CHRISTMAS MOUNTAINS RESEARCH SYMPOSIUM

2024

Terlingua Ranch Lodge
Brewster County, Texas
May 19–21, 2024

CHRISTMAS MOUNTAINS
THE TEXAS STATE UNIVERSITY SYSTEM

Sponsored by the Texas State University System, the TSUS Foundation,
and the Texas State University Department of Biology

2024 CHRISTMAS MOUNTAINS RESEARCH SYMPOSIUM

Terlingua Ranch Lodge
Brewster County, Texas
May 19th–21st, 2024

Sunday, May 19th

5:30 pm Informal social for meeting participants on the patio by the café

6:30 pm Dinner for meeting registrants at the Bad Rabbit Café (meal available for attendees who did not preregister, $20.00)

Monday, May 20th

8:00 am Field trip to Christmas Mountains overlook (meet in the parking lot outside the bunkhouse)

8:00 am Paleontology and Geology of the Cretaceous Upper Aguja Formation (meet on the patio outside the café)

1:00 pm Paper session (in the bunkhouse beneath the Bad Rabbit Café)

6:30 pm Dinner for meeting registrants at the Bad Rabbit Café (meal available for attendees who did not preregister, $25.00)

Tuesday, May 21st

8:00 am Field trip to Chalk Draw (meet in the parking lot outside the bunkhouse)

8:30 am Geology stroll (meet on the patio outside the café)

1:00 pm Afternoon paper session (in the bunkhouse beneath the Bad Rabbit Café)

6:30 pm Dinner for meeting registrants at the Bad Rabbit Café (meal available for attendees who did not preregister, $25.00)

FIELD TRIPS

Christmas Mountains Overlook
Trip leaders: Dave Lemke and Liz Measures
Tuesday morning at 8:00 – meet in the parking lot outside the bunkhouse

Participants will carpool up the summit road to a scenic overlook at the road's end. We will make several stops along the way to examine the geology and vegetation of the area and to take in views of the Rosillos Mountains and desert flats to the east and the Chisos Mountains to the southeast. The overlook, at an elevation of approximately 1640 m (5370 ft), provides stunning views of the region to the south and west, and participants will have the option of making the short but rugged hike to the summit at 1746 m (5728 ft).

Please note that the summit road requires short wheelbase, high-clearance vehicles and, consequently, the number of participants on this trip will, of necessity, be limited by the number of vehicles we have at our disposal.

Paleontology and Geology of the Cretaceous Upper Aguja Formation Exposed East of the Terlingua Ranch Lodge
Trip leaders: Thomas Shiller, Sue Mulroney and Adam Myers
Tuesday morning at 8:00 – meet on the patio outside the Bad Rabbit Café

In 1939, a team of paleontologists from the American Museum of Natural History traveled to the region now known as Terlingua Ranch. During their visit, Dr. Erich M. Schlaikjer and William O. Sweet collected vertebrate fossil remains from the Cretaceous Aguja Formation near Smallpox Well. These included the left mandible, limb bones (one later found to be the radius of a duck-billed dinosaur), and other fragments from a small horned dinosaur, and a *Deinosuchus* tooth (formerly referred to as *Phobosuchus*). The collection localities lie just to the east of the Terlingua Ranch lodge, adjacent to property owned by Adam Myers and Susan Mulroney. Broad exposures of the upper shale member of the Aguja Formation on the Myers/Mulroney property preserve a variety of vertebrate fossils (dinosaurs, turtles, and crocodilians) as well as fossil wood. A walk through the property will provide an opportunity to step back in time and observe rocks that formed when the landscape was strikingly different and discover the remains of plants and animals that lived over 65 million years ago.

Geology Stroll
Trip leader: Jim Chude
Wednesday morning at 8:30 – meet on the patio outside the Bad Rabbit Café

Join Jim Chude for a short hike to the overlook east of the headquarters area where he will provide an introduction to some of the major sedimentary rock formations and igneous intrusions that characterize the geology of the Christmas Mountains area. The hike will involve a short, mostly uphill trek over a gravel road and dirt path, as well as the possibility of some scrambling over open, rocky areas. This is a moderately easy hike, although since we are in the desert, plan to carry at least a liter of water with you.

Chalk Draw Overlook
Trip leaders: Bill Brown and Dave Lemke
Wednesday morning at 8:00 – meet in the parking lot outside the bunkhouse

Chalk Draw originates between Elephant Mountain and the Del Norte Mountains, southeast of Alpine in north central Brewster County and runs south-southeast for thirty-eight miles. It skirts the west side of Santiago Peak, then parallels the western base of the Santiago Mountains to its mouth on Nine Point Draw, north of the Rosillos Mountains. The course of the draw runs over Quaternary alluvial deposits derived from underlying Cretaceous limestones and from surrounding Tertiary igneous formations, such as those that form the Santiago Mountains. The area was once predominantly a semiarid grassland with abundant animal life, but overgrazing beginning at the close of the nineteenth century virtually destroyed this former biological community.

We will carpool to an overlook that provides spectacular views across Chalk Draw to the east and into Bee Cave Canyon, the largest known rock shelter in the Big Bend region (the canyon itself is on private property and inaccessible). The round-trip distance from Terlingua Ranch Lodge is about 60 miles and requires high-clearance vehicles and, consequently, the number of participants on this trip will, of necessity, be limited by the number of vehicles we have at our disposal.

2024 CHRISTMAS MOUNTAINS RESEARCH SYMPOSIUM

Monday, May 20

1:00 GOT Birds? How the Grassland Outcomes Tool for Birds will assist landowners, practitioners, and agencies with bird-focused conservation delivery in grasslands of the Chihuahuan Desert
Amanda Haverland*, Rebekah Rylander*, Anne Bartuszevige, Barry Robinson, Irene Ruvalcaba-Ortega and Chris Latimer—American Bird Conservancy, Rio Grande Joint Venture, Playa Lakes Joint Venture, Canadian Wildlife Service, Universidad Autónoma de Nuevo León and Bird Conservancy of the Rockies

1:15 Avian community response to removal of encroaching woody vegetation in Trans-Pecos grasslands
Audrey L. Taulli*, Carlos E. Gonzalez, Justin T. French and Maureen G. Frank—Sul Ross State University

1:30 Using geographic information systems to examine the potential Impact of wind turbines on grassland birds
Drew Berdo* and Joseph Veech—Texas State University

1:45 Interannual shifts in climatic suitability a potential indicator of itinerant breeding in Cassin's Sparrow (*Peucaea cassinii*)
John Schnase*, Mark Carroll, Paul Montesano, and Virginia Seamster—NASA Goddard Space Flight Center and New Mexico Department of Game and Fish

2:00 Winter habitat selection and movement behavior of scaled quail in the Trans-Pecos, Texas
Caleb Hughes*, Ryan Luna, Carlos Gonzalez-Gonzalez, Justin T. French and Louis A. Harveson—Sul Ross State University

2:15 Break

2:30 What just happened? Animal behavior during a solar eclipse
Christopher M. Ritzi, Sul Ross State University

2:45 Aoudad in the Trans-Pecos
Austin Bohannon—Texas Parks and Wildlife Department

3:00 Space use of sympatric aoudad and mule deer in the Trans-Pecos
Andrew T. Dotray[1]*, Carlos E. Gonzalez, Levi J. Heffelfinger, Shawn Gray, Froylan Hernandez and Justin T. French—Sul Ross State University, Texas A&M University-Kingsville, and Texas Parks & Wildlife Department

3:15 Black bear (*Ursus americanus*) research updates: What we have learned in the past year
Amanda Veals Dutt*, Matthew Hewitt, Nicole Dickan, Caitlin Camp, Justin T. French and Louis A. Harveson—Sul Ross State University

