CHRISTMAS MOUNTAINS RESEARCH SYMPOSIUM

2013

Terlingua Ranch Headquarters
Brewster County, Texas
May 13th–15th, 2013

THE TEXAS STATE UNIVERSITY SYSTEM™

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CHRISTMAS MOUNTAINS RESEARCH SYMPOSIUM

Terlingua Ranch Headquarters
Brewster County, Texas
May 13th–15th, 2013

Monday, May 13th

6:00 pm Informal social for meeting participants around the swimming pool (beer, wine, and non-alcoholic beverages available for purchase at the Bad Rabbit Café)

7:00 pm BBQ dinner for meeting registrants on the café patio (regular dinner menu will be available for others at the café)

Tuesday, May 14th

9:00 am Field trip to Christmas Mountains overlook (meet in the parking lot next to the swimming pool)

9:00 am Field trip to fluorspar mines (meet on the patio outside the café)

1:30 pm Paper session (in the bunkhouse beneath the Bad Rabbit Café)

Wednesday, May 15th

7:30 am Hike to Christmas Mountains overlook (meet in the parking lot next to the swimming pool)

9:00 am Field trip to fluorspar mines (meet on the patio outside the café)

1:30 pm Paper session (in the bunkhouse beneath the Bad Rabbit Café)

7:00 pm Dinner for meeting registrants on the patio (regular dinner menu will be available for others at the café)

FIELD TRIPS

Christmas Mountains Overlook
Trip leader: Michael Huston
Tuesday morning at 9:00 – meet in the parking lot next to the swimming pool

Participants will carpool up the Old Mine 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 Old Mine Road 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.

Fluorspar Mine Area
Trip leader: David Lemke
Tuesday morning at 9:00 – meet on the patio outside the Bad Rabbit Cafe

We will carpool to an area near the base of Paisano Peak and hike a short distance (approx. 1 km or 0.6 mi) to the site of the Paisano Fluorspar Mine, which operated in the Christmas Mountains from 1971 until 1982. Fluorspar, an aggregate of rock and mineral matter containing varying amounts of fluorite (CaF_2), is an important industrial mineral commodity for which there are no known substitutes in its major commercial uses. Participants will have the opportunity to explore the old mining camp, the mines (no spelunking—the shafts are sealed), and the piles of debris discarded by the miners. We will also have time to examine the desert plant communities characteristic of the area. This is a relatively easy hike, but since we are in the desert, plan to carry at least a liter of water with you.

Christmas Mountains Hike
Trip leader: David Lemke
Tuesday morning at 7:30 – meet in the parking lot next to the swimming pool

Participants will carpool to the parking area at the base of the Old Mine Road and hike to the scenic overlook at road's end. Along the way we will be able 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). The round-trip hike is approximately 11 km (7 mi) long and occasionally steep, and participants should be in good physical condition. Each hiker should wear sturdy hiking shoes and carry a minimum of 2 liters of water.

FIELD TRIPS (cont'd)

Fluorspar Mine Area
Trip leader: Michael Huston
Wednesday morning at 9:00 – meet on the patio outside the Bad Rabbit Cafe

We will carpool to an area near the base of Paisano Peak and hike a short distance (approx. 1 km or 0.6 mi) to the site of the Paisano Fluorspar Mine, which operated in the Christmas Mountains from 1971 until 1982. Fluorspar, an aggregate of rock and mineral matter containing varying amounts of fluorite (CaF_2), is an important industrial mineral commodity for which there are no known substitutes in its major commercial uses. Participants will have the opportunity to explore the old mining camp, the mines (no spelunking—the shafts are sealed), and the piles of debris discarded by the miners. We will also have time to examine the desert plant communities characteristic of the area. This is a relatively easy hike, but since we are in the desert, plan to carry at least a liter of water with you.

CHRISTMAS MOUNTAINS RESEARCH SYMPOSIUM

Tuesday, May 14

1:30 Welcome and Introductions

1:45 A historical perspective on the Christmas Mountains
Thomas C. Alex, National Park Service, Big Bend National Park

2:00 An introduction to the vegetation of the Christmas Mountains
David E. Lemke and Matthew Donahue, Texas State University

2:15 Resource map and petrology of the igneous rocks at the Christmas Mountains
Blake Huston, Sul Ross State University

2:30 CoCoRaHS For the Christmas Mountains
Jim DeBerry, National Weather Service

2:45 Break

3:00 The Center for Big Bend Studies and research in the vicinity of the Christmas Mountains
William A. Cloud, Sul Ross State University

3:15 A preliminary examination of mescaline levels in tissues of *Lophophora williamsii*
Molly T. Klein, Sul Ross State University

3:30 A geochemical and microbial diversity survey of a natural iron seep within Big Bend Ranch State Park
Julia Green, Sul Ross State University

3:45 Ichthyological review of the area with perspectives on the future
Timothy H. Bonner, Texas State University

4:00 Break

4:15 Survey of the Mexican beaver in Big Bend National Park
Joey Reich and Thomas R. Simpson, Texas State University

4:30 Occurrence, distribution, and habitat associations of freshwater sponges in arid and semi-arid regions of western gulf slope drainages
Harlan T. Nichols and Timothy H. Bonner, Texas State University

4:45 The role of radio communications in the Big Bend
Julianne Braun, Terlingua Ranch, TX

5:00 Desert soils in a global context
Michael Huston, Texas State University

Wednesday, May 15

1:30 The Shumla Caves peyote specimens: composition and possible uses
Martin Terry[1], Karen Steelman[2], Tom Guilderson[3] and Marvin Rowe[4], [1]Sul Ross State University; [2]University of Central Arkansas; [3]Lawrence Livermore National Laboratory; [4]Texas A&M University

