

*Caesar
Kleberg*
Wildlife Research Institute



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Current Research 2014–2015

This year's cover features a photograph of partridge pea, a native, annual legume that is especially common on sandy rangelands of South Texas in wet years. Partridge pea is a valuable food plant for bobwhites and provides habitat to a wide variety of insects. This early successional plant is also of interest for seed source development by *South Texas Natives* for use in wildlife habitat restoration on sandy soils (*South Texas Natives* and *Texas Native Seeds* are the only projects of their kind in Texas that have produced certified native seeds for habitat restoration).

Editor Alan M. Fedynich, Ph.D.

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December 2015

Report of *Current Research*

September 1, 2014 to August 31, 2015

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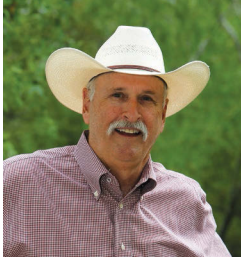
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FOREWORD



This year, my personal letter to you will be focused on the passing of a South Texas giant. It was a man for whom my endowed position was named.

Born in 1918, Leroy G. Denman, Jr. passed away on August 29th, 2015, leaving a legacy of influential leadership in his wake. His family history is an amazing story of service to others, a passion for what they believed in and a ranching and conservation ethic. My namesake will be referred to “Leroy” throughout this essay, to avoid confusion.

Leroy’s grandfather, Leroy Gilbert Denman, was born in Guadalupe County, Texas in 1855. From a simple farm life growing up, his grandfather went to the University of Virginia to study law. Upon graduation, he returned to Texas in 1880, practicing law for 2 years in New Braunfels before moving to San Antonio. He practiced law there and in 1894, was appointed to the Texas Supreme Court as Associate Justice by Gov. Jim Hogg. He resigned from the Bench in 1894 and practiced law in San Antonio the rest of his life. In the early 1900s, through a bank repossession, he acquired a 54,829-acre ranch called the St. Charles Ranch on the Texas coast. Leroy’s grandfather passed away in 1916.

Leroy’s father, Leroy Denman, Sr., also became a noted lawyer in San Antonio. In the 1920s, his father became counsel to King Ranch until his death in 1950. He inherited the St. Charles Ranch and purchased a ranch called the Powderhorn in 1936, which in its heyday included some 42,000 acres. In 1937, with funds from the sale of migratory bird stamps, the federal government purchased the St. Charles Ranch to create the *Aransas National Wildlife Refuge* as we know it today. In 1946, Leroy’s father served as a founding Trustee of the Caesar Kleberg Foundation for Wildlife Conservation along with visionary Robert J. Kleberg, Jr., President of King Ranch, and Dr. Ernest Poteet, President of what was then, Texas A&I University.

Leroy was raised in San Antonio. Leroy attended the University of Texas for both his undergraduate and law degrees. Following graduation in 1939, he first joined his father in the law firm of Denman, Franklin, and Denman. In 1942, he was recruited by the War Department to serve at the American Embassy in Guatemala and Argentina and for a time, in Washington D.C. In 1946, he rejoined his father in the prestigious

law firm, and practiced there until it closed in 2010. He served as legal counsel to King Ranch for 50 years from 1939–1988, and served as the first non-family Chairman of the Board of King Ranch from 1990–1995.

The unspoiled Powderhorn Ranch, which Leroy protected from 1936 until 2000, eventually became a conservation treasure in 2014 when it was purchased by several NGO’s. They created the *Powderhorn State Park and Wildlife Management Area* that is now in the public domain and owned by Texas Parks and Wildlife Department. Thus, the Denman family had a hand in preserving the 2 largest, undisturbed wildlife reserves on the upper Texas coast.

But, from where I sit, Leroy’s service as Trustee of the Caesar Kleberg Foundation for Wildlife Conservation from 1950 to 2013, over 63 years, was the family’s greatest contribution. I am grateful to have personally known Leroy from 1996 until his passing. The Denman legacy is remarkable, and I am humbled and proud to hold the title of “*The Leroy G. Denman, Jr. Endowed Director of Wildlife Research.*”

A handwritten signature in black ink that reads "Fred C. Bryant". The script is fluid and cursive.

Fred C. Bryant

*Leroy G. Denman, Jr. Endowed
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We acknowledge the donors of these student scholarships and fellowships on this special page.

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WHITE-TAILED DEER

The Comanche-Faith Deer Study Project

Charles A. DeYoung, Timothy E. Fulbright, David G. Hewitt, Kim N. Echols, Don A. Draeger, Blaise A. Korzekwa, Lindsey M. Phillips, Lindsay D. Roberts, John H. Clark, Emily H. Belser, Onalise R. Hill, and Ashley A. Wilson

The Comanche-Faith Project is named after the 2 ranches in Dimmit County, Texas where the study is replicated. The overall objective of the project is to determine the best combination of white-tailed deer density and supplemental feed while maintaining the native habitat. On each ranch, we are using 6 high-fenced enclosures of 200 acres each. The enclosures were constructed in 2003 and the first phase began in 2004.

Phase II began in April 2013 using the same 6 enclosures on each ranch. During this phase, enclosures receive treatments on each ranch as outlined in the table below. Numerous projects are being conducted within the overall experimental design. Some projects use all 12 enclosures while others use a subset.

Cooperative funding provided by the Comanche Ranch, T. Dan Friedkin, Faith Ranch, and Stedman West Foundation. Additional student support was provided by the various scholarships and named endowments listed on page 3 of this publication.

Treatments in enclosures on EACH of the Comanche and Faith ranches.

	Encl. 1	Encl. 2	Encl. 3	Encl. 4	Encl. 5	Encl. 6
No. of Deer	20	40	60	60	80	0
Actual Acres per Deer	10	5	3.33	3.33	2.5	-
Acres per Deer Adjusted for 33% Count	30	15	10	10	7.5	-
Water and Feeder Sites	1	1	1	3	4	1
Deer per Feeder	20	40	60	20	20	0

Precipitation May Mask Long-Term Effects of Deer Densities on Forb Communities

Lindsay D. Roberts, Timothy E. Fulbright, David G. Hewitt, Charles A. DeYoung, Kim N. Echols, and Don A. Draeger

Deer diets consist largely of forbs when available, but oftentimes there are few forbs available in a semi-arid environment. Our objective is to determine the maximum number of deer that can be supported in southwest Texas without altering forb and grass community dynamics when supplemental feed is provided.

In each enclosure, we harvested forbs and grasses in paired caged and uncaged plots each March and May during 2014–2015 to determine the effects of varying deer densities on herbaceous standing crop. During June 2013–2015, canopy cover of herbaceous vegetation was estimated using 9.8 x 19.7 inch frames. In addition, we monitored the presence of 2 palatable perennial forbs (low menodora and blackfoot daisy) monthly during 2014–2015.

Our preliminary findings showed that the standing crop of palatable and unpalatable forbs was similar between caged and uncaged plots and among deer densities. Additionally, the percentage cover of palatable and unpalatable forbs was similar across deer densities. These results contradict traditional predictions that unpalatable forbs will become dominant at higher deer densities as palatable forbs face greater foraging pressure. However, the probability of detecting previously marked blackfoot daisy declined with increasing deer densities. This finding indicates that observing marked plants over time may help to detect the effects of foraging on vegetation that are too subtle to be detected by traditional sampling methods.

In southwest Texas, precipitation may cause short-term changes in forb composition, possibly masking long-term effects. Information obtained in this study may help wildlife managers to more effectively prepare and manage for long-term lag effects that high white-tailed deer densities may have on forb community composition.

White-tailed Deer Behavior at Supplemental Feed Sites

Emily H. Belser, David G. Hewitt, Timothy E. Fulbright, Charles A. DeYoung, Kim N. Echols, and Don A. Draeger

Research from Phase I of the Comanche-Faith Project showed that dominance hierarchies limit accessibility to concentrated food resources for some age and sex groups of deer, particularly does and fawns. Multiple feeders within selected enclosures during the current phase of the study may provide more opportunities for less dominant deer to access feed than in enclosures with only a single feeder.

We will determine the proportion of each deer's diet composed of pelleted feed using stable isotope ratios in the pelleted feed and in hair and blood samples taken several times a year from individual deer. Additionally, we will assess the aggressive behaviors of individual deer by using video trail cameras placed at feeders in enclosures with 20 deer per 1 feeder, 60 deer per 1 feeder, and 60 deer per 3 feeders. Videos from 2-week periods in December 2014 and March, August, and December 2015 will be analyzed for aggressive interactions by deer to determine each individually tagged deer's place in the social hierarchy. Stable isotope samples will be matched up with dominant or subordinate deer identified by unique ear tag number and color combinations or antler characteristics.

Our goal is to compare individual feed consumption by dominant and subordinate deer to determine how behavior affects accessibility to concentrated food sources. Based on the results of this study, we hope to determine the optimum feeder density to ensure accessibility of supplemental feed for both dominant and subordinate deer.

Browse Species Responses to White-tailed Deer Densities

Justin P. Young, Timothy E. Fulbright, David G. Hewitt, Charles A. DeYoung, Kim N. Echols, and Don A. Draeger

Research on African shrub communities (similar to South Texas shrubland) suggests heavy browsing stimulates regrowth with higher nutritional quality than unbrowsed plants. Conversely, shrubs may allocate more resources to physical or chemical defenses such as thorns, branching, or secondary compounds. Our objective, based on the optimization hypothesis, is to test the prediction that there may be an optimum deer density at which regrowth and nutritional quality

of blackbrush acacia, twisted acacia, and spiny hackberry can be maintained through browsing.

Starting July 2014, we measured shoots and thorns annually on marked stems for 10 plants of each shrub species in enclosures with 0, 20, 40, and 60 deer per 200 acres and a single feeder to determine if these plants are producing compensatory growth. Each July and October, we will remove leaf and twig samples from 20 different plants of each shrub species for nutritional quality analysis. Measurements and samples will be taken within the white-tailed deer's browsing zone (20–40 inches from the ground) in each cardinal direction on the plants.

Traditionally, managers try to achieve deer densities that are low enough to avoid causing undesirable changes in the plant community. We are proposing a new approach: managing for deer densities that optimize browse quality and quantity. Taking this approach may enable managers to more efficiently use forage resources and to manage in a way that produces the highest quantity and quality forage for deer.

Pelleted Feed Consumption by White-tailed Deer in South Texas

Emily H. Belser, David G. Hewitt, Timothy E. Fulbright, Charles A. DeYoung, Kim N. Echols, and Don A. Draeger

Providing pelleted feed for white-tailed deer is a common management practice in South Texas. Research from Phase I of the Comanche-Faith Project showed that supplemental feed consumption declined over the summer. This decline coincides with the onset of prickly pear fruit and mesquite bean production.



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CKWRI researchers are examining the relationship between supplemental feed and naturally occurring plants.

However, no information exists regarding the relationship between mast disappearance and a decline in supplemental feed consumption.

Pelleted feed disappearance will be measured throughout the year. Summer feed disappearance will provide a contrast to the mast disappearance. In addition, measuring feed consumption will not only provide an estimate of per capita consumption, but comparing feed loss in the enclosures without deer could provide insight on feed loss to sources other than deer (i.e., waste and non-target species). Findings from this study will help us understand trends in diets of white-tailed deer in South Texas and encourage deer managers to manage for mesquite and prickly pear as they realize the potential value of these forages.

Effects of Deer Density on Overwinter Survival of White-tailed Deer Fawns

Justin P. Young, Timothy E. Fulbright, David G. Hewitt, Charles A. DeYoung, Kim N. Echols, and Don A. Draeger

Deer harvest recommendations made after autumn surveys are often based on the assumption that most fawns counted will be recruited into the population. However, considerable mortality of deer fawns in South Texas can occur during winter following weaning. Fawns may be pushed into lower quality portions of the habitat or they may have less opportunity to consume supplemental feed if increased deer density results in increased competition. Our objective is to determine the effects of increased deer and feeder densities on overwinter fawn nutrition and survival.

Fawns captured during November 2014 and 2015 in 200-acre research enclosures on the Comanche and Faith ranches will be fitted with Global Positioning Systems (GPS) collars and/or uniquely identifiable ear tags. The respective enclosures will have 40 deer and 1 feeder, 60 deer and 1 feeder, or 60 deer and 3 feeders. Trail cameras placed at feeders will be used in conjunction with the mark-resight method to estimate fawn survival and feeder use through March of each year. We will use relocation data from the GPS collars to examine the effects of deer density and feeder availability on habitat selection, movement rates, and temporal activity patterns of fawns.

Preliminary results suggest highest survival with low deer densities or high feeder densities, but 10% lower survival with high densities was observed even with supplemental feed. Managing for fawn recruitment is a key part of managing deer populations. Understanding how deer densities, feeder presence,



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There is concern that overwinter mortality of fawns may be higher than previously assumed for South Texas.

and available habitat affects overwinter fawn survival will provide managers with important information for ensuring optimum productivity and recruitment.

Summer Mast in White-tailed Deer Diets in South Texas

Emily H. Belser, David G. Hewitt, Timothy E. Fulbright, Charles A. DeYoung, Kim N. Echols, and Don A. Draeger

Summer diets of white-tailed deer in South Texas consist heavily of mesquite beans and prickly pear mast when available. However, the importance of these mast species is often overlooked.

To quantify the disappearance rate of mesquite beans and prickly pear mast, we monitored 5 mesquite trees and 5 prickly pear plants within each enclosure on both ranches during summer 2014. We marked 20 individual beans on each mesquite tree. Marked beans remaining on each mesquite and every fruit on each prickly pear were counted weekly to determine disappearance rates. We also measured canopy cover and counted the mast of 20 mesquites and 10 prickly pear plants randomly chosen in each enclosure to determine mast production. These methods will be repeated during the summers of 2015 and 2016.

Preliminary results show that mesquite mast disappeared sooner than prickly pear mast. Mast took longer to disappear in enclosures with high mast production than in enclosures with low production. Prickly pear and mesquite mast in each enclosure varied from 1,441 pounds up to 262,853 pounds. Although not equal in nutritive value, this production is equal to 29

to 5,245 50-pound bags of pelleted deer feed for every 200 acres. At \$10 per bag, mesquite and prickly pear mast could be valued from \$290 up to \$52,450 for every 200 acres, depending on production. Although deer are not the only wildlife consuming mast, these 2 native plants represent a vast food resource.

Seasonal and Environmental Influences on Water Consumption by White-tailed Deer

Jeffrey H. Brooks, Charles A. DeYoung, Timothy E. Fulbright, David G. Hewitt, Kim N. Echols, and Don A. Draeger

The highly variable rainfall and high temperatures that occur in South Texas have the potential to cause stress in deer if they are unable to maintain their water balance. Other factors that could influence water balance include body size, diet, and productive processes such as pregnancy and lactation. Our objective is to assess the impact that these factors have on water consumption by white-tailed deer.

Two 200-acre enclosures will be used on each ranch. One of the 2 enclosures has a target deer density of 60 deer and the other enclosure has a target deer density of 20 deer. Each enclosure has 1 feeder and 1 water site. Five uniquely tagged bucks and 5 uniquely tagged does of varying ages have been selected for observation in each enclosure. Water consumption by the marked deer will be recorded for a year using a tub of water on a scale monitored by video camera. The percentage of feed in the diet will be determined using stable isotope analysis from hair and blood samples. Water consumption will be compared to rainfall, temperature, Palmer Drought Severity Index, productive



© Jeffrey Brooks

Deer water consumption is being monitored using a scale and motion activated video camera.

processes, diet composition, and deer density to determine how these variables influence water consumption. The data gathered from this project will provide information on the importance of water for deer in a highly variable environment.

A Test of the Browsing Optimization Hypothesis

Lindsey M. Phillips, Timothy E. Fulbright, David G. Hewitt, Charles A. DeYoung, Kim N. Echols, and Don A. Draeger

The browsing optimization hypothesis states that with increasing grazing intensity, plant growth is increasingly stimulated until it reaches a point at which additional grazing causes declines in plant growth. Our first objective is to determine if increasing deer density results in increased canopy volume of browsed shrubs. Our second objective is to determine if there is a trade-off with increasing deer density wherein shrubs allocate resources to leaf and twig growth at the expense of mast (berries and pods) production.

Matching pairs of blackbrush acacia, granjeno, and guayacan were located within each enclosure in June 2013, and a plant from each pair was caged to protect it from deer browsing. From June 2013 until June 2018, detailed diameter measurements will be taken to estimate canopy volume for each plant. Mast production for each plant will also be estimated during April–July 2014–2018.

Based on our preliminary results, deer browsing, within the scope of this study, has a positive impact on the woody vegetation, causing the vegetation to allocate resources to new plant growth in an effort to compensate for the plant material that is being removed through intensive deer browsing. However, this is not causing a reduction in mast production as was originally predicted. Knowing the impacts of browsing at different deer densities can aid in the management of deer herds at optimal levels without causing negative impacts on the vegetation.

Does Increasing Deer and Feeder Density Reduce Woody Plants?

Lindsey M. Phillips, Timothy E. Fulbright, David G. Hewitt, Charles A. DeYoung, Kim N. Echols, and Don A. Draeger

The optimal white-tailed deer density for southwestern Texas is unclear. Exceeding the optimal deer density can result in over-utilization of the landscape,



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The amount of browse consumed is an indicator of whether deer densities are in line with the forage resources.

which can reduce palatable plants. Previous research has found the addition of supplemental feed does not appear to alter deer browsing habits that impact the vegetation. Our primary objective is to determine the highest number of white-tailed deer that can be supported without reducing palatable woody plants. Our secondary objective is to determine how increasing feeder density alters deer browsing habits and its impacts on the vegetation. We predict that increasing the density of feeders will allow a higher density of deer without negative impacts on woody plants from deer browsing.

Pre-established vegetation transects will be sampled each June during 2013–2018 to determine the effects of different deer and feeder densities on 2 vegetation characteristics. The characteristics monitored will be the following: (1) percentage of woody plant canopy cover, which will be sampled using the line intercept method and (2) density of 3 highly palatable plant species (orange zexmenia, awnless bushsunflower, and granjeno), which will be sampled using the belt transect method.

Based on our preliminary results, different deer densities and feeder densities had no influence on canopy cover of woody plants or density of orange zexmenia, awnless bushsunflower, and granjeno. Knowing the impacts of deer browsing on highly preferred vegetation species at different deer and feeder densities will help wildlife managers manage deer herds at optimal hunting levels without harming the habitat.

** End of In-Progress Comanche-Faith Project Abstracts **

Using DMP Pens to Increase Antler Size on High-Fenced Ranches

Stuart W. Stedman, Matthew T. Moore, and Charles A. DeYoung

Texas Parks and Wildlife Department issues Deer Management Permits (DMPs) for temporarily confining a buck with large antlers with up to 20 does for breeding purposes. The Faith Ranch is being used to evaluate how a population's average Boone and Crockett (B&C) score can be affected by use of DMPs.

The study is being conducted on the Faith Ranch in Dimmit County, Texas. Two adjacent, 1,100-acre treatment and control pastures separately surrounded by high fence were established in 2007. Both pastures are under identical supplemental feeding programs. Resident deer were removed from the treatment pasture prior to this study, and the pasture replenished with DMP deer. The control pasture has resident deer that were enclosed when the high fence was constructed. The DMP pasture is stocked with native deer from the property, and sires have averaged 182.875 B&C across 7 years of study.

Fawns are marked in the pastures each year with ear tags specific to year-of-birth. Each fall, marked bucks that are DMP offspring and marked bucks in the control pasture are captured using a helicopter. Antlers are measured for B&C score and compared within age classes.

In autumn 2014, there was no difference in average B&C score between treatment and control yearlings (1.5 years old). Also, treatment bucks compared to controls differed in average B&C inches as follows: 2.5-year-olds +1, 3.5-year-olds +30, 4.5-year-olds +3, 5.5-year-olds 0, 6.5-year-olds +26, and 7.5-year-olds +5. The study will continue for several years.

Cooperative funding provided by the Faith Ranch.

Cattle as a Deer Habitat Management Tool in North America: Where is it Successful?

Stacy L. Hines, Timothy E. Fulbright, J. Alfonso Ortega-Santos, David G. Hewitt, Thomas W. Boutton, and Alfonso Ortega-Sanchez, Jr.

The debate regarding whether cattle grazing has a positive or negative impact on deer is centuries old. In 1933, Aldo Leopold suggested cattle could be used as a habitat management tool in his book *Game*

Management. Since then, researchers have conducted studies regarding cattle and deer interactions throughout North America. However, results are conflicting, and there is no consensus on the effectiveness of cattle as a habitat management tool.

We are reviewing the literature on cattle-deer interactions to determine under what conditions cattle can be used as a tool for deer habitat management. Models will be constructed using data from the literature to examine (1) cattle and deer diet overlap, (2) cattle grazing effects on deer diets based on deer intake of vegetation, (3) cattle grazing effects on vegetation standing crop and recruitment, and (4) degree to which deer shift their use of areas to avoid cattle.

Currently, we have examined 2,685 peer-reviewed articles on cattle-deer interactions in North America. We used data from 102 of these that met the following: (1) cattle were the only livestock species, (2) there was no disturbance within 2 years of data collection, and (3) the study was conducted on non-cultivated lands.

With the synthesis and analysis of over 60 years of publications, we hope to have a robust conclusion about cattle and deer interactions. Our results will help guide sustainable management practices by determining under what conditions in North America cattle can be used as a habitat management tool for deer.

Cooperative funding provided by the East Foundation.

Environmental Variability: Effects on Deer Recruitment, Age Structure, and Harvest

Kory R. Gann, David G. Hewitt, Alfonso Ortega-Sanchez, Jr., Timothy E. Fulbright, J. Alfonso Ortega-Santos, Thomas W. Boutton, and Tyler A. Campbell

Environmental variability may affect recruitment of white-tailed deer in semiarid rangelands, thus influencing population age structure. Our objective is to determine how environmental variability influences productivity and age structure of deer populations on semiarid rangelands.

We captured 1,599 adult deer (1 or more years old) during 2011–2014 on 2 properties (one property along the Texas Gulf Coast and another 90 miles inland) where deer were not harvested or otherwise managed. Above average rainfall in spring and summer 2010 resulted in high fawn recruitment. As a result, yearling deer composed 15 to 17% of females and 20 to 26% of males captured on both properties in 2011. Drought during 2011–2013 resulted in decreased fawn

recruitment on the inland property, where yearling deer composed 1 to 7% of females and 1 to 9% of males captured from 2012–2014. The effects of drought on recruitment were less evident on the coastal property, where yearling deer were 8 to 12% of females and 10 to 25% of males captured from 2012–2014. Deer 6 years old or more composed 30 to 57% of the females and 16 to 43% of the males captured on both properties from 2011–2014, suggesting that survival of adults is high once they are recruited into these populations.

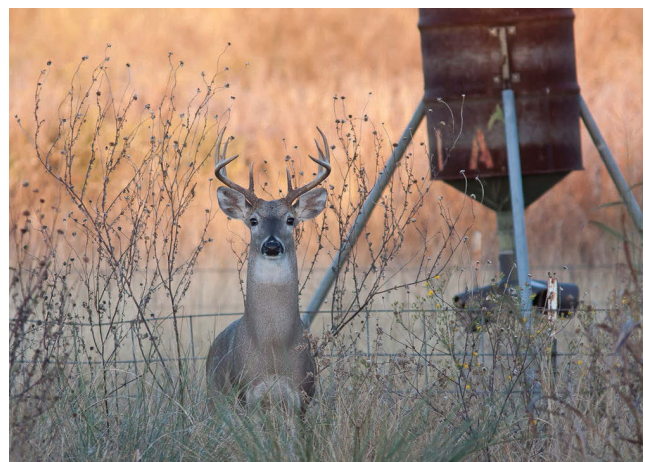
Recruitment of deer in western South Texas is limited by erratic precipitation, whereas recruitment is more stable in coastal populations. Frequent drought ensures that unmanaged populations in western South Texas rarely achieve high densities. Large numbers of older deer act to sustain the population through periods of low reproduction. Lowering adult survival through intense harvest may reduce the ability of these populations to persist at moderate densities.

Cooperative funding provided by the East Foundation.

Influence of Dietary Energy on Growth and Development of White-tailed Deer

Ryan L. Reitz, Donnie Frels, Justin A. Foster, David G. Hewitt, and Randy W. DeYoung

Dietary energy and protein influence body growth and antler development in white-tailed deer. The provision of supplemental feed is a common management technique in southern Texas, where recurring droughts affect forage availability. Most deer managers focus on protein supplementation, yet dietary energy may



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Protein supplements can have varying levels of usable energy, which can impact growth rates in deer.

be more limiting for white-tailed deer. We are studying the effects of dietary energy on body size and antler growth at the Donnie Harmel White-tailed Deer Research Facility in Kerr County, Texas.

We raised 2 cohorts of fawns on free-choice diets of low energy and standard energy pelleted rations post-weaning. Protein content of each diet was 16%, with similar vitamin and mineral content. We measured body weight and skeletal size of bucks and does at 1.5 years ($n = 178$) and 2.5 years old ($n = 66$).

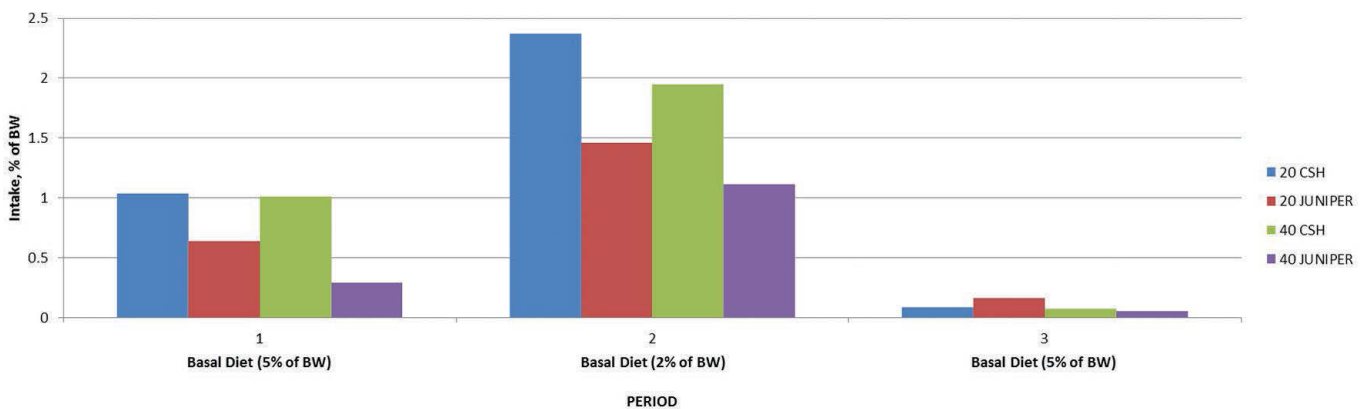
At 1.5 years, deer fed the standard ration were 17% heavier, and total body length was comparable to 2.5-year-old deer on the low-energy ration (53.8 inches and 53.3 inches, respectively). Gross Boone & Crockett scores of bucks on the standard ration were 23.2 inches and 26.6 inches larger than bucks on the low-energy ration at 1.5 and 2.5 years old, respectively. Deer on the low-energy ration consumed over 18% more feed, and thus more protein, than deer on the standard ration, yet had smaller body and antler sizes. The next phase of the study will determine if differences in body and antler size resulting from the low-energy diet carry-over into subsequent generations.

Cooperative funding provided by the Texas Parks and Wildlife Department.

Non-target Species Consumption of a Deer Supplement containing Ground Juniper

Jessica L. Glasscock, Travis Whitney, and David G. Hewitt

Game ranchers, landowners, wildlife managers, and hunters that feed wildlife often experience a high loss of supplemental feed because of non-target species. In some cases up to 40% of the feed is lost. The



Feral hogs only consumed 0.2% (Period 3) or 0.6% (Period 1) of their total body weight of a pelleted diet containing juniper when alternative food was readily available and less than 1.5% when the alternative food was significantly limited.

Note: CSH = cottonseed hulls

objective of this study is to produce a white-tailed deer supplement that would not be consumed by feral hogs.

Twenty-four feral hogs were assigned to 1 of 4 treatment diets during a 33-day feeding trial. The trial was composed of 3 periods in which hogs were fed basal diets (Ring Leader Pig Grower 18%) and treatment diets composed of 20% or 40% cottonseed hulls or ground juniper. To determine the effect of these treatments, hogs were fed treatment diets at 5% of total body weight (BW) for the duration of the trial and basal diets at 5% of their total BW during period 1 (days 0–17), 2% during period 2 (days 18–26), and 5% during period 3 (days 27–33).

Preliminary data show consumption of 40% and 20% juniper to be 0.3% and 0.6% of total BW during period 1, 1.1% and 1.5% during period 2, and 0.1% and 0.2% during period 3. Findings will be used to develop a field study to assess consumption of these diets by deer and feral hogs in the wild. Information obtained can be used to decrease economic loss when feeding supplements to white-tailed deer.

Cooperative funding provided by Texas A&M AgriLife Research.

Testing Additives to Improve the Palatability of Corn for White-tailed Deer

Darrion Crowley, Alexandra Lichtenberger, James C. Theis, Nicole A. Alonso, and David G. Hewitt

Wildlife biologists have many reasons to use corn as bait in white-tailed deer management and research. Camera-based census, treating deer with medications, and harvesting deer efficiently are some ways in which corn is used. The palatability of corn influences its

value as bait and, thus, products that increase palatability of corn would be beneficial.

The objective of this study is to determine if additives can influence deer choice of corn. We are testing the palatability of shelled corn, a powder additive mixed with the corn shortly before feeding, and an additive mixed with corn at the feed mill.

This study was conducted at the Albert and Margaret Alkek Ungulate Research Facility at Texas A&M University-Kingsville using 6 male and 6 female deer. For 30 minutes each morning for 7 days, deer were offered 3 containers, each containing one of the corn treatments. The weight of each type of corn eaten by each deer was recorded; video was recorded on days 1, 4, and 7 to document the deer's behavioral response to each treatment. Our findings will aid in producing corn bait that is highly palatable to deer.

Cooperative funding provided by Manna Pro Products, LLC.

Can Culling Bucks Lead to Genetic Change in Deer Populations on Large Acreages?

Don A. Draeger, T. Dan Friedkin, Charles A. DeYoung, Mitch A. Lockwood, Donnie Frels, Alan Cain, and Bronson K. Strickland

Deer breeders make genetic improvements in antler size by selectively breeding confined white-tailed deer, but data are limited on the effects of selective culling by hunters on ranches. We are conducting a long-term buck culling study on large acreages to determine results deer managers can expect.

Bucks are captured annually at random on 3 areas of the Comanche Ranch in Maverick County, Texas using a helicopter and net gun. Bucks are aged and measured for Boone and Crockett (B&C) score. Bucks meeting the culling criteria were sacrificed, and the meat donated to worthy users. Bucks not meeting culling criteria were released after a microchip was implanted. On one area, we culled yearlings with less than 6 points, 2-year-olds with less than 8 points, 3 and 4-year-olds with less than 9 points, and 5-year-olds and older with a gross B&C score less than 145. On another area, all yearlings and 2-year-olds were released and older deer culled by the same criteria as above. The third area served as a control and all bucks captured were released.

After 7 years of culling, we saw no response except the population in the intensive cull area had a divergent sex ratio and there were indications that antler size of



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CKWRI researchers are examining the long-term effects of culling as a management tool.

yearling bucks might be declining. We speculate this was because of environmental influences on late-born yearlings. Beginning in year 8 (2013), we ceased culling on all areas, but continued with captures to determine if there is a lag in the influence of culling.

After 9 years, 4,272 bucks have been captured, which included 1,533 recaptures. The number of culled bucks was 1,316. Our study will continue for 4 more years.

Cooperative funding provided by the Friedkin Conservation Fund.

Effects of the Thermal Environment on Deer Growth and Health during Summer

Nicole A. Alonso, David G. Hewitt, Randy W. DeYoung, Clayton D. Hilton, and Perry S. Barboza

White-tailed deer, like all mammals, must maintain body temperature. High summer temperatures in South Texas negatively influence the growth of deer, but the magnitude of those effects is largely unknown. This study, conducted with captive deer at the Albert and Margaret Alkek Ungulate Research Facility at Texas A&M University-Kingsville, will help determine the effect of high summer temperatures on growth and food consumption of fawns and yearlings.

To observe the effects of summer heat, we will randomly assign fawns to either an ambient temperature treatment or a treatment in which they can access a cooler environment. We will record food intake, growth rate, behavior, and indices of health. Additionally, we



© Randy DeYoung

High summer temperatures in South Texas likely have a negative influence on deer behavior and growth rates.

will fit yearling deer with rumen and body temperature monitors to help us understand relationships between food intake, water consumption, rumen temperature, and body temperature. We will use pedometers and video cameras to record each deer's activity and feeding patterns. During the second year, we will quantify the effect of eating and drinking on rumen temperature and dissipation of metabolic heat.

We hypothesize that the individuals with access to the cooled area will be able to dissipate digestive and metabolic heat more readily and, therefore, have higher intake rates, leading to higher growth rates and better health. Results from this study will help wildlife managers understand an important environmental constraint for deer in South Texas and will provide insight into habitat and water management projects that could help deer contend with summer heat.

Cooperative funding provided by a TAMUK University Research Award.

Effects of Selective Harvest on Male Mating Success and Strategies in White-tailed Deer

Masahiro Ohnishi, Randy W. DeYoung, Charles A. DeYoung, Don A. Draeger, David G. Hewitt, Bronson K. Strickland, Alan Cain, Mitch A. Lockwood, and Donnie Frels

Deer managers often practice culling. Conceptually, the bucks that remain are those that display above-average antler traits and pass on the desirable antler traits through reproduction. Although widely practiced, the effects of culling have not been documented

in real-world settings. Depending on the criteria and intensity of culling the practice may alter the sex ratio and age structure of the population, the distribution of mating success, and genetic variation.

Our goal is to define the effects of culling on male mating success in white-tailed deer from southern Texas. We established 3 study areas, 1 subject to intensive culling, 1 to moderate culling, and 1 as a control (no culling). Each autumn during 2006–2014, we captured deer using the helicopter and net-gun method. We estimated age, measured antler characteristics, and collected tissue samples for genetic analyses. Deer that did not meet culling criteria for their age class were sacrificed during 2006–2012.

We recorded 4,264 captures of 2,503 individual deer. We found that the culling treatments altered the sex ratio and male age structure. Currently, we are using genetic parentage techniques to evaluate the mating success of bucks in the 2 culling treatment populations and will compare the results to the control site. We will be able to determine if culling affects the distribution of male mating success.

The study will continue for an additional 2 years of capture. The resulting information should have important management implications for landowners and wildlife biologists who manage white-tailed deer.

Cooperative funding provided by the Comanche Ranch and Texas Parks and Wildlife Department.

Determining Dietary Overlap of Cattle, Nilgai, and White-tailed Deer

Stacy L. Hines, Timothy E. Fulbright, J. Alfonso Ortega-Santos, David G. Hewitt, Thomas W. Boutton, and Alfonso Ortega-Sanchez, Jr.

The degree of diet overlap among species could indicate competition for forage resources, which may lead to a reduction in profit for ranch managers. Stable isotope signatures of animal tissues can give researchers insight into an animal's diet during discrete time periods—it depends on how quickly the food resource is incorporated into the animal's tissues.

Our objectives are to gain insight into dietary overlap among cattle, deer, and nilgai by analyzing the stable isotope signatures of (1) fecal samples and (2) blood and hair samples collected during 2012–2015. Spring and autumn fecal samples provide information regarding forage consumption immediately following forage green-up, which we will compare to the winter

non-growing season. Blood and hair samples provide dietary information during 6 weeks of autumn, which is the only season in South Texas when forbs and grasses are concurrently producing ample forage.

Our preliminary results indicate (1) nilgai and deer diets have the highest probability of overlap, (2) cattle and nilgai diets do not overlap, and (3) cattle and deer diets do not overlap when ample grass is available (based on analysis of fecal samples collected during autumn 2012 to spring 2014). Our study was conducted under varying environmental conditions. Thus, our results will determine under what conditions the probability of dietary competition among cattle, deer, and nilgai increases in South Texas, thereby providing guidance to managers regarding adjustment of animal densities to minimize competition.

Cooperative funding provided by the East Foundation.

Foraging Ecology of Unmanaged Deer in Southern Texas

Kory R. Gann, David G. Hewitt, Alfonso Ortega-Sanchez, Jr., Timothy E. Fulbright, J. Alfonso Ortega-Santos, Thomas W. Boutton, and Tyler A. Campbell

The current trend for the intensive management of white-tailed deer in southern Texas makes deer populations not under some form of harvest or supplemental feed management uncommon. Unmanaged populations are important because they can provide baseline data on diets, body weight, body condition, and population parameters that allow researchers to determine the effects of current deer management practices.

We are studying the foraging ecology of unmanaged deer populations using stable isotopes. Stable isotopes are naturally occurring, non-radioactive forms of elements that are transferred along the food chain in predictable patterns. They can be used to reconstruct the diet of the animal. The stable isotopes of carbon in deer tissues and vegetation will be used to determine the proportion of C3 (shrubs and forbs) versus C4 plants (warm season grasses) and cacti consumed by individual deer.

