

CANYONLANDS
RESEARCH CENTER

THE SUNDIAL

FALL 2016

UPDATES FROM THE CRC TEAM

SCIENCE COMMITTEE CHAIR



DR. NICHOLE BARGER

September is always a time to reflect on the field season as temperatures cool and the stunning fall colors begin to appear in the upper elevations. We've had a busy season at the Canyonlands Research Center hosting both continuing and newly funded projects. One of the most exciting research themes to emerge at the CRC over the past several years is ecological restoration. Ecological restoration studies at the CRC focus on the best strategies to repair damaged or degraded ecosystems and include studies of best practices in restoring grassland, riparian, and soil ecosystems. As temperatures rise across the region and drought are predicted to become more severe in the past, the focus of our CRC research community on ecological restoration under a changing climate sends a message of hope for the future of these western landscapes that we all cherish. We hope that everyone has a wonderful fall and winter and we will see you next spring!

Nichole Barger

FIELD STATION MANAGER



PHILIP ADAMS

This year we continued on the trajectory of growth that we facilitated in 2015, which initiated the management team to focus on procedures that encouraged responsible growth. We produced and have implemented a research application for private property use and research code to help structure the conduct expected of researchers working with us. The primary pressure that we continue to experience is the desire to utilize private land for research, and as a team, we have focused on how best to manage future years by providing locations for researchers outside of the main campus. This year we made some necessary infrastructure improvements and continue to develop plans that will expand our season of use. Additionally, we began the tradition of Graduate Student Fellowships to assist young scientists tackle important knowledge gaps in aridland ecosystems. One of the highlights for me this year, besides the incredible diversity of researchers, was the ecology course from Weber State University led by Dr. John Mull. Every educational group that I've hosted has surprised me by not only their enthusiasm for the surrounding landscapes but their keen interest in the mission of the CRC.

CRC PROGRAM MANAGER



MATTHEW REDD

I would like to thank everyone for a productive year. The ranch would not have been such a success without Parker and Ricky running the cattle throughout the CRC lands and Eli tackling the Dugout Ranch's irrigation. Thanks to everyone who worked with us this year and I hope you have a great winter. I'll see you all soon!

Cover: Apache plume (*Fallugia paradoxa*) at CRC
Portraits courtesy James Q. Martin Photography.

CRC IN THE NEWS



In June, John Hollenhorst of Salt Lake City's KSL Channel 5 News filmed a special on the research occurring at the Canyonlands Research Center and its applicability to ranching. Dr. Kevin Grady, of Northern Arizona University, travelled to speak about the issues facing Fremont cottonwoods, a vital component to riparian areas in the Southwest, and how his research is working to identify specific subpopulations of cottonwoods that may be resilient in the face of a warming climate to be used for restoration purposes. While cottonwood research is the heart of the story, John also delved into the deeper mission of the research center including our goal of identifying adaptation strategies for ranching in desert ecosystems. The link to the KSL feature can be found at the following web address: [<http://www.ksl.com/?sid=40475765&nid=148>], or by going to their website [<http://www.ksl.com>] and searching for the words "Dugout" or "Heidi Redd".

Additionally, the Utah Chapter of The Nature Conservancy reports that this July an important group of visitors stopped by the Conservancy's Canyonlands Research Center near Moab. U.S. Secretary of the Interior, Sally Jewell, led a team of federal land managers and congressional staff on a tour of Utah's southeast corner, learning about the complex land and water issues at stake—and listening to the many local voices who care about the region's future.



"We were honored to have the chance to meet with Secretary Jewell and her colleagues," said Utah State Director, Dave Livermore. "It was a chance for us to share our vision for conservation of the Indian Creek Corridor, as well as the Canyonlands Research Center at the Dugout Ranch, where we are helping land managers and producers better prepare for a warmer and drier world."



Top left: CRC and Utah TNC staff pose with Sec. Jewell and Director of BLM Neil Kornze.

Top right: Dave Livermore presents Sec. Jewell with a copy of *Beyond the Hundredth Meridian* by Wallace Stegner.

Top: Dr. Barger illustrates past, present and future research within the CRC.

Middle: Heidi Redd talks about the history of the ranch.

Bottom: KSL TV logo.

Photos by Philip Adams

RESTORATION AND CLIMATE CHANGE

A conversation with Dr. David Hoover - U.S. Geological Survey

Dr. Hoover has two research projects occurring in the Indian Creek corridor focusing on how predicted shifts in temperature and precipitation may impact native plant communities. At the CRC he is focused on how James' galleta grass will adapt to changes in monsoon precipitation. Four distinct populations of the grass were harvested along a gradient of decreasing summer monsoon intensity, ranging from southern New Mexico to western Utah, and transplanted into a common garden in the fall of 2014. After ensuring that all the samples were stable in 2015, season-long drought stress began in 2016 and will continue into 2017. Partnering with the BLM's Colorado Plateau Native Plant Program, the objectives are to identify populations with the greatest resiliency for restoration purposes and gather data on how this species will adapt to a changing climate. The second experiment, situated near the border of the Needles District of Canyonlands National Park, is focused on whether Ephedra species will expand its range during periods of drier conditions. In this extreme drought experiment, Dr. Hoover is reducing natural precipitation by 66% across entire seasons to assess the effects on both Ephedra and Indian ricegrass.



