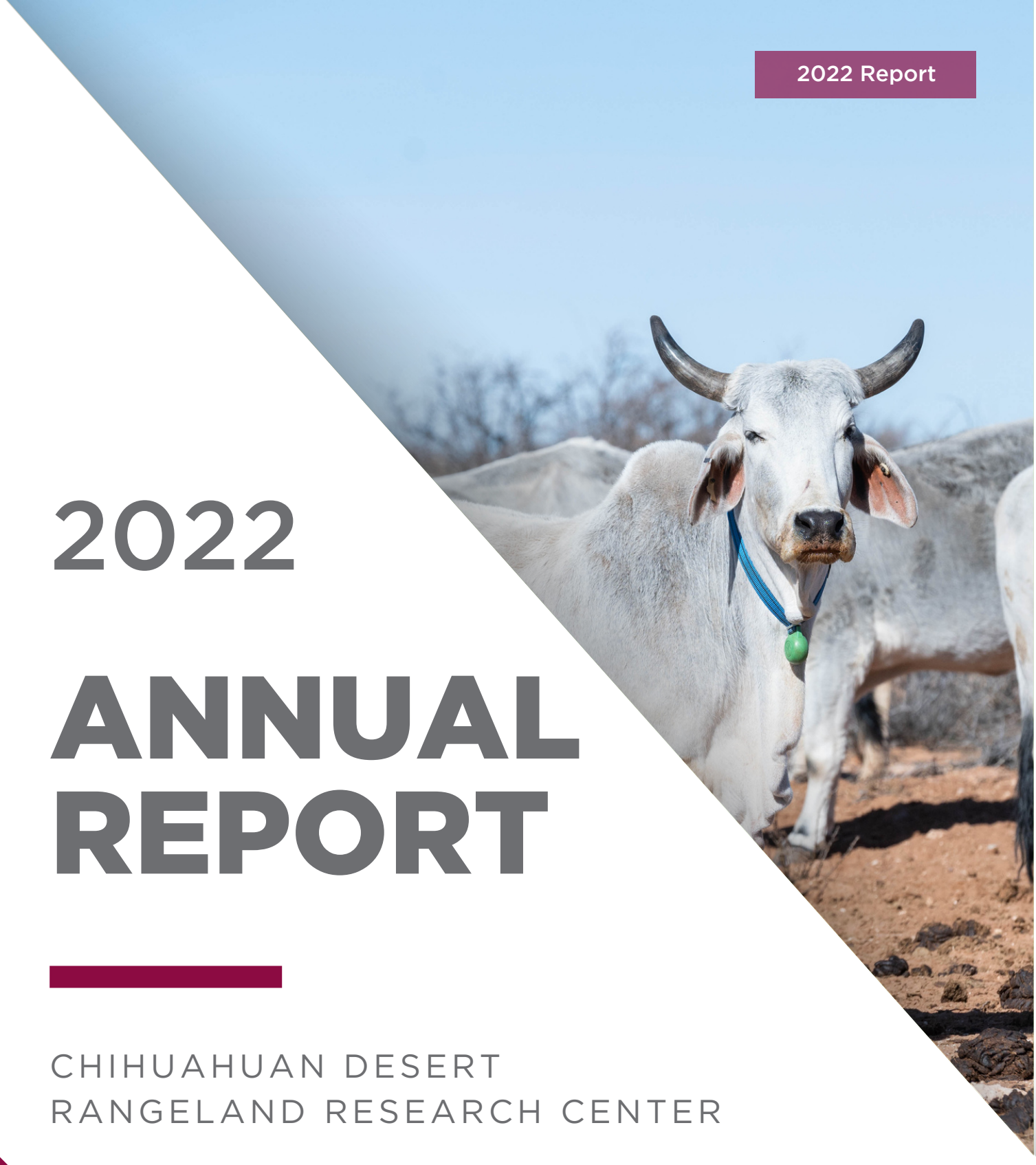
2022 Report



2022

ANNUAL REPORT

CHIHUAHUAN DESERT RANGELAND RESEARCH CENTER

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.

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Notice to Users of this Report

This report has been prepared to aid Science Center staff in analyzing the results of various research projects from the past year and to record data for future reference. These are not formal Agricultural Experiment Station Report research results. The reader is cautioned against drawing conclusions or making recommendations as a result of the data in this report. In many instances, data represents only one of several years' results that will ultimately constitute the final formal report. Although staff members have made every effort to check the accuracy of the data presented, this report was not prepared as a formal release.