1:45 An annotated vascular flora of The Nature Conservancy Davis Mountains Preserve, Jeff Davis County, Texas
Jeffrey J. Keeling, Sul Ross University

2:00 Predicting sky island forest vulnerability to climate change: fine scale climate variability, drought tolerance, and fire response
Dylan W. Schwilk, Russell Lackey and Maria Gaetani, Texas Tech University

2:15 An analysis of the distribution and diversity of Thaumarchaeota within the springs and soils of the northwestern Chihuahuan Desert
Laura Tang and Jackie Denson, Sul Ross State University

2:30 Break

2:45 Use of plant species as predictors of insect community composition
Virginia Brown and Michael Huston, Texas State University

3:00 A re-examination and morphological comparison of the Helminthoglyptid fossil land snails *Helix* and *Lysinoe* (Gastropoda:Pulmonata) from Presidio and Brewster counties of West Texas
Mary Jones and Ned Strenth, Angelo State University

3:15 Regional comparison of moths in Texas
Kate Seideman-Barclay and Michael Huston, Texas State University

3:30 Status of the Lucifer hummingbird in West Texas – a banding case study
Kelly B. Bryan, Fort Davis, TX

3:45 Break

4:00 Nutria (*Myocastor coypus*) in Big Bend National Park: a non-native species in desert wetlands
Matthew T. Milholland, Jason P. Shumate, Thomas R. Simpson and Richard W. Manning, Texas State University

4:15 Effects of dry versus wet winters on the size and species diversity of herbaceous plants in a man-made landscape
Matthew Haverland and Michael Huston, Texas State University

4:30 Variation in plant mortality from the 2011 drought and freeze along an elevational transect
W. Grady Terry and Michael Huston, Texas State University

ABSTRACTS

A historical perspective on the Christmas Mountains

Thomas C. Alex, National Park Service, Big Bend National Park, TX

The Christmas Mountains stand apart from the surrounding desert and testify to post-Pleistocene climate change. Prehistoric humans have camped around its base and left ephemeral sign of their presence. Although humans have approached and sometimes reached into this small but rugged range, their penetration has yet to fathom its secrets. Miners have probed its skirts, hunters and hikers have searched its peaks, but its steep slopes and rugged surface discourage those with only a casual interest. A few aware and enlightened individuals have sought to protect this small range from degradation at human hands. Removed from the subdivision and development that surrounds it, this isolated range has remained relatively untrammeled. It is a relic of ancient times and in the scientific search for what secrets lie protected in its deep crevices and canyons, we may yet learn new things. This presentation touches on the history of human use of the Christmas Mountains and the potential for knowledge that can come from scientific investigations and sound land conservation.

An introduction to the vegetation of the Christmas Mountains

David E. Lemke and Matthew Donahue, Department of Biology, Texas State University, San Marcos, TX

The Christmas Mountains occupy approximately 4000 hectares (10,000 acres) of rugged terrain adjacent to Big Bend National Park in Brewster County, Texas, that was deeded to the Texas State University System in September, 2011 for use as an educational and research area. A floristic inventory was begun in January, 2012 and has identified five major vegetation assemblages on the property: two desert communities dominated by creostoebush (*Larrea tridentata*) and acacias (*Acacia* spp.) at elevations below approximately 1100 m (3600 ft) above sea level; desert grassland dominated primarily by chino grama (*Bouteloua ramosa*), sotol (*Dasylirion leiophyllum*), and lechuguilla (*Agave lechuguilla*) at elevations between 1100 and 1500 m (3600–4900 ft); a sparse woodland of shin oak (*Quercus pungens*) and redberry juniper (*Juniperus pinchotii*) at the highest elevations; and an arroyo community dominated by a diverse array of shrubs traversing drainages across the desert flats and grasslands. The desert grasslands of the mid elevations of the Christmas Mountains may represent one of the best examples of Chihuahuan Desert grassland in the southern trans-Pecos region.

Resource map and petrology of the igneous rocks at the Christmas Mountains

Blake Huston, Department of Earth and Physical Sciences, Sul Ross State University, Alpine, TX

The transfer of the Christmas Mountains property to the Texas State University System presents an excellent opportunity to study the geology and geochemistry of the region. The region has been subjected to an array of geologic processes, which include Laramide compression, Tertiary volcanism, and Basin and Range extension. The Christmas Mountains is a domal structure that domed Cretaceous strata, due to the emplacement of a laccolithic-type magma body at depth during Tertiary magmatism. These processes have resulted in a geochemically diverse suite of igneous rocks that outcrop within and adjacent to the boundaries of Christmas

Mountains property. There are several types of igneous rocks associated with the magmatism that are significantly geochemically different, but that outcrop in close proximity to each other. For example, peralkaline quartz trachytes occur adjacent to metaluminous quartz trachytes. Silica oversaturated rocks dominate the terrain with some mafics. However, intermediate rocks are very few. Sampling and mapping will need to be carried out in order to compile geochemical data and improve the petrogenetic model. Understanding and interpreting processes occurring within the magma chamber will result in better ideas about the evolution of parental magmas and associated magmas in adjacent chambers. A digital resource map will be compiled, in ArcMap, which will include proper geology and geochemistry layers from past studies and this study. A geodatabase will be completed for all shapefiles and associated data tables. Once the map is completed, it will be submitted to the system for all disciplines to take advantage of for future studies. An individual may want to know the rock type a certain species thrives on, and what the chemical make-up may be. Professors may use it as a teaching tool for future field trips or projects. There are many uses for a product like this to which everyone should have access.

