Caesar Kleberg Wildlife Research Institute

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Current Research 2013–2014

This year's cover features a photograph of a mottled duck. This waterfowl species is a year-round resident of South Texas, which relies on coastal wetlands.

Editor Alan M. Fedynich, Ph.D.

December 2014

Report of *Current Research*

September 1, 2013 to August 31, 2014

Caesar Kleberg Wildlife Research Institute

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FOREWORD

In our darkest hour, back in 2009, many of you stepped up to help us through our *Caesar Kleberg Partner and Sustaining Contributors* Program, or you made donations to our programs in other ways. This was a Godsend. Your donations saved jobs and other painful cuts that would have significantly reduced our ability to deliver the research results that hopefully would help you conserve and manage your habitat and the wildlife that live there.

Today, we are healthier than ever. We invest your donations wisely in critical personnel, projects, and published materials like newsletters and our most recent bulletin "*Quail Harvest Guidelines*." And occasionally, we buy equipment that we could not have afforded otherwise: a boat trailer for work on the Gulf coast, laboratory equipment, or a truck to replace the one that had 160,000 miles on it.

As we look to the future, the CKWRI Advisory Board has stressed to me how much we need to be able to quickly launch into new, emerging areas of research, as well as stabilize our annual funding base. Every long-time supporter I know would love to see CKWRI live far out into the future—beyond my time here and beyond those who are actively and passionately giving to our programs, whether it be a $25–$100 gift each year, or those who give to us as *CK Partners* or *Sustaining Contributors*.

Several donors have stepped forward, quietly, to lead a new effort in building our endowment, which is already beyond $17 million. We will soon announce a new campaign "***Positioning CKWRI for Future Generations***," with a goal of growing our endowment by $40 million over the next 3 years. It is exciting to know we are almost halfway there.

When I think about all of the heartwarming examples that have happened to me over the past 18 years, I know it is possible. Examples are those who wouldn't let us borrow their tractor, but purchased one for us instead when we were desperate to get our first native seed harvest in the barn. Examples are those who gave so we could place a quail scientist in San Antonio. Examples are those who have given memorial gifts in the name of loved ones, some of which grew to an endowment of over $70,000, like the gifts in memory of Grady Cage. Examples are those who call me to make sure their annual gift will be received on time because they couldn't bear for it to come a day late.

In closing, funding is important, but it is not all about funding. We believe that we have captured 'lightning in a bottle' because our landowners, ranch managers, donors, and Advisory Board Members share a common passion—that science and research should be the backbone of our conservation and management efforts in South Texas. This shared vision and passion transcends politics and where we came from. This shared vision and passion is why every person at the Caesar Kleberg Wildlife Research Institute can't wait to get to work every morning, no matter how dog-tired they were the night before. Your continuing support inspires us to do our job better every single day.

Please know how much we appreciate every one of you for what you do for us. We are blessed beyond measure.

We hope you have the best Christmas and Holiday Season ever!

Fred C. Bryant

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Students listed above have participated in various CKWRI research studies and their abstracts are presented throughout the Current Research report.
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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**** End of Completed Comanche-Faith Project Abstracts ****

HABITAT RESTORATION AND ENHANCEMENT

BIOLOGY, ECOLOGY, AND MANAGEMENT

Hixon Ranch Bobwhite Habitat Restoration Project

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

Northern bobwhite numbers have declined because of non-native grass invasion, changes in land use, and habitat fragmentation. Large-scale restoration sites are needed to quantify the effects of habitat restoration efforts on bobwhites. Conserving wild quail in the future may depend on our ability to restore habitat and, in particular, to connect areas of remaining habitat by creating corridors of restored habitat. The Hixon Ranch Project is a large-scale research study attempting to create one of these quail habitat corridors and is the largest restoration research project attempted in South Texas.

Prior to this restoration project, we conducted a 4-year pilot study to develop the best restoration treatments for the large-scale study. We then selected a 300-acre pasture to restore that was dominated by non-native grasses and a nearby area of similar size that was used as an experimental control (no modification of habitat). We burned the 300-acre pasture in January 2014 to clear standing vegetation. Following burning, most of the brush was cleared using a dozer, but leaving some brush mottes for cover. We will repeatedly disc the entire 300 acres each time the non-native grasses sprout until the non-native seeds are not present in the soil. Following discing, we will sow locally adapted seeds of native forbs and grasses. We will also plant mottes with woody plants and prickly pear. We will monitor changes in vegetation and wildlife use from 2013 through 2017.