3:30 Proposed regulation concerning prohibition of “canned” hunting and establishment of trap standards for mountain lions (*Puma concolor*) in Texas
Krysta Demere—Texas Parks and Wildlife Department

3:45 Break

4:00 Case study of binational cactus conservation
Carolyn Whiting and Jeff Renfrow—Big Bend National Park and Rio Bravo Restoration

4:15 The structure of extrafloral nectaries in the Cactaceae
Jackson F. Burkholder and David E. Lemke*—Texas State University

4:30 Restoration of native vegetation in areas Invaded by Lehmann Lovegrass
Andres Solorio*, Carlos E. Gonzalez, Justin T. French and Louis A. Harveson—Sul Ross State University

4:45 Christmas Mountains summit road log for vehicle travel
Elizabeth A. Measures—Sul Ross State University

5:00 The geologic history recorded in rocks of Dog Canyon, Big Bend National Park
Jesse M. Kelsch—Sul Ross State University

Tuesday, May 21

1:00 Niche plasticity of desert bighorn sheep in the Trans-Pecos region, Texas
Elle Sutherland*, Justin T. French, Carlos E. Gonzalez, Michael J. Cherry, Shawn Gray and Froylan Hernandez—Sul Ross State University, Texas A&M University-Kingsville, and Texas Parks & Wildlife Department

1:15 Using satellite imagery to estimate carrying capacity of bighorn sheep on Elephant Mountain Wildlife Management Area
Hailey Barton*, Justin T. French, Carlos Gonzalez, Levi Heffelfinger, Froylan Hernandez and Shawn Gray—Sul Ross State University, Texas A&M University-Kingsville, and Texas Parks & Wildlife Department

1:30 Between a rock and a hard place: An investigation of rock squirrel (*Otospermophilus variegatus*) response to anthropogenic change
Elisa Williams* and Joseph Veech—Texas State University

1:45 Does hybridization, introgression, and syngameon formation drive oak species persistence at multiple overlapping range edges in Trans-Pecos, Texas?
Robinson Sudan—Texas State University

2:00 Population genomics and systematics of *Hebecarpa* (Polygalaceae)
Christopher Joaquín Muñoz, Michael Moody—The University of Texas at El Paso

2:15 Break

2:30 Bat Conservation International's nectarivorous bat survey and habitat restoration
Lindsey Bredemeyer—Texas Master Naturalists

2:45 White-nose syndrome in West Texas bat populations
Krysta Demere—Texas Parks and Wildlife Department

3:00 The space environment: How human activity is changing the sky
Stephen Hummel* and Teznie Pugh—The University of Texas at Austin McDonald Observatory

3:15 A Texas State University System collaborative initiative: A proposed 1.5-meter telescope for imaging and spectroscopy in the greater Big Bend International Dark Sky Reserve
Joel Walker, Philip Cole*, Jerry Lin, Andrea Banzatti, Anirban Bhattacharjee and Darrell Grissom—Sam Houston State University, Lamar University, Texas State University, Sul Ross State University and Lamar Institute of Technology

3:30 The TSUS Christmas Mountains observatory: Progress and preliminary data
Joel W. Walker*, C. Jerry Lin, Philip L. Cole, Darrell Grissom[4]and Michael Prokosch—Sam Houston State University, Lamar University and Lamar Institute of Technology

3:45 Break

4:00 Evidence for channel change in the lower canyons area, Rio Grande Wild and Scenic River
Kevin Urbanczyk—Sul Ross State University

4:15 An assessment of water chemistry in springs in the lower canyons, Rio Grande Wild and Scenic River
Chris Wright* and Kevin Urbanczyk—Sul Ross State University

4:30 Testing Toyah terraces: Preliminary results of ongoing archeological investigations along the Rio Grande at Big Bend Ranch State Park
Tim Gibbs—Big Bend Ranch State Park

4:45 The School of Constructive Arts: Building with the land
Bob Estrin* and Heather Christensen*-The School of Constructive Arts

5:00 New and old technologies for soil erosion control: Using remote sensing to monitor the effectiveness of trincheras
Gray Hancock*, Justin T. French, Carlos Gonzalez, Silverio Avila and Kevin Urbanczyk—Sul Ross State University

ABSTRACTS

Monday Afternoon

GOT Birds? How the Grassland Outcomes Tool for Birds will assist landowners, practitioners, and agencies with bird-focused conservation delivery in grasslands of the Chihuahuan Desert

Amanda Haverland[1]*, Rebekah Rylander[2]*, Anne Bartuszevige[3], Barry Robinson[4], Irene Ruvalcaba-Ortega[5] and Chris Latimer[6]—[1]American Bird Conservancy; [2]Rio Grande Joint Venture; [3]Playa Lakes Joint Venture; [4]Canadian Wildlife Service; [5]Facultad de Ciencias Biológicas; Universidad Autónoma de Nuevo León; and [6]Bird Conservancy of the Rockies

Grassland bird populations are declining at a rapid rate across the globe and throughout North America. Bird species dependent on the Chihuahuan Desert grasslands during the non-breeding portion of their life cycles are no exception. Some of these desert grassland species are suffering steep population declines due to woody plant encroachment, which decreases the quality and quantity of the grasslands that birds use. Over the past decade, many agencies, organizations, and universities have collaborated to model how woody plant encroachment, among other variables, have directly influenced North American breeding grassland bird abundance. However, few efforts have attempted modeling grassland threats on bird species abundance within the non-breeding season of their ranges, especially in Mexico. The Grasslands Outcomes Tool for Birds (GOT Birds) is on the frontline attempting such a feat. Using available geospatial data for both Mexico and the United States, GOT Birds is using boosted regression tree analysis to assess variables with the greatest influence on target grassland bird species abundances. Early results indicate that highly nomadic Chihuahuan Desert grassland birds may respond strongly to weather and climate covariates over landscape covariates, but more work is still needed on these analyses. Additionally, GOT Birds is creating “heat maps” of predicted bird species densities that will guide landowners and practitioners on where to focus conservation-related projects.

Avian community response to removal of encroaching woody vegetation in Trans-Pecos grasslands

Audrey L. Taulli*, Carlos E. Gonzalez, Justin T. French and Maureen G. Frank—Borderlands Research Institute, Department of Natural Sciences, Sul Ross State University

The grasslands of North America are one of the fastest declining habitat types on the continent. This is due to a variety of reasons, including energy conversion, livestock grazing, and woody plant encroachment. As a result of this habitat loss, grassland-obligate bird species are in steep decline across the continent. An estimated 88% of migratory grassland birds overwinter in the Chihuahuan Desert. Woody plant encroachment within the Chihuahuan Desert has decreased available grasses, leading to a reduction in winter food availability and nocturnal thermal cover. Encroached woody vegetation also provides more habitat and perching opportunities for avian predator species, such as loggerhead shrikes (*Lanius ludovicianus*) and American kestrels (*Falco sparverius*). Grassland restoration efforts typically involve brush removal using herbicide, mechanical removal, and fire. In the Trans-Pecos, we will study sites within the Marathon and Marfa grasslands where herbicide and mechanical removal have been used on mesquite varieties (*Prosopis glandulosa* var. *glandulosa* and *P. glandulosa* var. *torreyana*), creosote bush (*Larrea tridentata*), and tarbush (*Flourensia cernua*). We will be conducting non-breeding bird surveys and vegetation surveys across a control

site, a site 4-years post herbicide treatment, and a site that used mechanical removal 4 years after having been treated with herbicide. Our results will help inform broad-scale restoration that will hopefully result in increases for species currently listed as species of greatest conservation need.

