



# THE SUNDIAL

WINTER 2021



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 to 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: Aerial view of the Dugout Ranch and Canyonlands Research Center. Credit: Philip Adams/TNC

# RESEARCH DIRECTOR'S REPORT



It was with great relief and joy that we reopened the Canyonlands Research Center this past field season! After a disorienting year of virtual meetings, the ability to reconnect with colleagues, collaborators and friends brought a sense of normalcy back to our lives as we continue to navigate our path through the pandemic.

This past year also brought increasing awareness on the global stage of the immediate actions we need to take to secure a sustainable future. The United Nations Decade on Ecosystem Restoration, a movement to increase awareness of our collective impacts on ecosystems across the globe, was launched in 2021. The “Decade” sets ambitious goals to reverse the degradation of global ecosystems while maintaining livelihoods and biodiversity, and it provides platforms and strategies for localized action. The Nature Conservancy is also focused on helping the United States meet its goal of protecting or restoring 30 percent of our lands and waters by 2030. The vision is to create inclusive and collaborative

conservation to address climate change, protect parks and working open spaces and sustain vibrant rural and urban communities. Achieving these critical 2030 targets will take conserving and restoring lands and waters in a scientifically sound and collaborative manner.

At the CRC, we take these challenges seriously. Forty percent of the Earth’s surface is covered in drylands, and much of that is already degraded or threatened. The CRC’s research is largely focused on the actions we can take on the ground—right now—to heal the lands of the Colorado Plateau. We’re also developing practical strategies and tools for land managers and communities to help advance drylands restoration worldwide. But coming up with innovative solutions is only half the battle. The achievement of bold conservation goals will also take unprecedented collaboration and education—we must facilitate the coming together of diverse teams, communities and partners.

That’s why I’m so excited that this summer the CRC welcomed our first

class of the Tribal Natural Resource Leadership Program. This new program, in partnership with Utah State University-Blanding, will strengthen our partnerships with local communities, help us amplify important voices and learn from Indigenous experiences. The first three program participants, USU-Blanding students and members of the Navajo Nation, spent 12 weeks engaging with researchers on restoration and land management issues. The program also enabled the students to meet with local leaders working on sustainable land management and food sovereignty issues across the Four Corners region. (Read more on page 10).

There is no question that we face a moment of planetary crisis. But I remain hopeful about the next decade—and our collective capacity to choose the right path. I’m keenly aware that our research and education advances at the CRC are increasingly urgent and valuable.



**Nichole Barger,**  
*Research Director*  
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# SCIENCE HIGHLIGHT



## *Untangling the Web of Change: Cattle, Drought and Vegetation*

Ranching has long been a part of the Colorado Plateau. Large numbers of livestock, mainly sheep and cattle, were introduced here in the mid-19th century, and today approximately 90 percent of the Colorado Plateau is still used by the cattle industry. But if cows are a reality for this arid region, so are increasingly severe droughts driven by climate change. For Dr. Tara Bishop, a research ecologist with the USDA Forest Service, there's a pressing need to better understand how extreme drought and different grazing strategies will alter desert perennial grasslands on the Colorado Plateau. "The direct effects of grazing—especially during drought—on plants and soils can disrupt or alter dryland ecosystem processes and result in profound, often irreversible, changes," explains Bishop.

What if scientists and land managers could understand, predict and prevent those changes? Bishop and her teammates, including Dr. Mike Duniway, a soil scientist with the U.S. Geological Survey (USGS), are conducting a new study at the CRC to shed light on how drought and grazing act separately and in combination to influence the structure and function of dryland ecosystems.

The team has installed 20 small plots at two different locations that are grazed by CRC cattle, and over the next few years, they will simulate drought and various grazing treatments. "We'll bring all of that plant biomass back and analyze it for nutrient and protein content in addition to tracking what species are out there," says Bishop. "We want to see if drought affects the nutritional value of the plants for the grazers and/or causes changes in what kind of plants persist. We are also going to simulate hoof or stepping disturbance because we are interested in how the impact of walking may change the soil crusts and their activity."