Could you explain why James' galleta grass was chosen for this particular experiment rather than other common grass species in the southwest?

I was interested to work with Galleta grass because it is a dominant grass in the southwest and it lives across a huge gradient in monsoon precipitation. We wanted to understand how it could survive across this range to help land managers make informed restoration decisions and predict how this species will respond to future climate change.

How has your original hypothesis regarding the plasticity of these populations to drought treatments been informed after the first year of experimentation?

We are still processing our samples, but one of the most intriguing emerging patterns is that the population from Moab, which is intermediate along the monsoon gradient, is by far the smallest. This is leading us to believe that this climatic regime may lead to a conservative growth strategy due to variability in precipitation and water availability.

Your major partner in this study is the Colorado Plateau Native Plant Program. If there is a distinct difference in how these populations respond, what are the plans for developing a seed bank for restoration purposes?

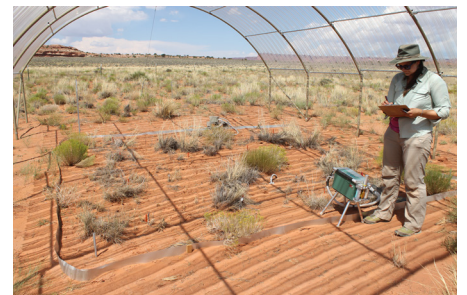
Currently the main seed source for Galleta grass is in central New Mexico, the southern end of the monsoon gradient. If we see evidence for local adaptation, the next step could be a reciprocal transplant experiment with native seed across this gradient. That would help confirm our hypothesis of local adaptation.

After installing the infrastructure for these drought experiments, what additional species are of interest following this species' experiment?

The infrastructure at the CRC was designed with future experiments in mind. After this current experiment we would like to use the site to explore the dynamics between native seed restoration, biocrust restoration and precipitation variability.

Recently you have accepted an ecohydrologist position with U.S. Department of Agriculture's Agricultural Research Services. How do you expect your experiences at the USGS will transfer into your new position?

My next position will be focused on energy, carbon and water fluxes in grasslands and how management and climate variability affect the production of livestock. My work with the USGS and CRC has given me great insight into the effects of drought and grazing in drylands, which will be a huge asset in this new position.



*Top: Dr. Hoover measures photosynthetic activity in diverse populations of James' galleta grass.
Middle: USGS technician taking measurements under one of four drought structures.
Bottom: USGS technician taking measurements at the Ephedra extreme drought experiment.*

*Photos by Philip Adams;
bottom courtesy of USGS*

WORKSHOPS AND CONFERENCES



Above: Nelson Stauffer presents monitoring protocols to 45 attendees.
Photo by Philip Adams

BLM AIM WORKSHOP

For the last three years the CRC has hosted a weeklong Bureau of Land Management Assessment, Inventory and Monitoring (AIM) training workshop. The objectives of these are to teach ecological monitoring protocols, demonstrate them in the field and calibrate rangeland technicians across the west prior to data collection. The CRC is an excellent location to host these classroom-to-field courses, incorporating classroom space and easy access to a variety of ecological conditions and land management missions. Land management agencies have been working to implement more universal data collection for long-term monitoring of rangeland conditions in order to align disparate methods used across agencies in the past. The AIM trainings are the culmination of multiple years' work to create monitoring protocols that capture the many variables needed to assess rangeland condition and trends across multiple spatial scales.

BIOCRUST CONFERENCE

The CRC hosted a lunch for the 3rd Annual Biocrust Conference which was held in Moab this year. Over 130 researchers from 16 countries attended the conference. CRC researchers, Dr. Matt Bowker (Northern Arizona University) and Dr. Sasha Reed (USGS Southwest Biological Science Center) co-chaired the 5-day conference. On their day long tour of the Canyon Country region, over 70 biocrust researchers had lunch at the CRC and then toured the research center. Drs. Anita Antoninka, Matt Bowker, Dave Hoover (USGS Southwest Biological Science Center), and Cheryl McIntyre (University of Arizona) gave brief presentations of their CRC research projects. Hosting the biocrust researchers gave the CRC a unique opportunity to highlight our research to a large international audience. We had many researchers interested in working at the CRC after such a beautiful day!



Left: Dr. Hoover presents his grass manipulation experiment.
Bottom: Biocrust attendees pose with Dr. Nichole Barger.
Right: Dr. Antoninka showcases her biocrust restoration project.
Photos by Nichole Barger

CRC FACILITIES UPGRADES



Top: Canyonlands Research Center / Dugout Ranch entrance.
Middle: Evaporative cooler anchored to the lab wall.
Bottom: New solar battery bank.
Photos by Philip Adams

With gracious support from donors to The Nature Conservancy, the Canyonlands Research Center and accompanying Dugout Ranch were able to make capital improvements to better accommodate both students and researchers.

