



THE SUNDIAL

WINTER 2020



CANYONLANDS
RESEARCH CENTER



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CANYONLANDS
RESEARCH CENTER

The mission of the 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 CRC is located at The Nature Conservancy's Dugout Ranch — a gateway to 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 CRC'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 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!

The Nature Conservancy 



COVER: View of the Moki Family formation. © Stuart Ruckman

RESEARCH DIRECTOR'S REPORT



“COVID-19 has been a disruptive force in the lives of people, and we are watching carefully to see the full impact of the global pandemic on our public lands.”

This past field season at the Canyonlands Research Center (CRC) headquarters was a quiet one as we all settled into our new reality of the tragic circumstances of the global COVID-19 pandemic. For those of you who have been directly affected, or who have lost a friend or family member, please know that our hearts are with you.

For many of us, the early shut down gave us time to reflect on the state of our planet in a way that is not normally afforded with busy work schedules and family commitments. This global and abrupt “anthropause” clearly showed us the impact that we have on our environment. Around the globe, we

witnessed how major changes in human behaviors affected everything from air quality to the movement of wildlife. In our region, as people’s mobility increased in southeast Utah, some national parks saw record increases in visitation creating additional pressures on ecosystems that are already heavily visited. COVID-19 has been a disruptive force in the lives of people, and we are watching carefully to see the full impact of the global pandemic on our public lands.

This last spring at the Dugout Ranch, we closed down the CRC during our normal opening time of mid-March. As we moved into summer and started gaining a better understanding of COVID-19 transmission, we were able to welcome a limited number of our researchers back to headquarters by June. Since this time, we have been hosting researchers under strict COVID-19 protocols to protect our researchers and our families living at the ranch. The wonderful news is that many of the groups that work at the CRC were able to persevere through these difficult times and continue with their research this field season. We welcomed several new projects at the

CRC designed to further our knowledge of how to mitigate the impacts of climate and restore degraded ecosystems. In this issue, you can read about some of the CRC’s exciting new research on cottonwood resilience, Criollo cattle and seed sources for drylands restoration.

Although we move into the winter season with a lot of uncertainty, what we do know is that we will continue to move forward in our work with the hopes that we will have some return to normalcy in mid to late 2021. Wishing you all good health and safety in the months ahead.



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

Canyonlands Research Center Management Team

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



SCIENCE HIGHLIGHT



Sowing Seeds of Hope

Small-leaf globemallow (*Sphaeralcea parvifolia*) likes the dry, rocky soils of the Colorado Plateau. This native perennial forb, which bursts into orange-red flowers from April through November, is also an excellent colonizer of disturbed lands and useful for erosion control. All of these qualities make the globemallow important for restoration scientists like Dr. Sasha Reed, with the U.S. Geological Survey. In a new study at the CRC, Reed and her partners are analyzing drought-response strategies in the small-leaf globemallow, yellow spiderflower (*Cleome lutea*), and sand dropseed (*Sporobolus cryptandrus*).

The project is called Germination for Restoration Information and Decision-making (GRID), and its goal is to answer questions about what seed sources might be the most successful for restoring the drylands of the Colorado Plateau. The GRID project gets Dr. Reed excited. “I love that we are focusing on seeds. While planting seedlings or adult plants can be great approaches to restoration, resource managers often have to use seeds when they need to restore large areas where using plants isn’t logistically or financially feasible,” she says.

In the face of human disturbances and increasing climate change, experts agree that restoring native plant communities is a key management need for the Colorado Plateau. But as Reed notes, it’s not an easy task to prescribe the right seeds to the right place. Scientists still have a lot to learn about how native plants respond to environmental variability—like increasing heat and drought. And finding the answers can be a challenge.

“It turns out it’s not very easy to be Mother Nature,” says Reed. She and her partners have their hands full trying to mimic natural rainfall but also change natural rainfall patterns to determine what sources of seed might be most successful with different amounts of precipitation. “We set up a translucent roof that keeps natural rainfall away from the seeds and seedlings so that we can give different populations of seeds different amounts of water. But figuring out how much water to provide so that not all the plants die has been hard and keeping up with the watering is a lot of work,” she explains.

