NM STATE™

BE BOLD. Shape the Future.®
College of Agricultural, Consumer and Environmental Sciences
Agricultural Experiment Station

CHIHUAHUAN DESERT RANGELAND RESEARCH CENTER

2023 ANNUAL REPORT

THE NMSU AGRICULTURAL EXPERIMENT STATION SUPPORTS RESEARCH THAT ADDRESSES REAL-WORLD PROBLEMS. RESEARCH IS AT THE CORE OF NMSU'S MISSION TO IMPROVE THE LIVES OF PEOPLE GLOBALLY.

ARCOX@NMSU.EDU
CHIHUAHUANSC.NMSU.EDU

TABLE OF CONTENTS

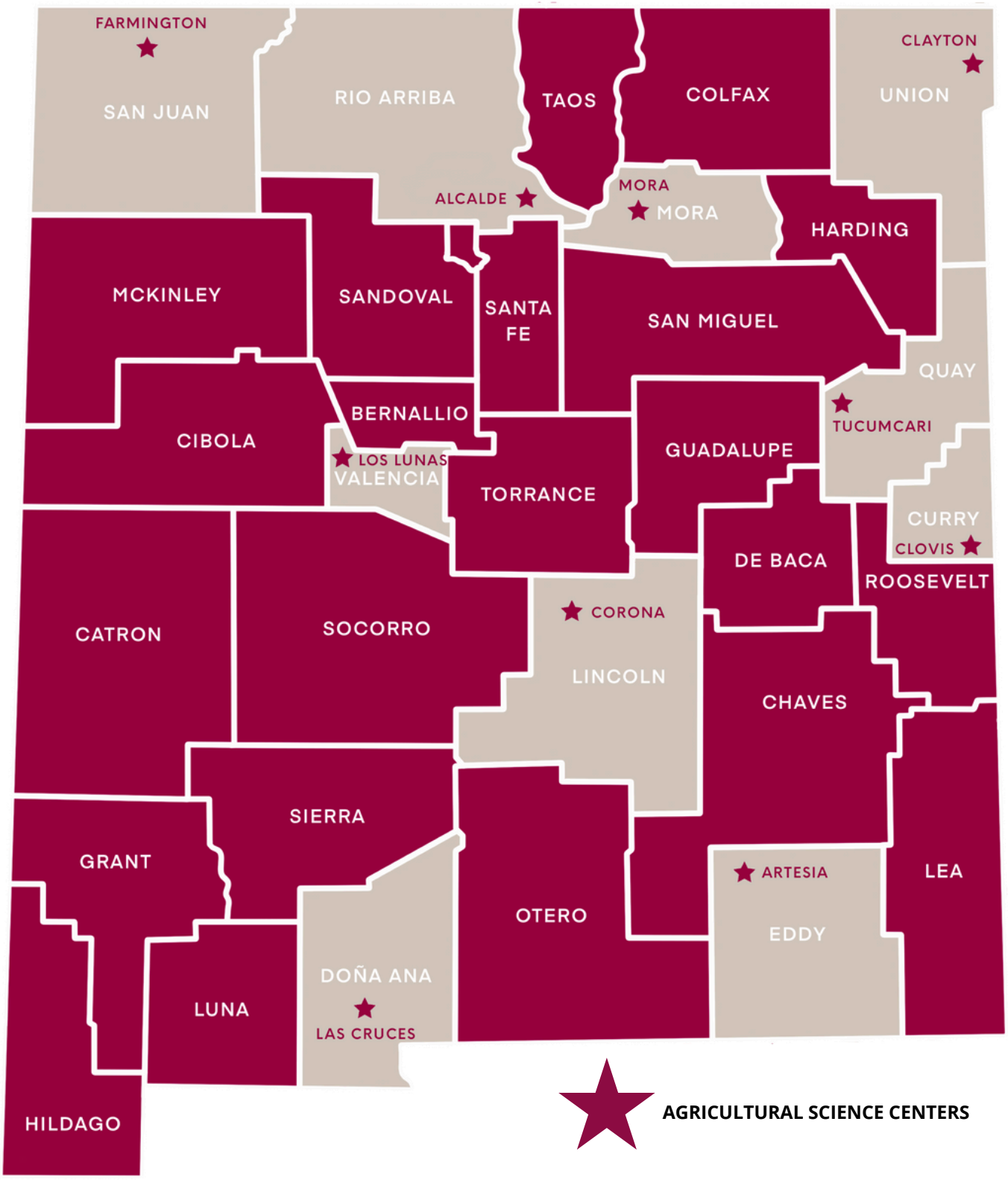
NOTICE TO USERS OF THIS REPORT

These are not formal Agricultural Experiment Station research results. Readers are cautioned against drawing conclusions or making recommendations as a result of the summaries in this report. In many instances, data represents only one of several years' results that will ultimately constitute the final formal report for a project.