In addition, Bishop and her colleagues are collaborating with New Mexico State University scientists who are processing samples at a molecular level from the soils to investigate how the actual metabolic processes are changing based on the interactions. "This is a deep dive into the understanding of possible mechanisms to the response of change."

It's the type of deep dive that's only possible at the CRC. The CRC has already yielded years of continuous climate and livestock use data from the Dugout Ranch, offering a rare opportunity to track historic trends and pinpoint the impacts of livestock management and climate. "We have great information from Matt Redd about the grazing patterns," Bishop notes, "and we have a great history on how these pastures were grazed. That gives us a perfect launching point of understanding when and how the best grazing treatments will serve the land managers of the area," says Bishop.

The hope is that the study's results will be useful for a range of stakeholders, from ranchers and land managers who need to know how plant communities may change, and how they can better mitigate any possible undesirable outcomes, to policy makers who are driving decisions about the future of the agriculture industry in the face of climate change. The team plans to share their findings widely through peer-reviewed journals and the outreach efforts of the CRC, Forest Service and USGS.

OPPOSITE: The research team installs a structure to simulate drought at the CRC. © Tara Bishop, USFS





# OUT ON THE RANGE



Matt and Kristen Redd hold their BLM award. © TNC

## *Q&A with Matt Redd, Project Director for the Canyonlands Research Center*

In September 2021, Matt and Kristen Redd, who lead stewardship and field station activities at the Dugout Ranch and the CRC, received national recognition from the Bureau of Land Management (BLM) Public Lands Council. The Rangeland Stewardship Award they received recognizes beneficial management practices to restore, protect or enhance rangelands.

### **What does it mean to you to earn this national recognition?**

It's a true honor to be recognized by the BLM's Public Lands Council. And it's even more special to me that we were nominated by the Monticello BLM office. These local BLM officials are our peers and partners in land management and conservation on the Colorado Plateau, and their recognition means a lot. Kristen and I definitely view this not as an individual success, but as the success of our whole team of researchers, ranchers and conservation leaders. This award shines a light on the innovative research and practices we've collaborated on over the last decade.

### **Why do you think the rangeland stewardship at the Dugout stands out?**

I think the variety of work we're doing stands out—from testing ranch management practices to adapt to changes in land use and climate to the research we're involved with on climate adaptation. We're not only actively looking for new solutions that will help agricultural producers and sustain the health of our public lands, but we're also implementing and testing those ideas on the working landscape of rangelands.

### **What stewardship innovation are you most proud of?**

The work that we're doing right now with different breeds of cattle at the CRC is important, and I'm proud of that effort. I believe our findings will open up new options for ranchers who are seeking to run viable operations and secure the long-term health of this increasingly arid landscape. I'm also excited about our experiments with additional sources of water that will allow us to have more flexibility in our grazing management, depending on what's happening with climate change year to year.

### **What changes in ranching have you observed over the years?**

It's gratifying to see the growing interest of ranchers seeking new ideas to help them remain sustainable in the face of climate change. There's always been a business interest in innovation to improve the bottom-line, but I also see a younger generation of ranchers who are considering long-term sustainability, and who recognize the challenges we face with climate change. They are interested in ranching tactics and strategies that will not only keep them viable now but also protect their grazing lands into the future.

OPPOSITE: Matt Redd rides the range at the Dugout Ranch. © James Q. Martin

# FIELD NOTES



The research team poses with “Restorebot”. © TNC

## Robots on the Range

You’ve heard of autonomous robots delivering parts on an assembly line, vacuuming a living floor, and even delivering hotel room service. Soon, they could also be helping scientists restore damaged drylands. In an exciting new project, Dr. Nichole Barger, the CRC’s Research Director, is working with Dr. Christoffer Heckman and Dr. Nikolaus Correll from the Department of Computer Science at CU Boulder to develop and test autonomous mobile robots. “We are bringing

technologies developed in related disciplines, such as autonomous vehicles and smart manufacturing techniques, to address urgent needs in restoring degraded lands. We envision that, with the right improvements, these techniques will enable large-scale ecological restoration,” says Heckman. These “restorebots” will ultimately be able to identify favorable seeding locations in degraded rangelands, navigate to these locations, and plant native seeds.

