The Sierra Nevada Research Institute (SNRI) at the University of California, Merced, was created to discover and share new knowledge that will help sustain the ecosystems of California and the world using integrated research in natural and social sciences and engineering.

SNRI’s faculty, researchers and students have affiliations with each of UC Merced’s schools and most of the campus’s graduate groups. Concentrating on the Sierra Nevada eco-region, which includes the Central Valley and adjacent areas, SNRI aims to educate while also focusing some of the most important issues facing our society:

- climate and hydrology
- ecology and ecosystem science
- air pollution and public health
- resource management

Many of our research projects are created with the region’s environmental and socio-economic issues as a context, an approach that results in breakthroughs and innovations that are regionally specific but globally applicable. In these and other ways, SNRI is transforming students’ lives and making a significant impact on the world.

Thank you for reading SNRI’s July 2011—June 2012 annual report. We focused this overview on what’s new this year about the institute, and the affiliated faculty and staff who are contributing to new knowledge that contributes to the well-being of the Sierra Nevada and its surrounding valleys.

SNRI has expanded its research impact and outreach programs in Fiscal Year 2011-12 as our campus grew to more than 5,000 students. Faculty with expertise ranging from air quality to wildfire prediction to water resources collaborate with outside academic and resource management organizations across California and around the world, including the U.S. Forest Service, National Parks Service, and World Bank.

Our work in the past year has included increased focus on impacting public policy, and making more information available to inform decisions on adaptive management of our resources. For instance, data from the Southern Sierra Critical Zone Observatory is freely available online at czo.ucmerced.edu.

Recent efforts, in partnership with UC Center for Information Technology Research in the Interest of Society (CITRIS), have expanded a network of low-cost wireless sensors to monitor the American River basin’s water availability.
The foundation for the Sierra Nevada Research Institute was laid in 1997, when SNRI was part of UC Merced’s original academic plan and the campus’s first partnerships with resource managers — Yosemite and Sequoia-Kings Canyon national parks — were formed. Sam Traina, SNRI’s founding director, joined UC Merced in 2001, and additional faculty and research scientists joined SNRI in 2003.

As I assumed the leadership in 2007, SNRI became UC Merced’s first organized research unit. SNRI faculty and researchers continue to be very productive in obtaining grants, largely from federal and state agencies, and several SNRI research projects are collaborative with colleagues from other campuses and government research organizations, significantly expanding the impact of SNRI. Nearly $17 million in total research grants — almost 40 percent of all research grants received by UC Merced — were awarded to SNRI faculty members in the past three years.

SNRI’s facilities, faculty members and researchers have left their marks in other ways, as well, leading or cooperating in a number of research, educational and outreach programs. These include the university’s growing National Parks Institute, which initiated an Executive Leadership Seminar in 2009 as a way to bring together national parks leaders from around the world to improve their ability to anticipate change, innovate and manage strategically.

UC Merced’s outreach programs for middle and high school students prepare disadvantaged youth for college are supported by hosting a 40-day dynamic literacy program at our Yosemite Field Station. UC Merced students address park and public lands management issues through a two-year Yosemite Leadership Program, also hosted in Wawona.

While we use the Sierra and adjacent valleys of California for our primary focus, SNRI’s researchers explored solutions to environmental and human problems around the world in the past year. We were increasingly active internationally in the past fiscal year, and this report reflects that growing world impact as well. Our research is highlighted in the center of this annual report.

Sincerely,

Roger Bales
Researchers Take Mountain Water Monitoring to the Next Level

Researchers at SNRI are taking an important step toward a statewide water-monitoring system to provide continuous information about how much water is available to users.

“Our research provides a template for the next-generation water information system for California,” said UC Merced lecturer and researcher Robert Rice. “We will be able to accurately know the amount of snow across the Sierra Nevada, as well as the timing and magnitude of snowmelt, which provides our water.”