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

Restoring Bobwhite Habitat: Vegetation Dynamics

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

The introduction of non-native grasses into South Texas for cattle production has dramatically changed the landscape. The dominance of non-native grasses has been found to lower the quality of many wildlife species including northern bobwhites. Buffelgrass and Old World bluestems cover much of South Texas including the area that is currently being restored on the Hixon Ranch. By removing these non-native grasses, we hope to greatly improve the vegetation community, which will provide for better quail habitat.

We sampled the vegetation community in June and October 2013 before the restoration process. Buffelgrass represented 72 to 75% of the herbaceous vegetation on the site intended for restoration and Old World bluestems accounted for another 14 to 17%. All native plant species combined contributed only 7 to 16% of the total herbaceous vegetation. The vegetation community on the study site will be sampled biannually until 2017 to determine patterns of establishment of sown native grasses.

Through this monitoring effort, we hope to observe a major increase in native vegetation as a result of the restoration process. Monitoring will also allow us to determine the rates at which the surrounding non-native species re-invade into a large tract of native habitat in South Texas.

Restoring Bobwhite Habitat: Effects of Herbicides on Exotic Grasses

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

The control of non-native invasive plant species is one of the most difficult processes that a landowner can face. Buffelgrass and Old World bluestems in South Texas are detrimental to northern bobwhite habitat. They are very difficult to remove once they become established, and herbicides are one of the most common tools used for control.

Roundup is an effective and affordable herbicide for most plant species, but requires many applications to remove buffelgrass and Kleberg bluestem. Our goal is to find a herbicide that needs fewer applications than Roundup and effectively kills the invasive grasses.

We will be testing the effectiveness of Roundup, Pastora, Pursuit, and a combination of Pastora and Pursuit. Our herbicide-treated plots will be replicated multiple times in a buffelgrass dominated grassland as well as a Kleberg bluestem dominated grassland. The different herbicides will be compared with control plots (no herbicides applied) to determine which herbicides effectively control the invasive grasses.

Our study will provide insight as to whether Pastora or Pursuit can be used as a viable replacement for Roundup. Additionally, information from our research may aid in developing better management strategies to control buffelgrass and Old World bluestems.

Restoring Bobwhite Habitat: Seed Bank Dynamics

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

Buffelgrass and Old World bluestems are invasive, exotic grasses that have replaced native vegetation throughout South Texas. These grasses reduce habitat quality for northern bobwhites and other wildlife and reduce plant species diversity. We are attempting to remove these invasive species using a repeated discing technique that we developed in previous pilot studies. The process involves repeatedly discing new growth of the exotic species until the soil seed bank appears to be depleted of the seeds from these plants. After the seed bank has been depleted, the area will be sown with native plant seeds. One of our objectives is to examine the soil seed bank before and after discing to determine the depletion rates of exotic grass seeds and to determine existing banks of seeds important as food to northern bobwhites.

We began this study by sampling the seed bank prior to the restoration process. The seed bank samples are being grown in a greenhouse where seedlings will be identified. As the restoration process continues, the seed bank will be sampled periodically until there are no more invasive seeds observed in the samples.

Many restoration projects have established native vegetation for a few years, but those projects never truly depleted the seed bank. Consequently, non-native species became reestablished.

This study allows us to determine whether repeated discing is truly depleting the seed bank. Additionally, by understanding what native seeds are already in the seed bank, we will have a better idea of what seeds should be sown after discing.

The Effects of Restoration and Thermal Environment on Bobwhite Habitat Use

Monika L. Burchette, Timothy E. Fulbright, Fidel Hernández, David B. Wester, Forrest S. Smith, and Eric D. Grahmann

Restoration of areas invaded by exotic grasses to native grasslands may be critical for the conservation of northern bobwhites. Little is known regarding how large-scale restoration affects the thermal conditions of the habitat. Our objectives are to (1) determine how different thermal stresses influence habitat selection of bobwhites during and after restoration of pastures to native vegetation, (2) examine quail-habitat interactions during restoration, and (3) compare thermal factors at brooding sites versus random sites.