We captured a total of 2,775 white-tailed deer during autumn 2011–2014 on 4 East Foundation properties where deer are not managed. We will use stable isotope ratios of deer tissue and vegetation to determine the proportion of C3 versus C4 plants and cacti in deer diets as related to deer age and sex, precipitation, cattle grazing intensity, and vegetation community.

Studying the stable isotope ratios in white-tailed deer tissues will provide information useful in assessing the impact of livestock grazing on deer use of warm season grasses and cacti, as well as addressing the importance of these forage items in deer diets on rangelands across southern Texas.

Cooperative funding provided by the East Foundation.

Antlers as a Model for Human Bone Injury and Disease

Brendan H. Lee, Zhechao C. Ruan, Abhirami Rajagopal, Philippe Campeau, Brian C. Dawson, Kim C. Worley, Randy W. DeYoung, and David G. Hewitt

Because antlers are made of bone-like tissue, knowledge of the processes and patterns of growth could have implications for the treatment of human bone disease or injuries. The overall process of antler growth is well-known, but technical advances that allow in-depth analysis of gene expression and function at the cellular level have only recently become available. Our objective is to learn what genes are expressed during different stages of antler growth and antler tissue types, and to relate the type and amount of gene expression to antler characteristics.

The gene expression profile requires a high-quality draft of the white-tailed deer genome to identify genes and coding regions. We accomplished this step during autumn 2014, based on sibling bucks from the Albert and Margaret Alkek Ungulate Research Facility at Texas A&M University-Kingsville. We then extracted and analyzed RNA in different portions of growing antler tissue to locate the candidate genes involved in antler growth and expression. Analyses are in progress, but preliminary data have revealed several promising leads, including different patterns of gene expression related to antler size and the overall regulation of the antler growth process.

Our findings may provide a basis for novel therapeutic treatments of human bone disease or injury. In addition, the high-quality genome will eventually be released to the public as an open-access resource that other researchers can use. Such advances will improve our understanding of antler growth patterns and provide insight into variation in physical traits among individuals and populations.

Cooperative funding provided by the Baylor College of Medicine.

Quail Outreach Program at the Caesar Kleberg Wildlife Research Institute

Fred C. Bryant, Eric D. Grahmann, Fidel Hernández, and Leonard A. Brennan

Texas supports some of the greatest quail populations remaining in the United States. The Caesar Kleberg Wildlife Research Institute began the Quail Outreach Program in August 2013 in an effort sustain bountiful populations of quail. The objectives of the program are to (1) provide science-based information on quail and their management to landowners, managers, and quail enthusiasts via free ranch visits and presentations and (2) expand our quail research.

Since August 2013, Dr. Eric Grahmann, our research scientist directing the program, has visited over 70 ranches encompassing more than half a million acres. These ranches occur from Matagorda to Crockett and from Gonzales to Starr counties. He has given over 50 quail management presentations across the state. We also provide a question-and-answer forum located on our quail website (<http://www.ckwri.tamuk.edu/research-programs/richard-m-kleberg-jr-center-for-quail-research/>) for any questions quail enthusiasts may have regarding wild quail ecology and management.

The quail research capacity of the Institute has increased by 5 projects over the past year. These projects are located on the northern and western peripheries of South Texas. Through this outreach and research program, we will be providing a service to keep South Texas the predominant destination for quail hunting and conservation.

Cooperative funding provided by San Antonio Quail Forever, South Texas Chapter of the Quail Coalition, Dr. Lacy Williams, Alfred C. Glassell, III, James Barrow, Ruth and Ed Austin Foundation, and the Richard M. Kleberg, Jr. Center for Quail Research.

Bobwhite Use of Coastal Bermudagrass Restored to Native Vegetation

Carter G. Crouch, Leonard A. Brennan, Eric D. Grahmann, Fidel Hernández, Robert H. Benson, and Jeffrey F. Kelly

Habitat loss and degradation from the conversion of native grassland to non-native grasses are threats to grassland birds, including bobwhites. Coastal bermudagrass is a commonly introduced grass planted widely

for cattle grazing in the southeastern United States. The objectives of this study are to document and compare patterns of bobwhite habitat use as well as abundance, density, and survival of bobwhites on a coastal bermudagrass pasture, a native shrubland community, and a pasture restored to bobwhite habitat that was previously a coastal bermudagrass pasture.

In 2014, we trapped 105 individual bobwhites in the restored site, 27 in the native shrubland, and 4 in the bermudagrass pasture. These results are not surprising, as the restored site had around 3.5 to 7.5 times more grass clumps suitable for nesting than the bermudagrass site and the native shrubland site. So far, 2015 has seen significantly more precipitation than 2014, and the bermudagrass site has seen a drastic increase in native and nonnative grass cover, as well as forbs. As of early June 2015, we have caught 30 bobwhites in the bermudagrass site, demonstrating the importance of multiple years of fieldwork.

This study reinforces the notion that bermudagrass provides poor habitat for bobwhites and that bermudagrass is detrimental to bobwhite populations. To our knowledge, this is the first study to actually quantify the effects of bermudagrass on bobwhite populations. It also demonstrates that bermudagrass pasture can be restored to quality bobwhite habitat.

Cooperative funding provided by San Christoval Ranch, South Texas Chapter of the Quail Coalition, and the Richard M. Kleberg, Jr. Center for Quail Research.

Montezuma Quail Occupancy and Habitat in the Edwards Plateau

Zachary J. Pearson, Eric D. Grahmann, Fidel Hernández, Robert Perez, and Joyce Moore

Montezuma quail historically inhabited nearly every county in the Edwards Plateau. They have since disappeared throughout most of this range likely because of more than a century of overgrazing. However, a remnant population still exists south of Rocksprings, Texas. Compared to Montezuma quail further west, little is known about the Edwards Plateau population including their distribution and habitat factors influencing their occupancy in this area.

Our objectives are to (1) refine the geographic range and (2) to define the macrohabitat and microhabitat suitability bounds of Montezuma quail in the Edwards Plateau. During March–August 2015 and

2016, we will be conducting call-back surveys at 60 survey points across 9 ranches located south and west of Rocksprings. These points span a range of conditions in terms of juniper coverage, slope, elevation, and terrain. At each call-back location, vegetation will be sampled during May and October. This study will provide valuable information to landowners and biologists hoping to manage this beautiful and secretive quail species in the Edwards Plateau.

Cooperative funding provided by the Texas Parks and Wildlife Department, 11 private ranches and landowner groups within the southern Edwards Plateau, South Texas Chapter of the Quail Coalition, and San Antonio Quail Forever.

Bobwhite Densities in Relation to Grazing Regimes in South Texas

Andrea Bruno, Leonard A. Brennan, Andrew N. Tri, Michael L. Morrison, and Eric D. Grahmann

Bobwhite populations in Texas are often managed on rangelands in conjunction with cattle operations. Researchers at the East Foundation and the Caesar Kleberg Wildlife Research Institute developed a large-scale monitoring project to assess the effect of different grazing regimes on bobwhite density and vegetation on an 18,000-acre pasture and 3 reference sites (areas where grazing is managed typical of a South Texas ranch) on East Foundation lands in Jim Hogg County, Texas. Our primary objectives are to (1) compare bobwhite population densities and (2) assess which vegetation parameters are correlated with bobwhite density pre- and post-grazing implementation and between different grazing regimes during December 2014–2017.

The pasture complex for this study is divided into 4 treatment areas (approximately 4,500 acres each) to represent the average size of a South Texas ranch. Grazing regimes include continuous and rotational, each divided into high (1 Animal Unit per 35 acres) and low (1 Animal Unit per 50 acres) stocking rates. We will estimate bobwhite density using line-transect distance sampling from a helicopter within the treatments and reference sites every December (treatment will begin December 2015). We will process survey data using Program Distance software. Vegetation surveys will focus on measurements of herbaceous cover, bare ground exposure, bunchgrass density, concealment, and forage utilization pre- and post-treatment and within each treatment and reference site

from October–November. The results from this study will provide a scientific basis for management decisions on Texas rangelands where cattle production and bobwhite conservation are integrated goals.

Cooperative funding provided by the East Foundation, South Texas Chapter of the Quail Coalition, C. C. “Charlie” Winn Endowed Chair for Quail Research, and Richard M. Kleberg, Jr. Center for Quail Research.

Translocation of Wild Bobwhites into the Rolling Plains of Texas

Michelle C. Downey, Dale Rollins, Fidel Hernández, and Eric D. Grahmann

Bobwhite populations have been declining throughout Texas even in areas with apparently sufficient habitat such as the Rolling Plains. Translocation of wild bobwhites has been used in an attempt to restore populations in other parts of the bobwhite’s range, but results have varied. This study will examine the efficacy of translocating wild-trapped bobwhites into recently depopulated habitat in the eastern Rolling Plains of Texas in an attempt to increase bobwhite population size. Survival, site fidelity, and reproduction of radio-marked translocated females will be measured. Translocation effectiveness will be evaluated based on population estimates derived from covey-call counts and helicopter surveys.

Two hundred and two and 207 wild bobwhites were translocated during March 2013 and 2014, respectively, from locations within the western Rolling Plains to 2 well-managed release sites (1,000 and 650 acres) in



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Graduate student Michelle Downey released bobwhites to re-establish populations on Rolling Plains ranches.

Stephens and Shackelford counties. Preliminary findings suggest that of the 186 translocated radio-marked hens, 35% survived to 6 months and 22% survived to 1 year. Seventy-four percent of translocated hens that entered the nesting season produced a nest, which resulted in 125 nests during the 2 years. On average, nest success was 46%, and hens nested at a rate of 1.1 nests per hen. Twenty-one (32%) and 7 (15%) translocated bobwhites dispersed greater than 1.25 miles from their release point during the summer of 2013 and 2014, respectively. Results from this project will guide future bobwhite restoration techniques aimed to increase population size.

Cooperative funding provided by the Rolling Plains Quail Research Foundation, Park Cities Chapter of the Quail Coalition, Cross Timbers Chapter of the Quail Coalition, South Texas Chapter of the Quail Coalition, and the Richard M. Kleberg, Jr. Center for Quail Research.

Thermal Environment and Vegetation in Habitat Selection by Scaled Quail

Holley N. Kline, Richard H. Sinclair, II, Timothy E. Fulbright, Fidel Hernández, Eric D. Grahmann, David B. Wester, and Leonard A. Brennan

Scaled quail in Arizona use grassland habitats, but the importance of grassland versus shrubland for the chestnut-bellied subspecies in South Texas is unclear. Additionally, high temperatures can fragment habitat for bobwhites, but the response of scaled quail to excessive heat is unknown. Our objective is to determine if scaled quail habitat use is negatively influenced

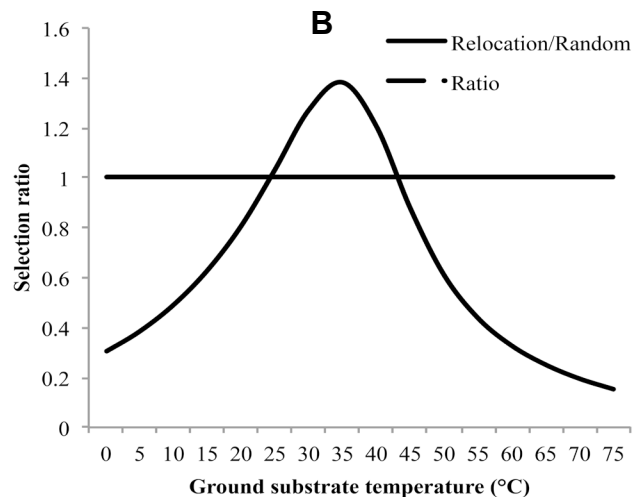
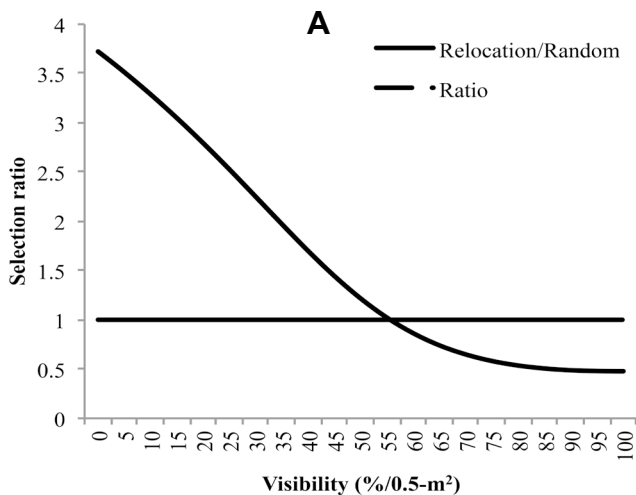
by increasing cover of non-native grass, decreasing woody canopy and vegetation structure, decreasing plant diversity, and increasing temperatures.

We radio-marked and relocated 126 scaled quail during April–August 2013 and 2014 on 5 ranches in La Salle County near Cotulla, Texas. Vegetation composition, vegetation structure, and black globe and soil temperatures were sampled at quail locations and random sites. Vegetation variables and temperatures were compared between used and random sites to determine variables important in habitat selection.

We compared 276 quail locations with paired random locations. Scaled quail used locations with less than 10% non-native grass cover, greater than 5% knifeleaf condalia cover, and sites with complex woody vegetation where visibility was limited to less than 57%. Scaled quail sought locations with more woody plant species than was generally available in the landscape during midday when loafing, but used locations with fewer woody plant species when foraging. Soil temperature was the best thermal predictor of scaled quail habitat, with birds avoiding locations over 106° F.

Conventional range management in Texas includes brush control and the planting of non-native grasses, both of which reduce habitat used by scaled quail. Our preliminary findings suggest that intact tracts of shrubland with minimal non-native grasses may be critical habitat for the scaled quail on South Texas rangelands.

Cooperative funding provided by the South Texas Chapter of the Quail Coalition, South Texas Charity Weekend, Inc., Hixon Ranch, San Antonio Chapter of the Quail Coalition, Meadows Professorship in Semi-Arid Ecology, and Houston Livestock Show and Rodeo.



Selection ratios of used versus available (A) percent visibility and (B) soil temperature. Both were the most important variables in site selection. Selection ratio values above 1 corresponded to values of the variable that were selected, those equal to 1 were neither selected nor avoided, and those below 1 were avoided.

Initial Nest Fate on Nest Concealment and Placement of Subsequent Bobwhite Nests

William L. Lutz, Jr., James P. Clark, Joshua D. Pearson, Eric D. Grahmann, Fidel Hernández, and Leonard A. Brennan

The bobwhite is an important gamebird throughout the South Texas region. Much is known about bobwhite nesting ecology. However, little is understood regarding how nest predators influence bobwhite nest selection and renesting behavior. The objective of our research study is to compare how the fate of an initial nest influences the renesting behavior of bobwhites (i.e., concealment, placement, and success of subsequent nests).

Our study is being conducted on 3 ranches in Goliad, Real, and Zavala counties in South Texas, where we are monitoring radio-marked bobwhites 3 times per week from April–August during 2014 and 2015. We are also using a dataset from a long-term radio telemetry study on bobwhites conducted in Brooks County during 2000–2008.

Through the use of radio telemetry, we are able to collect information on nest fate, nest substrate, and microclimate and determine if bobwhites select nest sites with different attributes depending on the fate of previous nests. We also hope to determine if there is a difference in how far bobwhites move between prior and subsequent nests depending on the success of the previous nest.

Data are currently being collected, and the study will conclude in 2016. This study will further our understanding regarding a little known aspect of bobwhite nesting ecology.

Cooperative funding provided by Mr. Russell Gordy, South Texas Charity Weekend, Inc., South Texas Chapter of the Quail Coalition, and various donors of the South Texas Quail Research Project.

Assessment of Bobwhite Response to Post-grazing Habitat Recovery

Rachel A. Smith, Leonard A. Brennan, Andrea Bruno, Ross O. Couvillon, and Fred C. Bryant

Research studies have shown that bobwhites need habitats with substantial grass cover for nesting, predator avoidance, and shelter from heat. In the past 2 decades, many land managers have reduced or eliminated cattle across pastures in South Texas in hopes



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Research is being focused on finding ways to reverse the quail population decline over their geographic range.

of improving bobwhite habitat. However, it is still uncertain how bobwhites respond to post-grazing habitat recovery. Our objective is to investigate how quail react to these habitats, thereby providing useful information to land managers on how to improve their habitat following destocking.

Our study is being conducted on a ranch in Jim Hogg County, Texas. We will examine how quail use 3 categories of post-grazing sites: (1) an area 15 years post-grazing, (2) an area 2 to 3 years post-grazing that had medium grazing intensity, and (3) an area 2 to 3 years post-grazing that had high grazing intensity.

Bobwhites will be radio-collared and located from April to September 2015 and 2016 on each of the 3 areas. We will compare nest-site selection, nesting success, and breeding season survival among these sites. Our findings have the potential to aid wildlife managers trying to optimize bobwhite habitat and management practices.

Cooperative funding provided by the South Texas Chapter of the Quail Coalition, the Richard M. Kleberg, Jr. Center for Quail Research, and the Quail Associates Program.

The Effects of Tanglehead on Bobwhite Abundance and Spatial Distribution

John T. Edwards, Fidel Hernández, Fred C. Bryant, Leonard A. Brennan, David B. Wester, and Chad J. Parent

Despite declines of bobwhites across their range, rangelands of the southwestern United States still hold vast amounts of bobwhite habitat. However, portions of

these rangelands within South Texas have seen a reduction in usable space because of the spread of non-native, invasive grasses. Tanglehead is a native grass that has recently spread throughout certain areas of South Texas increasing its dominance on these rangelands. The objective of our study is to determine how the recent increase of tanglehead affects bobwhite distribution and abundance.

We conducted helicopter surveys during December 2014 to estimate bobwhite abundance and spatial distribution across approximately 50,000 acres on portions of 4 ranches in Jim Hogg and Duval counties, Texas. Bobwhite densities ranged from 1 bobwhite per 1.2 acres to 1 bobwhite per 3.3 acres.

In spring 2015, vegetation measurements were taken at known covey locations and paired random locations. At each point, we measured tanglehead cover, non-native grass cover, bare ground, herbaceous species diversity, and woody cover. These data will allow us to determine the vegetative characteristics of covey locations and how these relate to what is generally available throughout the study area.

We will collect data on quail abundance and vegetation characteristics again in 2016. Findings from this study will help to explain how recent increases of tanglehead have affected bobwhites. It will also provide additional information to wildlife managers concerning suitable vegetative structure for bobwhites.

Cooperative funding provided by South Texas Charity Weekend, Inc. and South Texas Chapter of the Quail Coalition.

Habitat, Climate, and Raptors as Factors in the Bobwhite and Scaled Quail Declines

John T. Edwards, Fidel Hernández, Leonard A. Brennan, David B. Wester, Chad J. Parent, and Robert Perez

There is considerable spatial variability in the rate of declining quail populations. Despite severe declines of both bobwhites and scaled quail across much of their range, rangelands of the southwestern United States have harbored relatively stable populations of both species.

The ultimate cause of declining quail populations is changing land-use practices resulting in habitat loss and fragmentation. Habitat loss and fragmentation not only affects quail populations directly by reducing available habitat but also indirectly by potentially making populations more vulnerable to external factors such as predation and climate. Our objective is to



© Greg Lasley

Migratory hawks often overwinter in South Texas and contribute to predation pressure on local quail populations.

determine the relative influence of multiple landscape scale factors on bobwhite and scaled quail declines on southwestern rangelands.

Our focal area will include 7 states (Arizona, Colorado, Kansas, Nebraska, New Mexico, Oklahoma, and Texas), which hold vast amounts of rangeland habitat and encompass the entire scaled quail range as well as a large portion of the bobwhite's range. Quail abundance data will be obtained from the North American Breeding Bird Survey (BBS) dataset and include data from the last 20 years.

We will test the individual contributions of multiple factors (habitat, predator abundance, and climate) as they affect quail population trends. Measures of habitat will include rangeland amount, cropland amount, and multiple variables relating to the amount of habitat fragmentation. As a measure of predatory influence, we will use the BBS to determine the relative abundance of raptor species. We will also analyze multiple variables of temperature and precipitation to determine the influence of climate.

Influences of external factors such as predation and climate may be intensifying declines of quail populations already under significant pressure from the loss of habitat. Determining how these factors interact with each other and with quail populations will provide more in-depth knowledge to wildlife managers seeking to address these quail declines.

Cooperative funding provided by South Texas Charity Weekend, Inc. and Texas Parks and Wildlife Department.

Impacts of Eagle Ford Shale Exploration on Quail Habitat Use and Abundance

Kelsey R. Davis, Daisy J. Castillo, Eric D. Grahmann, Fidel Hernández, Timothy E. Fulbright, Chase Currie, and Fred C. Bryant

The Eagle Ford Shale occurs underneath 12 million acres of rangeland in Texas. Furthermore, its projected development will take place on some of the last great quail habitat remaining in the state. It is unclear how this disturbance might impact bobwhite and scaled quail populations. Our objective is to determine how bobwhites and scaled quail respond to localized oil and gas exploration and production activities in South Texas. We will assess bobwhite and scaled quail (1) space use and site fidelity and (2) abundance, nest success, and seasonal survival.

Our study is taking place on 2 private ranches in Dimmit County, Texas. We are monitoring quail populations and habitat use on 2 areas along an oil and gas exploration corridor and 2 areas where there is no exploration. Field research will be conducted from February–August 2015 and 2016 in each of the 4 areas. Traffic rates (vehicles per week) will be estimated using traffic counters placed on road segments. The noise level will be monitored for each road segment using a sound level meter. Information on quail habitat use and population ecology will be collected using radio telemetry of marked quail. Relative abundance of quail will be estimated using spring whistle call counts. Density estimates will be determined using mark-recapture data from trapping and distance sampling using helicopter surveys. Vegetation communities also will be surveyed. Because exploration



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Researchers are studying how bobwhites are impacted by oil and gas exploration activities in the Eagle Ford Shale.

activities from the Eagle Ford Shale have the potential to affect some of the last productive quail populations remaining in the United States, it is essential to identify the effects this disturbance may have on both bobwhites and scaled quail.

Cooperative funding provided by the Rancho San Pedro Joint Venture, Faith Ranch, South Texas Charity Weekend, Inc., and South Texas Chapter of the Quail Coalition.

Evaluating the Use of Roadside Surveys for Montezuma Quail in the Edwards Plateau

Eric D. Grahmann, Rufus Stephens, Robert Perez, Zachary J. Pearson, and Fidel Hernández

The Montezuma quail is a secretive species native to mountains and hilly oak-juniper-pine savannahs in the southwestern United States and Mexico. A remnant population exists in the southern Edwards Plateau, but its distribution and status are mostly unknown. Surveying for this quail is difficult because of their secretive nature coupled with their inaccessible distribution, which lies mostly on remote private land.

This past year, we initiated a study to evaluate the efficacy of surveying for Montezuma quail using call-back surveys from transects along roadways. The objectives are to (1) assess the effectiveness of conducting roadside surveys compared to surveys on private ranches and (2) develop baseline data for a long-term dataset to monitor the occupancy of Montezuma quail within the Edwards Plateau.

During June and July 2014, we conducted 2 call-back surveys at 168 points along 14 separate roadside routes based on past verified sightings. During this period, surveys were conducted on 14 private ranches in the same area using the same methodology at 113 points along 14 routes.

Montezuma quail were detected on 2 roadside routes and at 8 points (5% detection rate). As a comparison, they were detected on 9 transects sampled on nearby private ranches at 13 points (12% detection rate). Detection rates for Montezuma quail using roadside surveys were too low to justify future sampling using these same routes. However, poor detection rates were likely a result of routes placed in high traffic areas and in areas that represented marginal habitat (valleys versus hill ridges).

Roadside survey routes are being reallocated to areas where Montezuma quail are more likely to be found (i.e., hill ridges) and with lower traffic



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The Montezuma quail is one of 4 species of quails found in Texas and is the least studied.

disturbance. Our research will yield information on how to best survey for Montezuma quail to monitor their occupancy within the habitat.

Cooperative funding provided by the Texas Parks and Wildlife Department (especially the District 4 staff), Alfred C. Glassell, III, Dr. Lacy Williams, Oaks and Prairies Joint Venture, San Antonio Quail Forever, and South Texas Chapter of the Quail Coalition.

Influence of Woody Cover on Bobwhite Seasonal Survival

James P. Clark, William L. Lutz, Jr., Joshua D. Pearson, Eric D. Grahmann, Fidel Hernández, and Timothy E. Fulbright

Bobwhites have relatively low annual survival rates across their geographic distribution. Predation is the primary cause of the high mortality. The amount of brush available may have a local impact on bobwhite survival by providing escape cover and protection. Although many researchers have attempted to determine the woody cover requirements for bobwhites, few have studied how woody cover may influence bobwhite survival.

The objective of this research is to determine if bobwhite seasonal survival (March–August) is correlated with the amount of woody cover used at the individual location, home range, and pasture scales. Our study is taking place during 2014–2015 on 4 private ranches in Goliad, Zavala, and Real counties, Texas. We will also use data from a long-term research project conducted in Brooks County. Radio-marked bobwhites

were relocated 3 times per week to monitor survival and woody cover use. Woody cover was sampled at bobwhite locations and compared to paired, random locations. Points taken from bobwhites were uploaded into a mapping software platform (ArcGIS) to assess woody cover within home ranges.

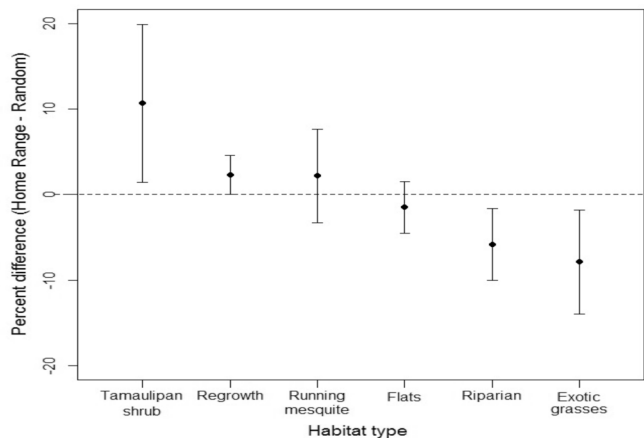
Data are currently being collected and analyzed, and the study will conclude in 2016. This study will provide information to those wishing to refine brush management strategies for bobwhites on their property.

Cooperative funding provided by Mr. Steve Lindley, Mr. John Lindley, Mr. Richard Lucas, South Texas Charity Weekend, Inc., South Texas Chapter of the Quail Coalition, various donors of the South Texas Quail Research Project, and San Antonio Quail Forever.

Vegetation Community in Home Range Selection and Use by Scaled Quail

Holley N. Kline, Richard H. Sinclair, II, Timothy E. Fulbright, Fidel Hernández, Eric D. Grahmann, David B. Wester, and Leonard A. Brennan

Scaled quail have been declining since the 1960s, a trend thought to be caused by habitat loss. In Texas, more than 11 million acres of native rangelands and croplands have been mechanically altered or converted to non-native pastures, which may fragment and reduce habitat for scaled quail. Our objective is to test the hypothesis that scaled quail prefer native unmanipulated vegetation communities and avoid manipulated or non-native grass-invaded areas.



Percentage differences for each vegetation community when comparing actual scaled quail home ranges with randomly-generated home ranges. Communities with positive differences were selected, those with differences overlapping 0 were neither selected nor avoided, and those with negative differences were avoided.

We radio-marked and relocated 126 scaled quail during April–August 2013 and 2014 on 5 ranches in La Salle County near Cotulla, Texas. Quail locations were imported into a Geographic Information Systems (GIS) software database to determine home ranges and create random home ranges. Vegetation communities on the study sites were delineated. Those resulting from past brush control efforts included non-native grasses and regrowth mesquite; those that were relatively free from past mechanical manipulation included saline/cordgrass-aster flats, riparian, running mesquite, and Tamaulipan shrubland.

We compared proportions of each vegetation community between 62 pairs of actual and random home ranges. Scaled quail home ranges included approximately 8% less area in communities with more than 30% non-native grasses, 3% more area of regrowth mesquite, 5% less area of riparian, and 10% more area of Tamaulipan shrub communities than was available. No difference was detected regarding use of running mesquite or saline/cordgrass-aster flats.

Scaled quail habitat in South Texas consists of native woody plant communities that have not been mechanically manipulated and are relatively free from non-native grasses. Conservation of these plant communities is essential for scaled quail in the region.

Cooperative funding provided by the South Texas Chapter of the Quail Coalition, South Texas Charity Weekend, Inc., Hixon Ranch, San Antonio Chapter of the Quail Coalition, and the Meadows Professorship in Semi-Arid Ecology.

Suitability Bounds of Woody Cover for Bobwhites

James P. Clark, William L. Lutz, Jr., Joshua D. Pearson, Eric D. Grahmann, Fidel Hernández, and Timothy E. Fulbright

Woody vegetation is an important component of bobwhite habitat, which is used for loafing, escape cover, thermoregulation, and food. Several studies have provided different recommendations for optimal amounts of woody cover. This variation could be caused by inconsistent research methodologies, differences in the scale of measurement, or the ability for bobwhites to interchange the use of habitat components—a concept also known as slack.

The objectives of our study are to (1) quantify the relationship between woody and herbaceous cover at bobwhite locations and (2) quantify woody cover used by bobwhites at 3 spatial scales (point-of-use, home

range, and pasture scale). Our study is taking place April–August (2014–2015) on 4 ranches in Goliad, Zavala, and Real counties, Texas.

Radio-marked bobwhites were located 3 times per week, and their locations were taken with a handheld Geographic Positioning Systems (GPS) unit. Vegetation data were recorded at bobwhite and paired, random locations.

Preliminary data analyses indicate that mean percent woody cover was greater at bobwhite locations (55%) compared to random locations (36%). We also found that mean percent herbaceous cover was similar between bobwhite locations (34%) and random locations (35%). Woody cover had a stronger effect on habitat use than herbaceous cover, but optimum use occurred when intermediate amounts of both were present. This research will allow bobwhite managers to refine brush management, based on spatial scale and the amount of herbaceous cover present.

Cooperative funding provided by Mr. Steve Lindley, Mr. John Lindley, Mr. Richard Lucas, South Texas Charity Weekend, Inc., South Texas Chapter of the Quail Coalition, and San Antonio Quail Forever.

Evaluation of Dense Juniper Removal for Restoration of Montezuma Quail Habitat

Zachary J. Pearson, Eric D. Grahmann, Fidel Hernández, Robert Perez, and Joyce Moore

Over the past century, overgrazing and subsequent woody plant encroachment has degraded Montezuma quail habitat in the Edwards Plateau region.



© Eric Grahmann

Montezuma quail habitat restoration in an area formerly covered with dense juniper 5 years prior.

Landowners have reported that juniper removal resulted in herbaceous plant communities favorable to Montezuma quail. This habitat improvement has apparently resulted in recolonization by Montezuma quail on some ranches.

The objective of our study is to evaluate the effect that ashe juniper removal has on re-establishing herbaceous plant communities that are favorable to Montezuma quail. Our research is taking place on 11 ranches in the southern Edwards Plateau. Vegetation sampling is occurring in May and October 2014 and 2015. Vegetation data will be compared between 9 ranches that currently harbor Montezuma quail and 2 ranches where juniper has been removed 1, 3, and 5 years prior. This research will provide information on the effectiveness of restoring Montezuma quail habitat via monotypic juniper removal in the Edwards Plateau.

Cooperative funding provided by the Texas Parks and Wildlife Department, 11 private ranches and landowner groups within the southern Edwards Plateau, South Texas Chapter of the Quail Coalition, and San Antonio Quail Forever.

Evaluation of the Extinction-Threshold Hypothesis in Bobwhites and Scaled Quail

John T. Edwards, Fidel Hernández, Leonard A. Brennan, David B. Wester, Chad J. Parent, and Robert Perez

Habitat loss and fragmentation are the principal causes linked to declining bobwhite and scaled quail populations. These processes occur at much larger scales than the scales traditionally used in research (i.e., a pasture or ranch). Thus, the inferences gained



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Quail biologists are concerned about the long-term decline in quail populations, prompting the need for more research.

from such studies may be limited. It is possible that quail populations may respond to habitat loss in a non-linear fashion, following a concept known as the extinction-threshold hypothesis, where small changes of habitat can have a profound effect on populations.

The need exists to investigate the quail declines at a much larger scale and evaluate whether quail respond to habitat loss in a linear manner. Our objectives are to determine an applicable scale at which to study habitat effects on quail populations and to evaluate the credibility of the extinction-threshold hypothesis as an explanation for bobwhite and scaled quail declines.

To investigate these landscape-scale processes, we will use a Geographic Information System (GIS) approach. Within GIS, we will use data from multiple sources to determine quail trends (North American Breeding Bird Survey, Christmas Bird Count, and state agency counts) and habitat trends (National Land Cover Database and Texas Ecological Systems Classification Project). Comparing quail and habitat trends at multiple scales will allow us to determine the appropriate scale of inference for each dataset. At this scale, we can then accurately evaluate the linearity of the habitat-quail relationship.

Determining an appropriate scale of inference for evaluating the effects of habitat on quail population trends for multiple datasets would set a standard for future studies. Also, determining the linearity of this relationship would provide insight in directing management decisions for quail habitat.

Cooperative funding provided by South Texas Charity Weekend, Inc. and Texas Parks and Wildlife Department.

Analysis of Adaptive Genetic Variation among Bobwhite Populations

Damon L. Williford, Randy W. DeYoung, and Leonard A. Brennan

The bobwhite is one of the most economically important gamebirds in North America, but has recently undergone a severe decline in geographic distribution and population size. Bobwhite management may benefit from a greater understanding of bobwhite adaptation to local or regional habitats throughout its range. Twenty-two subspecies have been described based on geographic variation in male plumage coloration. In previous studies, we found no association between mitochondrial DNA (mtDNA) lineages and subspecies designations. However, the extensive

variation in male plumage suggests the potential for variation in genes that control adaptive traits.

Mitochondrial DNA is a useful genetic marker for assessing demographic and biogeographic history of populations because it is neutral—not subject to selection. However, recent adaptations may be undetectable with neutral markers. In contrast, the nuclear genes that control adaptive traits may evolve rapidly if they are targets of natural selection.

Recent technological advances allow the rapid discovery and analysis of thousands of single nucleotide polymorphisms (SNPs, pronounced “snips”) throughout an organism’s genome. Analysis of SNPs can reveal patterns of adaptive variation that are invisible with neutral markers, such as mtDNA.

We obtained samples of northern bobwhites from Iowa, Missouri, Kansas, Oklahoma, and Texas and masked bobwhites from Sonora, Mexico. We processed 173 samples and are currently analyzing the SNP data. The results of this study should help us understand how bobwhites have adapted to different ecological and environmental conditions.

Cooperative funding provided by a TAMUK University Research Award.

Abundance and Distribution of Predators on Bobwhite Nest Density and Success

William L. Lutz, Jr., James P. Clark, Joshua D. Pearson, Eric D. Grahmann, Fidel Hernández, and Leonard A. Brennan

Much is known about bobwhite nesting ecology. However, little is understood regarding how predator abundance influences nest fate. Our objective is to determine how nest predator abundance influences bobwhite nest density and nest success.

Our study is being conducted on 3 study sites across South Texas in Goliad, Real, and Zavala counties. Predator abundance is being determined using scent stations on 3 consecutive days per month. Bobwhite nests are being located using birds fitted with radio telemetry transmitters and monitored to determine nest fates (successful or depredated).

Preliminary analysis of 44 nests monitored during 2014 suggests there is no relationship between relative predator abundance and bobwhite nest success. Bobwhite nest depredation by mesopredators such as raccoons, skunks, and opossums appears to be compensatory, whereby the same percentage of nests may be depredated regardless of predator density.



© Michelle Downey

Bobwhite eggs represent a food source for many small and medium-sized predators.

Our study concludes in 2016. The information obtained will further our understanding of how bobwhite nest success is related to nest predator abundance in South Texas.

Cooperative funding provided by Mr. Russell Gordy, South Texas Charity Weekend, Inc., South Texas Chapter of the Quail Coalition, and various donors of the South Texas Quail Research Project.

Bobwhite Proximity to Woody Cover Across Four Ecological Regions

Joshua D. Pearson, James P. Clark, William L. Lutz, Jr., Eric D. Grahmann, Fidel Hernández, and Chad A. Markert

Bobwhites use low growing woody cover to escape from predators and for thermal cover. The amount of woody cover needed has long been a point of contention for wildlife biologists as recommendations vary widely. Most science-based recommendations originate from estimates of average flight distances, which assume that woody cover should always be available for bobwhites within these flight distances. However, recommendations have not been substantiated through empirical habitat selection data.

Our objective is to quantify bobwhite proximity to woody cover across 4 ecological regions in South Texas. Our study occurs on 5 ranches representing habitat of the Gulf Coast Prairies and Marshes, Post Oak Savannah, Coastal Sand Plain, South Texas Plains, and Edwards Plateau ecoregions. In addition to data used from past research projects, from April–August

(2014–2015), we monitored bobwhite use of woody cover via radio telemetry. Locations of marked quail will be used as part of a proximity analysis, focusing on bobwhite proximity to woody cover.

Preliminary data suggest that when bobwhites are not in woody cover, they remain within 30 yards of it. Results from this project will assist wildlife managers in developing brush management protocols for bobwhites in South Texas.