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

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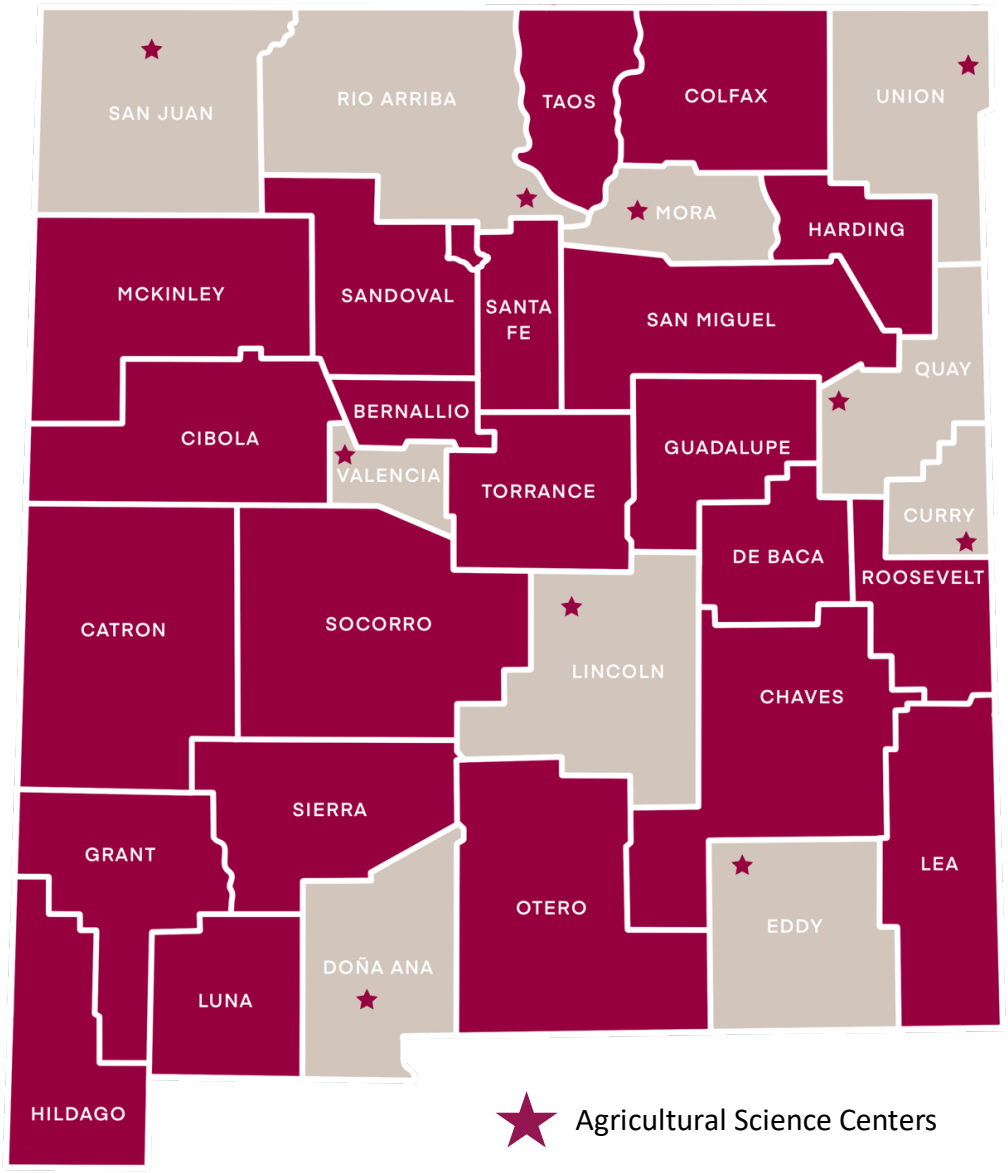
Agricultural Science Center Locations Map



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Executive Summary

The Chihuahuan Desert Rangeland Research Center continues to be a high-impact research center focused on the proper utilization of rangeland and livestock management. The CDRRC participates in multiple funded research projects, as well as, providing a location for classes to learn and practice rangeland management and forage/plant identification. Perhaps the biggest achievement or impact for the CDRRC this year was the work being conducted on virtual fencing. This work has helped validate the use of virtual fencing in arid rangeland environments with high levels of accuracy. Additionally, this work will help push forward the ability of producers and researchers to consider this technology for use in other areas where physical fencing or barriers are a challenge to install.

