



THE SUNDIAL

WINTER 2019



CANYONLANDS
RESEARCH CENTER



© Stuart Ruckman

IN THIS ISSUE

Innovations in Restoring Biocrust	5
Managing Water & Cows	7
Actionable Science: Studying Criollo.....	8
Outreach & Engagement	10

Learn more at www.canyonlandsresearchcenter.org.



CANYONLANDS
RESEARCH CENTER

The mission of Canyonlands Research Center 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 1,100-3,600 meters, the Center's study area is comprised of 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 Center an ideal location for research on the effects of climate on ecosystem processes and community dynamics. The Center is also situated along the boundary of the southwestern monsoon climate zone, making it particularly sensitive to climatic variation.

We Thank Our Collaborating Partners!

The Nature Conservancy 



COVER: Matt Redd, Director of the Canyonlands Research Center and the Dugout Ranch, feeding cattle.
© Stuart Ruckman

RESEARCH DIRECTOR'S REPORT



"We are trying to understand how we achieve restoration success in a future warmer, drier, and more variable climate."

This year at the Canyonlands Research Center we opened in March to a desert coming to life after the copious amounts of precipitation during the winter of 2018-19. The vibrant colors of the wildflower bloom were a reminder that desert life was only on pause during the extreme drought of 2018. Life in the desert this year continues to be defined by the extremes. The dazzling colors of spring have turned to the drying colors of late fall as we slide into another drought toward the end of this year. As we prepare to close our doors for a few brief winter months, we realize that our mission to monitor how

our natural environment responds to these dramatic shifts in climate is vital to the ecosystems and people of the Colorado Plateau. We continue to focus on restoring impaired dryland systems and, more recently, trying to understand how to achieve restoration success in a future warmer, drier, and more variable climate.

The CRC educational mission continues to expand. This past year, we created a botany walk as an educational resource for researchers and students. We planted and identified over 100 plants around the research center. We also installed a biological soil crust demonstration garden to illustrate the different restoration strategies we're trying for these critically important biological communities on the Colorado Plateau and across the globe. We also continue to engage with the next generation of environmental scientists. Throughout the year we hosted numerous university groups, including 10

undergraduates with the Ecological Society of America's Strategies for Ecology Education, Diversity and Sustainability (SEEDS) program, which was generously supported by the National Science Foundation.

The Ecological Society of America will be hosting their annual meeting in Salt Lake City in August 2020. CRC researchers will be leading a post-conference field trip to the CRC. If you plan to attend the annual meeting, please come join us!



Nichole Barger,
Research Director
nichole.barger@colorado.edu

Canyonlands Research Center Management Team

Nichole Barger, *Center Research Director*
Sue Bellagamba, *Canyonlands Regional Director*
Matt Redd, *Center and Dugout Ranch Director*
Kristen Redd, *Field Station Manager*



SCIENCE HIGHLIGHT



New Strategies in the Race to Save Biocrust

Imagine a skin graft for the Earth. That's how scientists are attempting to restore and sustain biocrust on the Colorado Plateau. Biocrust—a community of lichens, mosses and cyanobacteria that live on the dryland soil surface—is a critical component of deserts, stabilizing and fertilizing soil, and storing carbon. In an exciting new project, researchers are testing innovative ways to grow and transplant biocrust.

“Science is working hard to support land managers in their challenging work by providing information and tools,” explains Dr. Sasha Reed, an ecologist with the U.S. Geological Service (USGS). “This project provides hope that we can find creative ways to restore biological soil crusts and the important ecosystem services they provide into the future.”

The cutting-edge research was funded by a Wildlife Conservation Society grant through their Climate Adaptation Fund with support from the Doris Duke

Charitable Foundation. To conduct the groundwork, The Nature Conservancy and the CRC teamed up with the USGS, Northern Arizona University (NAU) and Rim to Rim Restoration.

Drylands cover roughly 40 percent of the planet, and within drylands, biocrusts are the dominant land cover. Crucial to the survival of vegetation and wildlife, biocrust prevents the erosion that causes dust storms. Today alarm is growing as biocrust across the southwestern United States falters under pressures from climate change and human impacts. Recent studies warn that biocrust is extremely vulnerable to the hotter, drier conditions predicted for this region.