All the careful, scientific labor will pay off if Reed and her team can determine which seeds do best with more rainfall and which do best with less. “This project gives us new insight into what seeds might be best suited for a range of future climate conditions, which can mean increased success for restoring plants after disturbance.”

The GRID project is underway now at the CRC, and the team will be monitoring and tracking the variations and successes of the seeds for a few months. The results will be important. For dryland ecosystems around the world, environmental stresses are on the rise. Our ability to regenerate dominant vegetation species could be a deciding factor in the fate of threatened ecosystems. “Understanding how we can promote plant recovery, both now and into the future, gives us great opportunities for maintaining the plants and wildlife we care about,” notes Reed. “If you love native plants and love the idea that we can help plant communities recover, this project is for you!”

OPPOSITE: Dr. Sasha Reed with the GRID plots. © Nate Murray @Local Motives



OUT ON THE RANGE



Matt Redd © Stuart Ruckman

Matt Redd, Project Director of the Canyonlands Research Center and the Dugout Ranch, provides an update on the CRC's work with Rarámuri Criollo (Criollo) cattle. Studies suggest the Criollo, bred in an isolated region of Mexico, could put less stress on the arid ecosystem.

What's happening right now with Criollo cattle at the CRC?

We're continuing work on our original Criollo cattle research in partnership with the Jornada Experimental Range and

the USDA Long Term Agroecosystem Research network and the U.S. Geological Survey. We just re-collared the study group, so we can track how these cattle use the range differently than our European breeds. COVID-19 slowed down our in-field observations, but we're refining our vegetation maps to assess whether the Criollo have a lesser impact on arid rangelands.

We're also now starting up some exciting new projects focused on the Criollo. We are part of a five-year National Institute of Food and Agriculture (NIFA) grant, led by New Mexico State University and the Jornada Experimental Range, to determine whether the current beef supply chain could assimilate the Criollo, or if not, what would need to change in the industry infrastructure. This study looks at what would happen if producers in the Southwest started using Criollo or Criollo hybrids on a larger scale. We're trying to fill knowledge gaps and advance the sustainability of beef production in arid landscapes. A new element to this multi-year project is our testing of sensor-driven precision technology. The sensors will give us real-time analysis of shifts in cattle movement patterns. This will allow us to intervene rapidly and make more informed management decisions. We also have another new NIFA grant that's funding

our work with Utah State University to use pedometers and GPS collars on our Criollo cattle. This data will show us how far the Criollo range from water sources and how they use vegetation differently from European breeds, particularly at lower elevations.

Why conduct all of this Criollo research?

The climate is changing quickly, especially in the American Southwest. Warmer and drier conditions are impacting the Colorado Plateau now. We need these breed comparison studies to assess whether the Criollo show real promise for economic and environmental sustainability in the severe and erratic conditions that appear to be the future benchmark of our climate.

Are you hopeful about the future?

What I find most compelling is being part of research that can help this operation, as well as livestock producers in the Southwest, conserve the environment while maintaining rural agriculture economies. We're observing differences between how traditional European breeds and the Criollo utilize forage and water. These differences indicate practical benefits in using this breed to adapt to the impacts of climate change while sustaining the resources on which nature and agriculture depend.

OPPOSITE: Matt Redd wrangles cattle at the Dugout Ranch. © James Q. Martin

FIELD NOTES



Small holes in the cottonwood leaves simulate insect attacks. © Rebecca Best

Riparian Resilience: Cottonwoods, Adaptation & Climate Change

Riparian trees such as Fremont cottonwoods (*Populus fremontii*) form the heart of our desert riparian ecosystems. Lining western rivers like thick green ribbons, these iconic trees impact a vast amount of life around them. They provide habitat and food for birds,

insects, and mammals, their shade reduces soil and water temperatures and slows evaporation, and when their leaves fall in the river, they supply food and nutrients to aquatic food webs from microbes to insects to fish.

