said. "We can get a better handle on it because the particulates are so much more concentrated. Offshore it's too dilute to be easily measured."

Impervious surfaces, like roads and parking lots, don't allow these pollutants to soak into the ground. Rather, they funnel pollutants into storm drains and streams, which then enter the lake if not treated. The pollutants not only cloud Lake Tahoe's renowned clarity, but can also upend the lake's ecology. Sediments can add more nutrients like phosphorus to the lake, which can then lead to algae growth. With enough time, Lake Tahoe's clarity could diminish.

To prevent that from happening, Susfalk is part of a multi-institutional group of scientists working to develop a long-term monitoring program for the nearshore regions. "To solve the problem of water quality," Susfalk said, "you not only have to look at where the pollutants are entering the lake, but also the onshore factors that create and move the pollutants toward the lake."

Measuring the clarity of the nearshore requires monitoring buoys and a 21-foot-long jet boat that has no propeller. Both the monitoring buoys and the jet boat contain on-board measuring instruments that can give a real-time reading of the water. An example of one of the measurements is turbidity, a measure of the amount of light that gets reflected back from the particles in the water.

But the existing instruments pose issues of their own. Rick is working on developing and acquiring instruments that are more sensitive and suitable for Lake Tahoe's clear waters.

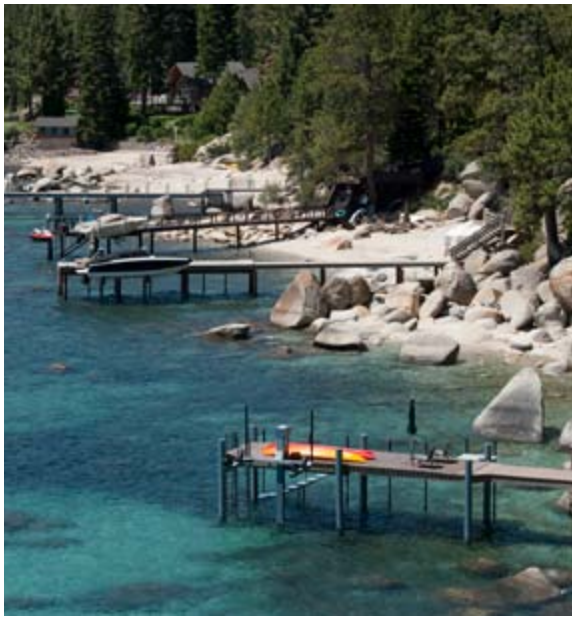
"One of the problems with measuring pollutants in Lake Tahoe is that the water quality is so good that many traditional methods and instruments are unable to measure the low concentrations present in the lake," said Susfalk.

Rick hasn't always worked with water quality. His previous work in the Lake Tahoe area investigated nutrient transformation and transport through forested and developed areas. Susfalk studied the nutrient cycles in the soils and vegetation of the upper watersheds and in developed areas where pollutants would gather before potentially streaming into the lake.

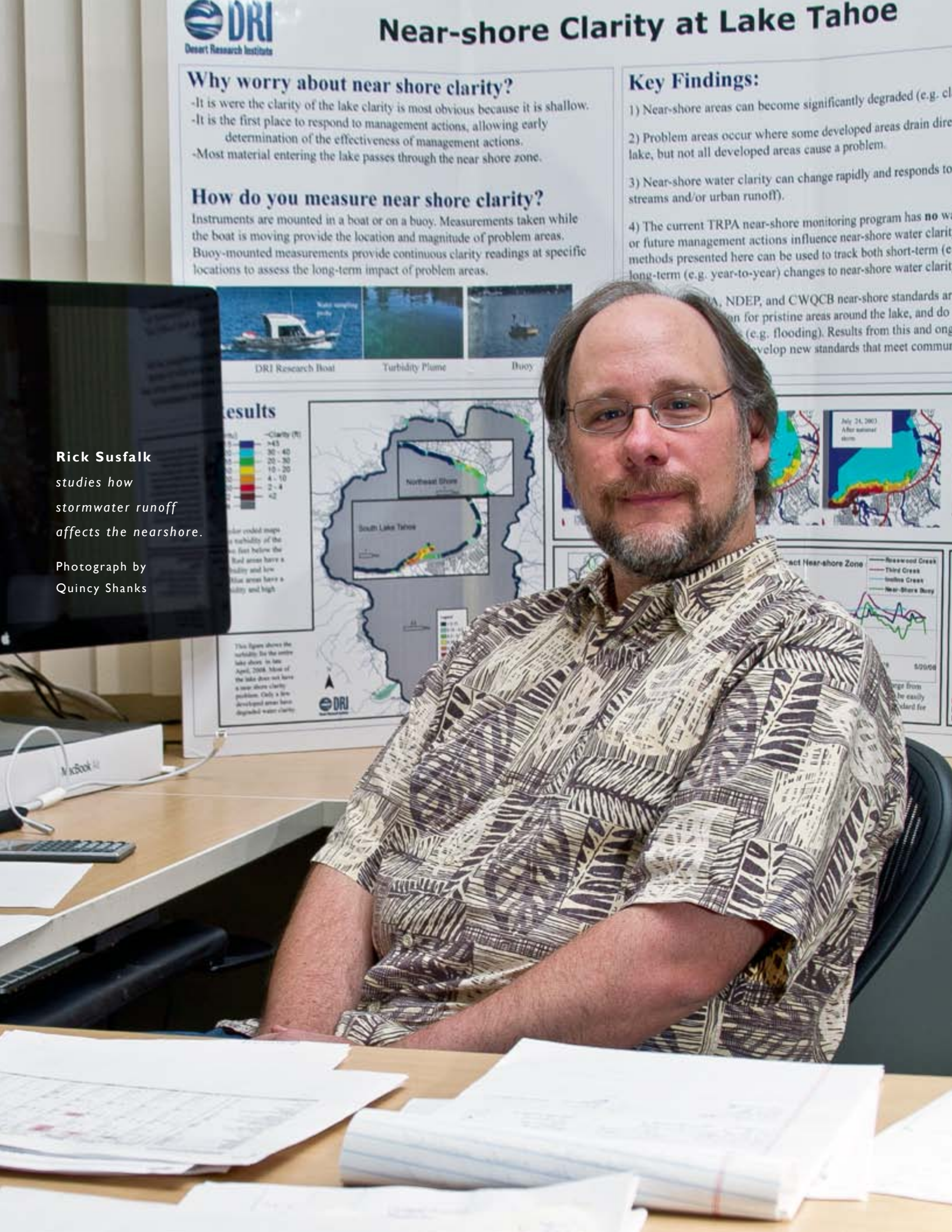
Susfalk has a background in chemistry but early in his career, he felt driven to work more in the field rather than in a lab. Now as a research scientist at DRI and an adjunct faculty member at the University of Nevada, Reno, Susfalk spends time in both settings, but with the bonus of Lake Tahoe's scenic background.