Cooperative funding provided by The Leach Foundation, Dietert Ranch, South Texas Chapter of the Quail Coalition, San Antonio Quail Forever, and various donors of the South Texas Quail Research Project.

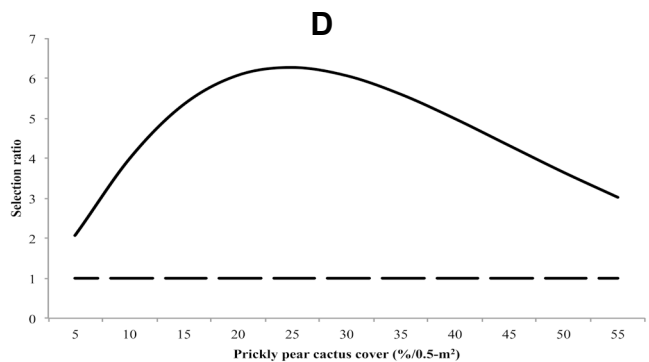
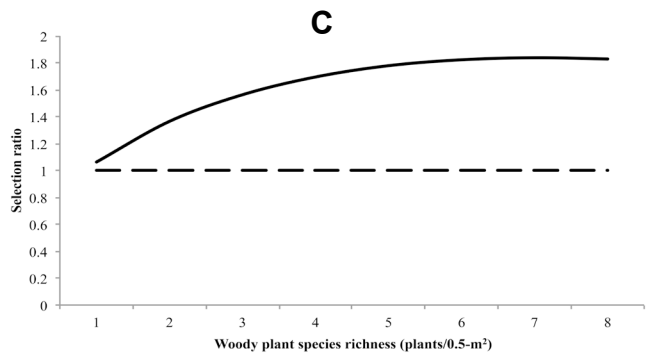
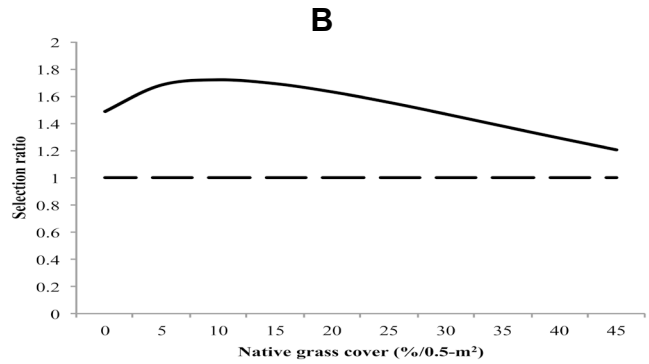
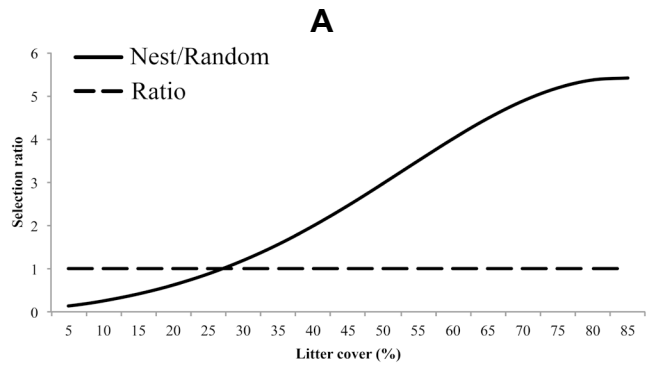
Importance of Vegetation in Scaled Quail Nest Site Selection

Holley N. Kline, Richard H. Sinclair, II, Timothy E. Fulbright, Fidel Hernández, Eric D. Grahmann, David B. Wester, and Leonard A. Brennan

The importance of vegetation attributes in nest site selection by chestnut-bellied scaled quail is poorly documented. Our objective is to test the hypotheses that nest site selection by scaled quail is positively influenced by (1) the decreasing percentage of bare ground, (2) decreasing traversability and visibility, (3) increasing cover of prickly pear cactus, and (4) increasing plant species richness. Traversability is an estimate of how easy it would be for a quail to walk across a site, whereas visibility is a measure of how easy it would be for a predator to see a nest.

We monitored 53 scaled quail nests April–August 2013 and 2014 on 5 ranches in La Salle County near Cotulla, Texas. Vegetation composition and structure were measured at quail nests and at sites randomly chosen within 165 feet of the nests. Vegetation variables were compared between used and random sites to determine their importance in nest site selection.

We compared 53 nests and random sites. Bare ground was not an important factor in nest site selection, whereas sites with more than 27% litter and more than 55% native grass cover were used. Scaled quail selected nest sites where woody vegetation was dense at the ground level (less than 87% traversability) and visibility was limited (less than 62%). In addition, scaled quail selected nest sites with greater than 5% prickly pear cover and sought sites with more woody plant species present than was generally available throughout the landscape.



Selection ratios of used versus available (A) percent litter cover, (B) percent native grass cover, (C) woody plant species richness, and (D) percent prickly pear cactus cover. Selection ratio values above 1 correspond to values of the variable that were selected, those equal to 1 were neither selected nor avoided, and those below 1 were avoided.

Dense, complexly structured patches of prickly pear cactus and other woody plants provide greater concealment of nests from predators. Our preliminary findings suggest that complex and diverse shrublands with prickly pear are necessary to provide suitable nesting habitat for chestnut-bellied scaled quail.

Cooperative funding provided by the South Texas Chapter of the Quail Coalition, South Texas Charity Weekend, Inc., Hixon Ranch, San Antonio Chapter of the Quail Coalition, Meadows Professorship in Semi-Arid Ecology, and Houston Livestock Show and Rodeo.

Assessment of Distance Sampling Survey Coverage for Bobwhite Populations

Andrea Bruno, Leonard A. Brennan, Andrew N. Tri, Michael L. Morrison, and Eric D. Grahmann

Precise estimates of population density are valuable for managing wildlife. Distance sampling from aerial platforms has the potential to provide precise and efficient estimates of vertebrate population density over large areas. The intensity of a distance sampling survey depends on total survey coverage of the area, which is dictated by the distance between transects.

There are few available data on potential loss of information and precision on density estimates among surveys designed with varying degrees of coverage (e.g., 100% versus 50%). Our objective is to assess whether or not survey coverage could be reduced from 100% to some lower level while achieving reliable density estimates (statistical coefficient of variation of less than 20%, 60–80 detections, 10–20 transects).



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Bobwhite surveys are conducted by helicopter on many ranches in South Texas.

We collected bobwhite density estimates on 18,000 acres of East Foundation lands in Jim Hogg County, Texas during December 13–15th, 2014. Data were collected using line-transect distance sampling from a helicopter (model R-44; 4-person) at 100% coverage. In post-hoc analyses, transects were removed at random in 10% increments to simulate different survey coverage designs (from 90 to 10%) and assessed using Program Distance software.

Our preliminary results suggest that when 100% coverage is not practical, at least 70% is needed to obtain reliable bobwhite density estimates with a coefficient of variation below 20% on South Texas rangelands. This study will continue over the next 3 years and address distance sampling survey coverage recommendations for estimating bobwhite population densities in relation to different grazing regimes on South Texas rangelands.

Cooperative funding provided by the East Foundation, South Texas Chapter of the Quail Coalition, C. C. “Charlie” Winn Endowed Chair for Quail Research, and the Richard M. Kleberg, Jr. Center for Quail Research.

Assessing Bobwhite Response to Habitat with Hydrological Supplementation

Ross O. Couvillon, Leonard A. Brennan, Fidel Hernández, and Bart M. Ballard

The more it rains in South Texas the better, as booms and busts in bobwhite populations follow rainfall patterns. Providing standing water for bobwhites to drink does not provide them any major benefit. However, maintaining habitat through irrigation may negate drought effects by providing oases of lush vegetation and high numbers of arthropods (quail food resource) across the landscape.

In 2013, lessees of a private hunting ranch in Jim Hogg County, Texas installed an irrigation system across part of the property. Our study is investigating the hypothesis that adding supplemental water to the landscape during dry conditions would maintain or increase bobwhite productivity and abundance. Hens will be tracked throughout the breeding season to record movements, breeding season survival, nesting success, nesting rate, and nesting season length. Arthropod abundance at watered areas, random points in the pasture, and brood foraging sites will be studied to determine if irrigation provides more food to nesting hens and young chicks. Furthermore, natural brood foraging

habitat will be assessed to determine what components young chicks need, and to see if these needs are being met at watered areas.

So far, this study has coincided with average to above average rainfall in South Texas. If these weather patterns continue, our study will provide baseline data for what is anticipated to be a long-term monitoring project.

Our research will provide insight about the mechanisms linking bobwhite productivity and rainfall. Additionally, we will develop and provide recommendations for this unique quail management practice.

Cooperative funding provided by the South Texas Chapter of the Quail Coalition, Encino Lodge, and the Richard M. Kleberg, Jr. Center for Quail Research.

Habitat Suitability Bounds for Bobwhites in the Edwards Plateau

Joshua D. Pearson, Eric D. Grahmann, Fidel Hernández, Timothy E. Fulbright, and Chad A. Markert

Bobwhite populations have declined precipitously within the Edwards Plateau over the past several decades. Unfortunately, few studies have focused on bobwhites in the Edwards Plateau, and no studies have quantified habitat features in this ecoregion. The objective of our study is to quantify habitat suitability bounds for bobwhites in the Edwards Plateau.

Our study is taking place during April–August and December–January (2014 and 2015) in northern Real County, Texas. Twenty sampling points were placed across the study ranch from which occupancy and relative abundance of bobwhites were determined by



© Joshua Pearson

Research is being conducted to learn about bobwhite habitat requirements in the Edwards Plateau.

whistle and covey-call counts. Whistle counts were conducted once per week during spring and summer, and covey call counts were conducted twice per sampling point during December and January. Vegetation was sampled at each point during June. Vegetation and spatial analysis data will be used to determine the habitat features needed by bobwhites within this region. The information obtained will be used to develop a habitat appraisal guide for bobwhites in the Edwards Plateau.

Cooperative funding provided by The Leach Foundation, Dietert Ranch, South Texas Chapter of the Quail Coalition, and San Antonio Quail Forever.

Genetic Basis for Plumage Color Variation in Bobwhites and other New World Quails

Damon L. Williford, Randy W. DeYoung, and Fred C. Bryant

Plumage coloration of birds is genetically controlled, and it plays an important role in camouflage, species recognition, and courtship displays. Although many different genes may affect coloration in birds and other vertebrates, the melanocortin-1 receptor (MC1R) gene is one of the most important. Activation of the MC1R gene leads to an increase in the synthesis of eumelanin, which produces black and brown coloration. A decrease in MC1R activity results in greater synthesis of pheomelanin, which contributes to red and yellow colors.

Sexually dimorphic plumages occur in 17 of the 31 species of New World quails, including the northern bobwhite and Gambel’s, California, and Montezuma quails. Other species, such as scaled and mountain quails, display little or no differences in plumage between the sexes. The northern bobwhite is especially notable for the extensive geographic variation in male plumage throughout its range. We are studying variation in the MC1R gene in northern and masked bobwhites and scaled, California, mountain, Montezuma, and Gambel’s quails.

We observed 31 mutations in the MC1R gene, including 3 that affect the amino acid sequence of the protein. None of the mutations were clearly associated with plumage differences within or among species and there was no evidence for positive selection. We did find evidence for purifying selection in the northern bobwhite, scaled quail, and Gambel’s quail. Purifying selection acts against extreme phenotypes, which may be important to maintain camouflage in ground-dwelling birds. Future work will attempt to sequence the MC1R gene from museum specimens of New World

quails and explore variation of other genes associated with coloration, such as the tyrosinase and premelanosome protein genes.

Predictive Montezuma Quail Habitat Modeling

Zachary J. Pearson, Eric D. Grahmann, Fidel Hernández, Humberto L. Perotto, Robert Perez, and Joyce Moore

Montezuma quail once ranged throughout the Edwards Plateau, but they have mostly vanished because of incompatible land use practices. At least 1 population remains in the southern Edwards Plateau, but small isolated populations are possible. Locating these populations is difficult because the areas where these quail are thought to occur are on private ranches with rugged terrain. In addition, the Montezuma quail's secretive nature makes this bird difficult to survey.

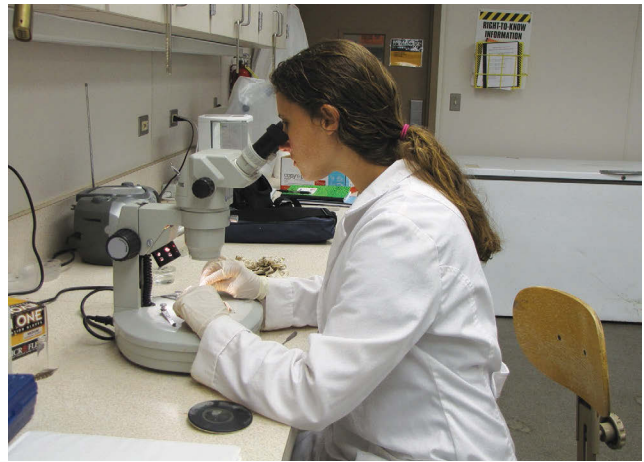
We initiated a study to identify macrohabitat variables needed for Montezuma quail. We are conducting call-back surveys at 60 points during March–August 2015 and 2016 on 9 ranches occupied by Montezuma quail in the southern Edwards Plateau. At these points, we will quantify macrohabitat variables where Montezuma quail are found. We will use this information to develop a predictive habitat map within the Edwards Plateau using mapping software (ArcGIS). Variables will include elevation, ecological site and soils, drought severity index, terrain type, terrain slope, and juniper cover. This map will aid wildlife biologists in (1) refining search areas for remnant populations and (2) developing a recovery strategy by identifying sites where restoration efforts are feasible.

Cooperative funding provided by the Texas Parks and Wildlife Department, 11 private ranches and landowner groups within the southern Edwards Plateau, South Texas Chapter of the Quail Coalition, and San Antonio Quail Forever.

Survey and Analysis of Helminth Parasites from Quail in South Texas

Stephanie A. Shea, Alan M. Fedynich, Leonard A. Brennan, and Glenn Perrigo

Habitat loss and fragmentation are often considered major causes for the decline in bobwhite and scaled quail populations across the United States including some areas in Texas. This decline has prompted some



© Alan Fedynich

Graduate student Stephanie Shea is examining quail from South Texas to learn about their parasites.

biologists to speculate about other causal factors such as parasitism and disease.

There have only been a few studies focusing on quail parasites in South Texas. However, parasitological research in other bird hosts, such as the blue grouse, has demonstrated that certain species of parasites have the ability to cause disease and regulate host populations. Thus, a survey and monitoring program has been initiated to gain a better understanding of quail parasites in South Texas.

Our objectives are to (1) identify helminth parasite species from hunter-donated bobwhites and scaled quail; (2) quantify the prevalence, intensity, and abundance of each parasite species; and (3) determine whether these values are influenced by host age, host body weight, host sex, and collection year (as well as precipitation and host density). One hundred twenty-four bobwhites and 2 scaled quail have been donated from the 2014–2015 hunting season. Complete necropsies of these whole birds are being conducted in the Buddy Temple Pathology and Diagnostic Laboratory at Texas A&M University-Kingsville.

Our research will provide insight into the composition of helminth communities of bobwhites and scaled quail in South Texas and aid in our understanding of the potential impacts of parasitic infections within individuals and populations of wild quail.

Cooperative funding provided by the South Texas Chapter of the Quail Coalition.

Temporal Segregation of Ocelots and Bobcats in South Texas

Justin P. Wied, Michael E. Tewes, John P. Leonard, Tyler A. Campbell, and Daniel J. Kunz

Species that are ecologically similar often segregate themselves temporally to reduce interspecific competition for limited resources. Ocelots and bobcats are essentially nocturnal species with activity peaks during twilight hours. The external cues provided by changes in daylight and moonlight can be investigated to understand degrees of overlap in activity between these species.

Surveys using cameras are being conducted on 2 properties in Willacy County, Texas to study ocelot and bobcat populations. The dates and times of wild cat photographs taken over a 4-year period are being compared to examine the influence of sunrise, sunset, lunar phase, lunar illumination, and season. The differences between these environmental cues will be compared to characterize the temporal distribution between ocelots and bobcats. Also, we will determine the amount of overlap of ocelot and bobcat activity patterns.

Detecting the similarity of ocelot and bobcat activity patterns enables scientists to understand the degree of competition that occurs between these 2 species. In addition, the chronobiology of the ocelot population in South Texas has not been previously analyzed. Consequently, the findings from this study will extend our understanding of this endangered cat within the United States.

Cooperative funding provided by the East Foundation, Tim and Karen Hixon Foundation, and Feline Research Program of the Caesar Kleberg Wildlife Research Institute.

Bobcat Density and Factors Affecting Their Abundance on East Foundation Ranches

Gordon W. Watts, III, Lon I. Grassman, Jr., Justin P. Wied, Tyler A. Campbell, and Michael E. Tewes

Specialists near the top of the food chain may function as indicator species because they use a narrow range of resources, which are sensitive to fluctuations. Bobcats are generalists that use a variety of habitats and food items within different ecosystems. These characteristics make bobcats good indicators of lower trophic level community health.

We examined bobcat populations using remote cameras and spatially explicit capture-recapture methods on 3 East Foundation ranches (Buena Vista, San Antonio Viejo, and Santa Rosa). Our objective is to determine the influence of climate, habitat, and coyotes on bobcat population density.

We are conducting camera surveys on each of the 3 ranches using a systematic grid system. Presently, we have surveyed over 70,000 camera-nights and have obtained an approximate 8:1 ratio of coyote to bobcat photo events.

Based on our surveys, the coyote is the most abundant carnivore on all 3 ranches. Coyotes are a major influence over bobcats. Bobcat densities were similar over time at each study site, but varied somewhat among the study sites. Differences in environmental productivity, habitat, and coyote occupancy rates may each partially explain the variation in bobcat density among the sites.

Because bobcats are widely distributed, closely tied to prey populations, and easily monitored using remote cameras, they may be good indicators for areas and time frames that are suitable for reintroducing upper trophic level species of conservation concern. Our continued monitoring will help to determine the influence of precipitation patterns, habitat, and competing carnivores on bobcats in South Texas.

Cooperative funding provided by the East Foundation, Feline Research Program of the Caesar Kleberg Wildlife Research Institute, and Wild Cat Conservation, Inc.

Using Camera Traps to Estimate Jaguar and Ocelot Population Density in Mexico

Sasha Carvajal-Villarreal, Arturo Caso, and Michael E. Tewes

The jaguar and ocelot are protected Neotropical felids that occur sympatrically in suitable forests in Mexico. Understanding the populations of these felids is important for determining appropriate conservation measures. As such, we are conducting a study to estimate jaguar and ocelot populations in Tamaulipas of northeastern Mexico.

Camera “trapping” surveys were used to estimate jaguar and ocelot populations in Rancho Caracol, which is located in the northern Sierra Tamaulipas, Mexico. Population densities of jaguars and ocelots were estimated using capture-recapture models of individuals identified in the photos by their unique coat patterns.

Nine jaguars (4 males, 4 females, and 1 of unknown sex) and 38 ocelots (17 males and 21 females) have been photographed using our camera-based surveys. We estimate that the current densities are about 1 jaguar per 6 mi² and 1 ocelot per 1 mi².

Jaguar density is relatively healthy, and habitat quality and ocelot densities are quite robust. The Sierra Tamaulipas appears to support enough ocelots to provide a potential source of ocelots for translocations into Texas.

Cooperative funding provided by the Tim and Karen Hixon Foundation, Caracol Ranch, Camotal Ranch, Barry Putegnat, Dean Putegnat, Feline Research Program of the Caesar Kleberg Wildlife Research Institute, and Wild Cat Conservation, Inc.

Rodent Monitoring for Ocelot and Bobcat Populations on the East El Sauz Ranch

Justin P. Wied, Eric L. Rulison, John P. Leonard, Lauren D. Balderas, Shelby B. Carter, and Michael E. Tewes

Rodents constitute most of the diet of ocelots and bobcats. Studies have shown that Southern Plains woodrats, hispid cotton rats, and Mexican spiny pocket mice are important prey for these felids. We are monitoring the rodent community on the East El Sauz Ranch to understand the availability and abundance of rodent prey.

We are trapping rodents with Sherman live traps placed 10 yards apart on 10 x 10 yard grids. There are 4 of these trap grids, which lie within 4 vegetation communities that represent major habitat types. The traps are checked daily during 4-day sessions. Individuals are marked with ear tags and data such as species, sex, age, and reproductive status are recorded. Trapping occurs quarterly to detect seasonal changes within the rodent populations.

During the period from January 2014 to February 2015, we had a trapping effort of 7,876 trap nights. The first trapping session resulted in 441 captures (273 unique individuals). The second session resulted in 310 captures (173 individuals). The third session resulted in 262 captures (140 individuals). The fourth session resulted in 335 captures (279 individuals). The latest session resulted in 505 captures (290 individuals). White-footed mice were the most abundant species captured. However, hispid cotton rats and Southern Plains woodrats have been increasing in abundance during the current study period.

Monitoring small mammals allows us to better understand the availability of prey items for the bobcat and the endangered ocelot. Additionally, management practices can be adjusted should competition for prey become an issue.

Cooperative funding provided by the East Foundation, Feline Research Program of the Caesar Kleberg Wildlife Research Institute, and Wild Cat Conservation, Inc.

Evaluation of the Population Structure of Ocelots in Texas

Jennifer M. Korn, Jan E. Janecka, Randy W. DeYoung, Arturo Caso, and Michael E. Tewes

Molecular studies suggest that 2 breeding ocelot subpopulations in Texas (Yturria Ranch [YTURRIA] in Willacy County and Laguna Atascosa Wildlife Refuge in Cameron County) exist in complete isolation and have lost genetic diversity. The loss of genetic diversity results from decreased gene flow and increased genetic drift and inbreeding. Previous analyses of population structure found that ocelots consistently grouped with their subpopulation of origin, and there was no indication of admixed individuals.

We re-evaluated the previous population structure and examined the current population structure with the addition of the third ocelot subpopulation on the East El Sauz Ranch (EAST) in Willacy County. The results from the software program STRUCTURE indicate some support for multiple scenarios. There was greater admixture between the 2 sampling sites of YTURRIA and EAST. High levels of admixture



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Several subpopulations of ocelots occur in the dense thornshrub habitat found within South Texas.

between individuals captured on YTURRIA during 1991–1998 and 2006–2013 with those captured on EAST and other surrounding areas during those time periods were supported by field observations and the lower levels of genetic differentiation between current YTURRIA (2006–2013) and EAST.

At present, ocelots in South Texas exist as 2 genetically distinct and isolated subpopulations, one within Cameron County and one within Willacy County (i.e., YTURRIA, EAST, and surrounding areas). It is important that genetic monitoring continue to assess population structure and other variables among the ocelot subpopulations occurring in South Texas.

Cooperative funding provided by the Tim and Karen Hixon Foundation, East Foundation, Feline Research Program of the Caesar Kleberg Wildlife Research Institute, and Wild Cat Conservation, Inc.

Habitat Use Factors Affecting Ocelot and Bobcat Coexistence

John P. Leonard, Justin P. Wied, and Michael E. Tewes

In South Texas, ocelots and bobcats are similar in size, consume similar sized prey items, and are primarily nocturnal and crepuscular. Because of this apparent overlap, we expect to find evidence for habitat partitioning between the 2 felids that would allow them to coexist.

In 2011, we initiated a telemetry study on the East El Sauz Ranch to investigate ocelot and bobcat home range, habitat selection, and movement patterns. To date, we have radio-collared 14 ocelots and 15 bobcats



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Bobcats and ocelots coexist in certain areas of South Texas creating the potential for interspecific competition.

using either VHF radio collars or Global Positioning Systems (GPS) collars. We classified land cover types into several categories including grassland, forestland, and scrub/shrub, and we examined parameters such as land cover type, distance to water, and percentage of canopy cover.

Ocelots and bobcats showed a positive association with canopy cover. Ocelots were positively associated with forestland cover and negatively associated with grassland cover, while the reverse was true for bobcats. There was a negative association with distance to nearest perennial water source for ocelots and bobcats indicating that both species selected areas that were near water.

Preliminary results suggest that ocelots and bobcats show similar patterns of habitat selection. We are continuing to collect high-resolution movement data on ocelots and bobcats using GPS collars, which will help us test for evidence of fine-scale niche partitioning between these felid species.

Cooperative funding provided by the East Foundation, Feline Research Program of the Caesar Kleberg Wildlife Research Institute, and Wild Cat Conservation, Inc.

Soil Characteristics of Habitat Used by Sympatric Ocelots and Bobcats

Justin P. Wied, Michael E. Tewes, and Jon S. Horne

The endangered ocelot and the bobcat share dense thornshrub habitat found in the Rio Grande Valley of South Texas. Ocelot habitat has previously been linked to soil types on Laguna Atascosa National Wildlife Refuge in Cameron County using Geographic Information Systems (GIS) mapping tools.

We are comparing the radio-tracking data from ocelots and bobcats to the soil characteristics found at Laguna Atascosa National Wildlife Refuge. Four soil samples were taken at each radio-tracking location. These soil samples are being analyzed for their physical and chemical properties.

Preliminary analysis showed that ocelots preferred sites with loamy clay soils, higher macronutrient content, slightly lower pH, and low levels of salinity, sodium, potassium, and sulfur. Bobcats were found across a variety of soil textures, and occurred at sites with higher levels of salinity and sodium than ocelots.

Radio-tracking efforts in Willacy County have allowed us to track the movements of 5 ocelots and 2 bobcats with Global Positioning Systems (GPS) collars.

We are collecting soil samples from a random sample of the GPS locations. These data will be analyzed in the same manner as past samples.

The specific chemical and physical characteristics of soils determine the type of vegetation that grows. This association allows us to use soil type as a proxy for habitat selection by ocelots and bobcats. A list of favorable soil types will give wildlife managers a quick and easy tool to identify potential areas for habitat conservation and restoration of these wild cats.

Cooperative funding provided by Tim and Karen Hixon, Feline Research Program of the Caesar Kleberg Wildlife Research Institute, and Wild Cat Conservation, Inc.



© Arturo Caso

Graduate student Sasha Carvajal-Villarreal is placing a camera “trap” along a trail to photograph wild cats.

Distribution of Jaguars, Ocelots, Margays, and Jaguarundis in Northeast Mexico

Sasha Carvajal-Villarreal, Arturo Caso, and Michael E. Tewes

The distribution ranges of wild felids can vary significantly based on studies reported in the literature. It is not uncommon for field guides to grossly over-estimate or under-estimate range distributions because of a lack of precision or knowledge. If distribution ranges are not accurately evaluated, future decisions for wild cat conservation, such as the creation of protected areas, may fail.

We are documenting the distribution of jaguars, ocelots, jaguarundis, and margays in northeastern Mexico (Nuevo Leon and Tamaulipas) using Class I and Class II records. Class I records are considered to be the most credible documentation class and consist typically of a carcass, camera-trap photo, or other record that is unambiguous. Class II records are sightings, which are considered less reliable. These Class II records are gathered from sighting reports from people with a wildlife background. Private lands, federally protected areas, and rural communities are included in our analysis. Additionally, information is obtained from literature, scientific collections, and records from personal communications that are considered reliable.

Thus far, our findings appear to establish northeastern Mexico as the northeastern distribution limit for jaguars, jaguarundis, and margays, whereas ocelots still occur in several subpopulations within South Texas. The information gathered in this study can be used by wildlife authorities for better management of protected areas.

Our findings will also be shared with the scientific community to help guide research for northeastern

Mexico. In addition, our results can be used to assist the International Union for the Conservation of Nature (Red List) in reassigning distribution ranges of jaguars, jaguarundis, and margays.

Cooperative funding provided by the Tim and Karen Hixon Foundation, Caracol Ranch, Camotal Ranch, Barry Putegnat, Dean Putegnat, Feline Research Program of the Caesar Kleberg Wildlife Research Institute, and Wild Cat Conservation, Inc.

Assessment of Microhabitat Use by Ocelots and Bobcats

Justin P. Wied, Michael E. Tewes, John P. Leonard, Tyler A. Campbell, and Alfonso Ortega-Sanchez, Jr.

Ocelots and bobcats occur sympatrically in the United States. However, the known breeding subpopulations of ocelots are located only in the Rio Grande Valley of southern Texas. Both species are ecologically similar in diet and activity. Ocelots are more strongly associated with dense thornshrub habitat, whereas bobcats will use more open habitat types in addition to dense thornshrub.

After 2 years of live trapping, we have captured and fitted 5 ocelots and 2 bobcats with Global Positioning Systems (GPS) radio collars that enable us to track these animals with high accuracy. We are collecting location data of the GPS-collared cats and are examining the microhabitats they are found in to determine differences between microhabitat selection. Vegetation sampling is underway to measure the microhabitat composition

of each GPS location. These measurements will be analyzed to determine which structural elements influence ocelot and bobcat choices of habitat.

Because habitat loss contributes to the decline of the endangered ocelot population in Texas, determining the manner that ocelots and bobcats segregate themselves spatially within the landscape provides valuable insight on how these 2 species interact. Such information can be used to improve future management decisions for ocelot habitat conservation.

Cooperative funding provided by the East Foundation, Tim and Karen Hixon Foundation, and Feline Research Program of the Caesar Kleberg Wildlife Research Institute.



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Major Histocompatibility Complex Allele and Ocelot Recovery in Texas

John P. Leonard, Michael E. Tewes, Randy W. DeYoung, and Jan E. Janecka

The Major Histocompatibility Complex (MHC) is a genomic region that is important in innate and adaptive immune responses. MHC genes, known to code for antigen-presenting molecules, are among the most diverse loci in vertebrate genomes. A high diversity of MHC alleles in a population is believed to be crucial for population resilience, as it allows populations to respond to a wide variety of pathogens.

The ocelot in the United States is confined to several isolated subpopulations in South Texas and has experienced a recent reduction in genetic diversity. All studies of genetic variation undertaken on free-ranging ocelot populations have examined only neutral variation, using the genetic techniques of examining either microsatellites or mitochondrial DNA sequences. A growing body of evidence indicates that such neutral measures of genetic variation do not always provide a clear and unbiased estimate of functional genetic variation. Using genetic samples collected over 30 years in the United States and Mexico, we initiated a study to measure levels of MHC variation within historical and contemporary ocelot populations.

We have sequenced one of the most polymorphic sites in vertebrate genomes for 18 ocelots from Willacy County, 32 ocelots from Cameron County, and 3 ocelots from Mexico. We are currently preparing to genotype all ocelot samples in our collection for this specific genetic information. By combining information on MHC diversity with previously obtained information on neutral genetic diversity, we will have a more accurate

CKWRI researchers use genetic techniques to determine genetic diversity within and among ocelot subpopulations.

understanding of the genetic health of the remaining ocelot subpopulations that can be used to help guide future translocation efforts.

Cooperative funding provided by the Tim and Karen Hixon Foundation, East Foundation, Feline Research Program of the Caesar Kleberg Wildlife Research Institute, and Wild Cat Conservation, Inc.

Effects of Drought on Population Dynamics of Ocelot Prey in South Texas

Justin P. Wied, Jennifer M. Korn, Michael E. Tewes, and Lon I. Grassman, Jr.

Prey abundance is one of the most important factors affecting the long-term survival of ocelots in South Texas. Therefore, it is necessary to monitor prey population fluctuations, particularly as they pertain to variable drought conditions. We have a long-term rodent monitoring project on the Yturria Ranch in Willacy County, Texas—a location that represents 1 of 3 known ocelot subpopulations in Texas.

Rodents were monitored using 5 transects of 60 Sherman live traps during October 2013, March 2014, April 2014, August 2014, and December 2014. Traps were set for 4 consecutive nights. Individual rodents captured were given unique numbered metal ear tags to identify any that were recaptured.

The white-footed mouse and the deer mouse comprised most of the captures. The Mexican spiny pocket mouse and hispid pocket mouse were also commonly captured. The last capture of a hispid cotton rat prior

to August 2014 was in October 2011. The absence of this species was likely because of the prolonged drought experienced during this period. However, captures of the hispid cotton rat increased during the trapping session of December 2014.

Drought conditions continued in South Texas, but lessened from severe to moderate. Increased trapping success during this report period, compared to the previous period, was likely because of increased rainfall.

Sustained long-term monitoring of rodent populations on the Yturria Ranch is essential to ocelot management and conservation in South Texas. The results herein may be applied to other ocelot subpopulations, and they may provide conservation guidance.

Cooperative funding provided by the Feline Research Program of the Caesar Kleberg Wildlife Research Institute, Tim and Karen Hixon Foundation, Friends of Laguna Atascosa National Wildlife Refuge, and Wild Cat Conservation, Inc.

Camera Survey for Ocelots, Bobcats, and other Carnivores on East El Sauz Ranch

Justin P. Wied, John A. Leonard, Arturo Caso, Alfonso Ortega-Sanchez, Jr., Daniel J. Kunz, Lauren D. Balderas, Shelby B. Carter, and Michael E. Tewes

Remote camera traps are useful for documenting secretive carnivores such as ocelots, bobcats, and coyotes. We are conducting a long-term survey using cameras to monitor these species on the East El Sauz Ranch in Willacy County, Texas.

Twenty-eight camera trap sets were operated within ocelot habitat. Each camera set consisted of 2 infrared



© Justin Wied

Researchers are using remote cameras to monitor ocelots and other carnivores in the Lower Rio Grande Valley.

sensor cameras from which photos taken will allow us to recognize individual animals. Cameras were placed adjacent to animal trails that ocelots, bobcats, and coyotes used as travel paths.

From August 2013 to March 2014, we took 9,888 and 7,907 photos during 5,571 and 4,642 camera trap nights for the north grid and south grid, respectively. We obtained 195 ocelot, 209 bobcat, and 217 coyote photographs on the north grid. From the ocelot photos, 9, 9, and 10 individuals were identified on the north grid for the 3 sessions. We obtained 62 ocelot, 111 bobcat, and 167 coyote photographs on the south grid. From the ocelot photos, 5, 3, and 4 individuals were identified on the south grid for the 3 sessions.

This ongoing study will be useful to document ocelot, bobcat, and coyote populations on the East El Sauz Ranch and assess their demographics over time. The competitive pressures placed on ocelots by bobcats and coyotes may be better understood with continued monitoring.

Cooperative funding provided by the East Foundation, Feline Research Program of the Caesar Kleberg Wildlife Research Institute, Texas Parks and Wildlife Department, and Wild Cat Conservation, Inc.

Activity Patterns of Selected Felids in the Sierra Tamaulipas, Mexico

Sasha Carvajal-Villarreal, Arturo Caso, and Michael E. Tewes

Activity patterns may affect the coexistence of sympatric wild felids. We studied the activity patterns of the jaguar, cougar, ocelot, and jaguarundi in northern Mexico to determine the extent that activity patterns contribute to spatial avoidance.

Camera trapping surveys were used to assess activity patterns. Data were collected over 15 months from February 2009 to June 2010 to document felid activity. To calculate the activity patterns of the wild cats, we used the time stamp of each photo and grouped the records into 24, 1-hour intervals, with the number of events of each species per hour multiplied by 100 to obtain an index. For activity comparisons between species, we used the Chao-Jaccard Index to minimize the negative bias of traditional similarity indices and to calculate confidence intervals for the comparisons.

The index indicated the greatest pair-wise similarity occurred between ocelot-cougar, ocelot-jaguar, and jaguar-cougar. Jaguars and ocelots were principally nocturnal, cougars showed intermittent activity

throughout diurnal and nocturnal periods, and the only diurnal felid was the jaguarundi. The highest activity peak for the jaguar was at 2100 hours, while the cougar had several activity peaks with the highest peak at 1800 hours. The ocelot exhibited 4 peaks of activity: 0100 hours, 0300 hours, 2000 hours, and 2300 hours. Jaguarundis had a single peak activity, which occurred at 0800 hours.

This study is the first to examine the interaction among jaguars, cougars, ocelots, and jaguarundis in Mexico. Future research should incorporate diet and habitat use analyses, along with activity patterns, to determine the factors that may allow the coexistence or avoidance of these species.

Cooperative funding provided by the Tim and Karen Hixon Foundation, Caracol Ranch, Camotal Ranch, Barry Putegnat, Dean Putegnat, Feline Research Program of the Caesar Kleberg Wildlife Research Institute, and Wild Cat Conservation, Inc.

Development of a Genetic Pedigree for the Willacy and Cameron Ocelot Populations

Jennifer M. Korn, Jan E. Janecka, Randy W. DeYoung, Arturo Caso, and Michael E. Tewes

During the past 30 years, ocelots in Texas have primarily occurred in 2 subpopulations: on the Yturria Ranch (YTURRIA) in Willacy County and the Laguna Atascosa National Wildlife Refuge in Cameron County. Molecular studies suggest that these remnant subpopulations exist in isolation. Recently, a third subpopulation has been found on the East El Sauz Ranch (EAST) in



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CKWRI researchers are using genetic techniques to determine the pedigree of ocelots in South Texas.

Willacy County, which exchanges individuals with the YTURRIA subpopulation.

Our objective is to create a partial pedigree of individuals in the 3 subpopulations occurring in Texas. Creation of a partial pedigree using parentage analysis will identify the occurrence of migration between the subpopulations, determine if the loss of diversity is attributable to the monopolization of breeding by a few individuals, and identify possible inbreeding.