None of the data are authorized for release or publication without the written prior approval of the New Mexico Agricultural Experiment Station.

Any reference in this report to any person, organization, activities, products, or services related to such person or organization is solely for informational purposes and does not constitute or imply the endorsement or recommendation of New Mexico State University or any of its employees or contractors. NMSU is dedicated to providing equal opportunities in areas of employment and academics without regard to age, ancestry, color, disability, gender identity, genetic information, national origin, race, religion, serious medical condition, sex, sexual orientation, spousal affiliation, or protected veteran status as outlined in federal and state anti-discrimination statutes. The College of Agricultural, Consumer, and Environmental Sciences is an engine for economic and community development in New Mexico. ACES academic programs help students discover new knowledge and become leaders in environmental stewardship, food and fiber production, water use and conservation, and improving the health of all New Mexicans. The College's research and extension outreach arms reach every county in the state and provide research-based knowledge and programs to improve the lives of all New Mexicans.

AGRICULTURAL SCIENCE CENTER LOCATIONS MAP



EXECUTIVE SUMMARY

The Chihuahuan Desert Rangeland Research Center (CDRRC) continues to be a high-impact research center focused on the implementation of precision livestock and rangeland management technologies. The research conducted at the CDRRC with the use of these technologies, such as virtual fencing and satellite-based forage production estimates is providing proof of concept for ranchers and resource managers alike. Additionally, the development of a Precision Ranching Computer Dashboard provides ranchers with real-time information regarding livestock activity, water trough levels, and precipitation throughout their ranch.

As a near-campus Agricultural Science Center, the CDRRC serves as an open-air lab for NMSU students and faculty and provides a unique location for NMSU visitors to observe some of the ongoing research. Over the past year, the CDRRC has been visited by researchers and the public from Ethiopia and Togo, as well as many other research and student groups from across the southwest.

Moving into the future, the CDRRC will participate in research regarding the use of photovoltaics in rangeland settings. The co-use of rangeland with agricultural production and photovoltaics, Agrivoltaics, is a new and exciting field of study that will offer land managers, solar developers, and the public answers to the problems associated with the combined use of rangelands. Solar-array installations on the CDRRC will be used to study the effects of photovoltaic installations on rangeland ecosystem health, livestock behavior, and production.

RESEARCH HIGHLIGHTS

IMPROVING THE INTERPRETATION OF SATELLITE REMOTELY SENSED FORAGE PRODUCTION ESTIMATES FOR SOUTHERN NEW MEXICO

Investigators: Sheri Spiegal (Jornada Experimental Range), Micah Funk (funkm@nmsu.edu), and Parker Winkler

PROJECT OVERVIEW

Remotely sensed forage production estimates are increasingly available across the United States. Several models were developed to estimate production from NDVI data in highly productive prairie ecosystems. Because of the ecological differences between the mesic systems where the models were designed and the low-production, shrub-invaded rangeland systems in New Mexico, the models tend to overestimate forage production in our state. The mismatch could lead to poorly informed planning and decision-making on setting stocking rates for livestock. Researchers identified areas that remote sensing estimated to have the highest forage production within four different levels of mesquite encroachment per pasture in four pastures. Within each of these areas, they collected forage production estimates by harvesting plant growth and compared the values to the remotely sensed data to determine the accuracy and reliability of currently available remotely sensed forage estimators.

MEETING THE NEEDS OF NEW MEXICO

Ground truthing remotely sensed forage production estimates will help to supply information to New Mexican producers and land managers about which tools available to them are useful and how they can best interpret the products from those tools to make the best possible management decisions for their areas.

IMPACT

Researchers found that remotely sensed and harvested forage production estimates differed from each other significantly, making remotely sensed estimates perhaps unreliable in heterogeneous, low-production areas until they can be further refined. On a local scale, remotely sensed estimates and harvested estimates appear to share more similarity in areas of higher productivity, such as playas, than uplands.

PRECISION RANCHING IN THE SOUTHWEST U.S.