"I decided if I was going to work 80 hours a week, I would rather work outside in the environment than a smelly chemistry lab," Susfalk said. "I like to understand what I see around me. And you can't go wrong working at Lake Tahoe."

Photographs by Amber Gallop



Photograph by Scott Hinton



Rick Susfalk *studies how stormwater runoff affects the nearshore.*

Photograph by Quincy Shanks

Sudeep Chandra

Turning Tahoe's invasive crayfish into a consumable delicacy

By Deanna Hearn

Photographs by Quincy Shanks

A Nevada-born idea to commercially harvest invasive crayfish at Lake Tahoe could make a big difference in lake clarity according to University of Nevada, Reno freshwater scientist Sudeep Chandra.

"This is the first major project of its kind to use private funding to remove an invasive species at Tahoe and use it for public consumption," said Chandra. "Private entrepreneurs will harvest the crayfish and sell them to local restaurants. At the same time, this venture will help save the lake, an especially important development since public funds to protect the lake are diminishing."

Nationally and regionally this idea is getting a lot of attention. "Science has driven the understanding of the crayfish impacts to the ecology of the lake, and now the science supports these private partners in removing the crayfish legally and delivering them to markets in the region," said Chandra. "We're about a year ahead of those thinking about using this strategy in the Laurentian Great Lakes like Lake Michigan. The research is also being used in other lakes in the region such as Crater Lake."

Crayfish–also known as crawfish or crawdads–were introduced to Lake Tahoe four times from the late 1800s until 1936 when they were firmly established in the lake. "The purpose originally was to try to augment the fishery," said Chandra, "by providing more food for the fish and making them bigger. In 1930, they were planted to encourage the local population to eat them, but that's not what we ate in the West at that time. It was part of a southern culture."

According to Chandra, warming in the lake has caused warm water fish to move and establish in the nearshore areas. Other invasives such as plants provide the habitat. The crayfish serve as a food base for the invasive warm water fish which in turn stimulates other invasive species. "The process is called invasion facilitation where one set of invasive species supports and augments another invasive species to help it get established. An invasion meltdown can occur. This is the first set we're starting to see."

A series of snapshot studies on Tahoe crayfish began in the 1960s which counted 18 crayfish per night per trap. By 1970 the numbers increased to 25. Chandra's studies began in 2007 and the number has risen to 38-40 per trap. Considering this doubling of the numbers since 1967, there are about 240 million crayfish in the lake which translates to eight million pounds.

"Studies we've done suggest crayfish graze on dead algae cells and excrete them, which releases nutrients that stimulate more algae growth. Algae growth is a major factor in Tahoe's declining clarity," Chandra said.

The partners in the new crayfish harvesting business are Tahoe Lobster Co. and Sierra Gold Seafood which will distribute the crayfish. Chandra will be working with Tahoe Lobster Co. to track potential ecological benefits in parts of the lake where the crayfish are removed.

Since 1800, a variety of invasive species have been introduced into Lake Tahoe. Some were intentional, such as the crayfish and certain fishes, while other warm water fishes, bass and plants were unintentional or illegal. Chandra claims the invasive species come from two primary sources: attachment to boats and transferred into Lake Tahoe and the dumping of aquarium plants.

Much work has been done to preserve the lake's clarity. "More than a billion dollars in private and public funds have been spent on maintaining water clarity in the last 45 years," said Chandra, who has been studying the lake for 20 years. "This is a wonderful opportunity to merge private funding with science to deliver a product welcomed by local chefs and make a difference in removing a destructive, invasive species and improving water clarity in parts of the lake."

Sudeep Chandra

works to incorporate invasive crayfish into local restaurant menus.

Photograph by Quincy Shanks

Justin Huntington

Research to help improve Tahoe Basin water management

By Deanna Hearn

Photographs by Quincy Shanks

Justin Huntington, assistant research professor at the Desert Research Institute's (DRI) Division of Hydrologic Sciences, and Richard Niswonger, U.S. Geological Survey (USGS) research hydrologist, are studying evaporation and surface and groundwater interactions with regard to the changing climate at Lake Tahoe. They are using a combination of surface and groundwater modeling techniques that could be pivotal for managing future water supplies.

A new science is evolving, according to Huntington, in the integration of surface and groundwater modeling because of new software and computer capabilities. "Existing hydrologic models at Tahoe are strictly surface water models. This is the first combined surface and groundwater model for Tahoe. Including a groundwater model is critical because surface water models alone don't account for groundwater processes." About a dozen models like this are being used across the country.

"We're seeing a shift in the timing of spring runoff in the Tahoe Basin," said Huntington. "The snowmelt is occurring earlier because spring temperatures are getting warmer. This past March was one of the warmest on record. What no one was looking at was how this affects summertime stream flows. We found that July, August and September stream flows are getting lower at a time of year when the demand is highest."

In research completed this year on several Tahoe Basin creeks, Huntington and Niswonger's findings support a paradox discovered by researchers in the Western United States: despite increases in annual precipitation, summertime stream flows are going down.

"That's not what one might initially expect," Huntington said. "Typically you would assume that with more annual precipitation there would be increased annual groundwater recharge and summertime base flows, but that's not what we're seeing. We used climate projections with the USGS integrated surface and groundwater model, GSFLOW, to look at the mechanisms behind this process and learned that snowmelt timing is an important factor affecting summertime flows and not just the amount of precipitation and groundwater recharge."

In another related project, Huntington is looking at historical, current and future open water evaporation from Lake Tahoe, and his findings are influencing water managers. In a report published last August, he estimated the evaporation of the lake and surrounding reservoirs for the last decade, while simulating the impact of heat storage in the bodies of water on evaporation.

"A standard evaporation pan that is 10 inches high and 47.5 inches in diameter has historically been used to estimate lake evaporation. The pan suggests peak evaporation is in July. However, the lake stores a lot of solar radiation in the form of heat because of its size and clarity, which shifts the peak evaporation to September and October, not July."

Huntington said, "In the past, water managers have used the pan evaporation data to estimate monthly evaporation rates, but that is changing now. They are working to incorporate the updated evaporation figures in the Truckee River Operating Agreement which will, hopefully, be completed by the end of the year."