Blood samples for genetic analyses were collected from 1984 to present. We estimated parentage using the likelihood ratio approach in the software program CERVUS. We assessed assignment of maternity or paternity for 140 offspring.

Parentage analyses and construction of a partial pedigree identified 6 and 7 inbred relationships in the Cameron and Willacy subpopulations, respectively. Analyses of the YTURRIA and EAST subpopulations indicated multiple individuals as either migrants or with recent migrant ancestry between the 2 sites.

By using parentage assignments, we will have a partial pedigree for ocelots in Texas that can be used to select individuals for within Texas translocations and track the genetic contribution of translocated individuals. This information is needed in guiding future ocelot translocation strategies.

Cooperative funding provided by the Feline Research Program of the Caesar Kleberg Wildlife Research Institute, Tim and Karen Hixon Foundation, Friends of Laguna Atascosa National Wildlife Refuge, and Wild Cat Conservation, Inc.

Effects of Microhabitat Structure and Lure Encounter Rates on Bobcats

Gordon W. Watts, III and Michael E. Tewes

Wild felids can be difficult to survey because of their secretive habits. Researchers typically place sampling stations such as camera traps at microhabitat sites that they believe will maximize encounter rates. They may also use attractants to increase encounter rates. Our objectives are to examine the influence of microhabitat structure and lures on bobcat encounter rates.

Camera stations were placed in a grid that resulted in 26 to 29 camera stations per site spaced 650 to 1,950 yards apart. We systematically placed 1 of 2 call lures (attract animals from greater distances) and 1 of 4 local lures (attract animals in the immediate vicinity) at each camera station so all combinations of call lures and local lures were achieved.



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Understanding microhabitat use by bobcats can lead to better management strategies for this species.

Photograph count data were divided into 2 sessions for each study site. The data were organized so that total site effort (i.e., number of camera trap nights) was similar before and after the lure was applied. We examined the response of bobcats to microhabitat variables and lures at each camera station. Three of the 7 microhabitat variables were included in the final model: horizontal cover (1.6–3.2 feet), canopy cover greater than 3 feet high, and vegetation opening width. Lure and study site were not important variables in the final model.

Examining microhabitat structure along bobcat travel routes can help wildlife managers maximize encounter rates when implementing surveys. The focus should be on fine-scale habitat structure to increase encounter rates of bobcats.

Cooperative funding provided by the East Foundation, Feline Research Program of the Caesar Kleberg Wildlife Research Institute, and Wild Cat Conservation, Inc.

HABITAT RESTORATION AND ENHANCEMENT

Hixon Ranch Bobwhite Habitat Restoration Project

Timothy E. Fulbright, Fidel Hernández, Eric D. Grahmann, David B. Wester, Michael W. Hehman, Forrest S. Smith, Anthony D. Falk, Matthew N. Wojda, Monika L. Burchette, Anthony K. Henehan, and Benjamin R. Olsen

Conserving wild quail in the future may depend in part on our ability to restore native vegetation in areas that have been invaded by non-native grasses such as Old World bluestems and buffelgrass. Restoration of vegetation must be accomplished in a manner that provides all the habitat components needed by bobwhites such as nesting cover, foraging areas, and cover that provides protection from predators and extreme temperatures. Habitat restoration may help to create large areas of contiguous habitat where fragmentation has occurred by creating connecting corridors of restored habitat. The Hixon Ranch Project is the first large-scale research attempt at creating one of these quail habitat corridors, and it is the largest restoration research project attempted in South Texas.

We conducted a 4-year pilot study before starting the main project to develop the best restoration treatment possible. We then selected a 300-acre pasture dominated by non-native grasses to restore, and a nearby area of similar size as an experimental control. We burned the 300-acre area in January 2014, and removed some brush using a dozer. Brush mottes were left to provide loafing and thermal cover. We disked the entire 300 acres 4 times between January 2014 and June 2015 to deplete the soil of non-native grass seeds. The site is currently in the final stages of preparation for planting. In the next step, we will sow locally adapted native seeds of forbs and grasses. We will plant mottes of woody plants and prickly pear in a configuration where any quail in the restored area will have brush available within distance that a flushed bird can easily reach. We will monitor changes in vegetation and wildlife use from 2015–2018.

Cooperative funding provided by George C. “Tim” Hixon, the Hixon family, Hixon Ranch, Texas Parks and Wildlife Department, South Texas Chapter of the Quail Coalition, Coastal Bend Audubon Society, and ExxonMobil Summer Internship Program. Additional student support was provided by the various scholarships and named endowments listed on page 3 of this publication.

Maintaining Brush for Wildlife during Restoration

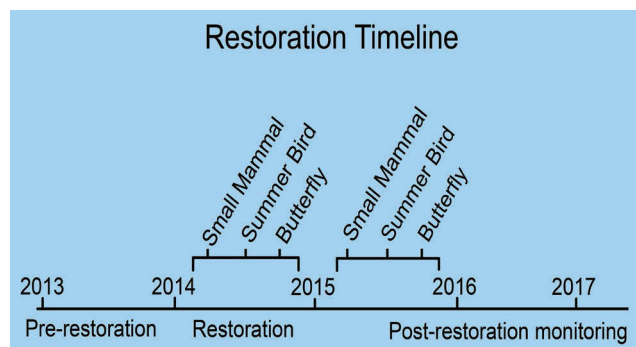
Anthony K. Henehan, Fidel Hernández, Timothy E. Fulbright, Eric D. Grahmann, David B. Wester, Michael W. Hehman, and Andrew N. Tri

Millions of acres of grasslands in southern Texas have experienced a reduction in native plant diversity, which in turn, negatively affects wildlife. This habitat alteration is caused by the aggressive spread of non-native grasses. Restoration of native plant

communities is one potential way to reverse declines of wildlife. We monitored grassland birds, migrating butterflies, and small mammals during restoration activities (2014–2015) on a restoration area, a non-native vegetation area, and native vegetation area. We left brush mottes of various sizes spaced across the restoration area to serve as refugia for wildlife.

Our preliminary results (June–July 2014) suggest that songbird densities were much lower on the restoration area (3.8 birds per acre) than the non-native area (13.5 birds per acre) or the native area (14.8 birds per acre). Migrating butterflies (October–November 2014) were 300% more abundant on the restoration area than the other 2 areas. Small mammals (March–April 2014–2015) were least diverse on the non-native area (3 species) and most diverse on the native area (6 species). The restoration area had 4 species.

Preliminary results may be explained by a lack of grass on the restoration area during the restoration process resulting in fewer birds and small mammals. In addition, when native vegetation began to return in the restoration area the primary vegetation consisted of flowering plants around which butterflies concentrated. Brush mottes helped maintain some



Timeline for restoration activities and wildlife surveys for the Hixon Ranch Project in La Salle County, Texas.

birds during restoration activities, but more vegetation diversity is required to support more species of small mammals. Flowers on the restoration area during migration resulted in a high abundance of butterflies.

This study represents the first effort of large-scale restoration in Texas. Findings will help land managers and biologists in managing grasslands dominated by non-native grasses and their associated wildlife.

Effects of In-Progress Restoration on Habitat Selection by Bobwhites

Monika L. Burchette, Timothy E. Fulbright, Fidel Hernández, David B. Wester, Eric D. Grahmann, Michael W. Hehman, Forrest S. Smith, Landen Gulick, and Shannon M. Hall

Large-scale restoration affects habitat use by animals and influences the thermal environment, but how animals respond to these changes is unclear. In this study, our objectives are to determine (1) the effects of restoration on bobwhite home range size, (2) how black globe temperature varies in plant communities, and (3) how thermal factors influence habitat selection by quail with and without broods.

We trapped and radio-collared 117 bobwhites from April to August in 2013 and 2014 on a 300-acre site being restored to native vegetation and a control site. Birds were tracked 2 to 3 times per week. Data collected at paired relocation and random sites included soil-surface temperature and black globe temperature. We analyzed the average black globe temperature from 80 stationary black globes placed within 5 plant communities on both sites.

We found no difference in size of home range or difference in habitat selection in the in-progress restoration area or control area. Once the restoration area was disked down to bare ground and before restoration seeding was conducted, only 18% of the area was used. Black globe temperatures were highest in grassland and grass-dominated patches in Tamaulipan scrub communities, exceeding 130° F at quail height. Black globe temperatures were lowest in the dense shade of plant communities along drainages, averaging 107° F. During summer, average temperatures in all plant communities were too hot for quail to use. However, birds were still able to find patches of thermal refugia below the plant community temperature average because black globe temperatures at bird locations were less than 106° F. When restoring bobwhite habitat, it is important to create thermally suitable woody plant mottes that reduce ground surface temperatures below 103° F during the midday in summer.

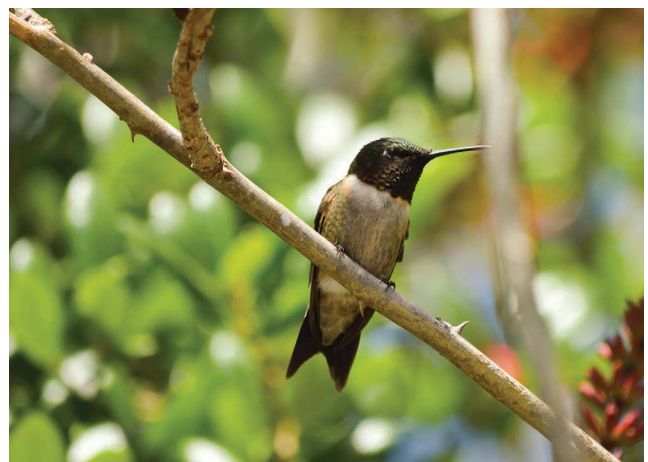
Habitat Restoration in South Texas for Pollinators

Anthony K. Henehan, Fidel Hernández, Eric D. Grahmann, Timothy E. Fulbright, David B. Wester, and Michael W. Hehman

Pollinating insects and birds play a vital role in the function of ecosystems. They serve as primary drivers of reproduction and genetic diversity for many species of flowering plants, as well as prey items for a multitude of wildlife species.

The spread of non-native grasses such as buffelgrass and Old World bluestems poses a substantial threat for pollinators because these plants out-compete and replace flowering plants that are important to pollinators. One way to reduce the loss of native plants and their respective pollinators may be through habitat restoration. However, habitat restoration for pollinators is little studied and understood. The objective of this study is to determine if planting flowering plants within brush mottes during grassland restoration will attract pollinators to the restoration area.

In May 2015, we began a habitat restoration effort for bees, butterflies, and hummingbirds within the 300-acre grassland restoration area. We identified 8 brush mottes to plant 4 densities of plants: control (no plants), low (1 plant per 26 ft²), medium (1 plant per 19 ft²), and high (1 plant per 13 ft²). We used 185 plants consisting of 6 species: tropical sage ($n = 48$), mealy sage ($n = 35$), red sage ($n = 15$), Texas lantana ($n = 26$), turk's cap ($n = 36$), and flame acanthus ($n = 25$). We will monitor plants during hummingbird breeding season (June–July), hummingbird migration (August–September), and butterfly migration



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Habitat restoration efforts that bring back native plant communities also help pollinators such as hummingbirds.

(October–November). This research will determine if these plantings can attract pollinators to grasslands currently devoid of flowering vegetation.

Restoring Bobwhite Habitat in South Texas: Seed Bank Dynamics

Matthew N. Wojda, Timothy E. Fulbright, Fidel Hernández, Eric D. Grahmann, David B. Wester, Forrest S. Smith, and Michael W. Hehman

Much of the native vegetation that once covered South Texas has been replaced by non-native invasive grasses such as buffelgrass and Old World bluestems. These invasive grasses reduce habitat quality for bobwhites and other wildlife, and reduce overall plant species diversity.

We are attempting to remove invasive species using a repeated disking technique that we developed in previous pilot studies. The process involves repeatedly disking new growth of the invasive species until the soil seed bank appears to be depleted of invasive grass seeds. Once the seed bank has been depleted, the area will be sown with seeds of native plant species.

The soil seed bank is sampled in the field. Soil samples are taken to the greenhouse to germinate seeds found therein. Emerging seedlings are identified and counted. We will sample the seed bank as the restoration process continues until there are no more invasive seeds as evidenced by no growth in soil samples maintained in the greenhouse.

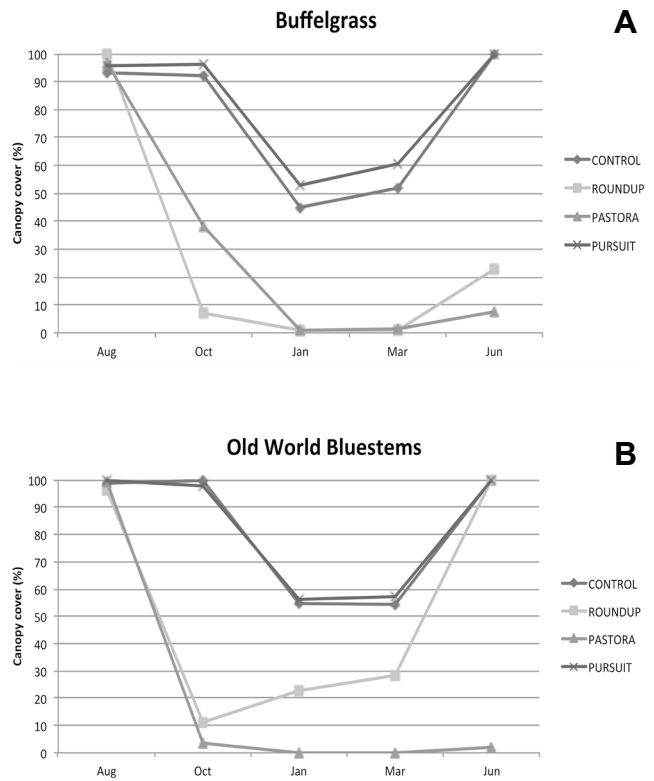
We have made 3 soil collections from the seed bank and are currently growing out the third soil collection in the greenhouse. Data from the first 2 collections have shown that one disking event decreased buffelgrass seeds by 87% and Old World bluestems by 63%.

Our preliminary results are very promising. Additional sampling of the seed bank will allow us to determine whether we are truly depleting the seed bank of these non-native invasive grasses.

Effects of Herbicides on Buffelgrass and Old World Bluestems

Matthew N. Wojda, Timothy E. Fulbright, Fidel Hernández, Eric D. Grahmann, David B. Wester, Michael W. Hehman, and Anthony D. Falk

Buffelgrass and Old World bluestems are exotic and invasive grasses that cover much of the rangeland landscape in South Texas. Studies have found that



Effects of applying herbicides on percent canopy cover of (A) buffelgrass and (B) Old World bluestems during a 10-month period of time compared to an experimental control with no herbicides applied in La Salle County, Texas during 2014–2015.

these grasses reduce the abundance of native plant and animal species.

Buffelgrass and Old World bluestems can be very difficult for a land manager to control as they are very hard to remove and, once removal has taken place, they often return. Herbicides are one of the most commonly used tools to kill these unwanted grasses. Roundup is an effective and affordable herbicide on most plant species, but requires multiple applications to remove buffelgrass and Kleberg bluestem. The goal of our study is to find a herbicide that requires fewer applications than Roundup to remove invasive grasses in South Texas.

We have been testing the effectiveness of Roundup, Pastora, Pursuit, and a combination of Pastora and Pursuit. Each herbicide is applied and replicated in plots dominated by buffelgrass as well as plots dominated by Old World bluestems. Two applications were applied in autumn 2014 and have been monitored monthly thereafter.

Preliminary results suggest that Pastora is more effective than Roundup; as of 10 months post-treatment for buffelgrass, there was a 92% and 72% reduction in canopy cover, respectively. Results also

suggest that Pastora is more effective than Roundup for Old World bluestems, which resulted in a 97% reduction in canopy cover. Roundup showed no reduction after 10 months post-treatment. Pursuit appeared to have no effect on the canopy cover of either grass post-treatment.

Our preliminary results are very promising for the removal of buffelgrass and Old World bluestems. At the completion of this study, we will be able to recommend which herbicide treatment will be effective in controlling buffelgrass and Old World bluestems in South Texas landscapes.

Wintering Bird Response to Grassland Restoration

Anthony K. Henehan, Fidel Hernández, Timothy E. Fulbright, Eric D. Grahmann, David B. Wester, Michael W. Hehman, and Andrew N. Tri

Grassland birds have experienced steep declines nationwide in recent decades. One of the main causes is the loss of wintering habitat. Some of the major threats facing grassland birds and their habitat include the increase of woody vegetation, the breaking up of large contiguous grasslands into small parcels, and degradation of native grasslands. Degradation can occur from the increase of non-native grasses. These grasses pose a significant threat because they can out-compete diverse plant communities, which provide food and shelter for birds. Buffelgrass, for example, has spread over millions of acres in Texas—an important state for wintering grassland birds.

We are monitoring wintering grassland birds on the large-scale (300 acres) grassland restoration area,



© Forrest Smith

Native grasslands represent a vital resource to many avian species wintering in South Texas.

a non-native vegetation area, and a native vegetation area. We began data collection during 2013 (pre-restoration) and continued collection in 2014 (during restoration). During restoration activities, we removed all non-native grass, but left brush mottes to determine if they would act as refugia for birds during winter.

Pre-restoration winter bird density was similar on the non-native and restoration areas (12.8 birds per acre and 11.6 birds per acre, respectively). These areas were nearly identical in vegetation composition during that time (e.g., solid stands of buffelgrass and Old World bluestems).

When the restoration process began, bird numbers declined by 330% (3.4 birds per acre) since most of the vegetation was completely removed. However, maintaining brush mottes appeared to help retain some birds on the area. These data represent the first documented response of wintering birds in Texas to large-scale restoration and will aid in providing landowners with information to increase birds on their property.

Restoring Bobwhite Habitat: Buffelgrass and Old World Bluestem Ecology

Matthew N. Wojda, Timothy E. Fulbright, Fidel Hernández, Eric D. Grahmann, David B. Wester, Forrest S. Smith, and Michael W. Hehman

The landscape of South Texas has changed dramatically since the introduction of non-native invasive grasses. These non-native grasses reduce the habitat quality for many wildlife species including bobwhites. Two of these grasses, buffelgrass and Old World bluestems, cover much of South Texas including the area that is currently being restored on the Hixon Ranch. We must know how these grasses interact with their surrounding biotic and abiotic factors to understand how to remove these grasses.

Our objective is to determine how these invasive grasses interact with the surrounding vegetation, soils, and soil seed bank. We sampled herbaceous and woody vegetation, determined soil chemical properties, and collected samples from the soil seed bank prior to the restoration process in June and October of 2013. Currently, we are conducting statistical analysis, which will help us understand how these non-native grasses can out-compete native vegetation.

Upon completion, we will have a better understanding of the relationship between invasive grasses and soil physical and chemical properties. Information obtained from this study can be used to create lasting native habitat on the Hixon Ranch.

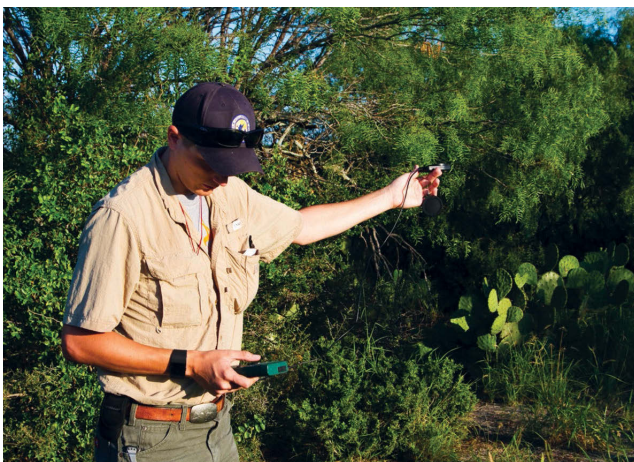
Using Global Positioning Systems Units on Bobwhites in a Restoration Project

Benjamin R. Olsen, Timothy E. Fulbright, Fidel Hernández, Eric D. Grahmann, David B. Wester, Forrest S. Smith, and Michael W. Hehman

Radio telemetry is one of the most useful techniques for studying wild bobwhites in the field. However, Very High Frequency (VHF) telemetry requires researchers to track and approach radioed birds to obtain information about the bird's location. Because bobwhites require transmitters that weigh no more than 0.25 ounces, past bobwhite research has been limited to VHF telemetry. With the advances in technology, Global Positioning Systems (GPS) units, which were once too heavy, can now be used.

Our objectives are to (1) measure bobwhite reactions to peak predator densities and (2) evaluate the difference between locations obtained by humans tracking birds compared to more natural locations obtained by remote GPS transmitters attached to birds. We will deploy 4 GPS units in August (period of average resident raptor density) and January (peak resident and migratory raptor densities). The units will gather 5 GPS locations for each radioed bobwhite every day for 20 days. After the 20 days, birds will be recaptured so the data can be downloaded from the GPS units. During the GPS deployment period, each bird will be tracked using standard VHF tracking techniques 3 times a week. The birds will be tracked within 15 minutes of a GPS location.

The data collected will be used to compare peak and non-peak raptor density periods to the distance bobwhites spend away from woody cover, as well as



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Graduate student Ben Olsen recording light intensity values on the Hixon Ranch.

to compare the telemetry-based locations to the GPS locations. If our initial experiments are successful, we will purchase additional GPS units to achieve a larger sample size in 2016. Information obtained from our work could provide researchers with a more efficient way to study bobwhites at a finer scale.

The Impact of Thermal Factors on Bobwhite Habitat Selection

Monika L. Burchette, Timothy E. Fulbright, Fidel Hernández, David B. Wester, Eric D. Grahmann, Michael W. Hehman, Forrest S. Smith, Landen Gulick, and Shannon M. Hall

Excessive heat can fragment bobwhite habitat creating only small areas that bobwhites can use during midday. Past researchers concluded bobwhites avoid operative temperatures greater than 104° F. Operative temperature can be obtained using black globe temperature recording units. New equipment, such as hand held black globes, allows us to assess the thermal environment on a finer, bird-centered scale.

Our objectives are to (1) compare the strength of the relationship among black globe temperatures recorded at the plant community scale, individual bird location scale, and habitat selection scale and (2) determine if measuring ground surface temperature at bobwhite locations is a better predictor of where a bird is going to be than black globe temperatures.

We tracked bobwhites and recorded bird activity, ground surface temperature, and hand held black globe temperatures at paired location and random sites for each bird 2 to 3 times per week during May–August 2014. We placed 80 stationary black globe units within 5 plant communities to get an estimate of plant community temperatures. These temperatures were averaged and then compared with bird locations and random locations within the vegetation community at the nearest half hour.

We found that surface temperature was the best predictor of bobwhite habitat selection, followed by hand-held black globe and plant community black globe temperatures. We recommend that researchers in the future include measurements of ground surface temperature when studying the influence of the thermal environment on habitat use by bobwhites.

** End of In-Progress Hixon Ranch Project Abstracts **

Update on Activities and Accomplishments of the South Texas Natives Project

Forrest S. Smith

South Texas Natives (STN) will celebrate 15 years of operations in 2016. The program has accomplished much in collaboration with the USDA Natural Resources Conservation Service (NRCS) E. “Kika” de la Garza Plant Materials Center, Rio Farms, Inc., Texas Department of Transportation (TxDOT), Douglass W. King Seed Company, Pogue Seed Company, and hundreds of South Texas private landowners.

Meeting the needs for locally-adapted native seed has been the primary goal of STN. To date, more than 30 South Texas-origin native seed products have been released. Most of these seed selections have been successfully and substantially commercialized by Douglass W. King Seed Company. Commercial seed supplies of these releases have been produced in quantities sufficient for over 30,000 acres of plantings annually by consumers in each of the past 4 years.

Promoting the use of native seeds on public and private lands is another goal of STN. Because of work by STN, seeding specifications of TxDOT and NRCS have been substantially changed—now included is the use of STN-developed native seeds. Substantial demonstration efforts have had many positive impacts since 2008, both on rangelands and in the Eagle Ford Shale and associated pipeline infrastructure.

We will continue working to meet native plant restoration challenges in South Texas. Our current focus is to make additional native seed selections available for use in restoring rangelands, reclaiming land dominated by exotic grasses, converting cropland to wildlife habitat, increasing pollinator habitat, and improving quail habitat. With the continued generous support of private, state, and federal partners, we look forward to another 15 years of success.

Cooperative funding provided by donors to South Texas Natives.

Improving Commercial Seed Supplies of Native Pollinator Plants for Texas

Forrest S. Smith, John Lloyd-Reilley, Anthony D. Falk, Keith A. Pawelek, Colin S. Shackelford, and Shelly D. Maher

Loss of native plant communities is thought to have considerable impacts on the abundance and diversity



© Forrest Smith

Seed of Indian blanket is being made available for use in pollinator plantings in Texas.

of pollinators. Most habitat restoration efforts in Texas have focused on the most abundant native plants, typically native grasses or woody species. Recent concerns over the decline in pollinators have led to greater demand for seeds of native flowering plants that benefit pollinators. However, the lack of large supplies of economically priced seeds of these plants limits their use in large-scale restoration efforts.

We are working to collect and increase seed stock of a number of common pollinator plants found in Texas. Species currently being increased include tropical salvia, gayfeather, frostweed, basketflower, tropical neptunia, skeleton leaf goldeneye, golden dalea, and Indian blanket. We have also revamped efforts to increase seed supplies of our previous pollinator-friendly releases, including Zapata Germplasm Rio Grande clammyweed, Venado Germplasm awnless bushsunflower, Goliad Germplasm orange zexmenia, Rio Grande Germplasm prairie acacia, and Balli Germplasm prostrate bundleflower. Large quantities of seed of each of these plants are being grown for distribution to commercial seed producers.

In 2015, a small-scale program was started to provide seeds to a limited number of cooperators conducting restoration projects to benefit pollinators and to stimulate awareness of the benefits of including these plants in seeding mixtures. The inclusion of flowering native plants in restoration seed mixes should have positive effects on improving and providing habitat for pollinators and other wildlife in Texas.

Cooperative funding provided by donors to South Texas Natives, USDA Natural Resources Conservation Service E. “Kika” de la Garza Plant Materials Center, and U.S. Fish and Wildlife Service.

Development of the TxDOT Right-of-Way Manager's Plant Field Guide

Colin S. Shackelford, Mia A. McCraw, Keith A. Pawelek, Anthony D. Falk, and Forrest S. Smith

Texas Native Seeds (TNS) is developing a plant identification field guide. It is designed for Texas Department of Transportation (TxDOT) right-of-way managers and contractors. The guide includes over 100 species representing plant releases from *South Texas Natives* and the USDA Natural Resources Conservation Service Plant Materials Program, plants being developed for commercial production through the TNS project, and other native plants.

The guide was developed to meet the need for those more familiar with highway engineering than plants. TxDOT personnel will be able to use the field guide for proper identification of seed that is about to be planted as part of the revegetation work on a completed construction project. Contractors can also use the guide for developing proper planting rates for revegetation work as well as be able to identify seedling emergence in completed planting projects.

Information for each species includes photos of plants at all stages: seed, seedling, mature plant, and flowering parts. Also included is a state distribution map, a brief description of the plant characteristics as well as information on seeding rates, number of seeds per pound, descriptions and range of adaptation for existing plant releases, and information on the types of soils the plant can tolerate. The field guide is in the final stages of completion with the hopes of copies being distributed to TxDOT field personnel and contractors by the end of 2015.

Cooperative funding provided by the Texas Department of Transportation.

Effects of Seasonal Burning on Cordgrass Communities in Coastal Texas

Adam E. Toomey, Sandra Rideout-Hanzak, David B. Wester, Tyler A. Campbell, Alfonso Ortega-Sanchez, Jr., and Victoria L. Haynes

Gulf cordgrass inhabits thousands of acres along Texas' coastal regions, and it is considered valued habitat and forage for various species. Cordgrass is a highly productive grass that can be found in continuous stands, but mature individuals are often



© Forrest Smith

Prescribed fire is being used on cordgrass stands to see if this technique can be an effective management tool.

undesirable forage because of coarseness, decreased palatability, and low nutritive quality. Prescribed burning can remove mature tissue and allow new growth that is more palatable and nutritious. The purpose of this research is to determine how season of burning affects the vegetative characteristics of cordgrass communities.

Our study is being conducted at the East El Sauz Ranch in Willacy County, Texas. We established 10 500-acre sites within cordgrass pastures. Sites were randomly assigned a fall, spring, or no burning treatment. We will sample vegetation before and after burning for species association, composition, diversity, production, nutritive quality, mortality, and recruitment. By studying the effects of different seasons of prescribed burning, we hope to improve the current management techniques for cordgrass communities.

Cooperative funding provided by the East Foundation and South Texas Chapter of the Quail Coalition.

Seed Bank Dynamics on Stockpiled Topsoils in the Western Rio Grande Plains

Mylea C. Lovell, Anthony D. Falk, Keith A. Pawelek, Forrest S. Smith, Veronica Acosta-Martinez, Sandra Rideout-Hanzak, Paula Maywald, Terry L. Blankenship, and David B. Wester

One of the most important features of our natural landscapes is topsoil. Topsoil links abiotic and biotic components of ecosystems through nutrient cycling and energy flow. Topsoil is also vulnerable

to disturbance associated with energy production. A common management recommendation is to stockpile topsoil for future use.

We are studying seed bank characteristics in stockpiled topsoils at 2 sites. We are using the plant emergence method to quantify seed bank size and composition and are assessing the dynamics associated with stockpiles as they age.

Results suggest that age of our stockpiles had no perceptible effect on seed bank characteristics. Differences in seed bank characteristics between stockpiled soil and intact soil and among sampling depths varied between study sites as well as season of sampling. These findings are likely caused by differences in soil characteristics, surrounding vegetation, and associated management practices. Protection of the seed bank through timing of management practices during an appropriate season and adding amendments to the soil would increase the value of stockpiled topsoil needed for future restoration activities.

Cooperative funding provided by the Houston Advanced Research Center and Alston and Holly Beinhorn.

West Texas Plant Materials Evaluation Site Expansion

Colin S. Shackelford, Jameson S. Crumpler, Louis A. Harveson, Keith A. Pawelek, Anthony D. Falk, and Forrest S. Smith

Infrastructure construction and farm site improvements have been completed on the Railway Ranch for a new plant evaluation and research site located



© Colin Shackelford

Evaluation plots at the Railway Ranch will be used to make selections of native plants that are adapted to West Texas.

in Upton County, Texas. This site was not possible without the help of ranch owner Stan Smith who generously agreed to donate use of 5 acres for this project. Improvements to the site include a new high fence, water well infrastructure improvements, and a new irrigation system.

Sixteen species were planted in mid-May. Silver bluestem, cane bluestem, and sideoats grama are in the final stage of evaluation before commercial release. The remaining 13 species will be released following 2 to 3 years of field research and selection efforts.

The availability of 2 research facilities for *Texas Native Seeds* in West Texas will allow plant material evaluations under varied climatic and soil conditions characteristic of this region. With much of the Trans-Pecos climate represented at the Sierra la Rana plant evaluation site in Alpine, the Railway Ranch site will provide much needed data to support plant material selections representative of the climate and soils found on the western Edwards Plateau, the southern Rolling Plains, and the Southern High Plains. This will allow *Texas Native Seeds* researchers to make more informed decisions on plant material releases based on local plant and seed performance, and ultimately, to release suitable seed selections for use in West Texas plant restoration projects.

Cooperative funding provided by the Texas Department of Transportation, Stan Smith, and the Railway Ranch.

Seed Increase of Little Barley to Provide Seed Stock for Release

Anthony D. Falk, Forrest S. Smith, Keith A. Pawelek, Colin S. Shackelford, Mia A. McCraw, James P. Muir, Louis A. Harveson, Chase A. Murphy, Dennis K. Markwardt, John Lloyd-Reilley, Shelly D. Maher, Jeff R. Breeden, Gary Rea, Brandon Carr, and Bonnie J. Warnock

Little barley is a cool season, native annual grass found throughout Texas. It is a colonizing species that quickly establishes itself in disturbed areas. This species may have utility for the Texas Department of Transportation as a cover crop to protect new right-of-ways from erosion until permanent vegetation can be seeded. Little barley is also complimentary to wildflowers. It has little value to deer, which can be attracted to roadsides by other cool-season cover crops, resulting in concerns about vehicle-deer collisions.

We selected 4 little barley populations for seed increase from an evaluation of over 30 collections

made throughout Texas. Selections were made based on origin, growth habit, seed production, and seed quality. Our goal is to make selections that could be economically mass-produced while having a wide range of adaptation across the state, which would facilitate adequate market size.

The first attempt to increase little barley was made in 2014. We planted 50 plants of each selection in Stephenville, Texas. These initial plots failed to produce seed because of inclement weather and late planting dates. Subsequently, plantings were made in spring 2015 at the *South Texas Natives* farm at the Tio and Janell Kleberg Wildlife Research Park in Kingsville, Texas. We successfully produced and harvested 2 to 5 pounds of little barley seed of each accession in 2015, which will allow us to plant much larger seed increase fields in 2016.

We hope to release a regionally adapted germplasm of little barley to commercial seed dealers for production in 2017. Once the germplasm of little barley is released, seed should be available from commercial growers thereafter.

Cooperative funding provided by the Texas Department of Transportation and numerous donors to Texas Native Seeds.

Update on the Progress of the *Texas Native Seeds* Project

Forrest S. Smith

Texas Native Seeds (TNS) began operations in Central and West Texas in September 2010. In 2015, we made the first seed releases (white tridens and



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Seed increase projects for white tridens (left) and purple threeawn (right) are underway by *Texas Native Seeds*.

purple threeawn) for use in these regions. In 2014, the Texas Department of Transportation (TxDOT) amended all seeding specifications for rural areas in Central and West Texas based on the work of the TNS. TxDOT now specifies native plants for these rural seeding projects.

We have obtained 1,643 seed collections of native plants from 2010–2015. Although hampered in early stages of the project by widespread drought, substantial progress has been made toward seed collection goals. These collections have facilitated current evaluation and selection studies on over 40 species of native plants for future seed releases. Evaluation locations include the Sierra la Rana Ranch near Alpine, Railway Ranch near Odessa, USDA Natural Resources Conservation Service (NRCS) James E. “Bud” Smith Plant Materials Center near Knox City, and the Texas AgriLife Research and Extension Center in Stephenville. Evaluation sites in Alpine and Odessa were built from scratch by project personnel.

Major financial support for TNS has been provided by the Texas Department of Transportation, augmented by several private foundations, and recently by the NRCS. Continued efforts to further develop the TNS program are being undertaken to ensure sustainability. We are extremely grateful for the contributions and cooperation of our partners, including Texas AgriLife Research in Stephenville, Tarleton State University, the USDA NRCS Plant Materials Center in Kingsville and in Knox City, and the Borderlands Research Institute for Natural Resources at Sul Ross State University.

Cooperative funding provided by Texas Department of Transportation, donors to the Texas Native Seeds Project, and USDA Natural Resources Conservation Service.

***Texas Native Seeds* – Central Texas Native Seed Collections**

Marissa D. McGhee, Forrest S. Smith, Keith A. Pawelek, Anthony D. Falk, Colin S. Shackelford, Dennis K. Markwardt, James P. Muir, Jeff R. Breeden, and Mia A. McCraw

Texas Native Seeds (TNS) has spent much of the past 5 years obtaining seed collections from Central Texas. Seed collections from a priority collection list of 45 grass and forb species have been acquired from throughout the 67 counties included in the ecologically diverse Central Texas region since 2010, primarily from private ranches.

In the past year, 56 collections were made from 13 counties. These included seeds of 37 grasses and 19 forbs. Our goal is to obtain at least 30 total collections of each species of interest, as well as a wide distribution of collections across the region. Reaching this goal allows evaluation of potential genetic and morphological diversity within the plant species.

Once target plant populations are located, a small seed collection is obtained by hand, and soils, location, and the ecological site name are documented. Each seed collection is cleaned, weighed, catalogued, and accessioned through our partnership with the USDA Natural Resources Conservation Service Plant Materials Center in Knox City. Seed collections obtained by TNS are available for use by project personnel and cooperative researchers.

Access to private ranches has significantly increased the number of collections available for our work. Growing participation and support from private landowners and state agencies have been essential to our success in the region. Efforts to obtain needed collections will continue for several years in order to develop regionally adapted seed sources to meet restoration needs in Central Texas.

Cooperative funding provided by the Texas Department of Transportation, Lee and Ramona Bass Foundation, and the Caesar Kleberg Partners.

Development of Milkweed Seed Supplies for Texas

Forrest S. Smith, John Lloyd-Reilley, Chris Best, Anthony D. Falk, Colin S. Shackelford, Keith A. Pawelek, and Shelly D. Maher

Concerns over the population decline and potential Endangered Species Act listing of the monarch butterfly have made the lack of seed supply of native milkweeds a high profile issue in the conservation community. Milkweeds are the only plants that rear monarchs. Native milkweeds found in Texas may be critically important to the North American monarch population. Texas milkweeds host the first spring and final fall breeding efforts of the butterfly for its spring and fall migrations, respectively. Some of the most widespread species found in the state include zizotes, green, and antelopehorn milkweeds.