Using geographic information systems to examine the potential Impact of wind turbines on grassland birds

Drew Berdo* and Joseph Veech—Department of Biology, Texas State University

While wind energy is a known way for humans to reduce emissions from fossil fuels, there is limited public discourse on how wind energy impacts wildlife. Grassland birds are one of the most threatened bird groups in the world and much of their habitat overlaps with the majority of current and future wind energy capacity in the United States. We are using data collected from the North American Breeding Bird Survey (BBS) and wind turbine data from the United States Geological Survey to examine the potential impact of wind turbines on how grassland birds utilize available habitat. We created a Turbine Proximity Index (TPI) that quantifies the potential impact of wind turbines on grassland birds through spatial analysis in ArcGIS Pro. The index quantitatively assesses BBS routes across grasslands of North America based on how they are potentially impacted by turbines. This index takes into account the number of turbines within a set distance of the route. Through statistical analysis, we will use a Before-After Control Impact (BACI) analysis to assess the relationship between the TPI and bird abundance and species richness along a selection of BBS routes.

Interannual shifts in climatic suitability a potential indicator of itinerant breeding in Cassin's Sparrow (*Peucaea cassinii*)

John Schnase[1]*, Mark Carroll[1], Paul Montesano[1], and Virginia Seamster[2]—[1]NASA Goddard Space Flight Center and [2]New Mexico Department of Game and Fish

Cassin’s Sparrow (*Peucaea cassinii*) is a grassland resident of the southwestern United States and northern Mexico. It has long been speculated that Cassin's Sparrow undertakes an unusual east-to-west migration over the course of the breeding season, perhaps in response to changing environmental conditions brought on by North American monsoon rainfall. Breeding season itinerancy is uncommon and almost impossible to demonstrate by direct evidence. This work examines the issue from a climatic suitability perspective.

High temporal resolution retrospective ecological niche modeling was used to create climatic suitability models for two-week intervals spanning the breeding season months of April through August for each five-year interval spanning the years 1980 through 2020. Theil-Sen trends were calculated across the ten biweekly, seasonal intervals in each of the eight five-year intervals to show trends in climatic suitability that occur during the breeding season as well as multidecadal trends in these seasonal trends that have occurred over the past 40 years. The weighted centroid for climatic suitability was determined for all the models in the study. The distance and bearing of the vector connecting the seasonal starting and ending centroids were calculated to determine seasonal bioclimatic velocities for each five-year span.

The resulting time series revealed a consistent east-to-west movement of suitable climatic conditions across the biweekly, seasonal intervals in each of the five-year intervals of the study. The average movement of the centroid of suitable conditions from east to west was 709.8 ±77.2 km during a season. There is a negative trend in the magnitude of this directional shift over the past 40 years, from a high of 992.9 km (1985) to 380.2

km (2020). These results lend indirect support to the hypothesis of an east-to-west breeding season itineracy in Cassin's Sparrow and raise a number of interesting questions that will be considered in this presentation.

Winter habitat selection and movement behavior of scaled quail in the Trans-Pecos, Texas

Caleb Hughes*, Ryan Luna, Carlos Gonzalez-Gonzalez, Justin T. French and Louis A. Harveson—Borderlands Research Institute, Department of Natural Sciences, Sul Ross State University

Scaled quail (*Callipepla squamata*) have experienced population declines in the last several decades due to habitat degradation. This compounds seasonal reductions in resources, such as those occurring during winter the Trans-Pecos region, where scaled quail face reduced food and cover availability amidst periodic winter climate events. As these factors can prompt behavioral responses to resultant changes in habitat quality, monitoring spatial behaviors can lend insight into how scaled quail respond to winter conditions. We hypothesized scaled quail would use supplemental resources and select for hydrologic features that offer greater availability of food, cover and thermal refuge. We trapped scaled quail in southern Brewster County during winter 2022–2023 using walk-in funnel traps and fit 37 individuals with Global Positioning System (GPS) backpacks to obtain winter location data. We modelled spatial behaviors with an integrated Step Selection Analysis, using distance to quail feeders, Topographic Position Index (TPI), monthly Modified Soil Adjusted Vegetation Index (MSAVI), slope, and ambient temperature as covariates. Scaled quail selected for quail feeders and hydrologic features and expressed functional responses to slope and greenness, revealing various selection strengths for low to moderate values of these variables. Scaled quail also exhibited reduced step lengths near feeders. Reduced movement near feeders may illustrate their role in reducing foraging effort and offsetting winter energy deficits. Scaled quail's positive relationship to greenness and hydrologic features illustrate the importance of landscape factors that facilitate vegetation carryover into winter, providing microsites that help scaled quail buffer the challenges of Trans-Pecos winters.

What just happened? Animal behavior during a solar eclipse

Christopher M. Ritzi—Biology Program, Department of Natural Sciences, Sul Ross State University

The study of animal behavior is driven by cause-and-effect relationships. Based on the adaptationist approach, animals should conduct the proper behavior based on the stimuli that they receive. These stimuli affect their immediate reactions, their daily circadian rhythms, as well as their reproductive and annual cycles. So, what do animals do when the normal pattern of stimuli gets disrupted in an unexpected way? An opportunity to examine this phenomenon was presented during the two eclipses that Texas experienced in October 2023 and April 2024. To try to better understand animal behavioral responses to the sudden darken of an eclipse, observers were situation in a natural park environment, recording audio behavior in conjunction with the NASA Soundscapes project, as well as making visual observations. A brief history of documented behaviors will be reviewed, prior to sharing the results of the October responses to an annular eclipse and the April responses to a total eclipse. Reports on various birds, turtles, insects, and mammals will be presented.

Aoudad in the Trans-Pecos

Austin Bohannon—Texas Parks and Wildlife Department, Alpine

Aoudad were introduced to west Texas in the 1950s to provide hunting opportunity. Since then, this population has exploded and is at a level that requires active management. We will discuss the positive and negative aspects of having these invasive animals on our west Texas landscape, including hunting opportunity, over population, over grazing, and disease spread to our native desert bighorn sheep.

Space use of sympatric aoudad and mule deer in the Trans-Pecos

Andrew T. Dotray[1]*, Carlos E. Gonzalez[1], Levi J. Heffelfinger[2], Shawn Gray[3], Froylan Hernandez[3] and Justin T. French[1]—[1]Borderlands Research Institute, Department of Natural Sciences, Sul Ross State University; [2]Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville; and [3]Texas Parks & Wildlife Department, Alpine

The ecology of aoudad (*Ammotragus lervia*) in Texas is poorly understood, where the introduced African species coexist and potentially interact with the native mule deer (*Odocoileus hemionus*). Aoudad space-use, daily activity cycles, and social dynamics are largely unknown in the Trans-Pecos region of Texas. However, they are important relative to their potential impact on mule deer and desert bighorn sheep (*Ovis canadensis*) recovery in the region. With improved quantitative techniques in movement ecology, aoudad space-use can be readily assessed using the Brownian bridges movement model, calculated using collar data. No literature has quantified aoudad utilization distributions using the BBMM or examined the influence of aerial gunning relative to changes in movement behavior. In March 2023, 40 aoudad and 40 mule deer were captured and collared in the Chinati and Quitman Mountain ranges. Collars recorded the animal's location via satellite at 2-hour fixes. To date, utilization distributions have been calculated for each collared individual. Results demonstrate aoudad on average range over wider areas (8.37 km^2 in the Quitmans and 9.60 km^2 in the Chinatis) compared to mule deer average space-use (4.01 km^2 in the Quitmans and 4.27 km^2 in the Chinatis). Utilization distribution overlap between species was calculated using the Bhattacharyya's Affinity (BA) niche overlap metric, resulting in a 61.8% overlap on the Quitmans and 52.9% on the Chinatis. Comparing pre- and post-gunning movement behavior will prove valuable in understanding aoudad response to population management in the region for future development in native big game recovery in Texas.