Northern bobwhites will be trapped and collared with radio transmitters from April to August in 2013 and 2014 on 2 study sites. These birds will be monitored, and the following data will be collected: Global Positioning Systems (GPS) location of the bird, type of vegetation community, vegetation within 1.5 feet of bird location, soil temperature, wind speed, black globe temperature, ambient temperature, and cloud cover. A random location point will also be sampled, and data will be collected on the same variables. Bobwhite location points and random location points will be compared to determine environmental variables important in habitat selection by bobwhites.

To date, we have captured 402 northern bobwhites and placed transmitters on 82 of these individuals. Adult bobwhites have avoided soil surface temperatures exceeding 99° F and brooding adults avoided areas above 95° F. We will create a Geographic Information Systems (GIS) map to analyze the aver-

© Larry Ditto

Although bobwhites occur throughout South Texas, certain areas are unusable because of excessive soil temperatures.

age operative temperature from 16 stationary black globes within each of 5 plant communities (mesquite motte, grassland, single shrub, Tamaulipan, and riparian) on both study sites. We hope to determine what vegetation communities support suitable thermal environments that will provide for a productive and huntable bobwhite population.

Wildlife Response to Bobwhite Habitat Restoration

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

Non-native grasses such as buffelgrass and Old World bluestems have spread throughout much of South Texas. They degrade habitat for bobwhites; however, the effects of these non-native grass invasions on most wildlife species are not well known. An important question in restoration ecology is whether restored native plant communities can support similar wildlife diversities compared to natural communities. The studies that have been conducted on this topic have typically used small study areas (less than 5 acres), and it is unclear how the results and conclusions would vary if larger study sites were used.

To learn more, we started a large-scale restoration project converting a buffelgrass pasture to native grassland during January 2014. In this study, we will document the response of birds, small mammals, and pollinators to this restoration project.

We will be monitoring wildlife in 3 separate 300+ acre pastures: one pasture will be burned and then repeatedly disced followed by a planting treatment (restoration treatment pasture), one will serve as an unaltered buffelgrass pasture for comparison (non-native control pasture), and another will serve as an unaltered native comparison (native control pasture). We will survey for small mammals during the spring (March–April), breeding birds during the summer (June–July), butterflies during the fall (September–October), and nonbreeding birds during the winter (December–January).

© Timothy Fulbright

Workers burned a pasture prior to discing and planting it with native vegetation on the Hixon Ranch.

It is expected that diversity and abundance of animal and pollinator species will increase in the restored pasture compared to the exotic grass pasture. Our work will provide insight about the effects of restoring native plant communities for northern bobwhites and the effect it has on small mammals, birds, and butterflies that use these same habitats.

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

Scaled Quail Habitat Use and Resource Selection

Holley N. Kline, Timothy E. Fulbright, Fidel Hernández, Eric D. Grahmann, and Leonard A. Brennan

Scaled quail populations have been declining since the 1960s throughout their range, but the trend is particularly apparent in South Texas. While the cause of the scaled quail decline is unclear, habitat loss and fragmentation may be the driving factors. Our objective is to test the hypotheses that scaled quail (1) prefer landscapes with low levels of exotic grasses, (2) select less fragmented landscapes, and (3) select for cooler microsites within the overall habitat.

Scaled quail will be radio-collared and located during April–August 2013 and 2014 on 5 ranches in LaSalle County near Cotulla, Texas. Vegetation composition, as well as air and soil temperatures, will be determined at quail locations, nest sites, and random sites. The monitored location of each bird will be imported into a Geographic Information Systems (GIS) software database and used to determine home range and core area sizes. Vegetation variables and temperatures will be compared between sites used by scaled quail and random sites to determine the variables that are important in habitat selection at the individual, core area, and home range scales.

Currently, 120 scaled quail have been radio-collared and monitored. Average woody canopy cover and average prickly pear canopy cover at sites

used by scaled quail were not different from random sites. Woody plant height was slightly taller (0.5 feet) at used sites than at random sites. Also, average soil temperatures and temperatures experienced by the birds at used sites have been 9° F and 4° F lower than at random sites, respectively. However, selection for temperature by scaled quail depends on the time of day. As we continue this research, we hope to identify habitat variables associated with providing thermally and structurally usable areas for scaled quail.

Cooperative funding provided by the South Texas Chapter of the Quail Coalition, South Texas Charity Quail Hunts, Inc., Hixon Ranch, and San Antonio Chapter of the Quail Coalition.

