Caesar Kleberg Wildlife Research Institute

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Editor Alan M. Fedynich, Ph.D.

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Caesar Kleberg Wildlife Research Institute

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FOREWORD

Dear Friends,

On behalf of the Caesar Kleberg Wildlife Research Institute, it is my pleasure to share with you the work of the CKWRI's students, staff, and scientists during the past year. Our Current Research report has been produced annually for 37 years, and it requires a great deal of time and effort by the students, the scientists, and especially by Alan Fedynich, the publication's editor. We invest this time and effort because it is important our supporters know what we have accomplished and that wildlife managers and enthusiasts have access to our findings. If any study described in this report is of particular interest, please feel free to contact the abstract's authors. These abstracts are concise by design and cannot convey all the aspects of the research and nuances of the findings. Your inquiries will be a welcome indication of interest from you, the ultimate consumers of the knowledge we produce.

The cover photo is of a crested caracara, long an iconic species of the South Texas brush. Caracaras used to be rare in central Texas, but are now thriving and expanding their distribution. The story of the caracara is an analogy for the success of the CKWRI. As you will see in these abstracts, the CKWRI, with its heart and soul in South Texas, is expanding its reach and influencing wildlife management across Texas and in many places across the United States. These are exciting times and with your support, the CKWRI will continue to provide the science behind the management of our state's and nation's treasured wildlife.

With Highest Regards,

David Hewitt
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We acknowledge the donors of these student scholarships and fellowships on this special page.

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Sponsors that provided funds for graduate student assistance are reported on page 3.

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TABLE OF CONTENTS

WILD CATS

HABITAT RESTORATION AND ENHANCEMENT

WATERFOWL AND OTHER GAMEBIRDS

BIOLOGY, ECOLOGY, AND MANAGEMENT

DISEASES AND PARASITES

COMPLETED RESEARCH

WHITE-TAILED DEER

**** End of Completed Comanche-Faith Project Abstracts****

BOBWHITES AND OTHER QUAILS

HABITAT RESTORATION AND ENHANCEMENT

BIOLOGY, ECOLOGY, AND MANAGEMENT

The Comanche-Faith Deer Research Project

Charles A. DeYoung, Timothy E. Fulbright, David G. Hewitt, Lindsey M. Phillips, Don A. Draeger, Emily H. Belser, Onalise R. Hill, Ryan M. Rothstein, and Daniel B. Brown

Supplemental feeding of white-tailed deer is a widespread practice in Texas, but the effects of increasing deer densities on deer performance and the vegetation when supplemental feed is available are unclear. In addition, the effects of increasing supplemental feeder density on deer performance and the vegetation are unknown.

The Comanche-Faith Deer Research Project is based in Dimmit County, Texas, and is named after the 2 ranches where the study is replicated. The project's overall objective is to determine the optimal combination of white-tailed deer and supplemental feeder densities for the landscape while maintaining the native habitat.

On each ranch, we are using 6 200-acre high-fenced enclosures, which were constructed in 2003. Phase I of the project began in 2004. Phase II of research began in April 2013 and used the same 6 enclosures on each ranch. Treatments during Phase II for each enclosure on each ranch are 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 found on page 3.

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

Supplemental Feed Consumption by White-tailed Deer in South Texas

Emily H. Belser, David G. Hewitt, Timothy E. Fulbright, Charles A. DeYoung, David B. Wester, Lindsey M. Phillips, and Don A. Draeger

The provision of supplemental feed for deer may increase antler size, body size, and fawn survival. However, supplemental feed may not be accessible to all deer because of competition at the feeder site, especially at high deer densities. Feed consumption may also vary by season and amount of rainfall, both of which affect available vegetation in variable environments. Feed may also be lost to non-target species and waste from spillage and moisture-induced spoilage.

We are testing the effects of deer density, season, and precipitation on feed consumption by providing supplemental feed year-round, *ad libitum*, within each enclosure. We are measuring feed levels when feeders are replenished to determine feed disappearance.

Preliminary results show that feed disappearance varied among months and increased as deer density increased to 45.4 deer per 200 acres—a density above which feed disappearance rates slowed. This finding suggests that either not all deer had access to feeders at higher densities or individual consumption was lower than consumption in the enclosures with lower deer densities. Feed lost to non-target species and waste was minimal. Rainfall did not significantly affect feed consumption for most months. These preliminary results suggest that deer density will affect access to a concentrated resource such as supplemental feed, which can ultimately affect management goals.

Effects of Deer and Supplemental Feeder Density on Fawn Movements

Onalise R. Hill, Justin P. Young, Timothy E. Fulbright, David G. Hewitt, Charles A. DeYoung, Lindsey M. Phillips, and Don A. Draeger

White-tailed deer are considered crepuscular animals, with peaks of activity around dawn and dusk. Little research has been conducted on white-tailed deer fawn movements and activity peaks, but the timing of the activity peaks and the total daily movements could affect fawn health and thus, successful recruitment and herd health.

We placed GPS collars on 36 fawns in November 2014 and 35 fawns in October 2015 in 3 treatments: 40 deer with 1 feeder, 60 deer with 1 feeder, and 60 deer with 3 feeders. Each collar was fitted with a timed drop-off mechanism scheduled to deploy after 29 weeks. We are analyzing the collar data from November 2014 through April 2015 and November 2015 through April 2016.

Preliminary results suggest 2 distinct activity peaks are present in all 3 treatments for all months investigated. Fawn activity appears to peak around sunrise and sunset. Not surprisingly, total daily fawn movements increased with an increase in fawn age. No evidence has been found to suggest that fawns were pushed to travel greater distances to forage and meet their nutritional needs as deer density increased or as supplemental feeder density decreased. Comparing white-tailed deer fawn activity peaks and total daily movements among enclosures with different deer densities and supplemental feeder densities may provide insight into the effects of nutritional availability, and potentially the social hierarchy, on fawn behavior.

Effects of White-tailed Deer Density on the Spatial Heterogeneity of Plants

Daniel B. Brown, Lindsay D. Roberts, Timothy E. Fulbright, Charles A. DeYoung, David G. Hewitt, David B. Wester, Lindsey M. Phillips, and Don A. Draeger

The white-tailed deer is a popular big game species in North America, and in South Texas wildlife managers may use supplemental feeding to maintain unnaturally high populations. It is not known what effects these high deer populations could have on the vegetation. Unpredictable rainfall patterns, such as those occurring in South Texas, can also have a large effect on herbaceous vegetation communities.

Sampling was conducted in June from 2012 until 2017 to determine spatial variability of plant species across the landscape. Percentage canopy cover of each herbaceous plant species was estimated along 20 164-foot transects in each enclosure. Two hundred and forty 20 inch x 8 inch Daubenmire plant sampling plots, situated in groups of 3 along each transect, were sampled. Data from weather stations on each ranch recorded temperature and rainfall, which will be used to determine the effects of limited rainfall on the herbaceous vegetation communities.

Based on the data thus far analyzed, in 2014, there was no difference in vegetation diversity among the enclosures. However, this was likely the result of a drought during the previous year, so wetter years could yield different results. Natural resource managers can use our findings to properly manage their deer populations to avoid damage to the plant communities.

Effects of White-tailed Deer Density on Antler Growth

Ryan M. Rothstein, Charles A. DeYoung, David G. Hewitt, Timothy E. Fulbright, Lindsey M. Phillips, and Don A. Draeger

Many white-tailed deer managers strive for a herd with a high percentage of mature bucks (5 years old or older) in addition to maintaining herd density at or near carrying capacity of the habitat. However, there is little information on how deer herds at high densities affect antler growth. Our objective is to determine whether deer density has an effect on antler growth among varying age classes of bucks with year-round access to supplemental feed.

Mature bucks are often desired by landowners, deer managers, and hunters.

The density treatments are as follows: 20 deer and 1 feeder, 40 deer and 1 feeder, 60 deer and 1 feeder, 60 deer and 3 feeders, and 80 deer with 4 feeders. The treatments are repeated on both ranches. Images from trail cameras of known-age, ear-tagged bucks from antler cycles in 2015 (144 bucks) and 2016 (158 bucks) have been created. A buck was considered "known-age" if he was first captured and marked as a fawn or yearling based on tooth replacement.

We will use the software BuckScore® to calculate gross Boone & Crockett antler scores for bucks aged 1.5, 2.5, 3.5, 4.5, and 5.5–8.5 years old (mature) for antlers grown in 2015 and 2016. We will compare mean gross Boone & Crockett scores of age classes among deer densities to determine if there is a density effect on antler growth. By determining whether deer density influences antler growth, wildlife managers can decide the appropriate deer densities to achieve their buck management goals.

Effects of Deer and Supplemental Feeder Density on Peak Feeding Times

Onalise R. Hill, Justin P. Young, Timothy E. Fulbright, David G. Hewitt, Charles A. DeYoung, Lindsey M. Phillips, and Don A. Draeger

White-tailed deer populations have increased dramatically in North America. Supplemental feed is used to address many white-tailed deer management issues associated with this increase. However, there may be problems with its application. Supplemental feed, for example, may not be equally accessible to all members of a deer population. Researchers suggest that dominant deer may have more access to feed than less dominant deer. Temporal feeding patterns within and among social classes of deer may prove useful in understanding whether or not all deer in a population have access to feeding sites.

We placed trail cameras at supplemental feeders from November 2014 through April 2015 and November 2015 through April 2016 to monitor the presence of tagged individuals. We targeted 3 treatments: 40 deer with 1 feeder, 60 deer with 1 feeder, and 60 deer with 3 feeders. Photos taken from the trail cameras are currently being analyzed. The feeding pattern of each individual tagged deer is being determined and averaged within social classes.

Preliminary results suggest that fawns are more likely to visit a supplemental feeder during midday than does or bucks in the high-density enclosure (60 deer with 1 feeder), though the difference is not extreme. Once data from all enclosures have been analyzed, we hope to determine if increasing white-tailed deer density or decreasing supplemental feeder density causes less dominant deer within the herd to be excluded from supplemental feed resources.

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Our researchers are studying how dominance hierarchies of white-tailed deer affect access to supplemental feed.

Influence of White-tailed Deer Density on Dominance Hierarchies

Emily H. Belser, David G. Hewitt, Timothy E. Fulbright, Charles A. DeYoung, Lindsey M. Phillips, and Don A. Draeger

Dominance hierarchies among deer are formed to prevent future aggressive encounters. High deer densities increase the number of deer integrated into a social hierarchy, perhaps obscuring relationships among individuals and increasing the number and intensity of aggressive encounters. These hierarchies may also prevent some age and sex groups from accessing concentrated resources, such as supplemental feed.

We will assess the social hierarchy in enclosures with 20 deer and 1 feeder, 60 deer and 1 feeder, and 60 deer and 3 feeders. Trail cameras were placed at the feeders to observe the aggressive behaviors of individually marked deer during December 2014 and March, August, and December 2015. Information obtained will allow comparison of the number and intensity of aggressive encounters related to deer density. Also, we will determine if the presence of additional feeders reduces the number and intensity of aggressive encounters by providing more feeding opportunities.

Because the social hierarchy may limit access to feeders, we will use the stable isotope data from

March and December 2015 to determine the effect of social standing on feed consumption. These results, in combination with the social hierarchy findings, will be used to test differences among the enclosures with varying feeder and deer densities. Our results should provide valuable information about the relationship between the number of feeder sites and deer density.

Effects of Deer Density on Buck Searching Activity during the Breeding Season

Ryan M. Rothstein, Charles A. DeYoung, David G. Hewitt, Timothy E. Fulbright, Lindsey M. Phillips, and Don A. Draeger

Although white-tailed deer movement patterns have been well studied, much is still unknown about how and when bucks move, particularly during the rut. Our objective is to compare buck movements during the rut to buck movements during the post-rut among varying deer densities and feeder densities.

In December 2016, 35 GPS collars were deployed on bucks of various age classes in a low-density enclosure (20 deer with 1 feeder) and 2 high-density enclosures (60 deer with 1 feeder, 60 deer with 3 feeders) on each ranch. The GPS collars were collected in July 2017 to obtain the recorded data. We will analyze movement patterns to see whether deer density has an effect on (1) frequency and timing of buck movements during the rut and post-rut and (2) habitat use by bucks during the rut and post-rut.

Determining how and when bucks move during the rut may have implications for wildlife managers. Timing of buck movements may impact hunting strategies regarding buck harvest objectives. Distances travelled may give insight into buck searching strategy for estrous females in relation to habitat features and food sources as they search for breeding opportunities.

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Graduate student Ryan Rothstein is monitoring buck movements during the rut.

The Effects of Deer and Feeder Density on Woody Canopy Cover

Onalise R. Hill, Lindsey M. Phillips, Timothy E. Fulbright, David G. Hewitt, Charles A. DeYoung, and Don A. Draeger

In North America, researchers have observed a shift in woody plant species composition as white-tailed deer densities have increased. Preferred deer browse tends to decline with increasing deer densities. However, most of the research documenting this relationship was conducted in forested regions. Deer managers have begun incorporating supplemental feed to lessen the pressure put on natural woody vegetation by deer. The decline in preferred woody plants, however, is not well supported by research in highly variable environments such as South Texas.

In 2004, 20 164-foot transects were established in each enclosure. During June 2012–2017, woody plant canopy cover was estimated by species. Woody plant and cactus species will be grouped into preferred and less preferred categories for analysis. Density of orange zexmenia, bush sunflower, and spiny hackberry (representing 3 highly preferred plant species of white-tailed deer) will also be estimated.

Preliminary results suggest that increasing deer density and supplemental feeder density had no effect on the percentage of canopy cover of preferred and less preferred species. Deer density and supplemental feeder density also had no effect on the density of spiny hackberry, bush sunflower, and orange zexmenia.

Quality white-tailed deer management involves adequate habitat for future populations in addition to existing deer herds. Thus, a balance between preferred and less preferred browse species is necessary for current and future stability.

Effects of White-tailed Deer and Feeder Densities on Deer Population Dynamics

Daniel B. Brown, Charles A. DeYoung, Timothy E. Fulbright, David G. Hewitt, Lindsey M. Phillips, and Don A. Draeger

White-tailed deer are an important species for most landowners and wildlife managers. They are a popular big game species. In South Texas, many landowners follow the practice of providing supplemental

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Understanding the effects of supplemental feeding is essential for effective management of white-tailed deer.

feed to maintain higher than normal deer populations for hunting. However, it is not well known how this affects the fitness of deer.

We will determine if deer and supplemental feeder densities affect growth of yearlings (1–2 years old) and fawns (young of the year), survival of adults, and the ratio of fawns to does. Data were collected (1) at biannual helicopter-aided captures during April and December 2013–2017 and (2) from mark-resight trail camera population estimates completed every January and October 2013–2017. Body condition score, hind leg length, and body weight were collected for each captured deer to calculate growth rates. Camera survey data will be used in conjunction with known mortality data to determine fawn to doe ratios and adult mortality.

Our goal is to help landowners and wildlife managers maintain deer densities that do not negatively impact the fitness of their deer populations. Although data have not yet been analyzed, it is hypothesized that artificially elevated deer populations could cause younger deer to be in poorer condition as well as increase mortality and decrease reproduction.

Effects of Deer and Supplemental Feeder Density on Plant Mast and Growth

Onalise R. Hill, Lindsey M. Phillips, Timothy E. Fulbright, David G. Hewitt, Charles A. DeYoung, and Don A. Draeger

Increases in white-tailed deer densities in North America are impacting ecosystem stability by affecting vegetation. The level at which deer herbivory becomes harmful is difficult to determine, especially in an environment with highly variable rainfall such as South Texas. Supplemental feeding is commonly used to lessen the negative effects of white-tailed deer on plant communities.

In June 2013, pairs of blackbrush acacia and granjeno at 2 height categories (less than 5 feet and greater than 5 feet) and guayacan within each enclosure were selected. We randomly selected 1 plant of each paired plant to be enclosed in a cage, thereby eliminating deer browsing, while the other remained uncaged. Every July from 2013 through 2017, diameter measurements were taken at specific height intervals on each plant. Mean canopy volume above and within the reach of deer was determined. Fruit production by each plant was estimated annually at peak mast production (April–June) by counting the number of fruits at specific height intervals in pre-determined directions.

Preliminary results suggest that the volume of the upper canopy of large blackbrush acacia plants decreased by over 50% with increasing white-tailed deer density (with 1 supplemental feeder present), while the volume of the upper canopy of granjeno increased by almost 50%. There was no effect of increasing deer densities when the deer to feeder ratio remained at 20:1. Rangeland and wildlife managers should consider natural plant species composition when making deer management decisions with or without the presence of supplemental feed.

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

DMP Pens Effect on Average White-tailed Deer Antler Size

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

Deer Management Permits (DMPs) are issued by the Texas Parks and Wildlife Department for the purpose of confining and breeding a large-antlered buck with up to 20 does. The confined deer and subsequent offspring are then released with the goal of upgrading overall antler size on the permitted property.

Our research is being conducted on the Faith Ranch in Dimmit County, Texas. Two high-fenced pastures of 1,100 acres each were established in 2007 under identical management, including intensive supplemental feeding. Resident deer were removed from the treatment pasture prior to this study, and the pasture

restocked with DMP sired offspring. The control pasture has resident deer that were present when the high-fence was constructed. DMP pens are stocked with native deer from the property. Fawns are tagged in DMP pens and the control area each year with ear tags specific to year-of-birth. Each autumn, marked bucks are captured via helicopter, and antlers are measured. Data obtained regarding antler size are compared within age classes across each pasture.

In autumn 2016, average Boone & Crockett (B&C) scores of DMP bucks differed from control pasture bucks as follows: 1.5-year-olds were -20 B&C inches; 2.5-year-olds were equal; 3.5-year-olds, +27 B&C inches; 4.5-year-olds, +14 B&C inches; 5.5-year-olds, +27 B&C inches; 6.5-year-olds were equal; 7.5-year-olds, -4 B&C inches; 8.5-year-olds, +31 B&C inches; and 9.5-year-olds, +25 B&C inches.

Cooperative funding provided by the Faith Ranch.

Do Movements Explain Weight Loss in Male White-tailed Deer?

Aaron M. Foley, David G. Hewitt, Matthew J. Schnupp, and Randy W. DeYoung

Mating activities are energetically expensive in male deer because of time spent searching for and defending females. Male white-tailed deer are reported to lose 20 to 25% of body weight, but it is unknown how much is lost because of locomotion.

We used body weight of over 7,500 males harvested on the King Ranch throughout the rut to estimate total weight loss for males aged 1.5 years old, 2.5 years old, and 3.5 years old and older. Movement data were obtained from 30 GPS-collared males on the King Ranch to estimate body weight loss attributed to locomotion during the rut.

Based on harvest records, total body weight loss was 0%, 12%, and 18% in 1.5, 2.5, and 3.5 years old and older deer, respectively. Based on movement data from GPS collars, energy expenditure from locomotion would cause 4 to 5% body weight loss for all age classes. Because 1.5-year-old males were modeled to lose body weight from locomotion but did not actually lose body weight, yearling males likely spent a significant amount of time foraging instead of participating in mating activities. Body weight loss was higher than cost of locomotion in 2.5-year-old and 3.5 years old and older deer—more so for the latter group. Thus, a reduction in time spent foraging must have occurred. Our results reveal there is a trade-off in time spent foraging versus time spent towards breeding activities. As males become physically mature, less time is devoted towards foraging and more time is dedicated to mating activities.

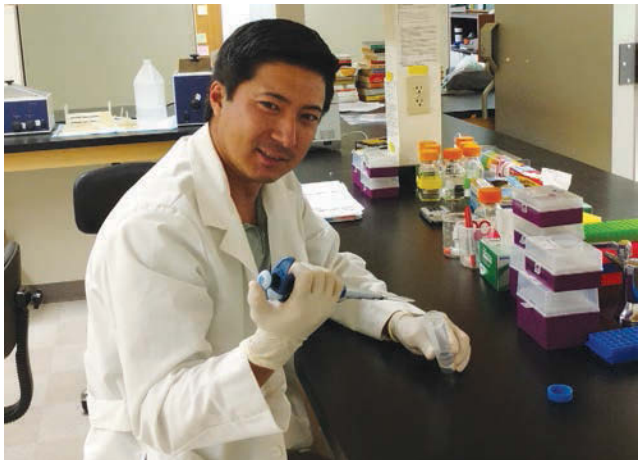
Cooperative funding provided by the East Foundation.

Heritability of Antler Traits in White-tailed Deer

Masahiro Ohnishi, Randy W. DeYoung, Charles A. DeYoung, Bronson K. Strickland, Don A. Draeger, David G. Hewitt, and Steven Lukefahr

Antler traits in populations of white-tailed deer are affected by age, nutrition, and genetics. The influence of age and nutrition on antler development has been studied in detail. However, the inherited genetic component of antler development has not been characterized in wild deer.

As part of a long-term study on the influence of culling on antler traits, we captured male deer from 3 sites on the Comanche Ranch each autumn during 2006–2016. We estimated age, measured antlers following the Boone & Crockett system, and collected tissue samples for genetic analyses. We conducted genetic parentage analyses to establish sire-offspring relationships and used this pedigree of related individuals and their antler traits in an animal model analytical approach. Specifically, we estimated the heritability of antler points for yearlings and 2.5-year-old bucks, and the heritability of Boone & Crockett (B&C) score for bucks aged 3.5 years old and older.



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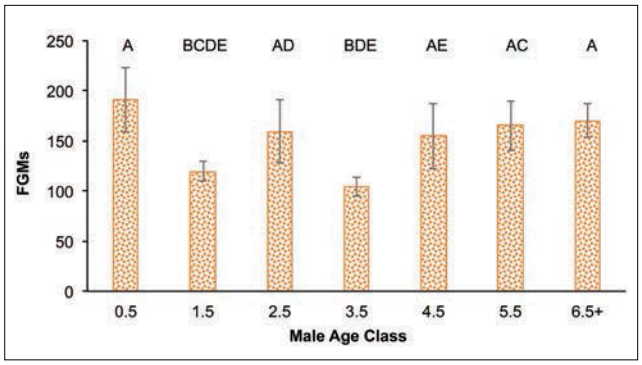
Graduate student Masahiro Ohnishi is studying the influence of genetics on antler traits of white-tailed deer.

We recorded 5,488 captures of 2,937 individual bucks and assigned sires for 1,950 male offspring. Preliminary results revealed that heritability of antler points for yearlings and 2.5-year-old bucks was low (24% and 25%, respectively), whereas the heritability estimate for B&C score for males 3.5 years old or older was moderate (45%).

It appears that contributions of maternal, environmental, and other factors to antler growth were more important than genetic potential for antler growth. The results of this study will have important implications for culling and harvest management.

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



Average male white-tailed deer fecal glucocorticoid metabolite (FGM) levels, a by-product of the primary stress hormone in deer, by age class. We captured males on 4 East Foundation properties in South Texas in autumn 2015 and 2016. Different letters indicate a statistical difference in FGMs among ages and the bars represent standard error.

Stress Status of White-tailed Deer in a Variable South Texas Environment

Michaela F. Rice, Randy W. DeYoung, David G. Hewitt, Michael J. Sheriff, David B. Wester, Tyler A. Campbell, and Alfonso Ortega-Sanchez, Jr.

Stress hormones allow mammals to cope with changes in their environment. White-tailed deer respond to predictable daily and seasonal rhythms and reproductive stages, and to unexpected events, such as social encounters, drought, or predation attempts. Stress levels can be monitored by quantifying metabolites of stress hormones in feces called fecal glucocorticoid metabolites (FGMs). We predicted that environmental variation among sites and between years would influence FGM levels. In addition, we predicted that male age plays a role in dominance status and thus, stress levels during pre-rut.

We captured over 300 white-tailed deer on 4 East Foundation ranches during autumn 2015 and 2016 in South Texas. The ranches occur from the coast to 90 miles inland, spanning various vegetative communities and a precipitation gradient, where rainfall decreases east to west.

Preliminary analyses revealed that FGMs in males and females were not different. However, stress levels varied by site, year, date of capture, and age class of deer. Males had significantly greater FGMs in 2015 compared to 2016.

Within males, fawns had the greatest FGM levels and 3.5-year-olds had the lowest. Males might have been in better condition during 2015 because of greater precipitation resulting in better forage quality, and the increase in FGM levels may be a result of greater social competition. It is possible that nutrition availability among ranches influences stress hormones on a finer scale.

We found that FGM levels can vary because of male social status and they can vary spatially, temporally, and among animals of different ages. These patterns will be further investigated to better understand white-tailed deer ecology and inform wildlife managers about the effects of stress on deer.

Cooperative funding provided by the East Foundation.

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

Genetic improvement in antler size is common with selective breeding in confined white-tailed deer. However, data are limited on the effects of culling on ranch-sized units to improve antler size. We are conducting a study on 3 areas of the Comanche Ranch in Maverick County, Texas to determine results that managers can expect from long-term buck culling.

Bucks are captured annually at random by helicopter and net gun, aged, and measured for Boone & Crockett (B&C) score. During 2006–2012, bucks meeting 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 of less than 145. On another area, all yearlings and 2-year-olds were released, and older deer were culled by the same criteria as above. A third area served as an experimental control and all bucks captured there were released.

After 7 years of culling, we saw no response except the intensive cull area had a widening sex ratio and signs yearling buck antlers might be declining. We speculated this was possibly the result of environmental influences on late-born yearlings. Beginning in year 8 (2013), we ceased culling on all areas. However, we are continuing to capture deer to determine if there is a lag in the influence of culling.

After 10 years, there are no obvious effects of the culling. Bucks captured have numbered 5,488, including 2,937 recaptures. Bucks culled have totaled 1,333. The study will continue for 2 more years.

Cooperative funding provided by the Friedkin Conservation Fund and Comanche Ranch.

Cattle Grazing Effects on White-tailed Deer Habitat in South Texas

Ramon Saenz, III, Dillan J. Drabek, J. Alfonso Ortega-Santos, Timothy E. Fulbright, David G. Hewitt, Tyler A. Campbell, and Alfonso Ortega-Sanchez, Jr.

Cattle have been in Texas since the Spanish settlement during the 18th century. Many landowners have begun to develop optimal habitat for wildlife because of the growing importance of wildlife related recreation. Cattle have been used as a tool to manipulate wildlife habitat for decades. Grazing stimulates increased forb production in tall grass prairies, but research on the effects of cattle grazing on forbs in South Texas is lacking.

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Traditionally, cattle have been used as a tool to manage wildlife habitat.

Six sites of approximately 6,200 acres each were chosen for study. We randomly placed 50 grazing exclosures, with a paired t-post identifying a point similar in forage production and plant community, within the 6 sites. Every autumn and spring, vegetation will be clipped and recorded; forbs will be categorized as preferred and non-preferred for white-tailed deer and grass species will be identified.

From the data gathered, we will attempt to determine the effect of herbivory on forb standing crop and species richness. We are anticipating results of the study will assist rangeland managers in the optimal use of cattle as a wildlife habitat management tool in arid to semiarid climates.

Cooperative funding provided by the East Foundation.

Recruitment Patterns of White-tailed Deer in South Texas

Michaela F. Rice, Kory R. Gann, Randy W. DeYoung, David G. Hewitt, David B. Wester, Aaron M. Foley, Tyler A. Campbell, Alfonso Ortega-Sanchez, Jr., and J. Alfonso Ortega-Santos

Environmental variability can influence recruitment of white-tailed deer in semiarid rangelands. This may be particularly evident in South Texas where such variability influences nutrition of white-tailed deer. Our objectives are to (1) investigate the influence of drought, age class, and location on the probability of lactation and (2) compare the effects of lactation on body reserves for deer in South Texas.

We captured 1,619 adult (2.5 years or older) female deer during autumn 2011–2016 on 4 East Foundation ranches in South Texas. The sites range from the Gulf Coast to 90 miles inland across a precipitation gradient, where rainfall decreases east to west.

Our data suggest that age greatly influenced the probability of lactation. Females 3.5 years old and older had a 28% probability of lactation, whereas 2.5-year-old females (bred at 1.5 years of age) had an 8% probability. During the wettest year (2015), the probability of lactation was the highest at 42%, compared to the driest year (2013) when the probability of lactation was only 14%. Probability of lactation varied among ranches, but further investigation is required to determine the importance of this variation.

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Body condition has a profound impact on a doe's ability to raise fawns, particularly in areas with periodic droughts.

We also found that lactating females had lower body condition scores than nonlactating females; there was no difference among age classes for lactating females. Our data reinforce how energetically expensive lactation is for all age classes of females. Since nutrition is a limiting factor for lactation, deer managers should consider the age of females, effects of drought on recruitment, and consequences of lactation on female body condition when implementing doe harvest plans.

Cooperative funding provided by the East Foundation.

Breeding Values for Antler Traits in White-tailed Deer

Masahiro Ohnishi, Randy W. DeYoung, Charles A. DeYoung, Bronson K. Strickland, Don A. Draeger, David G. Hewitt, and Steven Lukefahr

Selective harvest, or culling, is commonly used to improve antler traits in intensively managed populations of white-tailed deer. However, the effects of selective harvest on the phenotypes of wild deer populations are poorly understood because the genetic contributions of individual bucks are not quantifiable without pedigree information.

We used capture records and genetic parentage to establish pedigree records for wild bucks as part of a long-term study of culling on the Comanche Ranch. The study involved 3 treatments: (1) an intensive treatment (3,500 acres), where bucks of all age classes were culled; (2) a moderate treatment (18,000 acres), where only bucks 3 years old and older were culled; and (3) a control (5,000 acres) with no culling. Each autumn during 2006–2016, we captured bucks in each treatment, estimated age, and measured antler characteristics. Bucks that did not meet age-specific antler minimums were sacrificed during 2006–2012. We recorded 5,488 captures of 2,937 individual males and sacrificed 1,333; we assigned sires for 1,950 male offspring. We quantified breeding values for each sire as the difference between the offspring's antler traits and the population average.

Although most offspring were sired by bucks with desirable antler traits, we observed no increase in average breeding values of annual cohorts over time. Our preliminary results suggest that some bucks with large antlers do not pass the trait to their offspring. In addition, the environment influences yearling antler traits such that many young bucks are not able to express their potential until physically mature.

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

Temporal Reproductive Success of Male White-tailed Deer

Aaron M. Foley, David G. Hewitt, Matthew J. Schnupp, and Randy W. DeYoung

Gaining copulations in a competitive environment is difficult for many species of ungulates. Breeding success generally increases when male deer become physically mature and more competitive. For instance, male white-tailed deer aged 1.5 and 2.5 years old sire approximately 10% and 20% of the offspring, respectively, whereas males 3.5 years old or older sire approximately 70% of the offspring.

Examining the timing of conceptions can help researchers better understand the mating system. For example, in species where dominant males control harems or territories, young males can be more successful during late rut when dominant males are exhausted. It is unknown whether young male white-tailed deer are more successful during certain periods of the rut. Because females outnumber males, we hypothesized young males would be more successful during peak rut when the number of estrous females is at the peak.

We estimated conception dates of fetuses collected from harvested females on the King Ranch during 1999–2003 and 2008–2009 and used genetic parentage

assignments to identify sires. We found that there was not a period during rut when 1.5-year-old males were more successful. However, there was an increase in success during peak rut in 2.5-year-old males.

Ongoing research indicates that yearling (1.5-year-old) males are not devoting significant time towards breeding activities. Thus, their breeding success is low and likely by chance. For 2.5-year-old males, intra-specific competition during early and late rut is likely too severe resulting in breeding opportunities limited to peak rut. This study's findings provide researchers, biologists, and wildlife managers with a better understanding of the white-tailed deer breeding system.

Cooperative funding provided by the East Foundation.

Population Parameters of White-tailed Deer in South Texas

Michaela F. Rice, Randy W. DeYoung, David G. Hewitt, Aaron M. Foley, Tyler A. Campbell, and Alfonso Ortega-Sanchez, Jr.

Techniques commonly used to determine how ungulate populations use the landscape may be too coarse to identify fine-scale population structuring and movement patterns. How deer use rangelands in South Texas influences a multitude of ecological processes and management decisions. Genetic techniques can allow us to clearly identify local populations, identify landscape features that affect movements, and better understand the consequences of behavioral patterns of individuals. Our objectives are to examine the geographical extent of local white-tailed deer populations and their genetic structure in South Texas.

We captured over 600 individuals during autumn 2015 and 2016 across 4 East Foundation ranches in South Texas. The ranches are located along the Gulf Coast to 90 miles inland. Sites vary in annual precipitation and vegetative communities. Low fences and minimal high fencing occur around each ranch, which allows the free movement of deer. In addition, deer are not hunted on these ranches and the light hunting pressure on surrounding properties enables us to study populations that follow relatively natural dispersal behaviors and population structure. We will use tissue biopsies collected from each deer to conduct genetic analyses, which will allow us to describe population dynamics and structure of the deer herds.

Information regarding the fine-scale population structure on these ranches will allow effective management units to be identified. Our findings will allow us to better understand the dispersal limitations and patterns of male and female deer in South Texas.

Cooperative funding provided by the East Foundation.

Transition Frequency Analysis of Antler Traits in Male White-tailed Deer

Masahiro Ohnishi, Randy W. DeYoung, Charles A. DeYoung, Bronson K. Strickland, Don A. Draeger, and David G. Hewitt

Age-specific criteria for antler development are often used in selective harvest or culling programs for white-tailed deer. If future antler development can be predicted from antler traits at 1 or 2 years of age, a wildlife manager can identify which individuals to invest resources. However, annual antler growth is unpredictable because environmental factors may overcome genetic potential.

As part of a long-term study of white-tailed deer culling on the Comanche Ranch, we evaluated the reliability of antler traits to predict future growth and the consistency of antler growth from year to year. We established 3 culling treatments: intensive (3,500 acres), where bucks of all age classes were culled; moderate (18,000 acres), where only bucks 3 years old and older were culled; and a control (5,000 acres), with no culling. Each autumn during 2006–2016, we captured bucks, estimated age, and measured antler traits. Culling creates 2 distinct categories of bucks: "Cull" and "Keep." We combined all populations across treatments and estimated the proportion

Findings are showing that some bucks considered "culls" one year are "keepers" the following year and vise versa.

of bucks that changed from "Keep" to "Cull" or from "Cull" to "Keep" the following year.