Monthly evaporation estimates are required for reservoir operations and water storage upstream. "It's important we account for the increased surface area of the body of water since there will be additional loss from evaporation," said Huntington. "We need to get the right numbers each month. This particular model can use climate projections of temperature to estimate what Lake Tahoe evaporation is going to be while including the heat storage effect. The shift in peak evaporation from July to September/October is key in water management."

Including integrated surface and groundwater and evaporation models for analyzing changing climate is critical for estimating when Lake Tahoe will stop flowing into the Truckee River and drop below the natural rim, according to Huntington.

"Tahoe has ceased to flow over the rim 20 times in the last 110 years. If precipitation goes down and evaporation rates increase, then the likelihood of that occurring more often will increase. It's essential to look at those probabilities."

Justin Huntington
combines surface and groundwater modeling research to inform future water management.

Photograph by Quincy Shanks

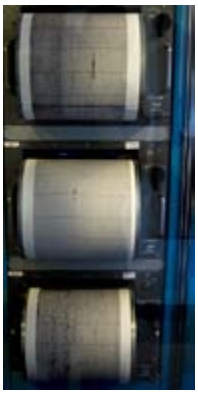
Ken Smith

Nevada's earthquake team

By Guia Del Prado

When a big earthquake hits anywhere in Nevada and eastern California, Ken Smith and the team at the Nevada Seismological Laboratory at the University of Nevada, Reno, immediately analyze the lab's data and update federal, state and local emergency management authorities. They are on call 24 hours a day, seven days a week.

"Many are overnight so we get buzzed and receive text messages and emails from a number of the network's automatic systems," Smith said. "We get woken up in the middle of the night. We have to get on our data center computers and see what impact the event may have had and ensure all of our earthquake response products make it to the right people."



Photographs by Quincy Shanks

As the Nevada Seismic Network Manager, Smith oversees a technical team and a network of more than 150 stations in Nevada and Eastern California, including the Lake Tahoe Basin. With large earthquakes, they access the Lab's seismic waveform data and refine the automatic location and magnitude of the earthquake. The lab not only conducts seismological research and data analysis, it's also a member of a national consortium of universities and government agencies monitoring earthquakes nationwide called the United States Geological Survey (USGS) Advanced National Seismic System (ANSS).

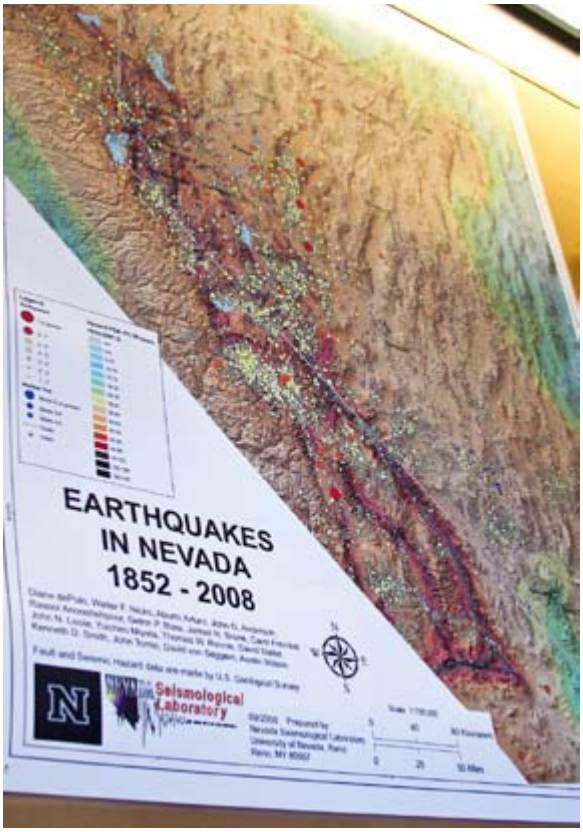
"We do research to better understand the region's seismic hazards but the Nevada Seismic Network also has a big service and public safety role for the state that takes priority over everything we do," Smith said. "If there's a large event we have to respond, everything else takes second priority."

Smith manages the statewide network but he said the Lake Tahoe Basin is an important area to monitor for earthquakes. Tahoe has been shaped by repeated earthquakes on major faults in the basin. The three main systems are the West Tahoe-Dollar Point, Stateline-North Tahoe and the Incline Village fault zones. To Smith and other seismologists the evidence for big fault ruptures in the past is clear. There will be large seismic events in the Tahoe Basin, but no one knows when the next one will be.

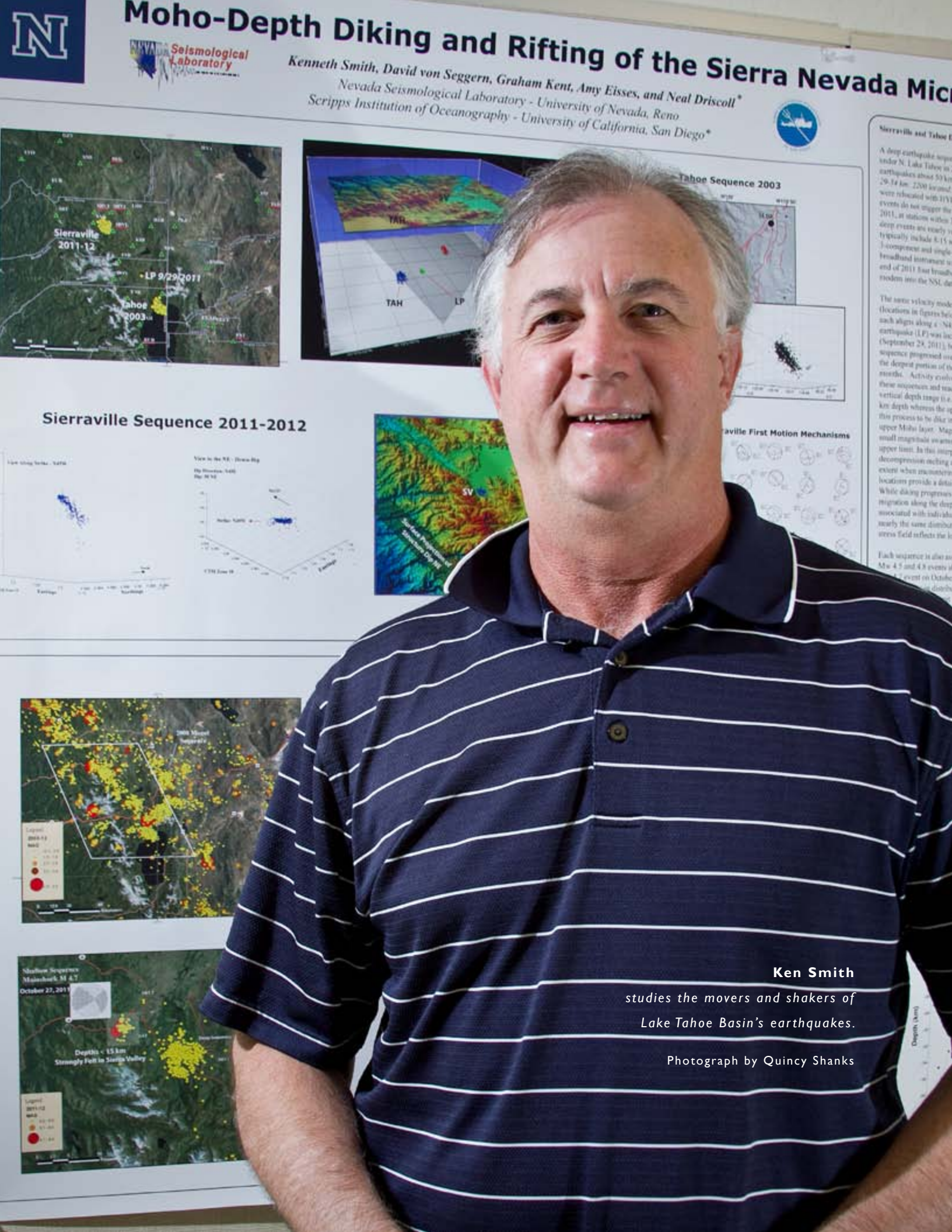
"Eventually there's going to be a big earthquake," Smith said. "And there are other looming issues such as landslides, possible tsunami run-ups, the kinds of natural hazards that regional planners and emergency responders are addressing. On any given day, summer or winter, the basin can be packed with visitors so a large earthquake will present enormous challenges."

