



THE SUNDIAL

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CANYONLANDS
RESEARCH CENTER



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Learn more at www.canyonlandsresearchcenter.org.



The mission of Canyonlands Research Center (CRC) is to facilitate research, education, and collaboration for understanding the interactive effects of land use and climate and developing management solutions that meet human needs while maintaining ecological viability on the Colorado Plateau and in semi-arid lands worldwide.

The Canyonlands Research Center is located at The Nature Conservancy's Dugout Ranch — a gateway to the Canyonlands National Park, 20 miles northwest of Monticello. Spanning over 3,000 square kilometers with an environmental gradient ranging from 1,100 to 3,600 meters, the CRC's study area includes lands managed by the USDA Forest Service, Bureau of Land Management and National Park Service. As such, scientists have the opportunity to study wide gradients of elevation, ecology and land-use histories, making the CRC an ideal location for research on the effects of climate on ecosystem processes and community dynamics. The CRC is also situated along the boundary of the southwestern monsoon climate zone, making it particularly sensitive to climatic variation.

We Thank Our Collaborating Partners!



COVER: Researcher tents at Canyonlands Research Center. © Stuart Ruckman

RESEARCH DIRECTOR'S REPORT



“The enthusiasm and curiosity that student groups bring to the CRC is an inspiration to us.”

This year at the Canyonlands Research Center (CRC) has been an illustration in contrasts. When we opened in March the landscape was well on its way to experiencing one of the worst droughts to hit this region over the past half century. Throughout the season, drought conditions only worsened, resulting in challenges in implementing and maintaining research projects and managing the ranch. Managing for and adapting to drought is part of our mission at the CRC, and this year has been a reminder of how drought not only impacts these

lands but also the people that rely on them. In contrast to the low rainfall, the number of researchers, research projects, and students we host each season continues to increase with each new year. Many of our research projects focus on the restoration of impaired dryland systems, and our hope is that we will continue to be recognized for our innovative research in this area.

Our research community is particularly excited to be engaged in supporting and training the next generation of scientists. This year we awarded fellowships to four talented graduate students to support their research programs. Graduate student fellowships provide financial support for research at a critical time in the careers of early scientists. We also hosted several student groups that ranged from university students to high schoolers. It's amazing to watch

the beauty of the landscape inspire the emotions of our visitors. The enthusiasm and curiosity that student groups bring to the CRC is an inspiration to us. Every time we host a student group we have renewed faith that this next generation will have the knowledge and skills to tackle our most pressing environmental problems.



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Canyonlands Research Center Management Team

Nichole Barger, *CRC Research Director*
Sue Bellagamba, *Canyonlands Regional Director*
Matt Redd, *CRC and Dugout Ranch Director*
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SCIENCE HIGHLIGHT



Sensitive & Depleted: Seeking Restoration that Works on the Plateau

Healing the soils and plants of the Colorado Plateau is no simple task. Restoration methods that work in other Western ecosystems often fail in this unique region, complicated by a lack of rainfall, low ground surface stability and soil and plants that are highly sensitive to disturbance. To add to the challenge, the lands of the Plateau now face intensifying impacts from climate change and a growing array of human demands, including recreation, grazing and mineral extraction.

“As scientists, we are continually discovering new and important ways the grasses and soils in this area function,” explains Mike Duniway, a Research Ecologist & Soil Scientist with U.S. Geological Survey (USGS), “and now we are in a race to understand how to improve their health and revive this ecosystem before we lose too much to climate change and other stressors.”

Duniway and Nichole Barger, CRC’s Director of Research and professor with the University of Colorado, are leading a new research project at the CRC designed to learn from past failures, and to think in novel and creative ways about restoration. Joining forces with Claire Karban from the University of Colorado and Rebecca Mann from the USGS in Moab, Duniway and Barger will test the use of soil stabilizers, green-house grown biological soil crusts, and small barriers as methods for promoting soil conservation and the establishment of native plants.

“I’m really excited about the integration of cattle in this research,” says Duniway. “Much of the Colorado Plateau is used for grazing cattle and sheep. When areas are restored, livestock are usually removed for one or three years. In this study, we will be putting them back on, and grazing

some of the experiment areas to evaluate how livestock use interferes, or not, with the restoration’s success.”

New solutions for the Plateau’s vulnerable lands cannot come soon enough. Dry land ecosystems make up 40 percent of Earth’s land surface and support about one-sixth of the world’s population, but 73 percent of range lands in dry areas have already been degraded. On the Plateau, scientists and land users alike have discovered that highly damaged lands—those altered by mismanaged grazing or intense recreation—simply do not recover without human intervention.

“This project is what the CRC is all about,” says Barger. “We’re able to use the Dugout Ranch and its cattle to test new ideas and hopefully deliver results that matter for ranchers, recreators, and communities—all of the people who rely on the Plateau.”