We recorded 5,488 captures of 2,937 individual bucks and culled 1,333. Our preliminary findings revealed that 68% of the yearling bucks and 56% of the 2-year-old bucks classed as "Culls" would be classed as "Keep" based on their antler growth the following year. For all age classes of bucks, 31 to 34% of the bucks classed as "Keep" were classed as "Cull" based on antler growth the following year. The results of our study will have important implications for harvest management.

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

Contribution of Northern Stock Sources to the Southeastern United States

Jordan L. Youngmann, Stephen Demarais, Randy W. DeYoung, Bronson K. Strickland, Johnathan Bordelon, Chris Cook, and William McKinley

Populations of white-tailed deer in the southeastern United States are genetically admixed as a result of restocking programs during the mid-1900s. Source stocks came from native populations and sources outside the region, including Michigan, Wisconsin, and New York. They fare poorly in the warm, humid southern climates and are not adapted to southern diseases. The contribution of northern stocks to the current populations of southeastern deer is unknown.

We sampled free-ranging deer populations from Louisiana, Mississippi, and Alabama at sites with known historical translocations of northern deer and their respective stock source populations, including Iron Mountain in Michigan, the Sandhill Wildlife Area in Wisconsin, and the Adirondacks in New York. We compared genetic relationships among sampling sites using 15 microsatellite DNA markers.

Research indicates that adding deer from northern regions may not be beneficial to local southern populations.

Southeastern populations were admixed and divided east to west along the Mississippi River, with further differentiation apparent in populations that received deer from North Carolina, as well as native Alabama populations that received no stocking. Analysis of genetic distance revealed a relationship between Black Warrior Wildlife Management Area in Alabama and Iron Mountain in Michigan, which provided 105 (74%) translocated deer to that area. This was the only evidence of a northern genetic signature still present in these southeastern populations.

It appears that careful consideration must be taken in choosing stock sources for restoration efforts. This research brings to light the potential inefficacy of using sources from different climates and evolutionary histories. Our ongoing work will refine the contribution of different stock sources to today's populations.

Cooperative funding provided by the Mississippi Department of Wildlife, Fisheries, and Parks, Louisiana Department of Wildlife and Fisheries, and Alabama Department of Conservation and Natural Resources via the Federal Aid in Wildlife Restoration Program.

Assessing Capture Stress in White-tailed Deer

Michaela F. Rice, Randy W. DeYoung, David G. Hewitt, Michael J. Sheriff, David B. Wester, Tyler A. Campbell, and Alfonso Ortega-Sanchez, Jr.

Mammals have a stress response that allows them to effectively cope with changes in their environment. The hormone cortisol, produced in response to a stressor, is released from the adrenal gland, travels throughout the body, and is finally metabolized and excreted. By quantifying the concentration of cortisol released in response to a particular event, we will be able understand how various classes of deer cope with changes in their environment. Our objectives are to (1) compare levels of cortisol in the blood and saliva of white-tailed deer to quantify the effects of short-term stress during capture and (2) compare blood and salivary cortisol levels resulting from capture to fecal hormone levels, which will allow a better understanding of the overall response to capture.

We captured over 300 individuals during autumn of 2015 and 2016 on 4 East Foundation ranches in South Texas using the helicopter and net-gun technique. Blood and saliva samples were collected 20 minutes after pursuit by the helicopter. We also collected fecal samples and monitored behavioral disposition, glucose metabolism, and body temperature of individuals.

Preliminary analyses revealed weak positive relationships among plasma, saliva, and fecal cortisol levels. We will further investigate these relationships while taking into account sex, age, capture location, time, and year of capture. This project represents the first wild ungulate study to quantify cortisol levels in blood, saliva, and feces from the same individual and provides unique opportunities to better understand the physiological responses of individual white-tailed deer to capture and environmental stressors.

Cooperative funding provided by the East Foundation.

© Randy DeYoung

Measurements of deer are essential in the studies examining the effects of culling on antler traits.

Response to Culling for Antler Traits in White-tailed Deer

Masahiro Ohnishi, Randy W. DeYoung, Charles A. DeYoung, Bronson K. Strickland, Don A. Draeger, David G. Hewitt, and Steven Lukefahr

Culling programs for white-tailed deer are designed to genetically improve antler size in managed populations. However, the potential gain per generation via culling is unclear.

We calculated predicted gains of antler traits as part of a long-term study of culling on the Comanche Ranch, located in South Texas. The study involved 3 treatments: an intensive treatment, where all age classes of bucks were culled; a moderate treatment, where bucks 3 years old and older were culled; and a no-cull control. During 2006–2012, we captured bucks, estimated age, measured antler traits, and removed bucks that met the culling criteria. We continued captures during 2013–2016 after culling ceased. We recorded 5,488 captures of 2,937 bucks and removed 1,333.

The heritability of antler points for 1- and 2-year-old bucks was about 25% and the heritability of Boone & Crockett score was 45% for bucks 3 years old and older. Those bucks that met the culling criteria had 3.7 more antler points as 1-year-olds and 17–26 more Boone & Crockett inches at 5 years old and older. Overall, environmental effects within the study area exerted a stronger influence on phenotypes of young bucks than did heritability.

Culling effectively removed undesirable bucks, but the offspring of desirable bucks were either culled or did not breed until more than 4 years old, which extended the generation time. Predicted gain per generation (8 to 9 years) was less than 1 antler point for bucks aged 1 to 4 years old and 5 to 6 Boone & Crockett inches for bucks greater than 5 years old. Preliminary results suggest intensive culling of bucks can reap only modest gains over an 8 to 10 year period.

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

Culling criteria used in a long-term study of culling on the Comanche Ranch.

	Treatment		
Buck Age Class	**Intensive**	**Moderate**	**Control**
1 year old	Cull if less than 6 antler points	No culling	No culling
2 years old	Cull if less than 8 antler points	No culling	No culling
3 to 4 years old	Cull if less than 9 antler points	Cull if less than 9 antler points	No culling
5 years and older	Cull if less than 145 B&C score	Cull if less than 145 B&C score	No culling

Optimal Levels of Brush Cover for Northern Bobwhites in the Rolling Plains

Bradley W. Kubečka, Dale Rollins, Fidel Hernández, and Humberto L. Perotto-Baldivieso

Recent research in South Texas suggests that bobwhite populations experience less variation between wet and dry years on landscapes with greater amounts of brush. That is, woody cover seems to buffer populations during drought years. Our objective is to examine associations of bobwhite abundance and woody cover in the Rolling Plains of Texas to learn more about the dynamic between cover and precipitation.

We are using northern bobwhite trapping data (296 traps) collected from 2009 to 2017 at the Rolling Plains Quail Research Ranch in Fisher County, Texas. For each trap, we have calculated bobwhite relative abundance and woody cover metrics (e.g., percent cover, configuration) surrounding trap sites. We used the GIS software platform to develop habitat-suitability models based on woody cover and bobwhite abundance distributions on the landscape.

Preliminary results indicated that highly suitable areas were characterized as having low (6%) brush cover. In addition, we failed to document that highly suitable areas were characterized by more woody cover during dry years. However, bobwhites occupied areas where woody patches were more aggregated during dry years.

Overall, our findings suggest woody cover in the Rolling Plains should be maintained at 5 to 20% brush cover. Managing for various woody patch sizes and configurations across the landscape, as recommended by the brush-sculpting paradigm, best meets the criteria for highly suitable areas from our models.

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

Assessing Patterns of Gene Expression in the Northern Bobwhite

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

Previous research on the northern bobwhite has found little genetic differentiation among the various subspecies. However, variation of bobwhites in plumage and body size and their wide geographic distribution suggest the potential for regional variation in adaptive traits.

Most genetic studies have analyzed neutral genetic markers because mutations in these parts of the genome have little effect on survival and reproductive success. Although useful for assessing population structure and inferring demographic history, neutral markers provide little insight into the genetic basis of traits that influence fitness. Northern bobwhite conservation and management actions can be improved if we know the genetic basis for important traits.

We will quantify gene expression in tissues and organs of bobwhites and characterize the genes expressed in each. Recent technological advances have made high-throughput analyses of genetic data for wildlife feasible and cost-effective. One can determine which genes are turned on in a tissue by isolating RNA from the cells and reading the template. The template sequence can be used to find matching DNA sequences in genome data and locate the gene.

We will take biopsies of the brain, heart, skin, skeletal muscle, liver, and gonads from male and female northern bobwhites collected in South Texas. From these tissue samples, we will extract RNA. Next-generation sequencing technology will be used to sequence the extracted RNA. We will use the RNA transcripts from our study to locate matching sequences in the draft bobwhite genome and compare our results to the high-quality, publicly available genomes of the chicken and turkey.

Cooperative funding provided by the Rotary Club of Corpus Christi (Harvey Weil Sportsman Conservationist Award Trust) and South Texas Chapter of Quail Coalition.

Evaluating Landscape Factors in the Bobwhite and Scaled Quail Declines

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

Habitat loss and subsequent fragmentation are the ultimate factors in the decline of both northern bobwhites and scaled quail. Historically, it was assumed that wildlife populations respond linearly to changes in habitat. However, recent work provides evidence of non-linearity in this relationship. In addition, proximate factors, such as weather trends and predation risk, may exert a greater influence on quail populations as

habitat is lost and the remaining habitat becomes more fragmented. All of these factors, both ultimate and proximate, operate at a scale beyond that of traditional quail studies, and their relative impacts on quail populations are not well understood.

Our research objectives are to (1) determine the linearity of the relationship between quail populations and habitat features and (2) determine the relative effects of habitat, weather, and raptors on the decline of bobwhites and scaled quail across multiple scales. Our study area encompasses the southwestern portion of the bobwhite's range and the entire range of scaled quail (TX, OK, NM, AZ, and CO).

We are using data from multiple sources to determine quail trends (Breeding Bird Survey, Christmas Bird Count, and ranch-level data), habitat composition and configuration (National Land Cover Database), raptor population trends (Breeding Bird Survey), and weather (PRISM Climate Group). Understanding scale-dependent contributions of multiple factors on quail population trends and determining the linearity of the quail-habitat relationship will be important in focusing both our quail management and research activities in the future.

Cooperative funding provided by South Texas Charity Weekend, Inc., Texas A&M AgriLife Extension Service, Texas Parks and Wildlife Department, and the Richard M. Kleberg, Jr. Center for Quail Research.

Montezuma Quail Habitat in the Edwards Plateau of Texas

Zachary J. Pearson, Eric D. Grahmann, Fidel Hernández, Robert M. Perez, Humberto L. Perotto-Baldivieso, Leonard A. Brennan, and Joyce Moore

Montezuma quail historically occurred in every county in the Edwards Plateau. Unfortunately, their range contracted over the last century from factors such as over-grazing, altered fire regimes, and the subsequent encroachment of juniper.

During the spring of 2015, we initiated a study to quantify Montezuma quail habitat within the Edwards Plateau to provide managers tangible information on this quail. During April–August, 2015–2016, call-back surveys (surveys in which a Montezuma quail call is played to invoke a call-back response) were conducted twice per month at 60 locations that encompassed a variety of habitat features. At these survey locations, habitat variables were sampled using vegetation transects.

Montezuma quail were detected at 30% and 43% of our survey points in 2015 and 2016, respectively. Ninety percent of occupied sites were on hillsides and hilltops compared to only 10% in valleys. Habitat attributes at these occupied sites averaged 46% total woody cover, 18% juniper cover, 30% grass cover, and 1.2 food plants per 11 ft^2.

Overall, diverse grassy hills peppered with low shrubs and oaks with low to moderate juniper coverage are preferred habitat for Montezuma quail in the Edwards Plateau. Our research will aid landowners, biologists, and quail enthusiasts in making science-based management decisions to conserve and restore this unique bird.

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

Vegetation Attributes Providing Thermal Refugia for Bobwhites in South Texas

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

Northern bobwhites are sensitive to extreme thermal conditions, especially along the western peripheries of their range where precipitation patterns are erratic and temperatures are typically high. South Texas is an area noted for hot, arid conditions. Thus,

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Cover is vital for northern bobwhites to survive in the extreme heat that occurs during summer in South Texas.

habitat must be managed in a way that provides adequate thermal refuge.

Temperatures during summer in South Texas commonly exceed 104° F, and these temperatures are potentially lethal to bobwhites. Temperatures are known to be lower in the shade provided by woody vegetation. However, the structural and compositional characteristics of woody vegetation that provide an environment where bobwhites can survive during hot summer days are unknown. Our objective is to quantify and characterize the structure of thermally suitable sites for bobwhites.

Our study is being conducted on the Hixon Ranch in LaSalle County, Texas. Forty bobwhites will be trapped and tracked March–August 2017 and 2018. At each bobwhite location, ground surface temperature, air temperature, black globe temperature, wind speed and direction, and percentage of shade cover are being collected. In addition, habitat attributes such as plant canopy density, vegetation height, percentage of woody and herbaceous cover, and canopy overlap are being measured.

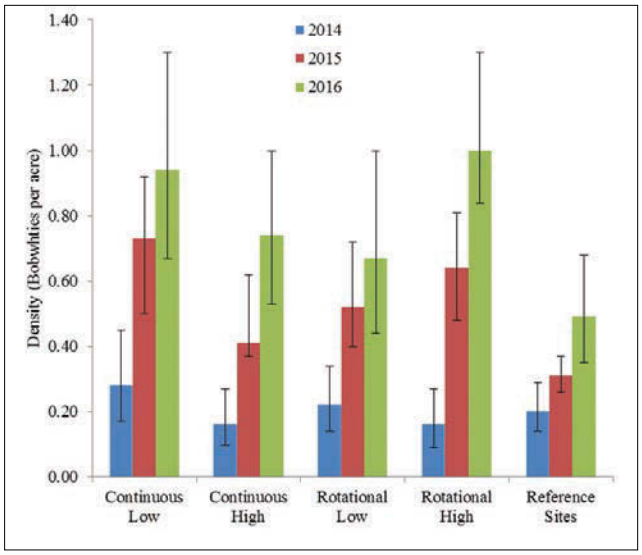
Removal of select thermal cover during brush management or other habitat management activities has the potential to substantially reduce bobwhite populations. Therefore, understanding the characteristics of the vegetation that provide temperatures where bobwhites can escape lethal temperatures is critical for wildlife managers, particularly with current trends in climate change.

Cooperative funding provided by the Hixon Family, Texas Parks and Wildlife Department, South Texas Chapter of Quail Coalition, San Antonio Chapter of Quail Coalition, San Antonio Chapter of Quail Forever, Hill Country Chapter of Quail Coalition, Coastal Bend Audubon Society, and the ExxonMobil Summer Jobs Program.

Northern Bobwhite Densities in Relation to Experimental Grazing Regimes

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

To successfully integrate the management of wildlife and livestock on rangelands is a common goal of natural resource managers, particularly where diversified enterprises provide the greatest economic opportunities. There have been studies on how cattle and northern bobwhites on semiarid landscapes interact; however, results differ based on grazing system, length of study, and location of study.



Northern bobwhite density (bobwhites per acre) estimates on 4 treatment sites (continuous high and low; rotational high and low) and pooled reference sites for December 2014–2016 on the San Antonio Viejo Ranch in Jim Hogg County, Texas.

We developed a large scale, long-term monitoring project to assess the impact of different grazing regimes on bobwhite density on 4 treatment pastures (18,989 acres; continuous and rotations at medium and low stocking rates) and reference sites (10,789 acres) on the San Antonio Viejo Ranch in Jim Hogg County, Texas. Our primary objectives are to compare (1) bobwhite densities and (2) vegetation parameters pre- and post-treatment on the treatment pastures and reference sites from December 2014–2017.

We estimated bobwhite density using line-transect distance sampling each December without cattle (2014–2015) and with cattle (2016). In 2014, there was no difference in density within the treatment sites (range: 0.16–0.29 quail per acre) and between the treatment and reference sites (0.20 quail per acre). Bobwhite density, pooled across treatments, was 77% higher than on the reference sites in 2015 and 71% higher than on the reference sites in 2016. Within years and among the 4 treatments, density was similar during the period 2014–2016, but increased by 175% from 2014 to 2015 and by 52% from 2015 to 2016.

This project will continue through 2017. Plans are to track bobwhite density and vegetation structure, composition, and use for 10 years.

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

Bermudagrass Control and Restoration of Native Prairie for Northern Bobwhites

Anthony D. Falk, Keith A. Pawelek, Forrest S. Smith, James P. Muir, Jamie Foster, Leo Herzberger, Trevor Farthing, and William P. Kuvlesky, Jr.

Bermudagrass is a non-native forage grass established across the southern United States. Bermudagrass grows into a dense sod, which prevents other plant species from growing. The structure of thick stands limits the movement of ground forging birds such as bobwhites. The goal of our study is to provide landowners and natural resource managers concise, tested techniques that can be used to remove bermudagrass and successfully establish native prairie to benefit northern bobwhites within South Texas.

In an attempt to control bermudagrass and re-establish native prairie to benefit quail, we tested 4 bermudagrass removal techniques, 3 seeding techniques in treated areas, and 3 seed mixes in 4 Texas ecoregions. The removal techniques were repeat application of the herbicide glyphosate, a single application of the herbicide imazapyr followed by repeat applications of glyphosate, shredding followed by repeat applications of glyphosate, and the planting of a cool season cover crop. The removal techniques were implemented in the summer of 2016. The seeding techniques were disk and drill seeding, no till drill, and disked and broadcast, and were implemented in the spring of 2017. The 3 seed mixes were a local harvest seed mix of native species, a low diversity commercial native mix, and a high diversity commercial native mix.

Results of the removal technique experiments were very promising. All herbicide treatments significantly reduced the amount of bermudagrass at all study sites. All locations received abundant rainfall following the spring 2017 planting, which should result in good establishment of the native vegetation. The sites will be sampled for seeded plant establishment and evaluated for bobwhite habitat quality for the next 2 years.

© Anthony Falk

Conversion of bermudagrass pasture to native grassland is needed to benefit northern bobwhites.

Cooperative funding provided by the Texas Parks and Wildlife Department.

Evaluating Methods for Monitoring Northern Bobwhite Populations

Bradley W. Kubečka, Dale Rollins, Fidel Hernández, and Humberto L. Perotto-Baldivieso

Indices such as spring cock call counts, fall covey counts, and roadside counts provide measures of relative abundance and are assumed to be directly proportional to population size. Density estimators, such as distance-based helicopter surveys and mark-recapture trapping, provide estimates of absolute abundance (i.e., actual population size). Indices are less expensive and easier to implement than density estimators, but often are less reliable. Our objectives are to (1) determine which index is the best predictor of fall populations and (2) evaluate whether helicopter surveys are comparable to mark-recapture estimates in the Rolling Plains.

We are using northern bobwhite count data collected from 2009 to 2017 at the Rolling Plains Quail Research Ranch in Fisher County, Texas. We are comparing spring cock call counts, fall covey counts, and roadside counts to density estimates from mark-recapture and helicopter-based distance sampling at 2 spatial scales—ranch-wide and listening stations.

Preliminary analyses suggest spring cock call counts were inadequate predictors of bobwhite density at both listening stations and for the ranch. Similar to spring cock call counts, fall covey call counts were poor predictors of bobwhite density surrounding listening stations, but good predictors of fall abundance for the ranch.

Overall, roadside surveys were the best predictor, explaining 98% of the variation in fall abundance across the ranch. Density estimates provided from helicopter surveys were strongly correlated with fall abundance, but when distance sampling was not used, the number of individuals counted per mile of helicopter surveys explained about 93% of the variation in fall abundance—usurped as an index by roadside surveys.

Our study provides valuable information needed to monitor bobwhite populations based on methods that best fit the needs of the wildlife manager.

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

The Impacts of Red Imported Fire Ants on Bobwhites and Prairie Chickens

Kelly M. Redmond, Nicole A. Hansen, Andrew P. Nicholson, Taylor R. Shirley, Eric D. Grahmann, Fidel Hernández, Leonard A. Brennan, Timothy Anderson, Michael E. Morrow, Kirk Feuerbacher, and Jay Kelso

Northern bobwhites have declined across their geographic range, and Attwater's prairie chickens presently exist in just 2 supplemented populations on the Texas Gulf Coast. Although these declines are attributed mostly to habitat loss, invasion by the red imported fire ant remains a worrisome topic among wildlife managers. Individual bobwhites and their nests can be negatively impacted by fire ants. However, biologists have yet to document a conclusive link between fire ant abundance and bobwhite abundance at the pasture-wide scale.

Our objective is to determine if red imported fire ants (1) affect bobwhite and prairie chicken demographic performance at the individual bird scale and (2) if these effects are reflected for bobwhite abundance on the pasture-wide scale. We predict that fire ants will affect demographic performance of individual birds, but that the population as a whole would be able to buffer negative impacts and reflect no correlation to fire ant abundance.

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During flooding conditions, red imported fire ants form floating mats, thereby allowing the colony to survive.

Our study is located on 3 ranches in Goliad and Refugio counties on 6 pastures that are approximately 1,000 acres each. We will estimate pasture-wide fire ant density and relative abundance by counting fire ant mounds and by using baited cup traps along random transects. Bobwhite and prairie chicken survival and nest success will be determined using radio telemetry monitoring. Bobwhite densities will be estimated using distance sampling via helicopter.

This study will provide information about the potential effects of red imported fire ants on gamebirds. Findings can aid in developing management strategies that aid northern bobwhites and Attwater's prairie chickens on the Texas Gulf Coast.

Cooperative funding provided by the Coastal Bend Bays and Estuaries Program, U.S. Fish and Wildlife Service, Steve and John Lindley, D Bar J Ranch, Dunn O'Connor River Ranch, JF Welder Heirs' Vidaurri Ranch, and South Texas Chapter of Quail Coalition.

Restoration of Quail Habitat in Areas Dominated by Non-Native Grasses

Ellart J. Vreugdenhil, Brandon J. Palmer, Eric D. Grahmann, Timothy E. Fulbright, Michael W. Hehman, Fidel Hernández, Forrest S. Smith, Keith A. Pawelek, and Anthony D. Falk

Non-native grasses, such as buffelgrass and Old-World bluestems have been planted in Texas since the 1940s. In southern Texas and Mexico, expansion of non-native grasses is a leading cause of quail habitat loss and fragmentation. These non-native plants tend to form dense monotypic stands, thereby eliminating travel corridors, decreasing structural heterogeneity, and reducing critical habitat components such as bare ground and food.

In 2008, we initiated a study to determine potential techniques to restore native plants in areas dominated by non-native grasses. Far surpassing other methods, repeated disking and/or glyphosate herbicide application and the subsequent planting of ecotypic native plants were successful. Bobwhite habitat components were restored, and densities increased from nearly 0 to 1 bobwhite per 3 acres. Unfortunately, these plots were small, and easily invaded by non-native plant species. Therefore, in 2014 we began a study to replicate this success on a large scale (approximately 300-acre pasture).

Our study is located on the Hixon Ranch in LaSalle County, Texas. For 2 years, the site has been repeatedly disked and sprayed (5 events each, respectively) to deplete the seedbank of non-native grasses. During October 2016, a diverse mix of native grasses and forbs was drill seeded onto the site. Woody plant seedlings were added during April 2017.

Since 2014, vegetation has been sampled, and this sampling will continue until 2019 to determine our effectiveness in creating bobwhite and scaled quail habitat. If this restoration is successful over the long-term and is beneficial to quail, it represents an important step in learning how to effectively restore quail habitat on a large scale.

Cooperative funding provided by the Hixon Family, Texas Parks and Wildlife Department, South Texas Chapter of Quail Coalition, San Antonio Chapter of Quail Coalition, San Antonio Chapter of Quail Forever, Hill Country Chapter of Quail Coalition, Coastal Bend Audubon Society, and the ExxonMobil Summer Jobs Program.

Vegetation Attributes of Thermal Refugia for Scaled Quail

Ellart J. Vreugdenhil, Brandon J. Palmer, Eric D. Grahmann, Timothy E. Fulbright, Fidel Hernández, and Michael W. Hehman

Scaled quail inhabit environments that test the limits of their thermoneutrality. These areas tend to be hot and dry and have relatively sparse herbaceous vegetation. Consequently, scaled quail must have access to thermally suitable microclimates.

Previous research has quantified the temperatures of scaled quail habitat. However, the structural composition of the plants is more obscure. Wildlife managers must be able to identify vegetation composition and structural characteristics of thermal cover where scaled quail can avoid heat stress. Our objective is to quantify the structure of this suitable thermal refuge.

Our study is on the Hixon Ranch in LaSalle County, Texas. From March through August 2017–2018, a minimum of 20 scaled quail will be trapped and tracked to determine what types of vegetation they are using. At a subsample of quail locations, we will take ground surface temperature, air temperature, black globe temperature, wind speed and direction, and percentage of shade cover. At these same locations, habitat attributes such as plant canopy density, vegetation height, percentage of woody and herbaceous cover, and canopy overlap will be measured. Information

Scaled quail need sufficient overhead cover to escape the extreme summer temperatures that occur in South Texas.

provided from this study will guide wildlife managers interested in identifying and restoring suitable thermal environments for scaled quail.

Cooperative funding provided by the Hixon Family, Texas Parks and Wildlife Department, South Texas Chapter of Quail Coalition, San Antonio Chapter of Quail Coalition, San Antonio Chapter of Quail Forever, Hill Country Chapter of Quail Coalition, Coastal Bend Audubon Society, and the ExxonMobil Summer Jobs Program.

Analysis of Adaptive Genetic Variation among Populations of Bobwhites

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

The northern bobwhite has undergone dramatic range contractions and population declines over the past 40 years. Studies based on mitochondrial DNA and nuclear microsatellite markers have shown that the northern bobwhite exhibits weak population structure. However, the broad geographic distribution and substantial morphological variation among populations of bobwhites suggest adaptive genetic variation that may not be detected by neutral markers. Therefore, we examined the genetic diversity and population structure of northern bobwhites west of the Mississippi River, which included Sonoran masked bobwhites, using 2,137 polymorphic single nucleotide polymorphisms (SNPs).

Preliminary results indicate that masked bobwhites had the lowest genetic diversity and were differentiated

from contiguous populations of bobwhites, whereas little structure was evident among the 5 populations in the United States. We identified 2 candidate genes for positive selection using FST outlier tests.

Genetic differentiation among Sonoran and U.S. populations may be the result of long-term geographic isolation of masked bobwhites resulting from increasing aridity in southwestern North America at the end of the Pleistocene. Lack of population structure among bobwhites in the United States may be the result of the combined effects of post-Pleistocene range expansion, long-distance dispersal, flexible mating system, and high effective population size.

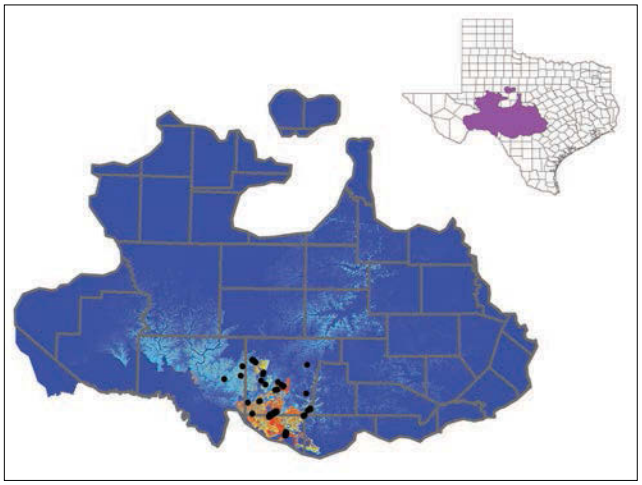
Our results suggest that masked bobwhites should be managed as a distinct unit. In addition, bobwhites in the United States should be managed on a regional basis with emphasis placed on preserving, restoring, and enlarging landscapes containing suitable habitat.

Cooperative funding provided by a Texas A&M University-Kingsville Research Award.

An Occupancy Model for Montezuma Quail in the Edwards Plateau

Zachary J. Pearson, Eric D. Grahmann, Fidel Hernández, Humberto L. Perotto-Baldivieso, Robert M. Perez, Leonard A. Brennan, and Joyce Moore

Throughout the past century or more, Montezuma quail in the Edwards Plateau have been in decline because of improper grazing, removal of fire from the landscape, and the consequent encroachment of woody plants. Likely once widespread across the entire Edwards Plateau region, Montezuma quail are now restricted to just 6 counties south and west of Rocksprings, Texas.



A predictive occupancy map for Montezuma quail in the Edwards Plateau of Texas; black dots represent confirmed quail locations. Occupancy probability map ranges from low (0.0 dark blue) to high (0.95 red).

We initiated a study to redefine the range of Montezuma quail and identify areas of suitable habitat in the Edwards Plateau. During April through August 2015–2016, we conducted call-back surveys (surveys in which a Montezuma quail call is played to invoke a call-back response) on 9 ranches, twice per month. Sixty survey locations were placed within a variety of habitat features. After completing surveys during 2016, we calculated patch-scale habitat features important for Montezuma quail (slope, elevation, woody cover, topographic position, and ecological type) using GIS software. Using this processed information, we will be able to develop a predictive map to identify the potential for Montezuma quail habitat in the Edwards Plateau. When complete, this map will be useful to landowners, biologists, and quail enthusiasts in identifying areas potentially harboring Montezuma quail and sites suitable for their restoration.

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

Northern Bobwhite Use of an Area Restored to Native Vegetation

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

Habitat loss and fragmentation are the leading factors in population declines of northern bobwhites. In South Texas, non-native grasses, particularly buffelgrass and Old World bluestems, are invading and displacing native vegetation, thereby reducing habitat for bobwhites. As a result, we are attempting to restore a 300-acre area by repeatedly disking and spraying herbicides, and then replanting native vegetation. The objective of this study is to assess how vegetation restoration influences bobwhite use relative to a site where native vegetation has not been restored.

Our study site is located on the Hixon Ranch in LaSalle County, Texas. The study site is divided into 2 areas, one that is being restored with native vegetation and another that is dominated by non-native grasses. Bobwhites have been monitored using radio telemetry

since 2014. We will continue to monitor these birds at least twice per week to determine bobwhite response to restoration activities.

During 2014, 4 bobwhite coveys relegated to the periphery of this area were displaced by the treatment, and all birds mostly avoided the site during restoration practices. A mixture of locally adapted native plant species was sown in October 2016 on the restoration site. Bobwhites have begun to use the site since planting, and several nests have been found.

We are still in the early stages of this restoration project and expect increased use by bobwhites through time. Our results will be insightful to landowners and natural resource managers wishing to restore bobwhite habitat in areas where non-native grasses have become established and have displaced bobwhites.

Cooperative funding provided by the Hixon Family, Texas Parks and Wildlife Department, South Texas Chapter of Quail Coalition, San Antonio Chapter of Quail Coalition, San Antonio Chapter of Quail Forever, Hill Country Chapter of Quail Coalition, Coastal Bend Audubon Society, and the ExxonMobil Summer Jobs Program.

Responses of Scaled and Gambel's Quails to Late Quaternary Climate Change

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

The geographic ranges of terrestrial species are largely determined by temperature and precipitation over large temporal and spatial scales. Human-induced climate change will alter temperature and precipitation regimes, which will have direct impacts on geographic distributions of gamebirds. The effects of past and future climate on a species' geographic distribution can be predicted using ecological niche models.

We constructed and validated models for the scaled quail and Gambel's quail using locality data from museum specimens and 9 temperature- and precipitation-related variables. Next, we predicted the past distribution of each species during the Last Glacial Maximum (21,000 years ago, cooler than the present) and 2 warmer periods—the Last Interglacial (120,000–140,000 years ago) and the Mid-Holocene (6,000 years ago). We then used the models to predict the future distribution of both species in 2070 under 2 different climatic scenarios.

The models predicted that both species had reduced geographic ranges during the Last Glacial Maximum, but scaled quail experienced a more extreme range contraction compared to Gambel's quail. The geographic range of scaled quail also contracted during the Last Interglacial. Higher precipitation during the Last Glacial Maximum and the Last Interglacial might have supported habitats preferred by Gambel's quail, but reduced habitat availability for scaled quail.

Our preliminary results suggest that warmer and drier future climates may allow scaled and Gambel's quails to expand their geographic ranges. However, the results should be interpreted carefully because the models do not incorporate projections of land use.

Effects of Tanglehead on Habitat Suitability for Bobwhites in South Texas

Jose M. Mata, Humberto L. Perotto-Baldivieso, Fidel Hernández, Eric D. Grahmann, Sandra Rideout-Hanzak, John T. Edwards, Jaclyn D. Robles, Michael T. Page, and Taylor M. Shedd

South Texas is one of the last great places for northern bobwhite habitat. The increase of tanglehead and its development into monotypic stands could negatively impact northern bobwhites by altering habitat structure and limiting the availability, accessibility, and use of important habitat components such as food and cover. Tanglehead is a perennial bunchgrass native to Texas and much of the southwestern United States. Over the past decade, stands of tanglehead have emerged in Jim Hogg and Duval counties, which resulted in a simplified native plant community. Unfortunately, the effects of tanglehead on quail habitat are not well known.

Our goal is to assess the impact tanglehead has on northern bobwhite habitat. To achieve this goal, we are using the gradient concept of landscape structure. This is a novel concept that can be useful to build spatially-explicit habitat suitability models.

We are generating a series of habitat suitability models based on landscape metrics such as percentage woody cover, mean patch area, edge density, and aggregation to quantify the distribution of northern bobwhite habitat and the potential effect of tanglehead in these areas. We are currently running intensive spatial analyses to evaluate these metrics in our study areas. The results of our study will provide an effective measurement of the potential impact of tanglehead on northern bobwhite habitat.