CoCoRaHS For the Christmas Mountains

Jim DeBerry, National Weather Service, Midland, TX

West Texas is one of the most sparsely populated areas of the state. As result, meteorological observations here are similarly sparse. Even automated observing platforms are not as abundant out here as in more populated areas of the state, for funding for such systems logically tends to be concentrated where benefits will be maximized, i.e., population centers. As a result, West Texas rainfall climatology is poor. In 1998, the CoCoRaHS (Community Collaborative Rain, Hail and Snow) network was established. CoCoRaHS is a unique, non-profit, community-based network of volunteers of all ages and backgrounds working together to measure and map precipitation (rain, hail and snow). With a simple rain gage and an internet connection, landowners can establish a climatology of rainfall on their land. The denser the observing network, the better, especially in mountainous terrain such as the Christmas Mountains, for rainfall can vary considerably in areas of dissimilar topography. CoCoRaHS is the cheapest, easiest-to-use network devised so far for measuring precipitation.

The Center for Big Bend Studies and research in the vicinity of the Christmas Mountains

William A. Cloud, Center for Big Bend Studies, Sul Ross State University, Alpine, TX

The Center for Big Bend Studies (CBBS) was founded in 1987 to facilitate the study of prehistoric, historic, and modern cultures of the borderlands region that encompasses trans-Pecos Texas and northeastern Mexico. The CBBS publishes an annual journal, has several other publication series, hosts an annual conference in November, provides archaeological compliance services, and conducts archaeological and historical research on both private and public properties in the greater Big Bend. Through their research they have documented a wide array of historic and prehistoric sites in the region, making in-roads not only in our understanding of past cultures, but also providing new information on the ancient environment. This presentation will highlight past CBBS efforts in the vicinity of the Christmas Mountains preserve and underscore future research possibilities on this Texas State University System property.

A preliminary examination of mescaline levels in tissues of *Lophophora williamsii*

Molly T. Klein and Martin Terry, Department of Biology, Sul Ross State University, Alpine, TX

The tops (crowns) of peyote (*Lophophora williamsii*) have historically been used by peoples of the Chihuahuan Desert for medicinal and religious purposes. Mescaline, the predominant psychoactive compound in the cactus, produces effects on sensory perception that contribute to the psychological state attained by Native American Church (NAC) members ingesting peyote as sacrament in their religious ceremonies. The non-ceremonial medicinal uses of peyote have not been studied to determine which constituent(s) of peyote (if any) may be pharmacologically active by the standards of Western medicine. Mescaline concentrations in peyote crowns are normally about 2−4% of the dry tissue weight. Mescaline concentrations in isolated subterranean stem tissue and isolated root tissue of peyote have not been previously reported. The objective of this study is to determine mescaline concentrations in the crown, subterranean stem, and root of *Lophophora williamsii*. This was accomplished by methanol extraction of alkaloids from ground dry tissue of each of the three tissue types, followed by a conventional acid-base extraction procedure. Separate determinations were done for each tissue type from each of 10 individuals from a South Texas population. This work has conservation implications, as it will determine the relative value – in terms of mescaline concentration alone − of each anatomical tissue type. If mescaline concentration in root proves to be substantially lower than that in the crown, then NAC members would be able to weigh the therapeutic value of the harvested root vs. the ceremonial value of preserving the plant by not harvesting the root.

A geochemical and microbial diversity survey of a natural iron seep within Big Bend Ranch State Park

Julia Green, Department of Biology, Sul Ross State University, Alpine, TX

Big Bend Ranch State Park, the largest state park in Texas, covers more than 120,000 hectares (300,000 acres) of the Chihuahuan Desert. While most surface features in this rugged, remote, and unpopulated setting are volcanic, underlying sedimentary features are found throughout the area. The presence of an orange biofilm containing a matrix of microbial sheaths was observed at two distinct springs within the park, Las Cuevas Amarillas and Ojo Mexicano. These springs are associated with dilute hydrocarbons and iron oxides within the water. This study presents the results of a geochemical and molecular ecology analysis of the Las Cuevas Amarillas site in order to better understand the microbial consortia and metabolic strategies associated with these unique surface features. Total DNA was extracted from the biofilm matrix and universal primer set combinations (Bacteria 27F, 1525R; Archaea A8F, A1041R) were utilized to amplify 16s rRNA genes. These amplicons were subsequently cloned, sequenced, and phylogenetically analyzed. Quantitative PCR was performed utilizing a variety of primer sets specific to unique microbial metabolic strategies (ammonia oxidation, methane oxidation, sulfate reduction, methanogenesis, iron reduction, iron oxidation, sulfur oxidation) to further reveal the uniqueness of the microbial consortia associated with these sites. *Leptothrix* spp., a sheath producing, iron and manganese oxidizing bacterium was determined to be the dominant genus. Other β- and γ- proteobacteria including *Thiobacillus* spp., *Curvibacter* spp., *Ideonella* spp., Chromatiaceae spp. and both Crenarchaeota and Euarchaeota were also detected.

Ichthyological review of the area with perspectives on the future

Timothy H. Bonner, Department of Biology, Texas State University, San Marcos, TX

The area, currently part of the Chihuahuan Desert, has a rich history of fish invasions, speciations, and extinctions. A timeline of the area's fish communities will be presented with emphasis on Pliocene and Pleistocene invasions and speciations and on Holocene extinctions, which collectively form contemporary fish communities. The ichthyological review demonstrates dynamic nature of the area's fish communities and provides perspectives for quantifiable predictions of the past and future. Past communities within the Big Bend and trans-Pecos areas are underexploited and represent exciting research opportunities. Future communities and expectations are relevant to resource managers as we collectively preserve and protect spring, stream, and riverine fishes.