OPPOSITE: Nichole Barger and fellow researchers seek new answers to improve the health of grasses and soil. © Stuart Ruckman



FROM THE RANCH



Drought on the Range Q&A with Matt Redd



Matt Redd is the Director of the CRC and the Dugout Ranch. © Stuart Ruckman

How does this drought compare to years past?

This is the worst drought I've seen here. I've also spoken to older people, and they claim it's the worst drought in 70 to 100 years. We're really in our second year of drought. It started

in the winter of 2016. We got only 25 percent of our normal winter precipitation, and things haven't improved much since then.

How does drought impact the cattle operation at the Dugout Ranch?

Each year we try to anticipate the conditions of the range and shift the cattle accordingly. This year, we've mitigated for the drought by changing up where the cattle are grazing, how many cattle are there, and for what duration. And we've also had to downsize the herd. This fall, we will likely have to cull or downsize even more. When you get to a certain point, there's only so much you can do.

How is the drought affecting other ranchers in the area?

Farmers here are used to dealing with erratic and marginal weather. They're experts at making the best out of the conditions and riding out a

dry spell. What's different is the intensity and duration of this drought. It's forcing many people to face grave decisions. I'm hearing them say things like: "I'm going to shut down and sell all my livestock and wait." For a rancher, these are extreme choices, and it's hard to recover from them.

What does the drought look and feel like on the ranch?

It feels like the mountain is sick. Everything is muted and just barely hanging on. Things are dustier and grittier than normal. The plants look stressed, and on the summer range, growing has simply shut down.

What role does the CRC play in this type of crisis?

A lot of the CRC's research is designed to help us adapt to this situation. For example, we're investigating the Criollo breed of cows to see if they are better suited to hotter and drier conditions. There's also many projects where scientists are looking at native grasses, trying to understand how they respond to drought and what we can do to help them be more resilient. I don't think you'd find many ranchers here who would dispute that the climate is changing. They may use different vocabulary, but their experience of this drought is real and indisputable.

OPPOSITE: Record-breaking drought takes a toll on cattle ranchers. © James Q. Martin

FIELD NOTES



Maxx Mill and his fellow Boy Scouts mimic beavers. © Sue Bellagamba/TNC

Scouts Channel Beavers

The heat was unforgiving, and the work was hard, but Maxx Mills and the scouts from Troop 808 based in Morrison, Colorado, were undaunted. “It was so rewarding to see the dam, and to know the value of it, that we really didn’t mind the heat,” says Mills, who was pursuing his eagle scout badge. Maxx and eight other scouts spent two days in August at the CRC.

One primary goal for the scouts: act like a beaver. In the middle of Indian Creek, the scouts constructed a beaver dam analog, a temporary structure made of wooden posts pounded into the streambed, then packed with dirt and woven willows. The structure is designed to act just like the handiwork of those famously busy mammals by creating a pond and increasing water storage and

providing habitat for wildlife. The scouts also worked with CRC staff to help prepare for the installation of a biocrust demonstration garden.

“What surprised me was how much I learned,” says Mills, “not only about the dam, but about the petroglyphs preserved nearby, how critical the biological soil crust is to the desert environment, and the effects of climate change and which plants and animals can best adapt.” The Eagle Scout project at the CRC also gave the boys an unforgettable chance to make a personal connection to the landscape. Explains Mill: “My favorite memory was standing at the Dugout Ranch at sunrise, looking at the majestic rock formations on every side, and knowing I was a very tiny part in efforts to protect that unique place. I felt small, but I felt like I really mattered.”

Fellows at the CRC

This summer, the CRC welcomed new talent and energy in the form of four graduate students participating in the CRC Fellowship Program. These young scientists, hailing from an array of universities, gained field experience while addressing questions that advance the CRC's mission.

Fellow Spencer Hudson from Utah State University is studying anthropogenic impacts on wildlife populations. At the CRC, he is researching whether reptile populations on the Colorado Plateau can remain viable in the face of climate change and landscape impacts. Through his fellowship, Hudson is also mentoring students from The Natural History Museum of Utah's Youth Teaching Youth Program.

"After working with the CRC, I am inclined to pursue a career in conservation biology," says Hudson. "Having the chance to be a mentor to young and aspiring scientists has also encouraged me to someday become a professor conducting research and teaching future generations."



CRC fellow Claire Karban (right) and her research assistant, Cloe Dickson, in the field. © Stuart Ruckman

For CRC fellow Tyara Vazquez, from the University of Toledo, the experience at the CRC enhanced her research on climate change and desert ectotherms, or animals that depend on external sources of body heat. "The CRC study area is a great place for research and there are tons of interesting questions to be asked," says Vazquez. "Being a CRC fellow has stimulated my passion for research and I plan on continuing research on climate change and conservation."