Cooperative funding provided by the Rotary Club of Corpus Christi (Harvey Weil Sportsman Conservationist Award Trust).

Seasonal Male and Female Ocelot Habitat Suitability in South Texas

Jason V. Lombardi, Michael E. Tewes, Humberto L. Perotto-Baldivieso, John P. Leonard, and Tyler A. Campbell

The Lower Texas Gulf Coast is home to the last 2 known breeding populations of ocelots in the United States. The ocelot, which is an endangered Neotropical medium-sized felid, is considered a habitat specialist occurring only in dense woody vegetation. Over the last 75 years, the loss, degradation, and fragmentation of ocelot habitat have been considered the primary drivers for population declines.

During 2016–2018, we will be capturing and attaching GPS collars and satellite collars on male and female ocelots on the East Foundation's El Sauz Ranch in Willacy County, Texas. Information collected will include data from the collars, land-cover data, weather data, and habitat variables. From this information, we will be able to generate seasonal male and female habitat suitability maps for ocelots.

Our research will shed light on areas that may indicate ocelot habitat and possible new populations in South Texas. Furthermore, it will allow biologists and wildlife managers to better protect ocelot habitat and identify areas in need of habitat restoration.

Cooperative funding provided by the Feline Research Program of the Caesar Kleberg Wildlife Research Institute, Wild Cat Conservation, Inc., East Foundation, Annova LNG and their parent company Exelon Generation, Brown Foundation, Tim and Karen Hixon Foundation, Travis and Bettina Mathis, and Ben F. Vaughan, III.

Change and Fragmentation of Woody Cover Affects Wild Cats in the Rio Grande Delta

Jason V. Lombardi, Michael E. Tewes, and Humberto L. Perotto-Baldivieso

The Lower Rio Grande Valley (LRGV) is one of the fastest urbanizing areas in the United States. In addition, cropland and rangeland conversion has led to loss and degradation of woody cover across the region. The endangered ocelot, which is native to southern Texas, has seen its geographic range diminished because of the loss of dense thornshrub and other cover.

We classified LANDSAT imagery data every 8 years from 1984–2016 to quantify different rates of land cover change and other land cover metrics. Using the Environmental Protection Agency's housing density projections for urban growth in the LRGV, we quantified the future rate of loss/gains of woody cover, agriculture, rangeland, and other land cover class metrics in areas that are predicted to be converted into urban areas.

Since 1984, woody cover increased from 14 to 16%; however, mean patch area, edge density, patch density, and Euclidean distance to nearest patch increased indicating severe fragmentation, especially in Cameron County. Rangeland and cropland conversion were the leading causes of change in woody cover—attributed to rapidly expanding urban areas.

Our projections covering the next 32 years indicate accelerated urbanization near the U.S.-Mexico border. This increasing trend will result in urban areas being the dominant land-cover type, and these urban areas will form a barrier for ocelots and fragmentation-sensitive species. Our dataset provides information for predicting future woody cover fragmentation, which will be useful in directing restoration efforts and developing effective conservation strategies.

Cooperative funding provided by the Feline Research Program of the Caesar Kleberg Wildlife Research Institute, Wild Cat Conservation, Inc., Annova LNG and their parent company Exelon Generation, Brown Foundation, Tim and Karen Hixon Foundation, Travis and Bettina Mathis, and Ben F. Vaughan, III.

Co-Occurrence of Jaguars, Pumas, Bobcats, Jaguarundis, and Ocelots in Tamaulipas

Jason V. Lombardi, Michael E. Tewes, Arturo Caso, Sasha Carajaval-Villarreal, and Shelby B. Carter

The Lower Rio Grande Valley of South Texas and the northern regions of Tamaulipas, Mexico are 2 of the most rapidly urbanizing areas of North America. The south-central region of Tamaulipas contains the largest undisturbed patches of forest in the region.

From 2009–2010, we conducted camera surveys on Rancho Caracol, Tamaulipas. From the information obtained, we determined that the area was home to 5 of North America's 7 native cat species (jaguar, puma, ocelot, jaguarundi, and bobcat) and a diverse community of other medium-to-small sized carnivores.

Over the last 40 years, there has been little research examining the factors that influence co-occurrence of the 5 felid species in one area, and no studies have examined jaguar-bobcat interactions. Furthermore, previous research in areas where jaguars are absent report that

ocelots often exhibit a top-down effect on smaller felid species known as the 'ocelot effect.'

The purpose of our research is to use multi-species occupancy models to identify factors that influence the co-occurrence of jaguars and pumas, jaguars and smaller felids, pumas and smaller felids, and whether ocelots exhibit top-down forces on bobcats and jaguarundis.

Findings from this study will contribute valuable information to felid ecology and management in northern Mexico. This information will help wildlife biologists understand the factors influencing felid coexistence and provide an incentive to protect these last remaining tracts of undisturbed habitat.

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

Noninvasive Fecal Sampling for Monitoring Ocelots and Bobcats

Daniel R. Taylor, Randy W. DeYoung, Michael E. Tewes, Terry L. Blankenship, Alfonso Ortega-Sanchez, Jr., and Tyler A. Campbell

Genetic monitoring can help answer long-term questions about demography and gene flow in wildlife populations. Scats can be used as a source of DNA. In addition, the scat sampling method is noninvasive and requires less effort per sample. Noninvasive techniques are especially valuable for species that are elusive and difficult to trap, such as wild carnivores.

We are evaluating the use of scats as a tool to estimate population abundance of bobcats and ocelots on the East Foundation's El Sauz Ranch in Willacy County, Texas. We compared scat sampling results to photo monitoring via a network of 27 infrared camera stations. We collected scats along ranch roads during 2016 and 2017. In 10 days of sampling, we collected 39 bobcat scats and identified 20 individuals (12 females and 8 males). The 21 miles of transect surveys yielded an average of 3.5 bobcat scats per day, which was double the bobcat photos per day from camera stations.

Scat sampling appears to be an efficient way to obtain DNA samples of bobcats, but additional sampling is needed for an accurate estimate of abundance. To date, no ocelots have been detected in our scat surveys. This suggests that ocelots do not use ranch roads for moving and scent marking as do other carnivores. Six ocelot photos were recorded during the sampling period, which confirmed that ocelots occupied the study area during scat collections. Future research into fine-scale habitat use and scent-marking behavior could reveal a better method of collecting DNA from ocelots.

Cooperative funding provided by the Rob and Bessie Welder Wildlife Foundation, Brown Foundation, James R. Dougherty Foundation, Travis and Bettina Mathis, Rachael and Ben Vaughan Foundation, and the East Foundation.

Felid Abundance, Activity Patterns, and Interactions with Ungulates

Shelby B. Carter, Jason V. Lombardi, Michael E. Tewes, Justin P. Wied, John P. Leonard, and Tyler A. Campbell

In the Lower Rio Grande Valley of Texas ocelots occur in 2 small populations. Of these, the East Foundation's El Sauz Ranch in Willacy County has the largest known population of ocelots in the United States, as well as a robust population of bobcats. Ocelot interactions with carnivores have been previously investigated across their geographic range. However, no studies have examined interactions among ocelots, bobcats, cattle, and large game species.

We are analyzing photographs from 28 camera stations on the El Sauz Ranch taken during 2011–2017 to quantify differences in abundance and activity patterns among felids, cattle, and large game species. Preliminary data indicate felids share similar activity patterns, whereas large game species and cattle were most active when felids were inactive. Nilgai were omnipresent on the landscape, whereas cattle were detected at sites closer to open pasture. Ocelots and feral hogs were more often detected in the northern part of the ranch.

Little is known about the interactions of ocelots with bobcats, cattle, and large game species within South Texas.

Information derived from this study will assist management of cattle and game species in areas where they co-occur with bobcats and ocelots. Furthermore, our findings can be used to aid in future ocelot recovery and conservation on private lands in South Texas.

Cooperative funding provided by the Feline Research Program of the Caesar Kleberg Wildlife Research Institute, East Foundation, Wild Cat Conservation, Inc., Annova LNG and their parent company Exelon Generation, Brown Foundation, Tim and Karen Hixon Foundation, Travis and Bettina Mathis, and Ben F. Vaughan, III.

Genetic Analysis of Bobcats Occurring in a Fragmented Landscape

Daniel R. Taylor, Randy W. DeYoung, Michael E. Tewes, and Terry L. Blankenship

Bobcats are capable of surviving among the rapid landscape changes in urban places such as the Lower Rio Grande Valley of Texas. This trait makes bobcats a valuable indicator species to study landscape connectivity, which is essential for maintaining genetic diversity within populations. Changes in genetic diversity can be used as an indicator that natural and human-related forces are limiting connectivity among populations.

We are using non-invasive fecal sampling and landscape genetics methods to determine if there is a relationship between habitat fragmentation and genetic diversity of bobcats in South Texas. Our sampling strategy allows us to efficiently collect bobcat scats across large study areas without having to trap and handle bobcats. We are analyzing the DNA extracted from scats to identify individual bobcats, as well as their relative genetic diversity and similarity. To date, we have analyzed DNA from over 200 bobcat scats from 14 sites in South Texas, including the southernmost tip of Texas and both sides of the U.S.–Mexico border.

Fecal sampling is an innovative way of obtaining genetic material for identifying individual bobcats.

Our findings will aid in the identification and prioritization of landscapes in the Lower Rio Grande region. The connectivity of habitat corridors within the Lower Rio Grande Valley will be important for the long-term conservation of wildlife in the region, including the remaining ocelot populations in Texas.

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

Habitat Factors of Ocelot Occupancy in the Sierra Tamaulipan Mountains

Jason V. Lombardi, Michael E. Tewes, Arturo Caso, Sasha Carajaval-Villarreal, and W. Chad Stasey

Translocations of wildlife populations are commonly used by biologists to reintroduce wildlife species to former habitats or to help bolster genetic diversity within small populations. In the United States, ocelots have suffered a severe population decline from habitat loss and fragmentation, road mortality, and loss of genetic diversity. Ocelots found in the Sierra Tamaulipan Mountains of Mexico have been identified as genetically similar to those found in Texas. With the purpose of bolstering the genetic diversity of ocelots in the United States, research began in 2009 to evaluate the source population in northeastern Mexico.

From May through December 2009, we conducted a remote camera study on Rancho Caracol, Tamaulipas, Mexico to determine how land cover types and landscape metrics influence occupancy of this potential source population of ocelots. Ocelots in the northern grid occurred in areas of increasing percentage of tropical deciduous forests and in the southern grid ocelots occurred in smaller areas of tropical deciduous forest.

Although ocelots were detected in thornshrub cover, tropical deciduous forests interspersed among thornshrub were the best predictor of ocelot occurrence. For ocelots to be successfully translocated, researchers may need to release individuals in areas with deciduous forested patches interspersed among thornshrub cover to mimic the cover types found in the source habitat.

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

Do Coyotes Impact Felid Co-Occurrence in South Texas?

Jason V. Lombardi, Michael E. Tewes, Humberto L. Perotto-Baldivieso, Justin P. Wied, John P. Leonard, and Tyler A. Campbell

Bobcats, ocelots, and coyotes are sympatric across much of the Lower Rio Grande Valley of South Texas. In other areas of North America, coyotes exhibit aggression towards gray foxes, red foxes, and bobcats. The impact of coyotes on ocelots is understudied, whereas bobcat-ocelot and coyote-bobcat co-occurrences have been examined. Over the last 50 years, there has been a sharp decline in the ocelot population in South Texas because of habitat loss and fragmentation, loss of genetic diversity, and road mortality; whereas, coyote and bobcat populations have remained stable.

Using remote camera data collected from 2011–2018 on the East Foundation's El Sauz Ranch, we are examining whether coyotes affect site-specific initial occupancy, colonization, localized extinction, and persistence of ocelots, and to a lesser extent bobcats. Our research will determine if coyotes can negatively impact bobcats and ocelots in dense thornshrub and live oak forests within South Texas. This information will be critical in developing management plans for felid conservation in South Texas.

Cooperative funding provided by the Feline Research Program of the Caesar Kleberg Wildlife Research Institute, Wild Cat Conservation, Inc., Annova LNG and their parent company Exelon Generation, Brown Foundation, Tim and Karen Hixon Foundation, Travis and Bettina Mathis, and Ben F. Vaughan, III.

Influence of Macro- and Micro-Habitat Components on Ocelot Occupancy

Jason V. Lombardi, Michael E. Tewes, Humberto L. Perotto-Baldivieso, Justin P. Wied, John P. Leonard, and Tyler A. Campbell

The ocelot is an endangered felid found in 2 small populations in the Lower Rio Grande Valley (LRGV) of Texas. Degradation and loss of habitat are principal causes of reduced ocelot genetic diversity in the region.

From 2011–2017, we conducted remote camera surveys at 28 sites on the East Foundation's El Sauz Ranch, located in Willacy County. Preliminary data indicate a seasonal trend in detection between hot and cool months. Initial occupancy was influenced by features of thermal cover (light intensity, humidity, temperature, and wind speed). Colonization was negatively influenced by sandy clay loam soils, but positively influenced by increasing woody patch density, greater wind speed, and lower light conditions. Local extinction was related to decreasing woody patch density and fine sandy soils.

Dr. Michael Tewes is setting up a camera "trap" to assess ocelot use of habitats within South Texas.

Our preliminary findings indicate thermal cover influenced where ocelots were likely to occur. The impact of thermal cover in dense thornshrub suggests that ocelots will seek out these areas when occupying new areas. As woody patch density decreases, there will be less preferred habitat for ocelots to colonize. In addition, soil types should be factored into future habitat preservation and restoration efforts.

This research provides information about habitat components that are most likely to influence ocelot occupancy. Such information is essential for future ocelot recovery and habitat restoration in the LRGV.

Cooperative funding provided by the Feline Research Program of the Caesar Kleberg Wildlife Research Institute, East Foundation, Wild Cat Conservation, Inc., Annova LNG and their parent company Exelon Generation, Brown Foundation, Tim and Karen Hixon Foundation, Travis and Bettina Mathis, and Ben F. Vaughan, III.

Blackland Prairie Restoration at Martindale Army Airfield near San Antonio

Forrest S. Smith, Keith A. Pawelek, Anthony D. Falk, Roberto Obregon, and Aaron R. Gilfillan

Much of the Texas blackland prairie has been lost because of farming and suburban development. Explosive population growth and further urbanization in the IH-35 corridor of Texas further threatens much of the remnant prairie existing today. Without restoration efforts to offset looming losses from urbanization and fragmentation, function of this highly modified ecosystem is greatly imperiled.

In 2016, we began working with the Texas Military Department to restore 103 acres of blackland prairie at Martindale Army Airfield near San Antonio, Texas. Beginning in spring 2017, we plowed the site to remove non-native grasses and implemented a repeated regime of herbicide applications to remove new growth of agricultural weeds and non-native grasses, thereby depleting the seedbank. In late summer 2017, we planted a diverse mix of native blackland prairie plants representing a variety of native grasses, forbs, and legumes, with an emphasis on inclusion of native milkweeds and nectar plants used by pollinators.

Following restoration plantings, we will monitor the establishment and persistence of the native plants for several years. If successful, this site should serve as an effective demonstration of the ability of current seed sources and available restoration methods to restore large tracts of blackland prairie in Texas. As part of this work, researchers will monitor the use of the restoration site by wildlife and pollinators to determine the impact of large-scale restoration seeding efforts for increasing habitat availability and conservation value in this rapidly disappearing ecosystem.

Cooperative funding provided by the Texas Military Department.

Release of Whiplash Pappusgrass for West Texas

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

Whiplash pappusgrass is widely distributed across West Texas, South Texas, and west into southern New Mexico and Arizona. It is a perennial bunchgrass that shows tolerance to both saline and alkaline sites across variable soil textures. It provides good cover for wildlife as well as good forage for livestock. Whiplash pappusgrass grows well in many of the harsh, dry ecological sites found across West Texas.

A new release of whiplash pappusgrass is being planned for West Texas. Four accessions of whiplash pappusgrass were selected for release from an initial evaluation of 20 accessions and 2 existing commercial varieties that began in 2013. Four high performing accessions from Hudspeth, Brewster, Martin, and Tom Green counties were selected for release after 3 years of data collection from 2 initial evaluation plantings in Alpine and Odessa. Seed increase plantings of these 4 accessions were installed in Alpine during 2016.

Plants grown from seed harvested from the initial seed increase plantings in Alpine were transplanted into fields at Douglass W. King Seed Company in San Antonio during May 2017. These plants will produce the breeder seed that will then be planted into larger commercial scale planting fields.

Commercial availability of whiplash pappusgrass is expected in mid-summer 2018. Whiplash pappusgrass will be an excellent plant for the restoration of many degraded sites found in former agricultural lands and for reclamation of sites after oil and gas production activities in the Permian Basin.

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

Cattle Grazing and Burning of Tanglehead to Increase Vegetation Diversity

Chase H. Walther, J. Alfonso Ortega-Santos, Humberto L. Perotto-Baldivieso, Sandra Rideout-Hanzak, and David B. Wester

In the United States, invasive introduced plants have destroyed desirable native plants in once rich rangelands and forestlands, thereby reducing the amount of wildlife habitat within these systems. In the absence of disturbances, such as fire and/or cattle grazing, some plant species such as tanglehead can become dominant within a plant community. In those cases, plant diversity may be reduced and the quality of the habitat declines.

Mature tanglehead palatability for cattle is very limited. In this study, we hypothesize that prescribed

burns of mature tanglehead will attract cattle to the burned patches because of the increase in palatability of the new growth after the burn. The objectives of the study are to evaluate the effect of winter burns and cattle grazing on (1) density of tanglehead and native plant species richness and (2) forage productivity and nutritive value of tanglehead.

Three 10-acre patches will be burned at the end of October in a 236-acre pasture dominated by tanglehead. The patches are paired with 3 control plots. Ten cows with GPS collars will be placed in the pasture a month before the burning to determine site preferences before the burn. The GPS collars will collect cow location readings every 20 minutes. With this information, we will determine the preference of cattle for the tanglehead burned areas.

Grazing exclosures will be used to determine percent use of forage. Variables we will examine include density of tanglehead, native species richness, forage standing crop, and nutritive value of tanglehead. This information will be used to develop recommendations to manage tanglehead invasions and increase plant species richness for wildlife species.

Cooperative funding provided by the Jones Ranch.

Dealing with Multiple Scales for Wildlife Habitat in the Edwards Plateau

Jaclyn D. Robles, Humberto L. Perotto-Baldivieso, Michael T. Page, and David B. Wester

When quantifying wildlife habitat relationships, appropriate scale has proven to be key to the interpretation of ecological data. The use of multiple scales in habitat studies can provide a good solution in overcoming scale mismatching between ecological processes and spatial patterns in the landscape. However, identifying when a change in scale occurs can be a challenging task. The scale continuum framework can provide a mechanism by which scales can be identified for analysis of spatial patterns and their related ecological processes.

Our goal is to assess the scale continuum with a focus on grassland birds such as the Rio Grande wild turkey. To achieve this goal, we classified aerial photos from Bandera, Kerr, and Real counties in the Edwards Plateau. We sampled the study area by systematically generating evenly distributed points and generating buffers with a radius ranging from 164 feet to 3,300 feet in 164-foot intervals. These buffers were used to clip classified imagery and analyze landscape spatial structure using the following landscape metrics: percentage of woody cover, mean patch area, patch density, edge density, largest patch index, and Euclidean distance to nearest neighbor.

Results are currently being analyzed. Our findings will be useful in developing multi-scale approaches to assess wildlife habitat.

Increase of Commercial Seed Supplies of Native Pollinator Plants for Texas

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

Personnel of *Texas Native Seeds* and the E. "Kika" de la Garza Plant Materials Center are working to develop commercial seed supplies of pollinator plants for use in native plant restoration efforts. We are obtaining South Texas collections of sensitive briar, blue mistflower, and cowpen daisy for evaluation. Also, we are evaluating potential seed releases of partridge pea, gayfeather, and Engelmann daisy.

We made considerable progress in increasing the seed of 3 important South Texas pollinator plants during 2016 and 2017. Frostweed, tropical sage, and Indian blanket increases of 1 pound, 5 pounds, and 10 pounds of seed were grown, respectively. New seed increase fields have been established in West Texas where 50 plants each of mistflower and Tahoka daisy were planted in 2017.

Other efforts we are undertaking include providing aid to commercial seed dealers in the production of

There is increasing interest in using plants in native plant restorations that will benefit monarch butterflies.

4 species of pollinator plants with the goal to make them commercially available for use in South Texas during 2017. Those plants selected are purple prairie clover, velvet bundleflower, Indian blanket, and Illinois bundleflower.

We provided assistance and foundation seed for increased production of Rio Grande clammyweed, prairie acacia, orange zexmenia, prostate bundleflower, and awnless bush sunflower. These plants were only available in limited commercial quantities. Through our efforts, we hope to facilitate commercial availability of at least 10 ecotypic native pollinator species in quantities needed for large-scale use by 2018.

Cooperative funding provided by the numerous donors to South Texas Natives, Texas Department of Transportation, and the U.S. Fish and Wildlife Service.

© Forrest Smith

An Eagle Ford oil pad site in South Texas that was restored to native grasses by *South Texas Natives* personnel.

Update on Programmatic Activities of the *South Texas Natives* Project

Forrest S. Smith, Anthony D. Falk, Keith A. Pawelek, Roberto Obregon, Liisa L. Hewitt, John Lloyd-Reilley, and Shelly D. Maher

The *South Texas Native*s (STN) project of the CKWRI remains a standard-bearer and a model program for enabling native plant restoration at meaningful ecological scales. Since 2001, the project has helped commercialize over 30 native plant restoration seed sources. In 2017, commercial provision and sale surpassed 40,000 pounds of seed for the 7th year running. Native plant seed markets, and the benefits provided by them, continue to show steady growth.

Several additional native plant seed sources for South Texas are being advanced, including specific needs for restoration of pipeline and energy rights-of-ways in the South Texas Sand Sheet, an area subjected to particularly intense development in recent years. STN is also focused on commercializing native populations of zizotes milkweed, frostweed, tropical sage, and other nectar plants for use in pollinator habitat restoration in South Texas.

We continue advancing efforts to commercialize desirable, but difficult-to-produce native grasses including big bluestem, seacoast bluestem, switchgrass, yellow Indiangrass, and big cenchrus. STN currently maintains breeder seed fields of over 50 native seed selections. These are needed to sustain foundation seed supply for commercial entities. In addition, STN maintains an intense focus on educating constituents in support of our mission in promoting restoration using native plants, conducting research to improve restoration methodologies, and demonstrating successful restoration efforts.

From 2016–2017, STN personnel assisted with cooperative restoration demonstrations that encompassed over 500 acres in South Texas. The STN project remains an important catalyst for habitat restoration and conservation in South Texas.

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

Season of Burning and Ungulate Use of Gulf Cordgrass

Victoria L. Haynes, Jose S. Avila-Sanchez, Sandra Rideout-Hanzak, J. Alfonso Ortega-Santos, David B. Wester, Timothy E. Fulbright, Humberto L. Perotto-Baldivieso, Tyler A. Campbell, Alfonso Ortega-Sanchez, Jr.

Gulf cordgrass is a native grass that occurs along the Texas Gulf Coast. While established gulf cordgrass provides adequate cover for wildlife, mature foliage is often undesirable for herbivore forage as its coarse characteristics have low nutritional value when not subjected to periodic defoliation.

In our study, prescribed fire has been applied in winter and summer to determine the optimal season for burning gulf cordgrass to improve nutritional value and use by large ungulates. Ten patches (roughly 500 acres each) were arranged to be burned each season for a 2-year period. Burning began February 2016

on the East Foundation's El Sauz property in Willacy County, Texas, and our last summer burns were conducted in 2017.

We collected forage samples on a weekly basis for 90 days following each prescribed burn to evaluate nutritional improvements to gulf cordgrass. We have also been tracking movements of 30 adult cows using GPS collars, along with conducting observational counts by vehicle of large ungulates (cattle, white-tailed deer, and nilgai).

Regardless of season, gulf cordgrass protein values reached 14%, 13%, and 10% at 30, 60, and 90 days following each burn. Data from our GPS collars and observational counts have revealed higher animal use in all burned areas during the 90 days following fire than before the burns occurred. Our research will provide information about the optimal time to burn gulf cordgrass and the cattle stocking rates needed to maintain gulf cordgrass at its highest quality.

Cooperative funding provided by the East Foundation, Texas Cattle Raisers Association, Southwestern Cattle Raisers Association, and Houston Safari Club.

Oso Bay Wetlands Preserve Coastal Prairie Restoration Project

Keith A. Pawelek, Forrest S. Smith, Anthony D. Falk, Sara Jose, and Russel Armstrong

Personnel of *South Texas Natives* and Oso Bay Wetlands Preserve are involved with restoring a native prairie near Oso Bay in Corpus Christi, Texas. Our goal is to restore coastal prairie grasslands presently dominated by non-native grasses. The sites will also serve as a valuable educational tool that can be used to raise public awareness about native plants, prairie ecosystems, and prairie restoration in the Coastal Bend region of Texas.

© Anthony Falk

***South Texas Natives* personnel are working to restore coastal prairie at the Oso Bay Wetlands Preserve.**

As the first step in this multi-year restoration process, coastal sites are being sprayed with herbicides to control non-native grasses, primarily guineagrass and Old World bluestems. A diverse native seed mix that includes over 50 native plant species will be sown on the coastal sites.

South Texas Natives personnel will monitor and collect data on performance of the plantings for 3 years after seeding. From the data collected, we will be able to make management recommendations and make educational presentations about restoring native coastal grasslands.

This project will allow us to learn more about native seed source adaptation in restoring similar wetland habitats along the Texas Gulf Coast. In addition, we will be able to provide recommendations to landowners and agencies desiring to restore similar sites in the region.

Cooperative funding provided by the Oso Bay Wetlands Preserve and Citgo.

Release of a Locally Adapted Native Seed Source of Silver Bluestem for West Texas

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

Silver bluestem, a mid-successional grass, is one of the most broadly distributed grasses in Texas, occurring in 76% of Texas counties. It is a robust perennial adapted to well drained clay, clay loam, loam, and rocky soils. Silver bluestem reseeds readily after drought or disturbance, and it can be competitive with some exotic grass species. In addition, it provides good wildlife cover and site stabilization. Silver bluestem can be an essential part of a restoration seed mix for West Texas.

A planned release of silver bluestem for West Texas is nearing formal release and commercial availability. Three accessions of silver bluestem were selected for release from an initial evaluation of 50 accessions that began in 2013. Advanced evaluation plantings of 9 high performing accessions were installed in 2015 at both the Sierra la Rana Plant Evaluation and Research

© Colin Shackelford

Silver bluestem is being grown in seed increase fields for use in West Texas for wildlife cover and soil stabilization.

Facility in Alpine and the Railway Ranch Plant Evaluation and Research Facility near Odessa. Three accessions from Kinney, Reeves, and Brewster counties with consistent plant growth and seed production characteristics were then selected for release. Seed increase plantings of these 3 accessions were installed in Alpine during 2016.

Plants grown from seed harvested from the initial seed increase plantings in Alpine were then transplanted into fields at Douglass W. King Seed Company in San Antonio. Seed harvested from these fields will act as breeder seed to be planted into large commercial scale plantings. Commercial availability of silver bluestem is expected in 2018.

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

TxDOT Native Plant Integration Program for South, Central, and West Texas

Forrest S. Smith, Dennis K. Markwardt, Anthony D. Falk, Keith A. Pawelek, Colin S. Shackelford, John R. Bow, Jameson S. Crumpler, Roberto Obregon, Liisa L. Hewitt, John Lloyd-Reilley, Shelly D. Maher, Brandon Carr, James P. Muir, Jeff R. Breeden, Chase A. Murphy, and Louis A. Harveson

The Texas Department of Transportation (TxDOT) is one of the most influential native seed consumers in Texas. Specifications for the department's Item 164-Seeding for Erosion Control guide on Texas roadsides influence thousands of acres of the state each year. In addition, these specifications are followed by many other agencies, individuals, and industries in revegetation work.

The specifications for native species planting are particularly important to those that are subject to oversight by the Texas Commission on Environmental Quality or the U.S. Environmental Protection Agency for adherence to revegetation standards of the Federal Clean Water Act. Historically, lack of commercial native seed supplies and poor performance of native seeds prohibited TxDOT from specifying the use of native plants for many revegetation activities conducted throughout Texas.

In 2011, we began work supported by TxDOT to increase the commercial availability of reliable native seed sources for South, Central, and West Texas. We also began evaluating available native seed selections for performance, comparing them to non-native grasses specified for use by TxDOT.

Our studies have documented the establishment ability of some native seed selections in meeting the revegetation requirements of the Clean Water Act. Based on these findings, we began working with commercial seed producers to increase the supply of seed and seed sources to meet the expected demand. We worked in each geographic region to collect, increase, and commercialize native plant species for this need based on identified limitations.

In 2014, as a result of our efforts, TxDOT published the new Item 164-Seeding for Erosion Control guide for rural areas of management districts in South, Central, and West Texas that includes only native plants. Our ongoing work will lead to the expansion of seed specifications for the use of native plants in additional TxDOT districts.

Cooperative funding provided by the Texas Department of Transportation.

Expansion of the *Texas Native Seeds* Program to a Statewide Effort

Forrest S. Smith, Keith A. Pawelek, Anthony D. Falk, David G. Hewitt, and Fred C. Bryant

Texas Native Seeds (TNS) personnel are working to expand the scope and impact of our native seed source development and restoration mission to encompass the entire state. In 2018, we hope to begin administering a network of 6 regional initiatives across Texas.

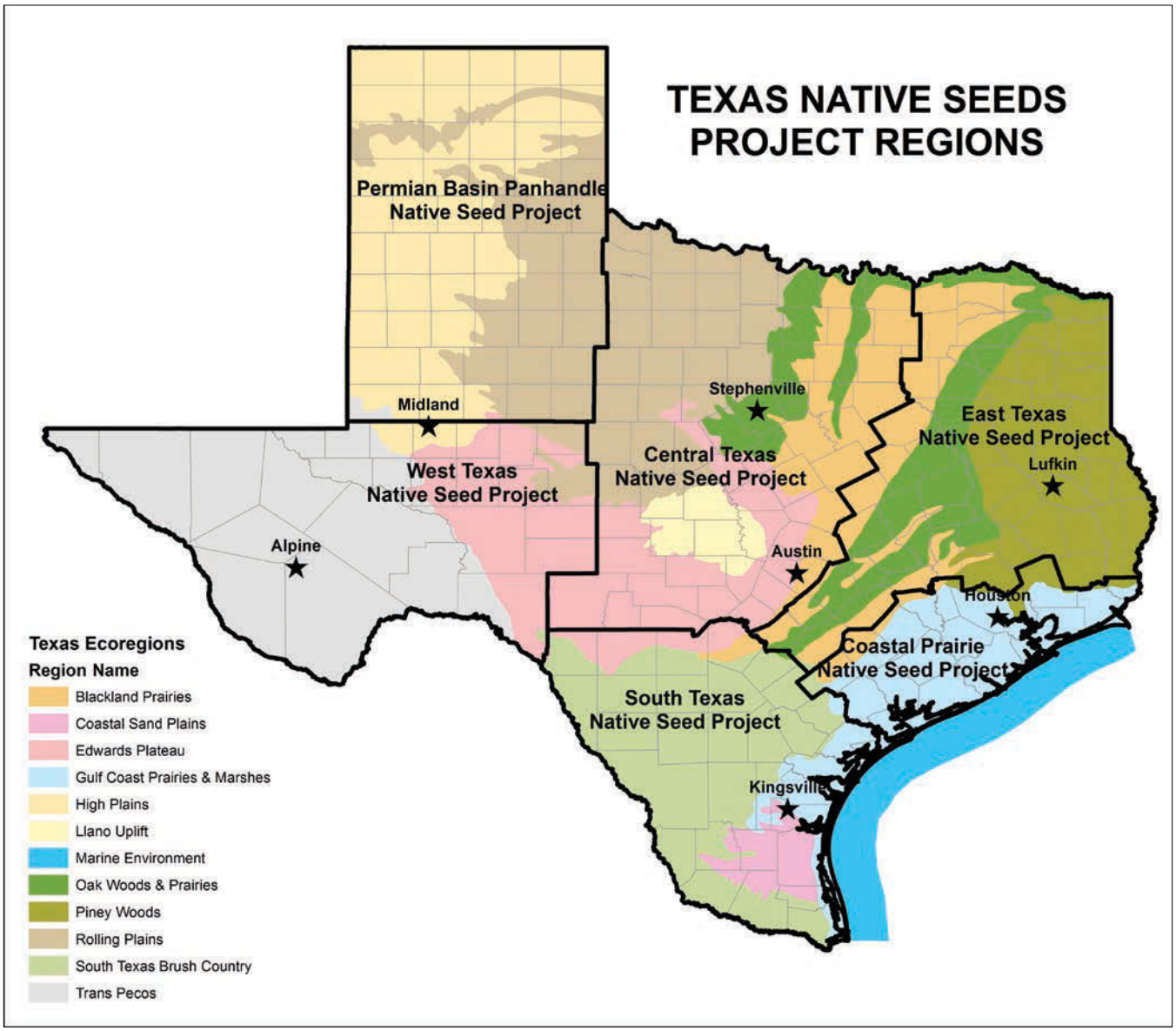
In addition to our long-running *South Texas Natives* project that began in 2001 and our Central and West Texas projects in operation since 2011, we are excited to take on projects in East Texas, the Coastal Prairies of Texas, and the Permian Basin.

As part of this effort, we are engaging donors, constituents, and private landowners throughout the state. Through work with private landowners, the commercial seed industry, state and federal agencies, and non-government organizations, our over-arching goal is to become the primary entity in the state advancing native plant and habitat restoration.