Dryland ecosystems make up 40 percent of Earth’s land surface and support about one-sixth of the world’s population, but a large percentage of rangelands in dry areas have already been degraded. Historically, scientists have struggled to bring these areas back. “It’s difficult to revegetate degraded drylands,” says Barger. “It requires an extraordinary amount of labor and the success rates are low.” Part of the challenge is finding the optimal site to place the native seeds—one with the right soil, light and nutrient conditions—so that revegetation is successful. Restorebot could help to solve this challenge by learning to evaluate and classify ideal sites for revegetation, and eventually, actually planting the native seeds. “This kind of ‘precision agriculture’ has tremendous potential in general but requires advances in both perception and robotic manipulation to be viable at scale,” says Correll. As part of this four-year project, the first robot is now being tested at the CRC, and the team is gathering data to help inform and refine the development of a second iteration of robots with more capabilities.



## Studying the Desert's Elusive Flows

Butler Wash in Canyonlands National Park and the neighboring Indian Creek boast some stunning ancient cliff dwellings, but Juli Scamardo is focused intently on the ground. A PhD student in geomorphology at Colorado State University, Scamardo is looking at the floodplains of these ephemeral washes and studying how sediment sources and erosion caused by flash floods have shaped their ability to support life. "I'm interested in understanding whether the range of topography, sand grain size and vegetation on an ephemeral floodplain is related to elements like the floodplain's width and sediment supply."

Scamardo's research will help fill a gap in our understanding of what role ephemeral streams play in the desert ecosystem. More than 81 percent of all streams in the arid Southwest are ephemeral, yet they are far less studied than their perennial

counterparts. Scamardo points out that these temporary flows provide key ecosystem services, such as nutrient cycling and groundwater recharge, as well as supporting migratory pathways for wildlife. As climate change intensifies, the vulnerability of ephemeral streams is a pressing concern.

"Understanding how to protect ephemeral streams may be essential to maintaining thriving desert ecosystems," says Scamardo. "What areas do we need to protect? What processes need to be maintained?" Scamardo's research involves indirect and interdisciplinary methods including aerial mapping, geochronology and geophysics. She will compare her results from Butler Wash and Indian Creek to data collected in four other ephemeral watersheds across the Colorado River Basin. "My hope," she says, "is that this research will help with land management decision-making in the future."



Juli Scamardo in the field. © Ellen Wohl

### Get Involved

You can help ensure the CRC continues to develop the science, technology and networks we need to protect and restore drylands on the Colorado Plateau and around the world. Contact Nancy Sears at [nancy.sears@tnc.org](mailto:nancy.sears@tnc.org) or (801) 238-2325.

# OUTREACH

## CRC & USU Launch Tribal Leadership Program

This summer, the students in the new Tribal Natural Resources Leadership Program taught as much as they learned. “I loved how after each session at the Dugout Ranch we were asked our insights on the lesson,” says Danielle Smiley, a member of the Navajo Nation, and one of the first program graduates. “Our culture and teachings of traditions from our elders are still being passed from our ancestors, and I felt like we finally had a voice.” For thousands of years, the Ute and Navajo people have nurtured deep connections to the lands and waters of the Colorado Plateau. “Scientists are learning the Earth needs to heal and Indigenous knowledge of the land needs to be included,” says Smiley.