Claire Karban is a first-year Ph.D. student at the University of Colorado Boulder. Through

the CRC fellowship, she will be studying the role of functional diversity in restoration seed mixes on seedling emergence and survival. "This fellowship has been so important to me," explains Karban. "Having this initial funding allowed me to run several experiments last summer, collect data, and get my feet wet. With my research, I hope to overcome some of the barriers to restoration success."

Fellow María Cristina Rengifo, from Northern Arizona University, calls the fellowship an experience that "has enhanced my growth as a young scientist." At the CRC, she's studying the role diversity plays in the resilience of moss-dominated biocrust to climate change. "One of the most important things I learned at the CRC is that joining efforts among institutions is what makes the scientific community answer larger research questions," says Rengifo. "It also allows us to apply the research to solve problems within our relationship to the environment."

OUTREACH



Students from Weber State spent a week studying desert vegetation at the CRC. © Heather Root

Botanists from Weber State

Ten junior and senior students from Weber State University made use of the CRC as an unforgettable outdoor classroom for one week this spring for their Advanced Field Botany course. Each morning, students participated in a presentation from USGS scientists, followed by an afternoon in the field, learning data gathering techniques and analysis. “The most successful element was the way the students bonded with each other and the landscape,” says Heather Root, Assistant Professor of Botany with Weber State. “The CRC provides a unique, low-cost way for students to become attached to the land and ecology of the area.”

Doris Duke Conservation Scholars

This summer, 20 students and staff from Northern Arizona University (NAU) visited the CRC for two days of immersion in Colorado Plateau science and land use issues. The students were part of the Doris Duke Conservation Scholars Program, hosted by NAU’s Landscape Conservation Initiative in collaboration with Conservation Science Partners and The Grand Canyon Trust and funded by the Doris Duke Charitable Foundation.

At the CRC, the scholars toured research areas, participated in presentations by several CRC staff and researchers, and completed a mini-science project in which they collected soils data and conducted tests for stability. The students also engaged in a multi-stakeholder activity on managing public lands for

multiple uses. The enthusiasm and energy the conservation scholars brought during their stay was infectious. While CRC staff hoped to inspire the students, by the end of their trip, it was the students who truly inspired everyone at the CRC.

The Doris Duke Scholars Program aims to ensure that the conservation field is holistic, relevant, and just by providing a transformative educational and research experience for students typically underrepresented in the conservation workforce.

“The Doris Duke Conservation Scholars inspired everyone at the CRC with their enthusiasm and energy.”

*Nichole Barger, CRC
Director of Research*

GET INVOLVED



Freshmen from Fountain Valley High School made memories with the CRC as their outdoor classroom. © Reilly Kaczmarek

High School Scientists

Fifteen freshmen from Fountain Valley High School in Colorado Springs spent five days at the CRC taking science to a new level. Far from desks and fluorescent lights, these kids explored the flora and fauna of the desert, using biocrust as a backdrop to learn how to ask scientific questions, observe the environment, and practice basic wet lab techniques. Facilitated

by Jed Haupt of Fountain Valley School and Sasha Reed of the U.S. Geological Survey, the class was designed to inspire a love for science that lasts well beyond ninth grade. “The remoteness and proximity to Canyonlands National Park made a meaningful impact on our students,” said Haupt, “they emerged from the week refreshed with a much greater understanding of the desert ecosystem and the impact of human activity and climate change.”

SPECIAL THANKS



Courtesy David O. Tanner

David O. Tanner

Thanks to David O. Tanner for his generous support of the CRC over the years. David’s love of Utah’s canyon country has been inspired by his mother, Grace Tanner, who was born and raised in southern Utah.

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A Boost for Biocrust

As biocrust goes, so goes the entire desert ecosystem. Throughout the Colorado Plateau, biocrust—a community of lichens, mosses, and cyanobacteria that live on the ground’s surface—stabilizes and fertilizes the soil. This delicate “skin” is crucial to plants and wildlife, and prevents erosion caused by dust storms. Today the Plateau’s biocrust is facing intense pressures from climate change and human impacts. As alarm grows, scientists at the CRC are taking action. Teaming up with U.S. Geological Survey, Northern Arizona University and Rim to Rim Restoration, CRC researchers will test methods for restoring biocrust. Funded by a Wildlife Conservation Society grant through its Climate Adaptation Fund, with support from the Doris Duke Charitable Foundation, the project aims to harvest biocrust from hotter, drier deserts, like the Mojave and Sonoran. Scientists will then grow and transplant those crusts to areas on the Plateau, helping to combat the effects of climate change.

Biocrust is a crucial component of the Colorado Plateau ecosystem. © Joel Tuhy