In much of Texas, seed sources of native plants remain insufficient for successful achievement of restoration goals. Such deficiencies in available plant materials are clear in agency revegetation projects, energy-related reclamation efforts, and the restoration of grassland habitats on former croplands or non-native pastures. By operating in a statewide context, TNS will be better positioned to attract support needed to underpin each of the 6 regional projects and to more effectively educate and advocate for native plant restoration efforts in Texas.

Additional work is needed to enable effective and economic restoration of native habitats within Texas. TNS is at the forefront of such efforts to conserve the wildlife and the unique ecosystems of the state.

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



Proposed regional structure of a statewide *Texas Native Seeds* program (map was constructed by the CKWRI Wildlife Technologies Laboratory).

Introducing the *Coastal Prairie Native Seeds* Project

Forrest S. Smith, Keith A. Pawelek, Jim Willis, Gary Stephens, Aaron Tjelmeland, and Sonia Najera

The Texas coastal prairie is one of the most imperiled ecosystems in Texas and the nation. Over 95% of the coastal prairie has been lost from farming, urbanization, and non-native grass invasion.

Recent land use changes and the influence of native plant communities to provide for recreational uses have resulted in renewed interest in restoration of native grasslands in this region. However, commercial supplies of adapted native seeds needed to successfully restore coastal prairie vegetation are severely lacking. Based on the model used successfully by *South Texas Natives*, *Texas Native Seeds* began working with several cooperators in 2017 to initiate a regional *Coastal Prairie Native Seeds* project.

Beginning in autumn 2017, we started to collect seed of important plant species from remnant prairies in the region. These collections, and those obtained in previous coastal prairie native seed-development efforts, will be planted for evaluation at The Nature Conservancy's Texas City Preserve and at the Wildlife Habitat Federation headquarters near Cat Spring beginning in spring 2018.

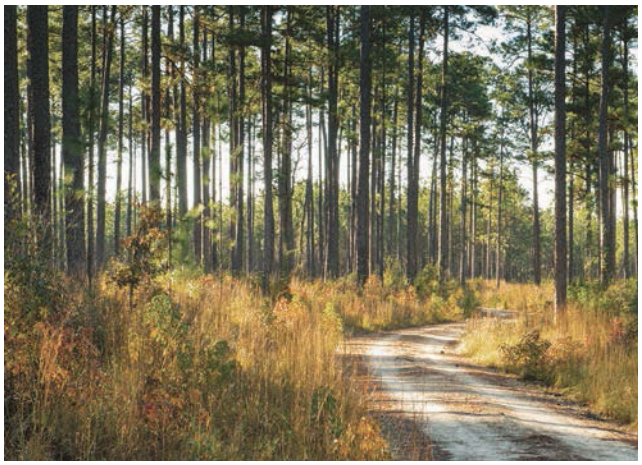
To meet restoration objectives for the Texas coastal prairie region, we will work to select suitable native populations of important species that are conducive to large-scale commercial seed production. With high quality, and consistently available native seed sources, we believe widespread restoration efforts and considerable restoration success will be possible in the coastal prairie.

Cooperative funding provided by Don Stephenson and Cynthia Pickett-Stephenson, USDA Natural Resources Conservation Service, Wildlife Habitat Federation, and The Nature Conservancy.

Introducing the *East Texas Natives* Project of the *Texas Native Seeds* Program

Forrest S. Smith, Robert Sanders, Alan Shadow, Fred C. Bryant, and David G. Hewitt

Commercial supplies of ecotypic native seed for use in East Texas restoration projects are not currently available to consumers. We have begun working with private landowners, interested partners, and funding agencies to develop *East Texas Natives* (ETN) as part of the *Texas Native Seeds* program. Efforts in East Texas will center on collection, evaluation, increase, and commercialization of important native plant species for grassland, prairie, and forest understory restoration. Ecoregions within the scope of the project will include the Pineywoods, Blackland Prairies, and Oak Woods and Prairies. Native plant species for use in restoration of herbaceous understory plant communities in longleaf and shortleaf pine ecosystems will be one priority of the ETN.



***East Texas Natives* will work to commercialize native seed sources for restoration in East Texas.**

Large-scale restoration needs, such as seed sources of native plants suitable for pipeline and highway right-of-way revegetation, will be another focal area. Other needs in East Texas include ecotypic seed sources and methods for converting bermudagrass and other non-native pastures to native prairies. Important cooperators in the ETN project include private landowners, USDA NRCS East Texas Plant Materials Center, Boggy Slough Conservation Area, and several non-government conservation organizations.

In May 2017, a meeting was held to plan for and scope the project. We will also convene a project technical committee meeting to select plant species needed for collection and evaluation. By January 2018, we hope to begin field operations of *East Texas Natives* and employ a regional project coordinator stationed in the region.

Cooperative funding provided by Ellen Temple and the National Christian Foundation-Joan and Rufus Duncan Memorial Fund.

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

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

Seven species of plants (blue grama, Hall's panicum, sand dropseed, sideoats grama, Gregg's mistflower, skeletonleaf goldeneye, and Tahoka daisy) to be released for use in West Texas were planted in seed increase plots in June 2017 at Alpine. The grass species silver bluestem and whiplash pappusgrass are in the second year of seed increase in Alpine and are moving to commercial scale production. Twenty-four accessions of ecotypic West Texas-origin plants are now being grown for eventual commercial release.

Two new evaluation plantings were installed at both the Sierra la Rana Plant Evaluation and Research Facility in Alpine and the Railway Ranch Plant Evaluation and Research Facility near Odessa. Twenty accessions of cowpen daisy and 39 accessions of hooded windmill grass were planted in June 2017. Cowpen daisy is an excellent forb for both pollinators and wildlife. Hooded windmill grass is well adapted for restoration projects in sandy soils. Data will be collected from these research plantings for 2 years before proceeding to seed increase fields. Eventually, the plant materials will be available for commercial release. Nineteen plant material evaluations have now been completed for West Texas.

Plant material collections for West Texas are ongoing to support future plant evaluations for the region. Thus far, over 1,100 collections have been made across the 37-county project area. Seed collections for Arizona cottontop, hairy grama, rayless gaillardia, and copper globemallow are expected to be completed in 2017. Evaluations of these plant collections are planned for 2018.

© Colin Shackelford

Seeds from whiplash pappusgrass are being harvested for assessment of productivity and use in West Texas.

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

Update on the *Central Texas Native Seeds* Project

John R. Bow, Forrest S. Smith, Keith A. Pawelek, Anthony D. Falk, Colin S. Shackelford, James P. Muir, Chase A. Murphy, and Jeff R. Breeden

The goal of *Texas Native Seeds* is to develop locally adapted native seed sources for Texas. This is accomplished through collecting, evaluating, selecting, increasing, and commercializing native plant populations from specific regions. Our Central Texas project is working to improve commercial native seed supplies for a 67-county region encompassing several ecoregions. Evaluations are conducted at the Texas A&M AgriLife Research and Extension Station in Stephenville and the USDA NRCS James E. "Bud" Smith Plant Materials Center in Knox City.

Important plant evaluations were established at both locations in 2016 and consisted of 3 common native grass species: meadow dropseed, silver bluestem, and little bluestem. Data collection includes growth measurements, plant characteristic rankings, seed potential, and seed quality. New collections in 2016 were focused on tall grama and hairy grama. In June 2017, new evaluation plots were transplanted from plantings in the greenhouse that consisted of 33 populations of tall grama and 36 populations of hairy grama collected from Central Texas.

Past evaluations resulted in 3 grass species and 2 legume species selections made up of several regional populations from each species: 4 rough tridens, 4 hooded windmillgrasses, 4 sand dropseed, 1 Illinois bundleflower, and 2 golden daleas. Transplants were established in isolated fields in Stephenville to increase seed. Seed harvested from these plantings will be released as a Selected Native Plant Germplasm and will result in commercially available seed sources for reclamation and restoration in Central Texas.

Cooperative funding provided by the Texas Department of Transportation, Lee and Ramona Bass Foundation, and Dr. Paul and Toni Burns.

Introducing the *Permian Basin Native Seeds* Project

Forrest S. Smith, Jesse Woods, Colin S. Shackelford, and Fred C. Bryant

The Permian Basin region of West Texas is host to some of the most intensive oil and gas exploration and production in the world. These activities had, and continue to have, a profound impact on the rangelands in this region. In recent years, greater interest in restoration by landowners and natural resource managers, regulatory concern over some wildlife species, and ecologically sustainable energy development have created demand for more effective restoration techniques and commercial supplies of regionally-adapted native seeds.

We have partnered with Concho Resources, a Midland-based oil and gas company, in a focused effort to better engage the energy industry in restoration of native habitats and to commercialize native seeds for use this region. With Concho's support, we will establish a regional project leader in Midland to spearhead this effort.

In addition to native seed source development, this initiative will work directly with oil and gas interests to engage, educate, and enable more native habitat restoration activities in areas subjected to intense development. For 2018, several industry supported demonstration projects are planned, and we will begin working with energy producers to determine their restoration needs.

Through our efforts, we hope to ensure that native habitats can be successfully restored as part of sustainable energy exploration in the Permian Basin region of West Texas, and that past impacts can be mitigated to provide better habitat for wildlife. Our work should have important implications for creating commercially attractive native seed markets to serve this region of the state.

© Colin Shackelford

Restoration needs in West Texas are rapidly growing because of increased energy production and transfer.

Cooperative funding provided by Concho Resources, Inc.

Estimation of Rangeland Biomass using Unmanned Aerial Systems

Karelys N. Labrador-Rodriguez, Humberto L. Perotto-Baldivieso, J. Alfonso Ortega-Santos, Chase H. Walther, Jinha Jung, Anjin Chang, and Junho Yeom

The application of unmanned aerial systems (UAS) in the management and monitoring of rangelands has been increasing in recent years. This is the result of new low altitude platforms, the reduction in the size of sensors for UAS, the development of high spatial resolution imagery, and the flexibility to fly UAS in remote environments. The application of UAS could be used to estimate the biomass of vegetation including invasive plants.

Tanglehead is a perennial grass found on rangelands in Texas. Although tanglehead is considered a native species, its behavior has been more representative of an invasive species. Tanglehead's growing abundance is a cause for concern by many landowners in the South Texas region.

The goal of our research is to test the feasibility of the UAS-based approach to estimate aboveground biomass. Our specific objectives are to (1) evaluate the feasibility of quantifying biomass in rangelands with very high-resolution imagery and (2) compare aboveground biomass development before and after prescribed fires in rangelands.

To accomplish these objectives, we acquired images by flying the UAS vehicle over an area invaded with tanglehead in Jim Hogg County, Texas. The images were acquired 15 days prior to prescribed burning and then 1 week after. Data obtained from the UAS vehicle are being used to produce 3D models to estimate tanglehead aboveground biomass. Our findings will provide landowners with useful information to monitor and manage tanglehead.

Cooperative funding provided by USDA/NIFA HSI Award No. 2016-38422-25543, Jones Ranch, and the Rotary Club of Corpus Christi (Harvey Weil Sportsman Conservationist Award Trust).

Restoration and Stock-Piled Topsoils in South Texas

David B. Wester, Forrest S. Smith, Sandra Rideout-Hanzak, and Veronica Acosta-Martinez

Topsoils are often removed from energy production sites and pipeline rights-of-ways throughout southern and western Texas. These soils are stored in large stock-piles for use in later restoration activities.

A fundamental assumption is that restoration success is enhanced by placing the stock-piled topsoil on disturbed areas after energy production activity ceases. However, short-term and long-term efficacy of this practice has not been tested, and the effects are unknown. The impacts of these practices have critical implications for restoration of native wildlife habitat in the South Texas region following oil and gas exploration and production activities.

In 2012, a frac pond was constructed on San Ysidro Ranch located in Dimmit County, Texas. This provided the opportunity to study a stock pile. Between 2012 and 2015, we examined seed bank characteristics and soil microbiological processes of this stock pile. On-going restoration efforts on the ranch now provide an unprecedented opportunity to study restoration success as affected by type of surface to be restored (3 different layers of the 4-year-old stock pile, a freshly-constructed stock pile, and an unamended soil surface).

We have collected soil samples for seed bank assessment and to characterize microbiological communities of the soil. In addition, we have established study plots on these surfaces that have been seeded with locally-adapted native grasses. Results from this project will enable us to develop guidelines that will enhance successful outcomes associated with restoration of energy-impacted sites.

Cooperative funding provided by Mr. and Mrs. Alston and Holly Beinhorn.

Comparison of Seasonal Burning Effects on Gulf Cordgrass Communities

Jose S. Avila-Sanchez, Victoria L. Haynes, Sandra Rideout-Hanzak, David B. Wester, J. Alfonso Ortega-Santos, Tyler A. Campbell, and Alfonso Ortega-Sanchez, Jr.

Gulf cordgrass is a highly productive, warm season perennial bunchgrass. Mature leaves and stems are very coarse, low in palatability, and low in nutritive value for livestock. Removing mature growth allows greater production of tender shoots and highly palatable regrowth stands. Better gulf cordgrass stands can result from prescribed burning or mechanical shredding. However, burning is more economical for the landowner than shredding.

We are evaluating if summer or winter is best for burning gulf cordgrass to help meet grazing management goals.

Prescribed fire is widely used as a method of habitat management in coastal grassland ecosystems. The most recognizable management goals when using prescribed fire are (1) improving forage quality, palatability, and accessibility; (2) improving grazing distribution; (3) reducing hazardous fuels; (4) increasing forage production; and (5) suppressing woody plants. The timing (season and frequency) of prescribed fire affects the outcome.

Our objective is to compare the effects of summer and winter prescribed burns on gulf cordgrass communities. Our project is being conducted on the East Foundation's El Sauz Ranch in Willacy County, Texas. Ten plots have been randomly assigned 1 of 3 treatments: (1) winter burn, (2) summer burn, and (3) control (no burn).

We have been documenting fire intensity with data loggers, plant species composition (species diversity, density, recruitment, and mortality), forage and forb production, foliar cover, visual obstruction, root morphology, and carbohydrate reserves.

Our project will allow us to determine proper season of burning for optimal management of gulf cordgrass. This information will be useful to natural resource managers in increasing wildlife habitat and livestock forage.

Cooperative funding provided by the East Foundation.

The Effects of Thrips on Native Grass Seed Quality

Tyler C. Wayland, Anthony D. Falk, Keith A. Pawelek, Forrest S. Smith, and Dean N. Williams

A critical step in the *South Texas Natives* project involves producing native seeds from seed increase plots established at the Tio and Janell Kleberg Wildlife Research Park in Kingsville. This seed is distributed to and used by commercial seed growers to establish large-scale production and provide affordable native seed mixes to the public.

To be as efficient as possible, high quality seed production is essential. Seed quality of 3 important native prairie grasses (little bluestem, big bluestem, and yellow Indiangrass) has been very poor when these species are grown in South Texas. Poor seed production in these species in other regions of the United States is a result of infestations by thrips. Thrips are insects that feed on seeds, thereby severely diminishing seed yields and seed quality.

In this study, we will evaluate the possible presence and effect of thrips on our seed increase plots. We will apply 2 insecticides (Carbaryl and Malathion), as needed, during seed production using a backpack sprayer. Half of each plot of each plant species will have the insecticides applied while the other half will remain untreated. Seed will be harvested by hand and collected by species and treatment. Harvested seed will be dried, weighed, and then compared using both germination and tetrazolium testing.

The results from our insecticide evaluations will provide useful information on controlling thrips. Being able to combat thrips will benefit seed growing projects focused on little bluestem, big bluestem, and yellow Indiangrass.

© Forrest Smith

We are evaluating the effects of thrips on seed production of big bluestem in South Texas.

Cooperative funding provided by the numerous donors to South Texas Natives and the Douglass W. King Seed Company.

Restoration of Monarch Butterfly Habitat at Longoria Wildlife Management Area

Forrest S. Smith, Keith A. Pawelek, Anthony D. Falk, Jimmy Stout, and Anna Strong

Restoration of native habitats including nectar plants and milkweeds is widely recommended for benefitting monarch butterflies. The Rio Grande Valley of South Texas plays an important role in the migration of monarchs, but much of the historical grassland habitat of the region has been lost to agriculture and urbanization. We are working to demonstrate large-scale restoration of native grasslands with a focus of providing habitat for monarchs at the Texas Parks and Wildlife Department's Longoria Wildlife Management Area in Cameron County.

In 2016, we began restoration treatments on a 65-acre tract of former cropland invaded by nonnative grasses, agricultural weeds, and invasive woody plants. Restoration treatments have included disking to remove existing plants and several herbicide applications to address infestations of Johnsongrass, Old World bluestems, bermudagrass, old man's beard, lead tree, and willow baccharis.

For the past year, we have also worked to produce seed of plants that were historically present on the wildlife management area and are needed for feeding by adult and larval stages of monarch butterflies. These include frostweed, tropical salvia, American basketflower, zizotes milkweed, and slim milkweed. In late summer 2017, we planted a diverse native seed mix comprised of grasses, forbs, legumes, wildflowers, and subshrubs in an attempt to provide sustainable habitat for monarchs and other wildlife.

Use of the site by migrating monarchs will be monitored in future years. The site will also be used in educational programs to stimulate greater interest in restoring native plant communities in the Lower Rio Grande Valley of Texas.

Cooperative funding provided by the Texas Parks and Wildlife Foundation and National Fish and Wildlife Foundation.

Texas Native Seeds—Genomic Analysis of Native Germplasm

John R. Bow, Forrest S. Smith, Keith A. Pawelek, Anthony D. Falk, James P. Muir, and Jeff A. Brady

Texas Native Seeds personnel collect and evaluate native plant material for the purpose of releasing seeds that are adapted to specific ecoregions. In our research, we evaluate locally collected populations with commercially available material in field trials. Significant variations in plant characteristics and adaptability are clear during the evaluation portion of the field research. One of our objectives is to understand the genetic relationships between native populations and commercial material already available of little bluestem, silver bluestem, and blue grama by examining DNA sequence differences in these species' genomes.

Plant tissue samples will be collected and processed at the Texas A&M AgriLife Research Center in Stephenville. The DNA samples will be sent to Texas A&M Genomics and Bioinformatics Services in College Station for genomic analysis. DNA sequences will then be analyzed to identify DNA markers associated with regional variability.

We have a wide geographical representation of these species in our test plots. We are looking to discover both regional DNA markers and trait-based DNA markers that correspond to our results from field evaluations. This information will give us a better understanding of the geographic range in which specific populations are best adapted. We also expect that the DNA results will help us confirm and reinforce our evaluation data, and will provide a substantive genomic fingerprint of plant materials that we will be releasing for commercial production.

Cooperative funding provided by donors to the Texas Native Seeds Program.

Commercial Seed Production of Native Seed Releases

Keith A. Pawelek, Forrest S. Smith, Anthony D. Falk, Dean N. Williams, and Nick Bamert

Commercial seed producers in Texas reported steady sales for the 2016–2017 seed production period. In the past year, we reached a milestone of 30 commercially released species from *South Texas Natives* and the USDA NRCS E. "Kika" de la Garza Plant Materials Center that are being grown commercially. Also, 2016 was the first year that commercial growers reported greater interest in native pollinator plant seeds for use in habitat restoration efforts.

A large scale field of zizotes milkweed has been established by Douglass W. King Seed Company.

Overall demand for regionally-adapted native seeds is strong and increasing. Over 43,000 pounds of our native germplasm seed releases were produced. Most of the seed was sold within the year for use in various restoration projects.

Spring of 2017 marked several additional milestones in commercial seed production of our releases. As of July, the first releases from *Texas Natives Seeds* were commercially produced. Consequently, seed from Guadulape Germplasm white tridens and Menard blend threeawn will be available by the spring of 2018. In addition, an experimental production block of zizotes milkweed was started to provide seed of this desired species in pollinator and monarch butterfly habitat restoration plantings.

We continue to urge consumers of native plant seeds to provide seed producers and dealers with ample notice for large seed orders. We anticipate continued demand for native seeds as a result of specification changes by governmental agencies, large scale needs associated with energy reclamation projects, and increased interest by private landowners and natural resource managers in habitat restoration activities.

Cooperative funding provided by the Douglass W. King Seed Company, Bamert Seed Company, and numerous donors to South Texas Natives.

Forecasting Habitat Availability of Sandhill Cranes Along the Texas Gulf Coast

Emily D. Wells, Bart M. Ballard, Shaun L. Oldenburger, Daniel P. Collins, and Humberto L. Perotto-Baldivieso

Sandhill cranes use an array of habitats such as agricultural fields, wetlands, and grasslands to meet their daily needs. Changes to these habitats have consequences for the populations depending on them.

Wintering grounds of sandhill cranes along the Texas coast continue to experience high rates of landscape-level changes as human development expands and agricultural practices change. This likely results in large changes to usable habitat for sandhill cranes. As the human population is expected to continue to rise in already growing metropolitan areas along the Texas coast, it becomes more important to incorporate predictions of future habitat availability into contemporary conservation and management strategies.

Our goal is to use current trends in land use change and a recent sandhill crane habitat selection dataset to forecast habitat availability and suitability throughout the Texas coast. The habitat selection dataset we are using includes several thousand locations of sandhill cranes that were monitored with satellite transmitters.

We will use publicly available spatial datasets from 2001, 2006, 2011, and 2016 to predict habitat availability for 2030 and 2050. Our spatial models will be tested for accuracy by comparing predicted 2016 land cover with the actual 2016 land cover.

Our results will identify areas along the Texas coast that are most likely to change in suitability for sandhill cranes. Information obtained can aid land managers in applying habitat conservation efforts in areas that will benefit future sandhill crane populations.

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

Developing Methodologies for Surveying Wild Turkeys in North Texas

Darrion M. Crowley, William P. Kuvlesky, Jr., Humberto L. Perotto-Baldivieso, J. Alfonso Ortega-Santos, and Leonard A. Brennan

The Rio Grande wild turkey and the eastern wild turkey are subspecies found in northern Texas. Recent breeding bird surveys indicate that turkey populations in Texas are at a standstill if not a steady decline. As a consequence to their growing popularity by hunters, wild turkeys need to be surveyed to detect population trends. Such trend information will be useful to biologists in making informed hunting regulation and management decisions.

Being able to use a survey methodology that accurately provides wild turkey population densities is a key factor in the management of turkeys. Our objectives are to (1) determine the precision of wild turkey survey protocols in estimating density while proposing an efficient protocol for estimating turkey abundance and (2) develop habitat suitability models that will enable Texas Military Department staff to determine which habitats are optimal for harboring turkeys. We will be able to integrate those models with a survey protocol that provides the most precise estimate of wild turkey abundance.

The methods being tested are road surveys, point count surveys, and roost count surveys. Study sites will be visited multiple times a year in which all survey methods being tested will be conducted. The number of wild turkeys observed using each of the 3 survey methods will be recorded. Statistical analysis of the data will be performed to identify differences among the methods.

Data collection will take place in 2018 and 2019 between the months of January and March. This project will provide information for optimizing field protocols based on habitat suitability and reduce time and cost of field surveys across large areas.

Cooperative funding provided by the Texas Military Department.

Autumn Migration Ecology of Greater White-fronted Geese

Jay A. VonBank, Bart M. Ballard, Kevin J. Kraai, and Daniel P. Collins

The greater white-fronted goose breeds in tundra and open boreal habitats located across northern Canada and Alaska. This species migrates during autumn to the southern United States and Mexico. Unfortunately, information is limited regarding their migration chronology as well as factors influencing the characteristics of migration.

Our objectives are to investigate migration chronology, determine migration routes and important

stopover areas, estimate stopover duration, and examine the effects of disturbance and environmental conditions on the migration characteristics of greater white-fronted geese. We plan to assess whether breeding status (successful or failed) influences the characteristics of migration described above.

To investigate our questions, we are attaching solar powered Global System for Mobile communications (GSM)-Global Positioning Systems (GPS) tracking devices to adult greater white-fronted geese wintering in the lower Texas coast (21), Rolling Plains (16), and South Texas Brushlands (9) regions of Texas. The GSM-GPS tracking devices collect location data on the geese at 30-minute intervals. The devices have a life of up to 2 years.

Based on findings from our first year of study, autumn migration was initiated earliest in white-fronted geese nesting south of the tundra (August 14) and later in those nesting in tundra habitat (August 18–September 8). Greater white-fronted geese terminated their autumn migrations in Texas or Arkansas between October 26 and December 9. The information we obtain from this research will help us understand the factors influencing autumn migration strategies of greater white-fronted geese.

Cooperative funding provided by the Texas Parks and Wildlife Department.

Evaluation of a Red Imported Fire Ant Treatment for Upland Gamebirds

Kelly M. Redmond, Nicole A. Hansen, Andrew P. Nicholson, Taylor R. Shirley, Eric D. Grahmann, Fidel Hernández, Leonard A. Brennan, Timothy Anderson, Michael E. Morrow, Kirk Feuerbacher, and Jay Kelso

Red imported fire ants have been blamed for upland gamebird and native insect declines since their arrival during the 1930s. Recently, a treatment (aerial application of 0.25% s-methoprene and 0.36% hydramethylnon) has been developed that shows promise in reducing fire ants. By reducing red imported fire ants, species harmed by them would be benefitted.

It has been hypothesized that increased abundance of native insects may translate to greater survivorship and densities of northern bobwhites and Attwater's prairie chickens in the Gulf Coastal Prairie. However, this benefit remains unclear. The objective of this research is to determine the effectiveness of this aerially applied insecticide in (1) reducing fire ant numbers and (2) increasing gamebird demographic performance and density.

Our study is located on 3 ranches in Goliad and Refugio counties. Each ranch contains a pasture of approximately 1,000 acres that will be treated with the fire ant insecticide. Paired similarly sized untreated pastures have been established for comparison. Pasture-wide fire ant density and relative abundance estimates will be determined by counting fire ant mounds and by using baited cup traps along random transects. Bobwhite and prairie chicken survival and nest success will be determined using radio telemetry; bobwhite densities will be estimated using distance sampling via helicopter. Gathering data on the effectiveness of using this insecticide will be important for making future management decisions on whether controlling red imported fire ants are worth the effort.

Cooperative funding provided by the Coastal Bend Bays and Estuaries Program, U.S. Fish and Wildlife Service, Steve and John Lindley, D Bar J Ranch, Dunn O'Connor River Ranch, JF Welder Heirs' Vidaurri Ranch, and South Texas Chapter of Quail Coalition.

Winter Habitat Selection by Gulf Coast Sandhill Cranes

Emily D. Wells, Bart M. Ballard, Shaun L. Oldenburger, Daniel P. Collins, David A. Brandt, Aaron T. Pearse, Humberto L. Perotto-Baldivieso, and David W. Wolfson

The Texas coast is an important region for wintering sandhill cranes. Over the last few decades, this region has experienced significant landscape-scale

A flock of sandhill cranes foraging in a pasture during winter along the Texas coast.

changes driven by human development and natural processes, and it is uncertain what effect this has on the sandhill crane population. More information is needed on sandhill crane winter ecology and habitat requirements to better understand how continuing land use change will impact this species throughout their Texas coast wintering grounds.

Our goals include estimating habitat use and selection for foraging and roosting habitats and estimating the degree of fidelity (the probability of returning to the same location) to wintering areas. Fidelity is an indication of habitat stability across years.

To achieve our goals, satellite transmitters were attached to 32 adult sandhill cranes on wintering areas along the Texas coast and to 8 adults on breeding areas in northern Minnesota. Transmitters are programed to record 4 to 6 GPS locations each day with a focus on morning foraging, midday resting, afternoon foraging, and nighttime roosting. These locations will be used in conjunction with habitat data to estimate selection for both foraging and roosting habitats.

Our research will increase our understanding of how sandhill cranes select habitats along the Texas coast during winter. This information is valuable for predicting the distribution of the population across the landscape as land use continues to change throughout the wintering range of sandhill cranes.

Cooperative funding provided by the Texas Parks and Wildlife Department, U.S. Fish and Wildlife Service, and U.S. Geological Survey.

Landscape Characteristics for Wild Turkey Habitat in the Edwards Plateau

Humberto L. Perotto-Baldivieso, Michael T. Page, Jaclyn D. Robles, Darrion M. Crowley, William P. Kuvlesky, Jr., X. Ben Wu, Markus J. Peterson, Nova J. Silvy, and Fred E. Smeins

The Edwards Plateau of Texas consists of woodland and grassland plant communities considered excellent habitat for Rio Grande wild turkeys. However, data collected by the Texas Parks and Wildlife Department show that wild turkeys have steadily declined in portions of Bandera, Kerr, and Real counties compared to other areas of the Edwards Plateau.

Potential factors affecting Rio Grande wild turkey populations include unsuitable woody areas and disturbance, which could lead to decreased availability of foraging resources and/or increased predators and diseases. Open areas, well interspersed with woody

Researchers are examining why populations of wild turkeys are declining in some areas of the Edwards Plateau.

cover and roosting sites are important features. Our objective is to quantify and compare landscape characteristics of sites with stable and declining populations of Rio Grande wild turkeys in the Edwards Plateau during 1995, 2004, and 2014 to better understand why the numbers have decreased over time.

We have analyzed aerial photographs from 1995 and 2014, and we are currently analyzing spatial data from 2004. We will use landscape metrics that describe vegetation spatial structure to evaluate the changes between sites and across time.

Initial results from 1995 indicate that increased woody cover and disturbance are likely factors affecting Rio Grande wild turkey populations in the Edwards Plateau. Our findings will be important for wildlife managers to assess and prioritize the amount of usable space for wild turkeys as well as understanding the landscape factors driving wild turkey numbers in this region of Texas.

Cooperative funding provided by Texas A&M University-Kingsville Council for Undergraduate Research.

Winter Movements and Habitat Selection by Greater White-fronted Geese

Jay A. VonBank, Bart M. Ballard, Kevin J. Kraai, Daniel P. Collins, and Humberto L. Perotto-Baldivieso

Historically, a large portion of the midcontinent population of the greater white-fronted goose wintered in Texas. Recently, however, winter population

surveys have shown changes in the winter distribution and abundance of greater white-fronted geese in Texas. Furthermore, a shift of overall winter distribution to the northeast, into Arkansas and the Mississippi Alluvial Valley, has become apparent.

Changes in land use, climate, and resource availability are likely drivers of the distribution shift. However, the degree to which these drivers affect the change in distribution of greater white-fronted geese is currently unknown.

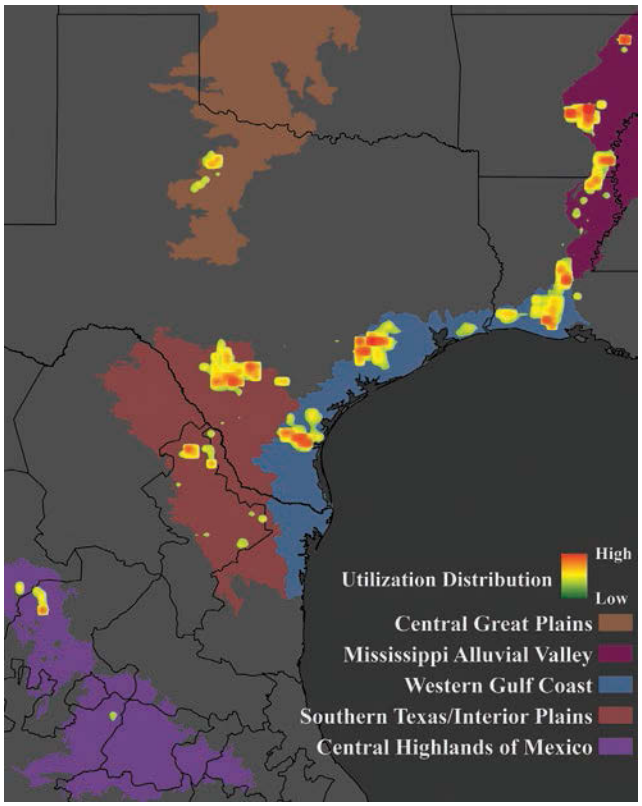
Our research aims to understand several aspects of white-fronted goose winter ecology, including habitat use and selection throughout winter and causes of local and regional movements. We plan to capture 60 adult white-fronted geese during winter and attach Global System for Mobile communications (GSM)-Global Positioning Systems (GPS) tracking devices. Locations are recorded by these devices every 30 minutes, which will allow us to determine how these geese select and use specific habitats throughout the winter.

Presently, we have captured 46 individuals. Preliminary analyses show that greater white-fronted geese, which were captured and marked in Texas, make considerable movements throughout winter. They spend portions of the winter in Texas, Louisiana, Arkansas, Mississippi, as well as Nuevo Leon, Tamaulipas, and Jalisco, Mexico. We are finding that white-fronted geese make long-distance movements during winter, which exposes them to variation in hunting season length and hunting pressure among states and between the United States and Mexico.

Drivers of white-fronted geese movements will be investigated to aid in our understanding of reasons for the overall shift in winter distribution. Our findings about habitat use and selection will provide vital information to landscape conservation managers to ensure that adequate habitat is available for white-fronted geese during winter.

© Jay VonBank

A greater white-fronted goose affixed with a GSM-GPS tracking device, which monitors its movements.



Winter distribution of 37 greater white-fronted geese fitted with GSM-GPS transmitters in Texas, 2016–2017.

Cooperative funding provided by the Texas Parks and Wildlife Department.

Depredation of Wild Turkey Nests by Feral Swine

Heather N. Sanders, Nathan P. Snow, David G. Hewitt, Kurt C. VerCauteren, and Humberto L. Perotto-Baldivieso

Feral swine continue to expand their range in North America, which has severe economic and ecological consequences. Feral swine are known to depredate nests of ground nesting birds, including the wild turkey. However, little is known about whether feral swine have foraging strategies they can use to increase their chances of finding a nest or how depredation influences overall nesting success.

We initiated this study to learn more about feral swine depredation on wild turkey nests. Our objectives are to (1) quantify changes in feral swine habitat

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Feral swine can depredate nests of wild turkeys and other ground nesting birds.

selection in response to seasonal availability of wild turkey nests and (2) quantify the impact of feral swine depredation on wild turkey nests relative to other nest predators within the study area.