Black bear (*Ursus americanus*) research updates: What we have learned in the past year

Amanda Veals Dutt*, Matthew Hewitt, Nicole Dickan, Caitlin Camp, Justin T. French and Louis A. Harveson—Borderlands Research Institute, Department of Natural Sciences, Sul Ross State University

After a 30+ year absence from the west Texas landscape, black bears (*Ursus americanus*) have begun recolonizing the private land interface outside Big Bend National Park. This recent influx of bears to places they have not been in many years requires updates in management practices and policies. Texas Parks and Wildlife Department's 10-year strategic plan outlines long term goals for the species, but without detailed or recent information on the recolonizing population, achieving these goals for bear conservation will be challenging. We at Borderlands Research Institute (BRI) at Sul Ross State University initiated a long-term study focused on the basic ecology of this bear population. Specific objectives include observing timing of denning,

diet preferences, spatial and temporal effects on bear movement, and establishing a method of estimating population density. To date, BRI has captured and collared 22 individuals (6 females, 16 males) ranging in age from 2–15 years old and weighing 80–460 lbs, and have collected over 50,000 GPS locations. From these locations, we learned that male denning duration is extremely variable, ranging from 0–113 days. Some males did not enter dens until mid-February and others entered in late-November. Overall, males denned for an average of 59 days while females denned for average of 122 days. Using Hidden Markov Models (HMM) we identified large scale patterns in bear movement data showing that space use is most stable in late fall and most variable in spring. Using similar methods, paired with extensive field validation, we can identify what environmental variables (vegetation, elevation, slope, etc.) bears are selecting for when choosing to exhibit a particular behavior (sleeping, foraging, traveling, etc.). With information like this, we hope to make a difference in the future of black bear management in Texas. Bears are continuing to recolonize our back yard and having detailed foundational knowledge of how they live and use the landscape will help managers make informed decisions regarding their future management.

Proposed regulation concerning prohibition of "canned" hunting and establishment of trap standards for mountain lions (*Puma concolor*) in Texas

Krysta Demere—Texas Parks and Wildlife Department, Ft. Davis

In early 2023, the Texas Parks and Wildlife Commission formed a Mountain Lion Stakeholder Group (MLSG) consisting of landowners, livestock producers, private land managers, trappers, and resource professionals to advise the Texas Parks and Wildlife Department (TPWD) on six charges to mountain lions in Texas. The MLSG met throughout 2023 with a focus on understanding the nuances of various positions related to policy options and management approaches regarding those six charges. The MLSG presented their finding at the January 2024 Commission meeting, and subsequently, the Commission directed TPWD to initial rulemaking to prohibit "canned" hunting and to establish trapping standards for mountain lions (*Puma concolor*) in Texas. The proposed Rule §65.950, concerning mountain lions was published in the April 19, 2024 Issue of the Texas Register and proposes 1) the prohibition the hunting of mountain lions in captivity as well as the release of captive mountain lions for purposes of being hunted or training dogs, and 2) the creation of an offense for a person allowing a live mountain lion to be captured in a trap or snare for more than 36 hours. Herein, we present background information on the decision to initiate rulemaking and introduce the proposed rule §65.950.

Case study of binational cactus conservation

Carolyn Whiting[1] and Jeff Renfrow[2]—[1]Big Bend National Park and [2]Rio Bravo Restoration

The socio-political boundary between Big Bend National Park and the neighboring protected areas managed by CONANP (Comisión Nacional de Áreas Naturales Protegidas) in Mexico contribute substantial barriers to effectively studying trans-boundary conservation issues. For one endangered cactus species, bunched cory cactus (*Coryphantha ramillosa*), almost all natural history studies were focused on a small population in Big Bend National Park due to the logistical challenges of studying other parts of the species' range. This study demonstrated an effective partnership between government agencies, NGOs, and local community groups to improve our understanding of the habitat requirements and population sizes of this cactus.

One of the logistical challenges we encountered with planning field work in our target study area, the remote parts of the Ocampo Flora and Fauna Protected Area, was an uncertainty with what roads and properties would be accessible ahead of time. To overcome this challenge, we used a modular, pre-planned sampling design of hexagonal sampling areas (called "cactagons") that allowed for flexibility in the field while maintaining statistical validity. The field work was completed by a binational team of Ocampo residents with training in restoration and ecological field methods, CONANP employees, botanists from the Universidad Autónoma Agraria Antonio Narro and the Universidad Autónoma de Nuevo León, Texas-based NGO Rio Bravo Restoration, and Big Bend National Park. We found a total of 136 bunched cory cacti collectively in the 190 plots we sampled, which we used to estimate a population size of 144,300 plants in the 142.5 km^2 sampling universe. The species was found in wide variety of habitat types that were not previously thought to be habitat, including on igneous formations and Quaternary deposits. This binational collaboration greatly improved our understanding of this cactus and will help better anticipate the impacts of future management activities throughout its range.

The structure of extrafloral nectaries in the Cactaceae

Jackson F. Burkholder and David E. Lemke*—Department of Biology, Texas State University

Extrafloral nectaries (EFNs) are specialized glands in plants that secrete an aqueous solution of sugars and amino acids. Unlike floral nectaries, which function primarily in pollination, EFNs are typically associated with plant defense, attracting invertebrates whose presence and activity can reduce herbivory. EFNs have been reported from four fern families and 108 families of flowering plants, primarily monocots and eudicots; they are absent from the gymnosperms.

EFNs were first observed in cacti in 1837 and have since been noted in at least 25 different genera of the family. Morphologically, cactus EFNs have been categorized as belonging to one of four distinct groups: short, blunt, obviously modified spines (type 1 EFNs); nectaries that resemble ordinary spines and have no readily apparent modifications (type 2 EFNs); nectaries associated with small foliage leaves occurring immediately adjacent to an areole (type 3 EFNs); and nectar-secreting regions of epidermis situated just below an areole (type 4 EFNs). Although the distribution of these morphological types has been examined, little is known of the structure of cactus EFNs.

Our studies have shown that type 1 EFNs are typically short, blunt projections consisting of a basal vascularized stalk and a broad secretory head containing layers of nectary parenchyma and subnectary parenchyma and secretion appears to be through the cuticular covering of the gland. In type 2 EFNs, nectar is produced in an area of small, isodiametric cells with dense cytoplasm at the base of a spine, then transported upwards to the sites of secretion. In type 3 and type 4 EFNs, nectar is secreted through open stomata onto the surface of the epidermis.

Restoration of native vegetation in areas invaded by Lehmann lovegrass

Andres Solorio*, Carlos E. Gonzalez, Justin T. French and Louis A. Harveson—Borderlands Research Institute, Department of Natural Sciences, Sul Ross State University

Native and non-native grassland species interact and compete for space and resources. Sometimes, those negative interactions can affect native species by leading them to eradication and converting a rangeland into monocultures. This is due to non-native species having aggressive behavior and better response than natives towards drought and wildfires. Also, some non-native plant species are not preferred by wildlife. For example, scaled quail (*Callipepla squamata*) habitat is indirectly affected by negative interactions with invasive species such as Lehmann lovegrass (*Eragrostis lehmanniana* (ERLE)). Therefore, we initiated a restoration project to mitigate Lehmann lovegrass monocultures and increase native plants for scaled quail. The project was situated in southern Brewster County and is part of the Chihuahuan Desert. Our goal was to evaluate ways to decrease and control Lehmann lovegrass. Therefore, we established 200 plots, each 16 m^2, with 4 treatments. Treatments were soil disturbance, native plant seeding, soil disturbance and seeding, and a control. We used three line intersections in each plot. We implemented treatments during the summer of 2022. Data was taken in the post-rainy season in October 2022, the winter season in February 2023, post-rainy season in October 2023 and the winter season in February 2024, achieving two years of monitoring data. So far, we have preliminary results for both post rain and growing seasons. Data already collected was treated with a RDA to find relationships between treatments and species, preliminary results indicate that in this season, ERLE is still present, but seeding, and soil disturbance and seeding treatments have more relation with native plant species and ERLE is more related with controls, while soil disturbance treatments have a negative relation with ERLE.