Survey of the Mexican beaver in Big Bend National Park

Joey Reich and Thomas R. Simpson, Department of Biology, Texas State University, San Marcos, TX

The Rio Grande River forms the 176 km (110 mi) boundary of Big Bend National Park with Mexico. The Rio Grande is home to the southwestern subspecies of North American beaver, *Castor canadensis mexicanus*. Wildlife biologists in northern Mexico and Big Bend National Park are interested in the status of this subspecies in northern Mexico and along the Rio Grande. The last survey on the Mexican beaver in Big Bend National Park was conducted in 1976 by J. Connor and B. Feeley The objective of this study is to document centers of beaver activity and estimate the population of beaver in Big Bend National Park for the National Park Service. We will survey the Rio Grande River from the mouth of Terlinqua Creek to the mouth of Boquillas Canyon by float trips using kayaks, canoes, and river rafts. On the float trips, we will record water depth, type of vegetation, and sign of active beaver colonies (presence of beaver tracks, scat, and cuttings). To date, we have extensively surveyed 40 km (25 mi) of the Rio Grande in Big Bend National Park, from Terlingua Creek to Black Dike. From data gathered on float trips, we have created an ArcGIS map showing bathymetry of the river, vegetation profiles, and active beaver sign. Over 20 active beaver dens have been located, indicating a healthy population of beaver in the park. Information generated from this project will be used by the National Park Service in implementing management practices to restore the river and riparian area to a more natural state. Practices include the removal of the exotic plant and animal species as well as planting and managing for native plant species such as cottonwoods and willows. The National Park Service has also requested reports on sign of nutria along the river.

Occurrence, distribution, and habitat associations of freshwater sponges in arid and semi-arid regions of western gulf slope drainages.

Harlan T. Nichols and Timothy H. Bonner, Department of Biology, Texas State University, San Marcos, TX

Freshwater sponges (Spongillidae) are an integral part of freshwater ecosystems, functioning as a key component in nutrient cycling and serving as indicators of water quality and quantity, but are generally overlooked and under appreciated within the western Gulf Slope drainages of south central North America. The objectives of this study were to identify the dominant species, to document distribution and abundance, and to describe habitat associations of freshwater sponges within streams of the Edwards Plateau and

Chihuahuan Desert bioregions. Initial results indicate that the dominant species within the study area is *Spongilla cenota*. To date, occurrence of *S. cenota* is confirmed in the Devils River (Rio Grande) and South Llano River (Colorado River). These are new, previously undocumented, accounts of this species within these rivers. We are in the process of confirming distribution within the upper Rio Grande and Pecos rivers. Our data indicate *Spongilla cenota* occurs among reaches with strong associations for cobble or limestone bedrock substrates, sluggish to moderate current velocities, and depths ranging from 0.20–2.5m.

The role of radio communications in the Big Bend

Julianne Braun, Terlingua Ranch, TX

The Big Bend area of southwest Texas is sparsely populated, remote from populous areas, mountainous, and with very limited roads covering a large area. Much of the area is not covered by cell phone service towers. In times of telephone service interruption, the causes of the problem are often difficult to locate and access for repairs. The arid climate contributes to such natural problems as brush fires. The baked dry soils combined with occasional heavy rains cause flooding to occur in many areas. The region is also subject to occasional high winds and tornadoes. The combination of limited telephone communications, access-limiting terrain, and hazardous conditions make radio communications of great importance to the area. Our mountainous terrain blocks direct radio communications for many locations, thus requiring the use of mountain top radio repeaters. In times of emergencies in remote locations and telephone service interruptions, radio communications provide the only means of much needed exchange of information.

The Christmas Mountains are home to a number of repeater systems used by the Brewster County Sheriff's Department, the Terlingua Fire and EMS, and the local amateur radio community. The amateur radio facilities are open for public use by any FCC licensed amateur radio operator. This amateur radio equipment owned and maintained by local amateur radio operators and the Big Bend Amateur Radio Club (BBARC), sometimes sited in locations which are very difficult to access, provides for emergency communications as well as dependable mobile to mobile and mobile to fixed station operation in our very rugged terrain. The amateur radio equipment also serves to rebroadcast SkyWarn messages originating from the Midland, Texas, office of the National Weather Service to local residents to enable us to avoid or prepare for some of the natural hazards. When emergencies do occur, amateur radio equipment is called into use by amateur radio operators who are part of the Amateur Radio Emergency Service (ARES), which is coordinated with the Brewster County Emergency Management Coordinator as governed by the Brewster County Emergency Services Plan. In short, the environment creates challenges that radio communications help the local population meet.

Desert soils in a global context

Michael Huston, Department of Biology, Texas State University, San Marcos, TX

Deserts are defined by low rainfall, which severely limits the size and abundance of the plant species that are able to survive. In the most extreme contrast with deserts, tropical rainforests are defined by high rainfall and are known for luxuriant plant growth and very high species diversity. However, few scientists realize that nutrient availability in most desert soils is actually much higher than in typical rainforest soils, which tend to be acidic and very low in essential plant nutrients. While rainfall is essential for plant growth, high levels of rainfall cause rapid breakdown of rock structure, chemical transformations of minerals, and the loss of most

soil nutrients through leaching. Consequently, soils in wet climates, as well as very old soils in any climate, are typically very acidic and extremely low in most plant nutrients. Scientists at the University of Missouri in the 1930s noticed that nutrients in prairie soils declined from the dry climate of eastern Colorado to the wetter climate of Missouri. Subsequently, W.A. Albrecht developed a general model of soil development and fertility across the full water gradient from extreme desert to rainforests and concluded that soils reached their maximum fertility, and plants their highest growth rates, under conditions where evapotranspiration is equal to precipitation. Under these conditions, plants have sufficient water for rapid growth, but most of the rain that falls is taken up by the plants, and thus unavailable to leach nutrients out of the soil. Most perennial plants in the Chihuahuan Desert are adapted to survive very dry conditions. However, the annual plants that come up from seed in years with more rainfall are able to take advantage of the high nutrient content of the soils, grow rapidly, and become very abundant in certain areas. Desert "blooms" are often characterized by large areas covered by near-monocultures of a relatively few species, such as bluebonnets or poppies. This pattern of dominance by a few abundant species is typically found where some species can grow rapidly to a relatively large size and crowd out smaller species. These conditions can occur on the nutrient-rich soils of deserts during years with abundant water.