The most noticeable transformation is the new entrance leading to the Dugout Ranch. In the past, it was often difficult for new participants to locate the correct turn into the ranch, sometimes sending folks all the way to the Needles District of Canyonlands. With beautifully constructed gabions and posts on either side of the new cattle guard, it will be difficult to miss the entrance. Extensions of rusted pipe rail utilized for fencing material were used to accentuate the entrance.

Perhaps the most impactful improvement for the operation of the ranch and CRC was the replacement of the defunct battery system that stores our solar power supply. Those who stayed with us in the past year remember the precarious state of our solar battery situation. In April, new gel-sealed batteries were installed, helping reduce the costs and carbon-impact associated with running the diesel generator. Gel-sealed batteries will result in continued savings in maintenance costs.

Those working at the CRC from late May through September greatly appreciated the installation of the evaporative cooler within the commons/laboratory room. During these months, temperatures inside would closely mirror the ambient temperature outside. Now this space can be used comfortably, drawing in cool air rather than circulating the trapped heat from above. This upgrade effectively extended our season of use in the summer and will greatly improve the CRC's ability to host researchers and students in the coming years.

Finally, and perhaps most recognizable to those staying at the CRC, in August we replaced all eight tent cabins that had deteriorated in the elements over five years. A big thank you to all of our donors and supporters!

RESEARCH UPDATES

NORTHERN ARIZONA UNIVERSITY - COTTONWOOD GENETICS

The Fremont cottonwood (*Populus fremontii*) genetics experiment, led by Dr. Kevin Grady, has sprouted in dramatic fashion since 4,000 trees were planted in June 2015. In some cases, trees have grown from eight-inch saplings to well over 10 feet. Three replicate common gardens are planted in the cold desert of southern Utah (CRC), the warm desert in central Arizona (Agua Fria National Monument) and the hot desert of southern Arizona (Yuma). The primary goal of the experiment is to assess the growth characteristics of genetically diverse populations collected across the species native range for restoration purposes. Interacting with growth, and an important component of this riparian species, is insect predation, which can influence the health of the trees.

This year their team made multiple trips to track growth and condition parameters and assess insect predation on the trees. One such trip in July included a group of students in the Doris Duke Conservation Scholar Program, who spent time working at the experiment site over three days. The project is funded by the National Science Foundation for five years.



UNIVERSITY OF ARIZONA - BIOCRUST-SEED GERMINATION

Ph.D. candidate Cheryl McIntyre has earned the record for time spent at the CRC over the last two years, spending over 30 days at a time in the spring and late summer months. She is focused on how different levels of biocrust development impede or assist a diverse range of native and invasive grass seed. Included within Cheryl's experiment is how unique morphological characteristics of seeds, namely awns, interact with the ability to imbed into the soil surface. At the CRC she utilizes a hoop house structure to act as a control to her field plots north of the research center.

In the spring, Cheryl focused on a wide range of native and invasive grass seed by paying particular attention to the morphological characteristics while tracking germination. In the fall, she focused on the invasive cheat grass (*Bromus tectorum*) germination exclusively. Conditions in the spring were cooler than expected and in the fall it was abnormally dry, which affected comparison of her field plots. She is due for a final round in spring 2017 to test germination and complete data collection for her Ph. D.



NORTHERN ARIZONA UNIVERSITY - BIOCRUST RESTORATION

Drs. Antoninka and Bowker, of Northern Arizona University, began testing the effects of a changing climate on soil crusts and restoration techniques at the CRC in 2015. First, they cultivated biocrust organisms in the lab and repatriated them into field plots, many of which were assisted by irrigation and/or jute cloth or straw for shading to help mitigate environmental stress. The goal is to assess what factors assist biocrust restoration. Second, a reciprocally transplanted common garden was created by transporting biocrust samples from three different elevations, ranging from 6,000 to 4,000 feet. The common garden will help determine if biocrust organisms are locally adapted to their native environments, or if there is some level of plasticity within the organisms that will allow them survive, or even thrive, in novel environments.

After the first six months, monitoring showed that the most impressive results are coming from jute cloth shade treatment and the straw-protected treatments. The biocrusts protected from harsh UV light and desiccation were the most developed, with 100 percent increase in cover over the initial inoculum placed within each plot, when compared to other treatments and the non-inoculated control plots. After one year, the reciprocally transplanted common garden has not shown significant changes in species composition.



Top: Insect traps set at the cottonwood common garden.
Middle: Cheryl McIntyre monitors germination in biocrust.
Bottom: Dr. Antoninka measures responses in the elevation biocrust common garden.

Photos by Philip Adams

PHOTOS FROM THE RANCH



Clockwise from top: overview of the CRC and ranch from the base of The Sundial (photo courtesy of Eric Waller); September staff meeting of the Moab and Monticello field offices of the Bureau of Land Management; hay bales at Dugout Ranch headquarters in July. *Photos by Philip Adams*



WE THANK OUR COLLABORATING PARTNERS!

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