Smith said to better monitor Tahoe, the USGS is supporting the upgrade of the lab's seismograph stations. They have good reason to monitor the area. Smith and the lab have detected very deep earthquakes under North Lake Tahoe that he said are most likely related to magma movements deep in the crust. It underscores the fact that Lake Tahoe is tectonically active today.

"Some of these older stations have been operating since the '80s," he said. "It would be like trading in your analog phone for a smartphone. We'll have a much better view of the earthquakes at Tahoe when this project is complete."



Photograph by Quincy Shanks



Ken Smith

studies the movers and shakers of Lake Tahoe Basin's earthquakes.

Photograph by Quincy Shanks

Tom Jackman

Lake Tahoe in a virtual reality setting

By Deanna Hearn

Photographs by Quincy Shanks

Imagine standing in the Lake Tahoe Basin surrounded by its beauty and seeing it in 3-D. It feels natural even though you're not there. In the real world, you would have to turn around to see what was behind you, or, if you were using a computer, you would have to use the mouse and the keyboard. Not here.

"We are creating terrain visualization for the earth, but, in particular, we're working on the visualization of the entire Tahoe Basin," said Tom Jackman, a computational scientist who directs the Desert Research Institute's (DRI) Center for Advanced Visualization, Computation and Modeling (CAVCam). "To our knowledge, there are only a handful of six-sided enclosures in the world. You can have a feet-on-the-ground view or a bird's eye view, plus you can look at the sky, rotate 360 degrees or see from any point of view.

"This is a comprehensive yet synthetic view. The advantage is that it gives you a cognitively satisfying experience. Being completely surrounded by the world you're looking at is how human beings perceive the natural world. It's as close as we can get using computer technology."

DRI's advanced visualization systems allow the world, the word used for the virtual scene, to be freely explored. Eight people will fit in the virtual reality enclosure or VRE, but one person controls the virtual space; the others see it from that user's perspective.

According to Jackman, the enclosure is a laboratory. "With these systems we can show what exists today and model how environments looked in the past or will look in the future. If we look at Lake Tahoe, we see water and trees, but our eyes are limited so we don't see temperature, air pressure or ground moisture. This technology expands our senses by adding other data and allows us to see the environment in an enhanced way. We can study Lake Tahoe in ways we are not able to in the real world."

The project requires large amounts of data including accurate representations of topography, vegetative cover, boundaries for bodies of water and more. "We utilize data from other DRI models such as surface or subsurface water transport, photographs and high altitude imagery. We can incorporate whatever relevant information, data and imagery we can find," said Jackman.

Funded by the U.S. Department of Energy and underway for nearly two years, the Tahoe project is expected to be completed next year. "Our region is dominated by how much water is available, especially when it comes to the Tahoe snowpack," said Jackman. "More generally, knowledge of water availability affects hydroelectric power and electricity production as well as water distribution in cities. The Department of Energy wants to know how environments like Lake Tahoe influence climates and respond to climate change. With this in-depth study of the lake, it can conceivably be used at other locations around the world."

The system is not just for scientists. It can also be used for community outreach and public policy. "We can teach people about the importance of Lake Tahoe," said Jackman, "of snowpack on water availability, and of the implications of building or irrigation on water purity and lake clarity."

"Our approach has been to study the system holistically and make all the data available in a way that people can find correlations between data sets, discover different relationships and use it as a tool for any future study," said Jackman. "It has both commercial and government uses."

A wildfire simulation is one of the system's premier applications. It allows people to visualize how wildfires propagate under various conditions.

"Visualization is the connection between computers and human beings. Our sense of sight allows us to connect a lot of computer-based analyse and modeling to human experts because visualization is the dominant sense for human beings," said Jackman. "I don't want to minimize the importance of computers, but the connection between computers and human beings in this immersive environment is a very effective tool."

Jackman is proud of his small, passionate team of University of Nevada, Reno graduates who do the work and explore how the system can be used.

Tom Jackman
utilizes 3-D technology to humanize data visualization.

Photograph by Quincy Shanks

Wally Miller

A tale of two fires

By Guia Del Prado

Photographs by Scott Hinton

Wildfires can be destructive to the immediate environment while they burn but they may also have lasting detrimental effects on the ecosystem sometimes long after they've been put out. Wally Miller and his colleagues Dale Johnson and Roger Walker have compared research findings from two large wildfires in the Lake Tahoe Basin to see how they affected runoff water quality from burned watersheds.

Miller and his colleagues studied the effects of the Gondola wildfire that burned in 2002 and compared their findings to those reported by other investigators from the Angora wildfire which occurred in 2007. They found that water from the overland flow runoff degraded sharply immediately following the Gondola wildfire, but generally improved after about three years. But Miller said that effect could change depending on the subsequent wet or dry water years.