With low-cost sensors installed across the American River basin, scientists, water managers, farmers, flood-control managers and others will be able to get a more detailed picture of the amount of water in the basin.

“We’re going from monitoring a 5-square-kilometer area to a 2,000-square-kilometer area in one big jump,” said engineering Professor Martha Conklin. “It’s a full-basin hydrologic observatory, and a prototype water information system.”

A modern, accurate water-information system is critical for water security, especially given the changes brought about by climate warming in the mountains.” - Roger Bales

Research at Environmental Analytical Laboratory is Universal

Even though most people will never see what’s going on in the Environmental Analytical Laboratory (EAL), many will be affected by the work that’s performed there.

UC Merced’s EAL, in the Science and Engineering Building, is home to a number of the university’s researchers, who are looking into everything from local water quality to global climate change.

In some cases, the work is very local—one researcher analyze from a Merced resident’s well, reporting that while some impurities in the well were above background, it still met water-quality standards.

And in some cases, the work is extremely global. One project provides long-term measurements of the Artic atmosphere, precipitation and snow/ice on the Greenland ice sheet to monitor and better understand climate change, as part of a long-term global sampling network.

But those are just a few of the EAL’s functions. More than 20 research projects funded by federal, state and grants have been conducted using the EAL. Those projects have trained more than 80 graduate and undergraduate students, postdoctoral researchers and others in using multiple tools
Researchers Take Mountain Water Monitoring to the Next Level

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Federal and state agencies, hydropower interests, irrigation districts and groups responsible for flood management and other water stakeholders are eagerly awaiting the stream of information that will result. Data is currently available online through the Department of Water Resources’ California Data Exchange Center website. The data will be public, so “the American River hydrologic observatory will be a place for the scientific community to work,” Rice said.

The project is also part of the Intelligent Water Infrastructure initiative at the Center for Information Technology Research in the Interest of Society (CITRIS), a collaboration between UC campuses in Merced, Berkeley, Santa Cruz and Davis.

to achieve their research goals.

Researchers, graduate students and undergraduate students are working on projects that include ways to improve agricultural soil and reduce contaminants; remediation of sites contaminated by uranium and mercury; methods to reduce biomass from agricultural and forest lands and dispose of excess nutrients from dairy manure; better management of carbon flows through ecosystems—work that’s critical in mitigating the effects climate change; medical research into issues like cystic fibrosis; and much more.
New Report Shows Modest Improvements in Central Valley Environmental Health

Five years have seen some steps forward in the environmental well-being of the 450 mile-long Central Valley of California. The Sierra Nevada Research Institute at the University of California Merced and The Great Valley Center jointly produced “The State of the Great Central Valley: Assessing the Region Via Indicators—The Environment 2006-2011.”

There has been a modest improvement in a number of key air quality indicators, a recharge of some groundwater to near normal levels, a slowing in the loss of prime agricultural land to urbanization and an increased restoration of wetland habitats.

The Central Valley’s depressed economy has dramatically slowed the use of prime land for new homes and commercial space. It has also given local and regional governments time to prepare and begin using blueprints to improve urban housing density and transportation choices.

However, the Central Valley has many red flags when it comes to the environment.

The number of days that ozone levels were above state and federal air quality standards has increased overall since 2005, and almost all counties in the region are not meeting the...
one-hour and eight-hour air quality standards for many days each year. The percentage of the Valley’s population at risk for respiratory problems because of poor air quality outpaces other California regions.

The level of nitrates in drinking water has increased due to use of nitrogen-based fertilizers and planting nitrogen-fixing cover crops. Poor soil drainage has damaged fragile ecosystems. In some cases, the numbers have increased beyond the proportional rise in population.

The report is one in a series that measures five rotating topics. The indicators have been used widely by local elected officials, the State Legislature, health and economic researchers and environmental nonprofit organizations to inform public policy and foundation investments in the region.

faculty, researchers and graduate students.