Christmas Mountains summit road log for vehicle travel

Elizabeth A. Measures—Geology Program, Department of Natural Sciences, Sul Ross State University

Rocks exposed along the Summit Road on the Christmas Mountains TSUS property display an excellent cross-section of the geology in the area. The road primarily cuts through Cretaceous-aged limestones at the edge of the mountains, but also transects small intrusions and parallels a larger intrusion, and related volcanics, of Cenozoic-age toward the interior of the mountains. The geology and the accessibility to that geology has driven the production of a road log to illustrate and explain a unique feature of the Earth. The road log is tailored to vehicular travel since that may be the way most visitors to the area journey up the mountain. The road log consists of two parts. One part has the basic geologic terminology and illustrations needed to put names to the features seen along the road. The second part indicates at which place on the road to best see the geology of the Summit Road. There are four stops (scenic overviews) indicated on the road log. Illustrations and explanations at these stops describe the geology adjacent to the road and the geology seen in the surrounding area. Between stops there are illustrations and explanations of the geology being traversed. The road log, hopefully, should answer questions about the features seen along, and from, the Summit Road. The road log should also help to understand geologic processes responsible for the formation of the scenery in this part of the Big Bend.

The geologic history recorded in rocks of Dog Canyon, Big Bend National Park

Jesse M. Kelsch—Geology Program, Department of Natural Sciences, Sul Ross State University

Dog Canyon in Big Bend National Park exposes vertically tilted sedimentary rock beds of part of a large reclined fold structure that was formed during Laramide contractional deformation of the Big Bend region's crust during the late Cretaceous and early Paleogene periods. These rocks form two ~200 x 60 m cliff walls

which expose several smaller-scale structures inside the larger fold that are easily seen by hikers at the canyon floor. The exposure of the minor structures within the larger fold provides an opportunity to test published fold models that hypothesize internal variations in rock-deformation directions, i.e., localized orientations of rock stretching and contraction. In this study, photographic imagery of one of the cliff walls was captured and converted to a single orthomosaic photo used as a base image on which to map these smaller complex fault and joint patterns, and from these map patterns localized orientations of stretch and contraction axes were identified. Results of this structural analysis document a three-stage deformation history between Laramide-synchronous crustal contraction and Rio-Grande rift crustal extension. The earliest strain occurred by orthogonal flexure during folding ahead of the west-southwest-verging Santiago thrust fault. Second, the lower, upright limb of the syncline was horizontally contracted as the thrust fault cut the upper limb of the fold. Last, the hinge and upper limb extended horizontally either upon relaxation of Laramide contraction or during subsequent Neogene extension. This geologic history and an explanation of the structural analysis behind it are presented as a panel to be installed by the National Park Service as an interpretive wayside exhibit in front of the cliff on the Dog Canyon trail.

Tuesday Afternoon

Niche plasticity of desert bighorn sheep in the Trans-Pecos region, Texas

Elle Sutherland[1], Justin T. French[1], Carlos E. Gonzalez[1], Michael J. Cherry[2], Shawn Gray[3] and Froylan Hernandez[3]—[1]Borderlands Research Institute, Department of Natural Sciences, Sul Ross State University; [2]Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville; and [3]Texas Parks & Wildlife Department, Alpine

In Trans-Pecos, Texas, desert bighorn sheep were extirpated by 1960. Restoration efforts have shown signs of success; however, management of desert bighorn populations of the Trans-Pecos region is particularly complex as they exhibit a high degree of niche overlap with invasive aoudad, which not only carry and transmit diseases to naïve desert bighorn populations but also compete with them for resources. Previous research has demonstrated that aoudad and desert bighorn niches heavily overlap in optimal habitat. However, there is still little information concerning how competition may impact desert bighorn space use. Recent die-offs in desert bighorn populations (following outbreaks of the pathogenic disease *Mycoplasma ovipneumoniae*), highlight the need for a deeper understanding of any factors impacting population viability, including niche constraint in the face of competition. The aim of this study is to explore variation in niche breadth among populations in the Trans-Pecos in order to determine whether desert bighorn exhibit niche conservatism. Specifically, we will use integrated step selection analyses to model inter-individual habitat selection behavior and assess niche breadth of populations. To accomplish this, we will utilize 21 population years of movement data accumulated from six separate desert bighorn populations. By focusing on potential competition induced niche shifts, we intend to lay the groundwork which will inform future targeted management actions for desert bighorn in landscapes co-occupied by aoudad.

Using satellite imagery to estimate carrying capacity of bighorn sheep on Elephant Mountain Wildlife Management Area

Hailey Barton[1]*, Justin T. French[1], Carlos Gonzalez[1], Levi Heffelfinger[2], Froylan Hernandez[3] and Shawn Gray[3]—[1]Borderlands Research Institute, Department of Natural Sciences, Sul Ross State University; [2]Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville; and [3]Texas Parks & Wildlife Department, Alpine

Elephant Mountain Wildlife Management Area (EMWMA) serves as a nursery herd for ongoing desert bighorn (*Ovis canadensis*) restoration efforts. Consequently, the primary management objective is production of surplus animals for use as source stock for translocation. However, EMWMA also provides public hunting opportunities, particularly for mule deer (*Odocoileus hemionus*). Thus, maintaining a healthy mule deer population is also a key management goal on EMWMA. Estimating Elephant Mountain's carrying capacity of bighorn is essential to mitigate competition between bighorn and mule deer, as well as preserve habitat quality. Traditional methods of estimating carrying capacity are time-consuming, tedious, imprecise, and costly. Due to these constraints, assessments are not conducted often. However, carrying capacity is not rigid through time, as precipitation and temperature can vary from year to year, causing dramatic shifts in environmental conditions. To keep pace with these shifts, a more efficient method of assessing habitat is needed to estimate carrying capacity on an annual basis. Our objective is to use remote sensing in the form of satellite imagery to monitor the quality of forage available to bighorn sheep and mule deer on Elephant Mountain. Previous studies established a relationship between satellite vegetation indices and bighorn nutritional performance. We expect this relationship to be density dependent, which allows us to estimate carrying capacity from satellite imagery. We hypothesize that a higher density of bighorn sheep reflects a more gradual slope of increasing MSAVI (modified soil adjusted vegetation index) and fecal nitrogen. With more animals present on the landscape, there is a lower quantity of high-quality forage available, which results in lower fecal nitrogen content throughout the population. We completed our first year of sampling and will complete laboratory analyses this summer. This study will provide a framework that can be extended for efficient monitoring of desert bighorn habitat via satellite, providing essential guidance for management.