Unfortunately, little past demand for milkweed seeds has resulted in almost none being available for restoring monarch habitat. At present, the regionally



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Zizotes milkweed seed sources are being developed to provide seed for monarch habitat restoration in Texas.

adapted seeds available from commercial sources cost \$0.60 per seed, and only small quantities are available to consumers. Seed costs and lack of supply make large-scale restoration of monarch habitat impractical because planting costs range upwards of several thousand dollars per acre at current seed prices and recommended planting rates.

We are working to obtain seed collections of zizotes, green, and antelopehorn milkweeds, and determine their large-scale seed production requirements. Eventually, we hope to release seed stock of ecotypic selections of each of these 3 milkweed species to commercial growers for production. The commercial availability of economically priced native milkweed seeds should have positive impacts on efforts by public and private entities in Texas to help sustain and restore the migratory population of monarch butterflies in North America.

Cooperative funding provided by the U.S. Fish and Wildlife Service, donors to South Texas Natives, and the USDA Natural Resources Conservation Service E. "Kika" de la Garza Plant Materials Center.

Habitat Suitability for Extant Populations of South Texas Ambrosia

Anastasia I. Krainyk, Ashley C. McCloughan, Bart M. Ballard, Sandra Rideout-Hanzak, and David B. Wester

South Texas ambrosia is a perennial, herbaceous plant in the sunflower family, which historically occurred in Jim Wells, Nueces, Cameron, and Kleberg

counties of South Texas and in the state of Tamaulipas, Mexico. Unfortunately, little is known about South Texas ambrosia.

Currently, there is no peer-reviewed literature published on South Texas ambrosia. Only anecdotal evidence and extrapolations from other plants in the same taxonomic family can be found in a report compiled by the U.S. Fish and Wildlife Service describing the likely ecology and biology of South Texas ambrosia.

We know that South Texas ambrosia once occurred in coastal prairie habitats within the region. However, the loss of coastal prairies through land use changes has led to a decline of the South Texas ambrosia population. Today, there are only 6 confirmed sites where South Texas ambrosia occurs.

There is considerable interest in identifying possible sites where South Texas ambrosia can occur, which will be useful for restoration efforts. This interest has highlighted the need for a spatial model that identifies potential suitable habitats for South Texas ambrosia. Additionally, new information from research conducted at the Caesar Kleberg Wildlife Research Institute regarding the management of this species has increased interest in identifying sites for South Texas ambrosia reintroductions, particularly those that can be managed through prescribed fire and mowing.

Our goal is to use locations of known populations to identify the key habitat features needed by South Texas ambrosia. With this information, we plan to build a spatial model, which will identify areas of potentially suitable habitat within the historical range of the species.

Information obtained in this study will be valuable in defining where South Texas ambrosia can occur in the region. This knowledge can then be used to aid in the recovery and management of this native species.

Native Seed Collection in West Texas to Develop Commercial Seed Sources

Colin S. Shackelford, Jameson S. Crumpler, Louis A. Harveson, Keith A. Pawelek, Anthony D. Falk, and Forrest S. Smith

Native seed collections have continued across the 37-county West Texas program region of *Texas Native Seeds*. From 2011–2015, project personnel accessed 60 properties resulting in over 800 new collections for use in the development of native seed sources. Extensive collaboration with private landowners and natural resource agencies granting access to their



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Seed collections are ongoing in West Texas in support of the development of regionally adapted native seed sources.

properties provides a majority of the plant collections used for our research.

Our efforts have focused on a collection list of 37 grasses and 40 forbs representing annual and perennial plants from multiple ecological communities and stages of plant succession. Collection lists were developed in partnership with regional resource professionals, academic partners, and interested landowners. Our goal is to collect a minimum of 30 populations across the geographic distribution of each species of interest before beginning plant material evaluations. Collection data are compiled and mapped annually for use in prioritizing future seed collection efforts. We plan to collect 2 populations from each county within the range of each plant species.

The abundant rainfall that occurred across West Texas in 2015 has set the stage for an unusually productive growing season, which plants will produce abundant seed and will greatly aid in our seed collections. These conditions combined with a number of new landowner partnerships, especially in the northeast portion of the project region near Abilene, should help us substantially meet many of our seed collection goals for West Texas.

Seed collection efforts in West Texas are an integral part of the eventual release and subsequent commercial availability of ecotypic native seed sources. Ultimately, our efforts will aid in native plant restoration of rangelands within the West Texas region.

Cooperative funding provided by the Texas Department of Transportation and the USDA Natural Resources Conservation Service.

Seed Increase of Past and Upcoming Native Seed Releases

Keith A. Pawelek, Dean N. Williams, Robert Obregon, Juan Garza, Forrest S. Smith, Andrew W. Scott, Jr., Anthony D. Falk, and John Lloyd-Reilly

Seed production in 2014 was again down a little from past years because of irrigation restrictions at Rio Farms in Monte Alto, Texas, which is one of our cooperators. To provide needed seed quantities, we developed a plan to use partnerships with cooperating commercial seed growers to help in the second stage of seed increase, while still keeping small seed increase plots at Rio Farms and the *South Texas Natives* farm at the Tio and Janell Kleberg Wildlife Research Park in Kingsville, Texas.

The small plots will serve as initial seed increase plots. These plots will be maintained on a long-term basis to minimize the potential of a major setback caused by any one plot failure and ensure that high quality supplies of stock seed of each plant release are continuously available to commercial growers.

In 2015, Douglass W. King Seed Company partnered with us to use their acreage, equipment, and personnel in establishing larger seed increase fields of species nearing release at a farm near San Antonio that has access to ample irrigation water. Species being grown with Douglass W. King Seed Company's help in 2015 will be sand dropseed, spike lovegrass, red lovegrass, white tridens, switchgrass, Indiangrass, brownseed paspalum, and big bluestem.

Seed produced through these efforts will be distributed to commercial seed companies for production of each species upon release. Because of our partnership,



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A commercial seed source of big bluestem for South Texas is being developed by *South Texas Natives*.

South Texas Natives and the USDA Natural Resources Conservation Service E. "Kika" de la Garza Plant Materials Center will make 5 new native seed releases in each of the next 2 years.

Cooperative funding provided by Rio Farms, Inc., Douglass W. King Seed Company, USDA Natural Resources Conservation Service, Joan and Herb C. Kelleher Charitable Foundation, and numerous donors to South Texas Natives.

Soil Microbial Communities on Stockpiled Topsoils in the Western Rio Grande Plains

Mylea C. Lovell, Anthony D. Falk, Keith A. Pawelek, Forrest S. Smith, Veronica Acosta-Martinez, Sandra Rideout-Hanzak, Paula Maywald, Terry L. Blankenship, and David B. Wester

Soil microbial communities are fundamental indicators of ecosystem function and health. These communities are also complex and dynamic over time and are sensitive to physical disturbances associated with energy production.

We are studying microbial community size and composition of stockpiled topsoils at 2 study sites in the western Rio Grande Plains. Soils are stockpiled when oil and gas companies dig trenches for pipelines and other excavation activities. The soils are then used to cover over the disturbed area.

We have collected soil samples at different depths in our stockpiles as well as in different seasons; intact, undisturbed soils are also sampled. In general, microbial community size (whether measured by microbial biomass carbon, microbial biomass nitrogen, or total fatty acids) decreases with increasing sample depth in the undisturbed intact soil, but does not change by depth in stockpiles. Furthermore, microbial community size was generally smaller at a 0 to 4-inch depth in stockpiles compared to intact soil. Microbial communities also generally differed in winter months and summer months. Finally, microbial communities in stockpiles differed from communities in intact soils throughout our 2-year sampling effort.

Results generally show a loss of spatial organization of microbial biomass as a consequence of strip-ping and stockpiling topsoil. Chances for future restoration success using stockpiled topsoils likely would be enhanced with organic amendment.

Cooperative funding provided by the Houston Advanced Research Center and Alston and Holly Beinhorn.

Grazing Behavior in Burned Coastal Cordgrass in South Texas Landscapes

Victoria L. Haynes, Sandra Rideout-Hanzak, J. Alfonso Ortega-Santos, David B. Wester, Tyler A. Campbell, Alfonso Ortega-Sanchez, Jr., and Adam E. Toomey

Gulf and marshhay cordgrasses are native perennial grasses that are prevalent in Texas coastal prairies. When cordgrass remains undisturbed and matures, its nutritional value declines, creating unpalatable and degraded forage for livestock.

In this study, we will apply prescribed fire to large cordgrass areas to remove old growth. We will then monitor the movement and foraging behavior of livestock within and around burned and non-burned areas. Our objectives are to (1) determine whether prescribed burning of cordgrass creates a grazing preference over non-burned cordgrass after burning in fall or spring, (2) determine the length of the preference and compare effects of season on length of preference, and (3) develop prescribed burning recommendations that will maximize livestock forage of cordgrass on a sustained basis.

This study is being conducted on the East Foundation's East El Sauz property in Willacy County, Texas. The study site consists of 10 plots (about 500 acres each). We will burn 2 plots each fall and spring with the first 2 plots being burned in fall 2015, for a total of 8 burned plots and 2 unburned control plots. We will track 20 head of cattle using Geographic Positioning Systems (GPS) collars in the first year, and we will add more individuals during the second year.

Grazing and prescribed fire are valuable habitat management treatments that encourage the



© Adam Toomey

Studies are underway to evaluate how prescribed fire influences grazing use of dense cordgrass stands.

development of new plant tissue through regrowth. Cordgrass has the potential to be a valuable grazing forage if proper management is applied to maintain an active growth stage.

Cooperative funding provided by the East Foundation.

Texas Native Seeds – Central Texas Plant Evaluations

Marissa D. McGhee, Forrest S. Smith, Keith A. Pawelek, Anthony D. Falk, Colin S. Shackelford, Dennis K. Markwardt, Chase A. Murphy, James P. Muir, Jeff R. Breeden, and Mia A. McCraw

Texas Native Seeds is currently in its 5th year of operations in Central Texas. Evaluation studies to aid native seed source development are being conducted at the Texas A&M AgriLife Research and Extension Center in Stephenville and the USDA Natural Resources Conservation Service James E. “Bud” Smith Plant Materials Center in Knox City.

Currently, plantings of 4 grass species, 1 forb species, and 1 legume species are being monitored at each of the Central Texas evaluation sites. These plantings represent collections of 322 plant populations, which include the following: 22 populations of plains bristlegrass, 97 populations of slim tridens, 48 populations of sand dropseed, 60 populations of hooded windmillgrass, 27 populations of golden dalea, and 68 populations of bundleflower. These evaluations originate from plant materials collected from across 67 counties in the Central Texas area.

Data collection at each planting location is completed monthly during the growing season. Seed is collected from each population for seed quality analyses. Plant performance data and seed germination results will be used to make selections of populations of each species for release as germplasms for production by commercial entities.

Native plant seed releases developed by *Texas Native Seeds* will provide new seed resources for land reclamation and restoration in Central Texas. Future releases will ensure that there is a consistent supply of high-quality, economically-priced native seeds for public and private landowners.

Cooperative funding provided by the Texas Department of Transportation, Lee and Ramona Bass Foundation, Ewing Halsell Foundation, Caesar Kleberg Partners, and numerous donors to Texas Native Seeds.

Commercial Seed Production of *South Texas Natives* Program Seed Releases

Keith A. Pawelek, Forrest S. Smith, Anthony D. Falk, Dean N. Williams, and Keith J. Walters

Commercial seed production and sales of native seed releases made by *South Texas Natives* (STN), the USDA Natural Resources Conservation Service E. “Kika” de la Garza Plant Materials Center, and Texas A&M AgriLife Experiment Research Station in Beeville were again strong in 2014 despite a dry start.

Seed of 25 released species is currently being grown by commercial producers. Total production of STN seed releases was over 41,000 pounds in 2014. Reports from commercial producers indicated that the demand in 2014 was very strong, and sales topped that of 2013. Sales reported through May 2015 are on pace to substantially exceed 2014 totals.

The fall 2014 harvest was strong, while the spring 2015 harvest was hindered by wet weather limiting field access. STN personnel are working with the Douglass W. King Seed Company to add large-scale production fields of Goliad Germplasm orange zexmenia, Starr Germplasm silver bluestem, Duval Germplasm red lovegrass, Ramadero Germplasm spike lovegrass, and Nueces Germplasm sand dropseed.

Average seed prices have also decreased because of increased production. Seed mixes for rangelands have been ranging \$80–120 per acre. Ample quantities of most releases made through the STN partnership should be available for plantings in 2016.

Cooperative funding provided by the numerous donors to South Texas Natives.

The Effects of Tanglehead on Ecosystem Processes and Native Plants

Joshua L. Grace, David B. Wester, Sandra Rideout-Hanzak, J. Alfonso Ortega-Santos, and Veronica Acosta-Martinez

Invasive grasses are quickly becoming a top concern of wildlife and range managers throughout South Texas. This is the case with tanglehead, a native grass invading much of the Texas Coastal Sandsheet.

We began a study in 2012 to determine just how tanglehead impacts native plant communities and ecosystem processes. Our objectives are to (1) determine whether tanglehead affects composition and structure of plant communities and whether they affect seasonal



© Forrest Smith

Tanglehead can form dense stands, thereby competing with native grasses and is often avoided by many wildlife species.

dynamics of foliar cover and biomass production of native species, (2) assess the effects of tanglehead on seed bank composition and dynamics, and (3) learn whether the presence of tanglehead, and its residual dry matter, alters soil microbial community composition and size.

We sampled more than 1,400 quadrats to estimate plant production, and amassed over 10,000 measurements on native plants and tanglehead. This aspect of the project is in its final year of data collection.

Preliminary findings suggest that the presence of tanglehead alters soil microbial dynamics. Experiments investigating seed bank dynamics and the potential effects of tanglehead residual dry matter are underway. This research will aid in identifying ecological feedback loops and underlying mechanisms contributing to tanglehead’s increasing invasiveness.

Cooperative funding provided by the George and Mary Josephine Hamman Foundation, the Rotary Club of Corpus Christi (Harvey Weil Sportsman Conservationist Award Trust), and the Brown Foundation.

Texas Native Seeds – West Texas Native Plant Evaluations

Colin S. Shackelford, Jameson S. Crumpler, Louis A. Harveson, Keith A. Pawelek, Anthony D. Falk, and Forrest S. Smith

New plant material evaluations for West Texas have expanded significantly in 2015. The 25-acre Sierra la Rana Plant Evaluation and Research Facility south of



© Colin Shackelford

Evaluation studies of various native plant collections are underway in West Texas.

Alpine, Texas is in its third year of operations. This site is now complemented by the new, fully operational Railway Ranch Plant Evaluation and Research Facility in Upton County near Odessa, Texas. The Railway Ranch site was not possible without Stan Smith, the ranch owner who donated use of 5 acres. New plantings were made in May and June of 2015 at both locations.

Sixteen species have been planted at both locations. Cane and silver bluestem as well as sideoats grama were planted in mid-May in advanced evaluation plantings. Nine populations of silver and cane bluestem were selected from the initial evaluation of 50 populations, and 9 populations of sideoats grama from the initial evaluation of 22 populations were selected for an advanced evaluation at each site. Advanced evaluations are focusing on consistent plant and seed production characteristics to determine selections for final plant releases for commercial production. Six species are in the second year of evaluation—blue grama, sand dropseed, tobosa grass, vine mesquite, whiplash pappus grass, and slim/rough tridens.

Plant production data and seed germination results are being examined in order to make selections for advanced evaluation trials. First-year plantings of black grama and skeletonleaf goldeneye were also made at both evaluation locations. Selections of plant material from these evaluations will result in commercially available seed developed specifically for restoration and reclamation projects in West Texas.

Cooperative funding provided by the Texas Department of Transportation, USDA Natural Resources Conservation Service, CF Properties and the Sierra la Rana Ranch, Stan Smith, and the Railway Ranch.

The Use of Mulching Material in Pipeline Restoration Activities

Jennifer B. Hoffman, Anthony D. Falk, Keith A. Pawelek, Forrest S. Smith, Veronica Acosta-Martinez, Sandra Rideout-Hanzak, Paula Maywald, Terry L. Blankenship, and David B. Wester

When pipelines are constructed, the valuable topsoil of the site is usually separated from subsoil material. Nevertheless, topsoil and subsoil sometimes get mixed in the process of pipeline completion. These “mixed soils” can have properties, both physical and chemical, that are unfavorable for plant growth.

Depending on day-to-day weather conditions, it is not uncommon for the temperature of bare soil to reach 100° F by mid-morning, peak at 140° F in early afternoon, and remain above 100° F until after sunset. Besides heat stress, extreme soil temperatures increase soil water loss. Seedling emergence and survival can be low under these forbidding conditions.

We are studying seedling emergence and establishment along pipelines that have been amended with mulch. One of our treatments involves the use of an “erosion control mat” on the soil surface. Two beneficial effects result from covering bare soil: (1) surface heating is delayed by several hours in the morning and (2) peak soil temperatures can be up to 14° F cooler in mid-afternoon. The net result of these moderated conditions is a more hospitable environment for seedling emergence and growth.

Our study plots covered with mulch had 3 to 9 more seedlings per square foot than nearby plots that were bare. Additionally, reduction of soil water loss under mulch cover prolongs favorable conditions for a developing seedling, allowing it to extend its roots deeper into the soil and enhance its chances for survival.

Cooperative funding provided by the Houston Advanced Research Center and L. Herbert Stumberg, Jr.

Does Plant Species Richness Increase at Moderate Grazing Intensities?

Stacy L. Hines, Timothy E. Fulbright, J. Alfonso Ortega-Santos, David G. Hewitt, Thomas W. Boutton, and Alfonso Ortega-Sanchez, Jr.

Researchers have proposed that plant species richness increases as herbivore grazing intensity increases up to some moderate intensity level, and then declines

with more intense grazing (a hump-backed relationship). In semiarid environments, it has been proposed that plant species richness declines with increasing grazing intensity.

Our objective is to determine if species richness displays a hump-back relationship with increasing grazing intensity by native (white-tailed deer) and non-native (cattle and nilgai) herbivores in South Texas. Every autumn and spring during 2012–2014 grazeable forage was identified to species, when possible, at 300 paired ungrazed and grazed sampling plots, 50 randomly allocated across each of 6 study sites located on East Foundation ranches. These study sites span from the Gulf Coast to western South Texas. We had paired sampling plots in areas with (1) deer only; (2) cattle and deer only; and (3) cattle, deer, and nilgai. To date, all data have been collected, and we are analyzing the results.

The semiarid environment in South Texas is highly variable, fluctuating from year to year between drought, normal, and wet conditions. A diverse assemblage of forage species will result in forage production available for ungulate consumption through a wide variety of environmental conditions.

Our results will assist managers in determining what combination of ungulates and what level of grazing intensity will provide the highest species richness of vegetation. Range and wildlife managers acting on this information will be able to provide sustainable forage production throughout the wide range of environmental conditions that occurs in South Texas.

Cooperative funding provided by the East Foundation.

Breeding Ecology of the Reddish Egret in the Laguna Madre of Texas

Lianne M. Koczur, Bart M. Ballard, and M. Clay Green

The reddish egret is a species of conservation concern throughout much of its range. It is listed as threatened in Texas where it is estimated that nearly half of all individuals breed. To examine the breeding ecology of the reddish egret, we attached Geographic Positioning Systems (GPS) satellite transmitters to 30 adults breeding in the Laguna Madre of Texas and obtained daily, year-round locations.

From the location information, we have identified 56 breeding attempts made by reddish egrets within 13 separate colonies along the Texas coast. Twelve of the reddish egrets provided information for multiple years and exhibited moderate levels of fidelity to a breeding colony. Three adults showed high fidelity, using the same island each breeding season. The other 9 adults nested in more than one colony across years, but used colonies within the same area of the Laguna Madre. Distance from the breeding colony to the mainland averaged 0.75 miles. Preliminary analyses show that the average distance adults traveled from the nest site to foraging areas varied, ranging from 1 to 14 miles.

Future analyses will quantify colony stability of reddish egrets in relation to the availability of, and proximity to, foraging habitat. Our findings will provide critical information on the use of breeding sites by reddish egrets, as well as optimal spatial relationships among breeding sites and foraging areas. Such information can be used to help conservation efforts as habitats change as a result of human development and global climate change.

Cooperative funding provided by the U.S. Fish and Wildlife Service.

Bringing Back the Dead: Genetic Material from Reddish Egret Carcasses

Lianne M. Koczur, Damon L. Williford, Bart M. Ballard, and Randy W. DeYoung

Genetic material obtained from fossils, archaeological remains, and museum specimens has revolutionized the study of ancient populations. The use of recently deceased specimens is less common because

carcasses are often badly decomposed under environmental conditions not conducive for the preservation of DNA. However, some tissues, such as bone or avian toepads, might preserve DNA after soft tissues have decomposed.

We collected 8 adult reddish egrets post-mortem from the Laguna Madre of Texas—a warm, humid marine environment that may promote the degradation of genetic material. The duration between death and retrieval ranged from 2 weeks to more than 3 months. We extracted DNA from toepad skin ($n = 3$), bones ($n = 6$), and feathers ($n = 4$). We used a set of 3 primers developed specifically for herons and egrets to amplify portions of the avian W and Z chromosomes using polymerase chain reaction (PCR).

We were able to amplify DNA in all toepad and bone samples, and in 3 of the 4 feather samples. We determined that the sample contained 6 males and 1 female. Our results show that usable genetic material can be gained from avian carcasses, even when badly decomposed in a marine environment.

The ability to sample salvaged carcasses may be useful in instances where the species of concern is threatened or endangered, and capture is considered risky, or for rare species that are difficult to sample. Ongoing work will investigate the amount and quality of DNA present in carcasses and identify tissues most likely to preserve DNA.

Nutrient Reserve Dynamics of Female Northern Pintails

Matthew J. Garrick, Bart M. Ballard, Kevin J. Kraai, David G. Hewitt, and Clayton D. Hilton

The Texas coast has historically provided important wintering habitat for large numbers of migratory waterfowl. Over the last few decades, waterfowl habitat has deteriorated because of declines in wetland habitats and rice acreage from changes in land uses. This region is also the most important wintering area for northern pintails in the Central Flyway.

Unfortunately, northern pintail abundance has declined throughout the 1980s and 1990s, and it has remained well below population objectives. Our objectives are to determine nutrient reserve and digestive tract dynamics in female northern pintails wintering along the Texas coast and to assess the effects of molt chronology and intensity on nutrient reserves of this waterfowl species.

We have collected female northern pintails along the Texas coast from inland freshwater and coastal wetlands. Each specimen is necropsied to assess changes in digestive organ mass and size, investigate muscle-mass dynamics, and extract diet items from the upper digestive tract. We will also examine intensity of molt in 29 feather tracts of each bird. Additionally, we will estimate fat and protein reserves of each bird to investigate changes in body condition of female northern pintails across the winter period. Our findings will provide insight about the quality of wintering habitat for northern pintails along the Texas coast and provide information to land managers on how to improve habitats for wintering waterfowl.

Cooperative funding provided by the Texas Parks and Wildlife Department.

Migratory Strategies of Adult Reddish Egrets

Lianne M. Koczur, Bart M. Ballard, and M. Clay Green

The reddish egret is a species of conservation concern throughout its range, yet there is much to be learned about the life-history strategies of this charismatic species. Reddish egrets have been described as weakly migratory; several egrets banded in Texas have been resighted in Mexico, Guatemala, and El Salvador. However, the extent to which this species displays migratory behaviors is largely unknown.

To determine the seasonal movements of reddish egrets, we attached Geographic Positioning Systems (GPS) satellite transmitters to 30 adults that were breeding in the Laguna Madre of Texas. We obtained 6 locations per day for up to 4 years on some individuals. Fifteen of the egrets were year-round residents in the Laguna Madre and did not migrate, whereas 11 individuals migrated away from the Laguna Madre during the winter months. These findings suggest that this species exhibits a partial migration strategy. Preliminary results also show that adults have a strong fidelity to stopover sites and wintering areas.

We are examining aspects of reddish egret migration that are currently unknown. In doing so, our research will identify important migratory stopover sites, migration routes, and wintering areas that will contribute to conservation efforts of this rare species.

Cooperative funding provided by the U.S. Fish and Wildlife Service.

Validation and Refinement of a Decision Support Tool for Mottled Duck Habitat

Anastasia I. Krainyk, Bart M. Ballard, Michael G. Brasher, Barry C. Wilson, and Jena A. Moon

The western Gulf Coast provides valuable habitat for the mottled duck, a resident species, which is highly associated with coastal marsh habitats and relies on these areas for all of its lifecycle needs. The disappearance of suitable nesting and brood-rearing habitat is believed to be the primary factor associated with a long-term population decline of the mottled duck. However, until now, there has been a lack of science-based knowledge about where, on a spatial scale, to apply conservation actions that would result in the greatest biological return on resource investment.

Recently, we developed a decision support tool for mottled duck habitat conservation that identifies and prioritizes habitat patches for conservation. Although the decision support tool will be valuable in the management decision-making process, it is built on spatial datasets that have an unknown amount of inherent error. Thus, our goal is to conduct several analyses to assess the performance of the mottled duck decision support tool as well as provide analyses to improve its performance in identifying suitable nesting and brood-rearing patches and landscapes.

We will use 3 separate measures to accomplish our goal. We will visit a random sample of patches to assess patch suitability as defined by the model, we will analyze the ability of the spatial model to identify high priority habitat by investigating use of these landscapes by breeding mottled ducks based on the annual Breeding Mottled Duck Survey, and we will assess



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Graduate student Anastasia Krainyk seen conducting aerial validation of mottled duck habitat patches.

the output to georeferenced locations of radio-marked mottled ducks during the breeding season. These measures will provide an indication of confidence in the model's output and help refine the model, which could be used to improve conservation efforts.

Cooperative funding provided by the Gulf Coast Prairies Landscape Conservation Cooperative.

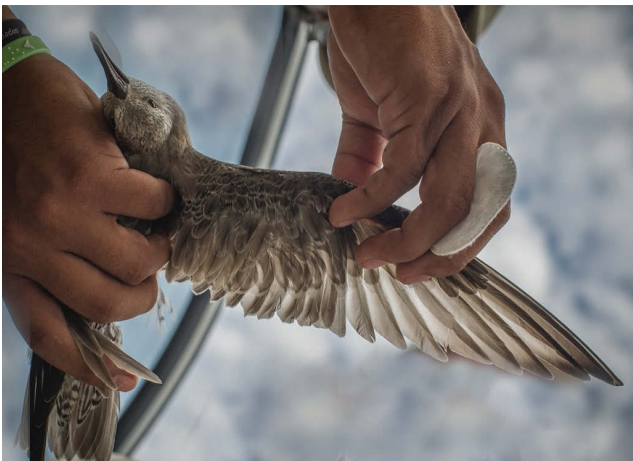
Red Knots at the Crossroads: Understanding Migratory Connectivity among Populations

David J. Newstead, Bart M. Ballard, Randy W. DeYoung, Lawrence J. Niles, and Joanna Burger

The red knot is a robin-sized shorebird that breeds in the brief Arctic summer and spends the rest of the year in temperate and tropical regions, including the northern Gulf of Mexico. The birds in Texas have been shown to use an array of migratory strategies and exhibit connectivity with both the Atlantic and Pacific flyways in addition to the Central Flyway. Conservation of this threatened species, and other shorebirds, is impossible without a better understanding of their migratory dynamics.

A long-term mark-recapture project was initiated in 2009. Presently, over 600 red knots have been uniquely marked, which will allow us to follow their migratory movements.

Blood and feather samples have also been taken from most of the captured red knots, which can be used to determine aspects about this bird's ecology. For example, the stable isotope ratios in the feathers provide a "signature" representative of the area



© Tim Romano

A red knot captured along the lower Texas coast is being prepared for sampling before being released into the wild.

in which the feather was molted. By analyzing these ratios, we will be able to better describe the migratory patterns of these birds that occur in the northern Gulf of Mexico and determine if there are differences in survival between groups. Blood samples will be used to determine if there are sex differences between the different migratory groups.

Through this study, we will gain a better understanding of the migration ecology of the red knot. Our research will provide conservation organizations with information they need to focus protection efforts towards the most important migratory sites used by red knots in multiple flyways.

Cooperative funding provided by Coastal Bend Bays and Estuaries Foundation and the U.S. Fish and Wildlife Service.

Nocturnal Roosting Habitat of Reddish Egrets

Lianne M. Koczur, Anastasia I. Krainyk, and Bart M. Ballard

The Laguna Madre of Texas is undeniably important for waterfowl and waterbirds. The reddish egret, a threatened species in Texas, relies on the Laguna Madre throughout the year. It provides critical habitat for nesting, foraging, and roosting. Roost sites are used for resting and sleeping, and safe roost sites are crucial for survival during nocturnal hours. Little is known about the habitat requirements for roosting in most waterbirds, including the reddish egret.

We attached Geographic Positioning Systems (GPS) satellite transmitters to 30 adult reddish egrets that were breeding in the Laguna Madre of Texas to examine their roosting ecology. We obtained 4 locations each day and 2 locations each night and used the nighttime locations to investigate roosting habitat use.

Preliminary results show that reddish egrets use open, shallow water areas that are located, on average, 0.6 miles (1 km) from the mainland. Roosting far from the mainland likely provides protection from mammalian predators. Furthermore, reddish egrets appear to display fidelity to roost sites, suggesting that the availability of high quality roost sites may be somewhat limited. Information from our study can be used to aid in the conservation of habitats vital to reddish egrets using the Laguna Madre of Texas.

Cooperative funding provided by the U.S. Fish and Wildlife Service.

Genetic Basis for Plumage Color Variation in the Reddish Egret and other Herons

Damon L. Williford, Lianne M. Koczur, Randy W. DeYoung, and Bart M. Ballard

Several species of herons, egrets, and bitterns display dramatic intraspecific plumage variation characterized by dark and white color morphs that occur within the population. Although plumage coloration is influenced by multiple genes, one of the most important is the melanocortin-1 receptor (MC1R) gene. Activation of this gene increases eumelanin, which produces black and brown coloration, whereas decreased MC1R activity results in greater production of pheomelanin and contributes to red and yellow colors. Mutations in the MC1R gene can reduce the synthesis of all melanins, resulting in white plumage.

We are investigating genetic variation at the MC1R gene and plumage dimorphism in herons and egrets. Sequences of the reddish egret were aligned with a sequence of the complete MC1R gene obtained from a publicly available whole genome of the little egret, a closely related species.

We observed relatively little variation within reddish egrets, and the mutations did not coincide with plumage coloration. Seven mutations were observed between the little and reddish egrets, including 1 that changes the amino acid sequence. Tests for selection and departure from mutation-drift equilibrium gave mixed results, depending on which groups of samples were included. We found little variation in the MC1R gene of the reddish egret, but the extensive interspecific variation between little egrets and reddish egrets suggested that selection on MC1R might have played a role in the divergence of species. We are analyzing other species to determine how genetic variation of MC1R relates to interspecific plumage variation.

Cooperative funding provided by the Texas Parks and Wildlife Department.

Survey of Gizzard Helminths in Wintering Female Northern Pintails

Derek C. Ballard, Matthew J. Garrick, Bart M. Ballard, and Alan M. Fedynich

Northern pintails breed from the southern Arctic to the Prairie Pothole region of southern Canada and the northern Great Plains of the United States.



© Matthew Garrick

Undergraduate student Derek Ballard is gaining research experience by studying parasites of northern pintails.

Major wintering areas for northern pintails include the Central Valley of California and the Gulf Coast of Texas and Louisiana. The northern pintail is currently 45% below population objectives and has been declining since the 1950s. Although many studies have been conducted to better understand the ecology of the northern pintail, there is little knowledge about the influence of parasites.

Parasite infections can lead to damage of the gizzard lining and cause gizzard dysfunction. Decreased functioning of this important organ needed for breaking down coarse food items could lead to weakness and possible poor growth rates of juveniles. Our objectives are to identify and determine the frequency and intensity of helminth parasites that occur underneath the gizzard lining in female northern pintails.

One hundred northern pintails, representing 51 adults and 49 juveniles, were collected along the Texas coast in October 2014 and March 2015. Each specimen was aged and necropsied as part of a larger study. During necropsy, the gizzard was cut open and the contents washed; the gizzard lining and wash were examined for parasites.

Preliminary findings indicate that 26% of the northern pintails were infected with one or more species of gizzard worms. Twenty-one percent were infected with nematodes and 5% had the cestode *Gastrotaenia cygni*. The nematodes are being identified to species.

Our findings will shed light on helminth parasites infecting the gizzards of northern pintails. This information can help determine the potential impact of these parasites on the overall health of pintails wintering along the Texas coast.

Seasonal Movements of Rio Grande Wild Turkeys in South Texas

Shannon M. Hall, J. Alfonso Ortega-Santos, William P. Kuvlesky, Jr., and Leonard A. Brennan

Information about what plant communities and habitat characteristics are preferred by Rio Grande wild turkeys on a seasonal basis is limited. What we do know is Rio Grande wild turkeys have 3 distinct seasonal periods: (1) fall/winter—development and gathering of winter flocks, (2) spring—early breeding and nesting, and (3) summer—late nesting and the raising of broods. The objective of this study is to analyze seasonal movements and home ranges of Rio Grande wild turkeys during each period. Our study is being conducted in Jim Hogg County, just southeast of Hebbronville, Texas.

Trapping started February 2015 using drop nets. We captured 11 Rio Grande wild turkeys, fitted each of them with a backpack radio transmitter along with a unique leg band, and released them at the trap location. The wild turkeys are being monitored via radio telemetry every other day till completion of the study.

Geographic Information Systems (GIS) technology that incorporates the radio telemetry data and vegetation sampling data will be used to determine home ranges, seasonal movements, and habitat preferences. Obtaining this information will help determine seasonal movements and habitat preferences of Rio Grande wild turkeys as well as providing insight about survival and nest success.

Cooperative funding provided by Las Huellas, Frost National Bank, Energy XXI Lease, and Elizita Ranch.

Spatial Ecology and Nest Site Selection of American Alligators in Texas

Cord B. Eversole, Scott E. Henke, Randy L. Powell, Bart M. Ballard, and Selma N. Glasscock

Despite the numerous studies that have been conducted on American alligators, information is still lacking about American alligator ecology and population dynamics. More specifically, there is a lack of scientific literature and information about nesting ecology and habitat requirements throughout the American alligator's range, especially in the southwestern portion of the species' range (i.e., Texas).

Nest site locations have been collected annually throughout the Texas Gulf Coast region as part of the Texas Parks and Wildlife Department's American alligator management program. Nest site locations and data have been compiled over the last decade and will be used for long-term monitoring and to identify trends in alligator selection of nest sites.

Our objectives are to determine (1) nest site selection of American alligators based on wetland type and habitat characteristics and (2) spatial characteristics of alligator nest site locations. We hypothesize that American alligator nests are not randomly distributed throughout wetland environments and that alligators select certain wetland types in which to build nests and subsequently rear their young. We also postulate that spatial trends in nest site locations are a function of alligator population dynamics, rather than ecological randomness. In addition, this study will provide information concerning nest success of various aged alligators, which then can be used to develop more accurate population estimates of this iconic and once endangered species.

Cooperative funding provided by the Rob and Bessie Welder Wildlife Foundation.

Impacts of Eagle Ford Shale Exploration on Avian Abundance and Reproduction

Kelsey R. Davis, Daisy J. Castillo, Eric D. Grahmann, Fidel Hernández, Timothy E. Fulbright, Chase Currie, and Fred C. Bryant

Disturbance caused by oil and gas exploration and development of the Eagle Ford Shale in Texas has the potential to negatively affect bird species. Our objective is to determine how localized oil and gas disturbance impacts avian density and reproductive success. We will (1) document nest success and density of avian species and (2) compare demographic levels of avian species.

Our study is taking place on 2 private ranches in Dimmit County, Texas. We are monitoring avian populations and reproduction on 2 areas along an oil and gas exploration corridor and 2 areas where there are no exploration related disturbances. Field research will be conducted during May–July 2015 and 2016 on each of the 4 areas. Point counts will be performed twice per week at 8 points across the study areas to estimate avian species density. Nest searches will be

performed twice per month in 32 rectangular, 328 × 1,312-foot (100 × 400-meter) plots to document nest success. Nests will be periodically checked to determine nest status.

As the Eagle Ford Shale is being rapidly developed in nearly 30 counties in Texas, it is important to determine how birds in the region could be affected. Identifying the effects of oil and gas exploration on birds may be necessary to preserve their populations in the future.

Cooperative funding provided by the Rancho San Pedro Joint Venture, Faith Ranch, South Texas Charity Weekend, Inc., and South Texas Chapter of the Quail Coalition.

A Long-Term Wildlife Monitoring Program for the East Foundation

Jeremy A. Baumgardt, Leonard A. Brennan, and Michael L. Morrison

One of the top priorities of the East Foundation is to develop and implement a long-term monitoring program to evaluate trends in the distribution and abundance of flora and fauna on the East Foundation ranches. Our goal is to identify and recommend appropriate sampling methods for monitoring small vertebrates and vegetation.

