

ANNUAL REPORT &  
RESEARCH HIGHLIGHTS  
2017/2018





**PHOTO:** Patrick Melarkey, lab technician in the Division of Atmospheric Sciences, places a filter on a scale for analysis. Credit: Cathleen Allison/Nevada Momentum.

**COVER PHOTOS:** UPPER LEFT: Brittany Kruger, staff research scientist of geology in the Division of Hydrologic Sciences, works in the environmental microbiology lab at DRI's Las Vegas campus. Credit: David Becker/ Nevada Momentum. UPPER RIGHT: Monica Arienzo, assistant research professor of hydrology in the Division of Hydrological Sciences, works in the ice core lab at DRI's Reno campus. Credit: Cathleen Allison/Nevada Momentum. LOWER LEFT: Richard Jasoni, associate research scientist of biology in the Division of Earth and Ecosystems Sciences works in the greenhouse at DRI's Reno campus. Credit: Cathleen Allison/Nevada Momentum. LOWER RIGHT: Adam Watts, associate research professor of fire ecology in the Division of Atmospheric Sciences, pilots a drone at a prescribed fire in Florida. Credit: David Godwin/Southern Fire Exchange.



# DRI AT A GLANCE

JULY 2017–JUNE 2018

OVER **300** PROJECTS ON ALL **7** CONTINENTS

**\$35 MILLION** IN SPONSORED RESEARCH

**40** SPECIALIZED LABS

**2** RESEARCH CAMPUSES

**100** PH.D. FACULTY

RESEARCH IN OVER **40** SCIENTIFIC DISCIPLINES

OVER **400** SCIENTISTS, ENGINEERS, STUDENTS, AND STAFF

## **5** RESIDENT GREAT HORNED OWLS

This spring, DRI's Reno campus was the scene of a wildlife phenomenon never before recorded by scientists: a trio of great horned owls, two female and one male, nesting on the ledge outside a second-story office window.



Credit: Dana Trimble

In coordination with the Nevada Department of Wildlife, DRI installed a nest camera and live-streamed the video on YouTube so that anyone interested could observe this rare nesting situation. The video feed quickly went viral and became a news sensation, attracting viewers from around the world and coverage by outlets such as *National Geographic* and *Audubon*. By the time the two owlets successfully fledged and the live stream was turned off in May, the video logged over 20 million hours of viewing.



# ABOUT DRI

## NEVADA SCIENCE, GLOBAL SOLUTIONS

The Desert Research Institute (DRI) is a recognized world leader in basic and applied interdisciplinary research. Committed to scientific excellence and integrity, DRI faculty, students, and staff have developed scientific knowledge and innovative technologies in projects around the globe. Since 1959, DRI's research has advanced scientific knowledge, supported Nevada's diversifying economy, provided science-based educational opportunities, and informed policy makers, business leaders, and community members. With campuses in Reno and Las Vegas, DRI serves as the non-profit research arm of the Nevada System of Higher Education.

DRI's faculty members are non-tenured and responsible for their own salaries through external grants and contracts. Through this blend of academic rigor and private-sector pragmatism, DRI has earned a reputation for delivering high quality scientific information in an efficient, transparent, and accountable fashion. For more information about DRI, visit [www.dri.edu](http://www.dri.edu).

## FROM THE PRESIDENT



According to the latest National Science Board Science and Engineering Indicators, most Americans agree or strongly agree that scientists work for the good of humanity, help to solve problems, and want to make life better for the average person. While Americans believe

in the power of science in general, few can connect with science on a deeper level. A poll released by Research America earlier this year showed that only 19 percent of people asked could name a living scientist.

Over the last year as President of the Desert Research Institute I have noticed a similar trend. I have heard nothing but praise from our stakeholders and our partners for the important work we do across Nevada and around the world. One problem I am facing, then, is not how to establish the importance of science in general but how to relate the value of what we do and the impact of our research to the people and communities we serve. We hope that building this community support will help generate financial support for the work that we do as well.

In the last year at DRI, I'm proud to say that we've made it a priority to engage with our neighbors, friends, elected officials, and communities and to show the importance of what we do for both our daily lives and the future of our changing planet.



Our engagement initiatives, like Science Distilled and May Science Be With You, are fostering connections between Nevadans and the work we do, and, most importantly, they have given the DRI faculty and students who have participated a sense of pride in sharing their stories and the space to develop a strong public engagement skillset.

We are also striving to highlight not only the results of our research but also the journey behind the science and the real people doing the work.

In coordination with local media partners and across our social media channels, we've increasingly showcased narratives about the people who make DRI a world-class research institution, including the researchers piloting the unmanned aerial vehicles monitoring smoke above a prescribed burn, the team melting 30,000-year-old ice cores inside our advanced ice core lab, and the men and women recruiting new water technology companies to Southern Nevada.

Since 1959, DRI has stood at the forefront of advancing scientific knowledge, understanding Earth's complex environmental systems, and improving human health and welfare throughout Nevada, the nation, and around the world. Going forward, we are committed to leading the way toward a new level of public engagement with science, for the good of our research, our institution, and our world.



Kristen Averyt, Ph.D.  
President, Desert Research Institute



## MORE RESEARCH NEWS

[dri.edu/newsroom](http://dri.edu/newsroom)

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## DRI SENIOR LEADERSHIP

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**Lawrence Buja, Ph.D.**, Vice President for Research

