2021

Habitat Research Report

BORDERLANDS RESEARCH ◆ INSTITUTE

CONSERVING THE LAST FRONTIER

OUR MISSION:

Conserving the natural resources of the Chihuahuan Desert Borderlands through research, education, and outreach.

Since 2007, the Borderlands Research Institute has encouraged effective land stewardship of the ruggedly beautiful terrain of the Chihuahuan Desert. By providing land managers with the most current scientific information, the Borderlands Research Institute is helping to conserve one of the most biologically diverse regions of the world.

Housed at Sul Ross State University, the Borderlands Research Institute builds on a long-lasting partnership with private landowners, the university's Range and Wildlife Program and cooperating state, federal, and non-governmental organizations. Faculty scientists and the graduate students they mentor are conducting groundbreaking research on every aspect of the desert landscape and the wildlife it supports.

HABITAT RESEARCH TEAM

Carlos "Lalo" Gonzalez, Ph.D.
Nau Endowed Professor of Habitat Research and Management
Justin French, Ph.D.
Research Scientist, Big Game Ecology and Management
Mieke Titulaer, Ph.D.
Research Scientist, Grassland Bird Conservation
Bonnie J. Warnock, Ph.D.
Dean, College of Agriculture, Life, and Physical Sciences

ENDOWMENTS

John L. Nau, III
Nau Endowed Professor of Habitat Research and Management

We are pleased to share BRI's 2021 Habitat Research Report with landowners, ranchers, supporters, and partners. Habitat is the common denominator in all wildlife management, providing food, cover, water, and space for all walks of life. The habitats in the Chihuahuan Desert are as diverse as its contrasting geography, ranging from pristine desert grasslands, to majestic montane forests, to rare riparian galleries and everything in between. Habitat quality in the desert is extremely dynamic, following patterns of sporadic monsoons and frequent drought. Each species has adapted in different ways to survive the harshness of the desert.

BRI strives to be a leader in habitat conservation for the region. We are able to do so because of you—our partners and donors. Through a generous gift by The Nau Foundation, BRI has established the Nau Endowed Professor in Habitat Research and Management to help spearhead habitat studies that focus on wildlife-livestock-habitat interactions, developing rangeland restoration techniques for West Texas, and mentoring students along the way.

As 2021 draws to a close, we are extremely thankful for the passion you have for all things wild and for your relentless support of the Borderlands Research Institute!

Louis A. Harveson, Ph.D.
Dan Allen Hughes, Jr., Endowed Director

The Habitat Research and Management Program at BRI emphasizes applied management and stewarding resources through sound science. The borderlands region contains various geologic and soil types and significant climatic variation that yields many different vegetation communities. This vegetation is critical to land managers as they work with livestock, wildlife, watersheds, riparian areas, and the health of the land. However, the present vegetation community may not meet a landowner's needs for managing livestock, wildlife, and water for many reasons. Therefore, we work with landowners to develop a program that fits the needs of working private lands.

Our research on private lands aims to encourage the development of economically feasible ways to decrease soil erosion, increase water harvest, reduce undesirable plant species, and sustain livestock and wildlife. We accomplish our goals by engaging students in these issues, and the students get practical field experience in rangeland and wildlife management and research while working directly with faculty. All this would not be possible without the continued support from landowners and conservation partners. Thank you for your contributions toward habitat conservation!

Carlos "Lalo" Gonzalez, Ph.D.
Nau Endowed Professor of Habitat Research and Management

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PRAIRIE DOGS AND CATTLE:

Influence of black-tailed prairie dog colonies on vegetation and cattle movement in the Marathon Basin, Texas

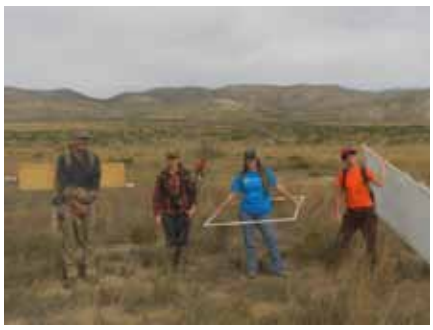
Cullom Simpson, Louis A. Harveson, Bonnie J. Warnock, Carlos E. Gonzalez, and Whitney J. Gann (Texas Parks and Wildlife Department)

The black-tailed prairie dog plays a vital role in preserving biological stability in western grasslands. Unfortunately, their current range has decreased by 98% throughout North America. Public opinion about potential competition for forage resources between prairie dogs and cattle influences conservation and management strategies for these native herbivores. Understanding the ecological relationship between prairie dogs, cattle, and rangelands is essential to sound management.