Research Projects

Virtual Fencing cattle on desert rangelands – Investigators: Nyamuryekung'e, S.; Cox, A.; Perea, A; Estell, R.E.; Cibils, A.F.; Duff, G.C.; Funk, M.; Gifford C.; Aney S; McIntosh, M.; Spiegal, S; Bestelmeyer, B.; Utsumi, S.A.

Oryx monitoring – Investigators: Louis C. Bender and Andrew Cox

Oryx-cattle co-distribution and interactions – Investigators: Louis C. Bender and Andrew Cox

Precision Ranching on NM Rangelands – Investigators: S. Nyamuryekung'e, A.R. Perea, S. Rahman, H. Chen, M. Funk, M. McIntosh, Z. Winkler, A. Cox, L. Macon, R. Dunlop, H. Cao, L. Boucheron, R. E. Estell, A.F. Cibils, G.C. Duff, M. J. Holland, T. Waterhouse, S. Spiegal, B. Bestelmeyer, and S. A. Utsumi

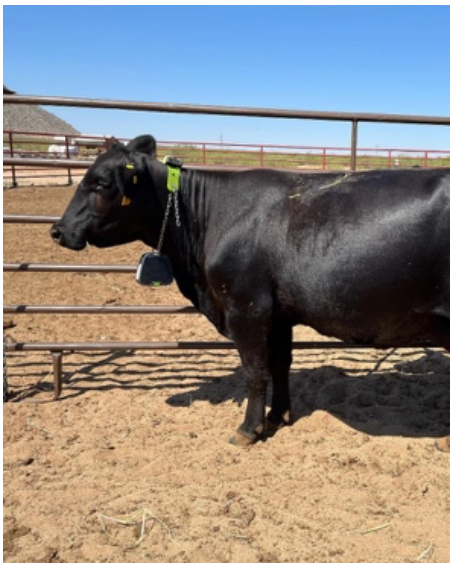
Virtual Fencing cattle on desert rangelands

Investigators: Nyamuryekung'e, S.; Cox, A.; Perea, A; Estell, R.E.; Cibils, A.F.; Duff, G.C.; Funk, M.; Gifford C.; Aney S; McIntosh, M.; Spiegal, S; Bestelmeyer, B.; Utsumi, S.A. (sutsumi@nmsu.edu)

Project Overview: Virtual fencing is among few modern animal management technologies that ranchers could implemented 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 in 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: Twenty-eight lactating Brangus cows were successfully trained and transitioned to a NoFence virtual fencing system. Collars were 98% successful to contain cattle inside the allowed training area and between 97% to 99% successful to alter grazing distribution when previously trained cattle were rotated on large desert pasture (1200 ac) using either a single grazing block (~ 700-800 ac) or a grazing block with a variable number of riparian patch enclosures (~ 8-10 ac). Virtual fencing did not change the daily walking distance or activity of cows suggesting no major effects on the daily time budget and welfare of cows. New applications leveraging from the present findings are being pursued to virtual fence up to 300 cattle on allotments where most physical fencing infrastructure has been severely impacted by the recent black fires. Virtual fencing show promise in providing a rapid and accurate method for precision livestock grazing on NM rangelands but additional applied research must inform other likely sources of variability of virtual fencing that were not accounted for by the present study.



Funding Acknowledgement: Initiative for Sustainable Agricultural Systems (USDA - National Institute of Food and Agriculture, Grant #2019-69012-29853)

Oryx monitoring

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

Project Overview: Oryx are an exotic antelope that have the potential to affect range use of livestock and other wildlife, through competition and possibly aggressive behavior. They are also a highly valued hunting trophy in New Mexico. This project will develop and assess monitoring protocols to determine oryx abundance or trend, distribution, and sustainable harvest to benefit wildlife enterprises. Monitoring protocols tested vary from intensive approaches (e.g., aerial surveys) to more extensive camera-based techniques (e.g., mark-resight population estimation; photographs/camera-day trend indices; etc.).

Meeting the Needs of New Mexico: Balancing the needs of wildlife and domestic livestock, and developing sustainable harvest strategies, requires accurate population monitoring. By validating a range of monitoring options, landowners can choose a method appropriate to the time and resources they desire to allocate to Oryx management.