Response of Bobwhites to Hydrological Habitat Enhancements

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

Productivity of northern bobwhites in South Texas is dependent on rainfall, a relationship readily apparent in nature and supported by numerous investigations. Results from previous studies lead to the question of whether adding water at the pasture scale can negate drought effects on bobwhites by providing oases of lush vegetation with high arthropod availability across the landscape.

During 2013, the Energy XXI Lease on the Eshleman-Vogt Ranch in Jim Hogg County, Texas installed an irrigation system across part of the property on 2 pastures. We began this study to investigate the hypothesis that adding supplemental water to the landscape during dry conditions would maintain or increase bobwhite productivity and abundance.

Bobwhite hens were fitted with radio collars and tracked throughout the breeding season to record movements, breeding season survival, nesting success, nesting rate, and nesting season length. Annual productivity will be based on age ratios from hunter harvested birds and fall densities estimated by helicopter surveys. Arthropod abundance at watered and non-watered areas will be studied to determine the role this treatment has on providing food to nesting hens and young chicks. Furthermore, vegetation structure of preferred brood habitats will be compared to that found on watered areas.

This study will seek to investigate mechanisms linking northern bobwhite productivity and landscape-scale irrigation (simulating the effects of rainfall).

Sprinklers at Encino Lodge in Jim Hogg County, Texas are intended to provide supplemental water to the landscape.

Additionally, we will provide recommendations to landowners and wildlife managers regarding the use of this quail management practice.

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

Qualitative Method for Detecting Aflatoxin for Use in Quail Management

Brent C. Newman, Scott E. Henke, Greta L. Schuster, Alan M. Fedynich, and James Cathey

Populations of bobwhites have steadily declined in the United States. To aid populations, wildlife managers have provided bobwhites with supplemental feed to counter potential nutritional deficiencies.

While supplemental feeding may be considered beneficial, cereal grains used in such a practice are also susceptible to the production of aflatoxin, a harmful fungal metabolite that can negatively affect bobwhites by reducing weight gain, cause reductions in serum proteins, lipids, and calcium, impair kidney and liver function, reduce immune function, cause hepatitis, and may lead to death. The Texas Parks and Wildlife Department has recommended that 50 parts-per-billion of aflatoxin should not be exceeded in wildlife feed.

Testing for aflatoxin can occur when the feed is packaged. Unfortunately, the fungus can continue to grow after grains are packaged. Consequently, actual concentrations may be higher after a sufficient amount

of time is spent in transit or storage before actual field use. Currently, ranchers must purchase expensive, specialized equipment and be trained on equipment use or send samples to a laboratory for determining aflatoxin concentrations in which several days may pass before the results are known.

As the ranching community continues to voice concerns about feeding aflatoxin-tainted grain to wildlife, no inexpensive, user-friendly method for detection is available. Therefore, our objectives are to (1) develop a simplified method for the detection of aflatoxin that can be performed by a rancher without the need for specialized equipment and (2) develop monitoring methods of stored grain that can benefit ranchers by reducing the growth of fungus on the grain.

This project is aimed to benefit ranchers who wish to monitor aflatoxin levels in quail feed, but who cannot afford the expensive equipment or have the time to receive specialized training.

Cooperative funding provided by Texas A&M AgriLife Extension Service and Ben and Rachel Vaughan Foundation.

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

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

Within declining quail populations, there is much spatial variability in the rate of decline. Populations in the southwestern United States have generally exhibited more stable population trends, though recently, local declines have become evident. The ultimate cause of declining quail populations appears to be changing land-use practices resulting in habitat loss and fragmentation. Along with direct effects, habitat loss and fragmentation also may indirectly affect quail by making populations more vulnerable to external factors such as predation and climate. Our objective is to evaluate the influence of habitat area, raptor abundance, and climate variation as explanatory variables in the bobwhite and scaled quail declines.

Our study will span the southwestern portion of the bobwhite's range and the entire scaled quail range and include data from the last 20 years. We will test the individual contributions of multiple factors as they affect quail population trends. Quail abundance data will be obtained from the North American Breeding Bird Survey (BBS) dataset. Habitat variables to be considered will include the amount of habitat available and various measures of fragmentation. We also will determine population trends of raptor species known to be quail predators. Climate variables to be tested will include measures of temperature and precipitation, as well as drought indices. Though the effects of habitat loss may be the ultimate factor in the quail decline, other factors may be contributing or compounding these effects. Understanding how these factors influence quail populations will aid in management decisions addressing the quail decline.