Investigators: Santiago Utsumi (sutsumi@nmsu.edu), Andrew Cox, Glenn Duff, Craig Gifford, Sheri Spiegal, Rick E. Estell, and Brandon T. Bestelmeyer

PROJECT OVERVIEW

CDRRC is collaborating with the development and scalable application of a Precision Ranching System to enable real-time collection, analysis, and visualization of 'big digital data' collected by hundreds of cattle precision monitoring collars, livestock drinking tanks, and rain gauges. Virtual fencing of livestock coupled with remote sensing ensembles are being tested as an extension to the CDRRC Precision Ranching application.

MEETING THE NEEDS OF NEW MEXICO

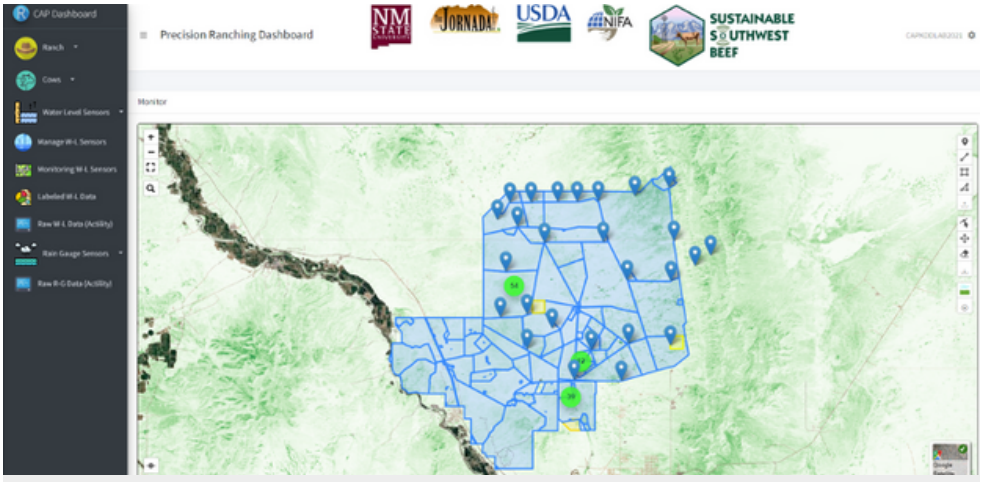
Ranchers in NM must oversee vast areas of rangeland, facing challenges for covering large distances, often through rugged terrain, to check on herds, assess forage conditions, and inspect drinking water. This limitation results in the inability to observe animals, water sources, and forages with sufficient frequency, hindering their capacity to respond promptly to many animal and rangeland stress events. Such events, if unaddressed, can accumulate into significant economic losses. Dashboards for surveillance of livestock coupled with virtual fencing technology, remote sensing tools, and systems to monitor weather and livestock drinking water are being developed at CDRRC and ranch partners in the Southwest. Big digital data could enhance climate-smart decision-making and adaptation, and ranchers' confidence in meeting grazing land conservation goals.

IMPACT

A dashboard system powered by unique AI tools allows the real-time tracking, monitoring, and visualization of virtual fenced cattle and ranch assets with a high degree of precision and confidence. Novel AI algorithms are being tested to improve accuracy in predicting animal welfare and health. Ensembles are being incorporated to include remotely sensed predictions of herbage mass across pastures.

FUNDING ACKNOWLEDGMENT:

USDA-NIFA-AFRI's and USDA's Long-Term Agroecosystem Research (LTAR) network



NMSU tools for surveillance of livestock coupled with virtual fencing technology, remote sensing of rangeland, and systems to monitor weather and livestock drinking water are being developed and implemented at the NMSU's Chihuahuan Desert Rangeland Research Center

DISTRIBUTED FIELD TRIAL NETWORK FOR DRYLAND RESTORATION

Investigators: Seth Munson (smunson@usgs.gov), Laura Shriver (lshriver@usgs.gov), Caroline Havrilla (caroline.havrilla@colostate.edu), Elisa Cornish (egornish@arizona.edu), Catherine Gehring (Catherine.gehring@nau.edu)

PROJECT OVERVIEW

RestoreNet is a co-produced research network that systematically tests dryland restoration treatments across environmental gradients in the Southwest. There are currently 25 RestoreNet sites spread across five states and seven ecoregions in the Southwest, including two sites in New Mexico, and one at NMSU CDRRC. RestoreNet experiments test the same treatments across sites that are placed across a network that spans environmental gradients, to determine how treatments and environmental factors interact to influence outcomes. At NMSU CDRRC, researchers are planning to implement RestoreNet 2.0: Harnessing livestock and microbes to improve rangeland productivity and soil health. At this site, treatments will include soil pits, seed balls, and live topsoil inoculation aimed at improving native plant establishment and soil health. Five other sites in the RestoreNet network will also receive targeted livestock treatments.