Between a rock and a hard place: An investigation of rock squirrel (*Otospermophilus variegatus*) response to anthropogenic change

Elisa Williams* and Joseph Veech—Department of Biology, Texas State University

As human populations grow, urbanization is transforming landscapes, leading to habitat loss and fragmentation. Urban adaptors, like rock squirrels, often exhibit behavioral flexibility in response to changing environments. While rock squirrels play vital roles in natural ecosystems, their adaptability to urban environments involves altered habitat use, potential synanthropy, and changes in social dynamics. Urbanization may affect behaviors such as territoriality and vigilance, impacting survival strategies. This study aims to investigate the effects of urbanization on rock squirrels, examining behavioral adaptations in rural and urban colonies through observation. Behavioral data has been extracted from videos obtained from wildlife cameras placed outside of known burrows at six sites across central Texas. Along with the videos, burrows were mapped in each site and nearby vegetation was documented. This research aims to contribute valuable insights into the success of synanthropes in urban environments and enhance our understanding of wildlife behavior in rapidly changing anthropogenic landscapes. Furthermore, addressing the prevalent issue of human-wildlife conflict, particularly in urban settings. The exploration of environmentally induced behavioral

changes in rock squirrels can also be used to inform management strategies and underscore their potential role as ecosystem engineers, highlighting their significance in urban biodiversity maintenance.

Does hybridization, introgression, and syngameon formation drive oak species persistence at multiple overlapping range edges in Trans-Pecos, Texas?

Robinson Sudan—Department of Biology, Texas State University

Hybridization and introgression (gene flow from one distinct population or species into the gene pool of another distinct population or species) are now recognized to be important forces in adaptation and evolution across the tree of life. In particular cases, when three or more interfertile sympatric species overlap in parts of their ranges and regularly hybridize, this interbreeding group is called a syngameon. These three phenomena (hybridization, introgression, and syngameon formation) have been shown to play particularly important adaptive roles at the periphery of species ranges, where a species' genetic diversity may be lowest. Recognizing the high prevalence of hybridization in most species of oaks contributed to the development of the syngameon concept as well as the ecological species concept (that species can be recognized as distinct entities based on their ecological differences despite ongoing gene flow). However, population genomic studies of oak syngameons are few; none have been published focusing on the highly diverse oak assemblage of Trans-Pecos Texas, where several species overlap at the periphery of their distributions. This project will characterize the population genomic structure of the two main clades of North American oaks (red oaks and white oaks) across Trans-Pecos Texas, to identify levels of admixture (genetic ancestry from more than one distinct lineage) and investigate the environmental and landscape factors contributing to hybridization and introgression in these populations. Understanding how the environment structures genetic diversity and influences the frequency and extent of gene flow among interbreeding populations of distinct species will help reveal more about the importance of hybridization, introgression, and syngameons to population adaptation in times of altered temperature and precipitation regimes. This will inform conservation priorities as the dynamics of these unique populations may hold the key to their continued adaptation and persistence as habitats shift in response to climate change.

Population genomics and systematics of *Hebecarpa* (Polygalaceae)

Christopher Joaquín Muñoz, Michael Moody—Department of Biological Sciences, The University of Texas at El Paso

The exact timing of Miocene warming, and its evolutionary effects on biota, remains unknown—preliminary genomic sequence data show a concomitant radiation of the *Hebecarpa obscura-H. barbeyana* (Polygalaceae) species complexes ~5 million years ago. Contemporary geographic distributions of these taxa suggest an affinity for habitat characterized by ecotonal margins at the interface of desert lowlands and temperate coniferous forests. This putative affinity for desert margins offers a unique opportunity to study patterns in ancestral ranges in the wake of shifting desert habitat boundaries acting as environmental filters across space and time. Preliminary data show compelling evidence of cryptic diversity within the H. obscura and *H. barbeyana* complexes as well as diversification across these lineages occurring within the last 5 million years. These preliminary data indicate a potential need for taxonomic revisions within the group. Identifying genetically isolated populations would highlight otherwise cryptic entities that may warrant taxonomic recognition as entirely new species for conservation purposes. The disjunct geographic distributions *of H.*

obscura and *H. barbeyana* may have played a role in facilitating genetic differentiation between populations to the extent that there may exist little to no contemporary gene flow between localities occurring at disjunct mountain ranges. The timing of species diversification across the genus is still unclear, as are the ecological and evolutionary mechanisms that facilitated this divergence. Calibrating the timing of diversification events within *Hebecarpa* may corroborate proposed climate shifts that may have had important, continental-scale biotic implications across evolutionary time. The link between aridification of the American Southwest and adaptive radiations has not been well-established or documented in plants—phylogenetic methods applied to the *Hebecarpa* system may address gaps in our understanding of how evolution differentially shapes both the physiological and morphological traits of plants under increasing aridification, elucidating important details of the genesis of the North American Deserts and the subsequent consequences this may have had on biota.

Bat Conservation International's nectarivorous bat survey and habitat restoration

Lindsey Bredemeyer—Texas Master Naturalists

While the Texas hill country is well known for its bat flights, the Chihuahuan ecoregion has more species of bats than any other region of Texas. Southern Mexico through the U.S. border desert regions also has the only nectarivorous bats on the North American mainland. Like other nectarivores, these species are at higher risk due to loss of habitat. They also tend to be more reclusive in behavior, diffuse in their feeding, and acoustically silent compared to insectivores making them problematic to survey. This talk addresses Bat Conservation International's process of environmental DNA (eDNA) surveying to better determine the ranges of these bats and address habitat restoration.

White-nose syndrome in West Texas bat populations

Krysta Demere—Texas Parks and Wildlife Department

Texas Parks and Wildlife Department (TPWD) has been funding research and disease surveillance for white-nose syndrome (WNS), a devastating disease afflicting hibernating bats, since 2011. These surveillance efforts did not detect WNS nor the fungus, *Pseudogymnoascus destructans* (*Pd*), that causes the disease between 2011 and 2016. However, surveys conducted January–February 2017 detected the fungus in six counties in the panhandle region of Texas. TPWD biologists later confirmed the first known development of the WNS in an infected cave myotis (*Myotis velifer*) found dead in central Texas on February 23, 2020. Since the detection of WNS in central Texas, TPWD Trans-Pecos staff have increased regional monitoring efforts of bats overwintering in west Texas. Herein, we present information on the disease surveillance efforts for the Trans-Pecos region from 2020–2024 and the findings to date.

The space environment: How human activity is changing the sky

Stephen Hummel* and Teznie Pugh—The University of Texas at Austin McDonald Observatory

Satellite mega-constellations and increased rocket launch activity are changing the night sky and Earth's upper atmosphere at a rapid pace. In January 2019 there were 2,272 active satellites. As of March 2024, there were 9,494. As of January 2024, there are over 540,000 applications for additional satellites, the vast majority for

communication purposes. At this pace, the number of satellites visible at certain hours of the night could be greater than the number of naked-eye visible stars by the end of the decade. The increasing number of satellites and associated launches poses challenges to astronomy, communications, and the environment. Many Big Bend residents and visitors have already noted the increased activity in the sky in the form of rocket exhaust plumes or satellite streaks. In this presentation, we will discuss the current and projected future impacts of space activity, as well as explore unresolved questions on the impact satellite constellations may have on the Big Bend region.

A Texas State University System collaborative initiative: A proposed 1.5-Meter telescope for imaging and spectroscopy in the greater Big Bend International Dark Sky Reserve

Joel Walker[1], Philip Cole[2]*, Jerry Lin[3], Andrea Banzatti[4], Anirban Bhattacharjee[5] and Darrell Grissom[6]—
[1]Department of Physics and Astronomy, Sam Houston State University; [2]Department of Physics, Lamar University; [3]Department of Civil & Environmental Engineering, Lamar University; [4]Department of Physics, Texas State University; [5]Department of Computer, Mathematical, and Physical Sciences, Sul Ross State University; and [6]Department of Technology, Lamar Institute of Technology

This presentation outlines the education, research, and outreach vision in astronomy at the proposed Texas State University System's (TSUS) Christmas Mountains Observatory in Brewster County, Texas. The observatory will be located next to Big Bend National Park, one of the least light-polluted locations in North America. The state of Texas gifted the 9,270-acre tract within the Dark Sky Park region of the peripheral protection zone to the TSUS in 2011. Coupled with the desert weather and elevation (peak height at 5,728 feet above sea level), locating a world-class observatory at this TSUS property confers extended observational time and reduced atmospheric interferences. These dark, elevated, arid conditions make for an ideal site for solar, planetary, and night sky observations. Among the opportunities offered by a medium-sized telescope in the Big Bend International Dark Sky Reserve are 1) developing a network of medium-sized telescopes across the globe, 2) deep field studies of the cosmos, 3) kilonovae in the optical range, i.e., multi-messenger observation of neutron star merger events, 3) measurement of central black hole masses and other galactic properties through reverberation mapping, and 4) studying jets and outflows from young pre-main-sequence stars and their protoplanetary disks over long timescales of days to months to years.