In our second field season, we have completed small mammal trapping on 50 grids across the San Antonio Viejo and El Sauz ranches. We sampled birds using point counts at 360 points over the 2 ranches with 5 total visits at each point. These data will allow us to estimate detection probabilities using repeat visits, double sampling, and distance sampling techniques. We have also sampled reptiles and amphibians at 36 locations using a combination of pitfall and funnel traps, sampled owls and nightjars using call-back surveys with 3 visits to 56 points, recorded bat echolocation calls using 5 detectors deployed for 5–7 consecutive nights at over 50 locations, and sampled vegetation at over 250 sites across both ranches.

Through these efforts, we have captured 5,917 individuals and detected 15 species of small mammals. With our reptile and amphibian traps, we have detected over 30 species, including 14 snakes, 11 lizards, and 5 amphibians. Additionally, we have recorded 122 detections from 5 species of owls and 133 detections from 5 species of nightjars.

Data will be analyzed to estimate detection and capture probabilities and will be used to identify any

changes needed for the 2016 field season. Ultimately, our results will be used to identify highly efficient methods that we will recommend to the East Foundation for long-term monitoring.

Cooperative funding provided by the East Foundation.

Winter-Spring Movements of Pronghorns in Relation to Barriers and Agriculture

Caroline L. Ward, Randy W. DeYoung, David G. Hewitt, Timothy E. Fulbright, Humberto L. Perotto, and Shawn S. Gray

The pronghorn antelope was once widespread throughout the grasslands of central and western North America, including much of Texas. Today, pronghorns are found only in the Trans-Pecos and Panhandle regions of Texas. Pronghorns have large home ranges and are capable of both daily and seasonal long-distance movements. Therefore, populations are managed on a large-scale, herd-unit basis. However, pronghorns are reluctant to cross net-wire fencing and major highways, and these features can function as barriers to movements. Human-wildlife conflicts associated with pronghorns are rare except where the animals forage on crops, such as winter wheat and alfalfa. More needs to be learned about pronghorn use of agriculture land adjacent to rangeland.

We captured and fitted 50 pronghorns with Global Positioning Systems (GPS) collars, 25 at each of 2 sites near Dalhart and Pampa, Texas during March 2014. The collars detached remotely in September, and we recovered the collars and downloaded the data.



Courtesy Texas Parks and Wildlife Department

Pronghorns are valued game animals, but may cause human-wildlife conflicts in agricultural settings.

Preliminary analyses revealed major highways, including U.S. Highway 87 and 385 in Dalhart and Texas Highway 70 in Pampa, were barriers that pronghorns did not cross. All collared pronghorns crossed smaller, low-traffic county and farm-to-market roads readily. Collared pronghorns in the Dalhart area used agricultural fields, primarily winter wheat and corn. Availability of agricultural fields influenced home range size and movements. Home ranges in Dalhart were qualitatively smaller than those in Pampa, where central-pivot agriculture was less prominent.

Ongoing analyses will address fine-scale resource selection, daily and seasonal movements, and home range sizes. Findings from this study can be used to aid in the management of pronghorns, benefitting both hunters and farmers in the Panhandle region of Texas.

Cooperative funding provided by the Texas Parks and Wildlife Department and the U.S. Fish and Wildlife Service Wildlife Restoration Section 4 Grants Program (TXW-148-R-1).

Conserving South Texas Birds through Science Curriculum and Citizen Science

Janel L. Ortiz, April A. Torres Conkey, Leonard A. Brennan, La Vonne Fedynich, and Mary E. Green

Unfortunately, wildlife education is not emphasized in school curricula, and many teachers have little background in the subject or experience in the field. This project aims to bring the Caesar Kleberg Wildlife Research Institute (CKWRI) and the community together for a wildlife education program to enhance the knowledge of birdlife in South Texas.

A wild bird education curriculum aligned with state standards (TEKS) has been developed for 6th grade science classrooms, although, these lessons can be adapted to any grade level. Lessons include wildlife techniques such as bird identification and mist-netting as well as the incorporation of CKWRI research like internal parasite surveys of quail and habitat fragmentation assessment. Students will learn to use tools such as binoculars, microscopes, the basics of Geographic Information Systems (GIS), scales, and most importantly field notebooks for data collection.

Participating districts come from the Coastal Bend and South Texas region including Kingsville ISD. Students and teachers will be assessed for their interest and understanding of birdlife and their enjoyment of citizen science participation using the South Texas Wintering Birds website to document bird sightings.



© April Torres Conkey

Local teachers handled live birds during a trapping demonstration at the curriculum training workshop.

This past summer, teachers participated in a 2-day training workshop to gather the background information they need to conduct lesson plans successfully. Bird lessons conducted in the classroom will expose students to a science, technology, engineering, and math (STEM) career and provide teachers with additional curriculum that will help students develop an interest in the outdoors.

Cooperative funding provided by the Elizabeth Huth Coates Charitable Foundation of 1992, Coastal Bend Audubon Society, and Ms. Leatrice Koch.

Evaluation of an Avian System to Monitor Bird Movements

Taylor J. Yerrick, Suzanne Contreras-Walsh, Bart M. Ballard, and David B. Wester

Ornithologists have used radar technology for several decades to examine bird movements, which have contributed significantly to our understanding of bird migration. Many bird species migrate at night and at relatively high altitudes making radar one of the few methods to effectively monitor movements of migrating birds.

Recently, the technological advancements of avian radar systems allow automated, continuous tracking and recording of bird targets. Automated avian radar systems are regularly used to monitor bird traffic through wind farms and to justify the appropriateness of wind farm placement as it relates to potential impacts on migratory birds.

Despite its broad use for investigating bird movements, little research has been conducted to investigate the limits of radar to monitor migratory birds. Our research aims to assess the performance of an avian radar unit in its ability to track migratory birds. We will conduct several ground-truthing exercises such as releasing birds of known size through the radar coverage area and identifying species and flock sizes of birds passing through the radar coverage. This information will be compared with the data output from the radar unit. The results of these tests will provide a general evaluation of the avian radar unit's ability to detect and discriminate birds.

The increasing application of avian radar systems has expanded our understanding of how birds use airspace, particularly during migration. This performance assessment will refine our ability to accurately quantify bird movements as we seek to better manage migratory birds.

Cooperative funding provided by the Robert J. Kleberg, Jr. and Helen C. Kleberg Foundation and the Faye L. and William L. Cowden Charitable Foundation.

Ecology of the Texas Tortoise on Rangelands Managed for Bobwhites

Ross O. Couvillon, Leonard A. Brennan, Fidel Hernández, and Bart M. Ballard

The Texas tortoise is the smallest North American tortoise. It is mainly associated with the Tamaulipan Biotic Province of southern Texas and northern Mexico. Its distribution appears to be restricted to



© Ross Couvillon

Texas tortoises enjoy eating prickly pear tunas when they ripen each summer.

thornscrub communities. Limited research on this species has been conducted in Texas, and almost nothing has been reported on the Mexican population. The Texas tortoise appears to use areas with woody cover, herbaceous cover, and bare ground.

A study was initiated this year to investigate Texas tortoise habitat use on a private hunting lease in Jim Hogg County, Texas. This property is actively managed for game species, particularly bobwhites. Tortoises will be tracked for 2 years during their active season (April 15th to October 15th). From the information collected, we will learn how tortoises use areas manipulated through habitat management practices such as prescribed burning, mechanical alteration, grazing, and herbicide application. In addition, data will be collected to determine when Texas tortoises seek shelter from the heat of the day, which will provide a better understanding about this aspect of their daily cycle.

Texas tortoises are listed as threatened in the state of Texas, but large land holdings in South Texas provide a stronghold for them. Understanding how tortoises interact with a landscape managed for game species will help ensure that South Texas retains a healthy tortoise population.

Cooperative funding provided by the Richard M. Kleberg, Jr. Center for Quail Research.

Evaluation of Survey Techniques and Sightability for Pronghorns in Texas

Caroline L. Ward, Randy W. DeYoung, David G. Hewitt, Timothy E. Fulbright, Louis A. Harveson, and Shawn S. Gray

Pronghorn antelope occur in the Panhandle and Trans-Pecos regions of Texas. The Texas Parks and Wildlife Department manages harvest via a permit system. Harvest permits are issued to landowners based on population estimates from annual aerial surveys. Aerial surveys are useful for tracking population trends. However, they underestimate the true population size because the probability of sighting animals depends on factors associated with habitat and animal behavior. Population estimates from aerial surveys can be improved if wildlife biologists understand how the probability of sighting animals changes in relation to habitat, behavior, and other conditions.

We captured 50 adult pronghorns, 25 at each of 2 sites near Pampa and Dalhart, Texas during March 2014. Pronghorns were fitted with Global Positioning

Systems (GPS) collars programmed to take locations every 5 to 15 minutes during aerial surveys. We flew repeated aerial surveys during June and recorded the number, sex, and age of pronghorns, group size, activity, habitat type, brush cover, terrain, and their distance from the survey line. Collared pronghorns were identified. Those not seen on the survey were located later to determine their location and group size.

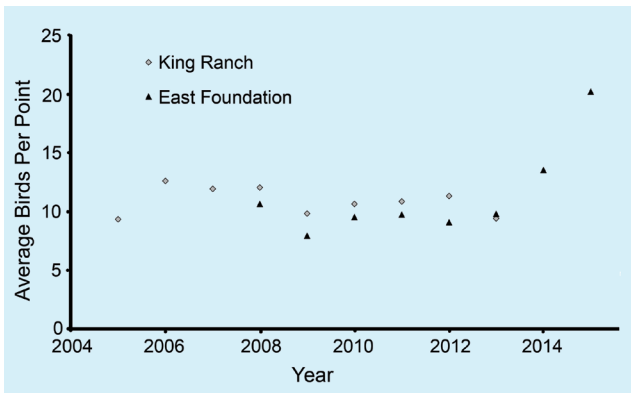
Data from the surveys will be used to correct estimates of population size based on distance from the survey line and on the proportion of marked animals seen on the surveys. We will also use the data to construct and test a sighting probability model. Application of the findings from our study will allow wildlife biologists to obtain population estimates that are more precise. This should allow more flexibility in harvest and management decisions for pronghorns in Texas.

Cooperative funding provided by the Texas Parks and Wildlife Department and the U.S. Fish and Wildlife Service Wildlife Restoration Section 4 Grants Program (TXW-148-R-1).

Influence of Drought and Grazing on Land Bird Abundance in South Texas

Maia L. Lipschutz, Leonard A. Brennan, Thomas M. Langschied, David B. Wester, Bart M. Ballard, Tyler A. Campbell, and Matthew J. Schnupp

South Texas rangelands provide habitat for many bird species, but the relationships among rainfall, cattle grazing, and land bird abundance are poorly understood. We are using survey data from 2 South Texas ranches to examine these relationships and analyze trends in bird abundance.



Annual averages of the number of birds recorded per point along breeding bird survey routes on 3 East Foundation ranches and 4 King Ranch divisions within South Texas.

Bird surveys were conducted annually on 3 East Foundation properties beginning in 2008. We counted breeding birds in May and June at 246 circular plots. Non-breeding birds were counted monthly from September through April along 0.3 mile (11,500 meters) transects. These data provide a basis for determining trends in abundance in relation to regional precipitation and drought conditions.

Annual breeding bird counts were conducted at 299 circular plots on 4 divisions of the King Ranch from 2005 to 2013. We will compare these data to cattle stocking rates in pastures where point counts were conducted and collect local rainfall information to assess relationships at a finer (pasture) scale.

Since the 2008 initiation of bird surveys on the East Foundation, we have documented 17,034 individuals of 109 species during breeding season surveys and 13,443 individuals of 165 species during non-breeding season surveys. In total, 21,154 individuals of 126 species were documented during the 9 years of breeding bird surveys conducted on the King Ranch.

During 2015, we documented the highest average number of birds per point of any breeding season survey at 20.2 birds per point. This increasing trend in bird abundance coincides with reduced grazing pressure and above-average rainfall. Our preliminary findings suggest that local land bird populations have the ability to respond relatively quickly and positively to increases in precipitation and the reduction in grazing pressure on South Texas rangelands.

Cooperative funding provided by the East Foundation and the Coastal Bend Audubon Society.

Bird Migration Characteristics Relative to Distance Inland from the Texas Coast

Suzanne Contreras-Walsh and Bart M. Ballard

The explosion of new and proposed wind energy development projects throughout the Western Hemisphere has increased interest in understanding bird movements and their relation to potential negative impacts by wind farms. The Texas coast is well known for its great diversity and abundance of birds, particularly during migratory periods.

Our recent research has shown that passage rates of birds migrating along the Texas coast are higher than those reported elsewhere in North America. However, little is known about the dispersion of migratory bird traffic inland from the coast.

We are using radar technology to investigate the dispersion of migration across the Coastal Plain of South Texas. We have collected information on several aspects of migration at 4 sites in Kenedy County: 0.5 mile, 10 miles, 20 miles, and 30 miles inland from the coast. Using radar units, we are collecting information on the timing, magnitude, flight direction, and flight altitude.

We tracked bird targets through the radar coverage across 4,411 hours of radar monitoring during spring and fall 2014. During 2 seasons of data collection, we recorded over 2.5 million radar tracks across all sites. We are currently involved in data analyses.

Our study will provide detailed data on bird migration to help guide management strategies for migratory birds along the lower Texas coast. This information will provide insight into how migration patterns vary in relation to distance from the coastline. Coastal managers may use this information to select specific development sites that minimize impacts to migratory birds from ongoing wind energy development along the Texas coast.

Cooperative funding provided the Robert J. Kleberg, Jr. and Helen C. Kleberg Foundation, Faye L. and William L. Cowden Charitable Foundation, and a TAMUK University Research Award.

Cost to Benefit Analysis of Coyote Removal for Livestock and Wildlife Enterprises

Kyle Brewster and Scott E. Henke

Coyote control measures often are recommended because of livestock depredations and to increase the harvestable surplus of game animals. However, coyotes also have an ecological value to the ecosystem by controlling small animals that can compete with livestock for forage.

It has been estimated that 29 black-tailed jackrabbits require as much daily forage as 1 Animal Unit. Small mammal herbivores (i.e., rodents and rabbits) can consume as much as 80% of the total annual primary plant production, can maintain less desirable vegetation successional stages, and slow weight gain in cattle because of forage competition. Therefore, our research question is...“Where is the balancing point when coyote control removes enough coyotes to reduce the undesirable aspects of livestock and game animal loss but not enough to create an ecological release in small herbivores?”



© Larry Ditto

Research is underway to assess the impact of coyote removal on livestock and wildlife operations.

In this study, we plan to review current and past datasets of livestock and game animal losses, coyote control efforts, seasonal coyote food habits, coyote and game animal densities, livestock stocking rates, market value of livestock, and costs of coyote removal efforts. Using STELLA modeling software, we will develop a cost to benefit analysis of various livestock production strategies. It is our hope that such an analysis will benefit the livestock ranching community of southern Texas.

Assessing Rio Grande Turkey Constructed Roosts for South Texas Rangelands

Brandon S. Mitchell, William P. Kuvlesky, Jr., J. Alfonso Ortega-Santos, Leonard A. Brennan, and Shannon M. Hall

The wild turkey is an important part of the South Texas wildlife community. One of the key components for wild turkeys is roosting habitat. Wild turkeys typically use large trees such as live oak and hackberry for roosting. Unfortunately, many of these large trees have died throughout the region due largely to the recent droughts.

Because of the recent die-off of roosting trees, wild turkey roosting cover may be a limiting factor in many areas. The consequence of this may lead to a decrease in the survival of wild turkeys and/or the vacating of areas where there is insufficient roosting cover. To mitigate this problem, many landowners have constructed roost sites for wild turkeys using man-made structures, such as abandoned windmills or telephone

poles, with added structural appendages at the top to provide adequate roosting area.

The objectives of this project are to (1) determine which factors are affecting the use of constructed roost sites and (2) develop guidelines to assist landowners in the placement of roost sites. The project involves measuring habitat components, such as brush cover, herbaceous cover, water availability, and supplemental feed sites surrounding pre-existing roosts to determine the most suitable areas for landowners to place constructed roosts. In addition, we will be examining design features that make constructed roosts more attractive to turkeys. Findings from this study can be used to maintain and increase turkey populations in South Texas in areas where native roost trees have died from drought conditions.

Cooperative funding provided by Mr. Renato Ramirez, Mr. Charlie Hoffman, Las Huellas, and Encino Lodge.

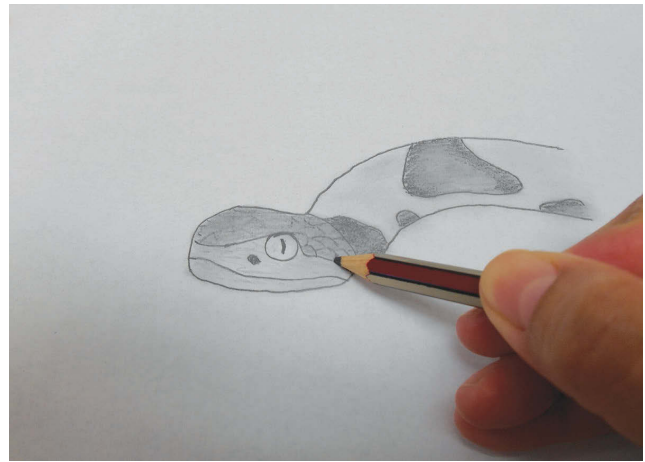
Full STEAM Ahead Wildlife Educational Outreach Program

George Vargas, April A. Torres Conkey, Mary E. Green, and Fulden Sara-Wissinger

The latest K-12 education standards encourage integrating the arts into science, technology, engineering, and math (STEM) to help unlock artistic potentials in innovation and design. However, arts programs are often lacking or underfunded in rural South Texas. To meet this need, the Texas A&M University-Kingsville (TAMUK) Rural Arts Program is collaborating with the Caesar Kleberg Wildlife Research Institute for the Full STEAM Ahead arts educational outreach program for 4th and 5th grade students from the Driscoll Independent School District in Driscoll, Texas.

The students will receive instruction from an art professor who will guide the students in creating their own original painting of the natural world. The students will also receive instruction about flora and fauna of South Texas and instruction to create a video describing their experience and what they learned.

The video will be linked to their artwork using the *Aurasma* app. The finished products will be featured in an interactive exhibit at the Ben Bailey Art Gallery located on the TAMUK campus. Exhibit viewers can download the free *Aurasma* app, hold their smartphone or tablet over the student's painting, and the student's video will play in augmented-reality fashion over the image.



© April Torres Conkey

Driscoll ISD students will participate in a program that uses art and technology to reinforce natural science concepts.

A lesson plan aligned with the Texas Essential Knowledge and Skills standards for art and science will be made available online for anyone to organize and host their own nature art exhibit. We expect that students who participate in this program will express a greater appreciation for both the arts and the natural environment upon program completion.

Cooperative funding provided by the Texas Commission on the Arts and Texas Women for the Arts.

Cattle Grazing Influence on Economics, Environment, and Human Dimensions

Gerardo A. Bezanilla-Enriquez and J. Alfonso Ortega-Santos

After years of research, outreach, and millions of dollars, large areas of rangelands still remain degraded in Mexico. Effective extension programs to promote good management practices to improve the environmental health, profitability, and the well-being of ranchers are seldom approached because of the complexity. Our objectives will be to (1) identify the main social factors that influence the decisions of ranchers, (2) measure the response of a planned behavior-influencing strategy focused on best grazing management practices, and (3) estimate how profitability changes with the use of best management practices and its effect on human behavior change.

In-person and email surveys of 13 ranchers located in the Chihuahuan Desert of Mexico will be used to identify the main social influences affecting ranching.

We will apply a structured behavior-influencing strategy (after assessing the ranch environmental and economic data) needed to improve the effectiveness of adopting the best grazing management methods and proper range management practices. The result of the intended change in behavior towards a more planned grazing management strategy and application of good range management practices will be measured using change in soil cover, soil carbon sequestration, underground water levels, and wind erosion.

Understanding the main factors influencing attitudes and the decision making process used by ranchers in the Chihuahuan Desert will provide the baseline needed to develop sound and effective extension programs. This will aid in increasing the environmental health, profitability, and welfare of the rural population in this part of Mexico.

A Novel Bait for Delivering Pesticide to Feral Swine

Nathan P. Snow, Joseph M. Halseth, Michael J. Lavelle, Thomas E. Hanson, Chad R. Blass, Justin A. Foster, David G. Hewitt, and Kurt C. VerCauteren

Invasive feral swine cause extensive damage to agricultural and wildlife resources throughout the United States. Development of a new orally delivered pesticide, micro-encapsulated sodium nitrite, is underway to curtail expansion of feral swine. This pesticide requires an oil-based matrix for stability. Our objective is to compare potential oil-based matrices for maximizing visitations by free-ranging feral swine and minimizing visitations by non-target species.



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Feral swine are consuming a mixture of corn and peanut paste at a bait site.

We evaluated the attractiveness of 3 possible bait matrices in south-central Texas: (1) uncolored peanut paste, (2) black colored peanut paste, and (3) peanut slurry. We deployed time-lapse cameras at 88 randomly located bait sites for 10 days, and compared the rates of visitation from feral swine and non-target species among the types of treatments to a reference treatment (whole-kernel corn).

Preliminary analyses indicate feral swine showed bait shyness to the uncolored peanut paste and peanut slurry treatments during the first days offered. This shyness subsided by the end of the treatment period, suggesting that feral swine needed time for acclimation. No shyness was detected for the black colored paste and, therefore, we identified this treatment as the best matrix for maximizing delivery of a pesticide to feral swine. White-tailed deer (i.e., the most frequent non-target species) and all non-target species combined visited the treatments equally; therefore, no bait matrix minimized non-target visitations.

Cooperative funding provided by USDA Animal and Plant Health Inspection Service Wildlife Services National Wildlife Research Center.

Assessing Human Dimensions of Wildlife Photography on Conservation

William C. Colson, April A. Torres Conkey, and Scott E. Henke

Conservation photography is a powerful tool that uses images of wildlife (often threatened or endangered species) and/or critical habitat to raise conservation awareness. The purpose of these images is to capture the beauty of nature, which few will ever physically see while also appealing to the viewer to participate in conservation. By using conservation photography, numerous organizations attempt to champion different environmental causes or, at best, educate the public about conservation issues they feel are important.

A few organizations, such as Wildlife in Focus, concentrate on regional locations and offer monetary prizes to photographers with the purpose of drawing attention to conservation issues. These contests are conducted generally on an annual or semiannual basis and attempt to unite photographers with landowners. Photographers may range in skill from novice to professional while landowners may be from small ranches/farms, large ranches, or conservation areas.

This project will gather information from both photographers and landowners to gain an understanding



© Kendra Colson

Graduate student William Colson is studying why people are attracted to and participate in wildlife photography.

of why they participate in these contests and what inspires them to photograph nature. By using either a mail-in or online survey, we will analyze the different socioeconomic factors of conservation photographers as well as the landowners who participate by offering the use of their property. Furthermore, we hope to discover if photographers and landowners participate in other conservation-related activities besides photography such as hunting, fishing, wildlife management and conservation, or habitat restoration.

Winter Ecology of American Kestrels in South Texas

Carter G. Crouch, Leonard A. Brennan, Eric D. Grahmann, Fidel Hernández, Robert H. Benson, and Jeffrey F. Kelly

American kestrels are the smallest and most common falcon in North America. However, like many grassland birds, they are declining in parts of their geographic range. Although kestrels are common winter residents in South Texas, there has not been much research on this species within the region or the rest of Texas. We initiated this study to estimate American kestrel wintering home range, survival, and site fidelity. We also are interested in determining what kestrels are using as roost sites.

We trapped 34 American kestrels along county roads in agricultural areas using a bal chatri trap. We color marked kestrels using color bands and non-toxic fabric dye on the breast feathers for future identification without recapture. We conducted searches for

kestrels throughout the winter. From the data being collected, we will be able to estimate home range and survival. In September 2015, we looked for marked kestrels to see if they returned to the same sites they used in the fall and winter of 2014–2015. We also found 7 kestrel roosts ranging from pump jacks to Spanish dagger shrubs.

To our knowledge, this is the first study to estimate wintering survival and home range size of American kestrels in South Texas. Information on winter survival rates may allow researchers to better understand where and why kestrels are declining in many parts of their geographic range. Documentation of American kestrel roost sites will advance our understanding of the types of habitats and structures that may be important in keeping kestrels safe from nocturnal predators and the elements.

Cooperative funding provided by San Christoval Ranch and the Richard M. Kleberg, Jr. Center for Quail Research.

Neospora caninum in Domestic Animals and Exotic Ungulates in Northern Mexico

Jose Remigo de la Torre-Garcia, J. Alfonso Ortega-Santos, Antonio Cantu, Clayton D. Hilton, and Scott E. Henke

Neosporosis is a disease caused by the intracellular parasite *Neospora caninum*, which causes abortion and neonatal mortality in domestic and wild animals worldwide. While the role of some species in the life-cycle of *N. caninum* has been demonstrated, the role of others is still unclear. Concern exists that the introduction of exotic cervids whose role in the lifecycle of the disease has not been determined might represent a risk to the health of native fauna and livestock. Our objectives are to (1) determine the presence of antibodies to *Neospora* in introduced species (axis and fallow deer), (2) determine the presence of antibodies in domestic animals (cows, horses, and dogs), and (3) determine if an association exists regarding the serological status of introduced and domestic animals.

Blood samples will be collected from axis deer, fallow deer, cows, horses, and dogs occurring on a private ranch in Soto la Marina Tamaulipas, Mexico. Samples will be tested to determine the presence of *N. caninum* antibodies.

Finding *N. caninum* antibodies in introduced cervids would suggest that axis deer and fallow deer act as a carrier for this parasite. The information obtained from this study will result in a better understanding

of the role that axis and fallow deer might play in the transmission of *N. caninum*.

Cooperative funding provided by Consejo Nacional de Ciencia y Tecnología, USDA Animal and Plant Health Inspection Service, and Rancho Miramar.

Development of Large Mammal Aerial Surveys for South Texas Landscapes

Mary K. Annala, David G. Hewitt, Andrew N. Tri, Randy W. DeYoung, Charles A. DeYoung, and Tyler A. Campbell

Aerial surveys are an efficient technique for counting animals over large areas, but population estimates from aerial surveys are usually biased low. This bias is caused by some animals not seen during the survey. Conventional distance sampling is a technique that can correct for unseen animals. However, because not all animals on the survey line are observed, this technique also results in low estimates. To correct for this, conventional distance sampling can be combined with mark-recapture methodology to estimate populations using mark-recapture distance sampling (MRDS). We are working with the East Foundation to develop a MRDS aerial survey protocol to monitor large mammals on their lands in South Texas.

The MRDS technique requires the recording of separate observations from the front and rear observers in a helicopter. We flew surveys during 2013, 2014, and 2015. White-tailed deer, nilgai, feral hogs, and javelinas were recorded, as well as characteristics of each sighting. At the conclusion of each survey, we estimated detection probabilities and population estimates, and compared results by habitat type, season, and survey intensity.

Javelinas and feral hogs were estimated to be missed most often on the survey line. White-tailed deer were missed least often. Javelinas and feral hogs also had

Average estimated detectability that was calculated for large mammals during aerial surveys on rangelands within South Texas.

Species	Average % Missed on Survey Line	Average % Detection Probability
White-tailed Deer	6.0	54.5
Nilgai	8.5	48.3
Feral Hogs and Javelinas	13.6	45.8

the lowest estimated overall detection probability, whereas white-tailed deer had the highest. Findings from this project will provide the East Foundation and other landowners with a large mammal survey technique that is less biased than traditional aerial surveys.

Cooperative funding provided by the East Foundation.

Translocation of American Alligators: Is it a Viable Management Strategy?

Cord B. Eversole, Scott E. Henke, Randy L. Powell, Bart M. Ballard, and Selma N. Glasscock

Historically, market hunting, poaching, and wetland habitat loss have resulted in a significant decrease in American alligator populations throughout the species' range in the southern United States. However, federal protection has allowed the American alligator to repopulate, flourish, and even expand its traditional range throughout the Gulf Coast region. This recent growth has caused a dramatic increase in human-alligator conflicts.

In Texas, about 500 nuisance alligator reports are received annually by the Texas Parks and Wildlife Department. Nearly 25% of these nuisance alligator reports are resolved by translocating the reported alligators to other areas. For a translocation to be successful an alligator must be taken to a new location without causing harm to the individual, the habitat, or alligator population in which the translocated alligator is introduced. In addition, the translocated alligator does not return to its site of origin or become a nuisance at the new location. Unfortunately, the success of translocating alligators as a management strategy is largely unknown.

In this study, success of translocation will be determined through the remote monitoring of translocated alligators that are outfitted with Global Positioning Systems (GPS) transmitters. Our objectives are to determine site fidelity, movement patterns, and homing ability of translocated American alligators. This project will be conducted in southeastern Texas and will aid in alleviating human-alligator conflicts. Information obtained will also help to improve the precision of current alligator management strategies in Texas.

Cooperative funding provided by the Rob and Bessie Welder Wildlife Foundation and a TAMUK University Research Award.

Aflatoxin Tests: Which Should a Rancher Choose?

Scott E. Henke, Greta Schuster, Alan M. Fedynich, and James C. Cathey

An increasingly common practice in the United States is the use of supplemental feed to attract and facilitate harvest of game animals. Many landowners and hunters now consider supplemental feeding a necessary and beneficial management tool. However, supplemental feeding of wildlife, although well intended, may present an insidious problem in the form of aflatoxin.

Aflatoxin, a harmful fungal metabolite produced by strains of *Aspergillus flavus* and *Aspergillus parasiticus* growing on grain, can negatively affect the health of animals and humans. Any cereal grain is susceptible to the production of aflatoxin, but one of the more affected grains is corn, a commonly used supplemental grain for wildlife. The U.S. Food and Drug Administration established a limit for aflatoxin in grain intended for human consumption and for various classes of animal feed because of its harmful effects. However, grain that has been condemned for human or domestic animal consumption typically is marketed as feed for wildlife.

To complicate matters, aflatoxin levels under the established limits at the time of purchase could become harmful later as the fungus continues to grow. Therefore, it is imperative for a rancher to test the grain regularly when providing supplemental feed to wildlife. Our objectives are to (1) develop a cost analysis of the various types of commercial aflatoxin tests, (2) determine the simplicity of each test, and (3) determine if common household products can be substituted for required test components. The method and equipment

deemed the easiest to use and most cost efficient will aid those who wish to supplementally feed wildlife and minimize wildlife’s exposure to aflatoxin.

Preliminary results show non-trained individuals required more than twice the specified time stated by the company to obtain results, and lacked accuracy and precision. Precision improved if 5 tests were averaged per sample, but obviously overall costs increased by performing 5 tests per sample. Formal training is needed for personnel to perform the aflatoxin tests to obtain acceptable accuracy and precision. Each quantitative test for aflatoxin does require specialized equipment that has a substantial associated cost.

Cooperative funding provided by Texas A&M AgriLife Extension Service and the Ben and Rachel Vaughan Foundation.

Citizen Science for South Texas Birds: Public Involvement in Data Collection

Janel L. Ortiz, April A. Torres Conkey, Leonard A. Brennan, La Vonne Fedynich, and Mary E. Green

The field of citizen science is growing. These projects allow public involvement in scientific research through data collection by volunteers of all ages and all experience levels. An additional benefit is that citizen science can provide important information regarding the changes to wildlife distribution and patterns across a variety of landscapes.

The South Texas Wintering Birds (STWB) program is a project of the Caesar Kleberg Wildlife Research Institute in collaboration with the Cornell Lab of Ornithology and the National Audubon Society. Similar to eBird in its functionality, STWB

Relative ease of completing quantitative aflatoxin tests, accuracy of results, equipment costs, and cost per test using 7 commercially available products (A–G) by non-trained personnel.

	Quantitative Test Methods									
	A ¹	B ¹	C ¹	D ¹	E ¹	E ²	F ¹	F ²	G ¹	G ²
Time to Complete (min)	97	78	83	115	107	127	75	63	43	37
% Accuracy (N = 15)	33%	40%	33%	27%	33%	27%	40%	60%	47%	73%
Equipment Cost	\$3,700	\$3,066	\$2,943	\$2,400	\$6,008		\$5,906		\$2,650	
Aflatoxin Range (ppb)	5–100	5–100	5–100	5–100	5–100		5–100		2–40	
Cost per Test	\$22	\$23	\$21	\$18	\$20		\$30		\$10	

¹ = printed instructions; ² = video instructions

specifically documents the presence of birds within the South Texas region while keeping the specific sighting location private. The project's goal is to involve private landowners in South Texas who are interested in learning and having a better understanding of the birds on their land, yet keeping their data private and only accessible at the county level.

We hope to gather interest from the community to continue building the database, thereby gaining a better understanding of the species present in the region. Our goal is to learn about the presence of all birds including game species such as bobwhites, wild turkeys, and doves.

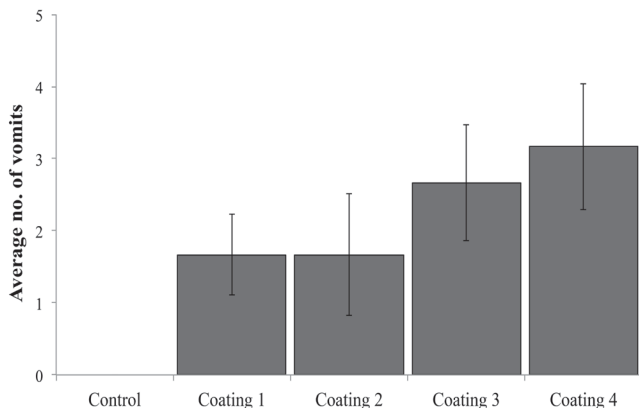
From the start of STWB in 2007, 415 species have been documented. Since the beginning of 2015, 197 species have been reported to the database. Anyone can participate by simply registering themselves in the program and recording the birds sighted on their property, backyard, or school campus. Sightings from the South Texas region are welcome and can be made during any time of the year! Visit www.stwb.org to get involved.

Cooperative funding provided by the Elizabeth Huth Coates Charitable Foundation of 1992.

Decreasing Pesticide-Induced Vomiting of Feral Swine to Reduce Non-target Exposure

Nathan P. Snow, Justin A. Foster, Katherine E. Horak, David G. Hewitt, and Kurt C. VerCauteren

A new orally delivered pesticide using encapsulated sodium nitrite is being developed for controlling invasive feral swine. Different formulations of



The average number of vomits and standard errors for 4 unique micro-encapsulation coatings tested to reduce vomiting of feral swine that consumed sodium nitrite.



© Nathan Snow

Small spheres of encapsulated sodium nitrite are mixed into a bait matrix as a potential pesticide for feral swine.

encapsulation can delay the release of sodium nitrite in feral swine, and possibly reduce vomiting by feral swine. Vomit may be a secondary hazard to scavenger species because sodium nitrite may persist in the vomit. Our objective is to evaluate potential formulations of encapsulated sodium nitrite for reducing possible hazards to non-target wildlife from vomit-contaminated pesticide.

We evaluated 4 formulations of encapsulated sodium nitrite. For each encapsulation treatment, we fed 6 feral swine 400 parts per million of sodium nitrite in a 10% concentrated peanut paste matrix. We also tested 4 feral swine as controls using encapsulated sugar. We observed the feral swine for signs of intoxication and vomiting until death. After death, we collected any vomit for chemical analysis of residual sodium nitrite, which would represent potential exposure to scavengers.

Preliminary analyses indicate that there were no differences among treatments for reducing vomiting. Feral swine treated with sodium nitrite averaged 2.3 vomits, whereas the control animals did not vomit. The time-till-death was similar for 3 of the formulations (average = 2.7 hours), and delayed for another (average = 12.4 hours). Chemical analyses are currently underway to determine the amount of residual sodium nitrite in vomit.

Cooperative funding provided by USDA Animal and Plant Health Inspection Service Wildlife Services National Wildlife Research Center.

WHITE-TAILED DEER

The Comanche-Faith Deer Study Project

Charles A. DeYoung, David G. Hewitt, Timothy E. Fulbright, Kim N. Echols, John H. Clark, Andrew N. Tri, David B. Wester, and Don A. Draeger

The Comanche-Faith Project derives its name from the 2 ranches in Dimmit County, on which the long-term South Texas research project is being conducted. The purpose of this research is to determine the best combination of deer density and supplemental feed while providing for the continued conservation of the natural habitat. Phase II of this study began in the spring of 2013, using the same 200-acre enclosures on each ranch that were used in Phase I (2004–2013), but employing a new experimental design. For Phase II, the new design includes a control enclosure (no deer), and 5 enclosures with varying densities of deer in conjunction with varying feeder densities as outlined in the table below. All deer in this new phase are provided with *ad libitum* supplemental feed. The summaries that follow represent completed research from this second phase.

Cooperative funding provided by the Comanche Ranch, T. Dan Friedkin, Faith Ranch, and Stedman West Foundation. Additional student support was provided by the various scholarships and named fellowships listed on page 3 of this publication.

Treatments in enclosures on EACH of the Comanche and Faith ranches.