MEETING THE NEEDS OF NEW MEXICO

RestoreNet networked restoration experiments aim to produce best management practices and actionable science that is specific to RestoreNet sites, ecoregions, and the whole network. The sites at the CDRRC and Jornada have produced and will continue to produce site-specific restoration information on what treatments do and do not work. RestoreNet results are also publicly available and summarized in research briefs, publications, and newsletters. The protocol to establish a RestoreNet site is publicly available to individual land managers and owners can use RestoreNet methods to answer restoration questions of their own.

IMPACT

RestoreNet sites directly benefit land managers and owners, as investigators co-produce knowledge by working together to decide which treatments to test, interpret results, and explore new ideas; they serve as restoration demonstration sites; and the small test plots reduce cost and build understanding that later supports larger scale projects. RestoreNet research also improves restoration outcomes, by testing standardized treatments across environmental gradients to explore how treatments interact with temperature, precipitation, and site-specific characteristics to influence outcomes. RestoreNet shares results and insights through research briefs, publications, newsletters, presentations, and workshops.

FUNDING ACKNOWLEDGMENT:

USGS programmatic funding from the Ecosystems Mission Area

USE OF HIGH-RESOLUTION DRONE IMAGERY AND STELLITE REMOTE SENSING TO ASSESS RANGELAND PASTURES

Investigators: Santiago Utsumi (sutsumi@nmsu.edu), Casey Spackman, Micah Funk, and Tiana Nez

PROJECT OVERVIEW

Remote sensing through multispectral satellite imagery can assess landscape-level forage production on rangelands but accuracy declines at the ranch, pasture, or plot levels. This work compared on-the-ground measurements of forage production with high-resolution multispectral drone imagery correlated to precipitation and solar radiation on several Chihuahuan Desert rangeland pastures to estimate forage production at the local scale. Estimates were then applied to large-scale multispectral satellite imagery to increase the accuracy of forage production estimates over larger areas of the Chihuahuan Desert.

MEETING THE NEEDS OF NEW MEXICO

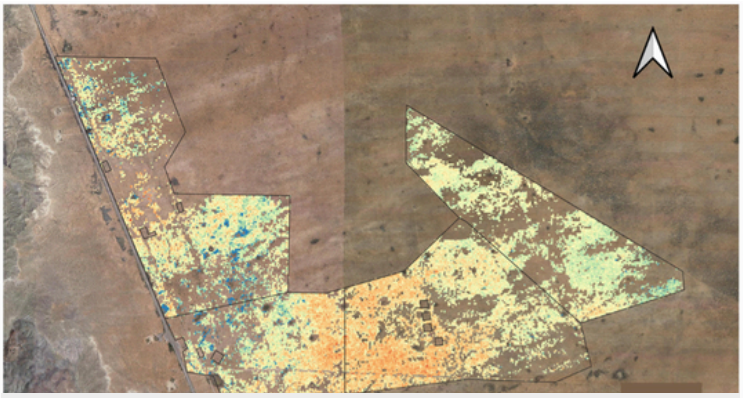
New Mexico cattle producers are a vital part of environmental stewardship and the state economy. There is a need to support ranchers through innovative, practical, and cost-effective technologies to inform rangeland management decisions. Traditional on-the-ground monitoring methods are costly, time-consuming, and only applicable to small areas of rangeland. Estimating forage production through the combined use of traditional methods and novel drone and satellite-based imagery has the potential to provide a cost-effective and scalable approach to managing vegetation and animals more sustainably on New Mexico rangelands.

IMPACT

The combination of on-the-ground measurements with high-resolution drone imagery applied to lower-resolution satellite imagery can accurately predict herbaceous plant productivity (g/m2) at the ranch, pasture, and plot level and across the growing season using the amount of photosynthetically active solar radiation absorbed (MJ/m2). During an average precipitation year, peak photosynthesis occurred in late August leading to a cumulative herbaceous productivity of 88kg/ha. During a drought year, peak photosynthesis occurred in May, leading to a cumulative herbaceous productivity of 70kg/ha. By implementing remote sensing technologies and improving the methodologies associated with estimating forage production, this work helps land managers and ranchers to implement climate-smart ranching practices, promote economic efficiency and stability, and provide a tool for sustainable grazing management at both the local and landscape levels.