Prior to joining SNRI’s staff, Dr. Hosley served for two years as interim vice chancellor for University Relations. He joined UC Merced as president of the Great Valley Center in 2008.

Dr. Hosley currently serves on the American Leadership Forum National Board and is secretary of the California Asian Pacific Chamber of Commerce Board of Directors. In that role, he represented UC Merced and SNRI at the China International Import-Expo in April.

A former broadcast journalist and manager, Dr. Hosley has coordinated growth in SNRI’s internet presence, including more print and video content and a new electronic newsletter. Dr. Hosley also serves on the UC Merced Athletics Board and assists the Research Center for Community Engaged Scholarship.

SNRI’s profile and visibility has been significantly updated with the migration to the new website at snri.ucmerced.edu as well as the addition of a public information representative, Lorena Anderson.
David Ardell and colleagues used a comparative genomics approach to infer ancestral genome organization and evolutionary scenarios through a pseudo-Boolean linear algorithm that could predict inversions, duplications, substitutions, and insertions (Research in Computational Molecular Biology, April 2012).

Andy Aguilar and colleagues discovered that prolonged periods (one to two months) of absolute food and water deprivation stimulates ATP degradation and decreases ATP synthesis, resulting in the accumulation of purines; also, the fasting seals possess a high capacity for purine salvage/recycling, which contributes to ATP supply and amelioration of oxidant production (Journal of Experimental Biology, May 2012).

Yihsu Chen and colleagues compared tradable permits and carbon taxes for the adoption of clean technologies for a coal-fired plant, finding offset and other price-control mechanisms are likely to delay clean technology investments (Energy Journal, 2011).

Mike Dawson found that speciation of Stigmatopora pipefishes between Western Australia and New Zealand occurred in parallel, suggesting similar environmental processes caused similar geographic patterns of diversification in two distinct lineages (Molecular Ecology, January 2012).

Benoit Dayrat and colleagues constructed 10 new complete mitochondrial genomes of pulmonates (Mollusca: Gastropoda) and demonstrated their impact on phylogenetic relationships (BMC Evolutionary Biology, October 2011).

“Our challenge at UC Merced is to seek out support and recognize and reward research and teaching that tackles questions and issues that transcend any one discipline.”
- Kathleen Hull
Roger Bales and colleagues estimated snow water equivalent across the Upper Merced and Tuolumne River basins of the Sierra Nevada of California for 2004 and 2005 using remotely sensed fractional snow-covered area, finding that middle elevations (2100-3000 m) contributes 40-60 percent of annual snowmelt, lower elevations (1500-2100 m) 10-15%, and higher elevations contribute 30-40 percent in both snow basins (Water Resources Research, August 2011).

Michael Beman and colleagues analyzed the ammonium oxidation rates of archaea and bacteria in the Gulf of California and eastern tropical North Pacific Ocean, and, through pyrosequencing and quantitative polymerase chain reactions, found that ammonia-oxidizing archaea are active within the euphotic zone while ammonia-oxidizing bacteria are confined to deeper portions of the water column (ISME Journal, May 2012).

Asmeret Asefaw Berhe and colleagues studied soil organic matter processes in eroding and depositional landform positions, and discovered that protection of soil organic matter by physical isolation were more effective in poorly drained, lowest-lying depositional landform positions compared to well-drained landform positions in the upper parts of an annual grassland watershed (Journal of Geophysical Research—Biogeosciences, 2012).

Henry Forman and colleagues discovered that tobacco smoke activates an enzyme called Src that is critical to the process that allows cancer cells to spread and was able to prevent the smoke from activating by introducing agents that prevent activation of the enzyme (Free Radical Biology and Medicine, April 2012).
Teamrat Ghezzehei developed a permeability evolution model that considers deposit morphology, finding that sparse and slender geochemical deposits causes a greater drop in permeability than uniform deposition (Advances in Water Resources, January 2012).