**Rina Schumer, Ph.D.**, Assistant Vice President for Research/Academic Officer

**Chris Ipsen**, Assistant Vice President for Information Technology and Resource Computing

**Peter Ross**, Assistant Vice President Campus Planning and Physical Plant

**Marc Pitchford, Ph.D.**, Executive Director for Division of Atmospheric Sciences

**Tim Minor, M.A.**, Interim Executive Director for Division of Earth and Ecosystem Sciences

**Kumud Acharya, Ph.D.**, Interim Executive Director for Division of Hydrologic Sciences

**Jennifer Schultz, M.S.**, Director of Human Resources

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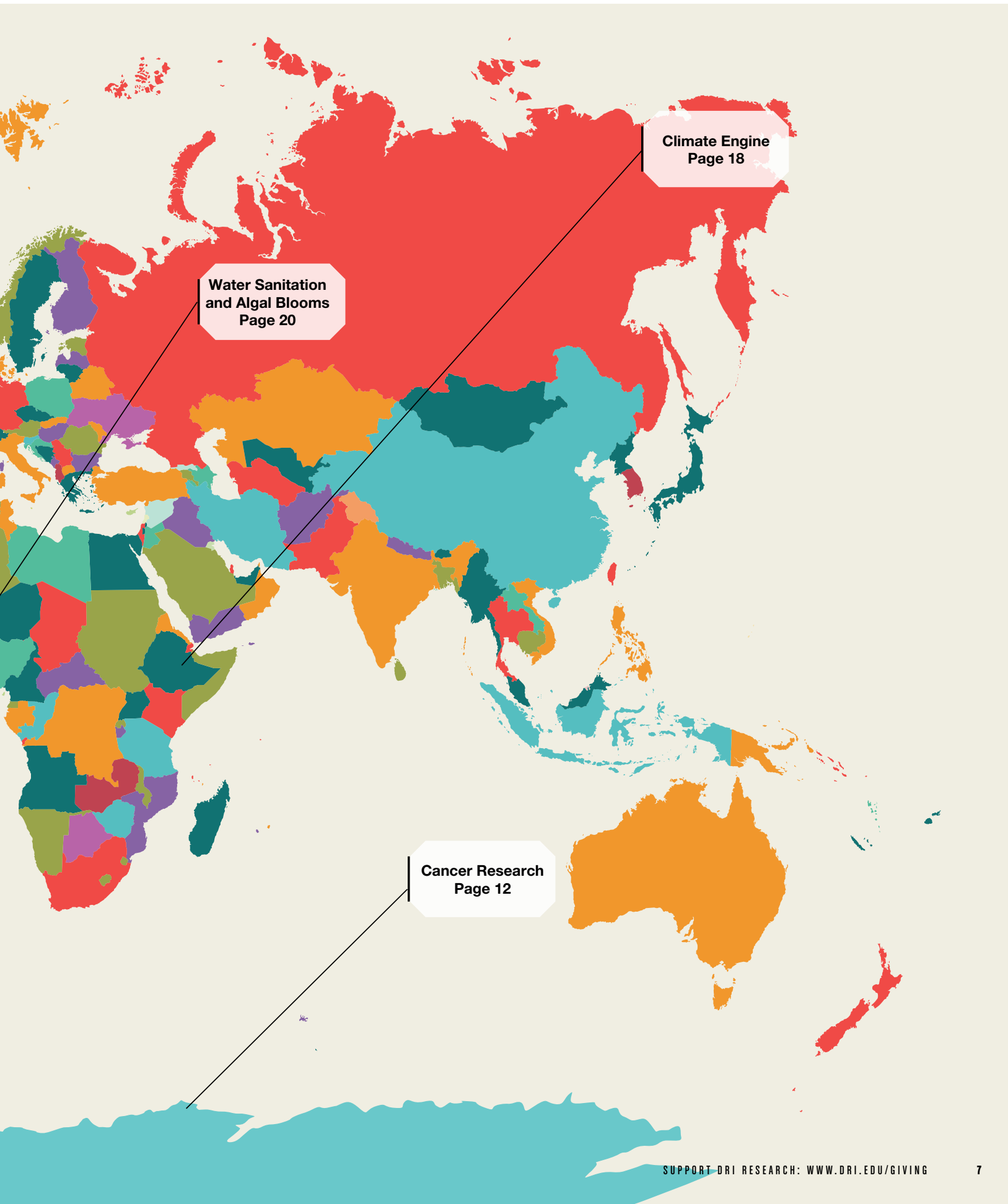
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## INVESTIGATING NORTHERN SIERRA NEVADA SNOW DROUGHTS

Featured Research: Benjamin Hatchett and Daniel McEvoy



Now droughts, or periods of below-normal snowpack, have become increasingly common in the Sierra Nevada and Cascade

mountains in recent years, as warming temperatures push snow lines higher up mountainsides and cause more precipitation to fall as rain.

Benjamin Hatchett, Ph.D., a postdoctoral researcher with DRI's Division of Atmospheric Sciences and avid backcountry skier, began to notice the trend several years ago. In 2017, he published research outlining an

approximately 1,200-foot rise in the winter snow elevations over the last ten years across the northern Sierra Nevada. Looking more deeply into the rising snow levels and a continued lack of snow in their local region, Hatchett and fellow DRI climate researcher Daniel McEvoy, Ph.D., an assistant research professor of climatology and regional climatologist at DRI's Western Regional Climate Center (WRCC), sought to expand upon the little that is currently known about snow droughts and their impacts to local watersheds and economies.

In a study published in 2018 in the journal *Earth Interactions*, Hatchett and McEvoy explored the root causes of snow droughts in the northern Sierra Nevada and investigated how snow droughts evolve throughout a winter season. To do this, they used hourly, daily, and monthly data to analyze the progression of eight historic snow droughts that occurred in the northern Sierra Nevada between 1951 and 2017.

"We were interested in looking at the different pathways that can lead to a snow drought and the different implications that each pathway has for

mountain systems," McEvoy explained. Previous research has used April 1st (the date that snowpack levels, measured as snow water equivalent or SWE, in the Sierra Nevada typically reach a maximum) as the primary date for calculating snow drought and classified each snow drought as one of two types, warm or dry. Hatchett and McEvoy's work expanded upon these concepts by examining the progression of snow droughts throughout the entire winter season.

Their results illustrate that each snow drought originates and develops along a different timeline, with some beginning early in the season and some not appearing until later. Snow droughts often occurred as a result of frequent rain-on-snow events, low precipitation years, and persistent dry periods with warmer than normal temperatures. The severity of each snow drought changed throughout the season, and effects were different at different elevations.

"We learned that if you just look at snow levels on April 1st, you miss out on a lot of important information," McEvoy said.

# ATMOSPHERIC SCIENCES





**PHOTOS:** PAGE 8 TOP: A view of downtown Reno and the Sierra Nevada from DRI's Reno Campus. Credit: Cathleen Allison/Nevada Momentum. PAGE 8 BOTTOM: A view of Slide Mt. and Mt. Rose from the east side of Washoe Lake shows the effects of ongoing snow drought on the Sierra Nevada in the 2017–2018 winter season. PAGE 9 TOP: George Nikolich (left) and Vic Etyemezian (right) work on air quality monitoring equipment. Credit: Dave Becker/Nevada Momentum. PAGE 9 BOTTOM LEFT: Dust and dirt in the Portable In Situ Wind Erosion Lab (PI-SWERL) at DRI's Las Vegas campus. Credit: Dave Becker/Nevada Momentum. PAGE 9 BOTTOM RIGHT: George Nikolich showcases equipment that measures dust emissions. Credit: Dave Becker/Nevada Momentum.



## RESUSPENSION OF MOUNT ST. HELENS VOLCANIC ASH BY WIND

Featured Research: Vic Etyemezian, Jack Gillies, and George Nikolich



In Washington's Cascade Range, Mount St. Helens—which produced its last major eruption in 1980—remains an active threat to communities and infrastructure in the region. The hazards posed by a future eruption of this volcano include not only the ash plumes and pyroclastic flows of the initial eruption but also the potential for resuspension of deposited volcanic ash by strong winds in the days, weeks, months, and years after the eruption.

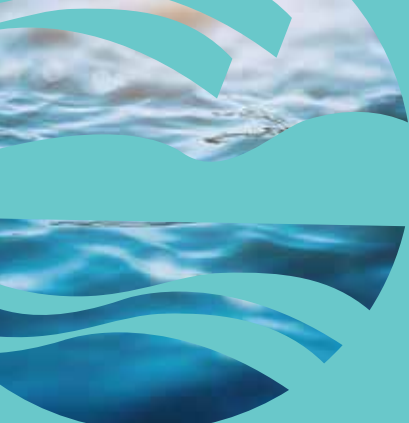
At the U.S. Department of Energy's (DOE) Hanford Site, a nuclear waste site located approximately 200 miles east of Mount St. Helens, a team of

DRI researchers is working to help assess the risk that resuspended volcanic ash could pose to a new Waste Treatment and Immobilization Plant (WTP). If ash concentrations in the air rose to a sufficiently high level, the filtration capabilities of the WTP could be exceeded, creating adverse safety conditions.