An intense hailstorm fell on the Gondola site about two weeks after the wildfire.

"The runoff from that particular storm contained very high concentrations of ash, sediment, nitrogen and phosphorus, which are of concern to the lake," Miller said.

Nutrients and sediment entering the lake can stimulate algae growth and increase suspension of fine particles in Lake Tahoe, both of which diminish lake clarity.

Miller found that the Gondola wildfire adversely affected runoff water quality to a much greater extent than that reported following the Angora wildfire, which burned a much larger area.

"The good news is that the effects of wildfire on runoff water quality and other soil-related characteristics appear to be relatively short lived," Miller said. "The bad news is that the potential impact on stream and lake water quality depends on whether or not the wildfire is followed by a major precipitation event on bare soil or an overall wet or dry year; something which is largely unpredictable."

Miller and his colleagues are currently writing a report summarizing their comparison of the two wildfires' potential long-term effects on the runoff water quality. He said their study shows that fire suppression has decreased the number of wildfires that burn in the basin. Still, when they do burn, a higher burn intensity coupled with a larger accumulation of organic debris can increase the potential for washing large amounts of nutrients and sediments into the lake.

Much of Miller's work explores the links between the upper watershed and the lake. Miller and his colleagues are currently examining how nutrients are cycled in the forest watershed, particularly in areas of nutrient accumulation.

"We're now looking at the presence and distribution of nutrient hotspots in forest soils and whether they contribute to increased nutrient transport," Miller said.

He believes it's important to address how nutrients are cycled in surrounding watershed forests before they enter the stream and lake ecosystems.

"For years the change in lake clarity has been related to enhanced nutrient loading and fine sediment loading," Miller said. "If what goes on in the upper watersheds tends to influence that, then it's important."

Photograph by Scott Hinton

Wally Miller
compares how two wildfires affected Lake Tahoe's water clarity.

Photograph by Quincy Shanks

Alan Heyvaert

Cleaning up the lakeshore

By Guia Del Prado

Photographs by Quincy Shanks

Historically, water quality has been tracked at the center of Lake Tahoe. Now Alan Heyvaert, Interim Director of the Center for Watersheds and Environmental Sustainability at the Desert Research Institute (DRI), is collaborating with other researchers to investigate how pollutants are affecting water quality in the near shore area.

"A lot of people never get out into the middle of the lake, but many people swim and kayak in the water or hike along the lakeshore," Heyvaert said. "They experience the near shore more directly than the middle of the lake."

It's also where most pollutants enter the lake through stream inflows and urban runoff. Pollutants like fine particulates concern Lake Tahoe's scientists because they affect water quality and clarity. Fine particulate sediments also contribute nutrients to the lake, which in turn can nurture algae growth and diminish lake clarity.

"You see a lot of changes and hear about changes in the near shore," Heyvaert said. "But we've never quantified these changes in an integrated way."

Heyvaert has been researching water quality and watershed management at Lake Tahoe for 20 years. Part of this research contributed to the development of the Lake Tahoe Total Maximum Daily Load (TMDL), a guideline listing how much pollution can enter the lake before affecting its water quality. Nevada state management and environmental agencies approved the TMDL in 2011.

He found that urban stormwater contributes more than two-thirds of the fine sediments and about a third of the total phosphorus to the lake. Fine particulates can be washed into storm drains and culverts from impervious surfaces like parking lots and roads as well as from compacted and disturbed areas. These often discharge directly into the lake.

"In the winter we also put out sand for traction," Heyvaert said. "This gets ground up over time by traffic and then gets washed off with the storm runoff."

Now that state agencies are trying to implement the TMDL's recommendations, Heyvaert is investigating management and treatment methods that will control pollutant loading from the urbanized watersheds.

"You have fewer problems downstream if you implement best management practices near the point of origin," he said. "Other useful practices include things like street sweeping to remove fine particles from road surfaces and management of road shoulders to prevent erosion. Most recently, we've been investigating the relationship between urban areas and their nearshore environments, which are at significant risk of change due to urban runoff, invasive species, and warmer temperatures."

Researchers are collaborating with Tahoe Basin agencies to implement an integrated nearshore program that will identify problems early and track progress as management actions are implemented.

As a paleolimnologist, Heyvaert has studied various historical changes at the lake and how its ecosystem has recovered from previous disturbances such as logging. The human impacts at Lake Tahoe are now more permanent than they have been in the past.

"With urbanization our effects are chronic and we're not leaving anytime soon," Heyvaert said. "These detrimental effects persist and we have to find ways to manage the impact. If we can't do it at a place like Lake Tahoe where the qualities are so unique and visible, we'll have a hard time doing it anywhere else in the world."

Photograph by Scott Hinton

Alan Heyvaert
studies the state of
Lake Tahoe's nearshore area.

Photograph by Quincy Shanks

Mike Collopy

The man behind the scenes

By Deanna Hearn

Photographs by Amber Gallop

Mike Collopy believes in bringing science to the people, and he's spent the last decade in Reno doing just that.

"I'm trying to make science accessible to the public and give voice to the extensive research and education at Lake Tahoe. One of my roles is to help translate what scientists are doing," said Collopy, assistant vice president for research and executive director of the Academy for the Environment at the University of Nevada, Reno. "I want to humanize our faculty by showing their character, passion and commitment and help them be seen as regular people who care about what they do."

That was the primary motivation behind the creation of the Tahoe Summit publication six years ago, the brainchild of Collopy and University Professor Wally Miller. "It's also important to raise the visibility of the incredible work scientists from both the University and DRI have done and continue to do in the Tahoe Basin," said Collopy.

In 1994, Collopy established and was the founding director of the USGS Forest and Rangeland Ecosystem Science Center (FRESC) in Corvallis, Oregon. "A major focus of my position was to support the development and implementation of the Northwest Forest Plan," said Collopy, "which was developed following a summit convened by President Bill Clinton in the Pacific Northwest to resolve issues associated with the conservation and management of northern spotted owls and old-growth forests."

The administration subsequently established three interagency teams: a research team, an economic development team and an implementation team. Collectively these teams developed a comprehensive plan to provide a new vision for the management of public lands in the Pacific Northwest that protected imperiled species and ecosystems, while providing predictable levels of timber harvest. Collopy was the only person appointed to all three teams. His primary contribution, however, was to the research team's Forest Ecosystem Management Assessment Team (FEMAT) report. He was the lead author on the implementation and adaptive management chapter of the forest plan.