Qinghua Guo and colleagues developed a new algorithm to segment individual trees from the small footprint discrete return airborne lidar point cloud from which tree structural attributes can be derived (Photogrammetric engineering & Remote Sensing, 2012).

Tom Harmon and colleagues demonstrated the capability of managing soil salinization in real-time using a receding horizontal control algorithm through a small-scale field test, which suggests that it can autonomously achieve water reuse and agricultural objectives while managing soil salinization with adequately structured and trained simulation model, senor networks and optimization algorithms (Journal of Environmental Management, July 2011).

Wolfgang Rogge and colleagues developed and employed a new sampling system to determine and quantify air pollutants associated with tiny airborne particles with a time resolution not seen before that provides a detailed look into the dynamics of atmospheric chemistry ongoing inside and round airborne particles during summer and winter for the Baltimore area and understand of how atmospheric chemistry may alter aerosol chemistry and human health within a few hours (Environmental Engineering Science, January 2012).

To see additional publications, visit snri.ucmerced.edu
Steve Hart and colleagues tested the predictability of below-ground carbon fluxes on the basis of taxonomic identity and genetic marker composition of replicated clones of individual genotypes through a common garden approach, finding that genetic makeup of the plants growing in soil has a significant influence on the release of carbon from soils to the atmosphere (*New Phytologist*, May 2012).

Kathleen Hull reviewed previous research and current understanding of California native prehistoric demography, offering new approaches for archaeological research that encompass the social, rather than simply the ecological, implications of demography (*Contemporary Issues in California Archaeology*, 2012).

Teenie Matlock, with colleague Lilian Davila and a UC Merced undergraduate, investigated the learning effectiveness of immersive 3D virtual reality environments, and discovered new ways to improve the perception of nanostructures, particularly carbon nanotubes (*MRS Online Proceedings Library*, 2011).

Tony Westerling and colleagues used hydroclimate and land-surface characteristics under a range of future climate and development scenarios to predict large wildfire occurrence and burned areas in California, finding that a significant increase in large wildfire occurrence and burned areas are likely to occur by mid-century due to the effects of increased temperatures on evapotranspiration and reduced precipitation (*Climate Change*, 2011).
National Parks Institute is Expanding to Meet Leadership Challenges

At a time when protected lands around the globe are under increasing stress from reduced government resources, an innovative institute incubated within the Sierra Nevada Research Institute is arming today’s and tomorrow’s park leaders with knowledge and approaches to sustainability.

A key element of NPI is its Executive Leadership Seminar, a joint effort among a handful of partners that aims to link park leaders from around the world and give them the opportunity to share ideas, skills and tools for thinking and working on a strategic scale. The National Park Service, Stanford University, Great Valley Center and Institute of the Golden Gate joined UC Merced in the NPI partnership this past year.

The intense, 11-day workshop was held in April and brought together 27 emerging leaders from parks in 13 countries, taking them from Cavallo Point in the Golden Gate National Recreation Area to UC Merced, and culminating in Yosemite National Park.

Newest SNRI Faculty Affiliate Has World View

Erik Rolland is as at home in Shanghai and Canada as he is in his native Norway or Yosemite National Park. Rolland came from UC Riverside in January, and joined Tony Westerling as UC Merced faculty leadership of this year’s National Parks Institute, which included more than a dozen parks and protected lands from Lebanon between Cameroon to Mongolia.

The Ernest and Julio Gallo Professor of Management represents UC Merced in a consortium of six eminent American universities that offer a certificate in Leadership for Public Lands and Cultural Heritage. The group plans to move toward a graduate degree as a next step to building a network of universities providing advanced training and research on parks and open spaces worldwide.

“Public lands face challenges that are unique, in that they require a holistic view of how to address key management problems,” says the new SNRI faculty member, who brings experience in strategic management, information systems, operations research and disaster response to his research efforts.