The Tribal Natural Resources Leadership Program is an effort to increase the CRC’s connection to the region’s Indigenous peoples and to amplify their leadership in conserving lands, waters and ways of life. A joint venture between the CRC and Utah State University-Blanding, the program offers students from tribal backgrounds experience in the fields of climate change science, restoration practices and research on Indigenous foods. In addition to Danielle Smiley, the first class of interns included Shailyn Parrish and Benjamin Tohsonii, also members of the Navajo Nation. These three USU students spent 12 weeks in class and on site at the CRC, receiving mentorship and training at the interface of scientific research and public lands management. “The experience opened up a whole new world of thought,” explains Tohsonii, “and I was able to get some hands-on experience in that world.” At the CRC this August, the



The first graduates of the Tribal Natural Resources Leadership Program, left to right: Danielle Smiley, Shailyn Parrish and Benjamin Tohsonii © Sue Bellagamba/TNC

three students celebrated their program graduation, and their success left CRC staff excited. “We’re gearing up to grow this program,” says Nichole Barger, the CRC’s Research Director. “This rich exchange of learning and cultures underscores how important it is to have conservation driven by diverse local communities.”



## Improving the Way We Share Science

Each field season brings a rush of researchers to the CRC, focused on a wide range of issues that affect the productivity and health of natural resources on the Colorado Plateau. These scientists are generating important answers for land managers—but those answers only help if they are shared. That's where Sallie Tucker, a graduate student at CU Boulder comes in. "I'm working to transcribe all of the



Scientists and land managers shared ideas at the Colorado Plateau Science and Management Forum. © Colorado Chapter of the Society for Range Management

research conducted at the CRC into single page fact sheets that we can keep in one database," Tucker explains. "I condense the background, methodologies and results into a format that provides easy access for land use managers." Tucker is a master's student in the Department of Ecology and Evolutionary Biology, studying plant-fungal interactions within aridland systems. She's also interested in scientific communication, so this project has been a good fit. "We are passionate about communicating our science to the public and especially to our federal partners," explains Nichole Barger, the CRC's Research Director and Tucker's advisor. "These fact sheets are a critical step in the process of taking our science which is published in peer-reviewed journals and communicating our work out to a broader audience."

## Coming Together

In October, CRC scientists and staff participated in the Colorado Plateau Science and Management Forum in Grand Junction. The annual gathering, co-hosted by the Colorado Chapter of the Society for Range Management, is a vital opportunity for researchers and resource managers to network, learn and share. This year's focus on avoiding, reducing and reversing land degradation provided a framework for thinking about how to respond strategically to future and current challenges like aridification and climate change. The forum encourages participants to collaborate on and enhance the effectiveness of their restoration and rehabilitation efforts.

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Staff from the CRC and the Access Fund collaborated to improve responsible recreation in the area. © James Q. Martin

## Stewardship Program Reaches Out to Climbers

How do we avoid loving a place to death? Millions of visitors flood southeast Utah each year to explore the incomparable scenery of the Canyonlands. For rock climbers, the draw is this region's world-renowned

sandstone crack routes. "This place is important to so many people for a lot of diverse reasons," says Kristen Redd, the CRC's Field Station Manager. "At the CRC we aim to collaborate with a wide range of stakeholders on how best to ensure the health of these lands into the future." With that in mind, the CRC teamed up with the Access Fund, a non-profit climbing advocacy group, on a key issue: education on outdoor ethics.

Together the CRC and the Access Fund have launched the Indian Creek Climbing Steward Program, which sponsors two people to live in Indian Creek for 10 weeks during the heavy visitation seasons of spring and fall. These stewards will be trained to engage with climbers in the area, sharing information and best practices for respectful visitation that reduces their impact on the local lands and waters.

The new Climbing Steward program is the result of a two-year collaboration between the CRC

and the Access Fund. The groups have also worked together to develop a larger vision for recreation that could help inform the Bureau of Land Management (BLM) as they revise plans to conform with President Biden's proclamation to restore Bears Ears National Monument to its original boundaries. The BLM will establish guidelines for camping and climbing on public lands in Indian Creek, the riparian corridor which is also home to the Dugout Ranch and CRC headquarters. This unique landscape boasts several rare and sensitive species and supports habitat for a wealth of local wildlife. An influx of recreators, coupled with improper and irresponsible behavior, can be a threat to the environment and impede CRC research. "People who love this landscape and who reap its benefits can be our best advocates in protecting it," says Redd. "We hope this new program encourages more people to think about conservation ethics so we can ensure Indian Creek is protected long into the future."