We equipped 35 feral swine with GPS collars in the Edwards Plateau region of Texas and monitored them from March–July 2016. We then placed 384 artificial turkey nests containing eggs within the home ranges of collared feral swine and monitored the nests using remote cameras and weekly visits.

Results indicate that feral swine were the primary predator of turkey nests. However, they did not change their foraging behavior during the turkey nesting season to strategically seek out nests.

In 2017, 36 feral swine and 21 wild turkey hens were equipped with GPS collars and monitored from March–July. Nests from marked hens were monitored using remote cameras. Presently, these data are being analyzed to provide additional information on turkey nest predation.

Our research will provide insight into the foraging behavior of feral swine during the wild turkey nesting season and will aid in our understanding of the effect of feral swine on nest success in the Edwards Plateau region of Texas. Our findings can be used to develop better management strategies for this important gamebird.

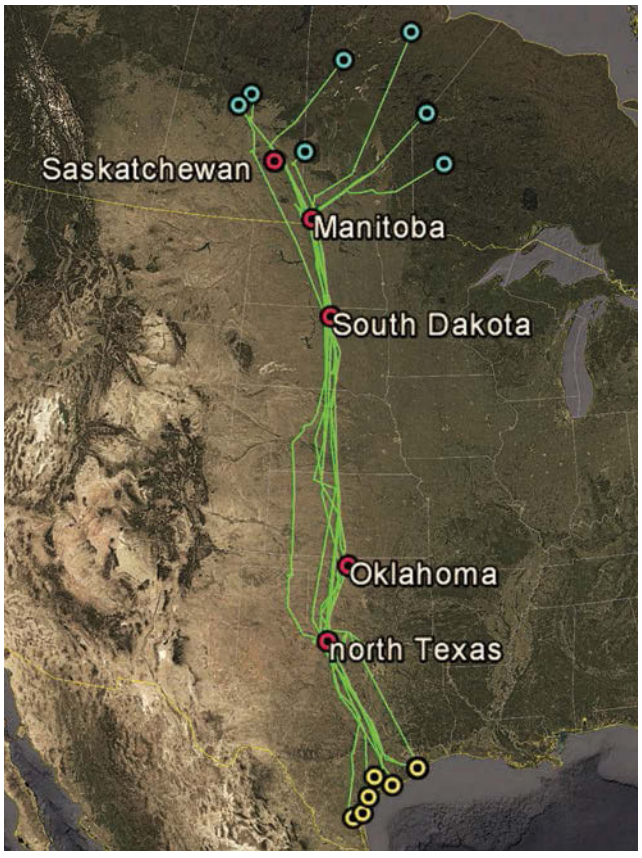
Cooperative funding provided by the USDA Animal and Plant Health Inspection Service National Feral Swine Damage Management Program and USDA Animal and Plant Health Inspection Service Wildlife Services National Wildlife Research Center.

Autumn Migration Ecology of the Mid-Continent Sandhill Crane Population

Emily D. Wells, Bart M. Ballard, Shaun L. Oldenburger, Daniel P. Collins, David A. Brandt, Aaron T. Pearse, and David W. Wolfson

The mid-continent population of sandhill cranes is the most abundant and geographically dispersed population of sandhill cranes in North America. The Gulf Coast subpopulation is the smaller of the 2 subpopulations comprising the mid-continent population. It has been studied to a much lesser extent than the larger western subpopulation despite differences in geographic range, migration chronology, and exposure to hunting. Our goal is to increase our understanding of autumn migration chronology, the use of staging areas, and exposure to hunting for Gulf Coast sandhill cranes throughout autumn and winter.

We attached satellite transmitters to 62 adult sandhill cranes to investigate the initiation of migration, timing and duration of stay at stopover sites, and number of days until arrival on the Gulf Coast wintering areas.



Autumn 2016 migration paths of 9 sandhill cranes from breeding grounds (blue) to Gulf Coast winter grounds (yellow). Important autumn staging areas included areas found in Saskatchewan, Manitoba, South Dakota, Oklahoma, and northern Texas (red).

Additionally, with the aid of geospatial datasets, we will investigate landscape configuration driving use of stopover sites and measure an array of environmental variables prior to and during stopovers to determine those variables that influence migratory movements. We will quantify hunting exposure using hunting season dates and time sandhill cranes spent within active hunting zones during migration.

Findings from this study will fill knowledge gaps in our understanding of sandhill crane autumn migration ecology. In addition, our results can be used to help inform wildlife managers and biologists on the factors influencing exposure to hunting and provide updated information for use by state and federal agencies when developing hunting regulations.

Cooperative funding provided by the Texas Parks and Wildlife Department, U.S. Fish and Wildlife Service, and U.S. Geological Survey.

Wild Turkey Use of Constructed Roosts in South Texas

Brandon S. Mitchell, William P. Kuvlesky, Jr., J. Alfonso Ortega-Santos, Leonard A. Brennan, and Humberto L. Perotto-Baldivieso

Roosting habitat is an essential requirement of Rio Grande wild turkeys. Typically, large trees of live oak and hackberry provide important natural roosting habitat in South Texas. Rio Grande wild turkeys also use structures erected by humans, such as transmission towers, telephone poles, and constructed roosts in areas where natural roosts are limited. Our goal is to determine habitat features, landscape features, and design features of constructed roosts that are important for turkeys in selecting roost sites.

During the summers and winters of 2014–2016, we measured specific attributes of 71 existing used and unused constructed roosts, as well as active natural roosts. Data were analyzed to identify roosting attributes preferred by wild turkeys. We also translocated 247 turkeys (56 males, 191 females) to properties where natural roosts were limited, but had constructed roosts. Evidence of constructed roost site use was obtained through visual inspections of roost sites and landowner reports.

Preliminary results indicate distance to water is important in turkey selection of roost sites. Used roost sites averaged 758 feet (0.15 miles) from water sources while unused roost sites averaged 1,677 feet (0.31 miles) from water sources. Specific habitat features associated with constructed roosts preferred by turkeys were not apparent. Additionally, a time lag of weeks to months seems to be needed for wild turkeys to get comfortable with constructed roosts and start using them. The findings from this project will enable landowners to identify appropriate locations to erect constructed roosts in areas where natural roosts are limited.

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Rio Grande wild turkeys will use artificial structures for roosting in areas where large roosting trees are uncommon.

Cooperative funding provided by Las Huellas Association, Frost National Bank, Energy XXI Lease, El Veleno Ranch, Hoffman H30 Ranch, and Elizita Ranch.

Assessing Habitat Associations of Birds during Migration

Samantha J. Wolfe, Bart M. Ballard, Matthew J. Schnupp, and Sandra Rideout-Hanzak

Recent research has shown that the lower Texas coast has higher passage rates of migratory birds compared to any other area in North America. The lower Texas coast is often the first landing spot for many trans-Gulf migrant birds during spring migration. Thus, it is crucial for resources to be present and in adequate supply.

Many of the challenges birds face during migration such as avoiding predation, obtaining adequate resources, and timing arrival on breeding areas can appropriately be minimized by having an abundance of high quality stopover habitats strategically placed along migration routes. Therefore, we are examining the vegetation characteristics that drive species richness and abundance of migratory birds at stopover habitats along the lower Texas coast. Using distance sampling, we are estimating detection probabilities and densities of birds during migration among 6 major habitats (grassland, shrub-grassland, brush, park, oak motte, and woodland).

Although each species shows affinities for different habitats, our preliminary results indicate that overall species richness and density are greatest in oak motte habitat, with little variation between other habitats. In fact, 6 more species, on average, were found in the oak motte habitat than the other 5 habitat classes.

The findings from our study will provide natural resource managers with a better understanding of the habitat characteristics needed by migratory birds along the lower Texas coast. Information obtained can be used to identify and preserve habitats along the lower Texas coast for migrating birds.

Determining Pronghorn Diet Composition using Metabarcoding Analyses

Gary Mizer, Anthony P. Opatz, Timothy E. Fulbright, Randy W. DeYoung, Humberto L. Perotto-Baldivieso, Warren C. Conway, and Shawn S. Gray

Pronghorns are present in 27 of the 56 counties in the Texas Panhandle Wildlife District. In our study, we are examining movements, home range, and response to the rangeland-agricultural landscape in the region. We are adding a dietary component to the collaborative research project on pronghorn movements and resource selection. Satellite collars deployed on 64 pronghorns in our study areas will allow us to examine dietary components of these pronghorns. Diet analyses can be an important tool to gain a better understanding about food habits, habitat use and requirements, and conservation needs.

We are using DNA metabarcoding from pronghorn fecal samples in 2 study areas: a crop dominated landscape near Dalhart, Texas and an area consisting of mostly native rangeland near Pampa, Texas. Fecal samples from individuals are collected after observed defecations along with GPS location and information on site characteristics.

Fecal samples from our initial collection have been sent to Northern Arizona University to conduct the metabarcoding process. We will analyze the differences between diet and food habits between male and females, both spatially and temporally, to more clearly identify how these animals are using food resources. From these samples, we will be able to identify plant species or genera that frequently appear in pronghorn fecal samples. Information from our study can be used to benefit pronghorn management in the Texas Panhandle region.

Cooperative funding provided by the Texas Parks and Wildlife Department, Dallas Safari Club, and the Rumsey Research and Development Fund at Texas Tech University.

Unveiling How Mint Can be a Repellent to Rodents

Heather J. Hannusch, Travis L. Dillard, and Scott E. Henke

Rodent infestation is considered a major problem worldwide because rodents cause health hazards and damage to households, agricultural crops, and businesses (e.g., transportation industry). Thus, development of rodenticides is a common approach for rodent control; however, most rodenticides are poisonous to other animals.

Plant secondary metabolites (PSM) are used by plants to deter their predators. Such natural extracts have been considered an alternative method to poisons. The aromatic properties of PSM's of the Laminacea family (mint) can be ideal if the extracts produce a learned avoidance behavior by rodents resulting from digestive distress. After such exposure,

rodents would avoid the area if they simply smell the extract. However, this premise must be tested before it can be accepted as feasible. Therefore, our objectives are to determine if mint leaves produce digestive distress in wild rodents, and if so, determine if a learned avoidance is developed, how many digestive events are required to produce a learned behavior, and length of time the learned behavior will last.

We plan to capture wild rodents that are common pest species in southern Texas, singly house them in aquaria, feed them fresh mint leaves, and assess their health after consumption of mint. We will provide rodents with free-choice feeders containing fresh vegetation or mint leaves. We will then determine their daily consumption to each food item to determine if rodents avoid mint after previous exposure and, if so, determine how long the avoidance behavior lasts. Our research will provide evidence about whether mint can be used as a deterrent for rodents.

The Human Dimensions of Conservation Photographers in Wildlife Management

William C. Colson, April A. Torres Conkey, Scott E. Henke, Richard L. Miller, Glenn Perrigo, and La Vonne Fedynich

Conservation photography has developed over recent decades to become a powerful tool for conservation awareness. Photographs of wildlife (often threatened or endangered species) and/or critical habitat allow the general population to see and learn of places that they would otherwise never know about.

Many organizations use conservation photography to inform the public about environmental causes or educate the public about conservation issues. However, while these organizations' efforts often have defined mission statements or goals, conservation photographers' and landowners' contributions to conservation awareness have not fully been defined.

An online survey was developed that asks questions about basic demographic information such as income, education, and ethnicity. Additionally, questions concerning viewpoints on conservation, including participation in conservation outreach, were added to the survey. These questions should offer insight into how photographers and landowners participate in other conservation-related activities such as hunting, fishing, wildlife management and conservation, or habitat restoration. Our online survey was launched February 2017 with emails sent to 129 landowners and photographers who are either current and/or previous participants of the Wildlife in Focus photography contest or are a member of a conservation or wildlife related photography group on Facebook.

Our study should provide an increased understanding of how conservation photographers and landowners influence others to participate in activities related to conservation. Furthermore, conservation photographers and landowners may develop a deeper connection to the natural world around them. This, in turn, might be conveyed to viewers of their photographs.

Use of Ground Juniper in Wildlife and Livestock Feeds

Jessica L. Glasscock, Travis R. Whitney, David G. Hewitt, Fred C. Bryant, and Susan S. Cooper

Millions of acres of North American rangelands are negatively impacted by the encroachment of woody plant species such as juniper. Removal of juniper in heavily infested areas can improve rangelands for use by livestock and wildlife. Research has shown the successful use of ground juniper as a roughage ingredient in sheep diets when compared to other common ingredients such as cottonseed hulls and oat hay. The focus of this study is to assess the effectiveness of ground juniper as a roughage ingredient in Spanish x Boar kid goat diets, white-tailed deer supplemental feeds, and its potential to deter feral pig consumption of supplemental feed.

Our results show that several species of juniper can effectively replace the use of cottonseed hulls in kid goat diets without negative impact to health, blood

© David Hewitt

Although juniper is invasive in some areas, it may be useful as a substitute for cottonseed hulls in supplemental feed.

serum chemistry, or growth performance. In a pen trial, we found feral pig consumption of supplemental pellets containing ground juniper was not significantly different from consumption of commercial hog pellets. Additional research is needed on the formulation of these diets.

Data are currently being analyzed from a field trial conducted at the Welder Wildlife Foundation to determine white-tailed deer and feral pig consumption of supplemental pellets containing ground juniper. Information gained from this research may help reduce livestock production costs, wildlife supplementation costs, and provide an incentive for the removal of juniper on heavily invaded rangelands.

Cooperative funding provided by Texas A&M AgriLife Research and the Rob and Bessie Welder Wildlife Foundation.

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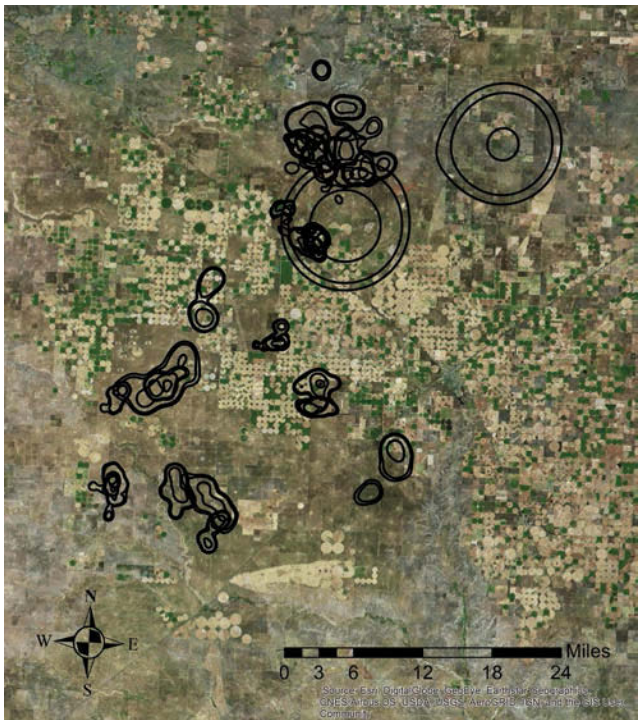
Pronghorns in the Panhandle of Texas have learned how to exploit agricultural crops.

Influence of Agricultural Production on Pronghorns in the Texas Panhandle

Anthony P. Opatz, Gary Mizer, Timothy E. Fulbright, Randy W. DeYoung, Humberto L. Perotto-Baldivieso, Warren C. Conway, and Shawn S. Gray

Pronghorns occur in the Trans-Pecos and Panhandle regions of Texas. However, information regarding the movements and behaviors of pronghorns in the Texas Panhandle is lacking. Croplands in the northern Panhandle are potentially important to pronghorns because they provide higher quality food on a more consistent basis than rangelands.



The black lines depict the outline of the collared pronghorns home ranges in our study area near Dalhart, Texas.

We placed GPS collars on 32 adult female and 32 adult male pronghorns in the Panhandle of Texas. These collars record the location of each animal every 2 hours and transmit the locations to satellites, thereby enabling us to download the location information. Half of the collared pronghorns are near Pampa and half are near Dalhart.

We are recording crop maturity stages and crop types within the animals' home ranges. We will analyze seasonal and annual movements of the animals and determine if there is a connection between crop species, crop growth stages, and animal location. We are also using remote sensing methods to compare forage availability between crops and the surrounding rangeland areas. We will determine the influence of plant communities, water sources, and roads/fences on pronghorn movements.

So far, our data show that male home ranges varied from 0.7 mi^2 to 187 mi^2 in size, whereas female home ranges varied from 1 mi^2 to 106 mi^2. Knowing this information will allow Texas Parks and Wildlife Department biologists to develop and implement accurate management strategies and assess crop use based on habitat preferences.

Cooperative funding provided by the Texas Parks and Wildlife Department.

Training K–12 Educators on the Wild Bird Conservation Curriculum

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

Grade school teachers and environmental educators often search for professional development opportunities to maintain credentials or refresh their classroom materials. The Wild Bird Conservation Curriculum program began with educator training workshops where 5 lesson plans were covered: bird identification, mist-netting, citizen science, quail internal parasites, and habitat fragmentation mapping. These free lesson plans, aligned with state of Texas standards, are providing local educators with tools to incorporate wildlife and introduce students to a STEM (Science, Technology, Engineering, and Mathematics) career.

Four workshops have been held with 49 participants consisting of pre-kindergarten through college-level teachers and environmental educators from across the Coastal Bend. The range of educator participation has allowed the curriculum to potentially reach over 20,000 students. Three teachers from Riviera ISD, Kenedy County-Wide CSD, and Corpus Christi ISD schools have participated in the classroom lesson evaluation, reaching over 150 students in the classroom.

Feedback on the workshop has been positive with educators most interested in the topics of bird identification and habitat fragmentation mapping. Educators consider the workshop well-organized, meeting their expectations, and would recommend this workshop to their colleagues in the future. Creating connections during these workshops encourages a positive relationship with the surrounding community, aids in promoting conservation, and provides a better understanding of the importance of wildlife.

An educator practices the "bander's grip" at the Wild Bird Conservation Curriculum Training Workshop.

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

Cattle Grazing Influence on Economics, Environment, and Human Dimensions

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

Outreach activities to encourage landowners to use sound management practices to improve environmental health, profitability, and welfare in rural Mexico are rare. Our objectives are to (1) identify social factors that influence decisions of ranchers, (2) measure the response of a planned behavior-influencing strategy focused on best grazing management practices, and (3) estimate profitability with the use of best management practices and its effect on human behavior.

We will survey landowners within the Chihuahuan Desert of Mexico. With the baseline information, we will develop a structured behavior-influencing strategy for ranchers to improve adoption of best grazing management practices. We will determine the change in soil cover, soil carbon sequestration, underground water levels, and wind erosion. The profitability of the ranches in the study will also be examined.

It is important to understand the factors affecting attitudes and the decision making process used by ranchers in the Chihuahuan Desert. This information is needed to develop appropriate and effective extension programs that optimize environmental health, profits, and wellbeing of landowners in northern Mexico.

Cooperative funding provided by Programa de Formacion de Profesores, Universidad de Chihuahua, and Border Environment Cooperation Commission.

Vertebrate Response in Relation to the Coloraditas Grazing Experiment

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

We are currently involved with developing and implementing a long-term monitoring program for plants (flora) and animals (fauna) across the East

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Lizards and other reptiles are being surveyed as part of a comprehensive study focusing on plants and animals.

Foundation ranches. In addition, we are monitoring the response of flora and fauna to a grazing experiment the East Foundation is conducting on the 18,000-acre Coloraditas pasture.

Our 3rd full field season has been completed. We have conducted an analysis of the small mammal data, provided the East Foundation with a comprehensive report of our findings and monitoring recommendations, and submitted a manuscript for publication, based on our findings. We are analyzing 3 years of survey data on breeding birds and raptors. In addition, we are working on a report of our findings, which will be provided to the East Foundation.

We are continuing to collect data for the Coloraditas grazing experiment. This includes trapping of mammals and herps (reptiles and amphibians), conducting callback surveys for owls and nightjars, conducting point count surveys for birds, recording echolocation calls from bats, and sampling vegetation.

During 2017, we captured 483 individuals representing 11 species of small mammals during 20,520 trap-nights (number of traps x number of nights trapping). With our herp trapping, we captured 702 individuals of 27 species over 779 trap-days (number of traps x number of days trapping). We tagged 252 individuals of 3 species of lizards and recaptured 225 individuals. We had 70 detections of nightjars and 64 detections of owls over 96 evening callback surveys. Currently, we are completing our sampling for breeding birds, vegetation, and bats.

The dataset will be analyzed to estimate detection and capture probabilities. The information obtained will be used for detecting the impacts of various cattle grazing treatments, as well as making recommendations for the East Foundation's long-term wildlife monitoring program.

Cooperative funding provided by the East Foundation.

Landscape Characteristics that Drive Avian Abundance during Migration

Samantha J. Wolfe, Bart M. Ballard, Matthew J. Schnupp, and Humberto L. Perotto-Baldivieso

A majority of the migratory routes used by land birds breeding in the central and eastern parts of North America converge along the lower Texas Gulf Coast, making it an important stopover area for many species. Past studies have shown that species differ in their preference and use of habitat types during migration. It is the goal of this study to assess larger scale landscape characteristics that influence migratory bird use along the lower Texas coast.

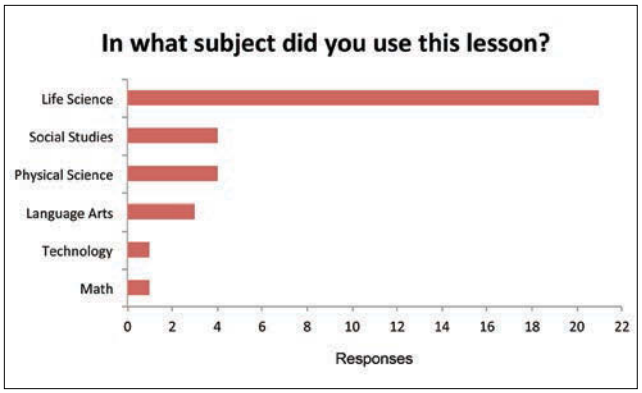
We conducted bird surveys across 2 years during autumn (September through October) and spring (April through May) migration that coincided with peak migration periods. Transects were placed in 10 major terrestrial habitat types in South Texas, and data on woody canopy cover and dominant plant species were collected at the time of the surveys.

In addition, we are using remote sensing techniques to obtain large-scale vegetation information from the landscape around each transect location. To ensure proper accuracy, we assessed high-resolution aerial photographs from the entire surveyed area based on over 600 points that were physically visited and verified. An array of landscape characteristics (average woody patch size, habitat heterogeneity, etc.) will be used to investigate their influence on bird use. Results from our study will provide information on landscape features that influence bird use of stopover habitats at spatial scales typically not investigated.

Evaluating Welder Wildlife Foundation's Rangeland Curriculum

Angelica F. Arredondo, April A. Torres Conkey, Selma N. Glasscock, and La Vonne Fedynich

The Millennial generation is perceived to spend less time outdoors and more time indoors with todays many technologies. Thus, there is a need to provide



Results of the classroom topics designed for kindergarten through 5th grade in which elementary teachers use the rangeland curriculum materials created by the Rob and Bessie Welder Wildlife Foundation to teach the basics of natural resources and ecosystems of Texas rangelands.

educational and outdoor experiences to mend this separation from the outdoors.

The Rangeland Curriculum, designed for kindergarten through 5th grade, was created by personnel from the Rob and Bessie Welder Wildlife Foundation to teach the basics about the natural resources and ecosystems of Texas rangelands. Through workshops held at Texas Education Service Centers (ESC), the lessons have been used in schools throughout all 20 Texas ESC regions. With an interest in promoting the curriculum at the national level, its creators would like to see how the curriculum is performing.

Evaluation of the curriculum was based on an online survey sent to participating teachers. The surveys were designed to look at the effectiveness of the teacher workshops and teacher use of the curriculum in the classroom.

Based on responses received from teachers, the following preliminary results have been obtained. Out of 800 teachers who were sent initial email requests to complete the survey, 560 surveys were delivered successfully, leaving 276 "bouncing" with invalid contact information. Of the 560 delivered emails, 397 were not opened. This left an initial sample size of 163, and a 29% response rate. Out of the 163 participants, 59 surveys were completed. Analysis of the survey responses is underway.

We hope to see a positive correlation between the use of the curriculum and increased student knowledge based on teacher feedback. In addition, with the use of this curriculum, we hope to instill a new appreciation for our rangelands for generations to come.

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

Effects of Agriculture on Mule Deer in the Texas Panhandle

Laura S. Warner, David G. Hewitt, Randy W. DeYoung, Timothy E. Fulbright, Louis A. Harveson, Warren C. Conway, Shawn S. Gray, and Dana J. Wright

Agricultural crops are necessary for food and fiber production. They can provide an additional source of nutrition for wildlife. However, they also fragment habitat. Mule deer in the Texas Panhandle use crops to supplement natural forage in their diet. Anecdotal observations suggest that mule deer in the Texas Panhandle make large seasonal movements to access crops. However, it is not well understood how crop use affects mule deer movements and their survival.

In October 2015 and 2016, we collared 43 adult mule deer with GPS collars and 30 fawns with standard radio collars at 2 study sites near Turkey and Stinnett, Texas. We recorded age, body weight, lactation status, body condition, and antler size of the captured deer. Deer movements and survival are currently being monitored at both sites through weekly radio telemetry tracking. Agricultural crops at each site are being monitored monthly to determine their growth stages.

We have evaluated the location data obtained from the first year at the Turkey site. Based on our data, winter wheat is used most by mule deer in that area, especially during the tillering and stem elongation growth stages of the plants.

Our results indicate that surveys to estimate mule deer density in areas where winter wheat is present should account for the aggregation of deer on wheat fields during particular plant growth stages. Because

A mule deer buck outfitted with a radio collar and ear tags needed to monitor his use of crops and natural forage.

artificially inflated mule deer densities can occur around field crops, wildlife biologists will be able use this knowledge to produce better harvest recommendations and meet landowner goals for deer management.

Cooperative funding provided by the Texas Parks and Wildlife Department, The Mule Deer Foundation, and Sul Ross State University.

Bird-Window Collision Mortality at Texas A&M University-Kingsville

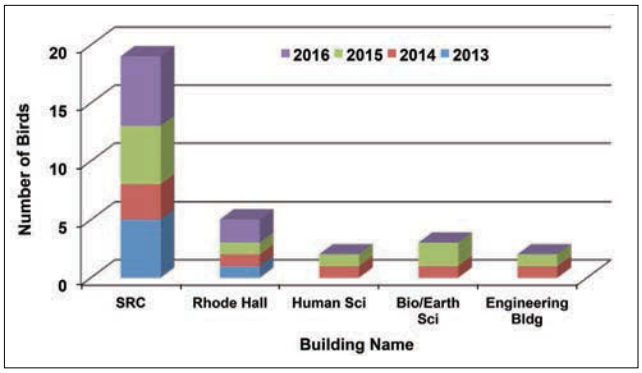
Human-Wildlife Conflict Resolution Course Students, April A. Torres Conkey, Stephen B. Hager, and Bradley J. Cosentino

Bird-window collision risk is related to the size and amount of windows in buildings and environmental features immediately surrounding the buildings. Since 2013, students from the Human-Wildlife Conflict Resolution course at Texas A&M University-Kingsville (TAMUK) have participated in an annual survey to assess bird-window collisions on the TAMUK campus.

The Student Recreation Center, Rhode Hall, Human Sciences Building, Biology/Earth Science Building, Engineering Complex, and one residence on Santa Anita Drive (west of Turner Hall) were selected for the surveys. Surveys were conducted every afternoon during autumn for bird carcasses resulting from collisions into the windows.

The 4-year study shows that the Student Recreation Center averages 5 bird-window kills, Rhode Hall averages 1 kill, and the other buildings have 0 to 1 kill per month during the autumn bird migration season. Most kills were along the long span of north and south-facing windows of the Student Recreation Center. Common urban species made up 53% of bird-window kills. Other birds found dead included migratory warblers, a migratory woodpecker, a cuckoo, and a burrowing owl. Burrowing owls live nearby on the King Ranch, but are not very common in the area and are rarely seen in town.

Although the kill numbers appear relatively low, the survey is only accounting for a small snapshot in time and space. The 2014 survey is part of a journal article published in 2017 analyzing collisions on a continental scale. The TAMUK bird-window collision survey will continue. It will be interesting to see whether the new windows being installed at the Engineering Complex will affect bird-window collisions at that site.



Bird-window collision mortality counts per building per year at Texas A&M University-Kingsville (SRC = Student Recreational Center, Human Sci = Human Science Building, Bio/Earth Sci = Biology/Earth Science Building).

A yellow-bellied sapsucker was found along Rhode Hall at Texas A&M University-Kingsville on October 14th, 2016.

Population Characteristics of Wildlife in Managed and Unmanaged Rangelands

Aaron M. Foley, David G. Hewitt, Randy W. DeYoung, Matthew J. Schnupp, and Tyler A. Campbell

South Texas has a long history of cattle ranching and wildlife management. Rangeland management practices geared towards cattle often benefit wildlife. Numerous small-scale studies have assessed the response of wildlife species to certain management practices. However, a true control rarely exists because experiments often take place on sites previously exposed to management.

We will compare and contrast wildlife population characteristics from lands administered by the King

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CKWRI researchers are evaluating population level impacts between managed and unmanaged deer herds.

Ranch and the East Foundation. Both large landholdings incorporate cattle management practices, which include prescribed burns and brush management. The key difference between the King Ranch and East Foundation landholdings is the management of native wildlife species. The King Ranch uses regulated hunter-harvest and supplemental nutrition to manage wildlife, whereas the East Foundation does not use harvest or supplemental nutrition.

Both ranches have conducted helicopter-based large mammal surveys during the period 2013–2016. This information allows direct comparison of population densities, sex ratios, and recruitment rates for white-tailed deer, collared peccaries, feral pigs, and nilgai. Morphological measurements of deer have been collected on both sites, which will provide an opportunity to evaluate differences in body weight, antler size, and age structure. Further, portions of both ranches are adjacent to each other. This provides an opportunity to evaluate differences in wildlife population characteristics within similar ecoregions.

Our design of studying wildlife populations that are being managed through hunting and comparing them to populations not being managed through hunting is novel, especially at the scale of our study. Results from this study will improve our understanding of how wildlife populations differ for cattle ranching enterprises across a diverse landscape with different game management objectives.

Cooperative funding provided by the East Foundation.

Northern Bobwhites and Parasites: Using a Holistic Approach

Nicole J. Traub and Alan M. Fedynich

The northern bobwhite is a game species of ecological, cultural, and recreational importance in Texas. Unfortunately, bobwhite populations across Texas are experiencing a long-term, widespread decline that has led to speculation that factors other than habitat may be playing a role in bobwhite population dynamics.

Bobwhite populations in Texas exhibit marked variations in abundance among years—a boom-and-bust phenomenon—that is attributed to fluctuations in weather conditions. When rainfall is abundant, vegetation is expected to be plentiful, populations of insects are expected to rise, and quail populations boom. It is unknown how this cycle affects parasite infection dynamics within bobwhites.

The present study is a continuation of a long-term project initiated in 2012 to gain a better understanding of the overall quail-parasite relationship in South Texas. In addition to surveying quail for parasites, our study expands the focus by (1) assessing the impact of precipitation on helminth prevalence and abundance, (2) investigating which insect species are used as intermediate hosts for the common helminth species, (3) determining the percentage of infected insects during summer, and (4) creating an interactive model that demonstrates how each component (bobwhite density, insect abundance, precipitation, and parasite infections) affects one another.

We have learned from the ongoing long-term quail parasite study which parasites are infecting quail. Now, we are taking the next essential step to see which environmental factors are influencing the relationships in the quail-parasite system operating in South Texas.

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

Disease Prevalence in Ocelots on the East Foundation's El Sauz Ranch

Jason V. Lombardi, Justin P. Wied, Michael E. Tewes, Daniel R. Taylor, Clayton D. Hilton, and Tyler A. Campbell

The East Foundation's El Sauz Ranch (EESR) is located adjacent to the town of Port Mansfield in Willacy County, Texas. In 2016, animal control officers and town officials announced that the feral cat population in the town tested positive for feline immunodeficiency virus (FIV) in addition to a variety of other feline-specific diseases.

The ocelot is a medium-sized endangered felid that has suffered severe population declines over the last century and is currently found in 2 small populations, one of which is located near the town of Port Mansfield. Although ocelots do not occupy areas near towns because of the lack of preferred habitat, there is a risk of possible disease agents being transmitted from feral cats to bobcats. Bobcats could then pass the disease agent to ocelots. Possible transmission of disease agents to the ocelot population would likely lead to population declines over the next few years.

To understand if FIV and other diseases are present in the Willacy ocelot population, we are capturing ocelots on the EESR and collecting serum samples to test for different diseases. This research will allow wildlife managers and biologists to gain a better understanding of possible risk factors to ocelots in South Texas and aid in developing management strategies to mitigate transmission of infectious agents among felids.

Cooperative funding provided by the Feline Research Program of the Caesar Kleberg Wildlife Research Institute, Wild Cat Conservation, Inc., East Foundation, Annova LNG and their parent company Exelon Generation, Brown Foundation, Tim and Karen Hixon Foundation, Travis and Bettina Mathis, and Ben F. Vaughan, III.

Insects: The Link Between Quail and Their Helminth Parasites

Nicole J. Traub, Horacio Rodriguez, Kai Drinnen, Matthew Townsend, Travis Opiela, Cynthia Puente, and Alan M. Fedynich

The connection between precipitation and quail density has been well documented; however, this is only one of many interactions experienced by quail. Less-understood interactions include the relationships between rainfall, insect abundance, and parasite infection. Although insects are an essential component of the quail diet, insects can serve as intermediate hosts for helminth parasites.