In 2016 and 2017, researchers Vic Etyemezian, Ph.D., Jack Gillies, Ph.D., and George Nikolich, M.Sc., from the Division of Atmospheric Sciences collected volcanic ash samples to serve as analogues for ash emitted from a hypothetical future eruption of Mount St. Helens. They then provided analysis of the threshold

wind speed for ash resuspension following deposition, collected ash samples for characterization (i.e., size and mineralogy), and developed particle resuspension rate relationships based on the wind and environmental conditions of the Hanford Site.

"This information will be used in determining the engineering requirements for the WTP facilities being constructed there," Etyemezian explained.



## IMPROVING PROSPECTS FOR DEVILS HOLE PUPFISH IN CAPTIVITY

Featured Research: Joshua Sackett, Brittany Kruger, and Duane Moser



At Devils Hole, an isolated, water-filled cavern of unknown depth located in a detached unit of Death Valley National Park in Amargosa Valley, NV, a team of DRI researchers led by Duane Moser, Ph.D., completed a first-of-its-kind study comparing the site's aquatic microbiology with that of a constructed scale replica at the nearby Ash Meadows Fish Conservation Facility (AMFCF). Their results, which were published in *PLOS ONE* in March 2018, show key differences in water chemistry and microbial communities that may be impacting the ability of the highly endangered Devils Hole Pupfish (*Cyprinodon diabolis*) to survive in captivity.

Devils Hole Pupfish (population 115 in autumn 2017) are an iridescent blue, one-inch-long pupfish native only to Devils Hole, where water temperatures and dissolved oxygen concentrations near their lethal limits for most fishes. Since 2013, scientists have been trying with limited success to establish a backup population of these endangered fish in a constructed tank at the AMFCF.

Moser's study, which characterized and compared the water chemistry and microbial communities between the two sites, found that the nutrient balance at each site was very different, with AMFCF being strongly nitrogen limited – about five times lower than the nitrogen level observed in Devils Hole. In the microbial communities, which contribute to the distribution and availability of dissolved nutrients in the water and provide a food source for the pupfish, the research team discovered high levels of species diversity at each site but found key differences in which bacterial phyla were dominant.

This study highlights the potential importance of considering water chemistry and microbiology when constructing artificial fish habitats—information that the team hopes will provide a valuable contribution to the continued survival of the Devils Hole Pupfish in captivity.

"This work revealed very different microbial populations, which we infer might correspond to large differences in nutrient dynamics between the sites—especially in terms of nitrogen," Moser said. "Consequently, some relatively

modest tweaks in how the refuge is operated could potentially improve the prospects for continued survival of one of Earth's most imperiled fishes."



**PHOTOS:** PAGE 10: DRI's Joshua Sackett and Duane Moser work with National Park Service officials during a routine sampling visit to Devils Hole. PAGE 11 TOP: Monica Arienzo works in the ultra-trace analytical lab at DRI's Reno campus. Credit: Cathleen Allison/Nevada Momentum. PAGE 11 BOTTOM: In January 2017, wildfires consumed roughly 273,000 hectares (1,060 square miles) in Chile, and smoke emissions from these extreme wildfires were visible from space. The Moderate Resolution Imaging Spectroradiometer (MODIS) instrument on NASA's Aqua satellite acquired this image of fires and visible smoke near the coast of Chile. Red outlines indicate areas with heat signatures indicative of active burning. Credit: NASA Earth Observatory, NASA image by Jeff Schmaltz, LANCE/EOSDIS Rapid Response.

# HYDROLOGIC SCIENCES







## BLACK CARBON FROM ANCIENT WILDFIRES LINKED TO HISTORICAL CLIMATE CONDITIONS

Featured Research: Monica Arienzo, Joe McConnell, and Nathan Chellman



**S**moky skies and burnt landscapes are the easily recognizable, immediate impacts of large wildfires. Long after these fires are gone, their emissions are cataloged and stored in ice covering the Earth's polar regions.

In June 2017, a DRI-led study published in the *Journal of Geophysical Research* revealed that Earth's ancient climate conditions affected large regional scale wildfires. The study identified a link between the concentration of wildfire black carbon emissions—a type of biomass-burning aerosol particle commonly known as soot—found in Antarctic ice cores and climate conditions in the Southern Hemisphere during the mid-Holocene, about 6,000 years ago.

Led by Monica Arienzo, Ph.D., an assistant research professor of hydrology at DRI, a team of international researchers used DRI's unique ultra-trace ice core analytical laboratory to measure black carbon concentrations

in two Antarctic ice cores, which contained traces of compounds present in the atmosphere at the time the snow fell. This method allowed researchers to make comparisons to other records, such as lake and marine sediment cores, and develop a high-resolution record of biomass-burning emissions in the Southern Hemisphere from 14 to 2.5 thousand years before present day.

"This is the longest ice core black carbon record published to date," Arienzo said, "and it tells us a fascinating story about wildfire." The new ice core record illustrated that, during the mid-Holocene, decreases in precipitation and soil moisture coupled with increases in temperature and fire season length in regions of South America were mirrored by increased concentrations of black carbon in Antarctic ice.

"Our analysis gives us a sense of what climate-fire relationships were like before significant human-caused changes to the climate," explained Joe McConnell, Ph.D., a study co-author and research



professor of hydrology at DRI. "Knowing what climate-fire relationships were like in the past will help scientists make more accurate climate models because they can account for black carbon contributions from wildfires in addition to those from human sources."



## CANCER RESEARCH IN ANTARCTICA

Featured Research: Alison Murray



In a project funded by the National Institutes of Health and the National Cancer Institute, Alison Murray, Ph.D., and her team are working to identify how the bacteria living symbiotically with an Antarctic invertebrate species

(*Syonicum adareanum*) produce palmerolides, natural antibiotic products that have been shown to specifically target melanoma, the most serious form of skin cancer. By analyzing genetic material from this unique microbial community, Murray's team aims to identify the specific bacteria that produce palmerolides and map their genetic makeup so that sustainable sources of the cancer-fighting palmerolides can be developed in future research.



# EARTH & ECOSYSTEM SCIENCES



## PROGRAM HIGHLIGHT: CULTURAL RESOURCE MANAGEMENT AT DRI



Since 1969, DRI anthropologists and archaeologists have worked to understand how culture and environmental conditions impact human decision-making. DRI anthropologists study the decisions and beliefs of modern peoples while archaeologists study the decisions reflected in what past peoples left behind.

In the last year, DRI's Cultural Resource Management experts have worked with private industry, government agencies, tribal organizations, universities, other non-profit groups, and private donors to achieve a better understanding of both the present and past during the environmental review and compliance process.



## LANDSCAPE USE AND SUBSISTENCE PRACTICES

**Featured Research: Teresa Wriston, Ken Adams, Amanda Keen-Zebert, and Meghan Collins**



In Coal Valley, part of eastern Nevada's newly established Basin and Range National Monument, DRI researchers Teresa Wriston, Ph.D., Ken Adams, Ph.D., Amanda Keen-Zebert, Ph.D., and Meghan Collins, M.Sc., are investigating landscape use and subsistence practices by people who inhabited the region during the late Pleistocene (less than 15,000 years ago) to middle Holocene (approximately 5,000 years ago). During the late Pleistocene, the Great Basin contained more than 80 pluvial lakes, including a large lake in Coal Valley called Lake Coal.