Since the last Christmas Mountains Symposium in May 2023, we have submitted two NSF proposals; one on the acquisition of the remotely operated 1.5-meter telescope and associated imaging and spectrographic instrumentation and the other on our recently established collaboration with the N3AS Physics Frontier Center (Network for Neutrinos, Nuclear Astrophysics, and Symmetries) at The University of California at Berkeley on Dense Matter and Neutron Stars. The 1.5-meter telescope facility will afford unique science opportunities at the intersection of optical astronomy, gravitational-wave astronomy, astrophysics, cosmology, particle physics, and nuclear physics. This project focuses on developing data collection and analysis protocols that allow the future remotely operated observatory to be deployed continuously. Students will be trained on test data collected at the Dominey Observatory at the Sam Houston State University (0.7-meter observatory), which was unveiled in March 2024, and publicly available science data collected by other observatories.

The TSUS Christmas Mountains observatory: Progress and preliminary data

Joel W. Walker[1]*, C. Jerry Lin[2], Philip L. Cole[3], Darrell Grissom[4] and Michael Prokosch[1]—[1]Department of Physics & Astronomy, Sam Houston State University; [2]Office of Research & Sponsored Programs Administration, Lamar University; [3]Department of Physics, Lamar University; and [4]Department of Technology, Lamar Institute of Technology

This talk will focus on logistical and practical issues related to the goal of bringing a large remotely-operated research telescope to the Christmas Mountains area. We will describe existing progress on the plans for this facility, including expectations for the telescope, enclosure, and attached imaging and spectroscopic instrumentation. We will describe our proposed approach to minimizing ecological impacts on the land and the surrounding viewshed, using satellite communication and a compact solar power array with a battery storage system. We will summarize ongoing efforts to select a site that best balances future science potential against practical challenges to development, construction, operations, and maintenance. This process will include the deployment of autonomous sky monitors for a year-long study of seeing conditions at four candidate sites, enabling a data-driven selection process. We will highlight preliminary short-baseline results from one such monitor. Several pending grant proposals will be reviewed, which are intended to fund the required equipment and to establish a working data analysis pipeline prior to construction. This pre-operational phase will use the new Dominey Observatory at Sam Houston State University to test remote operation and data processing protocols at a more easily accessible site. It will have the secondary benefit of providing outstanding opportunities for training students at all TSUS member institutions in various aspects of observational astronomy.

Evidence for channel change in the lower canyons area, Rio Grande Wild and Scenic River

Kevin Urbanczyk—Rio Grande Research Center, Sul Ross State University

The Lower Canyons are located downstream of Big Bend National Park (BBNP) in a section of the Rio Grande Wild and Scenic River, covering 134 km (83 miles) from La Linda to Dryden crossing. The Rio Grande in the Big Bend region has a degraded condition that is the combined result of reduced flow, overabundance of sediment, presence of invasive vegetation, and declining water quality. One significant result is a degraded, narrowed channel. This condition has been well documented upstream in BBNP, but has received very little attention in the Lower Canyons with the exception of preliminary data collected by Ken Saunders of Texas Parks in Wildlife Department in 2012–2014. During this time cross-section head and tail pins were established at seven locations from Taylors Farm to Dryden crossing. Basic cross-section profiles were measured between these pins using topographic level and measuring tape technology. A few of these were revisited periodically in subsequent years but none have received significant attention. I have recently initiated an effort, using laser total station and RTK GPS technology, to systematically revisit most of them to assess the potential of degraded channel conditions as seen upstream in BBNP. In 2022 and 2023, my team has been able to revisit cross section locations at Big Canyon, Reliz, Silber Canyon, “below Hot Springs,” Lower Madison, San Francisco Creek and a location referred to as “River Mile 701”. Most of these locations show evidence of significant sediment accumulation and/or channel narrowing since the original measurements, with the clearest evidence seen at the River Mile 701 location. It appears that the Lower Canyons section of the river, despite the significantly improved water quality due to inflow of fresh water via springs, is suffering from similar degraded channel morphology conditions as the river upstream. This raises several questions. First, what are potential downstream impacts of restoration projects designed to mobilize sediment? And second, what are the

implications of the sediment accumulation on the otherwise ecologically sound “groundwater dependent ecosystem”?

An assessment of water chemistry in springs in the lower canyons, Rio Grande Wild and Scenic River

Chris Wright* and Kevin Urbanczyk—Rio Grande Research Center, Sul Ross State University

The Lower Canyons reach of the Rio Grande Wild and Scenic River defines the U.S.-Mexico international border downstream from Big Bend National Park (BBNP) between La Linda and Dryden, Texas. Numerous springs issue from a trans-boundary aquifer in the area. The inflow of the springs improves the water quality and quantity in the Rio Grande by increasing flow and diluting the total dissolved solids (TDS). This research is focused on evaluating the chemical characteristics of these springs to better understand the regional groundwater flow paths and recharge areas. Two groups of springs have been identified and are distinguished by their TDS values. These groups can also be distinguished by their stable isotope values (d18O and d2H). The spring water chemistry matches similar groundwater samples on the U.S. side of the river implying a recharge area in the U.S. Similar studies need to be conducted on the Mexico side to determine possible recharge contributing to this important binational water source.

Testing Toyah Terraces: Preliminary Results of Ongoing Archeological Investigations along the Rio Grande at Big Bend Ranch State Park

Tim Gibbs—Big Bend Ranch State Park

With the recent discovery of well-preserved prehistoric cultural horizons along the Rio Grande, subsequent archeological testing has expanded the number of sites with potentially intact buried components present from four to six. This talk discusses recent findings from the second field season of the BBRSP River Corridor Testing Project, as well as potential implications on our understanding of the prehistoric archeology of the Big Bend.

The School of Constructive Arts - Building with the land

Bob Estrin*and Heather Christensen*—The School for Constructive Arts

The School of Constructive Arts is a field school teaching regenerative design, building, and ecology through direct observation, participation, and experimentation. Our central focus is on developing healthier habits for habitation, including innovation in building materials and systems. Our approach combines ancient knowledge of natural materials and energy with advancing technology to create living spaces in which human activity enriches the diversity, health, and vitality of the land. This way of building with the land integrates human needs with a program of ecological restoration by utilizing recycled water and returning nutrients to the soil. In line with this theory, we have begun to expand our curriculum to focus more closely on the role that soil plays beyond being an essential component in earth building, but also as a source and mediator of life. We have embarked on a number of arid dryland soil restoration strategies through the implementation of student-led small-scale land and watershed restoration projects, with the goal of expanding this work to our campus more broadly in the coming years. Recent student cohorts designed and built a series of water

retention and diversion structures using degraded compressed earth blocks that will slow water down on the land and inhibit deleterious channel incision. Future work will incorporate syntropic agroforestry techniques with the aim of encouraging resilient, woody vegetative growth. We will work with our students to begin a long-term remote monitoring investigation of the impact of these interventions on soil health, plant life, and biodiversity using a network of IoT sensors. To this end, we seek to position our efforts alongside regional conservation goals, and where possible work in collaboration with community and institutional partners on a shared vision of a regenerative future for the Big Bend