Based on an ongoing long-term study, all 13 helminth parasite species found thus far in bobwhites from South Texas require an intermediate insect host. To learn more, we plan to track insect abundance throughout the summer months to (1) determine which

insects are available as food for quail, (2) determine species of insects used as intermediate hosts, especially focusing on the cecal worm and eyeworm, (3) determine the percentage of the insect population infected by larval stages of the cecal worm and eyeworm, and (4) examine the relationship between insect abundance and rainfall.

We will be partnering with local ranches to collect insects during the summer. Insects will be identified and then examined for larval parasites. Parasites will be identified using DNA markers of adult parasites to confirm species. Studies such as ours are needed to better understand insect availability as a summer food resource for quail and learn more about the dynamics of parasite infections within quail.

Cooperative funding provided by the South Texas Chapter of Quail Coalition and the Texas A&M University-Kingsville Council for Undergraduate Research.

Selective Serosurvey of Pathogens in Free-ranging Black Bears in Mississippi

Christine Hoskinson, Clayton D. Hilton, Andrew N. Tri, David G. Hewitt, Jerry Belant, and Scott E. Henke

Black bears are the most widely distributed bear species in North America. However, until relatively recently, they had been extirpated from northwest Mississippi. A small population of black bears is recolonizing the region, and investigations into their health status are a way of gaining information to make sound management decisions.

Parasites and diseases typically are not reported as having a large effect on the regulation of bear populations, but morbidity and mortality factors can become regulatory when populations are under a threshold level. In our study, black bears are being trapped using culvert traps and modified Aldrich foot snares to obtain biological samples. The samples will be tested to determine the prevalence of antibodies to 4 pathogens: canine distemper virus, canine adenovirus, *Leptospira* spp., and *Toxoplasma gondii*.

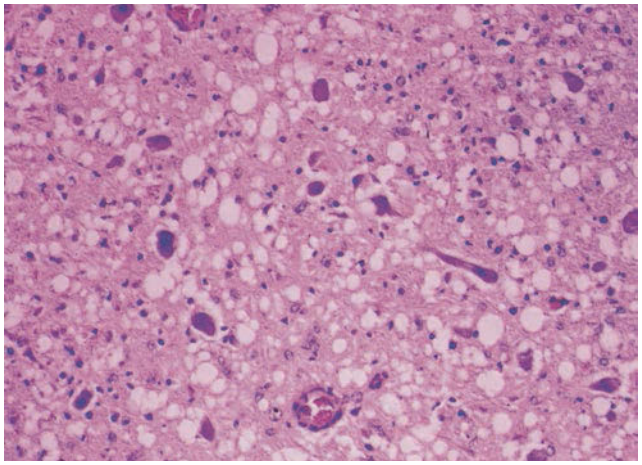
Preliminary results of the bear samples tested demonstrated non-protective titers for canine adenovirus and *Leptospira* spp. In addition, the majority of the bears had protective titers for *T. gondii* and to a lesser extent, canine distemper virus. This population of bears appears to have low prevalences of protective titers to the diseases we focused on in our study. These findings may be significant because historical evidence has shown black bears are susceptible to the aforementioned pathogens.

Because of the omnivorous tendencies of black bears, they could serve as indicators for the prevalence of infectious diseases of concern in other wildlife species that they are exposed to while foraging. As the Mississippi bear population continues to increase, it is likely that the incidence of human/bear and domestic animal/bear conflicts will increase. Knowledge of pathogen exposure in bears allows wildlife biologists to monitor the health of the population and make well-informed management decisions when conflicts or questions arise.

Using Landscape Genetics to Track Chronic Wasting Disease in Mule Deer

Gael A. Sanchez, Randy W. DeYoung, David G. Hewitt, Timothy E. Fulbright, Humberto L. Perotto-Baldivieso, Louis A. Harveson, and Shawn S. Gray

Chronic Wasting Disease (CWD) is a transmissible neurologic disease that affects elk, moose, caribou, mule deer, and white-tailed deer. This disease is caused by a mis-folded form of the prion protein, not by bacteria or viruses. When mis-folded prion proteins are ingested by the animal, they convert normal prion proteins to the mis-folded form. The mis-folded proteins cannot be broken down by the animal. They begin to accumulate in the brain, causing holes and swelling in the brain, leading to death. The mis-folded proteins can remain contagious in the environment for months or years. CWD has been present in mule deer



Courtesy: National Science Foundation/Elizabeth Williams

A photomicrograph from a mule deer with CWD showing the numerous "holes" (light-colored spots) in brain tissue.

in the Trans-Pecos region of Texas since 2012 and has recently been found in the Panhandle.

The genetic similarity between animals can inform us of the animal's movements across the landscape. The combination of population genetic analyses with landscape ecology has become a new discipline, termed 'landscape genetics.' By studying the effects of the landscape on animal movements and population structure, we are then able to understand how disease agents may travel.

The Texas Parks and Wildlife Department has collected over 2,300 tissue samples from hunter-harvested mule deer in the Panhandle and Trans-Pecos since 2012. We are genotyping these samples and will apply the genetic data to detect barriers to or corridors for deer movements. Using this analytical approach, we can then predict how individuals are moving between populations and if there are any natural barriers that could be used in management. The results of this study will have implications for the management of CWD in populations of Texas mule deer.

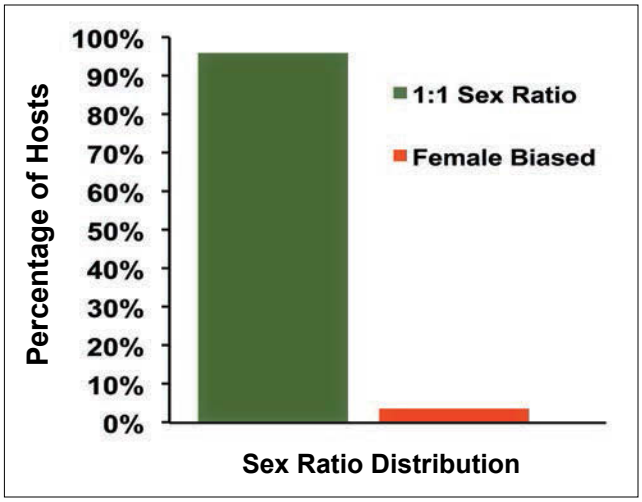
Cooperative funding provided by the Texas Parks and Wildlife Department and the U.S. Fish and Wildlife Service Wildlife Restoration Section 4 Grants Program (TXW-169-R-1).

Cecal Nematode Sex Ratios in Scaled Quail from South Texas

Taylor R. Shirley, Nicole J. Traub, and Alan M. Fedynich

Hypotheses concerning nematode reproduction strategies predict that the ratio of males to females within a host population is female biased when worm numbers within the host population are low and approach 1:1 as worm numbers increase. Mating strategies may explain why some nematodes are highly successful (highly prevalent and abundant), such as the quail cecal nematode.

High numbers of cecal worms are often found in northern bobwhites and scaled quail throughout Texas.



Sex ratios of cecal worms in 46 hunter-shot scaled quail from Zapata and Jim Hogg counties, Texas.

As part of a larger long-term project being conducted in South Texas on helminth parasites in quail, we obtained hunter-shot scaled quail collected in Zapata and Jim Hogg counties and examined them for the cecal nematode *Aulonocephalus pennula*. Nematodes were counted and sexed, and the resulting dataset compared statistically to assess whether the nematode populations were female biased.

Cecal nematodes occurred in 46 of the 54 (85%) scaled quail examined, ranged from 1–97 individuals per quail, and had averaged 16 individuals per infected bird, thereby indicating it was highly prevalent and fairly abundant. Forty-four of the 46 (96%) infected quail had nematode populations that approached or equaled a 1:1 sex ratio, indicating no female bias. In addition, the overall nematode sample consisting of 381 males and 365 females was not female biased.

Our preliminary findings indicate that the cecal nematode infects a high number of scaled quail, and populations consist of approximately equal numbers of male and female nematodes, thereby ensuring all females mate. Consequently, this parasite species has the capacity to be highly productive and persist within the host population. We are planning to continue this study of the cecal nematode to see whether 1:1 sex ratios can help explain why some parasite species are more successful than others in South Texas.

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

Disease and Parasite Transmission Related to Raccoon Density and Felid Presence

Jason V. Lombardi, Michael E. Tewes, Justin P. Wied, Daniel R. Taylor, and Tyler A. Campbell

The raccoon is a small carnivore found in a wide range of habitat types across its geographic range. Raccoons are known to transmit various disease agents and helminth parasites to other carnivore species in areas where they coexist. The ocelot is a small Neotropical felid. In South Texas, it occurs in 2 small populations because of habitat loss, road mortality, and lack of genetic diversity. Subsequently, Willacy and Cameron counties are the last remaining areas where ocelots, bobcats, and raccoons coexist within the United States.

We initiated this study to learn more about the potential for disease and parasite transmission from raccoons to ocelots and bobcats. We are quantifying the density of raccoons on the East Foundation's El Sauz Ranch in Willacy County, Texas. From 2016–2018, we will be capturing and collaring raccoons. The collars will be used to identify individual raccoons photographed during our carnivore camera surveys. We will then use a newly developed spatial mark-recapture method that will allow us to quantify raccoon density.

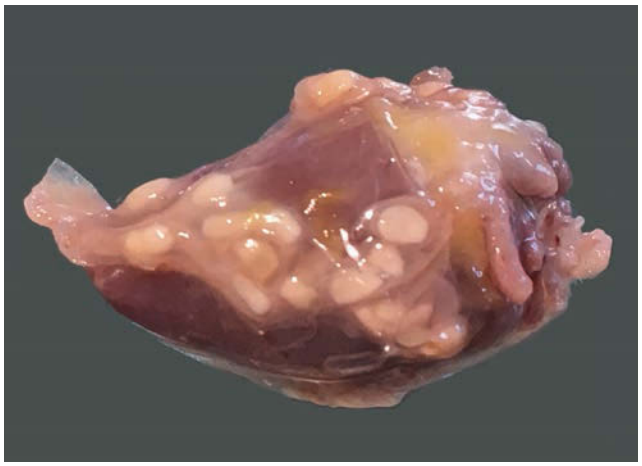
Data from our research will provide valuable insights about raccoon population density and the potential for disease and helminth parasite transmission. Our findings will be useful in understanding felid presence and aid in ocelot recovery efforts in South Texas.

Cooperative funding provided by the Feline Research Program of the Caesar Kleberg Wildlife Research Institute, East Foundation, Wild Cat Conservation, Inc., Annova LNG and their parent company Exelon Generation, Brown Foundation, Tim and Karen Hixon Foundation, Travis and Bettina Mathis, and Ben F. Vaughan, III.

A Newly Found Quail Parasite with the Potential to Infect Humans

Nicole J. Traub, Bradley W. Kubečka, Taylor R. Shirley, Dale Rollins, and Alan M. Fedynich

In February 2017, a hunter-shot northern bobwhite from Mitchell County, Texas and a scaled quail from Zapata County, Texas were found to be infected with



Larval stages of *Mesocestoides* appear as wet-looking white or cream colored oval objects on quail tissues.

larval stages of a tapeworm in the genus *Mesocestoides*. It appears that this is the first report of the occurrence of this parasite in wild North American birds.

Mesocestoides tapeworms have an indirect lifecycle requiring 3 hosts: 1st host is an insect; 2nd host may include small mammals, birds, reptiles, or amphibians; and 3rd host is a carnivore. The cycle begins when an insect ingests the tapeworm eggs excreted in the feces of an infected carnivore. Within the insect, the egg hatches and the worm develops into the 2nd stage larval form. For a quail to become infected, it must eat the infected insect. Within the quail, immature tapeworms migrate to the lining surrounding the heart, crop, and body cavity and develop into the 3rd stage larval form. There, it waits for the quail to be eaten by a carnivore. Once inside the carnivore, larvae develop into adults and shed eggs into the environment via the carnivore's feces, thereby completing the cycle.

The CDC has documented 10 cases of *Mesocestoides* infecting humans within the United States. Though infection of quails by *Mesocestoides* appears to be rare, consuming raw or under-cooked infected quail could result in infection. If the quail has wet-looking white or cream colored oval-shaped objects on the flesh or organs, discard the carcass where other carnivores (i.e., your hunting dogs) cannot eat it. Further, we suggest that hunters and carcass cleaners thoroughly wash their hands after touching an infected quail and consumers thoroughly cook all quail regardless of suspicion of infection.

Cooperative funding provided by the South Texas Chapter of Quail Coalition and the Rolling Plains Quail Research Foundation.

Genetics of Partial Resistance to Chronic Wasting Disease in Texas Mule Deer

Gael A. Sanchez, Randy W. DeYoung, David G. Hewitt, Timothy E. Fulbright, Humberto L. Perotto-Baldivieso, Louis A. Harveson, and Shawn S. Gray

Chronic Wasting Disease (CWD) is a neurodegenerative disease that affects members of the deer family. This disease is similar to "mad cow" disease and scrapie in livestock, where the causal agent is a mis-folded form of the prion protein. When ingested, the mis-folded form converts normal prion proteins to the abnormal form, which cannot be broken down by the body. The mis-folded prion proteins accumulate in the nervous system and cause holes and swelling in the brain, leading to death.

The disease is always fatal, but certain mutations in the prion protein gene affect the progression of the disease. A mutation in codon position 225, one of the building blocks of the protein, has been associated with longer incubation times before the appearance of clinical signs and ultimately death in mule deer. Unfortunately, the extended lifespan means the animal has more time to spread the disease throughout the environment with the potential of exposing more susceptible hosts.

Texas Parks and Wildlife Department personnel have collected over 2,300 tissue samples from hunter-harvested mule deer since 2012. We are sequencing the prion protein gene in a subset of these tissue samples to determine what allele forms are present in Texas mule deer.

Preliminary results from our analyses have identified the codon 225 mutation, as well as a mutation in codon 96 that was previously reported only in white-tailed deer. We also found novel mutations at 6 other codon positions that have not been reported in cervids. Our findings will have implications for the management of CWD in populations of Texas mule deer.

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Graduate student Gael Sanchez uses samples of mule deer tissue to study partial resistance to chronic wasting disease.

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-169-R-1).

Disease Surveillance of Relocated Turkeys in Southern Texas

Clayton D. Hilton, Brandon S. Mitchell, Julia Burchsted, William P. Kuvlesky, Jr., J. Alfonso Ortega-Santos, Leonard A. Brennan, and Humberto L. Perotto-Baldivieso

The Rio Grande wild turkey is a native gamebird of Texas that plays an important role in the South Texas ecosystem by consuming invertebrates and vegetation and by serving as a prey for predators. This species also provides recreational activities for birdwatchers and hunters.

Turkey populations have declined in South Texas over the past decade and disease may be a factor in this decline. To re-establish populations, turkeys are translocated across Texas. During translocation, diseases may be introduced into an area or the translocated turkeys may be exposed to diseases to which they have not previously been exposed.

Very few studies of wild turkeys have been conducted to determine if diseases are spread from translocated turkeys to resident populations. Therefore, we initiated disease surveillance of translocated turkeys to determine which disease agents they may have and to assess the potential threat these agents may pose to naive wild turkeys and other wildlife.

We sampled and tested blood from 126 juvenile and adult Rio Grande wild turkeys from 5 counties for exposure to *Mycoplasma gallisepticum*, *M. synoviae*, *Salmonella typhimurium*, *S. pullorum*, and avian influenza as these pathogens previously have been documented to occur in wild turkeys. Thirty-eight percent and 19% of the turkeys were positive on screening tests for *M. gallisepticum* and *M. synoviae*, respectively, and all were negative upon confirmatory testing. Regarding *S. typhimurium* and *S. pullorum*, less than 2% and 0%, respectively, were positive on screening tests. Five percent of the turkeys were positive for avian influenza on screening testing and none were positive via confirmatory testing.

While it is good news that the aforementioned disease agents can be ruled out as probable pathogens for wild turkeys in South Texas, our results indicate that the turkeys had been exposed to *Mycoplasma* and *Salmonella* species other than the species for which they were tested. This is significant because other *Mycoplasma* and *Salmonella* species can have major impacts on populations of turkeys. Further research is warranted to determine potential pathogens for translocated Rio Grande wild turkeys.

Cooperative funding provided by a Texas A&M University-Kingsville University Research Award.

© Bart Ballard

Raccoons can serve as reservoirs for diseases that can negatively impact endangered ocelots and other wildlife.

Transmission Potential of the Raccoon Roundworm to the Endangered Ocelot

Tiffany Weisheit, Scott E. Henke, Michael E. Tewes, Clayton D. Hilton, and Humberto L. Perotto-Baldivieso

Baylisascaris procyonis is a large nematode parasite found in the small intestine of raccoons. The adult worms are not pathogenic to raccoons, but the larvae in intermediate hosts can cause blindness, paralysis, and death. Humans can serve as intermediate hosts. Infected raccoons expose intermediate hosts through their feces, which can contain millions of eggs.

Recently, we demonstrated a single *B. procyonis*-infected raccoon could contaminate 0.25 acres per year with eggs. This represents a conservative estimate because the calculation assumes every square inch of ground would become contaminated. Consequently, the raccoon roundworm represents a risk to potential intermediate avian and mammal hosts, and especially threatened and endangered species such as ocelots in areas where infected raccoons and intermediate hosts co-occur. Ocelots could acquire infections by coming into contact with the roundworm eggs found in raccoon feces, by ingesting infected prey, and because cats frequently scratch the ground after urinating or defecating, by picking up roundworm eggs on their paws and then ingesting the eggs during self-grooming.

We propose to collect mammalian scat from locations where ocelots and raccoons co-occur. Scats will be used to identify the mammalian species. Scat location in the environment will be recorded and mapped via GPS. The scat will be analyzed for the presence of raccoon roundworm eggs.

Fifty-eight fecal samples from raccoons have been examined using the centrifugal flotation method. Of these, 3 fecal samples (5%) have been positive for *B. procyonis*, thereby confirming the presence of the raccoon roundworm in southern Texas.

Additional samples will be collected and analyzed to provide more information on this parasite's prevalence and dispersal. This study will determine if raccoon roundworm infections occurring in South Texas represent a potential and substantial morbidity or mortality factor for the endangered ocelot.

The Comanche-Faith Deer Research Project

Charles A. DeYoung, Timothy E. Fulbright, David G. Hewitt, Lindsey M. Phillips, Don A. Draeger, Emily H. Belser, Onalise R. Hill, Ryan M. Rothstein, and Daniel B. Brown

Supplemental feeding of white-tailed deer is a widespread practice in Texas, but the effects of increasing deer densities on deer performance and the vegetation when supplemental feed is available are unclear. In addition, the effects of increasing supplemental feeder density on deer performance and the vegetation are unknown.

The Comanche-Faith Deer Research Project is based in Dimmit County, Texas, and is named after the 2 ranches where the study is replicated. The project's overall objective is to determine the optimal combination of white-tailed deer and supplemental feeder densities for the landscape while maintaining the native habitat.

On each ranch, we are using 6 200-acre high-fenced enclosures, which were constructed in 2003. Phase I of the project began in 2004. Phase II of research began in April 2013 and used the same 6 enclosures on each ranch. Treatments during Phase II for each enclosure on each ranch are 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 found on page 3.

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

Availability of Summer Mast for White-tailed Deer in South Texas

Emily H. Belser, David G. Hewitt, Timothy E. Fulbright, Charles A. DeYoung, Lindsey M. Phillips, and Don A. Draeger

Although often unrecognized, honey mesquite and prickly pear cactus mast are important in the summer diets of wildlife in South Texas. However, assessments regarding the availability and quantity of these food resources are lacking.

To determine the amount of mast available, we measured canopy cover and counted the mast present on 20 honey mesquite plants and 10 prickly pear cactus plants within each enclosure during the summers of 2014, 2015, and 2016. To determine disappearance rates of mast, we monitored the amount of mast remaining on 5 prickly pear cactus plants and 5 honey mesquite plants in each enclosure throughout the summer. Prickly pear mast was monitored all 3 summers. Honey mesquite mast disappearance rate was only monitored in 2014 and 2016 because honey mesquites produced few pods in 2015.

- Honey mesquite mast disappeared sooner than prickly pear mast in 2014 and 2016.
- Mast took longer to disappear in enclosures with high mast production compared to enclosures with low mast production in all summers.
- Biomass of prickly pear mast was relatively constant among the summers (1,641 pounds per acre in 2015 to 2,056 pounds per acre in 2014).
- Honey mesquite mast production was more variable than prickly pear mast, ranging from 83 pounds per

acre in 2015 to 833 pounds per acre in 2014. In 2016, mast production fell within those ranges.
- Honey mesquite mast production decreased with increasing rainfall, which explains the high variation in mast production.
- Although there was variability in mast production among years, both native plant species represent a vast food resource for wildlife.

Assessment of Water Consumption by White-tailed Deer

Jeffery H. Brooks, Charles A. DeYoung, Timothy E. Fulbright, David G. Hewitt, Lindsey M. Phillips, and Don A. Draeger

Our objective was to determine how factors such as season, age, sex, and deer density affect water consumption of white-tailed deer. We used 2 enclosures on each ranch, one with 60 deer and one with 20 deer. All 4 enclosures had a centrally located supplemental feeder. Five uniquely tagged bucks and 5 uniquely tagged does of varying ages were selected in each enclosure. Water consumption by the tagged deer was recorded for 1 year using a tub of water on a scale monitored by video camera.

- Bucks consumed more than does in all age groups.
- Deer density within the enclosures had no effect on any age or sex combination.
- The older bucks consumed more water in autumn and winter.
- Findings indicate that older does consumed more water in spring and summer.
- Water consumption by deer at the water tub did not change when temporary water resources from rainfall were available.
- Diet composition and the amount of supplemental feed in the deer's diet may play a significant role in water requirements.

Influence of Social Hierarchy on Feed Use by White-tailed Deer

Emily H. Belser, David G. Hewitt, Timothy E. Fulbright, Charles A. DeYoung, David B. Wester, Lindsey M. Phillips, and Don A. Draeger

Dominance hierarchies among white-tailed deer may limit accessibility to concentrated food resources for some age and sex groups of deer, particularly does and fawns. Increasing feeder density may provide more opportunities for subordinate deer to access feed than in areas with a single feeder. In this study, we determined the proportion of each deer's diet composed of pelleted feed by analyzing stable isotope ratios in tissue samples taken several times a year from individual deer.

- All deer consumed supplemental feed during all months we studied (February, March, September, and December).
- Older deer ate more feed than younger deer.
- Males ate more feed than females in February and March, but not in September and December.
- In September, female deer had a higher percentage of feed in diets as deer density increased, but only as feeder density increased.
- Providing additional feeders may allow deer to consume more supplemental feed. It appears that increasing deer density can increase feed consumption by individuals, but there may be other consequences of high deer densities.

**** End of Completed Comanche-Faith Project Abstracts ****

The Effects of Temperature on White-tailed Deer Fawns

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

White-tailed deer fawns must maintain constant internal temperatures to maintain their proper physiological status. Unfortunately, the high summer

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The high temperatures found in summer within South Texas can have a negative effect on fawns.

temperatures in South Texas make it difficult for fawns to dissipate metabolic and digestive heat, thereby making it difficult to maintain body temperature. Although it is known that high internal temperatures of deer can negatively influence food consumption and growth rates, the magnitude of those effects is largely unknown.

This study was initiated to gain a better understanding of the environmental constraints that are placed on white-tailed deer fawns during summer in South Texas. We used captive deer housed at CKWRI's Albert and Margaret Alkek Ungulate Research Facility.

In July 2015, we began the temperature study using 11 buck and 6 doe fawns. Treatment fawns had access to a cooled portion of their pens while control fawns were held in the ambient temperature. Consumption rate, growth, activity, and health indices were monitored.

- At weaning, fawns in the treatment group weighed 2.4 pounds more than fawns in the control group.
- Fawns in the treatment group consumed more milk for the first 5 weeks than fawns in the control group.
- There was not a significant difference between treatment and control fawns in consumption of solid food.
- There was no difference between treatment and control fawns in activity.
- Fawns in the treatment group had 25% lower concentrations of stress hormones in their saliva than fawns in the control group.
- Our findings suggest that providing habitat in which fawns can reduce uptake of environmental heat and dissipate metabolic heat will be beneficial to them.

Assessment of Chorioptic Mange in White-tailed Deer from Southern Texas

Tiffany Weisheit, Clayton D. Hilton, and Scott E. Henke

Chorioptic mange is a common, contagious skin disease of herbivorous mammals most often caused by the cattle itch mite *Chorioptes bovis* or the Texas itch mite *Chorioptes texanus*. Species of mites in the genus *Chorioptes* are not host specific and can be found on domestic ruminants, wild ruminants, and horses.

Chorioptes mites are considered surface-dwelling mites. They burrow into the skin and are usually found on the lower limbs, causing oozing lesions. They also have been found on the scrotum and testicles—the resulting damage to reproductive organs can negatively impact fertility in infested ruminants.

© Tiffany Weisheit

Findings from our study indicate that white-tailed deer in South Texas can become infested with itch mites.

The goal of this study was to provide evidence of *Chorioptes* mites on the skin of white-tailed deer occurring in southern Texas. In 2016, we surveyed free-ranging white-tailed deer on 4 ranches for indicators of mite infestation.

Individual white-tailed deer with patches of hair loss were assessed for mites. Lesions with reddish-colored, oily, or thickened skin were sampled by scraping the affected area. The scraped material was examined under a microscope for mites. Mites found were then identified to genus.

- Of the 439 deer surveyed, skin scrapings were performed on 29 individuals.
- Two deer were positive for *Chorioptes* mites; this finding is the first account of this mite in free-ranging white-tailed deer.
- Based on our findings, we concluded that white-tailed deer in southern Texas can serve as hosts for *Chorioptes* mites.
- More research is needed to identify the impact of *Chorioptes* mites on white-tailed deer.
- Studies are needed to examine the potential for infested deer to serve as reservoir hosts, which could make them responsible for introducing or increasing the spread of these mites throughout livestock herds that inhabit similar areas within southern Texas.

The Effects of Temperature and Resource Availability on White-tailed Deer

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

White-tailed deer must maintain their body temperature during high summer temperatures that occur in South Texas. Our study, using captive deer, assessed the effect of temperature, type of food, food availability, and water availability on food consumption, body weight, and rumen temperature of mature bucks.

We conducted 4 studies during summer 2016. Treatment bucks had access to a cool A/C environment, whereas control bucks were held in the ambient temperature. Additionally, 3 sub-treatments were used that varied the times of food availability, water availability, and the type of food provided.

- In the baseline study, we found deer in the A/C treatment consumed 20% more food during the first half of the study.
- Deer fed overnight consumed 13% more food than deer fed during the day.
- We tested 2 types of feed, chopped alfalfa and pelleted feed. As the ambient temperature increased, so did pelleted feed consumption. Deer fed pelleted feed drank 0.3 gallons more water. There was no temperature effect on alfalfa consumption. Animals fed alfalfa in the A/C treatment had cooler rumen temperatures.
- When assessing the influence of water availability during the day or night, we found it had no effect on feed consumption; but, when the ambient temperature increased, water consumption also increased.

© Jessica Glasscock

Weight gain by white-tailed deer is affected by the extreme temperatures during summer in South Texas.

- Deer with access to water overnight gained nearly 9 pounds more body weight.
- Our results suggest summer temperatures in South Texas interact with timing of resource availability to influence food consumption and body weight.

Modeled Impacts of CWD on White-tailed Deer in South Texas

Aaron M. Foley, David G. Hewitt, Charles A. DeYoung, Randy W. DeYoung, and Matthew J. Schnupp

Chronic wasting disease (CWD) is a neurological disease that is fatal to members of the deer family. It can be transmitted directly from deer to deer and indirectly by contact with feces, urine, and saliva deposited by a diseased individual. Recently, CWD was found in captive deer in Texas prompting a need for a population model to forecast potential impacts on free-ranging deer.

We developed a model based on a 140,000-acre portion of the King Ranch where deer populations were estimated annually via helicopter surveys for 20 years. We calibrated the model with sex- and age-specific survival rates, fawn recruitment rates, and harvest rates. We then added CWD parameters from other studies in CWD-afflicted regions to predict changes in deer population sizes over 25 years under 4 scenarios.

- Without CWD and without harvest, deer populations increased 1.4% annually.
- Without CWD, deer populations were stable with a 2% annual harvest of both sexes.
- With CWD, deer populations were stable when there was no harvest.
- With CWD, deer populations declined with a 1% annual harvest of both sexes.
- With CWD, populations were stable when harvest was restricted to males. However, male age-structure became skewed towards young males because the CWD mortality rate increases with age in males.
- Deer populations in semiarid environments are sensitive to additional sources of mortality because variable rainfall has a strong effect on fawn recruitment rates. Recreational harvest would be greatly reduced if CWD appeared in free-ranging white-tailed deer populations within South Texas.

Cooperative funding provided by the East Foundation.

The Influence of Temperature on Plant Community Selection by Bobwhites

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

Temperatures greater than 105.8° F are lethal to bobwhites and such temperatures reduce portions of the landscape they can use. Our objective was to determine black globe temperatures (an estimate of the temperature an animal actually experiences) among plant communities from June–August, 2014. We compared black globe temperatures to the upper lethal limit for bobwhites among plant communities and then determined if bobwhites select the coolest plant communities during the middle of the day.

- From 10:01 AM to 5:30 PM, black globe temperatures were lowest in communities dominated by regrowth mesquite and in shrub clumps within plant communities along drainages (riparian sites).
- In all of August, 90% of black globes across all plant communities recorded mean temperatures lethal to bobwhites at 2:00 PM.
- The probability of use by bobwhites of riparian communities was 63% in the late morning and 65% in the early afternoon. Probability of use for the regrowth mesquite community was 66% in the late morning and 71% in the early afternoon.
- More than 90% of the landscape is, on average, hot enough to kill bobwhites in August.
- Future climate warming may reduce habitat space for bobwhites, making management for quality thermal cover and conservation of regrowth mesquite and riparian communities critically important.

Cooperative funding provided by George C. "Tim" Hixon, Hixon Family, Hixon Ranch, Texas Parks and Wildlife Department, and Rotary Club of Corpus Christi (Harvey Weil Sportsman Conservationist Award Trust).

Quantifying Urban Sprawl and Habitat Loss for Northern Bobwhites in Texas

Heather J. Hannusch, Humberto L. Perotto-Baldivieso, Katherine S. Miller, David B. Wester, and Leonard A. Brennan

As the human population continues to grow, urban and agricultural development also expands. Such changes have caused wildlife habitat degradation and population declines, particularly in Texas where the decline of bobwhites has been especially concerning. Our study assessed the current relationship between northern bobwhite populations and impervious cover as a way of predicting the potential amount of habitat lost in coming years.

The Texas Ecological Mapping System was used with bobwhite estimates obtained from the Breeding Bird Survey to examine the relationship between the percentage of impervious cover and bobwhite counts in 2010. Integrated Climate and Land Use Scenarios were then used to predict the growth of urbanization above the 0.77% threshold every 10 years under 4 model scenarios of development between the years 2020 and 2050.

- We found that bobwhite numbers decreased sharply when impervious cover was 0.77% or higher.
- There were up to 20 bobwhites per count below the 0.77% threshold and under 5 bobwhites per count above this threshold.
- The greatest loss of land in all 4 scenarios was rangelands and agriculture resulting from urbanization.
- The urbanization models, based on economic drivers, lost twice as much land as did the environmentally driven models.
- Findings from our study have implications for northern bobwhites and other grassland wildlife species. It is clear that future wildlife conservation activities need to be integrated with urban development policies.

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

Northern Bobwhite Parasitism in a Legacy Landscape of National Significance

Stephanie A. Shea and Alan M. Fedynich

Northern bobwhites have been experiencing a long-term decline throughout their range including South Texas—an area recently designated a Legacy Landscape of National Significance for Northern Bobwhite Conservation. Bobwhites are ecologically, recreationally, and economically important in this geographic region, gaining the attention of wildlife biologists and citizens alike. Within the backdrop of long-term declines, short-to-medium term trends in bobwhite populations follow what has been termed

"boom and bust cycles," which are caused by increasing and decreasing precipitation trends. Presently, it is unclear what role, if any, parasitism and disease play in bobwhite population dynamics.

A long-term project was initiated in 2012 to expand upon the minimal research on bobwhite parasitism in South Texas while encompassing varying annual precipitation and bobwhite density trends. As part of this long-term project, 356 bobwhites were collected from 20 ranches during the 2014–2015 and 2015–2016 hunting seasons.

- The cecal nematode was the most common species; it occurred in 80% of the population, comprised 99% of all helminths found, and averaged 49 individuals per infected bird (range: 1–635).
- The remaining 9 species were rare (less than 6% prevalence with a range of 1–25 individuals per infected bird).
- Two nematodes, *Dispharynx nasuta* and *Gongylonema* sp., were documented for the first time in bobwhites from South Texas.
- Host age, sex, and body weight had no effect on prevalence, intensity of infection, or abundance of the cecal nematode.
- Northern bobwhite density and precipitation influenced intensity and abundance of the cecal nematode in which infection was increased during periods of low and high precipitation and low and high host density.
- Our findings provide new information on helminth infection dynamics and the role that precipitation and host density plays in influencing infections of bobwhites within South Texas.

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

Woody Cover Use by Northern Bobwhites and Its Effects on Their Survival

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

Woody cover is an important habitat component for northern bobwhites. It is used for food, thermal refugia, loafing cover, and protection from predators. However, there are many discrepancies in the scientific literature concerning the amount of woody cover needed by bobwhites.

We used whistle counts and radio telemetry methods to determine bobwhite use of woody cover at 3 spatial scales (pasture-wide, home range, and organism-centered) during the breeding season (March–August). In addition, we analyzed the relationship between the use of woody cover and bobwhite survival. Data were collected over several counties and years in South Texas: Goliad, Real, and Zavala counties (2014–2015), La Salle County (2009–2011), and Brooks County (2000–2004).