DRI's research team is working to develop lake and landform histories for this region and to inventory cultural resources across an area of approximately 2,400 acres of land associated with past lakes or wetlands. They are also creating a video documenting how geomorphologists, geoarchaeologists, and archaeologists study past landscapes.

**PHOTOS:** PAGE 12 TOP: Antarctic marine ascidians (sea squirts) on the sea floor, 70ft from where palmerolide natural products with anti-cancer activity have been isolated. Credit: Bill Baker. PAGE 12 BOTTOM: Alison Murray works in DRI's molecular microbial ecology lab. Credit: Cathleen Allison/Nevada Momentum. PAGE 13 TOP: Dave Rhode works in DRI's Micro Analysis & Visualization Lab (MAVL). Credit: Cathleen Allison/Nevada Momentum. PAGE 13 INSET: Dave Rhode works with a core sample. Credit: Cathleen Allison/Nevada Momentum. PAGE 13 BOTTOM: On an old lake beach ridge in Coal Valley, Teresa Wriston photographs an excavated soil pit that was used to obtain an OSL (optically stimulated luminescence) sample of the old beach sands. The sample was analyzed to determine age at DRI's E.L. Cord Luminescence Laboratory.



Credit: Renown Health, Jeramie Lu Photography



## HEALTHY NEVADA PROJECT ENTERS SECOND PHASE

The Healthy Nevada Project, developed by the Renown Institute for Health Innovation (Renown IHI), is one of the first community-based population health studies in the U.S. A world-class team of researchers and physicians from DRI and the Renown Health healthcare network are working together to use genetics, environmental data, and individual health information to create a healthier Nevada.

**PHASE ONE** – Open to northern Nevada residents, the comprehensive pilot phase of the study offered community members the opportunity to volunteer for research and gain access to their individual genetic information free of charge on September 15, 2016.

- The pilot phase of the study enrolled 10,000 participants in less than 48 hours.
- Subsequent DNA sample collection from each participant was completed in just 60 working days.
- DNA genotyping was done with personal genetics company 23andMe.
- Participants in the pilot phase of the study range from ages 18-90 years old and come from 135 zip codes in northern Nevada.

# HEALTH & ENVIRONMENT





Credit: Renown Health, Jeramie Lu Photography

**PHASE TWO** – For the second phase of this project, research teams will have greater depth and quality of DNA data thanks to a public-private partnership with Helix, a personal genomics company that uses Next Generation Sequencing (NGS) technology and operates one of the world’s largest, most highly accredited exome sequencing labs.

Utilizing Helix’s proprietary NGS technology and uniquely personalized suite of DNA-powered products, research teams are offering an additional 40,000 Nevadans the opportunity to have their DNA sequenced and participate in the next phase of the study which opened for enrollment on March 15th, 2018.

In Phase Two, Renown IHI will begin providing advanced calcium score screenings to pilot phase participants at higher risk for cardiovascular disease. This will allow researchers to examine the link between genetics and calcium



Credit: Renown Health, Jeramie Lu Photography

**“Nevada is leading the country in growth and innovation. But sadly, we continue to rank among the worst regarding health at 47th in the nation. Through the Healthy Nevada Project, we now have the gift of insight to make needed changes not just for ourselves and our loved ones but for Nevada.”**

**— NEVADA GOVERNOR BRIAN SANDOVAL, THE HEALTHY NEVADA PROJECT’S FIRST PARTICIPANT**

buildup in the heart. Additionally, based on pilot phase data, researchers have seen increased use of regional healthcare correlated with fluctuations in air quality and so-called “bad air events” such as wildfires and atmospheric inversions. In phase two, Renown IHI will also evaluate possible links between genetics and increased susceptibility to respiratory ailments.

In the years ahead, Renown IHI aspires to offer genetic testing through the Healthy Nevada Project to every Nevadan interested in learning more about their health and genetic profile and drive positive health outcomes statewide. Simultaneously, the Healthy Nevada Project will expand the state’s access to cutting-edge clinical trials and foster new connections with biotechnology and pharmaceutical companies.



SUPPORT DRI RESEARCH: [WWW.DRI.EDU/GIVING](http://WWW.DRI.EDU/GIVING)



## INTEGRATED TERRAIN ANALYSIS PROGRAM: 20 YEARS OF SERVICE TO THE U.S. ARMY

The highly variable nature of terrain—including topography, vegetation cover, soil condition, and climate extremes—greatly impacts the success of U.S. military operations. DRI's Integrated Terrain Analysis Program (ITAP), led by Eric McDonald, Ph.D., provides the U.S. Department of Defense (DoD) with a wide range of science-based information in support of global military objectives.

Efforts range from improving technology to detect and defeat IEDs (Improvised Explosive Devices) to evaluating the suitability of DoD military testing and training installations as realistic analogs for deployment areas in Iraq and Afghanistan. DRI also conducts frequent briefings and site visits to DoD agencies and installations to enhance technology transfer and learn about current DoD issues that require scientific solutions.



## FEATURED PROJECT

### NEW GEODATABASE FOR MILITARY PLANNING AND TRAINING

This year, ITAP completed the first milestone in developing an innovative Geographic Information System (GIS) geodatabase product to enhance visualization and application of nearly 20 years of environmental data. The geodatabase will make DRI-collected environmental data and visualizations more accessible for a variety of users including non-military test engineers and product manufacturers, and will support evaluation activities of DoD facilities such as the Yuma Proving Ground.



## NAVAL EARTH SCIENCES AND ENGINEERING PROGRAM

The Naval Earth Sciences and Engineering Program (NESEP) contributes to national security on Department of Defense (DoD) programs with expertise in earth sciences as well as civil, geotechnical, mechanical, and systems engineering.

NESEP contributions are diverse and include aiding DoD stakeholders in actions associated with the California Groundwater Sustainability Act, the completion of a trial project

that demonstrates a novel approach to air quality monitoring immediately following the detonation of explosives, and the development of a patent-pending method of microbially passivating energetic materials including land mines, warheads, and rocket fuels.

The NESEP team is expanding contributions within DoD and the commercial sector. One spin-off is the Realtime Environmental Monitoring and Alert System (REMAs), which is a fully configurable and scalable data management system including measurement and analysis with alerting and web-based display. REMAs is a DRI proprietary system and can be readily combined with DRI's High Performance Computational Systems or third-party datasets for additional features.

# NATIONAL SECURITY







## MORE THAN 40 YEARS OF SERVICE TO THE U.S. DEPARTMENT OF ENERGY

Since the 1960s, DRI has served the U.S. Department of Energy (DOE) through a variety of programs at the Nevada National Security Site (NNSS) under DRI's Technical Research, Engineering, and Development Services (TREDS) contract.

In 2017, the TREDS contract was renewed for up to five years at a value of up to \$47.7 million. Led by Program Manager Jenny Chapman, M.Sc., DRI faculty and staff provide scientific and engineering services to the DOE National Nuclear Security Administration/Nevada Field Office in support of nuclear stockpile stewardship, nonproliferation and counterterrorism, emergency response to radiological and nuclear events, remediation and restoration of legacy environmental issues, cultural resources compliance, and sustainable land stewardship.



## SERVICES TO NNSS

### CULTURAL RESOURCES MANAGEMENT PROGRAM

This program researches and documents prehistoric and historic structures and artifacts on the NNSS. This includes recording the internationally significant role of the NNSS with nuclear testing during the Cold War.