FUNDING ACKNOWLEDGMENT:

USDA-NIFA



Spatial variability of monthly herbaceous plant production estimates in four pastures of the Chihuahuan Desert Rangeland Research Center

ORYX/CATTLE FORAGE CO-USE

Investigators: Louis C. Bender (lbender@nmsu.edu) and Andrew Cox

PROJECT OVERVIEW

Exotic oryx can potentially affect livestock in a variety of ways, including exploitation (i.e., scramble) and competition for limited forage. Oryx feed primarily on grasses, but also use palatable browse extensively when present; hence, diets of oryx and cattle show considerable overlap in Chihuahuan desert habitats. Consequently, increasing populations of oryx might decrease forage availability for cattle, especially given the relatively low forage abundance in Chihuahuan desert habitats. Continued evaluation of oryx-cattle interactions on the CDRRC is aimed at determining the nature of oryx-cattle forage interactions, i.e., whether exploitation competition is occurring, or whether other foraging interactions such as facilitation characterize their co-use of Chihuahuan desert rangeland.

MEETING THE NEEDS OF NEW MEXICO

Oryx currently occupies> 15,000 km2 in southern New Mexico, including New Mexico State University's Chihuahuan Desert Rangeland Research Center (CDRRC). Introductions of exotic wildlife have the potential to impact domestic livestock on shared ranges; however, these impacts are seldom evaluated. Previous work on the CDRRC found concerns regarding the aggressive behavior of oryx impacting livestock to be unwarranted. This project extends that work by determining the potential impact of oryx herbivory on livestock.

IMPACT

Determining forage co-use by oryx and cattle will help managers set sustainable stocking levels for livestock and identify sustainable oryx densities on shared rangeland.

VIRTUAL FENCING CATTLE ON DESERT RANGELANDS

Investigators: Shelemia Nyamuryekung'e, Andrew Cox, Andres Perea, Rick E. Estell, Andres Cibilis, Glenn Duff, Micah Funk, Craig Gifford, Skye Andy, Matthew McIntosh, Sheri Spiegal, Brandon T. Bestelmeyer, Santiago Utsumi (sutsumi@nmsu.edu)

PROJECT OVERVIEW

Virtual fencing is among the few modern animal management technologies that ranchers could implement to track livestock and control grazing dispersal in real-time, but the reliability and tradeoffs for implementing the technique on extensively managed rangelands are still unknown. This project will document the implementation of virtual fencing technology through the production cycle of a cow-calf operation in New Mexico. The project is aimed to identify success factors for the correct training and proper management of livestock in a virtual fencing system.

MEETING THE NEEDS OF NEW MEXICO

New Mexico ranchers could rely on the combination of physical and virtual fencing methods to manage livestock grazing distribution on private, state, and federal grazing lands. Virtual fencing consists of a fully automated neck collar that will deliver a deterrent electric impulse if an animal trespasses a predefined audio warning zone. Collars can be programmed to enable a flexible grazing management schedule, alter grazing pressure, or exclude livestock grazing from protected riparian areas. There is a need to support ranchers through the investigation of more efficient livestock, grazing, and land management strategies. The use of smart fencing collars has the potential to provide a scalable methodology for adaptive grazing management and resource conservation management on New Mexico ranches, thereby improving forage use and livestock production and enhancing habitat for biodiversity and other valuable ecosystem services provided by NM rangelands.

IMPACT

Ranchers in the southwestern US face challenges in managing vast rangelands, making it difficult to monitor herds and assess changes in forage condition promptly. This can lead to economic losses due to delayed responses to animal health, rangeland stress and natural disasters. The research team at NMSU-CDRRC is collaborating with ranchers, USDA-ARS Jornada scientists, and State and Federal stakeholders to introduce Precision Ranching technologies in beef production systems. By utilizing cattle virtual fencing collars along with remote sensing tools and embedded systems to monitor animals, researchers aim to provide 24/7 visibility and management benefits to extensively managed ranch operations. Training cattle to safely use fencing collars is essential to successfully transition to smart-geofencing system. Variations in learning ability were observed among cow breeds (Perea) and individuals (Campa). The studies also show that regardless of the breed of cattle, social status or lactating/nursing stage, cows were consistently contained 98% or more of the time by a precision fencing collar operated by 4G connectivity and applied for rotational grazing with varying pasture sizes, forage condition, rangeland types (desert grassland, juniper woodland, and California chaparral), season of grazing and grazing schedule.