For years, scientists thought that biocrusts grow and recover from disturbance too slowly to make restoration feasible. But recent studies showed that biocrusts can be successfully grown under greenhouse

and field conditions and restored more quickly. In this project, scientists harvested biocrusts from hotter, drier deserts, like the Mojave and Sonoran, and are transplanting and growing those samples at two sites on the Colorado Plateau. The idea is that these biocrusts are already adapted to survival in hotter and drier conditions, so they will be better suited to thrive on the Colorado Plateau as climate change delivers more droughts and heat to this region. “The biocrust farm and the sod techniques were an outrageous success,” notes Reed. Based on initial findings, the team has created a manual for land managers.

Dr. Anita Antoninka, who led the NAU science team, underlines the project's significance. “This research is of critical importance, because it delivers methods to scale up biocrust salvage, cultivation and restoration in the context of a changing climate.”

OPPOSITE: Scientists are excited by preliminary success in cultivating biocrust at this innovative “biocrust farm” near Moab © Kara Dohrenwend



FROM THE RANCH



Q&A with Matt Redd



Matt Redd is the Director of the Canyonlands Research Center and the Dugout Ranch © Stuart Ruckman

How is climate change impacting water and grazing on the ranch?

As climate change unfolds, precipitation patterns are changing. Consistent monsoon seasons used to provide water that filled stock ponds and puddled on the varied geology providing seasonal water sources for livestock and wildlife. This allowed us

to disperse the livestock over large areas of the summer grazing allotments. Now, we don't have dependable monsoons, and the precipitation tends to be localized and severe. On the ranch's winter range, snow is an important water source. These days we don't get much snow, instead we get rain. Without enough structures to store precipitation when it comes, we risk putting unsustainable grazing pressure the range.

What water management changes are you making to adapt to the new climate?

To adapt to the change in climate we're implementing structures that can store water when it comes, regardless of its erratic timing or form. If we store runoff water, then we have more options and control of where and when we graze cattle. This adaptation will allow us to manage and maintain sustainable grazing landscapes.

What about irrigation practices?

In addition to storage we are developing more efficient irrigation infrastructure to deliver water to the ranch's cultivated fields.

The timing of cattle grazing and irrigation are important because they impact our ability to maintain and improve the overall health of the range. We have predominately cool season grasses here, and we try to minimize the grazing pressure on them so that they have the best opportunity to grow and establish. In the past, the warm and cool seasons were more equal in length, and we were able to bring cattle onto the irrigated fields in May when the cool season grasses were active. Now we have shorter cool seasons and longer warm seasons, which means the native rangeland grasses become active earlier in the year. By updating and improving our irrigation systems, we leverage our existing agricultural resources to adapt and manage for this change.

These improvements will let us grow cultivated forage that cattle can be moved onto sooner, reducing grazing impact on native grasses. By making these changes, we may also help to improve the instream flow of Indian Creek. New water management and grazing strategies help us adapt to climate change and conserve public rangelands.

OPPOSITE: Adapting to climate change at the Dugout Ranch means trying new water and grazing management strategies. © James Q. Martin

FIELD NOTES



Graduate student Danielle Duni is conducting research that matters to ranchers and land managers. Photo courtesy Danielle Duni

Actionable Science: Helping Landscapes and Ranchers Thrive

Danielle Duni is a Range Science graduate student at New Mexico State University, and she's looking for answers. "Science needs to provide tangible solutions for the multiple challenges affecting rangelands in the Southwest today," she explains. For Duni, those answers include determining whether a special breed of cattle can help better protect arid lands and keep ranchers in business. At the CRC, Duni is part of a team, including Mike

Duniway with the U.S. Geological Survey, Andres Cibils with New Mexico State University, Alfredo Gonzalez from the Jornada Experimental Range in New Mexico and Matt Redd, director of the CRC, who are studying Raramuri Criollo cattle. Bred in the remote canyons of northern Mexico, the Criollo cattle have never been cross-bred, making their genetic line unique. They are known for thriving in desert environments, being hearty, and ranging further for forage.