Oryx-cattle co-distribution and interactions

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

Project Overview: Oryx have many characteristics that make them strong competitors of native and domestic herbivores, including a broad diet breadth, physiological and behavioral specializations to conserve water, and little vulnerability to native Chihuahuan desert predators. Additionally, oryx have an aggressive personality, which may allow them to dominate other large herbivores. This latter trait may influence interactions with cattle, especially regarding the use of limited resources such as water. This project will document oryx and cattle co-use of the CDRRC landscape, with an emphasis on any potential negative impacts of oryx on cattle distribution or access to resources.

Meeting the Needs of New Mexico: Native habitats, native wild herbivores, and domestic livestock can be negatively impacted by exotic species such as oryx. This project seeks to determine whether co-use of the CDRRC by oryx and cattle negatively impacts cattle use of or resource access on, shared rangeland, and thus whether co-production is a viable sustainable management strategy.

Precision Ranching on NM Rangelands

Investigators: S. Nyamuryekung'e, A.R. Perea, S. Rahman, H. Chen, M. Funk, M. McIntosh, Z. Winkler, A. Cox, L. Macon, R. Dunlop, H. Cao, L. Boucheron, R. E. Estell, A.F. Cibils, G.C. Duff, M. J. Holland, T. Waterhouse, S. Spiegal, B. Bestelmeyer, and S. A. Utsumi (sutsumi@nmu.edu)

Project Overview: Precision ranching (PR) involves the implementation of smart monitoring technologies for efficient management of livestock, forage growth, rainfall, and other critical ranch assets, such as stock tanks and drinkers. Application of sensor monitoring systems is common in intensive animal agriculture, but extremely rare on extensive cattle ranches where access to wireless connectivity is still limited. This project is developing a relatively low-cost Digital Ranching system for instrumentation on extensive ranches in the southwest. The infrastructure, hardware, and software of the system currently allow logging, analyzing, and visualizing sensor data being collected in real-time from multiple animals, distant stock and drinking tanks, and rain gauges on multiple sites.

Meeting the Needs of New Mexico: Cattle production is a vital economic activity in NM, and through the implementation of sensor-driven agriculture NM ranchers have the potential to make more efficient management decisions to sustain animal health and forage resources in extensive, increasingly arid rangelands. Real-time analysis of shifts in animal activity and grazing patterns associated with declining forages, faulty water supply, parturition, health, or predation can be used to deploy warning systems that would eventually allow ranchers to intervene on daily to weekly time scales.

Impact: A wireless LoRa WAN network of 9 semipermanent and portable receiving stations was installed over ~360 sq. miles of rangeland, and is currently being used to monitor over 120 head of cattle, 11 stock, livestock drinking tanks, and 5 rain gauges at three ranches in NM. A visualization dashboard operating on NMSU and AWS server services is being tested for real-time analysis of cattle locations, inspection of preferred grazing areas, visits to drinking water, shifts of hourly to daily activity patterns and walking distances, and machine learning classification of walking, grazing, and resting behavior with up to an 81% to 89 % precision. Ultrasonic sensors on tanks located up to 21 miles away from receiving stations are used to monitor drinking water (± 1 mm), and automatically alert on low water levels or overflow of tanks. This has focused efforts in the research area on higher-priority issues by reducing the amount of time spent checking all water locations. This system has alerted managers of 2 water system problems that they were able to fix, saving over 30,000 gallons of water and preventing the loss of water to cattle at drinkers. As these systems are adapted and finetuned, they can be shared with other ranches in New Mexico, increasing their efficiency by reducing their costs of energy and labor. Scalability of the system will include programmed installations on 3 operating ranches in UT, CA, and NM in 2023.