- Northern bobwhites used more woody cover with decreasing scale of observation (pasture-wide, home range, and organism-centered) and decreasing rainfall.
- The number of whistling male bobwhites detected decreased as woody cover increased at the pasture-wide scale. Woody cover within bobwhite home ranges was less (7–33%) compared to woody cover surrounding points-of-use (43–64%).
- The amount of woody cover used by bobwhites depended on the amount of herbaceous cover present at the organism-centered scale.
- Generally, bobwhites used more woody cover when herbaceous cover was lacking within the environment and used a wide range of woody cover (0–100%) when herbaceous cover was moderate to abundant (40–100%).
- Bobwhite survival was approximately 50% during the breeding season. There was a positive relationship between woody cover and survival at the organism-centered scale, but not the home range or pasture wide scales.
- Understanding the influence that scale and herbaceous cover have on woody cover use by bobwhites

The appropriate amount of woody cover is essential for northern bobwhite habitat in South Texas rangelands.

will aid managers in refining habitat management for this important gamebird.

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

The Effects of Tanglehead Expansion on Bobwhite Habitat Use in South Texas

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

Usable space for northern bobwhites has been reduced across a large portion of South Texas rangelands because of the spread of non-native, invasive grasses. A native grass, tanglehead has rapidly expanded its dominance in the western Sand Sheet of South Texas within the last 10 to 15 years. It has formed high-density monocultures, similar to non-native grasses, which are associated with losses of forb and grass diversity as well as bare ground, all of which are key components of bobwhite habitat.

- Based on field measurements, bobwhites strongly avoided areas with more than 20% canopy cover of tanglehead. Avoidance was similar for non-native grasses such as buffelgrass and Lehmann lovegrass.
- Analysis of helicopter survey and remotely sensed data showed that bobwhite density decreased with increasing cover and aggregation of tanglehead, beyond 20 to 40% for each.
- Increasing cover of tanglehead had a strong negative relationship with forb species richness, grass species richness, and bare ground—all important aspects of quail habitat.
- Further expansion by tanglehead has the potential to significantly reduce usable space and abundance of bobwhites in South Texas.

© Fidel Hernández

Extensive tanglehead stands decrease bobwhite habitat by reducing bare ground and forbs.

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

Northern Bobwhite Response to Habitat Irrigation

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

Over the last 5 years, the increase in bobwhite numbers after the drought ended has reinforced our understanding of the close relationship between bobwhite abundance and rainfall. Providing standing water to drink does not appear to be a worthwhile management effort, as bobwhites are adapted to semiarid environments. However, maintaining habitat through irrigation may negate drought effects by providing oases of lush vegetation with high arthropod availability.

We studied bobwhite hens from 2014–2016 on a property that implemented irrigation. While this study did not coincide with severe drought conditions, we think our findings provide useful information since data collection occurred during some long periods devoid of rainfall.

- It appears arthropod abundance and biomass are higher at irrigated locations than that found at random points or at locations where bobwhite broods foraged.
- Irrigation did not change the total home range of hens, but highly used areas were 8 to 45% smaller.
- While it appears irrigation may provide some resources important to bobwhites, future studies will need to determine hen survival, nest success, and vegetation structure at irrigated locations.
- Even if conditions are improved at irrigated locations during drought, this may not matter if hen and chick survival are still low during drought conditions or if vegetation structure at irrigated locations does not offer suitable conditions for foraging.

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

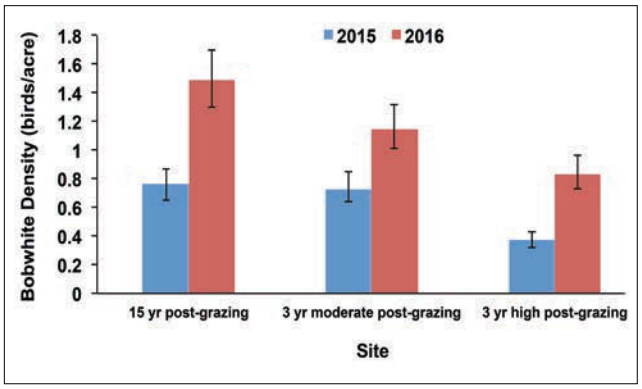
The Response of Bobwhites to Post-grazing Vegetation Recovery in South Texas

Rachel A. Smith, Leonard A. Brennan, Fidel Hernández, and Humberto L. Perotto-Baldivieso

Recently, many natural resource managers interested in improving northern bobwhite habitat have reduced or removed cattle on their land. However, it is unclear what impact livestock removal actually has on this gamebird in South Texas.

We investigated bobwhite response to vegetation changes following removal of grazing. Our study was conducted during 2015 and 2016 in Jim Hogg County on 3 post-grazing sites: a site rested from grazing for 15 years, a site rested 3 years from high grazing (17 acres per animal unit), and a site rested 3 years from moderate grazing (35 acres per animal unit).

- Breeding season adult survival did not differ among study sites. Overall, an adult bobwhite had a 48% chance of surviving the breeding season.
- Bobwhites at the 3-year high post-grazing site had a larger home range size (average of 48 acres), but was not statistically different between the 15-year (32 acres) or the 3-year moderate (32 acres) post-grazing sites.
- Bobwhite density improved on all sites from 2015 to 2016 and was consistently higher on the 15-year post-grazing site.
- Nest survival for the incubation period was higher on the 15-year post-grazing site (61%) compared to 32% on the 3-year moderate post-grazing site and 33% on the 3-year high post-grazing site.
- Woody cover around nests differed among the 3 sites, with higher patch density, edge density, and percentage cover on the 15-year post-grazing site compared to the 2 more recently grazed sites.



Density estimates of northern bobwhites from aerial surveys conducted during December 2015 and 2016 on 3 post-grazing sites in Jim Hogg County, Texas.

© Larry Ditto

Cattle grazing intensity can have an impact on habitat quality for northern bobwhites and other wildlife.

- Our results suggest that removing or reducing cattle can lead to vegetation structure more conducive to higher bobwhite nest survival, smaller home ranges, and higher density.

Cooperative funding provided by Cascabel Ranch, Houston Livestock Exposition, Richard M. Kleberg, Jr. Center for Quail Research, South Texas Chapter of Quail Coalition, and Texas A&M AgriLife Research and Extension Service.

Impacts of Eagle Ford Shale Exploration on Quail Space Use and Demographics

Kelsey R. Davis, Eric D. Grahmann, Fidel Hernández, Chase Currie, Timothy E. Fulbright, David B. Wester, Humberto L. Perotto-Baldivieso, and Fred C. Bryant

The northern bobwhite and scaled quail have been declining for at least 4 decades because of habitat loss. South Texas is one of the last remaining strongholds for these quail species in the United States. However, the recent increase in oil and gas exploration in South Texas, especially within the Eagle Ford Shale region, has the potential to negatively impact quail. The objective of this study was to determine how bobwhites and scaled quail respond to oil and gas related disturbance.

Our study took place on 2 adjacent ranches located in Dimmit County during March–October 2015 and 2016. Study sites were oil and gas exploration areas (disturbed) and areas where no exploration activities occurred (undisturbed). Sound levels were recorded using a sound level meter, and traffic rates were measured using traffic counters. Features of quail space

use and demographics were collected using radio telemetry of marked individuals.

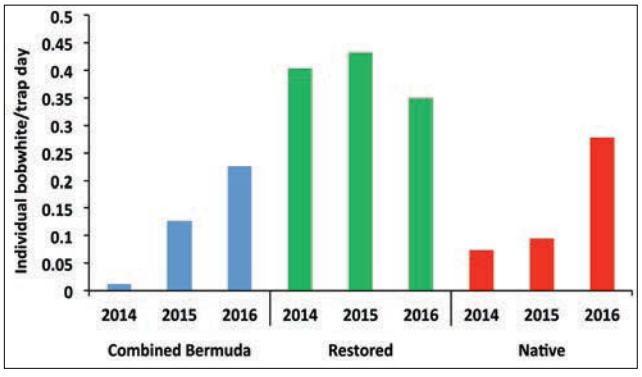
- Both species avoided sites with sound levels up to 6 decibels above ambient sound levels.
- We found no relationship between disturbance (traffic and sound levels) and home range size, seasonal survival, and nest success for either species.
- Seasonal survival for bobwhites and scaled quail was 12% and 44%, respectively.
- Nest success for bobwhites and scaled quail was 50% and 32%, respectively.
- Density of both species decreased from 2015–2016, but did not appear to be affected by disturbance.
- The apparent influence of noise related to oil and gas activity on quail site selection is an important management consideration as production in the Eagle Ford Shale region continues.

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

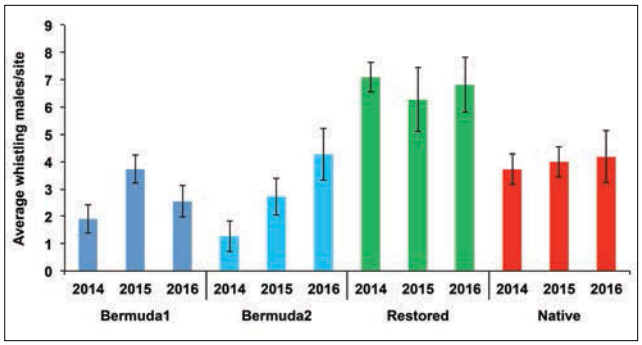
Northern Bobwhite Use of Bermudagrass Pastures Restored with Bunchgrasses

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

Conversion of rangeland to bermudagrass is a factor blamed for the decrease in bobwhite populations in both the Blackland Prairies and Post Oak Savannah of Texas. The objectives of this study were to examine bobwhite abundance and bobwhite habitat in bermudagrass pastures, native shrubland, and a pasture restored to bobwhite habitat that was previously a coastal bermudagrass pasture.



Trap success for each site during the breeding season. Trap success is equal to the number of individuals caught per trap at each site times the number of trapping days.



Average number of whistling male northern bobwhites in each site during the breeding season.

- Bobwhite abundance based on trap success and whistle count data was highest in the restored site in all 3 years. We found an increasing trend in bobwhite abundance in the bermudagrass sites from the 1st year to the 3rd year.
- We found improving bobwhite habitat in the bermudagrass sites from the 1st year to the 3rd year including an increase in forb canopy cover and suitable nesting clumps per acre.
- The improvement in habitat within the bermudagrass sites resulted from a combination of weather and management. Cessation of using fertilizer and broad-leafed herbicides followed by a major reduction in grazing resulted in an increase of forbs and other warm season grasses. Bobwhites began to increase once the habitat improved.
- Active restoration of bermudagrass pasture to warm season bunchgrasses can produce quality bobwhite habitat. However, passive restoration can also improve bermudagrass sites for bobwhite habitat.

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

Thermal Resource Selection by Northern Bobwhites in South Texas

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

Understanding bobwhite thermal ecology is critical for bobwhite conservation. Our goals were to determine (1) bobwhite selection bounds for black globe and ground surface temperatures, (2) if black globe temperature, ground surface temperature, or a combination of the 2 provide a better model of bobwhite thermal resource selection, and (3) times of the day

bobwhites seek cooler black globe and ground surface temperatures. Black globes provide an estimate of the temperature birds actually experience. We radio-marked 40 bobwhites and relocated them 2 to 3 times a week during April to September 2014–2016. We recorded black globe and ground surface temperatures at bobwhite locations and random locations.

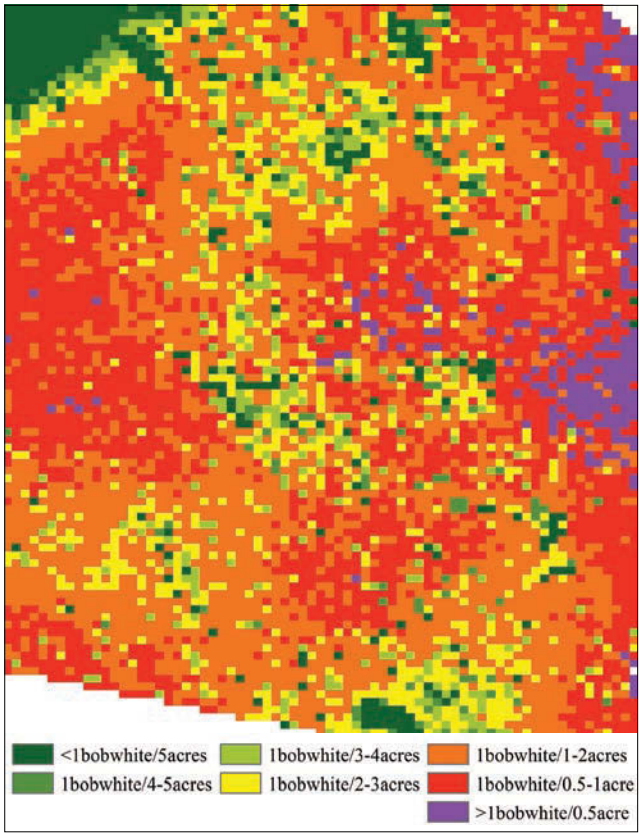
- Bobwhites selected black globe temperatures between 77° F and 109° F and ground surface temperatures between 73° F and 103° F.
- A combination of black globe and ground surface temperatures was a better predictor of bobwhite resource selection than either one individually.
- Between 7:30 AM and 7:45 PM bobwhites used locations with black globe temperatures cooler than the surrounding landscape.
- Bobwhites used locations with cooler ground surface temperatures than the surrounding landscape between 8:00 AM and 7:00 PM.
- During the early afternoon (1:30–5:30 PM) in August, black globe temperatures were 32% cooler at bobwhite locations than at random locations. Ground surface temperatures were 47% cooler at bobwhite locations than at random locations.
- Management for thermal cover should be a major objective in bobwhite management.

Cooperative funding provided by George C. "Tim" Hixon, Hixon Family, Hixon Ranch, Texas Parks and Wildlife Department, Hill Country Chapter of the Quail Coalition, and Rotary Club of Corpus Christi (Harvey Weil Sportsman Conservationist Award Trust).

Using Density Surface Modeling to Assess Northern Bobwhite-Habitat Relationships

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

Density estimates of the northern bobwhite historically have been derived using land-based, conventional distance sampling (CDS) methods, and have been limited in both extent and resolution (grain). Recent advances in aerial survey techniques, coupled with spatial developments of CDS methods (i.e., density surface modeling [DSM]), allow spatial representations and evaluations of animal density at higher grains across large areas. Furthermore, the use of DSM provides for the evaluation of bobwhite-habitat relationships within a high-grain/large-extent context, which has historically eluded researchers.



Northern bobwhite density map (2.5-acre resolution) for 2015, based on predictions from selected "best-fit" density surface modeling in Jim Hogg County, Texas.

- Compared to previous years, bobwhite densities during the study were good to excellent: 0.9 bobwhites per acre in 2015 and 0.4 bobwhites per acre in 2016.
- Density estimates for the entire study area were similar between CDS and DSM methods, both producing statistically reliable estimates.
- DSM methods provided slightly better accuracy in density estimates and had the added benefit of creating a density surface map.
- Relationships between bobwhite density and multiple habitat metrics were determined, showing a preference of bobwhites for moderate amounts and aggregation of brush cover.
- Despite achieving reliable density estimates, DSM achieved only adequate model fit. This was potentially compounded by the high grain of the study, the ubiquity of quail across the landscape, and the limiting nature of unmodeled habitat variables, such as invasive grass species.

Cooperative funding provided by South Texas Charity Weekend, Inc., Texas Parks and Wildlife Department, Texas A&M AgriLife Extension, and the Richard M. Kleberg, Jr. Center for Quail Research.

Changes in Soil Microbial Communities Along a Tanglehead Gradient

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

Tanglehead, a warm season native perennial grass, has expanded in the South Texas Coastal Sandsheet over the last 20 years. This expansion has affected ecosystem processes that can be studied by examining soil microbial communities. We completed a 3-year study of soil microbial communities along a tanglehead invasion gradient in sites dominated by native vegetation, tanglehead, and a mixture of native species and tanglehead.

- Soil microbial community size (as reflected in microbial biomass carbon, microbial biomass nitrogen, and total fatty acid methyl ester [FAME] analysis) and composition differed between native and tanglehead-dominated sites in 2013 and 2015.
- Soils invaded by tanglehead also had higher fungi-to-bacteria ratios than soils with native species.
- In an experimental setting where we introduced tanglehead to native soils, we detected no differences in microbial community structure, size, or relative abundance of key microbial FAME indicators over the course of 18 months.
- Our results suggest that plant communities with varying tanglehead abundance have distinct soil microbial communities compared to neighboring native plant communities. This difference, however, is also affected by environmental conditions (e.g., rainfall and temperature).

Cooperative funding provided by the George and Mary Josephine Hamman Foundation, Rotary Club of Corpus Christi (Harvey Weil Sportsman Conservationist Award Trust), Brown Foundation, and many donations to the CKWRI's Invasive Grass Program.

Development of a Commercial Seed Source for Zizotes Milkweed

Anthony D. Falk, Keith A Pawelek, Forrest S. Smith, John Lloyd-Reilley, Chris Best, and Dean N. Williams

Petitions have been made to list the monarch butterfly as a threatened species because of the steep population declines this species has experienced in recent decades. One possible explanation for the decline is the loss of native milkweeds, a plant critical to the monarch's lifecycle. Monarchs lay their eggs on milkweeds and the larva feed exclusively on the milkweed until they morph into adult butterflies.

Zizotes milkweed is hypothesized to be an important milkweed for monarch conservation since it is found in areas where the first and last breeding efforts of migrating monarchs occur each year. However, zizotes milkweed seed is not available commercially for use in restoration efforts.

To facilitate the use of zizotes milkweed to aid monarchs in restoration plantings within South Texas, personnel of *South Texas Natives* have been working to develop a seed release of this species that could be grown in large quantities and made available to consumers at reasonable prices.

- Three populations of zizotes milkweed were selected for increase based on their plant characteristics, seed quality, and origin. These selections are adapted to medium and course textured soils in South Texas.
- In spring 2017, 2,000 plants were grown and transplanted into a commercial seed field near San Antonio, Texas.
- The field represents the first commercial production effort for zizotes milkweed.
- Seed of zizotes milkweed could be available to consumers in limited supplies by spring 2018.

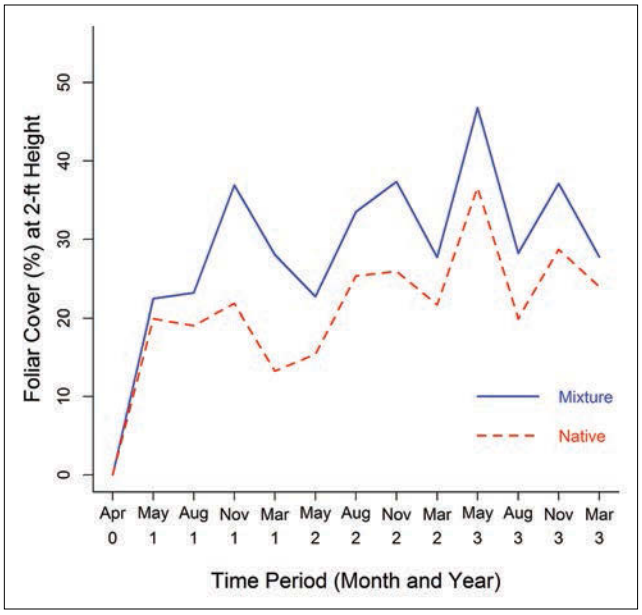
Cooperative funding provided by the U.S. Fish and Wildlife Service, Texas Parks and Wildlife Department, National Fish and Wildlife Foundation, and donors to South Texas Natives.

Plant Community Growth Dynamics Along a Tanglehead Invasion Gradient

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

Dramatic increases in tanglehead throughout the Coastal Sand Sheet in Texas change not only the plant species composition of impacted sites but also the structure of plant communities as tanglehead replaces native species. Over a 3-year period, we examined seasonal standing crop dynamics and canopy structure of plant communities dominated by tanglehead.

- Plant community characteristics measured at the



Vegetation foliar cover is higher in plant communities that include a mixture of tanglehead and native plant species than in communities dominated by native plant species (year 0 = initial measurement; years 1, 2, and 3 are 3 yearly growth periods).

"neighborhood scale," with and without tanglehead, exhibited several features common to vegetation invaded by exotic perennial grasses.

- Plant communities with tanglehead had higher total grass biomass and higher foliar cover in the canopy layer 2 feet above the ground surface than native plant communities, but less standing crop of native grasses and forbs.
- Patterns of canopy deployment throughout the season were similar in native plant sites and native plant-tanglehead mixture sites.
- Our findings suggest that the growth of tanglehead negatively impacts its native plant neighbors, but plant community traits such as vegetative cover and species richness may not change until a certain threshold of invasion is reached.
- Further research and monitoring of plant communities invaded by tanglehead may yield more information about potential tanglehead density thresholds resulting in loss of native plant standing crop and ultimately resulting in a monoculture of invasive tanglehead.

Cooperative funding provided by the George and Mary Josephine Hamman Foundation, Brown Foundation, Rotary Club of Corpus Christi (Harvey Weil Sportsman Conservationist Award Trust), and many donations to the CKWRI's Invasive Grass Program.

Development of Little Barley for Use as a Cool Season Cover Crop

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

Cereal grains such as wheat, oats, ryegrass, and triticale have traditionally been used as cool season cover crops to prevent soil erosion on highway rights-of-ways when construction is completed in winter months. The use of these cover crops can be problematic because these plants attract wildlife into the road right-of-way, which increases the chances of wildlife-vehicle collisions. In addition, these plants produce large amounts of biomass requiring mowing, making subsequent seeding difficult, and slowing later establishment of wildflowers and permanent native grass-dominated vegetation.

To alleviate problems associated with using cereal grains as vegetative cover, *Texas Native Seeds* personnel tested a blend of native Texas populations of little barley. This species is a low growing, cool season annual grass that could be used in place of the cereal grains in much of the state.

- Three populations of little barley were selected based on their original seed collection locations, height, and seed production attributes.
- These selections of little barley showed promise as a cool season cover crop throughout South, Central, and West Texas.
- Two acres of commercial production fields were

Little barley is a cool season grass that has the potential to replace cereal grains in soil cover plantings.

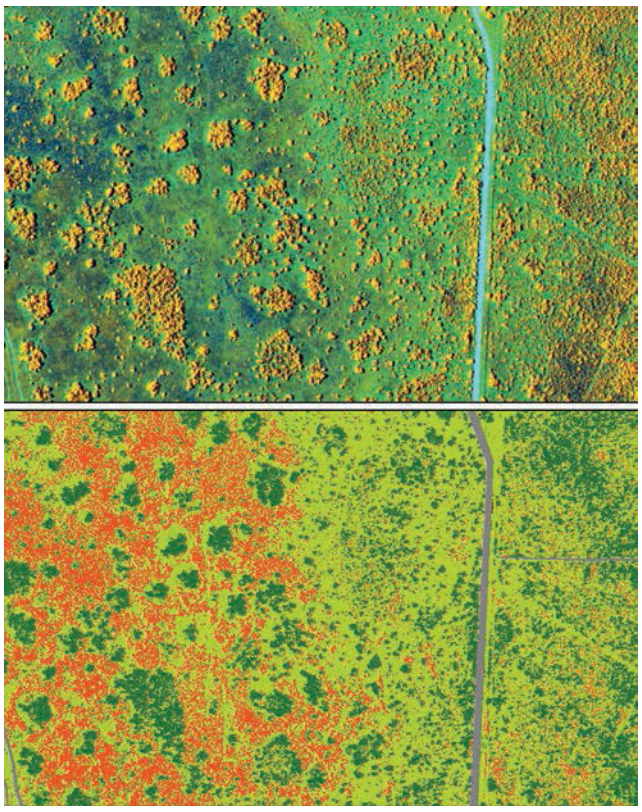
established in autumn 2016. We produced over 300 pounds of seed from this planting. This seed was used to establish a much larger commercial seed production field in fall 2017.
- Seed should be available for purchase in the spring of 2018.

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

Assessing the Distribution of Tanglehead in South Texas

Jose M. Mata, Humberto L. Perotto-Baldivieso, Fidel Hernández, Eric D. Grahmann, Sandra Rideout-Hanzak, John T. Edwards, Jaclyn D. Robles, Michael T. Page, and Taylor M. Shedd

Tanglehead is a grass native to rangelands of the southwestern United States. However, its presence as an invader in rangelands of South Texas has increased rapidly. In the last decade, large monotypic stands of tanglehead have been observed in Jim Hogg, Duval, Brooks, and Kleberg counties. Such dense stands of tanglehead can potentially have negative effects on wildlife populations.



Top: Processed aerial imagery (National Agriculture Imagery Program; 1-m [3.3 ft] resolution) natural color, near infrared, and normalized differential vegetation index layers. Bottom: classified imagery: woody (dark green), tanglehead (red), herbaceous (light green) and roads (gray).

© Humberto Perotto-Baldivieso

A large stand of tanglehead in Jim Hogg County, Texas, which is not suitable habitat for many wildlife species.

The aim of this research was to quantify the spatial and temporal dynamics of tanglehead invasions in our study areas. We assessed the spread of tanglehead using 3.3-foot resolution imagery for 2008, 2010, 2012, and 2014, and combined this information with soils and road spatial databases.

- We found that tanglehead occurred only in sandy and sandy loamy soils. The highest proportions of tanglehead were observed in sandy soils (up to 43% of the soil area) and loamy sand soils (up to 38% of the soil area).
- Roads were a factor influencing tanglehead dispersal. We found that over 85% of newly established patches were within 500 feet of roads.
- Once small patches of tanglehead become established, they grow and coalesce into larger patches and become monocultures in the landscape.
- Our study shows that tanglehead can be effectively mapped and identified from other vegetation types using remote sensing techniques.
- A combination of fieldwork, remote sensing, geographic information systems (GIS) techniques, and landscape ecology principles are useful in quantifying the spatial and temporal distribution of tanglehead in South Texas.

Cooperative funding provided by the Rotary Club of Corpus Christi (Harvey Weil Sportsman Conservationist Award Trust).

Seed Banks in Rangelands with Tanglehead or Lehmann Lovegrass Invasion

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

Because soil seed banks reflect historical processes as well as current plant species composition, invasive plants can have profound effects on future vegetation dynamics. We examined soil seed banks along invasion gradients of either tanglehead or Lehmann lovegrass over a 3-year period.

- The seed bank size of invasive plants was generally higher in soils collected from invaded plant community sites compared to the non-invaded sites, as we expected.
- Species richness and diversity metrics, however, generally did not change along invasion gradients of either tanglehead or Lehmann lovegrass.
- Native and invasive/native-mixture sites were more similar in emerged seedbank size and community composition than they were with invaded community types for both invasive species.
- Our results suggest that seed bank dynamics may not drastically change as either tanglehead or Lehmann lovegrass increase in the plant community up to a certain threshold.
- Germinable seed banks at native plant community sites were equally diverse and rich in species in most instances as at the sites with plant communities dominated by tanglehead or Lehmann lovegrass. This suggests that restoration of these rangeland sites may be feasible.

Cooperative funding provided by the George and Mary Josephine Hamman Foundation, Brown Foundation, Rotary Club of Corpus Christi (Harvey Weil Sportsman Conservationist Award Trust), and many donations to the CKWRI's Invasive Grass Program.

Assessing Breeding Ecology and Habitat Use of Reddish Egrets in Texas

Lianne M. Koczur, Bart M. Ballard, M. Clay Green, David G. Hewitt, and Scott E. Henke

The reddish egret is the rarest and least studied heron in North America. The global population is estimated to be within the range of 5,000–11,300 mature individuals, with nearly 2,000 occurring in Texas. Because the reddish egret is listed as a threatened species in Texas, information is needed that can be used to aid conservation efforts. We attached GPS-equipped satellite transmitters to 30 adult reddish egrets that were breeding in the Laguna Madre to learn more about the breeding ecology of this species.

- On average, reddish egrets that remained resident within their breeding range initiated breeding behavior 17 days earlier than migrating individuals.
- Fidelity to a breeding colony was relatively low. However, reddish egrets generally exhibited high fidelity to the upper or lower Laguna Madre. Residents had higher site fidelity than migrants.
- All reddish egrets exhibited relatively high fidelity to foraging areas across years.
- The average flight distance from breeding colonies to foraging locations was 9 miles.
- There was a positive relationship between the amount of foraging habitat near the breeding colony and the number of reddish egrets breeding at that colony.
- Our results suggest that reddish egrets nest in relation to foraging areas and do not necessarily return to the same colony. Thus, it appears that if nesting sites are limiting, new colony establishment near foraging areas would be beneficial.

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

Impact of Human Disturbance on the Relative Abundance of Bird Species

Alexandra M. Sigg, Oscar F. Mariscal, Janel L. Ortiz, and April A. Torres Conkey

The intermediate disturbance theory suggests that mildly disturbed areas yield higher overall species richness compared to areas of high and low disturbance. However, there are few studies that have examined this effect in the transition zone from rural to urban areas.

Our project was developed as part of the requirements for the Wildlife Management Techniques course at Texas A&M University-Kingsville. Areas chosen for study were in Kingsville, Texas. Sites selected were transition sites: a neighborhood park (high disturbance-HD), a cemetery (mild disturbance-MD), and a brushy lot along a grazed pasture (low disturbance-LD).

We wanted to test (1) if "increaser" species (native species that tend to increase in numbers in urban areas) and non-native species are more common in the higher disturbance areas and (2) based on the intermediate disturbance theory, if the highest numbers of species are in the mild disturbance site. Fifteen-minute bird observation surveys were conducted once a week for 4 weeks (September 2–October 7, 2016) at each of the study sites.

- White-winged doves were the most common species observed (relative abundance: 68% LD, 37% MD, and 57% HD).
- The only increaser species that was common in the HD area was the great kiskadee (relative abundance: 2% LD, 5% MD, and 21% HD).
- The only non-native species that was common in the HD area was the European starling (relative abundance: 0% LD, 1% MD, and 3% HD).
- The mild disturbance site had 20 bird species, compared to the low disturbance site (10 species) and high disturbance site (17 species).
- Our study supported the intermediate disturbance theory; however, we recommend that future studies take place over a longer period of time and account for habitat differences among sites.

Efficacy of Mint-scented Spray to Repel Rodents

Travis L. Dillard and Scott E. Henke

Rodents, as a wildlife group, are typically considered a nuisance. They are consumers of certain agricultural crops, and they are uninvited guests in barns and homes.

Various deterrent products have been developed to repel rodents including auditory devices and scented sprays. One such product is a mint-scented spray that

advertises to repel rodents. Therefore, we tested the efficacy of this product as a rodent repellent.

We sprayed 25 Sherman live traps daily with 4 sprays of mint-scented repellent (2 sprays inside each trap and 1 spray on each outer side) for 14 days. In addition, we used 25 non-sprayed Sherman live traps as a control group. Treatment for individual traps was constant throughout our study, but trap order between treatment and control traps was random each night as well as trap line location.

- We caught 120 rodents, which represented 6 species (cotton rat, house mouse, hispid pocket mouse, white-footed mouse, deer mouse, and northern grasshopper mouse).
- No statistical difference occurred in the number of captured rodents between mint sprayed traps and non-sprayed traps.
- More cotton rats were caught than other species, which most likely was a function of their higher relative abundance and more available habitat within the study area.
- The mint-scented spray had no effect on repelling rodents; however, on the positive side, it did not attract rodents to traps either. Therefore, the mint-scented product tested did not perform as advertised (i.e., does not repel rodents).

Nilgai and Cattle Fever Tick Management in South Texas

Aaron M. Foley, John A. Goolsby, Alfonso Ortega-Sanchez, Jr., J. Alfonso Ortega-Santos, Adalberto Perez de Leon, David G. Hewitt, and Tyler A. Campbell

Cattle fever ticks (CFT) are a threat to the cattle industry because they carry parasites that cause bovine babesiosis, which is lethal to cattle. A quarantine area exists between Texas and Mexico because wildlife and stray cattle that carry CFT can freely cross the border.

Nilgai carry CFT and, therefore, are of interest in understanding how CFT may be spread throughout the landscape. Thirty nilgai were fitted with GPS collars on the East Foundation's El Sauz Ranch near Port Mansfield, Texas and monitored from April 2015 to May 2016 to gather information useful for CFT management strategies.

- Nilgai movement patterns were highly variable; however, there were noticeable peaks in female space-use during June–August. Increased movements appeared to be a function of social group break-ups rather than a response to environmental conditions.
- Harvest prior to break-up of social groups may be effective in reducing the risk of CFT spreading through the landscape.
- Nilgai generally did not leave the study site after being exposed to helicopter activities during deer captures, cattle gatherings, nilgai harvests, and large mammal surveys. However, several nilgai left the study area immediately after being captured.
- Routine ranch activities that include the use of a helicopter are not expected to cause nilgai to disperse into new areas.
- Nilgai regularly crossed cattle fences except those fences running parallel to highways. Well-maintained fences running parallel to high-speed highways may be useful in delineating CFT management zones.

Cooperative funding provided by USDA Animal and Plant Health Inspection Service, USDA Agricultural Research Service, Texas Animal Health Commission, and the East Foundation.

The Influence of Nest Patch on Nest Site Selection and Success of Alligators

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

Selection of particular nest sites results in nonrandom patterns of nest distribution and is said to be driven by natural selection. These nonrandom patterns

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Studies on alligators are essential for conservation and management of this formerly endangered species.

result from selection of habitat characteristics, such as patches in a habitat mosaic or specific microhabitats by nesting females. To our knowledge no studies have attempted to directly elaborate on this concept for American alligators.

In this study, we evaluated the influence of nest patch on nest site selection and preference by female American alligators to demonstrate the role of "nursery" habitat in alligator ecology. We also examined the effect of nest patch and nest site characteristics on alligator nest success.