The plan represented the first time the Bureau of Land Management (BLM) and the U.S. Forest Service, in conjunction with other federal agencies, developed a coordinated management approach for an entire ecological region of the nearly 25 million acres administered by these agencies within the owl's range.

"My experience with the BLM and USGS in Oregon served me well," said Collopy, who moved to Reno after 10 years leading FRESC, a center that remains one of the most successful in the Western United States in terms of research productivity in dealing with forest and rangeland habitat.

"When I came to Reno as the chair of the Department of Natural Resources and Environmental Science, discussions were being held about how to organize the research institutions into an entity that could better represent the Tahoe science community," said Collopy. "We worked collectively to form the Tahoe Science Consortium (TSC) with funding from the Southern Nevada Public Land Management Act. Since it was established, the TSC has worked closely with resource management agencies to provide various kinds of requested technical assistance. TSC has also had the responsibility for administering a competitive, peer-reviewed process which improved both the quality of the applied research being proposed and the projects that received funding."

Collopy also served as the co-editor of the TSC's Tahoe Science Plan, which provided information on the state of our scientific knowledge in the basin and identified short- and long-term research priorities. This report was published in 2010 as a Forest Service General Technical Report that provided both resource managers and the scientific community with a snapshot of emerging research priorities and where information gaps existed.

Collopy is a wildlife ecologist who has directed research on birds of prey from Alaska to Venezuela. Orderly and organized by definition, he's excelled in several key administrative posts while staying actively involved in research with his graduate students. Although not currently conducting his own research at Tahoe, he is the designated supporter, promoter and facilitator in pulling together scientific research generated by university faculty in a way the public can understand and appreciate.

Mike Collopy
is dedicated to making science accessible in the Tahoe Basin.

Photograph by Quincy Shanks

Daniel Obrist

Chasing fires

By Guia Del Prado

For scientist Daniel Obrist, chasing fires is just part of the job. Obrist, an associate research professor at the Desert Research Institute (DRI), followed controlled burns for two years to identify airborne particles in smoke that result from different types of fires. He hopes to create a database of fire emissions to help Lake Tahoe environmental agencies identify different types of prescribed fire and emissions associated with them.

Photographs by Quincy Shanks

"I think an important part of regulatory issues is to understand air quality concerns in regards to prescribed burns," he said. "Do different types of fires lead to different chemical emissions? Is there an easy way to measure them?"

Management agencies at Lake Tahoe allow a number of controlled fires each summer to decrease naturally occurring forest fuel that could lead to larger, more destructive wildfires. Obrist coordinated with the United States Forest Service and the Incline Fire Department to collect data at various sites of fires. With the data collection complete, Obrist and his team are now analyzing the data and writing the reports.

"I said 'give us a call when you burn," Obrist said. "We hunted down the smoke at a relatively close proximity, making sure we were downwind where the fires occurred."

From the emissions measurements, Obrist and his colleagues are now creating a database of fire emissions and particulates to better quantify how managed fires affect air quality in the Lake Tahoe Basin. Ultimately the database could lead to observation stations to identify what types of fires have burned in the Lake Tahoe Basin and where they occurred.

"We're concerned with fires that occur in the Tahoe Basin," he said. "When you live in the area you get impacted by the emissions of those prescribed fires."

Obrist started at DRI while a graduate student in 1999. For several years he researched how mercury is processed in the ecosystem. As a scientist working on how pollutants are cycled between the land surfaces and the air, Obrist hopes his past two year's research will shed more light on the impacts of atmospheric pollution to the health of the basin's land and water ecology.

"This research is not just to look at the atmospheric side but to try to understand to what degree terrestrial areas can have implications on what we find in the atmosphere," Obrist said.

Photograph by Quincy Shanks

Daniel Obrist
studies the particles in prescribed fire smoke.

Photograph by Quincy Shanks

Jason Kuchnicki

Restoring Lake Tahoe to its former clarity

By Guia Del Prado

Photographs by Quincy Shanks

Jason Kuchnicki is working to restore and conserve Lake Tahoe's unique ecosystem. But his history with the lake stretches back to when he was 16 years old. Kuchnicki was in Lake Tahoe for a skiing trip from his hometown of Chagrin Falls, Ohio.

"I remember riding up the ski lift at Heavenly Ski Resort, looking back at this amazing blue, huge body of water in the midst of its alpine panoramic backdrop, thinking 'wow, this is incredible,'" he said. He has since been attracted to live and work in the area.

As the Lake Tahoe Watershed Program Manager at the Nevada Division of Environmental Protection (NDEP), Kuchnicki's main focus has been to develop a science-based plan to restore historic clarity to Lake Tahoe. His efforts helped produce the Lake Tahoe Total Maximum Daily Load (TMDL), an effort to better understand the causes of Lake Tahoe's degrading water clarity, determine how much pollution needs to be reduced to reinstate historic clarity and to develop a cost-effective implementation strategy.

A steady trend of degrading water clarity and transparency is apparent in lake monitoring since the late 1960s.

Kuchnicki, who has a background in geology and hydrogeology, co-managed the development of the TMDL, which the United States Environmental Protection Agency approved in August 2011.

"This research provided the foundation for developing a TMDL that was based on the best available science," he said.

Kuchnicki said the TMDL is one of the most robust efforts of its kind, combining the work of respected scientists from a variety of research institutions and consulting firms from across the country.

The TMDL finds that fine sediment particles and the nutrients nitrogen and phosphorous degrade the water's clarity. Fine sediment particles scatter light and nutrients fuel algal growth. Though they act differently, the effect is the same: less light enters the water, making it harder to see into deeper depths.

Not only did scientists and environmental agencies identify which pollutants are most harmful, they also prioritized where to focus clean up efforts: urbanized areas. Rain and snow falls on impervious surfaces like roads, parking lots and sidewalks where it cannot seep into the ground. Instead, fine sediments and nutrients are washed into storm drains and inevitably make their way into the lake. A key source of the pollutants appears to be roadways. Transportation authorities apply traction materials to improve winter driving conditions, but cars pulverize the materials. The road may serve as an important source itself as vehicle chains break down the road's surface and the materials are washed into storm drains. Research to pinpoint the specific sources of the pollutants is currently ongoing.

NDEP and the Lahontan Water Quality Control Board have established a 65-year goal to increase the clarity of the lake from an annual average of 68 feet to nearly 100 feet. Now the problem of implementation confronts stormwater managers and scientists in the Lake Tahoe Basin.

"The next big step is to determine the most cost-effective implementation strategies and to prioritize where to target these actions," Kuchnicki said.