### SOILS PROJECT

This project investigates wind and water processes and conditions that control movement of soil particles in semi-arid environments from lands with residual surface contamination. Results support restoration and long-term stewardship activities.



### COMMUNITY ENVIRONMENTAL MONITORING PROGRAM

The CEMP is a citizen science based environmental monitoring network. For program details, see page 24.



### UNDERGROUND TEST AREA PROJECT

This project predicts movement of groundwater and contaminants from underground nuclear testing by collecting subsurface data with specialized equipment and developing computer-based groundwater models.



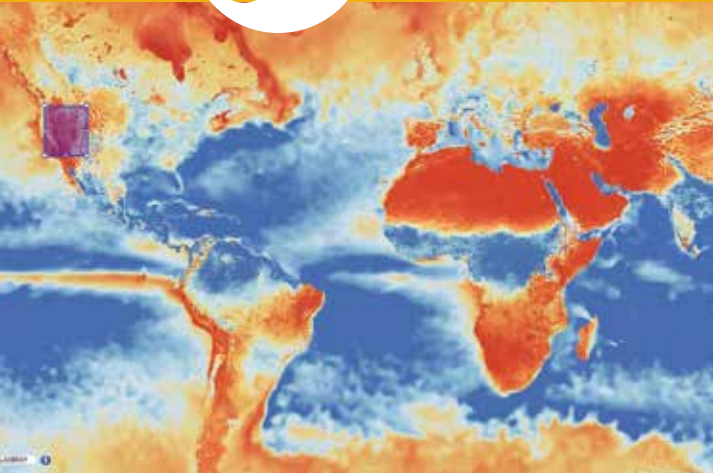
### NATIONAL SECURITY ACTIVITIES

DRI advisors support the stockpile stewardship program ensuring national defense readiness and develop tools for nuclear test detection in support of treaty verification and nuclear nonproliferation.

**PHOTOS:** PAGE 17 TOP: Aerial image of the town of Mercury at the Nevada National Security Site. Credit: National Nuclear Security Administration/Nevada Field Office. PAGE 17 RIGHT: Civil effects test house at the Nevada National Security Site. Credit: National Nuclear Security Administration/Nevada Field Office.



## CLIMATE ENGINE IMPROVES MAPPING CAPABILITIES



Climate Engine ([climateengine.org](http://climateengine.org)), a new, free web-based application created by a team of scientists from DRI, University of Idaho, and Google, improves the accessibility of climate and weather data by allowing users to create on-demand maps or graphs of various earth observation datasets using a standard web browser.

In November 2017, new research led by Justin Huntington, Ph.D., co-principal investigator of the Climate Engine project and associate research professor of hydrology at DRI, was featured in the *Bulletin of the American Meteorological Society* and described the development, design, and potential uses for this tool. The study outlined the capability of Climate Engine to analyze temperature change in the Arctic, evaluate vegetation stress during a historic drought in the Great Plains, map fire danger and burned acreage in Idaho, monitor groundwater-dependent ecosystems in Nevada, and support famine early-warning efforts in Ethiopia.



## NEVADA WATER RESOURCE RESEARCH INSTITUTE

The Division of Hydrologic Sciences (DHS) at DRI serves as the Nevada Water Resources Research Institute (NWRRI), one of 54 member institutes in the U.S. funded through the National Institutes for Water Resources (NIWR) for research, information transfer, training, and program management to help solve critical state water problems.

With this funding, the NWRRI seeks to develop the water sciences knowledge and expertise that support Nevada's water needs, encourage our nation to manage water responsibly, and train students to become productive professionals. NIWR funding normally supports five graduate students and one postdoctoral researcher per year, as well as up to five research projects per year and up to seven faculty.



## FEATURED PROJECTS

### WASTEWATER REUSE

In Las Vegas, researchers Kumud Acharya, Ph.D., (DRI) and Daniel Gerrity, Ph.D., (UNLV) are conducting experiments in a climate-controlled greenhouse on the UNLV campus to learn about the potential for human exposure to chemical and microbiological contaminants of emerging concern (CECs) through food crops irrigated with reclaimed water.

### HISTORIC HYDROCLIMATE

Researchers Steven Bacon, M.Sc., and Rina Schumer, Ph.D., received NIWR support to develop an 8,000-year record of hydroclimate for the southern Sierra Nevada region. This chronology will be about 6,000 years longer than similar records for the western U.S. and will represent the longest reconstruction of streamflow and associated lake-level fluctuations in North America.

# CLIMATE & WATER





## NATIVE WATERS ON ARID LANDS

**N**ative Waters on Arid Lands (NWAL) is a five-year (2015–2020) project that connects researchers from DRI and other research institutions across the U.S. with extension experts and tribal communities in the Great Basin and American Southwest to collaboratively understand the impacts of climate change and evaluate adaptation options for sustaining water resources and agriculture on tribal reservations. DRI faculty, led by Program Director Maureen McCarthy, Ph.D., contribute expertise to this project through climate modeling, archaeology, traditional knowledge and ecology, youth engagement, agriculture, and more.

In November 2017, the project team gathered in Reno for the annual Tribal Summit, which drew more than 120 people from



universities, communities, and reservations across the U.S. for two days of interactive talks and workshops related to climate change, climate adaptation, agriculture, water resources, and other topics.

Other accomplishments from the last year include a Youth Day event held at DRI, the installation of weather stations for collection of climate data on reservations around the western U.S., a series of climate resilience workshops for tribal members, the development of a document library, a new faculty research partnership program, and a podcast documenting the work of the project team.



## WILDLAND FIRE SCIENCE CENTER

Researchers from DRI's Wildland Fire Science Center (WFSC) utilize expertise in operational fire support, fire emissions, fire ecology, and fire hydrology to understand fire causes, processes, and effects on the environment and communities.



## CENTER FOR INTERNATIONAL WATER AND SUSTAINABILITY

The Center for International Water and Sustainability (CIWAS) has seen significant growth in several key programs over the past year, involving additional faculty from all three divisions of DRI.

### FEATURED PROJECTS

#### WASH CAPACITY BUILDING PROGRAM

CIWAS has obtained a significant five-year grant from World Vision to support a major expansion of the DRI Water, Sanitation, and Hygiene Capacity Building (WASHCap) Program. The WASHCap Program was launched in collaboration with Drexel University to address capacity gaps related to WASH and environmental resource management that persist in developing countries. The program is run through the University of Nevada, Reno and provides capacity building and action research to staff across Africa and throughout the developing world.

#### ALGAL BLOOM STUDY

CIWAS is working with the government of Ghana, Ghana Water Company Limited, and Ghana Standards Authority to improve the management of increasingly stressed water resources and establish the presence of harmful algal blooms (HABs) in the water supply provided by the Ghana Water Company Ltd. CIWAS will leverage DRI's capabilities in hydrological and climate change modeling, and DRI's satellite imagery and GIS resources in a second phase to design a long-term monitoring program for HABs and water resources management plans.



Credit: David Godwin/Southern Fire Exchange

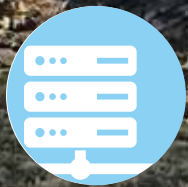
### FEATURED PROJECT

#### UAS APPLICATION IN FIRE RESEARCH

In April 2018, Adam Watts, Ph.D., associate research professor of fire ecology, and postdoctoral researcher Kellen Nelson, Ph.D., traveled to Florida to represent DRI and participate in the Prescribed Fire Science Consortium's 2018 research burn. This week-long event provided an opportunity to deploy the air-quality and smoke-sampling payload developed by a DRI team, led by Nelson. DRI also collaborated with University of Idaho on a new airborne sampling concept and with the EPA to deploy a suite of sensors used for improving biomass burning emissions measurements.