The Shumla Caves peyote specimens: composition and possible uses

Martin Terry[1], Karen Steelman[2], Tom Guilderson[3] and Marvin Rowe[4], [1]Department of Biology, Sul Ross State University, Alpine, TX; [2]Department of Chemistry, University of Central Arkansas, Conway, AR; [3]Center for Accelerator Mass Spectrometry, Lawrence Livermore National Laboratory, Livermore, CA; [4]Department of Chemistry, Texas A&M University, College Station, TX

The Shumla Caves peyote specimens, which we previously radiocarbon-dated to a calibrated age of about 6,000 calendar years, are not desiccated peyote crowns, but artifacts that resemble peyote buttons. We compared stable isotope ratios of the Shumla Caves specimens with those of modern peyote cactus specimens, and δ13C values indicated that the composition of the Shumla Caves specimens is not pure peyote tissue, but rather a mixture of peyote (which, like most cacti, exhibits Crassulacean acid metabolism) and some other plant species that utilizes C3 metabolism. While any inference as to the nature of the use(s) of the Shumla Caves peyote specimens in the Archaic culture that produced them is inherently speculative, there are two characterizations that merit particular consideration: (1) religious ceremonial artifacts and (2) examples of an oral pharmaceutical formulation (these not being mutually exclusive). Small flecks of yellow pigment on the surface of one of the specimens suggest a possible ceremonial use, comparable to a known modern use by the Huichol people in Mexico. A published quantitative analytical finding of a 2% mescaline concentration in the Shumla Caves specimens suggests that these objects could have been created as "tablets" for oral administration – for the psychoactive effects of mescaline and/or for therapeutic indications.

An annotated vascular flora of The Nature Conservancy Davis Mountains Preserve, Jeff Davis County, Texas

Jeffrey J. Keeling, Department of Biology, Sul Ross State University, Alpine, TX

The Nature Conservancy's Davis Mountains Preserve (DMP) is located 40 km (25 mi) north of Fort Davis, Texas, in the northeastern region of the Chihuahuan Desert. The Davis Mountains are the largest single range in the trans-Pecos Texas volcanic field, spanning from 1524 to 2560 m (5000–8400 ft) in elevation and were part of a continental volcanic arc active in Texas between 48 and 31 Ma. The cool-temperate region receives an annual

precipitation between 28 and 57 cm (11–22 in) with the majority occurring during the late summer monsoonal months of June through September. This "sky island" ecosystem caters to the requirements that are needed to accommodate a wide range of vegetation patterns, endemism, and unique biodiversity. Forests composed of pinyon pine, juniper, and mixed conifer species dominate the elevations between 1747 and 2469 m (5700–8100 ft), while Chihuahuan Desert grasslands dominate the lower elevations. Dominant species of the forests include *Juniperus deppeana*, *Quercus grisea*, *Q. gravesii*, *Q. hypoleucoides*, *Pinus cembroides*, *P. ponderosa*, *and P. strobiformis*. The current study began in May of 2011 and aims to catalogue the vascular flora of the 13,000 hectares (32,000 acres) of Nature Conservancy property south of Highway 118 and directly surrounding Mount Livermore. Many sampling areas were selected according to their intricacy of topography resulting in likely unique, but unvisited, microhabitats such as deep, sinuous canyons and the tops of higher peaks. The results of previous botanical investigations are presented, as well as biogeographic relationships of the flora. The best-represented families are Asteraceae (92 spp., 16.9 % of the total flora), Poaceae (86 spp., 15.8% of the total flora), and Fabaceae (28 spp., 5.1% of the total flora).

Predicting sky island forest vulnerability to climate change: fine scale climate variability, drought tolerance, and fire response

Dylan W. Schwilk, Russell Lackey and Maria Gaetani, Department of Biological Sciences, Texas Tech University, Lubbock, TX

The sky island forests of the southwestern United States constitute one of the most diverse temperate forest ecosystems in the world. U.S. National Climate Assessments project that this region will face a hotter climate in the future with significant drying particularly in spring. Simple models of plant response to warming climates predict vegetation moving to cooler and wetter locations (“marching upslope”). However, the mechanisms explaining species-specific responses to changes in temperature and water availability are much more complex. Nighttime low and daytime high temperatures may show contrasting elevational patterns, and water availability does not uniformly increase with elevation. We aim to 1) identify the key functional traits influencing contemporary distributions and environmental affinities of keystone forest tree species (oaks, pines and junipers) in the northern Sierra Madre Oriental in western Texas, including the Guadalupe Mountains, the Davis Mountains, and the Chisos Mountains; 2) collect micro-climate and soil moisture measurements and use these to conduct fine-scale climate downscaling (to 3 m DEM) across three replicated mountain ranges; and thereby 3) predict how species and trait distributions might shift under future warmer and drier climates. This work is ongoing, but thus far we have investigated fire response and drought tolerance in multiple oak species and found that relative investment in bark changes with tree age and with fire regime. Dry site specialists such as *Quercus grisea* invest early in thick bark and decrease investment as they age. In contrast, *Q. hypoleucoides* has thin bark in young stems and it accelerates investment over time resulting in among the thickest bark when mature. These fire survival strategies are associated with water use: the late investing strategy is associated with greater xylem susceptibility to drought. Increasing fire frequency and increasing precipitation variability may cause dramatic shifts in species composition as the early-investing drought-tolerant species are favored.