In challenging environments like the Gila National Forest, emergency implementation of a LoRa WAN tracking and virtual fencing collar proved highly effective to monitor and manage cattle despite the damaged infrastructure to the 2022 Black fire and flood disaster (Gifford). Increased livestock monitoring has led to 20% reductions in time and labor for gathering cattle, along with improved ranch operational efficiencies and a 10% income increase. This has enabled compliance with USDA-USFS regulations and grazing plans and supported better decision-making to allow climate-smart adaptation. Animal tracking and geofencing technologies can empower ranchers to meet conservation goals and regulatory requirements while enhancing overall ranching confidence and sustainability.

FUNDING ACKNOWLEDGMENT:
USDA-National Institute of Food and Agriculture

BY THE NUMBERS

RESEARCH PUBLICATIONS

- Balazs, K.R., Munson, S.M., Havrilla, C.A. and Butterfield, B.J., 2022. Directional selection shifts trait distributions of planted species in dryland restoration. Journal of Ecology, 110: 540-552.
- Balazs, K.R., Munson, S.M. and Butterfield, B.J. 2022. Functional composition of plant communities mediates biomass effects on ecosystem service recovery across an experimental dryland restoration network. Functional Ecology 36: 2317-2330.
- Bender, L. C., and A. Cox. 2024. Codistribution of cattle and exotic oryx on Chihuahuan Desert rangeland, south-central, New Mexico. Rangeland Ecology and Management 93: 81 – 86.
- Bestelmeyer, B.T., S.A. Utsumi, S. McCord, D.M. Browning, L.M. Burkett, E. Elias, R. Estell, J. Herrick, D. James, S. Spiegal, N.P. Webb and J. Williamson. 2023 Managing an arid ranch in the 21st century: New technologies for novel ecosystems. Rangelands 45, 60-67.
- Butterfield, B.J., and Munson, S.M., 2023, Do seeding and seedling planting result in similar restored plant communities? Applied Vegetation Science 26: e12758
- Butterfield, B.J, Munson, S.M., and Farrell, H.L., 2023, Plant water-use strategies predict restoration success across degraded drylands. Journal of Applied Ecology 60: 1170-1180.
- Farrell, H.L., Munson, S.M., Butterfield, B.J., Duniway, M.C., Faist, A.M., Gornish, E.S., Havrilla, C.A., Larios, L., Reed, S.C., Rowe, H.I., Laushman. K.M., and McCormick M.L.., 2023, Soil surface treatments and precipitation timing determine seedling development across southwestern US restoration sites. Ecological Applications, DOI: 10.1002/eap.2834
- Funk, M., Utsumi, S., Spackman, C., Nez, T. 2024. Combining high-resolution drone imagery and satellite remote sensing to assess rangeland pastures. Conference proceedings of the 77th Annual Meeting of the Society for Range Management, Sparks, NV. January 30th, 2024.
- Havrilla, C.,A., Munson, S.M., Yackulic, E.O., Butterfield, B.J., 2021, Ontogenetic trait shifts: Seedlings display high trait variability during early stages of development, Functional Ecology 35: 2409-2423
- Havrilla, C.A., Munson, S.M., McCormick, M.L., Laushman, K.M., Balazs, K.R. and Butterfield, B.J., 2020. RestoreNet: An emerging restoration network reveals controls on seeding success across dryland ecosystems. Journal of Applied Ecology 57: 2191-2202.
- McIntosh, M.M., S.A. Utsumi, S. Nyamuryekung'e, R.E. Estell, A. Cox, D. Duni, A.F. Cibils, Q. Gong, A. Waterhouse, J. Holland, H. Cao, L. Boucheron, H. Chen, and S. Spiegal. 2023. Deployment of a LoRa-WAN near real-time precision ranching system on extensive desert rangelands: what we have learned. Applied Animal Science 39, 257-362.
- Nyamuryekung'e, S., G. Duff, S.A. Utsumi, R. Estell, M.M. McIntosh, M. Funk, A. Cox, H. Cao, S. Spiegal, A. Perea, and A.F. Cibils. 2023. Real-Time Monitoring of Grazing Cattle Using LORA-WAN Sensors to Improve Precision in Detecting Animal Welfare Implications via Daily Distance Walked Metrics. Animals 13, 2624.
- Nyamuryekung'e, S., A. Cox, A.R. Perea, R.E. Estell, A.F. Cibils, J. Holland, T. Waterhouse, G. Duff, M.M. McIntosh, M. Funk, S. Spiegal, B.T. Bestelmeyer, S.A. Utsumi. 2023. Behavioral Adaptations of Nursing Brangus Cows to Virtual Fencing: Insights from a Training Deployment Phase. Animals 13, 3558.
- Yang, B., Balazs, K.R., Butterfield, B.J., Laushman, K.M., Munson, S.M., Gornish, E.S., and Barberán, A., 2022, Does restoration of plant diversity trigger concomitant soil microbiome changes in dryland ecosystems? Journal of Applied Ecology 59: 560-573.