- Nest site selection by alligators was influenced by nest patch characteristics.
- Patch characteristics of nursery habitats selected by nesting female alligators such as presence of islands, shallow water, and adequate vegetation coverage contributed to increased nest and hatchling survival.
- Most likely natural selection has favored behaviors that increase nest success by lowering the probability of nest depredation and increasing the probability of hatchling survival.
- Wildlife biologists focusing on alligators should consider habitat characteristics for nest sites when implementing management strategies.
- Promotion of these habitats aids in increasing survival of hatchling alligators and, subsequently, the overall stainability of alligator populations in the United States.

Cooperative funding provided by the Rob and Bessie Welder Wildlife Foundation, Harry L. Willet Foundation, and the Texas A&M University-Kingsville Council for Undergraduate Research.

Evaluation of Aerial Population Estimation Techniques for Pronghorns in Texas

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

Aerial surveys are an efficient way to track population trends of large mammals, but often underestimate population size because some animals are not seen. In Texas, aerial surveys for pronghorns are flown on strip transects using a fixed-wing aircraft at low altitude (100 feet) to obtain abundance and herd composition estimates. We evaluated the performance of distance sampling and a sighting probability model for aerial surveys of pronghorns in the Panhandle and Trans-Pecos regions of Texas.

Better survey methods for pronghorns allow more accurate population estimates leading to improved management.

We surveyed herds that contained radio-collared pronghorns during June 2014 and 2015, and recorded activity, group size, vegetation type, percent cover, terrain, available light, and distance of the animal from the survey line. We compared population estimates derived from distance sampling and the sighting probability model to an independent estimate based on resightings of marked animals.

- The uncorrected counts underestimated population size by 23% compared to mark-resight estimates, 45% versus distance sampling estimates, and 69% versus sighting probability model estimates.
- Pronghorn detection probabilities were similar to past studies (sighting probability model: 73%; distance sampling: 65–67%). Significant variables in the sighting probability model were animal activity, distance, cover, terrain, and light.
- Population estimates from the sighting probability model were often high and variable compared to mark-resight estimates. Distance sampling with animal activity as a covariate generated estimates similar to mark-resight estimates.
- Distance sampling with animal activity as a covariate was the best approach for low-altitude population surveys of pronghorns in Texas.
- Our results emphasize the importance of tailoring survey methodologies to the conditions and management needs of a given geographic region.

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).

Research and Citizen Science in the College Classroom

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

An undergraduate research project was incorporated into a junior level course to improve bird identification, study design, and writing skills. The Wildlife Management Techniques course at Texas A&M University-Kingsville aims to provide hands-on experiences to students and expose them to a variety of research methods. We proposed a bird observation study, with data contribution to a citizen science program, as an addition to the existing course. Students formulated a research question, designed a 4-week bird observation study to address their research question, and wrote a report in scientific journal format.

Of 44 enrolled students, 38 participated and completed pre- and post-surveys. Surveys assessed their knowledge and attitudes toward scientific writing, study design, bird identification, research methods, and citizen science. We expected positive changes in student awareness of citizen science, confidence in conducting a research project, and improved bird identification skills.

- Awareness of citizen science was improved with 92% of students correctly defining citizen science as the involvement of the public in the scientific research process.
- The post survey indicated that student confidence in conducting a research project remained neutral; however, 97% of students agreed that the project improved their research/survey skills.

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Undergraduates enrolled in the Wildlife Management Techniques course conducted bird research projects.

- Eighty-nine percent of the students agreed that the course helped them improve their bird identification skills. Based on the survey, students significantly improved their ability to identify birds by full common name, increasing their scores by an average of 17 points.
- Students gained experience in scientific writing, learned about experimental design, collected data, and interpreted their findings while working in a collaborative environment.
- With these newly developed skills, students become more marketable for future employment or graduate school opportunities.

Cooperative funding provided by the Elizabeth Huth Coates Charitable Foundation of 1992.

Migratory Movements and Stopover Use by Adult Reddish Egrets

Lianne M. Koczur and Bart M. Ballard

Reddish egrets are described as 'weakly migratory' based on recoveries of several individuals that were banded in Texas and resighted in Mexico, Guatemala, and El Salvador. However, the extent of migratory behavior and the ecology of migratory reddish egrets have not been studied. We attached GPS-equipped satellite transmitters to adult reddish egrets that were breeding in the Laguna Madre of Texas to examine migration patterns of this species.

- Reddish egrets breeding in Texas exhibited a partial migration strategy, with 11 of 27 marked birds migrating southward out of the Laguna Madre during winter.
- Departure of reddish egrets from the Laguna Madre coincided with the time in which available foraging habitat decreased.
- Four egrets migrated short distances (approximately 53 miles) into Tamaulipas, Mexico, and 7 migrated long distances (820 to 1,200 miles) to sites in Mexico and El Salvador.
- Egrets initiated migration at or after dusk; nearly all movements made during migration were during the night. Five major stopover sites were identified along the Gulf of Mexico coast, which were used consistently by long-distance migrants.
- Long-distance migrants used a short-flight migration strategy, often flying relatively short distances between successive stopover sites.

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Graduate student Lianne Koczur is preparing to release a white phase reddish egret with a GPS satellite transmitter.

- Our findings relating to stopover use and identification of critical stopover areas will enable wildlife managers to efficiently use resources to protect the most important areas for migrating reddish egrets.

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

Survey of Texas Rancher's Perceptions of Livestock-Predator Conflicts

Richard K. Brewster, Scott E. Henke, J. Alfonso Ortega-Santos, Benjamin L. Turner, and John M. Tomecek

Predator conflicts largely occur when predators interfere with human economic interests in livestock and wildlife. The goal of this research was to quantify the perceived threat of livestock depredation in Texas.

We surveyed ranchers regarding their beliefs toward predators, severity of predator damage, predator management efforts, coyote biology, and demographics of survey respondents. We received 460 responses from ranchers throughout Texas and assessed the findings.

- The majority of responses came from ranchers who were over 50 years old, 2nd generation or more cattle ranchers that derived more than 50% of their annual income from ranching, and owned properties in central and eastern Texas.
- Most ranchers (74%) considered predators to be a problem on their ranch, of which 62% deemed coyotes to be the greatest threat to their livestock.
- The majority of respondents (60%) believed livestock losses from predation occurred during the first 2 weeks after parturition, 50% believed that those losses accounted for less than 1% of their livestock herd, and 23% felt that predator losses accounted for 1 to 3% of their herd.
- Shooting was the most commonly used control method (89%); however, it was unclear whether these were planned or opportunistic approaches to coyote removal.
- Ranchers overestimated coyote size, abundance, and the carnivorous nature of coyotes, but they were accurate regarding coyote litter size.
- It is important to understand that experience, heritage, and knowledge vary greatly among Texas ranchers resulting in wide-ranging levels of tolerance towards predators and the perceived need for predator control.

Cooperative funding provided by Texas A&M AgriLife Extension Service.

Studying the 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 most common falcon in North America, but are declining in many parts of their geographic range. Knowledge of the ecology and demographics of kestrels throughout the annual cycle is an important step in understanding and addressing the widespread decline of this species. We initiated this study to estimate wintering territory size, survival, and site fidelity of wintering kestrels.

During October–December 2014 and 2015, we trapped 65 kestrels along county roads in agricultural areas. We re-sighted these individuals throughout the winter (September–March) for 3 seasons 2014–2015, 2015–2016, 2016–2017.

- For individuals with 10 or more locations, we took the maximum linear distance between locations to estimate territory size. The average territory size ranged from 1,743 feet in 2016–2017 to 2,443 feet in 2014–2015.
- Winter territory sizes (pooled over 3 years) were less than half the size of those previously reported in northern latitudes.
- Site fidelity adjusted for winter mortality and

dispersal ranged from 57 to 65%. These estimates of kestrel site fidelity are 10 to 19% higher than previously reported.
- We estimated annual apparent survival for kestrels at 48%. Although this is lower than estimates from a study in Florida (74% for females and 75% for males), it is similar to results from other studies.
- High site fidelity and small territory sizes indicate that agricultural areas in South Texas likely provide quality habitat for wintering American kestrels.

Cooperative funding provided by San Christoval Ranch and the Richard M. Kleberg, Jr. Center for Quail Research.

Efficacy of Sound-emitting Devices to Repel Nuisance Wildlife Species

Zachary Naegelin, Travis L. Dillard, and Scott E. Henke

White-tailed deer play the role of Dr. Jekyll and Mr. Hyde in Texas. Some people love deer because they constitute a billion dollar hunting industry, while others fear deer because the species represents economic losses resulting from vehicle collisions and damage to gardens and home landscape vegetation. To reduce economic losses, products that repel deer have been developed.

We tested the efficacy of a sound-emitting product that advertises to repel deer and other wildlife species for a 50-foot radius. We set up 4 feeder sites that dispersed corn 4 times per day and photographed animals that visited the feeders. We used a study design in which 2-week intervals were divided into 4 periods; periods 1 and 3 were control periods where sound-emitting devices were not used. During period 2, sound-emitting devices were used on 2 sites while the remaining sites were control sites, then during period 4 the treatment and control sites were switched.

- White-tailed deer, raccoons, javelina, and feral hogs consistently came to our feeder sites.
- The overall general trend was that the number of animals that came to the feeders and the number of visits per day by each species did not change among treatments.
- Time spent by each species at feeders with sound-emitting devices was greater than time spent at feeders without such devices.
- Sound-emitting devices appeared to deter animals initially for 1 to 2 days, but animals quickly became habituated to the effects of the device.
- Species use of feeders, in general, increased with successive periods.
- Wildlife species became habituated to the accessibility of food and perhaps remained near feeders. Therefore, sound-emitting devices as a single deterrent method are not effective in repelling nuisance wildlife species.

Wild Bird Conservation in the 6th and 7th Grade Classroom

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

Natural history and wildlife are topics put aside by teachers in the classroom because of the lack of time, resources, and priority preparation for state testing. This project provided students with wildlife education to enhance their knowledge of South Texas birdlife while reducing their disconnection with the outdoors. Five lesson plans aligned with state science standards composed the Wild Bird Conservation Curriculum: bird identification, mist-netting, citizen science, internal parasites, and habitat fragmentation. Thirty-six 6th graders and 49 7th graders from the Coastal Bend were assessed in their affinity and knowledge of wildlife, birds, and working with a scientist through pre- and post-surveys.

- There was no change in affinity before or after the lessons. Students reported that they "like wildlife" and "enjoy working with a scientist."
- Both 6th and 7th grade students showed positive

The 6th grade students of Sarita Elementary age quail wings as part of the Wild Bird Conservation Curriculum.

changes regarding their knowledge of and their ability to identify birds.
- The lessons provided local students with an introduction to a STEM (Science, Technology, Engineering, and Mathematics) career as a wildlife biologist and to learn about local birdlife.
- Lessons such as these provide students the opportunity to get outdoors and improve their awareness of wild birds.
- Teachers have the opportunity to supplement their existing lesson plans and enrich their own background in science.
- Scientists visiting the classroom benefit by developing their communication skills, enhancing community outreach programs, and by being given the opportunity to cultivate future conservationists.

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

Population Trends and Preferred Habitat of the Horned Lizard Species

Taylor M. Shedd, Scott E. Henke, and Humberto L. Perotto-Baldivieso

Horned lizards occur throughout much of the western United States; there are 9 species endemic to the United States. Much of the public has fond memories of growing up with horned lizards. Unfortunately, most species appear to be declining in abundance and distribution. Therefore, our objectives were to determine past and present distribution ranges and habitat use for each endemic species of horned lizard. We used current and historical records of occurrence and general habitat maps of the western United States to determine the trends in populations for each species.

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Most horned lizard species have declined across the western United States and may have an uncertain future.

- Distribution ranges were as small as 3,673 mi^2 for the flat-tailed horned lizard to as large as 412,645 mi^2 for the Texas horned lizard.
- Distribution ranges decreased for all species during the last 20 years, except for the regal horned lizard whose range increased by 5%.
- Short scrubland habitat was the most important habitat type for each horned lizard species, constituting 40 to 82% of the species' distributions.
- The acreage of short scrubland habitat decreased by as much as 28% during the last 20 years for all species except for round-tailed and regal horned lizards, for which the preferred habitat acreage increased by 4%.
- Information derived from this study identified the downward population trend for this iconic group of reptiles and can be used as a base to develop future research and management strategies.

Creating Nesting Habitat for the Colonial Breeding Reddish Egret

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

The reddish egret is the rarest heron in North America and relies on shallow, coastal wetlands throughout the year. The reddish egret breeding population in Texas has declined by approximately 30% since the 1970s. Nearly half of the breeding population of reddish egrets in the United States occurs within the Laguna Madre of Texas, where they nest on islands created from dredge spoil deposition.

We developed a spatial model to identify areas within the Laguna Madre that would be priority sites for creating new dredge spoil islands and for restoring currently unused islands. Priority scores ranging from 0–100 were assigned to each area based on several ecological parameters, including the amount of foraging habitat, distance from the mainland, and distance from active colonial nesting islands.

- Approximately 83,600 acres were identified as priority sites for island establishment.
- Priority scores ranged from 25 to 78, with higher

priority sites (50 to 78) located in both the upper and lower sections of the Laguna Madre.
- The area with the highest priority score was located in the southern portion of the Laguna Madre.
- Our research provides guidance for use of dredge material from dredging operations in the Laguna Madre to benefit reddish egrets and other colonial nesting waterbirds.

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

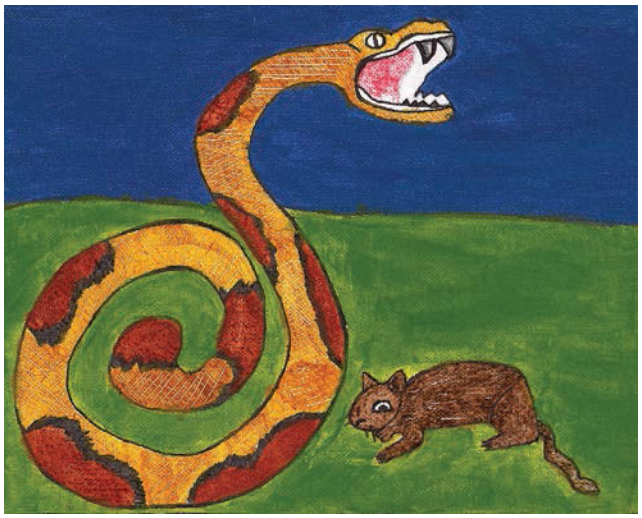
Full STEAM Ahead Educational Outreach Program

April A. Torres Conkey and Mary E. Green

Using art to engage students in learning about their environment involves them cognitively and emotionally, but art programs in primary schools are often lacking or underfunded. The Texas A&M University-Kingsville Rural Arts program collaborated with the CKWRI in an arts educational outreach program for 4th and 5th grade students from the Driscoll Independent School District.

After a field trip to Texas A&M University-Kingsville, where the students learned about local ecosystem food chains (using rattlesnakes in South Texas as the focus animal), they painted a native snake in its environment (including a plant, a herbivore, and a carnivore in the scene). Student learning was assessed by scoring and comparing their pre-activity drawing with their post-activity painting.

- Most pre-activity drawings were of snakes in a desert with saguaro cactus, while post-activity paintings featured snakes in settings more closely related to South Texas.
- Some students who had previously not expressed interest in art became more engaged by the topic of painting a snake (and predator-prey interactions).
- Students correctly described artistic techniques they used to enhance the details in their paintings of animal features (such as scoring to create snake scales or fur patterns).
- Teachers reported that the students were able to transfer their knowledge and apply food chain/web terminology to a separate reading assignment.
- Students were better able to represent snakes and components of their environment and to communicate what they learned by the end of the program.



A painting by 5th grade student Ava Meza-Briones of a copperhead snake violently hissing and going to attack a wild field mouse.

- A lesson plan based on our research findings has been created, and over 20 teachers have been trained on its use.

Cooperative funding provided by the Texas Women for the Arts.

The Effectiveness of using Nail Polish to Mark Turtles for Population Assessment

Mitchell M. Green, Matthew Hewitt, Christina Richey, and April A. Torres Conkey

Turtles can be used as an indicator of pond health, and their population size can be calculated using mark-recapture methods. Marking turtles is usually conducted using a wood file to make a series of unique notches along the edge of the shell. However, this method is time-consuming, difficult for students to master, and cannot be used on soft-shell turtles. This study was part of an Honors student project for the Wildlife Management Techniques course at Texas A&M University-Kingsville to learn about the effectiveness of using nail polish to mark turtles.

We used hoop nets baited with sardines to capture turtles for 6 days at the pond at Dick Kleberg Park, Kingsville, Texas. Hard-shelled turtles were marked with red colored quick-drying nail polish on the claws of their front feet and by painting a number on the top of their shell. The turtles were measured and released back into the pond.

- Twenty-one turtles were caught during the study (18 red-eared sliders and 3 spiny softshell turtles).
- Nail polish wore off the claws of recaptured turtles within 1 day.
- Nail polish on the shell of recaptured turtles lasted through the week.
- The population size in the pond was estimated to be 81 turtles (a healthy population).
- We concluded that nail polish was not effective on turtle claws, but it could be used as a non-invasive marking technique on the shell of hard-shelled turtles for a short-term study.

Breeding Birds and Their Habitat on the East Foundation's El Sauz Ranch

Janel L. Ortiz, April A. Torres Conkey, Leonard A. Brennan, Humberto L. Perotto-Baldivieso, David B. Wester, and Tyler A. Campbell

Breeding birds must select sites that are most suitable in resources (food, shelter, protection) for themselves and their young. Considering the needs of reproductive birds, habitat and productivity can be considered important factors in the number of birds and species found in an area.

We conducted breeding bird surveys on the East Foundation's El Sauz Ranch in South Texas during May and June 2014–2016. We looked at productivity, a measure of landscape "greenness" using the normalized difference vegetation index (NDVI), and structural measures of spatial distribution of vegetation patches to determine habitat relationships among bird numbers and bird feeding styles (ground, air, canopy/shrub/bark feeders).

- The relationship between bird numbers and vegetation greenness (NDVI levels) depended on the year (i.e., average versus wetter) and greenness in months prior to and during bird surveys.
- In an average year, greenness had very little effect on May bird numbers, yet June bird numbers were positively and negatively related to May greenness depending on level.
- In a wetter year, bird numbers were positively related to previous greenness levels in both survey months of May and June.
- Ground feeding birds appeared to be highly influenced by landscape structure in comparison with air and canopy/shrub/bark feeding birds, meaning they may require more complex habitat characteristics.

The painted bunting occurs in South Texas during the summer breeding season.

- Breeding bird surveys can help monitor bird species and numbers on the East Foundation's El Sauz Ranch during migration and for those species occurring during the summer breeding period.

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

Analyses of Home Range Size and Habitat Use of GPS Collared Pronghorns in Texas

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

Pronghorn movements and habitat use are influenced by human-related impacts on the landscape, including livestock fences and brush encroachment. However, the effects of landscape alteration on pronghorns have rarely been quantified. We evaluated pronghorn home range and habitat use in an area with agriculture and livestock production in Texas.

Pronghorns were captured and fitted with GPS collars at 2 sites in the Panhandle during March 2014 and in the Trans-Pecos during February 2015. We determined seasonal home range size. Habitat use and availability were quantified at the animal and landscape scales.

- We observed that pronghorn movements were limited most by fencing and high-traffic highways.
- There was no statistical difference in home range size between the sexes.

- Home range size was larger in the Panhandle (Dalhart study site, 2,891 acres; Pampa study site, 3,039 acres) than the Trans-Pecos (Alpine study site, 470 acres; Marathon study site, 1,804 acres).
- Habitat use for each region corresponded to habitat availability. Pronghorns in the Panhandle used 60% grassland (56% available), 20% shrubland (20% available), and 17% agriculture (20% available). Pronghorns in the Trans-Pecos used 70% grassland (65% available), 18% shrubland (21% available), and 11% scrub (14% available).
- We concluded that differences in home range size between the ecoregions are the result of livestock fencing, agriculture, and brush encroachment.

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).

Ecology of the Texas Tortoise on Managed South Texas Rangelands

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

The Texas tortoise is found in southern Texas and northern Mexico in thornscrub communities of the Tamaulipan Biotic Province. We tracked tortoises with radio telemetry from 2015–2016 on a hunting ranch in Jim Hogg County during their active season (April–November).

Tortoises must retreat to a cooler microhabitat during the day as mid-day surface temperatures during the summer are lethal to tortoises. Our objectives were to determine how tortoises move around the landscape and what habitat characteristics are important to them.

© Greg Lasley

Our research into the ecology of the Texas tortoise provides information that is useful in their management.

- Overall, adult males had the largest home ranges. The smallest home range recorded for adult males, adult females, and juveniles was 3.8 acres, 0.9 acre, and 0.1 acre, respectively. However, much larger home ranges were occupied by other individuals in each age and sex class as home range size was highly variable.
- Many ground cover components, particularly dead grass, offered good screening cover to shade tortoises. Although tortoises feed on pads and tunas of prickly pear, there was no difference in prickly pear coverage between locations used by tortoises and random locations.
- Brush was an important habitat component for tortoises. Forty-eight percent of survey transects at locations used by tortoises fell underneath brush taller than 3 feet, whereas only 30% of transects were covered at random locations.
- Tortoises usually avoided areas with sparse or dense brush (less than 20% or greater than 80% canopy coverage).
- It appears the habitat needs of the Texas tortoise are best met in areas with a mosaic of woody cover, herbaceous cover, and bare ground.

Cooperative funding provided by Encino Lodge, Quail Associates Program, and the Richard M. Kleberg, Jr. Center for Quail Research.

Cost Analysis of Coyote Removal to Aid Cattle Production in Texas

Richard K. Brewster, Scott E. Henke, J. Alfonso Ortega-Santos, Benjamin L. Turner, and John M. Tomecek

Coyotes are native canids that range across North America and continue to be reported as a top predator of livestock. For example, a 2011 USDA survey in Texas reported that coyotes were the top predator of cattle and calves, killing more than 17,000 calves. Ranchers throughout Texas contribute considerable time, money, and effort to remove coyotes through various lethal and non-lethal methods.

Our objective was to determine the cost effectiveness of the various methods and combinations of methods of coyote control. We used modeling software to conduct multiple scenario simulations based on coyote population, ecological limitations, various

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Many ranchers consider coyotes as major predators on their livestock, but do not recognize the benefits of coyotes.

coyote control methods, timing of control application, cattle price, and percentage of calves depredated. Eighty-eight scenarios were tested for individual and multiple coyote management methods and number of applications of those methods per year.

- Use of snares (applied a month prior to calving) combined with the year-round use of livestock guard animals was the most effective method of coyote predation control for cattle.
- Model scenarios using continuous coyote management throughout the year indicated that a dedicated call and shoot approach and/or use of livestock guard animals provide the greatest overall benefit to cattle producers.
- The ecological value of coyotes to ecosystems (i.e., predator of rabbits, which are grazing competitors with cattle) would likely negate the negative effects of cattle predation.
- The ecological value of coyotes should be considered by ranchers before lethal coyote management methods are used.

Survival of Adult Reddish Egrets Marked with Satellite Transmitters

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

The reddish egret is a priority species for conservation throughout much of its range. Survival rates of juvenile reddish egrets have been examined; however, there are no estimates of adult survival. In long-lived species, adult survival is particularly important because of its influence on the rate of population growth. Determining survival rates during all life stages can be important in directing conservation efforts to times in which survival is lowest. We used data from 30 adult reddish egrets marked with satellite transmitters to model monthly survival for the period June 2010–August 2016.

- Monthly survival of adult reddish egrets was best explained by season, with lower survival during the nonbreeding season (95% survival) than the breeding season (99% survival).
- Overall annual survival was 76%.
- Eleven of 15 known mortalities occurred in Texas.
- We did not detect differences in survival between resident and migratory reddish egrets.
- Males and females survived at similar rates over the study period.
- Further investigation is needed to understand those factors causing lower survival during the nonbreeding season.

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

A Theoretical Harvest Model for American Alligators in Texas

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

Harvest of alligators typically includes egg collecting and hunting. However, the effects of harvest on alligator populations have received little to no scientific scrutiny. A theoretical simulation model was developed to evaluate the impact of several harvest strategies on long-term (i.e., 100 years) alligator population trends. System dynamics software was used to develop the model, and data for the model were acquired through literature and anecdotal information on alligator ecology.

- Current harvest (50% egg harvest, 2% subadult harvest, 2% adult harvest) in Texas is sustainable, but alligator populations will stabilize at levels below their population potential.
- The best scenario for a sustainable harvest that maintains alligator populations at a relatively unchanging level is a 38% egg harvest, 2% subadult harvest, and 2% adult harvest.

- An elevated egg harvest (80%) can be sustained if no hunting harvest occurs.
- An increased alligator hunting harvest (4% subadult, 4% adult) can be sustained if there is no harvesting of eggs.
- Our model identifies the function of current alligator harvest within populations and provides a tool for future use in determining the effect of changes in harvest or life-history characteristics on alligator population dynamics.

Cooperative funding provided by the Rob and Bessie Welder Wildlife Foundation, Harry L. Willet Foundation, and the Texas A&M University-Kingsville Council for Undergraduate Research.

Impacts of Eagle Ford Shale Exploration on Avian Nesting and Abundance

Kelsey R. Davis, William L. Lutz, Jr., Eric D. Grahmann, Fidel Hernández, Chase Currie, Timothy E. Fulbright, David B. Wester, Humberto L. Perotto-Baldivieso, and Fred C. Bryant

South Texas is an important area for avian conservation because it contains large tracts of unfragmented habitat, mostly in the form of privately owned ranches. However, the recent increase in oil and gas exploration in this area, especially within the Eagle Ford Shale formation, has the potential to negatively impact bird populations. The objective of this study was to determine how birds respond to disturbances related to oil and gas exploration.

Our study took place on 2 adjacent ranches located in Dimmit County during March–October 2015 and 2016. Study sites were located on oil and gas exploration areas (disturbed) and areas where no exploration activities occurred (undisturbed). Sound levels were recorded using a sound level meter, and traffic rates were measured using traffic counters. Nest searches and bird counts were conducted to measure avian nest site selection, nest success, and abundance.

- Birds avoided sites with sound levels about 1–3 decibels above ambient sound levels.
- Nest success was greater in the undisturbed areas (69% of 13 nests) than in the disturbed areas (41% of 17 nests).
- Mean relative abundance was lower in undisturbed areas (2.1 birds per point) than in disturbed areas (3.0 birds per point).
- The apparent impact of oil and gas exploration noise on avian nest site selection and abundance is an important management consideration as production in the Eagle Ford Shale region continues.

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

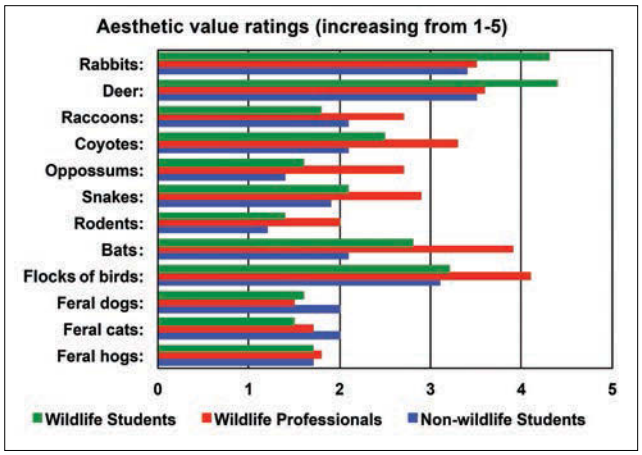
Survey of Local Attitudes Toward Wildlife Damage and Control

Heather J. Hannusch and April A. Torres Conkey

A first step for wildlife managers to meet the needs of the human community is to assess perceptions, values, and limitations. Because perceptions are influenced by culture and experiences, they are likely to vary between localities.

As part of an Honors student project for the Human-Wildlife Conflict Resolution course at Texas A&M University-Kingsville, we developed a survey to assess local attitudes toward wildlife damage. Three groups of individuals were surveyed: non-wildlife students, wildlife students, and wildlife professionals (veterinarians, professors, and wildlife control agents). We expected that wildlife professionals would exhibit ecologically sound perceptions based on their occupation, experiences, and knowledge. Analysis was conducted on 30 completed surveys (10 from each group).

- Most of the survey respondents viewed wildlife as valuable ecologically, aesthetically, scientifically, and recreationally.
- Non-wildlife students most often reported that they did not experience wildlife damage, yet they felt



Non-wildlife students, wildlife students, and wildlife professionals were asked to rate wildlife on a scale of low aesthetic value (0) to high aesthetic value (5).

stronger than wildlife students and professionals that "pest" species were creating damage; however, they valued feral cats and feral dogs more than the other survey groups.
- Wildlife students and professionals had similar perceptions regarding wildlife damage; professionals were more tolerant of and placed greater ecological value on "pest" species, but they were less tolerant of feral dogs, cats, and hogs.
- All groups reported that they would support lethal removal of wildlife damaging their property; however, wildlife professionals were more likely to advocate relocation.
- All groups supported the idea that humans should change their attitudes/behaviors to address wildlife conflict issues (instead of changing resources or trying to change animal behavior).
- Surveys are useful to identify community perceptions and to target education programs to prevent over-reactions and minimize misconceptions when implementing wildlife control measures.

Effects of Density, Sex, and Age on Growth and Survival of Hatchling Alligators

David M. Campbell, Scott E. Henke, and Cord B. Eversole

The American alligator is an iconic wetland and keystone species that has rebounded from its endangered status within the past 30 years. Strict harvest regulations have been cited as the most important factor in the restoration of alligator populations. However, liberal harvest of alligator eggs could put alligators back on the threatened and endangered lists. Knowledge of the ecology of hatchling alligators is sparse, but it is critical in making informed decisions about alligator management. Our objectives were to determine the effects of density, dominance, sex, and age on growth and survival of captive hatchlings housed in aquaria.

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Alligators are a conservation success, and state agencies now allow the harvesting of individuals and eggs.

- Of 21 hatchling alligators, 48% survived their first year with a density of 2 or more alligators per 50 ft^2 of surface area within the aquatic tank.
- Dominance was not related to sex or size, but individual temperament.
- Males grew at a faster rate than females; however, most growth occurred June–August for both sexes.
- Because alligators become sexually mature at a certain size rather than a certain age, knowing sex-based growth rates and annual survival is important to determine recruitment. This information can be used to develop better management strategies.

Space Use and Movements of Adult Reddish Egrets during Winter

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

Much of the research conducted on the reddish egret has focused largely on breeding ecology. Little research has been conducted on their winter ecology. Consequently, much remains unknown about this portion of their annual cycle. We used GPS-equipped satellite transmitters to learn about habitat use and winter site fidelity of reddish egrets.

- Reddish egrets breeding in Texas wintered at sites in Texas, Mexico, and El Salvador.
- In Texas, reddish egrets selected unvegetated wind tidal flats for roosting and foraging, and they avoided areas that were predominantly seagrass.
- Sixty-six percent of the reddish egrets showed considerable overlap of roosting and foraging areas within a winter season.
- Daily flight distances from roosting to foraging locations ranged from 0.1 to 3 miles on average, and females flew farther distances than males.
- Reddish egrets exhibited a relatively high degree of fidelity to winter sites across years.
- Information gained from this study aids in directing conservation efforts for the species.

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

Evaluating the Status of Horned Lizards in the United States

Taylor M. Shedd, Scott E. Henke, and Humberto L. Perotto-Baldivieso

Horned lizards are iconic reptiles native to the western United States. To learn more about this group, we surveyed state wildlife agencies in the western United States to determine the legal status, current relative abundance, population trends, and distribution of the 9 species of horned lizards.

- No state agency actively conducted surveys to assess populations of horned lizards. Either the surveys were not conducted within a state, or state agencies relied on external organizations and citizen science groups to determine the distribution and relative abundance of horned lizards.
- The range of distributions was as little as a small region of southeastern California and southwestern Arizona for the flat-tailed horned lizard to as big as 12 states for the short horned lizard.
- The legal status of horned lizards varies greatly by species and by state. For example, the Texas horned lizard is listed as threatened by Texas, protected in Colorado and Oklahoma, but has non-game status in New Mexico, Kansas, and Missouri.
- The majority of horned lizard species have unknown or declining populations, yet over 50% of the western states allow commercial or hobby collection of horned lizards.
- We argue for a moratorium on collection of horned lizard species until a national survey can be conducted to establish baselines for abundance and distribution of each horned lizard species after which proper management can be instituted.

Assessing the Effects of Land Use on the Ethiopian Hedgehog in Qatar

Mohammad A. Abu Baker, Nigel Reeve, Ivan Mohedano-Mendez, April A. Torres Conkey, David W. Macdonald, and Nobuyuki Yamaguchi

The State of Qatar has one of the fastest growing economies in the world. With this growth, human alteration of natural environments can have major effects on native wildlife species such as the Ethiopian or desert hedgehog.

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A GPS tracking tag, located on the back of a Ethiopian hedgehog, was used to determine movement patterns.

Although European hedgehogs are well studied, little is known about their biology. We used GPS tracking to study the effect of land use on the home range size and movement patterns of free-ranging Ethiopian hedgehogs. The study areas were an irrigated agricultural farm and a natural desert environment within a biosphere reserve.

Free-ranging Ethiopian hedgehogs were caught at each site from April to June of 2014 and 2015, marked, sexed, and weighed. GPS and VHF radio tags were glued to the back of 24 (12 ♂, 12 ♀) hedgehogs at the farm and 22 (12 ♂, 10 ♀) at the biosphere reserve.

- Hedgehog home ranges in the reserve (average of 568 acres for males and 371 acres for females) were over twice the size of the home ranges in the irrigated farm area.
- Most home ranges of individuals overlapped with several other individuals of either sex suggesting non-territorial promiscuous mating behavior, but there was a greater overlap in the farm area.
- Females were heavier than males, but body weight had no effect on home range size.
- Home ranges for both sexes were smaller at the farm site suggesting that hedgehogs used resources on the farm (food, water, and shelter), whereas hedgehogs in the desert reserve had to range farther to find resources and mates.

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