	Encl. 1	Encl. 2	Encl. 3	Encl. 4	Encl. 5	Encl. 6
No. of Deer	20	40	60	60	80	0
Actual Acres per Deer	10	5	3.33	3.33	2.5	-
Acres per Deer Adjusted for 33% Count	30	15	10	10	7.5	-
Water and Feeder Sites	1	1	1	3	4	1
Deer per Feeder	20	40	60	20	20	0

Effect of Density on Deer Fawning Season Home Ranges in South Texas

John H. Clark, David G. Hewitt, Timothy E. Fulbright, Charles A. DeYoung, Kim N. Echols, Andrew N. Tri, David B. Wester, and Don A. Draeger

Female deer may spatially isolate themselves during fawning by decreasing their home range size prior to parturition. We fitted 35 does with Geographic Positioning Systems (GPS) collars to better understand how deer density affects home range size and overlap during fawning. On each ranch, we used a high-density (60 deer) enclosure and a low-density (20 deer) enclosure. GPS collars were deployed for 27 weeks beginning March 29th, 2014 and recorded locations every 30 minutes.

We generated 95% home ranges and compared sizes across densities. Weeks 2–7 were averaged for each deer to determine individual pre-fawning home range

sizes. When an animal's home range dropped significantly below its pre-fawning average for 2 consecutive weeks, the first week was estimated to be when birth occurred. We also generated weekly home range overlap indices for each pair of does in an enclosure.

- Average home range size varied weekly and was smaller after July 5th than before.
- Home ranges were 38% larger in low than high-density enclosures (38 acres versus 28 acres).
- Overlap was less when 1 or both does in a comparison had given birth.
- Overlap did not statistically differ between low and high deer densities, but was 40% lower in high-density enclosures. Increased sample sizes of deer would likely reveal differences.
- At high densities, deer are forced to rely on smaller habitat patches that may also be of lower quality because of range degradation.

- Smaller home ranges may lower the nutritional plane reducing fawn survival and growth rates. Ultimately, slower growth rates may have a negative effect on mature body size.

Effect of Deer and Feeder Density on Deer Growth Rates

John H. Clark, David G. Hewitt, Timothy E. Fulbright, Charles A. DeYoung, Kim N. Echols, David B. Wester, and Don A. Draeger

Deer population trends sometimes follow density dependence models in the northern and southeastern United States. However, in regions with highly variable rainfall, such as South Texas, populations may function differently.

We sought to investigate the effects of deer and supplemental feeder density on population growth rates and morphology. Each October and January, we conducted camera surveys and used mark-resight techniques to estimate population size. Deer were added or removed from enclosures in December and March to maintain target densities (20, 40, 60, or 80 deer per 200 acres). Population estimates from mark-resight analysis and population reconstructions yielded growth rates for each enclosure. During captures, we also measured body weight for all fawns and yearlings handled. Buckscore™ was used to estimate scores for all previously marked males.

- Neither deer density nor supplemental feeder density had significant effects on population growth rates. However, as deer density increased, population growth trended downwards.
- Although not statistically significant, maintaining a lower deer to feeder ratio tended to positively influence population growth.
- Neither deer density nor feeder density affected fawn or yearling growth rates.
- Neither deer density nor feeder density affected antler score or number of points. The mature bucks we analyzed had been raised under different experimental treatments; therefore, there might not have been enough time for treatment effects to affect antler characteristics.
- Although no negative effects of high deer density were observed, we suggest caution in using these results from 1 year of treatment effects when making management decisions.

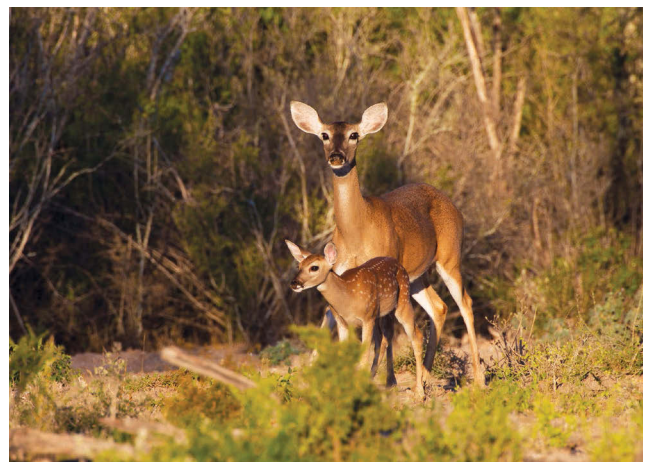
White-tailed Deer Fawn Use of Supplemental Feed Sites

Blaise A. Korzekwa, David G. Hewitt, Timothy E. Fulbright, Charles A. DeYoung, Kim N. Echols, and Don A. Draeger

Fawn use of supplemental feed sites is important, especially in environments such as southwestern Texas. Poor nutrition, especially in drought years, creates the need for an alternative source of nutrition in order to have a productive deer population.

We used motion-triggered trail cameras and uniquely identifiable ear tags to better understand how deer density and feeder density impacts fawn use of supplemental feed sites. Fawn-to-doe ratios of photographed deer at supplemental feed sites between the weeks of September 2nd, 2013 and February 17th, 2014 were compared to the true fawn-to-doe ratio of each enclosure to determine dates when fawn use of feed sites was similar to that of adult female deer for each treatment. We marked fawns with ear tags in December 2013 to calculate visitation rates of individual fawns to better understand how the treatments influenced fawns on an individual basis.

- We did not find a significant effect of deer density or feeder density on fawn use of the supplemental feed sites.
- Time of year was an important variable in fawn use of feed sites. Fawns did not use feed sites at the same rate as adult females until early November.
- Variation of fawn visitation to feed sites was greatest in December and decreased as fawns grew older.
- If the goal of a camera survey is to assess the fawn-to-doe ratio, these surveys will provide



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Fawn survival may be increased if they have access to supplemental feed resources during the winter.

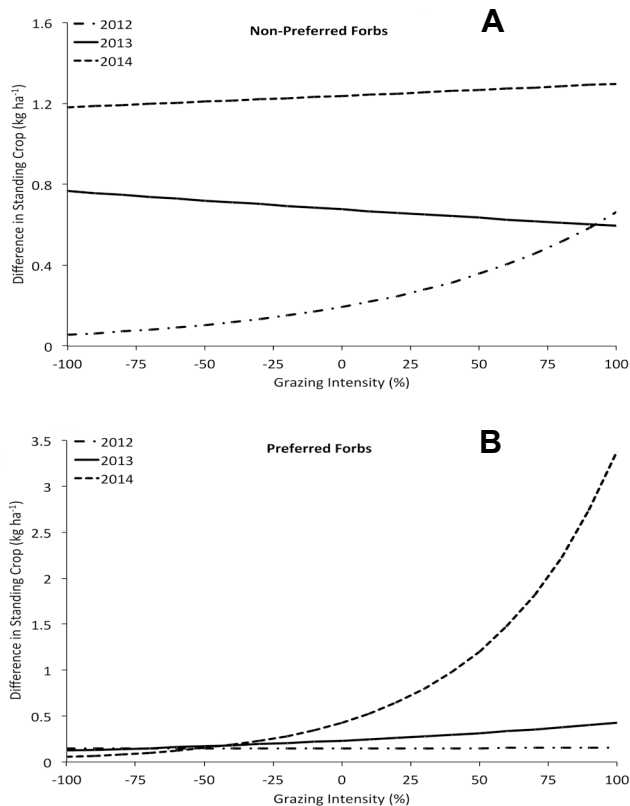
more accurate results if conducted in late Autumn. Individual fawns that appeared earlier and more often at feed sites will more than likely benefit the most from a ranch's supplemental feeding program.

** End of Completed Comanche-Faith Project Abstracts **

Does Cattle Grazing Increase Preferred Deer Forbs in South Texas?

Stacy L. Hines, Timothy E. Fulbright, J. Alfonso Ortega-Santos, David B. Wester, David G. Hewitt, Thomas W. Boutton, and Alfonso Ortega-Sanchez, Jr.

Cattle grazing is frequently recommended by biologists as a way to reduce grass cover and increase forbs for white-tailed deer and other wildlife. Our objective



A. Difference in forb standing crop comparing grazed to paired ungrazed area. For every 1% increase in cattle grazing intensity, non-preferred deer forbs increased 1.4% during 2012, decreased 1.2% during 2013, and there was no relationship during 2014.

B. During 2012, there was no relationship between grazing intensity and standing crop of preferred deer forbs, but during 2013 and 2014, preferred deer forbs increased 1.4% and 2.0%, respectively, for every 1% increase in cattle grazing intensity.

was to determine the relationship between intensity of cattle grazing and standing crop of forbs preferred by white-tailed deer and forbs that are not palatable to white-tailed deer. Every autumn for 3 years, we collected standing crop of (1) grasses, (2) non-preferred deer forbs, and (3) preferred deer forbs at 300 paired ungrazed and grazed sampling plots, 50 randomly allocated across each of 6 study sites located on East Foundation ranches, spanning from the Gulf Coast to western South Texas.

- Non-preferred forbs increased 1.4% during 2012 and decreased 1.2% during 2013 for every 1% increase in cattle grazing intensity; grazing intensity was unrelated to standing crop of non-preferred forbs in 2014.
- There was no relationship between grazing intensity and standing crop of preferred forbs during 2012, but preferred forbs increased 1.4% and 2.0% for every 1% increase in cattle grazing intensity during 2013 and 2014, respectively.
- The increase in preferred deer forbs was 3 pounds per acre as the result of cattle grazing—too small to benefit white-tailed deer. We did not detect a negative impact of cattle grazing on the standing crop of preferred forbs.
- Cattle grazing has little effect on forbs in South Texas whether they are preferred by deer or not; consequently, using cattle grazing as a habitat manipulation tool to increase food for deer is not substantiated for areas with a long history of high grazing use.

Cooperative funding provided by the East Foundation.

Efficacy of Two Anesthesia Regimes for Immobilizing White-tailed Deer

Clayton D. Hilton, David G. Hewitt, Lauren D. Balderas, Leslie Bowman, and William R. Lance

White-tailed deer may need to be chemically immobilized for research projects or to treat medical conditions. Most available options are difficult to use because of Drug Enforcement Agency (DEA) regulations and protracted anesthesia.

We evaluated the quality of anesthesia in white-tailed deer produced by a combination of nalbuphine-medetomidine (NM) and nalbuphine-azaperone-medetomidine (NAM) and an antagonism using naltrexone and atipamezole. The study was conducted

at the Albert and Margaret Alkek Ungulate Research Facility at Texas A&M University-Kingsville.

We used 5 adult male and 6 adult female white-tailed deer; each deer was anesthetized twice and reversed twice, using the 2 different combinations of anesthetics. Metrics for evaluating anesthesia quality were time to first effect, time until deer laid down, ease of handling, respiration rate, oxygen saturation, heart rate, and body temperature. Quality of anesthetic reversal was measured by time to first effect, time to sit up, time to stand, and time to walk.

- Deer treated using NAM showed signs of anesthesia 2 to 3 minutes sooner and transitioned through recovery stages 2 to 4 minutes slower than deer treated using NM.
- The only physiological parameter measured in which the treatments differed was respiration rate, which was 10 breaths per minute slower in deer anesthetized with NAM.
- Both treatments produced high-quality anesthesia and no adverse effects.
- We recommend these drug combinations be considered when there is a need to anesthetize white-tailed deer for short periods (20 to 30 minutes) and wish to use drugs not regulated by the DEA.

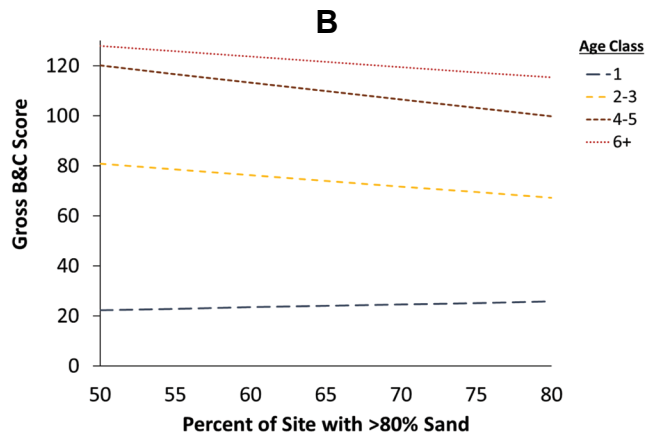
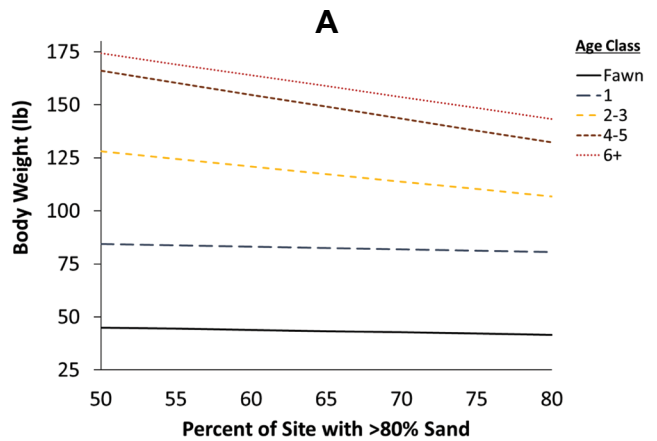
Cooperative funding provided by Wildlife Pharmaceuticals, Inc.

Geographic Variation in the Morphology of White-tailed Deer in South Texas

Kory R. Gann, David G. Hewitt, J. Alfonso Ortega-Santos, Timothy E. Fulbright, Alfonso Ortega-Sanchez, Jr., Thomas W. Boutton, and Tyler A. Campbell

To assess the relationship between soil physical properties and deer morphology, we captured 2,775 deer in autumn 2011–2014 on 4 East Foundation properties located from the Gulf Coast to 90 miles inland. We determined the percentage of each capture area composed of soils with a surface texture classified as sandy loam or clay loam, as well as the percentage of each capture area composed of soils with an average percentage sand greater than 70% and greater than 80% at a depth of 0–24 inches.

- The percentage of each capture area composed of soils with greater than 80% sand best-explained differences in deer morphology.



Effect of the soil parameter (% of site with greater than 80% sand) on (A) body weight and (B) antler size of male white-tailed deer.

- For every 1% increase in the proportion of the capture area composed of soils with greater than 80% sand (1) female body weight decreased by 0.29 pounds for 2–3 year olds, 0.35 pounds for 4–5 year olds, and 0.39 pounds for the 6+ age class; (2) male body weight decreased by 0.71 pounds for 2–3 year olds, 1.13 pounds for 4–5 year olds, and 1.03 pounds for the 6+ age class; (3) antler size decreased by 0.45 inches for 2–3 year olds, 0.68 inches for 4–5 year olds, and 0.42 inches for the 6+ age class.
- The soil parameter had no effect on body weight of fawns or yearling (1 year old) deer of either sex or antler size of yearling males.
- The efficiency of deer management programs may be reduced on sites with sandy soils resulting from the increased amount of time necessary to achieve desired results.

Cooperative funding provided by the East Foundation.

HABITAT RESTORATION AND ENHANCEMENT

Release of Ramadero Germplasm Spike Lovegrass

Anthony D. Falk, Forrest S. Smith, Keith A. Pawelek, John Lloyd-Reilley, Shelly D. Maher, Andrew W. Scott, Jr., and Juan Garza

South Texas Natives and the USDA Natural Resources Conservation Service E. “Kika” de la Garza Plant Materials Center have completed the release of a locally adapted seed source of spike lovegrass. This grass is a robust warm-season perennial found on clay and loamy soils. Spike lovegrass is also well adapted to saline and alkaline sites, making it an excellent candidate for difficult to restore areas, particularly in western South Texas. Ramadero Germplasm spike lovegrass produces abundant cattle forage and has excellent erosion control ability around tank dams and in seasonal drainages and wetlands.

This release will provide commercial seed sources for use in areas of South Texas where grazing has eliminated it. Ramadero Germplasm spike lovegrass has had superior seed quality and drought hardiness compared to other options for seeding on many sites.

- Ramadero Germplasm spike lovegrass originates from saline clay loam soil in La Salle County, Texas.
- Ramadero Germplasm spike lovegrass has been successfully tested for adaptation to similar conditions throughout the South Texas Plains region.
- This release will make an excellent addition to range and right-of-way seed mixes because of its forage, wildlife, and erosion control value.
- Commercial seed is being produced by Douglass W. King Seed Company and should be available to consumers by 2016.

Cooperative funding provided by the donors to South Texas Natives.

Wilson County Eagle Ford Shale Pipeline Research Trial

Keith A. Pawelek, Anthony D. Falk, Forrest S. Smith, and Ryan L. Darr

There is a need to restore pipeline right-of-ways in South Texas to native habitat as a result of the energy exploration in the Eagle Ford Shale. *South Texas Natives* conducted a pipeline restoration planting trial

on the Buen Vecino Ranch in Wilson County, located in the heart of the Eagle Ford Shale oil and gas exploration and production region.

This study was developed to provide guidance to landowners and oil and gas operators on selecting the best techniques for restoring pipeline right-of-ways. The objectives were to (1) examine the differences in seeding results using a Truax seed drill and a Truax trillion seeder and (2) compare results of using a low diversity native seed mix of 10 locally adapted native grasses and a high diversity mix of 31 locally adapted native grasses, forbs, and legumes.

- Vegetation establishment did not differ between plots planted with the Truax seed drill or Truax trillion seeder.
- The low diversity and the high diversity seed mixes achieved successful stand establishment densities of seeded plants exceeding 1 plant per square foot.
- As expected, the high diversity seed mix yielded a more diverse plant community; however, many species from the 31 species mix did not establish.
- Individual species establishment varied according to soil type.
- These findings suggest diverse seed mixes are needed for successful plantings on areas that have large amounts of soil variability.

Cooperative funding provided by the Rotary Club of Corpus Christi (Harvey Weil Sportsman Conservationist Award Trust), Buen Vecino Ranch, and the numerous donors to South Texas Natives.

The Release of Duval Germplasm Red Lovegrass

Anthony D. Falk, Forrest S. Smith, Keith A. Pawelek, John Lloyd-Reilley, Shelly D. Maher, Andrew W. Scott, Jr., and Juan Garza

Restoration of native plant communities on sandy soils in South Texas can be challenging because of the unique plant communities found on these sites. *South Texas Natives* (STN) in collaboration with the USDA Natural Resources Conservation Service Plant Materials Center has released Duval Germplasm red lovegrass for use in sandy soil restoration projects in the region. Red lovegrass is a low-growing, warm season perennial grass adapted to sandy soils. It is an early successional species that is well adapted to colonizing disturbed areas.

Until now, there has been no locally-adapted commercial seed of red lovegrass for use in South Texas, and very little locally-adapted commercial seed that would work on sandy soils in general. Duval Germplasm red lovegrass should provide a seed source that will establish reliably and quickly on sandy soil sites in South Texas that are prone to erosion and invasion by non-native species.

- Duval Germplasm red lovegrass is made up of 4 populations, all of which originate from sand or sandy loam soils in Zavala, Calhoun, Jim Hogg, and Duval counties.
- This release is adapted to the Rio Grande Plains, Gulf Coast Prairies and Marshes, and Coastal Sand Plain. In addition, it has shown some ability to grow in the southern portion of the Post Oak Savannah ecoregion.
- Duval Germplasm red lovegrass should be a good addition to both range and right-of-way seed mixes because of its ability to quickly establish and provide vegetative cover in sandy soils.
- Duval Germplasm red lovegrass should be available for purchase from Douglass W. King Seed Company by 2016.

Cooperative funding provided by the donors to South Texas Natives.

Conservation of Endangered Slender Rush-pea in South Texas

Ashley C. McCloughan, Sandra Rideout-Hanzak, and David B. Wester

Slender rush-pea is a small herbaceous plant endemic only to Nueces and Kleberg counties. Native to former short-grass prairies, it is currently classified as Endangered without Critical Habitat because of encroachment by non-native, invasive grasses. We compared 4 management techniques for conserving slender rush-pea at the St. James Catholic Cemetery in Nueces County: (1) prescribed burning, (2) herbicide treatment of neighboring plants, (3) weed-eating neighboring plants, and (4) no treatment as a control.

- Mortality throughout our 2-year study was low in all treatments, suggesting that slender rush-pea is a long-lived species.
- Prescribed burning resulted in an immediate increase in the number of stems and flowers

compared to plants in the control treatment. It also produced an increase in length of longest stem and number of leaves after several months.

- Herbicide treatment to control neighboring plants resulted in more stems, more leaves, or more flowers than control plants at various times throughout the treatment.
- Weed-eating neighboring plants eventually produced more stems on slender rush-pea than control plants, but did not affect stem length, number of leaves, or number of flowers.
- Prescribed burning appears to be the best method for increasing the robustness of slender rush-pea as measured in the number of stems, stem length, number of leaves, and number of flowers per plant. A herbicide that is grass-specific would be the next best substitute.
- More research on slender rush-pea pollination methods, reproduction, and lifespan is necessary to fully understand this species' ecology and optimal methods of management and restoration.

Cooperative funding provided by the U.S. Navy and U.S. Fish and Wildlife Service.

Evaluation of Native Seed Sources in Gamebird Food Plots

Anthony D. Falk, Keith A. Pawelek, Forrest S. Smith, Matthew J. Schnupp, Robert Sanders, Aaron Cantu, Terry Hanzak, and Rudy Gonzalez

The practice of planting seed producing agricultural crops to lure gamebirds is often used in South



© Forrest Smith

Rio Grande clammyweed may have utility for use in gamebird food plots within South Texas.

Texas. These crops take a considerable amount of input including fertilization and irrigation in most years. Additionally, gamebirds often prefer to feed on native seeds. Because of these factors, many landowners are interested in native seed producing plants for use in their food plots.

During the summer of 2014, *South Texas Natives* developed food plots on 6 South Texas ranches using seed of 6 locally adapted, commercially available native plants. Each species was planted at half the recommended seeding rate to create open ground, which allows the birds to land and feed. Additionally, each species was planted in a monoculture plot so that we could observe if birds demonstrated a preference for a particular native plant species.

- Drought conditions limited establishment of all species planted. However, each location had at least 1 species establish to varying degrees.
- Zapata Rio Grande clammyweed, Balli Germplasm prostrate bundleflower, and Oso Germplasm Halls panicum were the most successful at all locations.
- Annual weeds and grasses that are common in most food plot settings hindered establishment of the native species.
- Plots were planted the last week of June and the first week of July. This time period proved to be too late as most plants set seed during the split between dove seasons.
- Drought conditions limited seed production and, consequently, gamebird use of the species planted. The use of native seed sources for gamebird food plots should be cautiously considered during drought conditions.

Cooperative funding provided by the Caesar Kleberg Partners.

The Release of Nueces Germplasm Sand Dropseed

Anthony D. Falk, Forrest S. Smith, Keith A. Pawelek, John Lloyd-Reilly, Shelly D. Maher, Andrew W. Scott, Jr., and Juan Garza

South Texas Natives released Nueces Germplasm sand dropseed in 2015 in collaboration with the USDA Natural Resources Conservation Service E. “Kika” de la Garza Plant Materials Center. Sand dropseed is an early-successional, perennial grass that is adapted to a wide variety of soil types. Sand dropseed is an



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Nueces Germplasm sand dropseed was released by *South Texas Natives* in 2015.

important cattle forage because of its abundance in many native plant communities, especially on sandy soils. It also provides food for a number of birds, including bobwhites and wild turkeys.

Historically, sand dropseed has been difficult to establish because of the high dormancy rates found in non-local sources of seed. Other available commercial selections of sand dropseed persist poorly when planted in South Texas. Nueces Germplasm sand dropseed has shown indications of high seed germination and, since it originates from South Texas, it should persist well in the area.

- Nueces Germplasm sand dropseed is made up of 5 collections selected from an evaluation containing over 30 different sand dropseed populations.
- Testing showed the release is adapted to the Rio Grande Plains, Coastal Sand Plains, and Gulf Coast Prairies and Marshes ecoregions.
- Nueces Germplasm sand dropseed can be included in rangeland and right-of-way seed mixes because of its forage value to livestock and value to wildlife. In addition, Nueces Germplasm sand dropseed is quick to establish.
- With collections originating from sandy soils in South Texas, Nueces Germplasm sand dropseed will provide another option for restoration efforts on sandy soils where there has been few choices of adapted plants that grow well and persist.

Cooperative funding provided by the donors to South Texas Natives.

Long-Term Evaluation of Rangeland Seeding in South Texas

Anthony D. Falk, Keith A. Pawelek, and Forrest S. Smith

Locally adapted native seeds became commercially available beginning in 2008. *South Texas Natives* (STN) has made a substantial effort to quantify the performance of these seed sources in rangeland plantings and develop recommendations for seed mixes and planting techniques.

In 2008, STN conducted 11 plantings across South Texas. These plantings spanned a range of soil types, various climatic conditions, and multiple land management practices. Since planting, each site has been monitored twice annually to document long-term performance, compositional shifts in vegetation following restoration, and longevity of restored native plant communities. Our findings are based on 7 years of field data and are summarized below.

- Locally adapted native seeds can be used to successfully restore native plant communities in South Texas given that the proper seed mixes and planting techniques are used.
- Planting dates between late August and early October were the most successful.
- Repeated land preparation treatments are needed to create seedbeds for successful native plant seeding on rangelands, especially in areas where invasive grasses occur.
- Choice of land preparation (mechanical disturbance, herbicide, or a combination) was less important than was repeated application.



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Over the past 15 years, *South Texas Natives* has made important contributions to native plant restoration.

- Seed mix composition is important and should be based on historical plant communities of the specific planting site. However, native species not naturally found on similar areas as the restoration site are unlikely to persist, despite use of regionally adapted seeds.
- Following successful establishment, restored stands can be expected to fluctuate dramatically with rainfall. However, plant community composition changed little on these planting sites during the 7 years of this study.

Cooperative funding provided by numerous donors to South Texas Natives and the Caesar Kleberg Partners.

The Release of Menard Germplasm Purple Threawn

Anthony D. Falk, Forrest S. Smith, Keith A. Pawelek, Colin S. Shackelford, Mia A. McCraw, James P. Muir, Louis A. Harveson, Chase A. Murphy, Dennis K. Markwardt, John Lloyd-Reilley, Shelly D. Maher, Jeff R. Breeden, Gary Rea, Brandon Carr, and Bonnie J. Warnock

Menard Germplasm purple threawn is one of the first formal releases of ecotypic native plant material made by *Texas Native Seeds* in collaboration with the USDA Natural Resources Conservation Service E. “Kika” de la Garza and James E. “Bud” Smith Plant Materials centers, Texas AgriLife Extension Service, Tarleton State University, and Sul Ross State University. Purple threawn is a warm-season perennial grass adapted to shallow soil areas occurring throughout Texas.

This release should be a beneficial addition to highway right-of-way seed mixes because of its ability to grow on extremely dry sites and in poor soil conditions. This release will also be a good component of range seed mixes because of its widespread distribution in many rangelands and its use by many wildlife.

- Menard Germplasm purple threawn is made up of 6 collections, which originate from Jim Wells, Menard, Kenedy, Bee, McMullen, and Hood counties in Texas.
- Evaluations indicated this seed is adapted to the Rolling Plains, Edwards Plateau, Rio Grande Plains, Coastal Sand Plains, and Gulf Coast Prairies and Marshes ecoregions.
- Commercial availability of purple threawn seed will provide an additional native seed mix

component for use on shallow, rocky, and sandy soils throughout much of Texas.

- Proposals for the commercial seed production of Menard Germplasm purple threeawn will be requested from seed growers in early 2016.

Cooperative funding provided by the Texas Department of Transportation and numerous donors to Texas Native Seeds.

Assessing Season of Prescribed Burning on Old World Bluestems

Adam E. Toomey, Sandra Rideout-Hanzak, and David B. Wester

Non-native Old World bluestems (OWB) are an increasing threat to native vegetation and wildlife conservation throughout the Texas Plains and Gulf Coast Prairies. We established 10 permanent grazing exclosures at the South Pasture Research Facility in Kleberg County, Texas to investigate the influence of season of burning on grasslands dominated by OWB. Exclosures were treated with summer burns, winter burns, or no burning (control). We then sampled vegetation at both the individual and community levels to capture effects 1 year after burning.

- Individually-marked OWB were found to have similar mortality regardless of treatment. The most abundant native species, Texas tridens, exhibited similar mortality across all treatments.
- Surviving OWB individuals showed an increase in aboveground biomass following each treatment. However, summer and winter burn treated plants



© Sandra Rideout-Hanzak

CKWRI researchers studied how prescribed fire affected the persistence and growth of Old World bluestems.

with a pre-treatment biomass greater than 0.5 oz exhibited smaller gains than control plants. All Texas tridens individuals exhibited similar biomass increases regardless of treatment.

- Summer burning produced a greater dead crown density than either winter and control treatments, which produced similar densities.
- Seedling densities were highest the growing season after both summer and winter treatments. Although OWB rapidly germinates following a burning event, few individuals survive to reach maturity.
- No treatment effects were observed on total soil seed bank species richness, diversity, or evenness; however, annual forb richness was greater in the control than the burning treatments.
- Many of our measurement comparisons were almost statistically significant; differences among treatments may have become apparent if climatic factors during the study were different.

Cooperative funding provided by the Rotary Club of Corpus Christi (Harvey Weil Sportsman Conservation Award Trust) and South Texas Chapter of the Quail Coalition.

The Release of Guadalupe Germplasm White Tridens

Anthony D. Falk, Forrest S. Smith, Keith A. Pawelek, Colin S. Shackelford, Mia A. McCraw, James P. Muir, Louis A. Harveson, Chase A. Murphy, Dennis K. Markwardt, John Lloyd-Reilley, Shelly D. Maher, Jeff R. Breeden, Gary Rea, Brandon Carr, and Bonnie J. Warnock

Guadalupe Germplasm white tridens is one of the first seed releases from the *Texas Native Seeds* program in collaboration with USDA Natural Resources Conservation Service E. “Kika” de la Garza and James E. “Bud” Smith Plant Materials centers, Texas AgriLife Extension Service, Tarleton State University, and Sul Ross State University. White tridens is a warm-season perennial that has fair to good wildlife and cattle value. White tridens is primarily found in moist, clayey soils, as well as saline and alkaline sites.

Release of this species should provide an excellent early successional seed source for addition to range seeding mixes throughout the state. It will also be beneficial to highway right-of-way plantings because of its ability to grow and persist in low areas that are frequently subjected to standing water.

- Guadalupe Germplasm white tridens is comprised of 5 collections chosen from an evaluation of over



© Anthony Falk

Guadalupe Germplasm white tridens will benefit wildlife, cattle, and highway right-of-way plantings in wet areas.

30 populations. Collections in the release originate from Tom Green, Nueces, Guadalupe, Parker, and Regan counties in Texas.

- This release is the first regionally adapted seed selection of white tridens for use in Texas.
- Based on evaluation data, Guadalupe Germplasm white tridens is adapted to the Cross Timbers, Blackland Prairie, Edwards Plateau, Trans-Pecos, and South Texas Plains ecoregions.
- Commercial production proposals for production of Guadalupe Germplasm white tridens seed will be evaluated in 2016.

Cooperative funding provided by the Texas Department of Transportation and numerous donors to Texas Native Seeds.

Modeling Sea Level Rise along the Lower Texas Coast

Corey J. Lange, Bart M. Ballard, Kris L. Metzger, and Daniel P. Collins

The majority of North America's redheads spend the winter along the lower Texas coast. During winter, they travel between foraging areas in the Laguna Madre and freshwater drinking sites in coastal ponds on the mainland. Most coastal ponds that are used by wintering redheads are close to sea level; thus, the threat of rising sea levels could have a severe effect on their future distribution and availability. We developed a model to identify areas adjacent to the Laguna Madre that will be most affected by rising sea levels.

- Most projected land cover changes caused by sea level rise did not occur until year 2040 and 2060.
- Wetland types important to redheads exhibited declines of 19 to 93% by 2100.
- Our model predicted that 60% of coastal ponds will become inundated with salt water from a 3.2 foot (1 meter) rise in sea level by 2100.
- Our model predicts that by 2100 only 11.5% of the currently available coastal ponds will hold fresh water for redheads during dry years; these ponds are located in areas that will allow redheads to access only 49.6% of their current foraging areas along the lower Texas coast.

Cooperative funding provided by the U.S. Fish and Wildlife Service.

Local Spatial Avoidance of the Ocelot and Jaguarundi in Mexico

Arturo Caso and Michael E. Tewes

Ocelots and jaguarundis co-occur in suitable habitat within northern Mexico. We studied the ecology of these species with radio telemetry on the Los Ebanos Ranch in Tamaulipas, Mexico to assess home range size, habitat use, and activity patterns. We captured 21 jaguarundis (13 males, 8 females) and 22 ocelots (9 males, 13 females) and assessed their movements.

- Mean home range size (95% fixed kernel estimator) for male and female ocelots was 5.8 mi² and 3.2 mi², respectively.

- Mean home range size (95% fixed kernel estimator) of male and female jaguarundis was 6.2 mi² and 4.6 mi², respectively.
- Home ranges of both species overlapped; however, core area overlap was reduced.
- Ocelots were nocturnal, whereas jaguarundis were predominantly diurnal.
- Ocelots used mature forest more intensively than open habitats available in their home ranges, whereas jaguarundis used mature forest and pasture-grassland with similar intensities.
- This study provided first-ever ecological data on the spatial avoidance of free-ranging ocelots and jaguarundis. This information contributes to our understanding of the natural history of these 2 felids from which further conservation measures can be developed.

Cooperative funding provided by the Dallas Zoo and Los Ebanos Ranch.

Impacts of Wind Energy on Redheads Wintering along the Lower Texas Coast

Corey J. Lange, Bart M. Ballard, and Daniel P. Collins

The lower Texas coast is extremely important to wintering redheads as nearly 80% of the continent's population winters there. With the relatively recent surge of development interest in the Texas coast from the wind power industry, the potential impacts on native wildlife, including redheads, are unknown.

The distribution and abundance of coastal ponds along the lower Texas coast are critical for redheads using the Laguna Madre. We investigated redhead distribution and use of coastal ponds before and after construction of a large wind farm along the lower Texas coast.

- The average number of redheads detected per aerial survey on coastal ponds within the wind farm decreased by 77% from pre-construction to post-construction; however, the average number of redheads per survey across the entire study area increased by 226% between pre-construction and post-construction.
- Analyses using Geographic Information Systems (GIS) and the Palmer Drought Severity Index indicated the number of ponds within the wind farm was lower than expected following construction.

- Eighty-eight percent of ponds available during pre-construction were available during post-construction during wet conditions, 30% were available during years of average wetness, and less than 1% during years of dry conditions.
- Results suggest that the wind farm has impacted wintering redheads by reducing coastal pond availability and causing redheads to avoid the area located within the wind farm.
- Based on their proximity to foraging areas and other ponds, coastal ponds within the wind farm were, prior to construction, one of 2 areas of highest conservation priority for wintering redheads along the lower Texas coast.

Cooperative funding provided by the U.S. Fish and Wildlife Service.

Wetland Habitat Selection by Mottled Duck Broods in Texas

Anastasia I. Krainyk, Richard S. Finger, Russell H. Terry, Bart M. Ballard, and M. Todd Merendino

The Texas coast provides important habitat for migrating and resident waterfowl, including the mottled duck, which relies on this region for all its life-cycle events. However, much of the historical wetland area throughout the coastal plain of Texas has been lost or degraded because of human activities. The loss of nesting and brood-rearing habitat is thought to be the main culprit for the long-term decline in mottled duck abundance within Texas.

Understanding the requirements of mottled duck broods so that recruitment can be increased has been cited as a key element to the recovery of the population. The purpose of our study was to gain an understanding into what wetland characteristics are important for brood-rearing activities of mottled ducks.

- Mottled duck broods selected semi-permanent and seasonally flooded freshwater to brackish wetlands for brood-rearing activities.
- Wetlands for brood-rearing also had more than 30% emergent vegetation cover and low salinity.
- For successful broods of radio-marked mottled ducks, average movements between nest site and first brood-rearing wetland they traveled to was approximately 1 mile, which is important in understanding landscape configuration of nesting and brood-rearing habitats.

- Distance between nest site and brood-rearing wetlands appeared to influence brood survival, as broods with longer movements tended to have lower survival.

Cooperative funding provided by the Texas Parks and Wildlife Department.

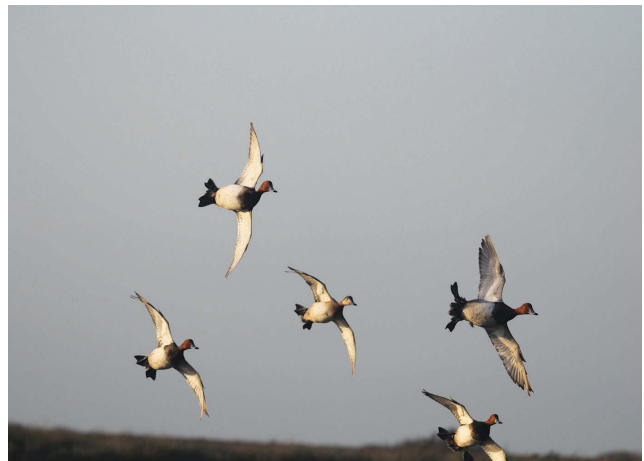
Conservation Strategy for Coastal Ponds along the Lower Texas Coast

Corey J. Lange, Bart M. Ballard, Barry C. Wilson, Daniel P. Collins, and J. Dale James

Coastal ponds adjacent to the Laguna Madre provide an important and heavily used source of freshwater for wintering redheads. Consequently, the distribution and abundance of coastal ponds have a large influence on the availability of foraging areas in the Laguna Madre because these 2 resources function collectively to support wintering redhead populations.