# INTERDISCIPLINARY RESEARCH





## WESTERN REGIONAL CLIMATE CENTER

The Western Regional Climate Center (WRCC) is one of six Regional Climate Centers in the U.S. WRCC's mission is to serve as a repository for historical climate data and information for the western U.S., disseminate high quality climate data and information, improve the coordination of climate activities in the state, region, and nation, and engage in applied research related to climate issues.



## FEATURED PROJECT CLIMATE APPLICATIONS

Dan McEvoy, Ph.D., spent much of 2017 working with several teams to develop a new drought index, the Evaporative Demand Drought Index (EDDI), and new state of the art drought monitoring web applications including Climate Engine and the WestWide Drought Tracker. Climate Engine (as described on page 18) was produced through a collaboration with Google using the Google Earth Engine cloud computing platform. These tools are used by agencies such as the U.S. Department of Agriculture to inform drought mitigation decisions and the Famine Early Warning Systems Network to provide global food insecurity monitoring and outlooks.



## FEATURED PROJECT POST-FIRE DEBRIS FLOWS

In 2017, Regional Climatologist Nina Oakley, Ph.D., led a team conducting research on post-fire debris flows in California. Because wildfires in southern California often occur in areas of steep terrain and erosion-prone soil during the dry season and are followed by intense rainfall during the wet season, post-fire debris flows can be triggered even in cases of relatively small rainfall totals. These natural hazards threaten public health and welfare.

Oakley and her colleagues found a greater likelihood of post-fire debris flows following atmospheric rivers and identified several other conditions that might help forecasters identify post-fire debris flow triggers. Building on this work, WRCC conducted monitoring in the Big Sur area of California and analysis of the Montecito debris flow event that killed 23 people in January 2018. The team is now seeking funding to continue this research, working in cooperation with federal, state, and local agencies.



## DESERT RESEARCH CORPORATION

The Desert Research Corporation (DRC) serves as the technology commercialization partner to DRI. DRC aligns nearly 60 years of world-renown scientific resources, specialized laboratories and facilities, and subject matter expertise with market-based solutions targeting some of the most complex sustainability challenges of our era.

For the last year, DRC staff have been working to establish DRI's investment business process and structure an innovation pipeline that replicates industrial research and development, extending from basic science to commercialization.

Portfolio management theory underlies DRC evaluation, prioritization, and investment decision process and also concurrently prepares projects within our growing portfolio of opportunities for external evaluation and investor diligence.



# INNOVATION & INDUSTRY



## Tū Biomix

### VENTURE-CAPITAL FUNDING RAISED FOR Tū BIOMIX

Tū Biomix Inc., born from DRI's expertise in microbial ecology, is an agricultural pharmaceutical company that targets industrial scale farming and its significant soil health challenges.

In conjunction with DRI's soil and molecular biology scientists, Tū Biomix is driving the development of organic antifungal chemicals as a cost-effective alternative to currently available options. DRI scientists have demonstrated the ability of Biological Control Agents (BCAs) to eliminate white rot, a fungal pathogen impacting onion and garlic crops, under laboratory conditions.



## PREDIRA

### FIRST DRC SPIN-OUT COMPANY LAUNCHES

Predira Inc. leverages DRI's weather intelligence platform to provide localized pest and disease forecasts for industrial scale farming through a web-based software product called ForecastView. With its companion smartphone app, FieldScout, users can input real-time data and get timely, detailed pest and disease forecasts as well as response options to mitigate significant crop loss.

DRI scientists are completing software development and beta testing of ForecastView and FieldScout with some of California's largest berry growers.





## KNOWLEDGE FUND

Nevada's Knowledge Fund was created in 2011 to encourage research, innovation, and commercialization in Nevada. Since then, DRI has contributed significantly to enhancing Nevada's new economy through support of three unique ventures: WaterStart, the Applied Innovation Center, and Unmanned Aerial Vehicles.



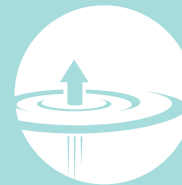
Credit: David Godwin/Southern Fire Exchange



## UNMANNED AERIAL VEHICLES

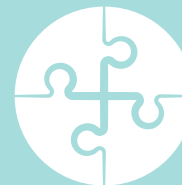
Researchers at DRI are exploring ways in which unmanned aircraft systems (UAS) can be integrated into civilian government work as well as the private sector for use in applications as diverse as cloud seeding and fighting forest fires. DRI has been actively engaged in UAS sensor development and scientific applications for many years and was a partner in the state's FAA Test Site application in 2013.

- **Agriculture:** The ability of the UAS to fly over land that is not easily accessible by traditional farm vehicles allows for detailed real-time agricultural and environmental inspections. DRI is assisting Nevada farmers by using UAS to perform surface topography mapping, visually assess crop health, determine water use and irrigation efficiencies, and monitor soil erosion and ecosystem functions across large farms in hours instead of days.
- **Weather Modification:** The first-of-its-kind DRI unmanned cloud-seeding aircraft can reduce the risks and costs in the cloud-seeding industry. This unique aircraft is being developed as a tool to improve cloud-seeding operations, thereby potentially increasing water supplies and weather forecasting across the West.
- **Wildfire Science:** From situational awareness in pre/post-burn analysis to real-time emissions and thermal monitoring, DRI researchers are using UAS to provide visual and tactical tools for wildland fire prediction and mitigation.



## WATERSTART

WaterStart is a cluster of global leaders in the implementation of water innovation working to make Nevada a global water technology hub and portal for investment by leveraging the state's leadership and expertise in water. Since 2015, WaterStart has recruited 15 companies to Nevada and has significantly strengthened DRI's public-private partnerships in the water industry.



## APPLIED INNOVATION CENTER (AIC)

The AIC leverages the intellectual capital of DRI faculty and 60 years of environmental science research in four main areas of applied research: climate, weather, and energy nexus; Internet of Things (IoT) and remote sensing; engineering and design; and life sciences and informatics. From these four core areas, the AIC builds hardware and software for industry, leverages these platforms for sponsored projects, creates jobs, and helps build innovative companies in Nevada.





## STORIES IN THE SNOW

No two snow crystals are alike, an old saying goes, and during winter 2017–2018, students and adults from across the Reno-Tahoe region helped DRI researchers begin to decipher exactly what the unique shape of each freshly-fallen snowflake means for Nevada’s changing climate.

Stories in the Snow, DRI’s newest citizen science project, enlisted help from a network of students and volunteers in the Reno-Tahoe region to collect photographs of snow crystals each time it snowed. Over the course of the winter, the project collected more than 550 photographs and data points.

Project participants used a smartphone and data collection kit to capture up-close photographs of snowflakes, then submitted the photos along with weather data on time, temperature, and location to a DRI research team through the Citizen Science Lake Tahoe mobile app. Following the Tom’s Shoes philanthropic model, each snowflake picture kit purchased through the project’s



crowdfunding site provided a one-to-one matching donation of Stories in the Snow kits and training for local students.