Objectives for this study included assessing spatial variation and trade-offs between forage quality and quantity in and out of prairie dog colonies, documenting seasonal variation in forage quality and quantity, and evaluating movement and grazing patterns of cattle in pastures with varying ratios of prairie dog and non-prairie dog colony.

Samples of vegetation were collected every month from June 2017 - June 2018 from a grid across the Marathon Grassland Preserve. Cattle (n = 25; 10 with Global Positioning System collars) were rotated through three pastures with differing amounts of prairie dog colony to evaluate movement and grazing patterns. Vegetation collected from the field was prepared for nutrition analyses, and collar data was used to determine cattle use on prairie dog colonies.

During vegetation sampling on the Marathon Grassland Preserve, 74 species of plants were collected. This included 21 species of grasses, 45 species of forbs, and eight species of shrubs and vines. Results for prairie dogs' influences on vegetation showed no difference in vegetation biomass or basal cover between prairie dog colony and non-prairie dog colony. Cattle movement increased when grazing on the prairie dog colony during the warm-dry and warm-wet seasons.



Based on this study, we've learned that prairie dogs influence vegetation and cattle movement in the Marathon Basin of Texas. This study provides support to land managers who harbor black-tailed prairie dogs and seek to graze cattle. The use of appropriate stocking rates in combination with rotational grazing can be conducted in areas with black-tailed prairie dogs in a way that maximizes benefits to cattle.

NATIVE SEEDS:

West Texas Native Seeds Project

Colin S. Shackelford, Louis A. Harveson, Carlos E. Gonzalez, and Keith A. Pawelek (Caesar Kleberg Wildlife Research Institute)

Native plants are adapted to local climate and soil conditions. These vital plant species provide shelter and food resources for native wildlife, birds, butterflies, insects, and livestock.

To assist with habitat restoration across West Texas using native seed sources, the West Texas Native Seeds partnership was established over a decade ago between the Caesar Kleberg Wildlife Research Institute and the Borderlands Research Institute. To date, evaluation plantings of 38 accessions of hairy grama, 11 accessions of narrowleaf globemallow, and an advanced evaluation of 10 accessions of tobosa grass are in the second year of the evaluation process in West Texas. These evaluation plantings were installed in 2019 at both the Sierra la Rana Plant Evaluation and Research Facility in Alpine and the Railway Ranch Plant Evaluation and Research Facility near Odessa. Data collection for these species continued through 2020 before selected accessions were planted for seed increase for eventual commercial release. In addition, a feasibility planting of one accession of huisache daisy was installed in May 2020. Twenty-three plant material evaluations have now been completed or are underway in West Texas.

Twelve species for grassland restoration in West Texas are currently in the seed increase phase before commercial release. These include eight grass species (black grama, blue grama, Hall's panicum, hooded windmill grass, sand dropseed, sideoats grama, silver bluestem, and whiplash pappusgrass) as well as four forb or shrub species (cowpen daisy, Gregg's mistflower, skeletonleaf goldeneye, and Tahoka daisy).

Three plant material releases have been completed and are currently in commercial production: Brewster Germplasm sideoats grama, Permian Germplasm whiplash pappusgrass, and Santiago Germplasm silver bluestem. In addition, plans are in place to release sand dropseed and cowpen daisy in the near future. Plant material collections for West Texas are ongoing to support future plant evaluations for the region. To date, nearly 1,400 collections have been made across West Texas. Collections for Arizona cottontop, Canada wildrye, rayless gaillardia, huisache daisy, and prairie coneflower are nearing completion, with evaluations planned for these species soon.

FORBS, PRONGHORN, AND CATTLE:

Effects of continuous and rotational livestock grazing on forb quality and quantity

Jacob C. Locke, Justin T. French, Carlos E. Gonzalez, Louis A. Harveson, Bonnie J. Warnock, and Shawn S. Gray (Texas Parks and Wildlife Department)

Pronghorn populations have declined throughout their range in New Mexico, Texas, Arizona, and Mexico. The declines in pronghorn numbers are generally attributed to habitat loss through degradation and fragmentation. Habitat loss due to brush encroachment is one of the main factors affecting struggling pronghorn populations in Texas, Arizona, and Mexico. Habitat degradation is a significant past and present influencer in the decline of pronghorn populations in New Mexico and Arizona. In New Mexico, limited quantity and forage quality have negatively affected pronghorn populations by reducing nutrient availability. In addition, the high variation in precipitation suggests that pronghorn demographics are susceptible to drought conditions. This juxtaposition is critical concerning quality forage and fawning cover.