CONFERENCE PROCEEDINGS

- Perea A.R., L. Macon, S. Rahman, A. Cox, S. Nyamuryekung'e, A.F. Cibils, R. Estell, G.C. Duff, S.A. Utsumi. 2023. Detection of parturition of rangeland beef cattle using GPS and accelerometer data. Proceedings of the 2023 ASAS-CSAS-WSASAS Annual Meeting, July 16-20, Albuquerque, NM.
- Utsumi S.A., S. Nyamuryekung'e, A.R. Perea, M. Spetter, A. Cox, L. Macon, R.E. Estell, G. Duff. 2023. Virtual fencing of nursing vs. weaned rangeland cows. Proceedings of the 2023 ASAS-CSAS-WSASAS Annual Meeting, July 16-20, Albuquerque, NM.
- Nyamuryekung'e, S.; Cox, A.; Perea, A.R.; Estell, R.E.; Cibils, A.F.; Holland J.; Waterhouse, T.; Duff, G.C.; Funk, M.; Aney S; McIntosh, M.M.; Spiegal, S.; Bestelmeyer, B.T.; Utsumi, S.A. 2023. Virtual Fencing of nursing cattle grazing large pastures of Chihuahuan Desert rangeland. Society for Range Management, 76th Annual Meeting and Trade Show, Feb. 12-16, 2023, Boise, ID.
- Perea A.R., L. Macon, S. Rahman, S. Nyamuryekung'e, A.F. Cibils, R.E. Estell, G.C. Duff, S.A. Utsumi. 2023. Behavior classification of grazing cows on desert rangeland in the southwestern United States. Proceedings of the 2023 ASAS-CSAS-WSASAS Annual Meeting, July 16-20, Albuquerque, NM.[CM1] [CM1]If you would like to include conference proceedings, those should be broken out into another category away from research publications.

GRANTS AND CONTRACTS

- The Sustainable Southwest Beef Coordinated Agricultural Project was funded by the USDA National Institute of Food and Agriculture, Agriculture and Food Research Initiative's Sustainable Agricultural Systems (SAS) program. Grant #2019-69012-29853. This research was also a contribution from the Long-Term Agroecosystem Research (LTAR) network. LTAR is supported by the United States Department of Agriculture.
- Novel Strategies to Increase Sustainability of Beef Production Systems in the Western United States. NIFA-AFRI-SAS #2019-69012-29853, $8,937,554, 2019-2025 **(Active)**
- Natural Resource Career Development Program (NRCD) for Hispanic Students. USDA-NRCS #NR233A750015C012, $230,000, 2023-2025. **(Active)**
- Implementation of virtual fencing technology to build resiliency of agriculture systems impacted by wildfire and subsequent flooding. NIFA-AFRI- # A1712 $222,192 2023-2024. **(Active)**

OUTREACH ACTIVITIES

- Host Multistate Hatch Development Committee
- Host Animal Scientist and University Leadership from Ethiopia
- Host Soume Bouriaima as part of the Mandela Washington Fellowship
- 2023 CDRRC Field Day
- Host Dan Macon UCCE Livestock and Natural Resource Advisor
- CDRRC Ranch Manager/Research Coordinator Andrew Cox presented regarding the use of Virtual Fencing:
  - Southeast New Mexico Ranchers Workshop
  - U.S. Beef Academy
  - New Mexico Cattle Growers Mid-Year Conference
  - International Livestock Identification Association Annual Meeting
  - New Mexico Farm and Livestock Bureau Annual Meeting

PEOPLE

COOPERATORS AND COLLABORATORS

- NMSU Animal and Range Sciences
- USDA-ARS Jornada Experimental Range, Las Cruces, NM
- USDA-Southwestern Climate Hub
- Corta Madera Ranch, Pine Valley CA
- The Nature Conservancy Dugout Ranch, Monticello, UT
- Sunrise Ranch, Rodeo, NM
- Diamond e Ranch, McNeal, AZ
- Bureau of Land Management,
- U.S. Forest Service
- National Park Service
- U.S. Bureau of Reclamation
- University of Arizona Santa Rita Experimental Range
- University of California-Riverside
- Ute Mountain Ute Tribe
- Navajo Nation
- McDowell Sonoran Conservancy
- Babbitt Ranches
- Diablo Trust
- NMSU UASNR Laboratory
- Long Term Ecosystems Research (LTER)
- Long Term Agroecosystems Research (LTAR)
- USDA Southwest Climate Hub
- Kansas State University
- Texas A&M AgriLife Research
- The Nature Conservancy Dugout Ranch
- Evergreen Ranching
- Rancho Corta Madera
- Asombro Institute
- BlueSTEM AgriLearning Center
- NMSU Department of Extension Animal Sciences and Natural Resources