He is currently working with the local governments on the Nevada side of Lake Tahoe to develop load reduction plans to reduce stormwater loads in their jurisdictions.

"Restoring Lake Tahoe is a collaborative effort that involves the participation and cooperation at all levels, even down to residents and visitors of the watershed," Kuchnicki said. "I think the reason we continue to have great success is because nearly everyone realizes what an important asset Lake Tahoe is, not only in terms of its extraordinary ecologic value, but as a recreation destination, drinking water source and asset to the local and regional economies."

Jason Kuchnicki *seeks to implement the Lake Tahoe Total Maximum Daily Load (TMDL).*

Photograph by Quincy Shanks

Dave Rios

An interdisciplinary approach

By Deanna Hearn

He calls himself an interdisciplinary scientist, and his work reflects that. For Dave Rios, this broad range of scientific inquiry gives him variety in both the natural sciences, such as biology and wildlife, and the physical sciences which include things like stormwater, water resources and soils. Rios works for Nichols Consulting Engineers (NCE) at Lake Tahoe where he spends 80 percent of his time working on projects in the Tahoe Basin.

"I get to dabble in the natural sciences when working on environmental improvement projects such as the planning, permitting and preparation of environmental documents as they relate to wildlife and botanical resources," said Rios, "and I wear my physical sciences hat when I work on stormwater and water resource projects with the engineers. I really enjoy it."

Rios has a particular type of project he's passionate about. "In grad school, half my work was on water quality and stormwater issues. Here at NCE we're developing our water resources services to include water quality monitoring and collecting information relevant to stormwater, which can provide valuable information to our clients.

"There are many firms that do this type of work, and it's highly competitive in the area. My boss has an extensive background in stormwater and water resources on a policy and program level through the development of stormwater management plans and stormwater finance strategies. The other part that's important to meet regulatory requirements is the collection, analysis and presentation of water quality data. Understanding this information can inform our clients more fully. That's where I hope I can ramp up our effort and create more opportunities for the firm," said Rios.

After getting his undergraduate degree in biology, Rios spent a number of years living in the Tahoe/Truckee area working on wildlife-related projects that involved characterizing bird and small mammal communities, searching for bird nests, and surveying butterflies, bats, reptiles, amphibians, and other creatures. He also worked for the U.S. Forest Service as part of a team collecting extensive data on wildlife and vegetation both before and after a meadow restoration project.

"We lived in the Heavenly Valley Ski Resort employee housing during the field season. We'd get up at 4:00 a.m. and do our surveys, then get back by 4:00 p.m., have a barbecue and talk about our day. It was fun, like a dorm experience, and that's where I met my wife," said Rios.

Yet Rios decided he wanted to go back to school. He knew about field methods and data collection but wanted to learn more about analyzing data and communicating it. That's what prompted him to get a master's degree in natural resources and environmental science from the University of Nevada, Reno in 2010, while also working with scientists at the Desert Research Institute.

A South Lake Tahoe resident, Rios grew up in Auburn. He likes the open space, natural beauty and the many outdoor activities Tahoe affords. "Because of what I do professionally and my experience working at Tahoe," said Rios, "it makes complete sense to live here."

Photographs by Quincy Shanks

Photograph by Quincy Shanks

Dave Rios
takes an interdisciplinary approach to working in the Tahoe Basin.

Photograph by Quincy Shanks

Nicole Gergans

Working to protect the Tahoe Basin

By Deanna Hearn

Photographs by Quincy Shanks

After receiving her master's degree in natural resources and environmental science at the University of Nevada, Reno, Nicole Gergans spent the last four years promoting policies that best protect the lake and its surrounding watershed while working for one of Tahoe's oldest nonprofit environmental organizations, the League to Save Lake Tahoe.

Today, in a new role as natural resources manager, she is focusing on prevention and control of invasive aquatic species and fine sediment moving into the lake. She is also working with the Tahoe Regional Planning Agency (TRPA) as part of the agency's effort to update its management plan for Lake Tahoe. "The League is a major stakeholder in this process," said Gergans, "and I am working with TRPA staff, our board of directors and other stakeholders to ensure the regional plan will be effective at improving and protecting the Tahoe watershed and ecology."

According to Gergans, her education at the University prepared her for the type of work she's doing. "Bridging the gap between policy and science in the basin is a constant challenge," said Gergans. "My training allows me to bring the scientific perspective to policy discussions and management recommendations." This is an important skill as the League undergoes an organizational shift and focuses more on stewardship, community participation and implementing solutions.

Community participation was key to a recent treatment project of an aquatic weed, Eurasian watermilfoil, at Tahoe's south shore. "We partnered with the U.S. Forest Service and the TRPA at Baldwin Beach," said Gergans. "The support of community volunteers is critical to this multi-year project. They pulled out the weeds and placed barriers on the bottom of the lake to block the sunlight so the milfoil will die."

Her new position will also allow her to take a closer look at fine sediment and different management strategies that can be used to prevent it from entering the lake. "One of the programs we're working on is another community engagement volunteer effort," said Gergans. "The League and the Friends of the West Shore are engaging people to take a personal interest in what enters the lake through the pipes in their neighborhoods. The group is called the Pipe Keepers, and they will receive training this summer on how to collect water samples. The data from these samples will go to agencies in the basin to advocate for stopping the pollution from going into the lake. The League's community engagement manager is organizing the neighborhoods, and I am involved on the science side."

Two of the main pollutants entering the lake that promote algae growth and affect clarity are nitrogen and phosphorous. Gergans' research for her master's thesis expanded the earlier findings of three University scientists, Wally Miller, Dale Johnson and Roger Walker, who discovered high concentrations of nitrogen and phosphorous in runoff from the forest floors that could affect Tahoe's clarity if the nutrients reach the lake.

"My research focused on riparian areas and wetlands which have long been used as a management tool for the interception of nutrients, but there had been little scientific research done on this," said Gergans. "The research results, however, were surprising and discouraging. The riparian area was ineffective at intercepting and retaining those nutrients. This particular site had a narrow riparian buffer so it's possible larger riparian areas could be more effective at intercepting the nutrients before they reach the stream. This is particularly important because fire suppression has allowed lodge pole pines to encroach on meadow areas, narrowing that buffer zone. It's important further research be conducted to provide better understanding to agencies on how best to manage these resources."

Gergans' study was published in the Soil Science Society of America Journal last fall.

Nicole Gergans
works to protect the lake from aquatic invasives and fine sediment.