Management efforts to restore pronghorn should focus on understanding the processes that affect the quality and quantity of pronghorn habitats. Pronghorn life history is adapted to grassland habitats. They rely on their vision to detect predators and their speed to avoid them. Because of this, they require open habitats with little woody vegetation. Pronghorn exhibit a strong preference for high quality forbs, with secondary use of shrub species. These critical habitat factors are all shaped by the distribution and intensity of grazing by larger herbivores. Thus, grazing was and continues to be a dominant force shaping these aspects of pronghorn habitat.

Pronghorn evolved sympatrically with American bison on the grasslands of North America. Bison grazed in large herds, moving between areas after short periods while periodically resting the rangeland. Bison preferred grasses and grazed fewer forbs, leaving them available to pronghorn. However, bison were nearly extirpated in the 1800s due to the combination of overhunting and habitat loss. Following the decline of bison, cattle became the primary large grazer on North American rangelands. The shift from bison to cattle as the dominant grazer on North American prairies altered the frequency and intensity of grazing.

Fences associated with cattle grazing permit management of timing, frequency, and intensity, leading to various grazing management approaches. Continuous grazing is the simplest and most common grazing method, requiring little labor, infrastructure, or maintenance. This strategy applies grazing to a specific pasture year-round or while grazing is feasible. On the other hand, rotational grazing consists of moving cattle across different pastures throughout the year. Because this strategy requires regular movement of cattle and additional fencing, it is more labor intensive and costly than continuous grazing. Rotational grazing strategies could emulate the historical relationship between pronghorn and bison to achieve similar benefits. How grazing affects forb abundance and quality may make it a valuable tool for improving pronghorn habitat.

We investigated the effect of grazing strategies on forb abundance and quality to determine the utility of alternative methods for improving pronghorn habitat. We compared the biomass, protein, and energy of forb communities under moderately stocked continuous and rotational grazing regimes to those in ungrazed exclosures for two years with variable precipitation levels.

We found there is variability in biomass and nutritional values of forbs across grazing regimes. Evidence suggests that relatively high quality and biomass of forbs was more frequent under rotational than continuous or no grazing in 2019. These characteristics were more frequent in the ungrazed exclosures in 2018. While we detected small differences in means between the two grazing systems and no grazing, small differences might be of interest. Grazing influenced forbs, but the effect varied by year. Therefore, we suspect the annual differences in forb quality and quantity were driven by changes in timing and amount of precipitation. Our two-year study suggests that in areas with late and limited rainfall, exclusion from grazing facilitates the highest frequency of desired pronghorn forage production in late summer. However, in years that experience spring rainfall, rotational grazing may facilitate this response.

Long-term data are needed to understand how forb communities respond to annual precipitation in combination with grazing systems. Such data will allow future pronghorn habitat management and restoration efforts to better adapt to annual environmental conditions.

BIGHORN RESTORATION:

Habitat distribution for desert bighorn sheep

Carlos E. Gonzalez, Louis A. Harveson, Brian L. Pierce (Texas A&M Natural Resources Institute), Roel R. Lopez (Texas A&M Natural Resources Institute), and Froylan Hernandez (Texas Parks and Wildlife Department)

Restoration efforts for desert bighorn have historically relied on translocations, with over 2,000 individuals translocated in Texas since 1978. Presently, >50% of the existing bighorn populations are from the result of translocations. However, the success rate of six western states was only 41% between 1923–1997. A common reason for unsuccessful translocation efforts has been insufficient knowledge of what habitat wildlife selects for and where it is distributed. Though desert bighorn are considered habitat specialists, the relationships within habitat variables and habitat selection are complex and poorly understood.

Advancements in technology now allow researchers to display quantitative relationships between the habitat variable preferences and the species' habitat distribution at large scales. The results from these types of models can be helpful in restoration as they provide a predictive measure of occurrence for a species over its potential geographic range. Therefore, the objectives of this study were to 1) quantify the relationship between habitat variables used by desert bighorn and 2) identify the distribution of such habitat across a landscape for desert bighorn within the Trans-Pecos region of Texas.