Raptors such as this Cooper's hawk are efficient predators of quail; it is unknown if they affect quail populations.

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

Influence of Prior Nest Fate on Renesting Behavior of Bobwhites in Texas

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

The bobwhite is an important gamebird throughout South Texas. Much is known about bobwhite nesting ecology; however, relatively little is understood regarding how bobwhite nest selection and renesting behavior are influenced by predation. The objectives of our research are to study how nest predator abundance influences (1) nest concealment and placement, (2) nest density across the landscape, and (3) success of renesting attempts compared to prior nests.

The study will take place on 3 ranches in Goliad, Real, and Zavala counties where we will monitor radio-marked bobwhites twice per week from April–August

during 2014 and 2015. We also will use a dataset from a long-term radio telemetry study on bobwhites conducted in Brooks County from 2000–2008. We will use predator scent stations to monitor relative predator abundance and collect information on nest fate, nest substrate, and microclimate, which will allow us to evaluate how predation influences renesting behavior. Through this project, we have the potential to gain a better understanding of how bobwhite nesting behavior relates to predators and the risk of predation.

Cooperative funding provided by the South Texas Chapter of the Quail Coalition, La Ceniza Ranch, and various donors of the South Texas Quail Research Project.

Past, Present, and Future: Ecological Niche Models of New World Quails

Erika L. Dodd, Damon L. Williford, Leonard A. Brennan, Fidel Hernández, and William P. Kuvlesky, Jr.

Six species of quail are native to the contiguous United States. Climate change and land use are the greatest threat to quail populations. Fragmentation and loss of habitat coupled with droughts have had a negative effect on quail populations. Of the 6 species of quails in the United States, the northern bobwhite and scaled quail have experienced the most significant population declines across their ranges. In addition, the Montezuma quail inhabits less than 1% of its historical range in Texas and the mountain quail appears to be declining in the Upper Columbia River Basin of the Intermountain Region. The California and Gamble's quail populations remain stable.

Dave Menke; U.S. Fish and Wildlife Service

The California quail is one of the 6 species of New World quails that occurs in the United States.

We plan to create ecological niche models to determine the geographic ranges for 6 species of North American quails during the last interglacial period (approximately 130,000 to 116,000 years ago), compare these distributions to the current geographic distributions, and then predict the distributions of these 6 species 100 years into the future. Various climatic and land use variables will be used in the models as we seek to discover how these factors might influence quail populations in the United States. Our findings also will identify potential areas to apply conservation strategies in the future.

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

Occupancy and Habitat of Montezuma Quail in the Edwards Plateau

Eric D. Grahmann, Robert M. Perez, Fidel Hernández, and Leonard A. Brennan

The Montezuma quail is a secretive species that inhabits mountains of the southwestern United States and Mexico. As late as the 1800s, it occurred throughout the Edwards Plateau (north of Highway 90 and west of Interstate 35) and West Texas. Today, its range has been reduced to several mountain ranges throughout West Texas and 5 counties in the southern Edwards Plateau. Although a few studies have been conducted in West Texas, little is known about the remnant population in the southern Edwards Plateau.

This year we initiated a study to (1) assess the current distribution of Montezuma quail in the Edwards Plateau region of Texas, (2) quantitatively characterize the habitat where the species is found, (3) develop a habitat suitability model based on macrohabitat variables known to be important to Montezuma quail, and (4) document vegetation response to habitat restoration techniques.

Our research will take place on several private ranches and public areas throughout Edwards, Kerr, Kinney, Real, Uvalde, and Val Verde counties. We will survey for Montezuma quail using call-back surveys during February–August from 2014–2016. In areas where Montezuma quail are found, we will survey the vegetation. Macrohabitat variables will be incorporated into a Geographic Information Systems (GIS) interactive database to create a predictive distribution map for the planned recovery of this species.

© Randy DeYoung

Very little is known about Montezuma quail found in the Edwards Plateau region of Texas.

Our goal is to provide information to landowners and agencies interested in the management and recovery of Montezuma quail within the Edwards Plateau.