Dr. Rolland studied in both the U.S. and Norway, receiving undergraduate and
During the whirlwind seminar, participants immersed themselves in discussions about theories of change, management, organizational renewal, strategic planning, impacts of climate change on ecological systems, generational changes in park workforce and visitors, and illegal activities in parks and open spaces.

Sula Jacobs, deputy superintendent of Florida’s Biscayne National Park, said that the seminar showed that the problems faced by U.S. park leaders are universal.

“We all have visitors from different areas; we have ecological issues, natural resource issues and funding issues that are occurring,” she said.

UC Merced and the National Park Service plan to expand NPI to create a virtual forum for managers of parks and public lands. UC Merced also has plans to add an expert in park management to its faculty and increase research efforts in subjects relevant to the adaptive management of parks and other protected spaces.
Becca Fenwick Leads Yosemite Field Station

As the new director of UC Merced’s Yosemite Field Station, Becca Fenwick combines her love of the outdoors and of the educational opportunities such settings can offer.

“I have always been drawn to the world around us and love to foster that in others,” Fenwick says. “Field stations and Yosemite in particular provide a venue in which to do this on many levels, from public outreach to cutting-edge scientific research.”

The Yosemite Field Station is used by SNRI researchers along with other University of California faculty and guest researchers. It is also the home of the Yosemite Leadership Program for UC Merced undergraduate students and the Adventure, Risk, Challenge program for San Joaquin Valley teenagers to gain confidence in their language skills while taking on physical challenges in a team setting.

“Becca is an experienced scientist and natural reserve manager,” SNRI Director Roger Bales observes. “Her enthusiasm and vision will take the Yosemite Field Station to the next level as it supports signature programs for UC Merced and the broader community.”

Kathleen Hull Advances Anthropology and Archaeology

When the audience listened to UC Merced professor Kathleen Hull’s talk about the archaeology of Yosemite Indian life this summer at Parsons Memorial Lodge on the edge of Tuolumne Meadows, it came from someone who not only knows Yosemite today, she knows about the region’s people before there was recorded history.

Dr. Hull’s presentation focused on the Colonial Period, and comes from the double context of anthropology and archaeology. She studies prehistoric demography, along with hunter-gatherer societies of western North America and colonial encounters in the Americas. Once an archaeologist for the National Park Service in Yosemite, Dr. Hull has done environmental compliance work for an international engineering firm, both of those experiences leading up to an appointment in 2006 as one of the founding anthropology faculty members at UC Merced.

It’s not a surprise, then, that Dr. Hull is an advocate for cross-disciplinary scholarship. And that includes understanding those who have come before us and how they lived and died.

Dr. Hull has a way with titles for some of her research. Her 2009 book is “Pestilence and
The complete renovation of the Data Visualization Center (DVC) was a major change at the station this year, and was completed using National Science Foundation stimulus funds. A new shake roof was installed on the building, and has already been adopted by the park as the new standard for shake roofing in Wawona.

The DVC can be used as a place where researchers gather to analyze and interrogate their data. Large screens and fast internet access will play a vital role in this, along with the flexible set up of the desks and chairs. It is also able to host retreats, conferences and classes, further expanding the ability of the field station to serve a wide variety of people who work in and visit the park.

Persistence: Yosemite Indian Demography and Culture in Colonial California,” and last year she contributed a chapter in a Cambridge University Press volume that she titled “Death and Sex: Procreation in the Wake of Fatal Epidemics within Indigenous Communities.” She uses those titling skills as associate editor of the journal of California Archaeology, and is undertaking a new research project for the National Park Service on dating artifacts of Bodie Hills obsidian via hydration analysis. Such tools are common in the north portion of Yosemite National Park, and this dating method examines the uptake of molecular water into the obsidian over time to gauge how much time has passed since artifact production. In this way, the age of camp and village sites can be determined, a necessary first step in any archaeological research project.
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David Graber
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The Director’s Council is being formed and will commence by summer 2012.

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