Data collected for the creation of the habitat models used desert bighorn captured from Elephant Mountain Wildlife Management Area (EMWMA) in December 2010 (12 Males, 34 Females), Sierra Diablos (SD) in December 2011 (19 M, 76 F), EMWMA in December 2012 (20 M, 20 F), EMWMA in January 2014 (16 M, 30 F), and SD in January 2015 (8 M, 10 F) using a net gun fired from a helicopter. Upon capture, each individual

was blindfolded, hobbled, and transported to a central staging area where they were fitted with Global Positioning System (GPS) collars. From 2010 to 2015, a total of 172 GPS collars were allocated on desert bighorn.

Over 250,000 GPS locations of desert bighorn were recorded across six years in five mountain ranges. When considering slope, terrain ruggedness, elevation, aspect, and canopy cover from vegetation, results demonstrated that slope in combination with elevation is essential for desert bighorn. While 50% slope or higher was generally preferred, elevation values showed selection for elevations between 3,900–5,250 feet, having a median of 4,750 feet. This study represents the first suitability model of potential habitat at a regional scale for desert bighorn in Texas that can be used as a basis for making decisions for future translocation efforts. It is now possible to evaluate where suitable habitat may be present and locations of marginal habitat. In addition, results from this study demonstrate the need to assess multiple habitat variables and to understand which variables have significant impact on habitat selection, as was the case for slope, elevation, terrain ruggedness, and canopy cover for desert bighorn.

Our knowledge and the practice of animal reintroductions have increased rapidly using habitat models, which are quickly becoming a necessary tool for management. A key challenge for future reintroductions is to have results evaluated and provided in a way that is available to all potential decision-making personnel, practitioners, land managers, and the public as they develop restoration programs. At the same time, habitat models must address the fundamental question of where to possibly translocate desert bighorn. Knowledge gained from this study can be used as a critical tool to assess the suitability of areas for restoration.

Desert bighorn should not be reintroduced into historical habitat solely because they once occupied that range, as historical locations might no longer indicate currently viable habitat. Studies have shown that the ranges of species are historically dynamic, expanding and contracting over time. Therefore, evaluation of habitat at a local scale to assess vegetation communities is also encouraged. Translocating into poor and fragmented habitats may increase mortality and cause increased movements.

Research should continue to document how environmental factors influence desert bighorn survival, reproduction, and movements, identification of international travel corridors between Texas and Mexico, and implications for future restoration and management efforts.

PRONGHORN HABITAT CONNECTIVITY:

Pronghorn habitat connectivity across the Trans-Pecos, Texas

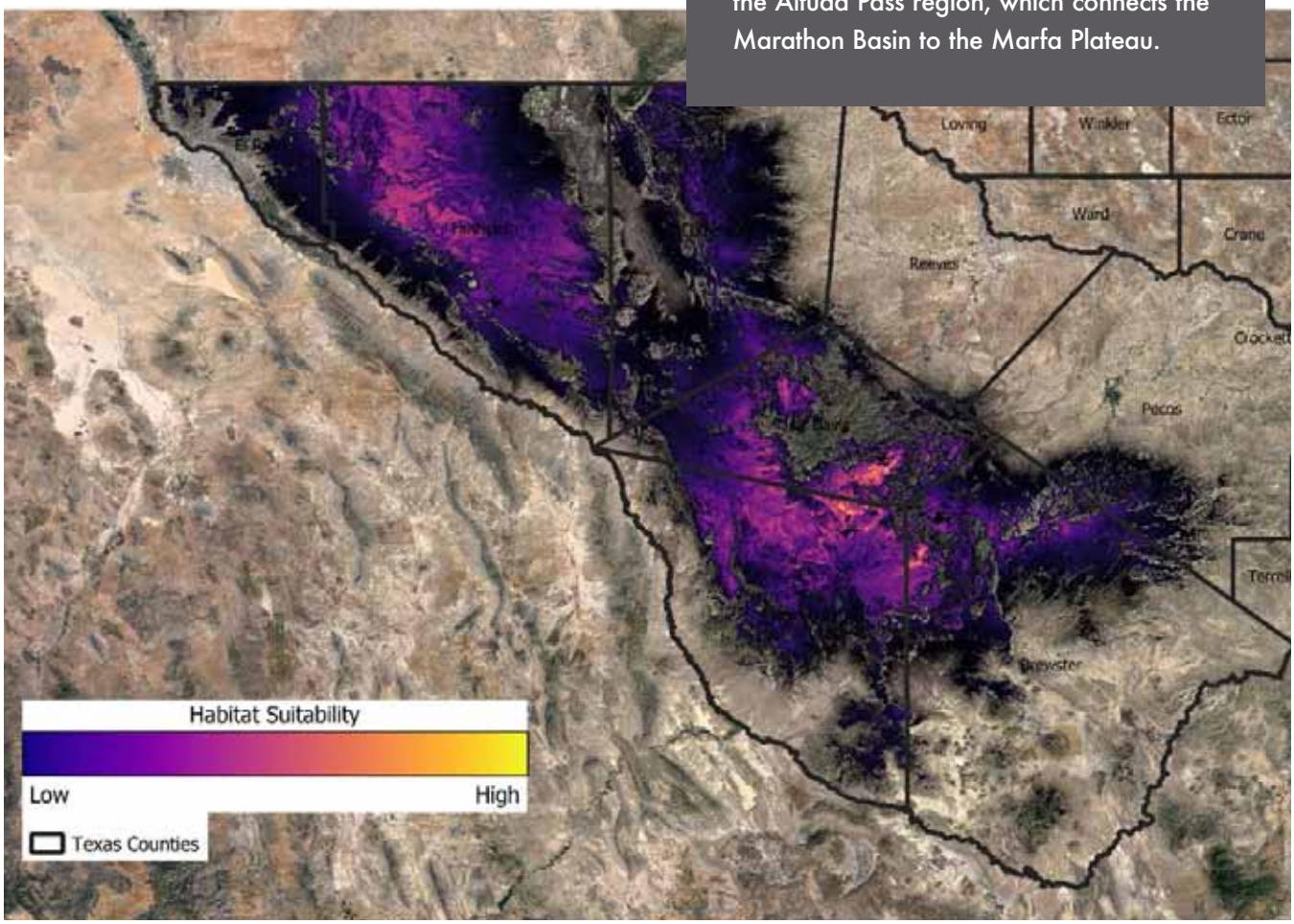
Justin T. French, Louis A. Harveson, and Carlos E. Gonzalez

Pronghorn are icons of the American prairies and are well adapted to open grassland habitats. As the fastest land mammal in North America, they rely on speed to escape predators. In addition, their keen vision allows them to spot predators at long distances. Thus, open spaces with few obstructions are critical for pronghorn survival. Pronghorn rely on high quality forage to fuel this active lifestyle, and while many assume they eat grass, they eat forbs: soft, fleshy flowering plants. In addition, they are highly selective, only choosing the best parts of the most palatable and nutritious species available to them.

These qualities affect how pronghorn choose habitats. For example, areas of high brush density are inhospitable for pronghorn, while areas with high levels of herbaceous vegetation (such as forbs and grasses) are preferable. We also expect pronghorn to avoid particularly rugged terrain to more effectively escape predators. On a larger scale, the grassland habitats pronghorn prefer only occur within certain elevation limits in the Trans-Pecos. Thus, the objective of our study was to model habitat selection across the region as a function of these variables (percent brush cover, percent herbaceous cover, slope, ruggedness, and elevation).

We projected habitat selection based on data from 379 pronghorn collared in translocation events throughout the past 10 years. Collars were programmed to record data for 1-2 years, resulting in 556,465 locations for our analysis. These data contain information on both habitat selection and movement behavior, which we separated in our study. This is important because while a particular place may meet a pronghorn's requirements, they may not be able to access it, or it may not be useful in a large enough patch. We used our data to simulate pronghorn movements throughout the landscape to see how we expect pronghorn to be distributed and determine which populations are connected.

We see that Trans-Pecos pronghorn habitat is concentrated in three major regions, as shown in the map below:
1) Hudspeth County, from the Diablo Plateau and northwest to the Hueco Mountains; 2) Central Culberson County, along the eastern edge of the Delaware Mountains; and 3) the Marfa Plateau and Marathon Basin. Simulation results show that pronghorn use these three areas but have limited connectivity between them. Thus, we see three significant corridors:
1) The Lobo Valley region of southern Culberson County features a faint corridor connecting the Marfa Plateau to the southern areas of Hudspeth County;
2) a corridor through the western Apache Mountains that connects the Central Culberson population to the Marfa Plateau; and 3) a high degree of connectivity in the Altuda Pass region, which connects the Marathon Basin to the Marfa Plateau.