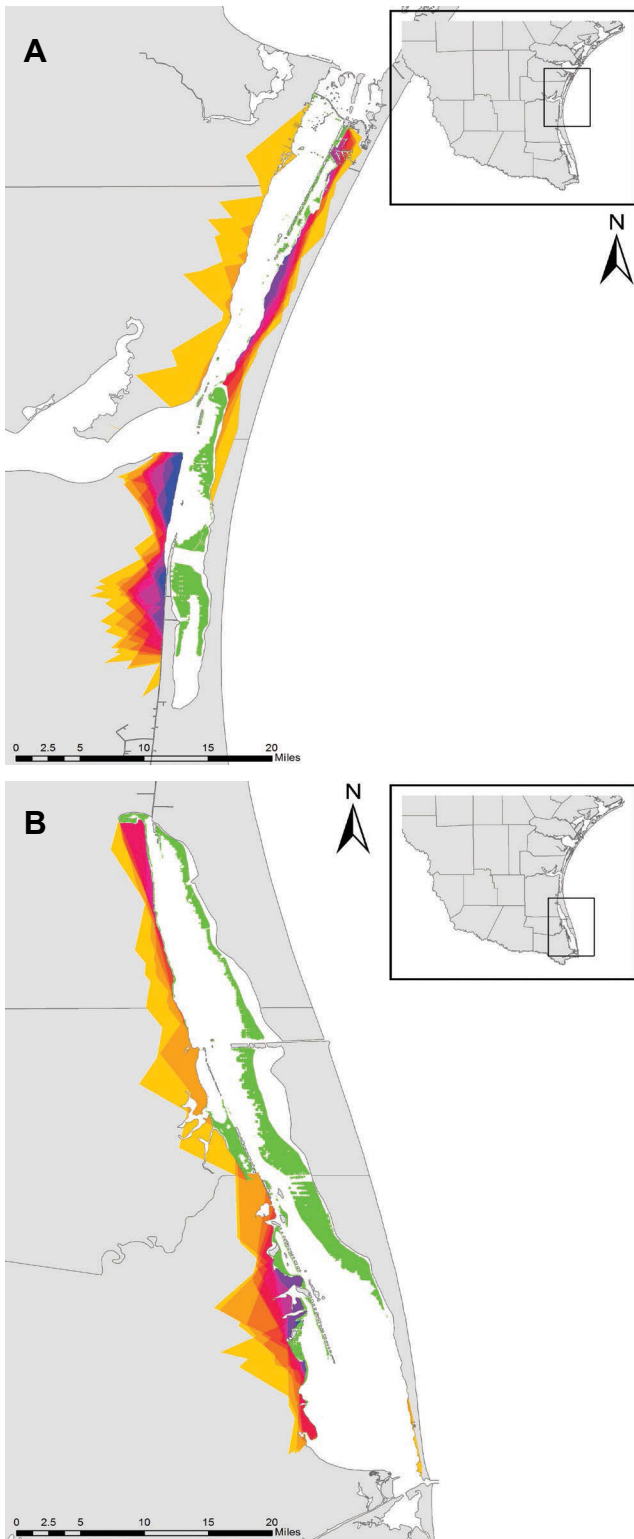
For each pond identified as being used by redheads, we calculated the amount of nearby foraging area, the permanence of the pond, and its isolation from other ponds. These 3 factors were used to provide a conservation rank for coastal ponds and redhead flight paths to foraging areas. We conducted 101 weekly aerial surveys to monitor redhead use of the coastal ponds adjacent to the Laguna Madre across 5 winters.

- We identified 156 coastal ponds used by redheads across the 5 years of varying habitat conditions.
- Based on the distribution of coastal ponds, 33% of foraging habitat in the Laguna Madre is unavailable



© Bart Ballard

The Laguna Madre represents a major wintering area for the continental redhead population.



A. The Upper Laguna Madre highlighting areas along the coast that could be receiving the highest amount (purple color) of redhead flight traffic from foraging areas to coastal ponds, compared to more yellow areas receiving less traffic.

B. The Lower Laguna Madre highlighting areas along the coast that could be receiving the highest amount (purple color) of redhead flight traffic from foraging areas to coastal ponds, compared to more yellow areas receiving less traffic.

to redheads during dry years because there is no fresh water in close proximity.

- The area of greatest conservation value to redheads occurs on North Padre Island, the Kenedy Ranch, and Laguna Atascosa National Wildlife Refuge.

Cooperative funding provided by the U.S. Fish and Wildlife Service.

Ecological Niche Modeling of Northern, Black-throated, and Crested Bobwhites

Damon L. Williford, Randy W. DeYoung, Rodney L. Honeycutt, Leonard A. Brennan, and Fidel Hernández

The geographic distribution and population dynamics of the northern bobwhite are heavily influenced by temperature and precipitation. Less is known about the closely related black-throated and crested bobwhites. Ecological niche modeling (ENM) can be used to predict how the geographic range of an organism will respond to changes in environmental variables. We constructed ENMs for all 3 species of bobwhites based on their geographic distribution in today’s climate and estimated their geographic range during the Mid-Holocene (6,000 years ago), Last Glacial Maximum (21,000 years ago), and the Last Interglacial (130,000 years ago).

- The predicted distribution for northern, black-throated, and crested bobwhites under contemporary and Mid-Holocene conditions was similar to published range maps.
- During the Last Glacial Maximum, geographic distribution of the northern bobwhite was restricted to Mexico and the extreme southern United States, whereas the crested bobwhite’s geographic distribution expanded in South America.
- Each species had reduced ranges during the Last Interglacial. The northern bobwhite was absent from the Great Plains and was confined to the southeastern United States and Mexico. The black-throated bobwhite occurred in 2 small, isolated pockets on the Yucatán Peninsula. The crested bobwhite was absent from Central America except for Panama.
- The ENMs demonstrated that all 3 species of bobwhites were sensitive to changes in climate. Wildlife biologists should take climate change into account during the design of conservation strategies. Existing bobwhite habitat in areas that

served as refugia for these 3 species during the Last Interglacial, when temperatures were 3 to 5 degrees warmer than today, should be preserved.

Cooperative funding provided by the Richard M. Kleberg, Jr. Center for Quail Research.

Chemical Immobilization for Capturing Wild Jaguarundis

Arturo Caso, Michael E. Tewes, Emilio Rendon-Franco, and Lon I. Grassman, Jr.

The jaguarundi is an endangered species in the United States, and occurs more commonly in northern Mexico. We conducted the first study of the chemical immobilization of jaguarundis in the wild to aid researchers in future studies. We anesthetized 20 jaguarundis at 2 sites in northeastern Mexico using a mixture of ketamine hydrochloride (Ketaset®, KH) and xylazine hydrochloride (Rompun®, XH). Respiration and muscle rigidity were monitored during sedation.

- The induction time, duration of anesthesia, and recovery time of KH-XH were satisfactory for field research procedures including radio-collaring.
- No adverse physiological effects were observed; however, several individuals experienced early arousal followed by prolonged recovery.
- Individuals were released after full recovery and monitored using radio telemetry for 1 to 13 months with no observed detrimental effects related to chemical immobilization.
- We conclude that KH-XH may be safe and effective for wild jaguarundis; however, further field research is needed to test other adrenergic antagonist drug combinations for this species.

Cooperative funding provided by the Dallas Zoo, Los Ebanos Ranch, Gladys Porter Zoo, and Feline Research Program of the Caesar Kleberg Wildlife Research Institute.

Diet and Nutrition of Female Northern Pintails along the Texas Coast

Nathaniel R. Huck, Bart M. Ballard, Kevin J. Kraai, and Matt R. Kaminski

The Texas coast remains one of the most important wintering areas in North America for the northern



© Randy DeYoung

Wetlands along the Texas coast are vital to wintering northern pintails and other duck species.

pintail. Historically, the northern pintail was one of the most abundant ducks in North America. However, its abundance has declined over the last several decades, and it is well below population objectives. Reductions in habitat quality and quantity for northern pintails along the Texas coast may affect their ability to meet nutrient requirements. Our goal was to estimate the composition and energy content of the diet of female pintails wintering in freshwater and saltwater habitats along the Texas coast.

- We identified 104 different food items in the upper digestive tracts of female northern pintails, inclusive of 57 plant taxa and 47 animal taxa.
- Fourteen species comprised 85% of the diet with paspalum, smartweed, and pondweeds comprising most of the diet on inland freshwater habitats.
- In Texas coastal habitats, shoalgrass rhizomes, *Gammarus* amphipods, and gastropods comprised most of the diet.
- Energy available in the diet was similar between inland and coastal habitats between fall and spring, but 43% greater in inland than coastal habitats during winter.
- Energy available from diets of female northern pintails wintering in other regions of North America was 39 to 91% greater than diets found in coastal habitats and 4 to 87% greater than diets found in inland freshwater habitats.

Cooperative funding provided by the Texas Parks and Wildlife Department.

Prioritizing Mottled Duck Habitat along the Western Gulf Coast

Anastasia I. Krainyk, Bart M. Ballard, Michael G. Brasher, Barry C. Wilson, Mark W. Parr, Jena A. Moon, and Cynthia Kallio-Edwards

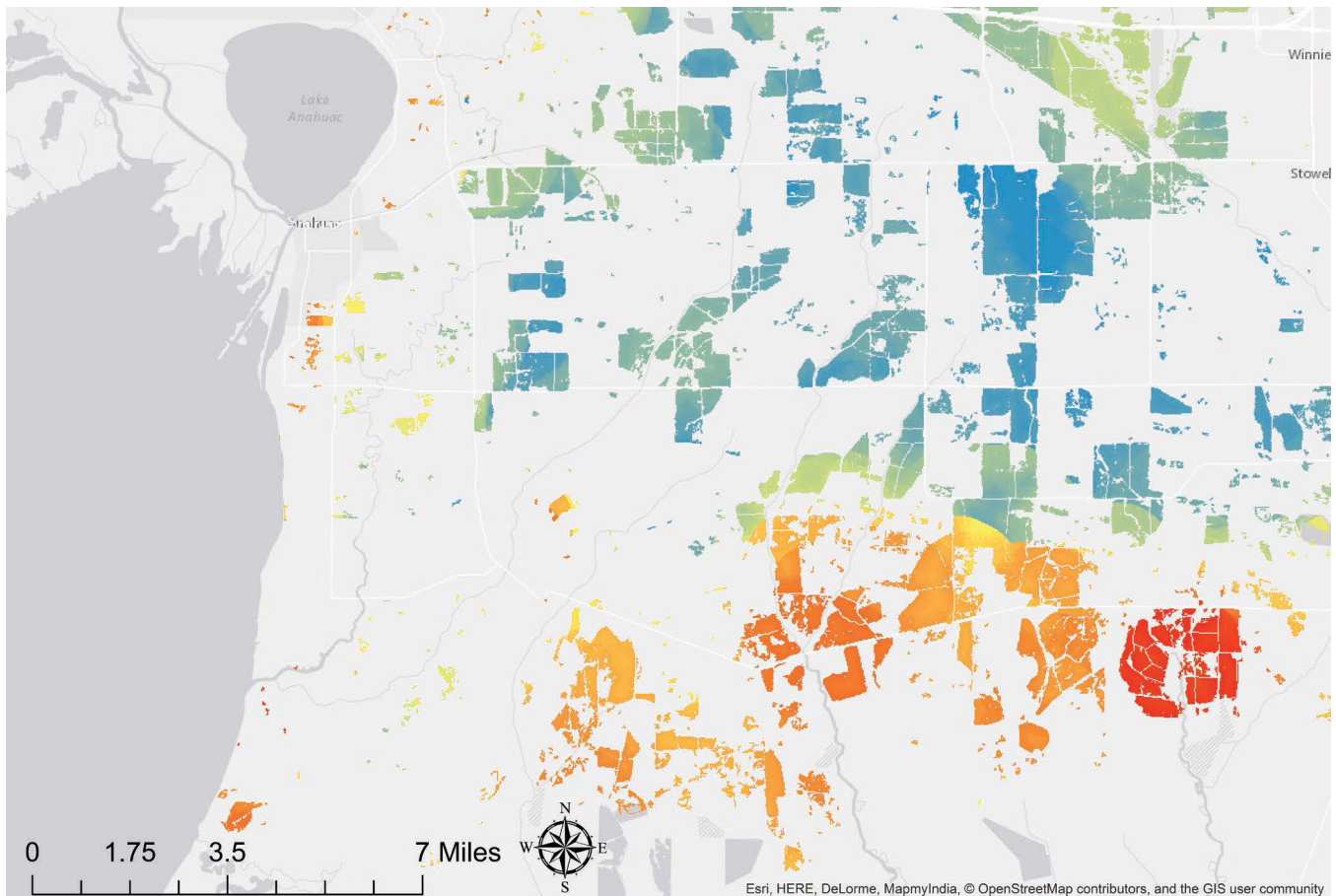
The mottled duck is a year-round resident of the Gulf of Mexico Coast. However, this species has been declining over the years in areas that traditionally held abundant populations.

The steady decline of the mottled duck population has earned it a “Red” status on the Audubon WatchList and a species of concern among state and federal wildlife agencies. Scientists believe that nesting and brood-rearing habitat loss and degradation of existing habitats are the most important threats to the Western Gulf Coast population.

Decision Support Systems are tools that aid in the decision-making processes by consolidating biological and ecological knowledge and taking into account temporal and spatial variation at the landscape level.

Our objective was to use available biological knowledge of mottled duck nesting and brood rearing requirements to develop models that can be used to aid wildlife managers in targeting areas for conservation and management.

- We developed 3 spatially explicit models that were used to identify and prioritize currently suitable mottled duck nesting and brood-rearing habitat, identify and prioritize areas for grassland establishment, and identify and prioritize wetland basins for freshwater enhancement.
- The spatial models indicated that only 1,495 acres of currently suitable mottled duck nesting habitat and 2,337 acres of currently suitable brood-rearing habitat fall in the highest priority (top 10%) for conservation ranking.
- Availability of suitable brood-rearing wetlands appears to be the limiting feature in the Texas Mid-Coast and the Laguna Madre initiative areas, whereas, availability of suitable nesting patches appears to be the most limiting feature in the



Prioritized landscape for grassland establishment to increase mottled duck nest success in the Texas Chenier Plain Initiative Area. Colors range from red to blue where the red color represents the highest priority for grassland establishment and the blue color represents the lowest priority for grassland establishment.

coastal Chenier Plain and Mississippi River Coastal Wetlands initiative areas.

- There is a high density of wetland basins of high priority for freshwater enhancement in coastal Louisiana and the upper Texas coast.
- There is a high density of areas of high priority for grassland establishment in agricultural areas in Texas and Louisiana.

Cooperative funding provided by the Gulf Coast Prairies Landscape Conservation Cooperative.

Landscape Effects on Genetic Diversity and Population Structure of the Bobwhite

Katherine S. Miller, Leonard A. Brennan, Randy W. DeYoung, Fidel Hernández, X. Ben Wu, and Damon L. Williford

The bobwhite has declined during the past 3 decades across its geographic range because of loss and fragmentation of habitat. Habitat fragmentation may isolate bobwhite populations, reduce dispersal and genetic diversity, and increase genetic differentiation among populations.

Bobwhites are assumed to have limited dispersal, which may result in strong genetic structure among populations. However, local and regional studies indicate weak genetic structure among bobwhite populations. Our objective was to determine the effects of landscape features on genetic diversity and population structure of bobwhites in Texas and the Great Plains.

- We sampled 641 bobwhites from 23 populations in 5 states (Iowa, Kansas, Missouri, Oklahoma, and Texas) and amplified 13 microsatellite DNA loci. We used a causal modeling approach to evaluate the effects of geographic distance, barriers, and landscape resistance to dispersal on genetic divergence among sites.
- Genetic diversity was moderate and did not differ among regions or sites. Surprisingly, we observed weak genetic structure, and most variation was within populations (97%).
- Barrier effects were detectable only over the entire 5-state study region. Geographic distance had a strong effect on population structure in the Great Plains, while landscape resistance to dispersal was more prominent in South Texas.
- Bobwhites occurring within intact landscapes may be able to maintain a sufficient population size, which limits genetic drift. Alternatively, the effects



© Scott Conard

Our bobwhite genetics study has confirmed the importance of habitat connectivity for healthy bobwhite populations.

of the landscape on bobwhite populations may be too recent to detect the effects of genetic drift.

- The correlation of genetic differentiation with landscape factors reinforces the critical role of habitat in the maintenance of connectivity among local populations of bobwhites.

Cooperative funding provided by the Richard M. Kleberg, Jr. Center for Quail Research and the South Texas Chapter of the Quail Coalition.

Need for Public Education Regarding the Zoonotic Parasite, *Baylisascaris procyonis*

Jacob L. Ogdee, Scott E. Henke, David B. Wester, and La Vonne Fedynich

Baylisascaris procyonis is a large parasitic nematode found in the small intestines of raccoons (which serves as the definitive host), and causes larval migrans in humans and other animals. Humans can become infected with *B. procyonis* by ingesting eggs, which can remain viable in the environment for years. Exposure comes from egg-contaminated vegetation, soil, water, raccoon feces, or hands.

Prevalence of *B. procyonis* in humans is unknown. However, humans infected with *B. procyonis* may be more common in endemic areas than reported as humans with low-level infections may not develop clinical symptoms and can go undiagnosed. Therefore, prevalence of *B. procyonis* in humans could be high, especially in areas where suburban sprawl increases the likelihood of frequent human contact with raccoons and their feces. We surveyed adults from Texas to determine their knowledge of raccoon behavior and of *B. procyonis* as a potential zoonotic disease.

- No statistical differences were observed in the responses of the participants based on their sex, ethnicity, age, or education.
- In general, Texans had superficial knowledge of raccoons, and virtually no participant had knowledge of *B. procyonis* and its inherent dangers as an emerging zoonotic disease.
- Because of limited public awareness about the potential clinical hazards presented by *B. procyonis*, greater public education efforts are warranted.

Cooperative funding provided by the Harry L. Willet Foundation.

Survey for Bobwhite and Scaled Quail Parasites in South Texas

Andrew C. Olsen and Alan M. Fedynich

There is recent interest in diseases, including those caused by parasites, which affect bobwhites and scaled quail in South Texas. A landscape-scale survey of hunter-shot quail was conducted in South Texas to catalogue helminth parasites infecting these gamebirds

and to look for diseased tissues caused by parasitic infections. In addition, examination of helminth infections related to host age, sex, body weight, and season of collection were conducted.

Two hundred nine bobwhites and 23 scaled quail were donated by hunters in South Texas during the 2012–2013 and 2013–2014 hunting seasons. Each bird was examined for helminth parasites.

- Nine helminth species were found in bobwhites and 7 helminth species in scaled quail.
- The cecal nematode, *Aulonocephalus pennula*, was the most common helminth in bobwhites (78% infected, average of 82 worms, range: 1–585 worms) and scaled quail (91%, average of 62 worms, range: 1–559 worms).
- The eyeworm, *Oxyspirura petrowi*, rarely occurred in bobwhites (9% infected, average of 5 worms, range: 1–36 worms) and scaled quail (13%, average of 2 worms, range 1–3 worms).
- Two species (eyeworm and proventricular worm), known to cause tissue damage, were recovered from bobwhites and scaled quail. There was no macroscopic evidence of tissue damage caused by these helminths in the quail samples examined.
- Although no obvious evidence of disease caused by helminth parasites was documented, the impacts, if any, that these parasites may have on quail biology such as survival and breeding success are unknown.

Cooperative funding provided by the South Texas Chapter of the Quail Coalition.

Mange Prevalence in Carnivores and Potential Risk to Ocelots

Gordon W. Watts, III, Sasha Carvajal-Villarreal, Alfonso Ortega-Sanchez, Jr., Arturo Caso, Daniel J. Kunz, and Michael E. Tewes

Mange is an often serious, communicable skin disease that can occur in many wild mammal species, including the endangered ocelot. The ocelot in South Texas is extremely vulnerable to the effects of mange given their small population size and difficulty in recovering from the additive mortality that a mange outbreak can cause.

In July 2011, we began a remote sensing camera survey for ocelots and other carnivores at the East El Sauz Ranch in Willacy County, Texas. Our survey

consisted of 15 paired camera stations that were operated for 8,329 camera-nights.

- We documented mange in 32% of 538 coyote photo events on the East El Sauz Ranch.
- Mange was also detected in a male and a female bobcat, but not in ocelots despite their high density and spatial overlap with the other species.
- Mange in coyotes was detected at 3 other ranches managed by the East Foundation (San Antonio Viejo, Buena Vista, and Santa Rosa).
- We surveyed these ranches for 38,815 camera-nights. Coyote mange prevalence varied between 5 and 12% among these ranches despite similar abundance indices.
- Although mange in ocelots was not documented during this survey, previous records of mange have been recorded in ocelots, and mange remains a potential disease threat to ocelots.

Cooperative funding provided by the East Foundation, Feline Research Program of the Caesar Kleberg Wildlife Research Institute, Wild Cat Conservation, Inc., and Texas Parks and Wildlife Department.

Permeability and Viability of *Baylisascaris procyonis* Eggs in Soil

Jacob L. Ogdee, Scott E. Henke, and David B. Wester

Baylisascaris procyonis is a large parasitic nematode found in raccoons, which serve as the definitive host. It is considered an emerging zoonotic threat, and it occurs throughout much of the United States. Adult worms typically do not harm their definitive hosts; however, in intermediate hosts, the larvae can cause visceral, ocular, and neural larval migrans.

Our objective was to determine the quantity and viability of *B. procyonis* eggs in 4 soil textures (sand, silt, clay, and loam soils), 2 levels of soil moisture (greater than 75% soil moisture content and less than 20% soil moisture content), 2 vegetation canopies (soils exposed to full sunlight and soils under 100% canopy cover), and at 4 soil depths: soil surface, 0.4–0.8 inches (1.0–2.0 cm), 0.8–2.4 inches (2.1–6.0 cm), and 2.4–4.0 inches (6.1–10.0 cm).

A solution containing 100 *B. procyonis* eggs was pipetted into the center of each of 100 squares per soil texture; 5 squares were randomly selected at time 0, 1, 3, 6, 12, 18, and 24 months after egg placement. A soil column was extracted, and the number of eggs

was determined for each soil depth, texture, moisture, and canopy feature.

- Dry soils were mainly impermeable; even after 2 years, greater than 60% of the *B. procyonis* eggs remained on the surface of all soil textures.
- Wet soils were more permeable than dry soils, but after 2 years, approximately 30 to 80% of *B. procyonis* eggs for sandy to clay soils, respectively, remained on the soil surface.
- Egg movement through the soil column was slow. For example, in wet sandy soils, it required 1 year before the majority of eggs transitioned from the soil surface to the next soil depth.
- For all soil textures, moistures, canopies, and depths, greater than 92% of *B. procyonis* eggs remained viable after 2 years.
- *Baylisascaris procyonis* must be considered an important zoonotic parasite; physicians and veterinarians should be aware of its possible occurrence in humans and domestic animals.

Cooperative funding provided by the Harry L. Willet Foundation.

Evaluating Storage Methods of Wildlife Corn to Reduce Aflatoxin Production

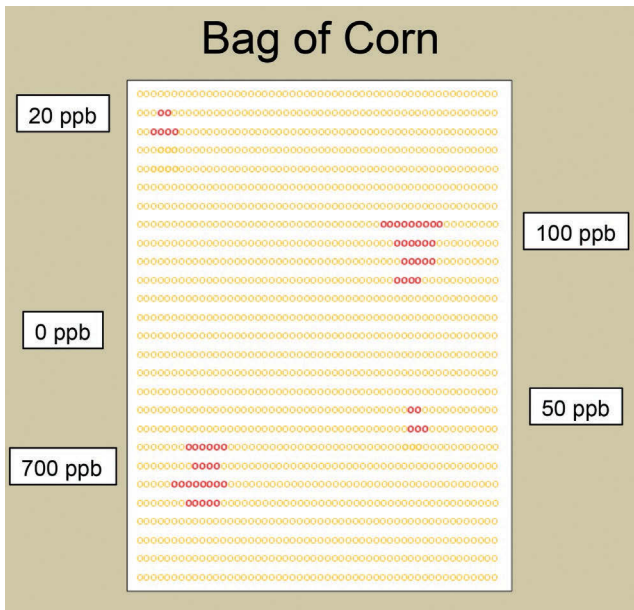
Brent C. Newman, Scott E. Henke, Greta Schuster, Alan M. Fedynich, and James C. Cathey

The bobwhite population has steadily declined in the United States, prompting some wildlife managers to provide supplemental feed as a way to help quail



© Greta Schuster

Aflatoxin is a toxic by-product resulting from the growth of certain types of fungus, which can be harmful to quail.



An example of how the distribution and level of aflatoxin can vary in a single bag of corn.

survive on their properties. Unfortunately, grain can contain aflatoxin, which is a harmful fungal metabolite of *Aspergillus flavus* and *Aspergillus parasiticus*. Our objective was to assess common grain storage methods of wildlife corn that can shed light on how to reduce aflatoxin production.

We placed wildlife corn in open air, barn, and pavilion environments, and in metal containers, aluminum containers, and plastic containers, which mimicked feeder-type structures. We determined weekly aflatoxin levels and grain moisture content. In addition, we monitored weather parameters (daily temperature, relative humidity, and dew point) inside and outside of each storage structure.

- Grain moisture and aflatoxin concentrations fluctuated weekly within each type of storage container and ranged from 10 to 98% and 0 to 1,200 parts per billion (ppb), respectively.
- Each storage type contained corn samples that exceeded recommended aflatoxin levels deemed safe for wildlife within 2 weeks.
- After 8 weeks of grain storage, aflatoxin concentrations began to increase dramatically regardless of storage method.
- Condensation buildup within metal storage containers increased fungal growth on corn, which subsequently resulted in greater aflatoxin concentrations of corn along the sides of such containers compared to corn sampled within the center of the same container.

- Obtaining a low aflatoxin concentration does not necessarily mean low concentrations will occur thereafter, and vice versa. A high concentration of aflatoxin could be followed by a low concentration in another sample within the same bag of grain because aflatoxin is rarely, if ever, evenly distributed throughout grain.
- We recommend storing grain less than 2 months and thoroughly clean and dry wildlife feeders often to minimize exposure of aflatoxin to quail and other wildlife species that are being fed with supplemental grain.

Cooperative funding provided by the Texas A&M AgriLife Extension Service and the Ben and Rachel Vaughan Foundation.

Parasitological Survey of Scaled Quail from West Texas

Kelsey A. Bedford, Alan M. Fedynich, Fidel Hernández, and Dale Rollins

The scaled quail has experienced a long-term decline. Habitat loss and fragmentation have been suggested as direct causes. However, the influence of other factors have not been adequately examined, which may have synergistic effects. For example, little is known about the influence of helminth parasites on scaled quail and it is unclear which parasite species are even found in scaled quail.

Our objectives were to determine the influence of host age, sex, body weight, year of collection, and Palmer's Drought Severity Index (PDSI) on helminth



© Larry Ditto

Research has provided new information about parasites infecting scaled quail in Texas.

Prevalence (% of birds infected), mean intensity (average number of helminth individuals in infected birds), and abundance (average number of helminths in the total host sample) of helminth parasites from 170 scaled quail collected during the 2012–2013, 2013–2014, and 2014–2015 hunting seasons in west Texas.

Helminth Species	Prevalence	Intensity of Infection		Abundance		
	<i>n</i> (%)	mean ± SE	Range	Mean ± SE	Total	% of Total
<i>Aulonocephalus pennula</i> *	161 (97)	68.2 ± 6.1	1–583	65.8 ± 5.9	10,983	95
<i>Oxyspirura petrowi</i>	79 (44)	5.6 ± 0.6	1–28	2.6 ± 0.4	442	4
<i>Procyrnea pileata</i>	51 (25)	1.9 ± 0.2	1–5	0.5 ± <0.1	85	<1
Acanthocephalan larvae	18 (9)	3.0 ± 1.0	1–16	0.3 ± 0.1	53	<1
<i>Fuhrmannetta</i> sp.	3 (2)	1.0 ± N/A	1	<0.1 ± <0.1	3	<1
<i>Tetrameres</i> sp.	3 (2)	1.0 ± N/A	1	<0.1 ± <0.1	3	<1
<i>Mediorhynchus papillosus</i>	2 (1)	2.0 ± N/A	2	<0.1 ± <0.1	4	<1

**Aulonocephalus pennula* calculations based on *n* = 167

infections and to document pathological responses of selected tissues. Hunters donated 170 scaled quail for parasitological examination over 3 consecutive hunting seasons (2012–2013, 2013–2014, and 2014–2015).

- Seven helminth species were identified: 4 nematodes, 2 acanthocephalans (one in its larval stage), and 1 cestode.
- *Aulonocephalus pennula* (cecal worm) exceeded all of the other helminths in count, prevalence, mean intensity, and mean abundance. Mean abundance between juveniles and adults was similar across years except during the first year when adults had fewer cecal worms than juveniles.
- *Oxyspirura petrowi* (eyeworm) prevalence varied among years. Eyeworm mean abundance was higher in adults during the first and third years, but did not differ by age during the second year.
- Predicted mean abundance of eyeworms increased with the increase in host body weight and decreased as the drought subsided.
- The intraorbital glands infected with eyeworms exhibited an immune response and degradation of the ducts. Infected cecal tissue displayed an immune response and a breakdown of the cells lining the villi.
- This study provides researchers with baseline data, including identification of parasite species known to cause harm to quail, needed to refine future experiments that focus on population level effects of infections.

Cooperative funding provided by the Rolling Plains Quail Research Foundation.

ABSTRACT EXTERNAL AUTHORS AND CO-AUTHORS

- Dr. Veronica Acosta-Martinez, USDA Agricultural Research Service
Dr. Perry S. Barboza, Texas A&M University
Dr. Jeremy A. Baumgardt, Texas A&M University
Dr. Robert H. Benson, Texas A&M University Corpus Christi
Mr. Chris Best, U.S. Fish and Wildlife Service
Dr. Terry L. Blankship, Rob and Bessie Welder Wildlife Foundation
Mr. Chad R. Blass, USDA APHIS Wildlife Services
Dr. Thomas W. Boutton, Texas A&M University
Dr. Michael G. Brasher, Gulf Coast Joint Venture
Dr. Jeff R. Breeden, Tarleton State University
Dr. Joanna Burger, Rutgers University
Mr. Alan Cain, Texas Parks and Wildlife Department
Dr. Tyler A. Campbell, East Foundation
Dr. Philippe Campeau, Baylor College of Medicine
Mr. Aaron Cantu, Laborcitas Creek Ranch
Dr. Antonio Cantu, Instituto Nacional de Investigaciones, Agrícolas, Forestales, y Agropecuarias
Mr. Brandon Carr, USDA NRCS James E. "Bud" Smith Plant Materials Center
Dr. Arturo Caso, Secretaria de Medio Ambient y Recursos Naturales
Dr. James C. Cathey, Texas A&M AgriLife Extension Service
Dr. Daniel P. Collins, U.S. Fish and Wildlife Service
Mr. Jameson S. Crumpler, Sul Ross State University
Mr. Chase Currie, Rancho San Pedro Joint Venture
Mr. Ryan L. Darr, Texas Parks and Wildlife Department
Dr. Brian C. Dawson, Baylor College of Medicine
Mr. Don A. Draeger, Comanche Ranch
Dr. La Vonne Fedynich, Texas A&M University-Kingsville
Mr. Richard S. Finger, Washington Department of Fish and Wildlife
Mr. Justin A. Foster, Texas Parks and Wildlife Department
Mr. Donnie Frels, Texas Parks and Wildlife Department
Mr. T. Dan Friedkin, Comanche Ranch
Mr. Juan Garza, Rio Farms, Inc.
Dr. Selma N. Glasscock, Rob and Bessie Welder Wildlife Foundation
Mr. Rudy Gonzalez, Light Ranch
Mr. Shawn S. Gray, Texas Parks and Wildlife Department
Dr. M. Clay Green, Texas State University
Dr. Mary E. Green, Texas A&M University-Kingsville
Mr. Joseph M. Halseth, USDA APHIS Wildlife Services National Wildlife Research Center
Mr. Thomas E. Hanson, USDA APHIS Wildlife Services
Mr. Terry Hanzak, Cone Ranch
Dr. Louis A. Harveson, Sul Ross State University
Mr. Michael W. Hehman, Hixon Ranch
Dr. Clayton D. Hilton, Texas A&M University-Kingsville
Ms. Jennifer B. Hoffman
Dr. Rodney L. Honeycutt, Pepperdine University
Dr. Katherine E. Horak, USDA APHIS Wildlife Services
Dr. Jon S. Horne, University of Idaho
Dr. J. Dale James, Ducks Unlimited, Inc.
Dr. Jan E. Janecka, Texas A&M University
Ms. Cynthia Kallio-Edwards, Gulf Coast Prairies Landscape Conservation Cooperative
Mr. Matt R. Kaminski, Ducks Unlimited, Inc.
Dr. Jeffrey F. Kelly, Oklahoma Biological Survey, University of Oklahoma
Dr. Jennifer M. Korn, Florida Fish and Wildlife Conservation Commission
Mr. Kevin J. Kraai, Texas Parks and Wildlife Department
Mr. Daniel J. Kunz, Texas Parks and Wildlife Department
Dr. William R. Lance, Wildlife Pharmaceuticals, Inc.
Mr. Thomas M. Langschie, King Ranch, Inc.
Mr. Michael J. Lavelle, USDA APHIS Wildlife Services
Dr. Brendan H. Lee, Baylor College of Medicine
Mr. John Lloyd-Reilley, USDA NRCS E. "Kika" de la Garza Plant Materials Center
Mr. Mitch Lockwood, Texas Parks and Wildlife Department
Mrs. Shelly D. Maher, USDA NRCS E. "Kika" de la Garza Plant Materials Center
Mr. Chad A. Markert, Dietert Ranch
Mr. Dennis K. Markwardt, Texas Department of Transportation
Ms. Paula Maywald, Land Steward Consultants
Ms. Marissa D. McGhee, Texas A&M AgriLife Research and Extension Center at Stephenville
Dr. M. Todd Merendino, Ducks Unlimited, Inc.
Ms. Kris L. Metzger, U.S. Fish and Wildlife Service
Ms. Jena A. Moon, U.S. Fish and Wildlife Service
Ms. Joyce Moore, Texas Parks and Wildlife Department
Mr. Matthew T. Moore, Faith Ranch
Dr. Michael L. Morrison, Texas A&M University
Dr. James P. Muir, Texas A&M AgriLife Research and Extension Center at Stephenville
Mr. Chase A. Murphy, Texas A&M AgriLife Research and Extension Center at Stephenville
Dr. Lawrence J. Niles, LJ Niles Associates
Dr. Alfonso Ortega-Sanchez, Jr., East Foundation
Dr. Chad J. Parent, Michigan State University
Mr. Mark W. Parr, Gulf Coast Joint Venture
Mr. Robert Perez, Texas Parks and Wildlife Department
Dr. Glenn Perrigo, Texas A&M University-Kingsville
Dr. Randy L. Powell, Texas A&M University-Kingsville
Dr. Abhirami Rajagopal, Baylor College of Medicine
Dr. Gary Rea, USDA NRCS James E. "Bud" Smith Plant Materials Center
Mr. Ryan L. Reitz, Texas Parks and Wildlife Department
Dr. Emilio Rendon-Franco, Universidad Autonoma Metropolitana, Unidad Xochimilco, Mexico
Dr. Dale Rollins, Texas A&M AgriLife Extension Service
Dr. Zhechao C. Ruan, Baylor College of Medicine
Mr. Robert Sanders, Temple Ranch
Ms. Fulden Sara-Wissinger, Texas A&M University-Kingsville
Mr. Matthew J. Schnupp, King Ranch, Inc.
Dr. Greta Schuster, Texas A&M University-Kingsville
Mr. Andrew W. Scott, Jr., Rio Farms, Inc.
Mr. Stuart W. Stedman, Faith Ranch
Mr. Rufus Stephens, Texas Parks and Wildlife Department
Dr. Bronson K. Strickland, Mississippi State University
Mr. Russell H. Terry, Ducks Unlimited, Inc.
Dr. George Vargas, Texas A&M University-Kingsville
Dr. Kurt C. VerCauteren, USDA APHIS Wildlife Services
Mr. Keith J. Walters, Pogue Agri Partners
Dr. Bonnie J. Warnock, Sul Ross State University
Dr. Travis Whitney, Texas A&M AgriLife Extension Service
Mr. Dean N. Williams, Douglass W. King Seed Company
Mr. Barry C. Wilson, Gulf Coast Joint Venture
Dr. Kim C. Worley, Baylor College of Medicine
Dr. X. Ben Wu, Texas A&M University

TAMUK Undergraduate Students

- Ms. Lauren D. Balderas
Mr. Derek C. Ballard
Ms. Leslie Bowman
Ms. Shelby B. Carter
Ms. Daisy J. Castillo
Mr. Darrion Crowley
Mr. Landen Gulick
Ms. Alexandra Lichtenberger
Mr. James C. Theis

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Caesar Kleberg Wildlife Research Institute
Texas A&M University-Kingsville
700 University Boulevard, MSC 218
Kingsville, Texas 78363-8202

(361) 593-3922

<http://www.ckwri.tamuk.edu>



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