New and old technologies for soil erosion control: Using remote sensing to monitor the effectiveness of trincheras

Gray Hancock[1]*, Justin T. French[1], Carlos Gonzalez[1], Silverio Avila[1] and Kevin Urbanczyk—[1]Borderlands Research Institute, Department of Natural Sciences, Sul Ross State University and [2]Rio Grande Research Center, Sul Ross State University

Erosion is a widespread problem that leads to habitat degradation and topsoil loss. Understanding this process is essential for establishing healthy rangeland communities and targeting efficient management strategies for habitat restoration. With recent advancements in remote sensing technology, accessibilities to UAVs capable of efficiently collecting large amounts of data while simultaneously minimizing input and cost for observation has led to new strategies to map, monitor, and survey change over time for researchers across the globe. This project will be focused on using drone imagery to strategically map and construct three-dimensional digital elevation models (DEMs) of drainage channels and monitor the effectiveness of trincheras, or rock filter dams, at retaining topsoil. Using the process of photogrammetry, images taken from multiple perspectives of the channel will be then used to construct a 3d model using the SIFT algorithm. Several factors can contribute to unwanted error in elevation models such as sensor specs, flight altitude, and image overlap. The first chapter of this project will test different combinations of flight settings and camera sensors on the drone to minimize unwanted noise in our DEMs to accurately map geomorphic change over time. After an accurate mapping process is developed, the second chapter of this project will use DEMs developed using our mapping methodology to monitor the effectiveness of using trincheras to trap sediment and reduce erosive processes. This will be done by creating 3d models of the trincheras within these channels after flood events and comparing them will DEMs created at the time of trinchera placement. These differences will give us a volume of soil accumulated at trinchera locations and hopefully guide management on where to place erosion control structures to maximize efficiency.

Welcome to Terlingua Ranch Lodge

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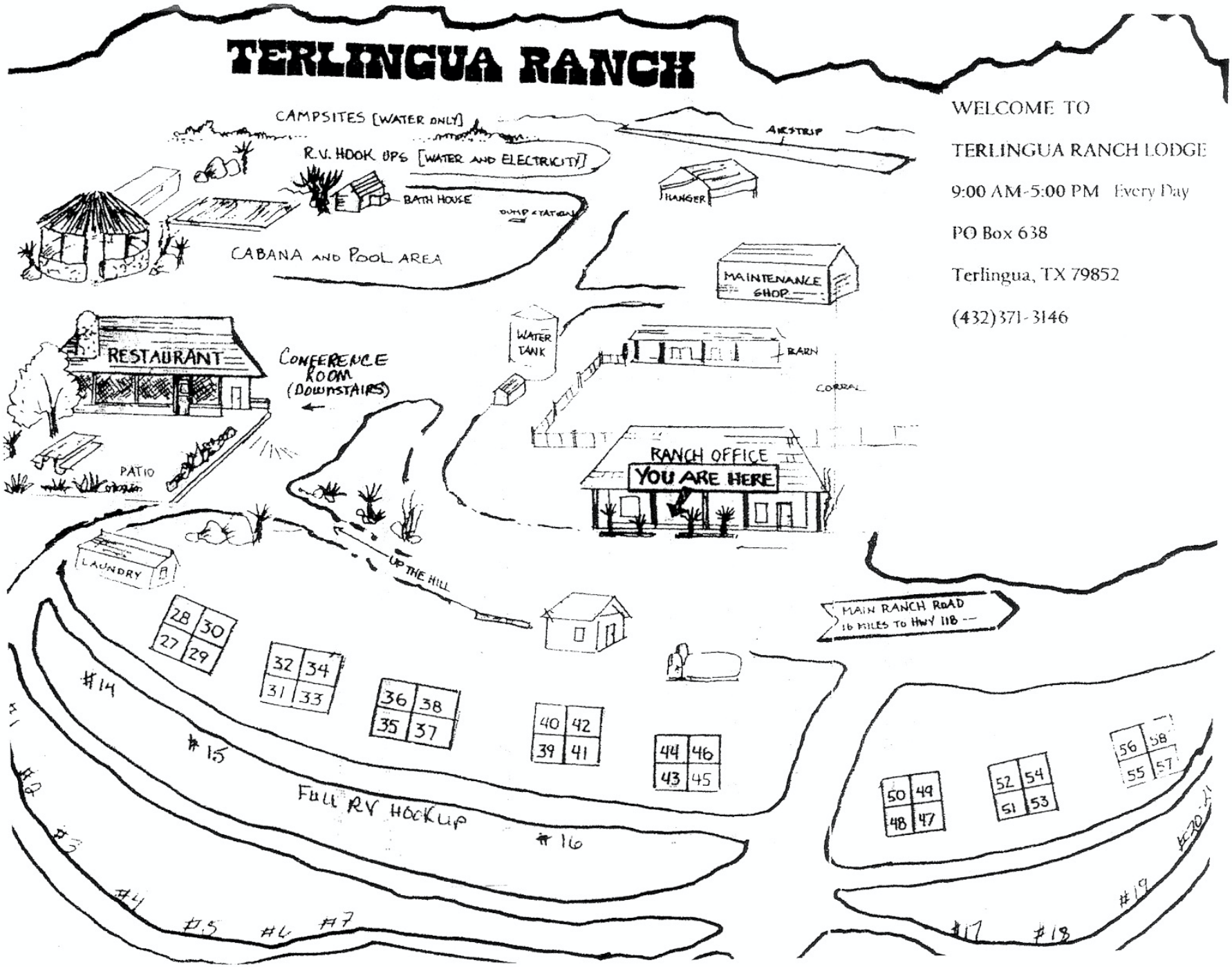
(432) 371-3146

www.terlinguaranch.com

Office open 8:00 am to 3:00 pm

- **Room service.** If you need additional towels or linens, please come to the Front Desk.
- **Check-out** time is 11:00 am. If you wish to extend your stay, please notify the Front Desk prior to check - out.
- **The Bad Rabbit Café** is open from 7:00 am to 8:00 pm daily (hours may be extended for holidays, special occasions, and hunting season).
- **Security and Assistance** – for after-hours emergencies, a **911** phone is located on the patio next to the pool.
- **Pets** must be on a leash in common areas.
- **Pool hours** are 10:00 am to 10:00 pm. The bath house is open 24 hours, seven days a week.
- **Laundry** is open noon to 10:00 pm.
- **Water** is scarce – please conserve.
- **Burn ban** is currently in effect for Brewster County with warm temperatures and dry, windy conditions. Please confine outdoor cooking to the use of propane stoves. See the Front Desk for more information regarding burn bans.
- **Smoking** is allowed outdoors only. Please dispose of cigarettes in butt cans located throughout the Lodge.
- Please obey posted **speed limits**.
- Please respect **No Trespassing** and **No Hunting** signs throughout the ranch.



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CHRISTMAS MOUNTAINS RESEARCH SYMPOSIUM 2025

Terlingua Ranch Lodge

May 19th–21st, 2025

Front cover illustration: Fifteen different kinds of complex galls can be found developing on the leaves, stems, and buds of creosotebush (*Larrea tridentata*) throughout its range. Each type of gall is formed by a different species of gall midge belonging to the genus *Asphondylia*. The adult midges are small, 1–5 mm in length, brownish in color, with cylindrical antennae and large eyes. The females have a needle-like ovipositor with which they insert their eggs into living plant tissue. The stem gall illustrated here is produced by the midge species *Asphondylia auripila*. Original photo taken by D. Lemke at Terlingua Ranch.