BROWSE NUTRITION:

Nutritional evaluation of Trans-Pecos browse species

Justin T. French, Louis A. Harveson, and Carlos E. Gonzalez

The classes of plants found in Texas vary extensively in each ecoregion. The variance is due, in part, to the variability of rainfall, soils, and changes in elevation. For example, within West Texas's Chihuahuan Desert, plant species change continuously, as well as their nutritional values.

While typical vegetation within the area consists of grama grasses, lechuguilla, ocotillo, yucca, prickly pear, and other arid land plants, shrubs (or woody plants) are essential to some wildlife species. Without woody plants, West Texas would not have the abundance and diversity of wildlife that distinguishes the area. Examples of important brush species include four-wing saltbush, littleleaf sumac (pictured top left), skeletonleaf goldeneye (pictured bottom left), and Texas kidneywood.

Beginning in the spring of 2018, we initiated a Trans-Pecos-wide browse nutrition study. The objectives were to 1) find and identify as many browse (brush) species as possible across eight different mountain ranges/areas, and 2) identify regional nutritional differences within species. To accomplish this study, we sampled browse on 13 different properties throughout eight mountain ranges/areas (the Apache, Cathedral, Chinati, Davis, Del Norte, and Delaware mountains, the Sanderson area, and south Brewster County) throughout three seasons (hot/dry [March – June], warm/wet [July – October], and cold/dry [November – February]). Once all samples were collected each season, we dried, ground, and sent the materials to the Dairy One Nutrition Lab for analysis.

In total, we sampled more than 130 species of browse across all collection sites and obtained nutritional values for over 1,500 samples of browse. As an example, skeletonleaf goldeneye showed greater values of micronutrients (copper, iron, manganese, and molybdenum) in the Del Norte mountains compared to the other ranges. Likewise, skeletonleaf goldeneye in the Chinati mountain range displayed the widest variation in macronutrients (calcium and vitamin K). For crude protein, we found the highest values in the Apache and Chinati mountains for skeletonleaf goldeneye. We will continue to analyze these data to help landowners and resource managers better understand regional nutritional content of browse species.

HABITAT RESTORATION:

Conservation partnerships

Billy Tarrant and Louis A. Harveson

For the last few years, BRI has been a key player in the Respect Big Bend effort spearheaded by the Cynthia and George Mitchell Foundation. One of the principal recommendations of the Respect Big Bend Stakeholder Advisory Group was for BRI to build on its role as a leader in providing landowner and community resources. The land management and outreach arm of BRI is focused on sharing and implementing best management practices to ensure the sustainability of private lands. This is accomplished by providing resources and technical guidance to area landowners to assist them in their conservation and management goals. BRI is currently working with its conservation partners and funders to help establish a center at BRI to serve West Texas landowners and communities in this capacity.

Through various cost share programs, landowners are provided the opportunity to manage their wildlife habitat and to ultimately make a difference in terms of healthy terrestrial and aquatic ecosystems. Additionally, by collaborating with other prominent conservation partners, such as the Texas Parks and Wildlife Department, Rio Grande Joint Venture and Natural Resources Conservation Service, BRI is able to leverage resources and positively impact habitat on a larger landscape level.

Effective monitoring of habitat restoration projects, such as grassland and riparian restoration, is also a priority that can greatly improve conservation actions moving forward. In addition, BRI staff prioritize education and outreach opportunities with the goal to positively impact future habitat management decisions. One-on-one training, field days, and educational workshops are conducted for all relevant conservation partners, landowners, and land managers. Similarly, conservation results and recommendations are disseminated through applicable media conduits and social media.

CURRENT STUDENTS AND ONGOING PROJECTS

LEANNA (LILLY) MORIN

Lilly grew up in Hondo, Texas, and is a first generation college graduate. She attended Southwest Texas Junior College and Texas A&M University-Kingsville, graduating in 2020 with a degree in Agriculture, Range, and Wildlife Management. She interned with the USDA and Oregon State University Extension to study grazing effects on sagebrush-obligate avian habitats, developing a passion for natural sciences and conservation. Family is a big part of Lilly's life, as they have supported her throughout her collegiate career. She shares her passion for nature with her nieces and nephews by taking trips to the park, walking nature trails, and catching bugs together.