An analysis of the distribution and diversity of Thaumarchaeota within the springs and soils of the northwestern Chihuahuan Desert

Laura Tang and Jackie Denson, Department of Biology, Sul Ross State University, Alpine, TX

Archaea are considered to possess ancestral forms of replication, transcription, and translation analogous to the more complex processes found in the eukaryotic cell. The domain was branched into two major lineages, Euryarchaeota and Crenarchaeota, through 16S rRNA analyses. Evidence accumulated with the discovery of ammonia oxidizing archaea and indicated that the archaeal phylogeny includes more than two major lineages. A third phylum called Thaumarchaeota was introduced and shown to branch off before the separation of Euryarchaeota and Crenarchaeota. The recent discovery of the widespread distribution of ammonia oxidation by mesophilic Thaumarchaeaota in marine and terrestrial environments signifies their importance in the global nitrogen cycle. Despite their significance, very little is known about their contribution to nitrification, especially in desert soils. This study will analyze the prevalence of ammonia oxidizing bacteria (AOB) and ammonia oxidizing archaea (AOA) from locations chosen based on unique microclimates within the Chihuahuan Desert Research Institute property, Big Bend National Park, and Big Bend State Ranch Park. Total DNA was extracted from soil samples and universal primer set combinations (Bacteria 27F, 1407R; Archaea A8F, A1041R) were utilized to amplify 16S rRNA genes. These amplicons were subsequently cloned, sequenced, and phylogenetically analyzed to gain a better understanding of both their distribution and diversity within the Chihuahuan Desert. Relative quantification of AOB and AOA within unique microniches were compared utilizing real time quantitative PCR targeting the amoA gene. This survey provides an understanding of whether the dominant ammonia oxidizers are bacteria or archaea in desert soils and selected springs of this region.

Use of plant species as predictors of insect community composition

Virginia Brown and Michael Huston, Department of Biology, Texas State University, San Marcos, TX

Food availability is one of the factors that determines the abundance and types of animals found in a given habitat. A literature review is being conducted to determine what moth species are known to consume plant species that inhabit the Christmas Mountains, located in the Chihuahuan Desert. We expect that this review will help predict what species of moths occur in the Christmas Mountains. Two locations have been chosen in the Christmas Mountains to serve as sampling sites for nocturnal Lepidoptera. Using a UV light trap, moths and other nocturnal insects have been sampled from these two sites bi-monthly for an hour and a half between the full moon and the new moon lunar phases. Samples are sorted to morphospecies to be cross-referenced with the list of potential moth species. Species that have been identified include the yucca moth and the mesquite looper, which are thought to be representatives of the immediate habitat around the UV traps. We also captured numerous white-lined sphinx moths, which are long distance flyers and might be representative of the productivity of the habitat along the Rio Grande. Other than these few species that have been identified, there has been little overlap between the physical surveys and the species list compiled from the literature review. This indicates that there is a strong need for further research on the food habits and the host plants of nocturnal Lepidoptera in this region of the Chihuahuan Desert.

A re-examination and morphological comparison of the Helminthoglyptid fossil land snails *Helix* and *Lysinoe* (Gastropoda: Pulmonata) from Presidio and Brewster counties of West Texas

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The presence of fossil land snails from the Eocene age Colmena and Chambers tuffs of the Vieja Group, Presidio County, Texas, was first noted by the vertebrate paleontologist J.A. Wilson in 1968. Pampe (1974), in publishing the first taxonomic listing of fossil invertebrates from the trans-Pecos region, assigned several specimens from this series to fossil taxa known from localities outside of Texas. Among these were *Oreohelix grangeri* from the lower Eocene of Wyoming and *Helix leidyi* from the Eocene of Nebraska. Roth (1984) in his description of a new pulmonate fossil land snail, *Lysinoe breedlovei*, re-assigned the Texas material of *Oreohelix grangeri* and *Helix leidyi* to this new taxon; he also assigned the "*Helix*" sp. specimen from the Middle Oligocene of northeastern Mexico to this new species. As part of this current study, the paratypic series of *Lysinoe breedlovei* was examined using X-ray Computed Tomography. X-ray CT scanning allows for a non-invasive examination of the internal morphology that was not available to previous researchers. Using the computer software program IMAGEJ, linear and angular measurements were obtained for multiple characteristics. Results from initial analysis of morphometric characteristics of the paratypic series of *L. breedlovei* do not support the assignment of the *Oreohelix grangeri* nor the "*Helix*" sp. material to this new species. Due to this significant variation in morphology and geological age within the paratypic series of *L. breedlovei*, a complete re-examination of all fossil Helminthoglyptid material from Presidio and Brewster counties in west Texas appears warranted. Analysis using multiple techniques will determine the degree and taxonomic significance of variation within this series of fossil land snails. Recently collected material from the Alamo de Cesario Creek area (Dalquest Desert Research Site) is currently being acquired for examination. Specimens from the Indio Mountains in Hudspeth County, the O-2 Ranch in Brewster County, and the Rancho Gaitan just northwest of Ojinaga in Chihuahua, Mexico, will also be examined. Results of this study should provide a clarification as to the taxonomic assignment of all examined specimens to either *Lysinoe* or *Helix*.

Regional comparison of moths in Texas

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The variation in rainfall across Texas creates an ideal study area to compare the effects of rainfall on populations of plants and animals. While primary production in terrestrial habitats is expected to respond to differences in rainfall, the biomass of the populations that feed on plant tissues could also be a useful tool in comparing regions. In this study, the biomass of moths (and other night flying insects) is being compared in two different regions of Texas. The locations sampled were Freeman Ranch, Hays County, Texas (average annual rainfall 94 cm (37 in)) and the Christmas Mountains, Brewster County, Texas (average annual rainfall 43 cm (17 in)). The Chihuahuan Desert habitat (Christmas Mountains) would generally be expected to have lower primary production, and therefore less moth biomass than the Central Texas habitat (Freeman Ranch). UV light traps were used to determine the overall biomass of moths in two different habitats at each of the two sites. Insects were collected beginning 30 minutes after sunset during the new moon for 1.5 hours at both locations. The Freeman location was sampled at least monthly, and the Christmas Mountains location was sampled approximately every 2 months. Total biomass was recorded and compared at each site. Weather data were obtained from Weather Underground and the National Oceanic and Atmospheric Administration and temperatures were recorded for each sample period. Preliminary results indicate that biomass was higher at the Christmas Mountains than at Freeman Ranch for most months in which simultaneous sampling occurred.