Duni and her teammates are using GPS collars to track Criollo cows as well as the more traditional Red Angus cows at the CRC, to see how they use desert and forest landscapes differently. The hope is that the Criollo will be better suited to the climate changes unfolding in this region and will have less of an impact on the fragile ecosystem of the Colorado Plateau. Many of the native plants that typically sustain Angus cattle are succumbing to heat and drought. Initial studies from NMSU and Jornada

suggest that Criollo, because they can roam further, might be able to graze on shrubs more than the Angus, who rely on grasses. Duni expects her project to have real-world implications: "the type of science that I am conducting seeks to help ranchers and land managers care for the land while insuring the sustainability of ranching operations."

Microbial Focus

In June, Dr. Peter Salamon from San Diego State University hosted a workshop at the CRC on Thermodynamic Theory and Microbial Ecology. Dr. Salamon notes, "the workshop was significant in advancing our understanding of energy budgets in naturally occurring microbiomes." Participants discussed designs for ultra-sensitive calorimeters and field tested a new type of calorimeter for measuring heat production by the microbiota in water samples from the reservoir at the CRC.



A new garden showcases cutting-edge biocrust reclamation efforts at the CRC. © James Q. Martin

Biocrust Garden

Visitors and researchers at the CRC this year will find a new botanical resource on the grounds. This summer, Kristen Redd, CRC field station manager created a biocrust garden, showcasing some of the restoration strategies scientists are testing on the Colorado Plateau. The garden features harvested biocrusts from the Chihuahuan Desert, Sonoran Desert, Great Basin, and Colorado Plateau. Redd created the garden through a meticulous process of salvaging, screening and replanting biocrusts to ensure the samples have the best chance of re-establishment. The biocrust garden highlights the differences in the soil and biocrust from various desert regions and demonstrates the latest techniques in reclamation practices.

Crust Crusaders

This fall CRC volunteers helped complete the final phase of an innovative biocrust reclamation project (learn more on page 5). Volunteers spent the day rolling out biocrust sod over an expanse of 20 acres at sites on the Colorado Plateau. Scientists had salvaged and harvested the sod from the Mojave and Sonoran Deserts, and then nurtured it at a “biocrust farm” owned by Rim to Rim Restoration at the Mayberry Plant Center near Moab. This first-of-its-kind farm played the critical role of “growing” the harvested biocrusts for a couple of years to acclimatize it to local conditions. After the successful inoculation by volunteers, scientists will now monitor the newly planted biocrust to see whether it can thrive in its new home.



Volunteers help transplant harvested biocrust to its new home on the Colorado Plateau. © Stuart Ruckman

OUTREACH



SEEDS program students in the field at the CRC. © Mark Brunson

SEEDS Students Get Hands On

“I believe the CRC is located in one of the most beautiful and fascinating places on Earth, so it was natural for me to want to bring the SEEDS students here,” explains Mark Brunson, a professor of environment and society at Utah State University. SEEDS, or Strategies for Ecology Education, Diversity and Sustainability, is a program run by the Ecological Society of America that offers engaging experiences in ecology for students from diverse backgrounds. Brunson has been active with the CRC since

its founding and is a member of the CRC Science Committee. He also serves as a SEEDS student mentor and advisory board member.

Last spring, Brunson brought 10 SEEDS students to the CRC to explore the landscape, and to learn about local ecosystems and the impacts of climate change. The students also had an intense science day where they explored potential research sites, developed research questions, designed a study, gathered and analyzed the data, and reported what they found. “I’ve been with the SEEDS students before, so I know how awesome they are,” Brunson notes. “But watching the students assimilate information about an environment they’d never seen before, develop a research study, and execute it effectively was a highlight for me as a host.”