By combining the photographs with weather information and the time and location from which each snow crystal image was captured, DRI atmospheric research teams are now analyzing the data to learn about the temperature and water content of winter storm clouds. They are using the pictures and weather data to better understand how snow storms in the Reno-Tahoe region form and how warmer winters are impacting cloud physics and

snow levels.

“We want to unravel what goes on in the clouds as a storm moves over the Sierra Crest and through our region,” said Frank McDonough, Ph.D., research lead for the Stories in the Snow project and associate research professor of atmospheric science at DRI. “The ice crystals tell us a lot about what happened during each snowflake’s journey—from how it first formed in the cloud all the way to how early it might melt and where it could land.”



## COMMUNITY ENVIRONMENTAL MONITORING PROGRAM

The Community Environmental Monitoring Program (CEMP) is a network of monitoring stations located in communities surrounding and downwind of the Nevada National Security Site (NNSS) that monitor the air and groundwater for manmade radioactivity.

The stations, located in Nevada, Utah, and California, collect a variety of environmental data. Citizen scientists manage the stations, serving as Community Environmental Monitors (CEMs). CEMs, many of whom are local science teachers, are responsible for monitoring the equipment, collecting air samples, and serving as points-of-contact for residents in their communities.

# CITIZEN SCIENCE







## DRI'S GRADUATE PROGRAMS

Faculty at DRI serve as advisors for graduate students in a variety of degree programs at the University of Nevada, Reno and the University of Nevada, Las Vegas. Students conduct their research at DRI while earning degrees at the universities in programs such as Atmospheric Sciences, Hydrologic Sciences, Cellular and Molecular Biology, Environmental Science, Life Sciences, Geological Sciences, and Anthropology.

**29 COLLEGE AND UNIVERSITY COURSES TAUGHT BY DRI FACULTY**

**44 NEVADA PH.D. STUDENTS WITH DRI ADVISORS**

**15 NEVADA MASTERS STUDENTS WITH DRI ADVISORS**



### WALKER WEIR

"I work under Dr. Mark Hausner and Dr. Eric McDonald alongside a fantastic team looking at the influence of soil properties and environmental conditions on

subsurface landmine and improvised explosive device (IED) detection to support the military's countermine efforts. So far, DRI has proven to be a highly stimulating and enjoyable place to be, and I look forward to getting to know more talented scientists and researchers."



### KAYLA NEUARTH

"I became interested in DRI because of the range of projects that use interdisciplinary fields, each involving environmental work.

I am working with

Dr. Mark Hausner on a project at Devils Hole, in southern Nevada. The project encompasses making a hydrodynamic model of the water column above a shallow shelf in Devils Hole, where a species of fish called the Devils Hole pupfish lives."



## DRI LAUNCHES CYBERSECURITY INTERNSHIP PROGRAM

From malware infections to attacks on critical infrastructure like electricity grids, cybercrime is a growing concern across all industries and sectors of our world. The prevention of cyberattacks of the future requires the training of a new generation of internet security specialists. To provide cybersecurity skills and experience for interested individuals, DRI is launching an all-new Cybersecurity Internship Program in partnership with the SANS Institute, a world-renowned internet security research and education organization.

The internship, which will run from August through December 2018, is open to residents of northern Nevada, including high school graduates, college students, and

people interested in making a career change. Applicants will compete to earn one of several positions in the program, which includes a scholarship for the SANS CyberStart Essentials course, the CyberStart Essentials certification exam, and a 120-hour, hands-on cybersecurity internship at DRI.

# GRADUATE EDUCATION



## MAY SCIENCE BE WITH YOU

On May 3, 2018, DRI welcomed more than 2,800 community members to the Las Vegas Campus for the third annual “May Science Be With You” event. This Star Wars-themed event was held in collaboration with the Las Vegas Science and Technology Festival and featured science presentations from DRI faculty and staff and our partners at the National Atomic Testing Museum, hands-on activities for all ages, and tours of DRI’s labs. Also on hand was VIP guest John Roesch, a professional sound effects artist that has worked on such films as *The Empire Strikes Back*, *ET*, *Back to the Future*, *Inception*, and *Guardians of the Galaxy Vol. 2*.



Credit: Stuart Murtland/The Discovery



## SCIENCE DISTILLED

Science Distilled, a lecture series organized in partnership with the Terry Lee Wells Nevada Discovery Museum, features

emerging research on current topics in an engaging presentation style and provides opportunity for audience interaction with scientists—all over a good beer. This successful lecture series started in 2016 and has grown to five events per year, all held in Reno at various locations in the community. Topics for the 2017-2018 season included Sculpting the Earth, The Ecology of Snow, Genetics—The Key to My Heart, The Future of Fighting Cybercrime, and Lake Tahoe—A Global Success Story.



# PUBLIC ENGAGEMENT





## 2017-2018 AT A GLANCE

- 662 TEACHERS TRAINED
- 23,184 STUDENTS REACHED
- 502 SCHOOLS REACHED SINCE 2012 (OVER 70% OF NEVADA SCHOOLS)



## PROMOTING STEM IN NEVADA

Science Alive, DRI's PreK-12 education and engagement program, fosters a diverse and capable Nevada STEM workforce by promoting teaching, designing and disseminating STEM curriculum through self-contained Green Boxes, and engaging community interest in STEM. This year, Science Alive was approved as one of only two local nonprofits in Nevada to be selected for the Governor's Office of Science and Innovation STEM Program lists. Science Alive was also recognized by the national organization Change the Equation and was added to their "STEMWorks" approved STEM program web site.

In spring of 2018, Science Alive staff presented two sessions on their teacher trainings and Green Box program at the National Science Teacher Association Conference in Atlanta and hosted the first state-wide STEAM conference in collaboration with the Nevada Museum of Art in Reno, which drew 246 participants.



## NEW GREEN BOXES

- Unmanned Aerial Systems (UAS)
- Erosion in Arid Climates
- Drought in the Southwest
- Bilingual Green Boxes on Energy Efficiency and Waste Warriors

# SCIENCE ALIVE



## 2017 DRI NEVADA MEDAL EVENT

In September 2017, DRI was proud to honor Marcia McNutt, Ph.D., President of the National Academy of Sciences and Chair of the National Research Council, as the 30th DRI Nevada Medalist. Established in 1988 to acknowledge outstanding achievement in the fields of science and engineering, the DRI Nevada Medal is the highest scientific honor in the state.



*"I am grateful for the recognition of the Nevada Medal not just for all that it means to me personally, but also because it validates the concept that one can forego one's own personal research career and still have impact through leadership and service to science and the nation."*

— MARCIA MCNUTT, PRESIDENT OF  
NATIONAL ACADEMY OF SCIENCES AND  
2017 NEVADA MEDAL WINNER



A distinguished geophysicist, McNutt's research focuses on marine geophysics, a field in which she has published more than 100 peer-reviewed scientific articles and helped develop a variety of remote sensing techniques to understand the origin of clusters of volcanoes in the middle of tectonic plates. From 2013 to 2016, she served as editor-in-chief of the *Science* family of journals. Before that, she served as director of the U.S. Geological Survey from 2009 to 2013, during which time USGS responded to a number of major disasters, including the Deepwater Horizon oil spill.