EMILY CARD

Emily grew up in southeastern Michigan, where she cultivated a love for the natural world while exploring the woods behind her house and the Great Lakes beaches with her sisters. She attended Michigan State University as an undergraduate student and graduated with a degree in Zoology. After graduation, she worked as a wildlife technician on various conservation-related projects focusing on herpetofauna, prairie dogs, and grassland and marsh birds. She loves to bird, hike, camp, knit, and listen to true crime podcasts in her free time.

Pronghorn forage selection and vegetation community response to livestock grazing

Pronghorn habitat in West Texas has become fragmented and degraded, leading to decreased forage quality and quantity. Experiments analyzing grazing effects on pronghorn vegetation selection in the region are limited. To analyze pronghorn dietary selection, Lilly is collecting 50 random fecal samples around Marfa and examining plant species composition using microhistology. She is also studying vegetation production across continuous, rotational, and deferred cattle grazing systems, analyzing samples for biomass, energy composition, moisture content, and protein composition. This research is essential in understanding the effects of livestock grazing on forbs, and it may assist landowners and biologists in restoring pronghorn habitat using grazing as a tool.

Effects of woody plant removal on grassland bird habitat characteristics

Grassland birds are one of the most imperiled avian groups in North America, having experienced consistent and rapid population declines due to habitat loss. Approximately 90% of migratory grassland bird species that breed on North America's Great Plains overwinter in the Chihuahuan Desert. However, the encroachment of woody plants into grasslands degrades and changes suitable habitat. Emily is conducting grassland bird and vegetation surveys on West Texas ranches, comparing plots treated with herbicide to remove woody plants and untreated plots. This information will help researchers and landowners understand if woody plant removal is an effective way to restore grassland bird habitat.

AARON ORTEGA

Aaron graduated with a Bachelor of Environmental Engineering from the Animal Science and Ecology Department through the Autonomous University of Chihuahua. Before joining BRI, he participated in several projects to conserve desert grasslands and related ecosystems. These projects were led by researchers from NGOs in Mexico (ProFauna and IMC Vida Silvestre) and international NGOs (Rocky Mountain Bird Observatory, Ducks Unlimited, and World Wildlife Fund) collaborating with multiple universities. Aaron is interested in the sustainability of ecosystem services, livestock management, and agriculture. He hopes to help find a means to balance economic and social development and the conservation of natural resources.

Habitat enhancement for scaled quail

Management activities targeted to overcome habitat degradation can be expensive and can lead to unexpected and sometimes negative consequences. Given the challenges of habitat restoration, determining the proper recipes for habitat enhancement across a gradient of soil textures and treatments is needed. This can assist in achieving effective habitat management for species such as scaled quail. Using several tools to identify and anticipate habitat dynamics, Aaron will employ an adaptive management strategy to assess improvements using site-specific recommendations. Research objectives include developing prescriptions for grassland habitat restoration, observing scaled quail response to grassland restoration in areas invaded by Lehmann's lovegrass and creosote bush, and restoring scaled quail populations through habitat improvements.

KEVIN LEGROW

Kevin grew up in Plano, a suburb of Dallas. He attended the University of Texas and graduated with a B.A. in Geography in 1997. After many years in the workforce, he decided to pursue a career in conservation and wildlife management, so he quit his job and went back to school at Texas State University, where he graduated in 2021 with a B.S. in Wildlife Biology. The time he spent hunting and fishing as a child led to a love of the outdoors and ultimately led to his decision to go back to school for a career change. During his time at Texas State, he interned for Texas Parks & Wildlife Department at Kerr Wildlife Management Area and Black Gap Wildlife Management Area. These internships helped form his career goal of working for Texas Parks & Wildlife Department as a wildlife biologist.

Analyzing vegetation changes in the Chihuahuan Desert ecosystem using long-term Landsat imagery

The importance of monitoring shrublands to detect and understand changes through time is increasingly recognized as critical to management. The use of remote sensing data to classify and map vegetation based on spectral characteristics can provide a visual presentation of brush communities, density, and canopy cover through Landsat imagery. For example, we can monitor spatial changes in brush/plant communities after herbicide treatments. Remote sensing provides the tools to perform habitat assessments, identify land changes, and incorporate that data to analyze and map the changes on a temporal and spatial scale. It will also include the use of field observations for validation.

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Photos courtesy of Paul Slocumb (front and back cover), Ben Masters (P8, P9 bottom, P13), and BRI staff, faculty, and students.
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Still Water Foundation
Texas Department of Transportation
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