CRC in the Spotlight

The Nature Conservancy has launched a new web feature highlighting the CRC and the important research happening here. The feature includes video interviews with Dugout Rancher Heidi Redd, Dr. Nichole Barger and María Cristina Rengifo-Faiffer, a recent CRC fellow. **Check it out: [nature.org/canyonlands](https://www.nature.org/canyonlands).**



Heidi Redd shares her perspective on the CRC in a new web feature. © Ted Wood

GET INVOLVED



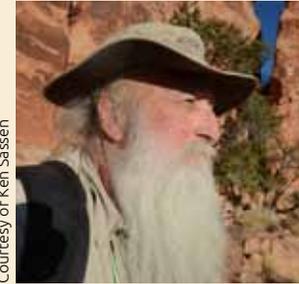
Students studied lizards at the CRC through a program with The Natural History Museum of Utah. © Jonny Gonzalez

Urban Teens Meet Desert Lizards

For three days in July, a group of teens from the Youth Teaching Youth (YTY) program at The Natural History Museum of Utah (NMHU), immersed themselves in the CRC's unique environment—and also got up close and personal with its scaly residents. “Seeing each teen get their first lizard catch was memorable,” says Jonny Gonzalez, a YTY Program Specialist at NHMU. “You could see how amazed they were by such small, beautiful creatures.” The students were catching and studying the reptiles alongside Spencer Hudson, a CRC

fellow and PhD student at Utah State University, who is researching whether reptile populations on the Colorado Plateau can remain viable in the face of climate change and landscape impacts. During their stay at the CRC, the six students from Salt Lake City captured and measured lizards and learned about desert ecosystems. Back at the Museum, they shared their experience and knowledge with other students in the YTY program. Gonzalez says their trip to the CRC was impactful. “The kids are so surprised to find out there are people who get to do these kinds of things for a job. It’s an empowering realization. One teen in particular has been so affected that she is now pursuing biology as an undergraduate at Salt Lake Community College and hopes to transfer to Utah State University to pursue research.”

SPECIAL THANK YOU



Courtesy of Ken Sassen

We’d like to recognize Ken Sassen for his important gift to the CRC and The

Nature Conservancy’s Dugout Ranch this year. Ken has been a TNC member since 1997 and is also a Legacy Club member. As a retired professor, Ken admires the work being done at the CRC. He finds endless pleasure hiking Utah’s canyons and searching for rock art, similar to the petroglyphs that TNC helped to preserve at the Dugout Ranch. Thanks to generous supporters like Ken, scientists are using the CRC and the Dugout Ranch to develop new strategies for protecting and restoring the Colorado Plateau in the face of climate change.

VISIT: www.canyonlandsresearchcenter.org

FOLLOW: www.facebook.com/canyonlandsresearchcenterTNC

CONTACT: canyonlandsresearchcenter@gmail.com



LEFT: Scientist Ian Clifton. © Ian Clifton. RIGHT: Greater short-horned lizard.
© Carla Kishinami

Desert Reptiles and a Changing Climate

The greater short-horned lizard isn't speedy, but he's well camouflaged. His flat body melds into the reddish-brown soils of the Abajo Mountains near the CRC. It's only his sudden scamper that gives him away, catching the sharp eye of Ian Clifton, a PhD candidate from the University

of Toledo. "Initially there's generally a lot of walking around, staring at the ground, hoping to spot some movement," says Clifton, who's using the CRC as a base for his lizard research. The reptiles he and his team catch are fitted with a small radio-transmitter backpack and released, scurrying back into the desert.

Clifton's research goal is to understand how individual lizards respond to climatic changes and how their responses affect other activities such as growth and reproduction. Clifton explains: "A lot of research has focused on the potential species-level consequences of climate change, but less is known about the individual-level mechanisms that mediate an animal's response to climate change."

Already Clifton and his colleagues have found that lizards are able to rapidly change their

behavior in response to climatic changes. Their answers are important for understanding what the future holds for these species, especially as prolonged droughts and higher temperatures become the norm on the Colorado Plateau. Lizard populations around the globe are showing decline, and scientists see climate change as a major stressor.

Using the CRC headquarters as a base camp, Clifton is able to have a spacious lab area and consistent electricity while staying close to his field sites. He plans to wrap up most of his field research in 2020 and share his findings with scientific community in the next few years. "To fully appreciate the consequences of climate change," says Clifton. "It is imperative to have a thorough understanding of how individuals deal with climate change and how their responses affect other aspects of their life."