Photograph by Quincy Shanks

Maureen McCarthy

Demonstrating a return on investment from Tahoe science

By Deanna Hearn

Photograph by Quincy Shanks

For Maureen McCarthy, her dream continues to make the wealth of information from 50 years of research in the Lake Tahoe Basin available to those facing the challenges of helping society and the environment coexist in sensitive mountain ecosystems throughout the country and the world. Her goal: create opportunities for the Tahoe Science Consortium (TSC) to make science a cornerstone of restoration and redevelopment in the Tahoe Basin and share this knowledge broadly so others can learn from what's been accomplished there.

"We see the work at Tahoe in a broader perspective." said McCarthy, TSC's executive director. It's bigger than just preserving the lake or understanding human development in a special environment. We can export our knowledge on changes we see in population, climate and economic realities. We can no longer base environmental protection on emotions. We have to present an economically-based argument as to why it's the right thing to do for both government and private industry."

Science-based decision-making is now becoming common practice in some agencies in the basin, according to McCarthy, but more work is needed to help organizations understand the linkages between the natural world and human society.

People from around the country attended the 2012 Tahoe Science Conference that included contributions from the social sciences and resource economics, as well as a public policy forum; all part of the TSC's move to help science demonstrate a return on investment for protecting and restoring the environment.

Established in 2005, the TSC partners include the University of Nevada, Reno; the Desert Research Institute; the University of California, Davis; the U.S. Geological Survey; and the U.S. Forest Service, Pacific Southwest Research Station. The final round of Southern Nevada Public Lands Management Act (SNPLA) research grants were awarded this year. Work on these projects will continue through 2015.

Lake Tahoe to Pyramid Lake

Summer research experience in the arid West

By Deanna Hearn

Photograph by Quincy Shanks

For the last three summers, students came from across the country to spend an intense 10 weeks immersed in a Research Experience for Undergraduates (REU) where they learned about the Tahoe-Truckee-Pyramid watershed while working on individual projects with faculty mentors. Sponsored by the National Science Foundation, the program is organized by the University of Nevada, Reno's Office of Undergraduate and Interdisciplinary Research and the Great Basin Institute.

The students took field trips to sites at Lake Tahoe, the Truckee River and Pyramid Lake, the three main bodies of water on which their projects were focused. This gave them a broad overview of the research, policy and management issues throughout the watershed.

They also attended weekly seminars presented by invited speakers and University faculty and staff. The opportunity to meet leaders from a variety of fields and learn about many different issues and viewpoints were key elements of this portion of the program.

Their faculty mentors helped the students develop research skills and complete research projects within their discipline of interest. In addition to the interaction with faculty, most students worked with the mentor's research lab or group. They presented their own research findings at the University's campus-wide Undergraduate Summer Research Poster Conference.

A highly successful program, the REU experience was wide-ranging and comprehensive, and it increased the interest in a number of students to attend graduate school.

Photograph by Quincy Shanks

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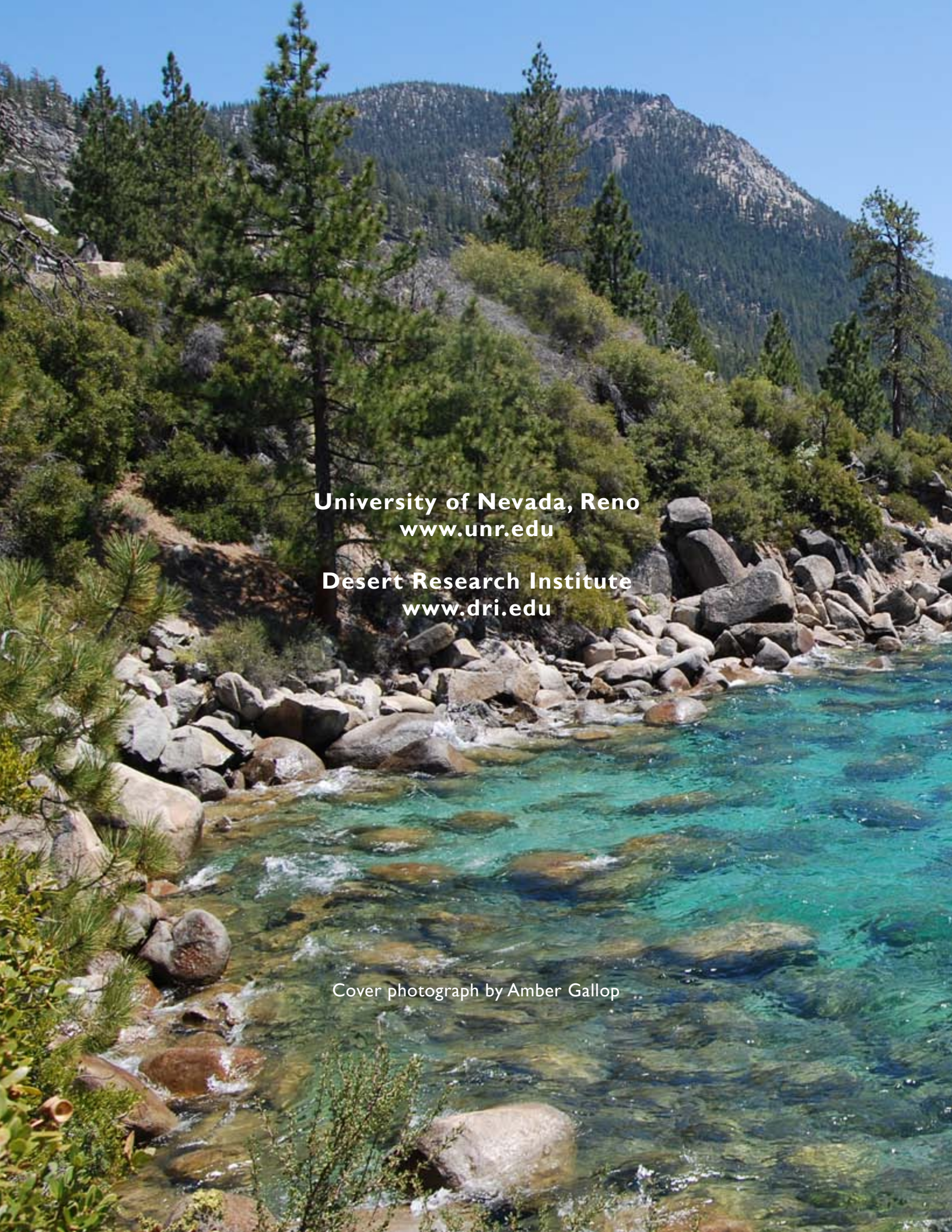

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Cover photograph by Amber Gallop