Unusual weather patterns in both areas may have affected the results. More research and sampling is needed to determine if moths can be an indicator of the overall primary production in these Texas regions.

Status of the Lucifer hummingbird in West Texas – a banding case study

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The Lucifer hummingbird is a desert-adapted species that barely enters the United States in the Big Bend area of west Texas, southwestern New Mexico and southeastern Arizona. Banding data are presented for 410 Lucifer hummingbirds that were captured and banded between August of 2008 and October of 2012. These data were collected as part of a larger project to determine the overall status and distribution of the hummingbirds of the trans-Pecos region. For the project as a whole, fifteen species of hummingbirds and 11,592 individual birds have been banded at twelve different study sites. The age/sex ratios of banded Lucifer hummingbirds were 144 adult males, 136 adult females, 90 juvenile males, and 39 juvenile females. Also included in the database are 397 recaptures of previously banded birds represented by 154 different individuals (37.6% of the total birds banded). Seventy-nine individuals (51.3%) were recaptured only once, while individuals recaptured multiple times are led by one bird recaptured eleven times, two birds twelve times and one bird fourteen times. One adult female initially banded in August of 2008 (as an adult female) was recaptured in May of 2012 and is now five years old. Both banded and recapture totals were highest in August, which coincides with the peak of fall migration (peak abundance) for most other western hummingbird species. Other data presented include the number of juvenile birds captured by year (including the effects of the 2011 drought on reproductive success), a comparison of Lucifer vs. Black-chinned hummingbird captures at a single sampling site, and a comparison of Lucifer hummingbird captures in two different habitat types (lower desert vs. montane woodlands). Finally, complete morphometric data are presented for this little known, little studied Chihuahuan Desert borderlands species.

Nutria (*Myocastor coypus*) in Big Bend National Park: a non-native species in desert wetlands

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Nutria (*Myocastor coypus*) are large, semi-aquatic rodents first introduced into the United States from South America as a fur resource during the 1890s. Nutria were first reported at Rio Grande Village, Big Bend National Park, in 1993. During 2004 and 2005, more than 30 locations of nutria activity were documented along a 16 km (10 mi) section of the Rio Grande from 7.6 km (4.7 mi) upstream of Rio Grande Village to Boquillas Canyon including the Rio Grande Village beaver pond. Seventeen nutria were captured, marked, and released. Using the Schnabel and Chapman methods, 38–74 nutria were estimated to inhabit the Rio Grande Village area. Stomach contents (n = 14) contained common reed (*Phragmites australis*), water pennywort (*Hydrocotyle umbellata*), giant reed (*Arundo donax*), spikerush (*Eleocharis caribaea*), bermudagrass (*Cynodon dactylon*), water hyssop (*Bacopa monnieri*), foxtail (*Alopecurus* sp.), and flatsedge (*Cyperus* sp.).

Effects of dry versus wet winters on the size and species diversity of herbaceous plants in a man-made landscape

Matthew Haverland and Michael Huston, Department of Biology, Texas State University

Inter-annual variation in rainfall is very high in semi-arid and arid environments, and has dramatic effects on the growth and diversity of plants, particularly annuals. Our study focuses on the effects of a wet versus a dry winter on the stature and diversity of early spring annual and perennial plants in a single location, a runoff-storage basin on the campus of Texas State University in San Marcos. Following the extreme summer drought of 2011, the winter of 2011–2012 was unusually wet in San Marcos, while the wet summer of 2012 was followed by a very dry winter. In both years, we sampled vegetation in early March, which had regrown after mowing in early October. Overall, the average stature (weighted maximum height) of the plants in plots that were sampled in each year decreased from 31.45 cm in 2012 to 15.66 cm in 2013. In 2012 we found a total of 36 species in 46 plots sampled, while in 2013 we found 47 species in 75 plots. The average number of species per plot in 2012 was 6.22 (min: 2, max: 12) and in 2013 was 5.87 (min: 3, max: 12). The relationship between average maximum height and a composite diversity index (Inverse Simpson's) was positive in 2013 (R^2=0.31) while there was no relationship in 2012 (R^2<0.001). Various statistical techniques are still being considered to create a composite data set and test potential predictor variables. Results from this ongoing study will be compared to responses of the spatial patterns in size and diversity of desert annuals that we will be monitoring during future research in and around the Christmas Mountains.

Variation in plant mortality from the 2011 drought and freeze along an elevational transect

W. Grady Terry and Michael Huston, Department of Biology, Texas State University

Across the state of Texas, the "exceptional drought" of 2011 is estimated to have killed about 10% of all trees. In the Chihuahuan Desert of the Big Bend region, the mortality of many typical desert species was apparently much higher. We sampled woody and succulent species in nine 30 x 30 m (100 x 100 ft) plots along a 300 m (1000 ft) elevational gradient from along Ben's Hole Creek on the west side of the Christmas Mountains. We mapped the locations of the most abundant woody and succulent species in 10 x 10 m (30 x 30 ft) subplots of each plot, recorded status (living, dead, flowering) or estimated the proportion of an individual that was dead, and measured the maximum height of each individual. The proportion of mortality in individual species varied across the gradient, with species such as mesquite (*Prosopis glandulosa*) having higher mortality at low elevations, and species such as prickly pear (*Opuntia engelmannii*) having higher mortality at higher elevations. Several of the species (prickly pear, mesquite and beaked yucca (*Yucca thompsoniana*)), were distributed across the entire gradient. Plants such as Apache plume (*Fallugia paradoxa*) and sotol (*Dasylirion leiophyllum*) were only found in the higher elevated plots while species such as lechuguilla (*Agave lechuguilla*) and tasajillo (*Opuntia leptocaulis*) were found in lower plots.