# NEVADA MEDAL





## DRI FOUNDATION

Formed in 1982 as a not-for-profit, 501 (c)(3), the DRI Foundation was designed to cultivate philanthropic giving in support of the mission and vision of DRI. For over 25 years, the Foundation trustees have worked with DRI benefactors to support environmental science research to maximize DRI's impact on improving people's lives throughout Nevada, the nation, and the world.

The DRI Foundation's mission is to maximize DRI's global environmental impact by securing necessary funding, promoting DRI to multiple constituencies, and expanding DRI's reach through its relationships with donors and other supporters.

## IN MEMORIAM



It was with great sadness that the DRI community said goodbye to DRI Foundation Trustee John Worthington in 2018.

Serving on the

DRI Foundation Board of Trustees for over a decade, his contributions and commitment to both science and the arts left a meaningful impact on DRI and his community. John was always a welcome addition to DRI events throughout the years, and in addition to serving the DRI Foundation, he served on the boards of the Reno Philharmonic Orchestra, Nevada Museum of Art, Saint Mary's Hospital Foundation, and the University of Nevada Foundation.

### FOUNDATION LEADERSHIP

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Holger Liepmann, Secretary

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Howard Wahl

# DRI FOUNDATION

## INNOVATION RESEARCH PROGRAM



The goal of the DRI Innovation Research Program is to increase the opportunities for DRI's faculty, students, and staff to succeed in their research by financially supporting their very best ideas. The program includes funds for postdoctoral scholars; early-career, mid-career, and senior faculty; technological development; and special projects. By providing this financial support, the Innovation Research Program enhances DRI's reputation as a world-class environmental research institution and attracts high-quality scientific talent.

During the 2018 fiscal year, the Innovation Research Program raised \$257,000 to support DRI research, with major contributions from several donors, including the Tom and Mary Kay Gallagher Foundation, Lewis Group, Pioneer Touch, Trustee Holger Liepmann, Trustee Stephanie Tyler, the Bretzlaff Foundation, and #GivingTuesday crowd-funding donors.

**FY 2019 GOAL: \$1 MILLION**

### WHY I SUPPORT DRI

*"My wife, Mary Kay, and I chose DRI because of its extraordinary potential to improve life, not just in Nevada, but also on a national and international scale."*

— TOM GALLAGHER, DRI FOUNDATION  
TRUSTEE

**TO SUPPORT DRI RESEARCH, PLEASE VISIT [DRI.EDU/GIVING](http://DRI.EDU/GIVING)**

## MAKI ENDOWMENT



The Sulo and Aileen Maki Endowment was established by the Sulo and Aileen Maki Trust to be used by DRI for research, instruction, and scholarships relevant to southern Nevada water issues. The endowment supports innovative, creative, and multidisciplinary research, as well as scholarly endeavors such as journal publications and presentations at scientific conferences, water resources course instruction and student scholarships, and community outreach and service. Since 2008, the Maki Endowment has provided funding for more than 15 faculty, six postdoctoral researchers, five graduate student fellowships, and has contributed to DRI's K-12 education efforts through support for the Science Alive Green Box program.



### FEATURED PROJECT

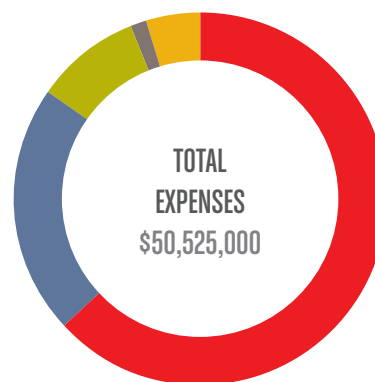
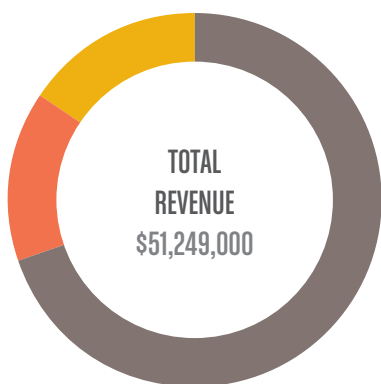
#### GROUNDWATER DECLINE

Increasing demand for groundwater in southern Nevada has led to concerns about sustainable development and stress on ecosystems from decreasing groundwater levels. At a spring in Moapa Valley, Don Sada, Ph.D., and Mark Hausner, Ph.D., are investigating ecological effects of reduction in spring discharge to help determine the amount of groundwater use that is consistent with sustainable water use.

**SUPPORT  
DRI SCIENCE**



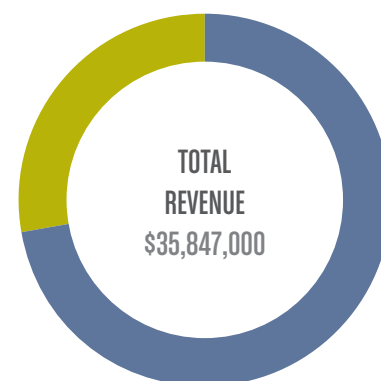
## DRI FISCAL YEAR 2017 FINANCIALS (JULY 2016–JUNE 2017)



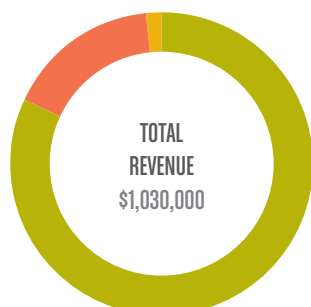
■ Total Grants & Contracts	\$35,847,000	■ Employee Compensation & Benefits	\$31,855,000
Federal	\$25,965,000	■ Supplies & Services	\$10,959,000
Private & Foreign	\$3,879,000	■ Depreciation	\$4,660,000
State & Local	\$4,028,000	■ Utilities	\$736,000
Other State Government	\$1,975,000	■ Total Other Non-Operating Expenses	\$2,285,000
■ Total State Appropriations	\$7,461,000		
■ Total Other Revenue	\$7,941,000		

## DRI FY 2017 GRANT AND CONTRACTS FUNDING SOURCES

FEDERAL	\$25,965,000	NON-FEDERAL	\$9,882,000
Dept. of Energy (DOE)	33.1%	Private	35.5%
Dept. of Defense (DOD)	17.4%	State Government	34.5%
Environmental Protection Agency	10.9%	Other Non-Nevada State Government	20.0%
National Science Foundation (NSF)	9.9%	Local Government	26.3%
Dept. of Commerce (DOC)	8.1%	International	3.8%
USDA	5.8%	<b>Total</b>	<b>25.9%</b>
NASA	4.4%		
Other	0.2%		
<b>Total</b>	<b>74.1%</b>		



## DRI FOUNDATION FY 2017 FINANCIALS



■ Gifts, Contributions & Event Proceeds	\$846,000
■ DRI Support	\$168,000
■ Other Revenue	\$16,000

In FY 2017, over \$900,000 was given to DRI by the Foundation to support activities and programs.

**Desert Research Institute**

2215 Raggio Parkway

Reno, NV 89512



**NORTHERN NEVADA SCIENCE CENTER**

2215 Raggio Parkway Reno, Nevada 89512

(775) 673-7300



**SOUTHERN NEVADA SCIENCE CENTER**

755 East Flamingo Road Las Vegas, Nevada 89119

(702) 862-5400

EXPLORE MORE ONLINE AT [WWW.DRI.EDU](http://WWW.DRI.EDU)

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