For Dr. Rebecca Best, an ecologist from Northern Arizona University, and her teammates, the crucial role cottonwoods play for nature (and humans) makes them perfect candidates for a study that looks at the evolutionary past and attempts to see the future. “A tree’s genes probably set it up not just to do the same thing all the time, but to respond to environmental stresses like hot or dry conditions or insect outbreaks in particular ways that will help it survive. Without ways to predict these responses or their effects on ecosystems, our ability to understand the consequences of climate change is really limited,” Best says. “Our hope is that by understanding the stresses this species has experienced in the past, we can better predict what these trees will be able to do in the rapidly changing landscape of the future.”

With a grant from the National Science Foundation (NSF), Best and her partners are using the common garden at the CRC as well as matching gardens on the Agua Fria River in central Arizona and on the Colorado



Dr. Rebecca Best © Northern Arizona University

River near Yuma, to apply stresses, such as increasing temperature and simulated insect attacks, to cottonwood genotypes from all over Arizona. “We hope to be able to predict how well these trees will be able to survive, grow, reproduce, and support riparian ecosystems under future stresses, and we also want to identify which trees will do this best so we can plant those genotypes in restoration projects.” For the last 150 years, the West’s riparian areas have been degraded by invasive species, mismanaged

grazing, groundwater pumping and development. Now the increasing heat and prolonged droughts of climate change are threatening these native trees in an unprecedented way.

One thing Best and her team have already learned: the genotype of cottonwood and its location impact how it manages stresses to survive. “Fremont cottonwoods are genetically very different across their range; the southern populations do better in hot locations and the cold populations from the Colorado Plateau do better in locations with cold winters,” says Best. “One of the most interesting discoveries we’ve made is that trees deal with different stresses in related ways. For example, because of the way they form their water transport systems, trees from places with hard winter frosts are actually also better at dealing with fall drought, although not necessarily extreme temperatures.” By exploring the relationships between trait expression, adaptation, and climate, Best and her teammates hope to help land managers

restore riparian ecosystems across the climate-stressed Southwest. This research is supported through partnerships with The Nature Conservancy, Arizona Game and Fish Department and the Bureau of Land Management, and NSF funding to Best, Gery Allan, Kevin Grady, Catherine Gehring, and Tom Whitham at NAU, and to Kevin Hultine at the Desert Botanical Garden.



Field Assistant, Forrest Fanara, at the CRC © Iris Garthwaite

OUTREACH



Sierra Jech in the field. Courtesy Sierra Jech

Research Fellow Uses Genetic Sequencing

The high-pitched trill of desert amphibians marked Sierra Jech's introduction to the Colorado Plateau and to her current research topic: biological soil crusts. "Each spring, at the end of the Nordic ski season as an undergrad, my coaches would take us backpacking," remembers Jech, a 2020 CRC Research Fellow. "We'd spend a week in Utah's red rock canyons listening to the red-spotted toads, learning respect for ancient human artifacts, and practicing how to step carefully through the biocrust." Fast-forward a few years, and Jech now finds herself steeped in the desert

in a whole new way—she's doing specialized research to improve biocrust restoration. A first-year Ph.D. student at the University of Colorado, Boulder, Jech spent her summer at the CRC using microbial ecology and genetic techniques to assess the health and viability of biocrust that was grown at a large scale for restoration.

"This fellowship funded a sequencing analysis of the microbial composition of our biocrust inoculum over time," says Jech. "Genetic sequencing will provide us with a lot of information about the organisms present in our soils and what they may need to survive longer at the degraded sites."

Like most things in 2020, Jech's fellowship this summer looked different due to COVID-19. "My goal was to minimize contact with CRC employees. I would wake up with the sun and head to my biocrust inoculation plots to take photos and samples." Despite the restrictions and extra solitude, Jech advanced her research and treasured

her experience. "This fellowship has allowed me to work side-by-side with some of the top ecologists in my field and helped me pursue my own research interests in a way that is guided by real-world application." Jech, who plans to continue her work in biocrust restoration, is now eager to track the results and impacts of her summer experiments. Jech earned one of four CRC research fellowships awarded in 2020. The other 2020 fellows are Ian Clifton from the University of Toledo and Danielle Duni and Megan Rabinowich, both from New Mexico State University. To learn more about this year's fellowship projects, visit: [canyonlandsresearchcenter.org/news](https://www.canyonlandsresearchcenter.org/news).