Funding Acknowledgement: USDA - National Institute of Food and Agriculture, Grant #2019-69012-29853

Grants and Contracts

- USDA-National Institute of Food and Agriculture, Grant # 2019-69012-29853 $8.9 million Active

Research Publications

- Nyamuryekung'e, S., Cox, A., Perea, A, Estell, R.E., Cibils, A.F., Holland J. Waterhouse, T., Duff, G., Funk, M., Aney S., McIntosh, M., Spiegal, S., Bestelmeyer B., Utsumi, S.A. 2023. Training beef cattle for using a virtual fence system. Proceedings of the 2nd US Precision Livestock Farming Conference, May 21-24, 2023, Knoxville, Tennessee

- Nyamuryekung'e, S., Cox, A., Perea, A., Estell, R.E., Cibils, A.F., Holland J., Waterhouse, T., Duff, G.C., Funk, M., Aney S, McIntosh, M., Spiegal, S., Bestelmeyer, B., Utsumi, S.A. 2023. Virtual Fencing of nursing cattle grazing large pastures of Chihuahuan Desert rangelands. 76th Annual Meeting of the Society for Range Management, Feb 13 - Feb 16, 2023, Albuquerque, New Mexico. (Abstract and Presentations)

Outreach Activities

- CDRRC Hosts Multistate Hatch Development Committee: Agricultural economists, rangeland ecologists, and rural sociologists from five western states are collaborating to model the socio-economic sustainability of operations and communities that rely on U.S. rangelands. The research group met at NMSU in October 2022 to develop their Hatch project proposal (WDC54). The collaborators kicked off their three-day meeting with a field tour at the USDA Jornada Experimental Range and Chihuahuan Desert Rangeland Research Center. After observing heritage Raramuri Criollo cattle and grassland to shrubland transitions at the Jornada, they headed to the neighboring CDRRC to learn firsthand from manager Andrew Cox about his use of virtual fencing as part of the Sustainable Southwest Beef Project. The tour at CDRRC helped the researchers better understand the challenges of arid land ranching, and how precision ranching technologies can support environmental and economic ranching goals in these conditions. The researchers thanked the hosts for an "incredibly informative" field program, which helped them write an effective proposal.

- CDRRC Hosts Anthropology 389/523 Archeological Mapping – Classrooms without Walls: Dr. Rani Alexander taught 8 full field days of Anthropology 389/523 Archaeological Mapping taught at the CDRRC in 2022.

    - "We have held this course in many settings around Las Cruces since we launched the curriculum in 2005 at the CDRRC. It's a pleasure to be back at the College Ranch for this round of the class – on a working ranch with stunning views of Summerford Mountain and NMSU's Long Term Ecological Research study site. It's always a treat to escape from the main campus."
    - The students in the course are utilizing the structures and features of the CDRRC Headquarters and surrounding areas to build their skills in documenting cultural resources, mapping, and experience with a range of survey instrumentation. "Whoo, it was hot out there last Friday," the students said, but "we recovered by attending Saturday's NMSU game and tailgate." In the field, students will learn how to use the equipment, collect data, and perform calculations necessary for creating a detailed archeological site plan map and develop the ability to record the information on the NM Cultural Resource Information System.

- CDRRC Hosts NAGPRA Site Reinternment Visit: Many of the cultural objects and all of the human remains housed at the NMSU Museum are subject to the requirements of the Native American Graves Protection and Repatriation Act (NAGPRA, 43 CFR 10), Many, donated by private citizens have minimal or no provenance or tribal affiliation. NAGPRA requires consultation with the appropriate Native American Tribal Governments to develop a plan and execute that plan resulting in the repatriation of the remains. Those

objects and remains of unknown cultural affiliation will be reburied on NMSU property. Representatives from eight tribal governments along with NMSU representatives and federal agency staff attended the meeting. One of the sites was well received by the tribal representatives and selected as the location for reinternment.

- CDRRC Hosts Range Science 452 Vegetation Measurement and Rangeland Analysis: Students from the Range Science 452, Vegetation Measurement and Rangeland Analysis class taught by Dr. Shelemia Nyamuryekung'e visit the CDRRC for hands-on experience collecting their data to determine shrub density using four different methods. The students will later analyze the data to understand how different sampling methods impact statistical analysis. Throughout the class, the students will continue learning various methods to collect, analyze and interpret vegetation data on rangelands, which can inform resource management.

Cooperators and Collaborators

- Texas A&M University
- Kansas State University
- USDA Long-Term Ecological Research
- USDA Long-Term Agroecosystem Research
- Asombro Institute
- The Nature Conservancy Dugout Ranch
- Corta Madera Ranch
- Evergreen Ranching
- Blue STEM
- ReStore Net
- Universidad Autonoma de Chihuahua
- Instituto Nacional de Tecnologia Agropecuaria
- USDA ARS Jornada Experimental Range

Personnel

- Andrew Cox, Ranch Manager
- Dr. Adam Summers, Research Coordinator