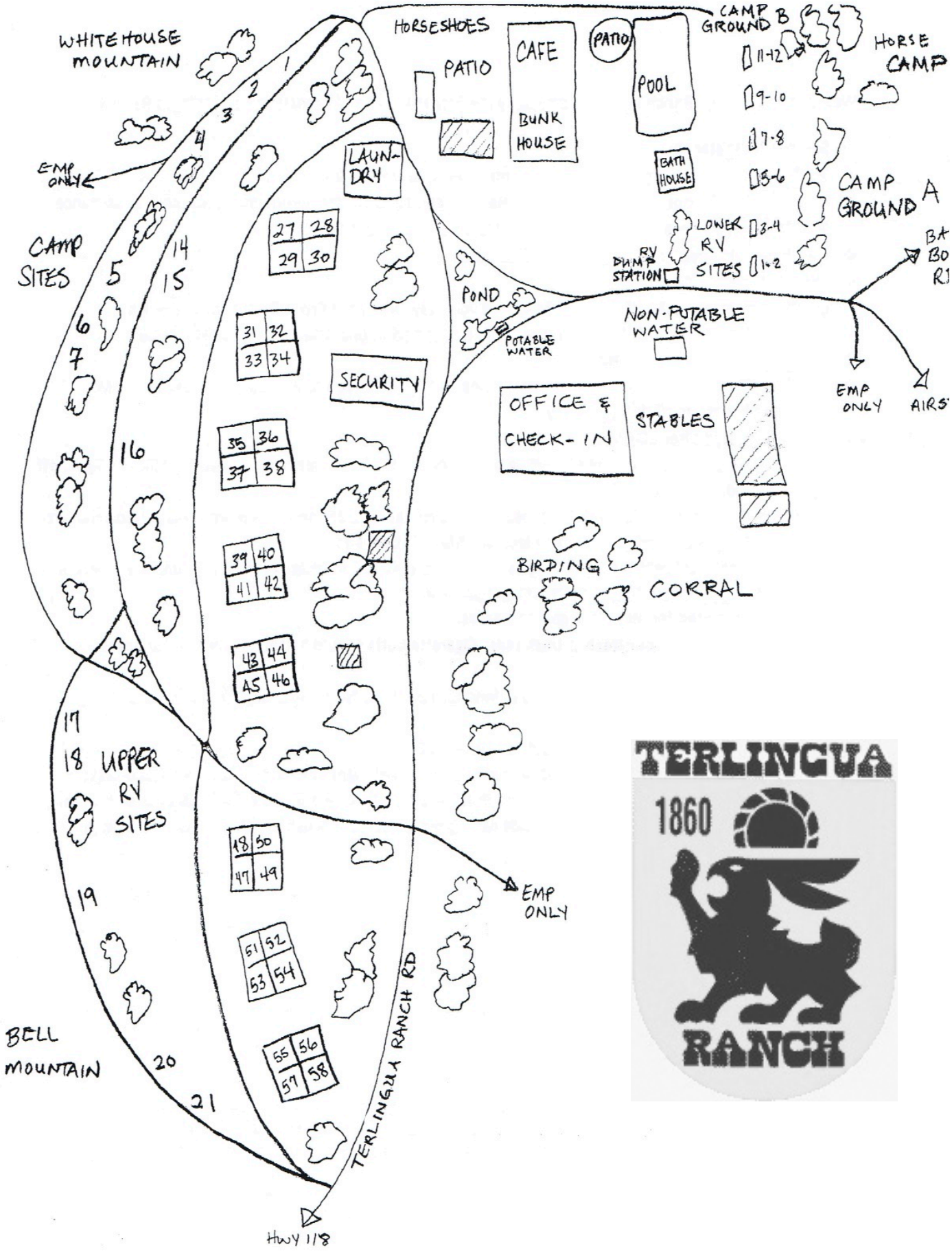
Welcome to Terlingua Ranch Lodge

16000 Terlingua Ranch Road
P.O. Box 638
Terlingua Ranch, TX 79852
(432) 371-3146

www.terlinguaranch.com

Office open daily 9:00 am to 5:00 pm

- **Check-in** time is 3:00 pm. If you need additional 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 6:30 am to 9:00 pm Monday through Saturday and from 6:30 am to 6:00 pm on Sunday (hours are extended for holidays and hunting season)
- **Security and Assistance** – for after-hours emergencies, please contact Security in the Security house located across the parking lot from the main office or phone (432) 371-2960. The **911** phone is located on the patio next to the pool; you may also make credit card or phone card calls.
- **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 10:00 am to 10:00 pm.
- **Water** is scarce – please conserve.
- **Burn bans** may be in effect while you are here. Campfires are limited to existing fire rings. No charcoal grilles, only propane allowed. Please see the Front Desk for information regarding burn bans.
- **Smoking** is allowed outdoors only. Please dispose of cigarette butts in butt cans located throughout the Lodge.
- **Christmas Mountains** access permits are available at the Front Desk.
- Please obey posted **speed limits**.
- Please respect **No Trespassing** and **No Hunting** signs throughout the ranch.


WHITEHOUSE MOUNTAIN
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1-2
BATH HOUSE
CAMP GROUND A
LOWER RV SITES
RV DUMP STATION
EMP ONLY
LAUN-DRY
CAMP SITES
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Terlingua Ranch Headquarters

May 19th–21st, 2014