Thank You

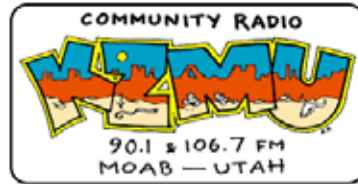
We'd like to extend a special thank you to **Alternative Visions Fund at the Chicago Community Foundation** for their major contribution to the CRC this year.

Biocrust Gets Animated

Many people still don't understand the vital role biological soil crusts play for ecosystems and for human wellbeing. A short, new animated video aims to change that, bringing biocrust to life for a wide range of audiences. Narrated by Dr. Sasha Reed, a member of the CRC Science Advisory Committee and restoration scientist with the U.S. Geological Survey, the video dives into the importance and protection of the tiny organic community that lives on the soil surface of drylands. Check out the video at [Nature.org/Utah](https://www.nature.org/Utah).



Biocrust illustration © Kidealabs



Spotlight on Regional Science

Every Friday at 11:30 am MST, Kristina Young takes to the radio waves on KZMU, Moab's local community station, and explores a cutting-edge science topic about the Colorado Plateau. A soil ecologist working on her doctorate, Young launched the "Science Moab" program in 2017 and has interviewed more than 30 scientists doing regional research. Show topics span ecology, geology, chemistry, archaeology, hydrology and more. Young aims to focus on local topics, with local experts, and present them in a way that is accessible to everyone. "Science Moab" is archived online at kzmu.org, and you can find it on iTunes as a podcast.

Special Tribute: Alfredo Lucas Gonzalez



© James Q. Martin

The staff at the CRC and the entire Rarámuri Criollo cattle research team are mourning the loss of a special friend and leader.

Alfredo Lucas Gonzalez passed away on July 8. Alfredo worked at the USDA Jornada Experimental Range and with New Mexico State University. He was key member of the research team tracking Rarámuri Criollo cattle at the CRC. Alfredo, who held a master's degree in animal science, was instrumental in bringing the Rarámuri Criollo into the United States from the Copper Canyon of Mexico. "Alfredo's passion for the Rarámuri Criollo was prescient and inspiring," says Matt Redd, the CRC's project director. "We are so grateful for the time we had with Alfredo, and we are committed to carrying his passion forward."

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CONTACT: canyonlandsresearchcenter@gmail.com



Attendees at the November 2019 Forum. © Lee Gelatt Photography

New Forum Promotes Collaboration

No one likes working in isolation. But for the scientists, land managers and practitioners trying to sustain the ecosystems of the Colorado Plateau, the need for collaboration is vital. The Plateau's vast range of land use histories, management policies, and human pressures makes it unique and complex. Now climate change,

which is already impacting the region's lands and waters, adds a daunting new challenge. Time is running out for people to understand enough and act quickly enough—at a scale large enough—to sustain the Plateau's ecosystems.

That's why the gathering that took place in Grand Junction, Colorado, in November 2019 was so important. It marked the first Colorado Plateau Science and Management Forum. Launched by the CRC Science Committee, the Forum facilitates communication, collaboration, and knowledge exchange between researchers, resource managers, and other interest groups on the Colorado Plateau. Federal land managers and other stakeholder groups set the agenda, and at the first meeting, the group tackled the topics of climate change, ecosystem restoration, and wildlife habitat and management. Scientists who are working on these issues across the region presented their latest progress, and

Forum participants then worked in breakout groups to discuss and collaborate on solutions. "Most of the day was spent in small interactive discussion groups, and it gave land managers and scientists a chance to really discuss their most pressing issues," explains Nichole Barger, the CRC research director. "Building relationships and sharing information during Forum meetings is one of the most critical components to promote knowledge exchange across the Colorado Plateau region." The next meeting for the Forum is being planned for Fall 2021, and the CRC Science Committee plans to hold the gatherings biannually. To find out more about the Forum, contact Nichole Barger at nichole.barger@colorado.edu.



Illustrator Kriss Whittmann at the Forum. © Lee Gelatt Photography