COOPERATORS AND COLLABORATORS

Jornada LTER

- **John Anderson** - NPP GRG precipitation
- **Dave Lightfoot** - Grasshopper flush quadrats at NPP sites (LTER II)
- **Deb Peters (2000)** - LTER II plant net primary production in 5 dominant vegetation zones at 15 sites
- **Enrique Vivoni (2017)** - LTER-I Transects soil water content measurements
- **Enrique Vivoni (2017)** - LTER II soil water content - NPP sites
- **Brandon Bestelmeyer** - Jornada Small Mammal Exclosure Study
- **John Anderson** - LTER-I transect vegetation plant line intercept study
- **John Anderson** - LTER-I fenceline vegetation plant line intercept study
- **Bob Schooley** - Lagomorph demography: Rabbit survey
- **John Anderson** - Jornada LTER Weather Station
- **John Anderson** - Wetfall and Dryfall deposition chemistry data
- **John Anderson** - Upper Trailer tipping bucket rain gauge (TBRG) data
- **Greg Okin** - Particle deposition at Jornada NPP sites and the Geomet site using Atmospheric Dust Collector
- **Erica Rosenblum** - Convergent Evolution And Divergent Selection: A Comparative Study Of Lizard Coloration In Southern New Mexico
- **Brandon Bestelmeyer/Bob Schooley** - [Ecotone small mammal study] Demography, Resource use and Genetic Structure of a Small Mammal Population in the Chihuahuan Desert: Feedbacks Between Rodents and the Dynamics of Grassland-Shrubland Ecotones
- **John Anderson** - Tipping bucket rain gauge precipitation - NPP sites
- **Dawn Browning** - Perennial Plant Phenology on NPP Sites
- **Greg Okin** - BSNE dust collection at NPP, JER Pasture 13, Geomet sites
- **John Anderson** - Annual photos of LTER-II NPP plots
- **Ashley Asmus** - Nutrient Network (NutNet) at 3 NPP grassland sites
- **John Anderson** - NPP instrumentation on a wireless network at 15 NPP sites
- **Bob Schooley** - Camera trapping of mammals and line-point-intercept (LPI) methods to measure vegetation cover on Ecotone Study
- **Enrique Vivoni** - Instrumentation of 18 playas to monitor water depth during flooding events
- **Nicole Pietrasiak** - Application of an Area-Based Quality Index (ABQI) to Assess and Manage Biological Soil Crusts in the Hot Deserts of the Western U.S.
- **Erik Lehnhoff** - Biotic and abiotic drivers of Lehmann lovegrass invasion
- **Curtis Monger** - CO2 fluctuations in a desert soil at Study 011 C-SAND site
- **John Anderson** - LTER Standalone Tipping Bucket Rain Gauges (TBRG) at former Biodiversity Study
- **John Anderson** - Jornada LTER plant species list
- **Kirsten Romig** - RestoreNet: Distributed Field Trial Network for Dryland Restoration- Chihuahuan Desert
- **Niall Hanan** - Ground Control Point collection and UAV flights at the 15 NPP sites of Study 011
- **Jennie McLaren** - Phosphorus Dynamics in the Dryland Critical Zone
- **Bob Schooley** - Mammalian herbivores and state transitions: effects of invasive oryx relative to native small mammals and livestock
- **Enrique Vivoni** - Evapotranspiration and soil moisture measurements at Vine-mesquite Playa on CDRRC
- **Sarah McCord** - RestoreNet 2.0: Harnessing microbes to improve rangeland productivity and soil health

GRADUATE STUDENTS

- Andres Perea (PhD Range Science)
- Sara Campa (MS Animal Science)
- Lucia Gil (Visiting MS Animal Science)
- Parker Winkler (Undergraduate Assistant Range Science)
- Luis Ochoa NMSU ANRS Graduate Student

POST. DOC

- Mehmet Bakir (Postdoc Computer Science)
- Maximiliano Spetter (Postdoc Animal Science)

ASC PERSONNEL

ANDREW COX

Ranch Manager
Research Coordinator

SHAD COX

Program Operations Director