Cooperative funding provided by the Texas Parks and Wildlife Department, several private ranches, and the Richard M. Kleberg, Jr. Center for Quail Research.

Analysis of Adaptive Genetic Variation Among Bobwhite Populations

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

The northern bobwhite has been one of the most economically important gamebirds in North America, but has experienced a precipitous decline in geographic range and population size during the last 40 years. Bobwhite conservation can benefit from a better understanding of how genetic variation is partitioned across this species' range. Previous genetic research based on mitochondrial DNA found little congruence between subspecies and genetic differentiation among the 22 subspecies. However, the wide geographic range and extensive plumage variation among subspecies suggest regional variation in adaptive traits.

Mitochondrial DNA can provide a useful assessment of population structure and the biogeographic and demographic forces that have shaped current populations. Unfortunately, it is selectively neutral and is of limited use for the study of adaptive genetic variation. Nuclear genes that control adaptive traits are targets of selection and, therefore, evolve more rapidly.

We will use a newly developed method, restriction site-associated DNA sequencing (RADseq), to discover a large number of single nucleotide polymorphisms throughout the bobwhite genome. We will then determine if these genetic variants are associated with physical characters or regional populations.

We have acquired hunter-harvested birds from Texas, Oklahoma, Missouri, Kansas, and Iowa to assess how genetic variation is apportioned among populations in different ecoregions. We are extracting genomic DNA from these samples and assessing the quantity and quality of the extracts. We will collect and analyze the genetic data during autumn of 2014.

Cooperative funding provided by a TAMUK University Research Award.

Survey of Bobwhites and Scaled Quail for Parasites within South Texas

Andrew C. Olsen and Alan M. Fedynich

Parasites can affect individual gamebirds and potentially regulate gamebird populations as demonstrated in the European red grouse and sooty grouse. South Texas, an area with some of the largest contiguous tracts of quail habitat, has had little research on the parasites infecting quail, and there has never been a landscape-scale survey.

To learn more, northern bobwhites and scaled quail were collected from hunters during the 2012–2013 and 2013–2014 hunting seasons. Necropsies were performed on the harvested birds to identify and count helminths. With this dataset, the effects of host gender, age, and other factors were compared to parasite prevalence and abundance.

Over these 2 hunting seasons, 206 whole northern bobwhites, 23 whole scaled quail, and an additional 35 bobwhite heads were donated. Several helminth species were identified in each quail species. By far, the most prevalent and abundant helminth species encountered was the cecal nematode. Statistics on cecal worms in bobwhites collected during the 2012–2013 season indicated that adult bobwhites were infected more often (95%) and had more cecal worms (119) than juveniles (81%, 62 worms), but the influence of bobwhite gender was not evident.

Initial results from the 2013–2014 hunting season indicate that cecal worm prevalence and abundance vary greatly with county and/or ranch of collection (35% prevalence in Kenedy County to 100%

in Dimmit County). This study provides additional information on parasites of northern bobwhites and scaled quail and illuminates the importance of widespread and continued surveillance for parasites and diseases caused by them within South Texas.

Cooperative funding provided by the South Texas Chapter of the Quail Coalition and Title V Promoting Postbaccalaureate Opportunities for Hispanic Americans Program.

Bobwhite Spatial Distribution in Relation to Rangeland Management

Joshua D. Pearson, Eric D. Grahmann, and Fidel Hernández

Bobwhites have experienced severe declines across their range. Although Texas generally has not experienced such a drastic decline, certain ecoregions in the state have not been immune to declining populations. The bobwhite decline within Texas has been especially pronounced in the Edwards Plateau, where bobwhite densities have declined about 4.5% per year since 1966. We hypothesize that incompatible land use is a contributing factor. Unfortunately, no formal research study has been completed within this region on bobwhites. The objectives of this study are to understand the vegetational and spatial characteristics influencing bobwhite occupancy within this region.

Our study will take place on the Dietert Ranch in Real County, Texas from April–August 2014 and 2015. We will determine bobwhite occupancy and relative density using 4 methods (trapping, radio telemetry, call counts, and helicopter surveys) and relate these data with vegetational and spatial variables. With this information, we will develop a habitat appraisal guide to assist landowners in the restoration of bobwhite habitat within the Edwards Plateau.

Cooperative funding provided by the Leach Foundation and the Dietert Ranch.

Evaluating Bobwhite Nesting Sites in Relation to Paired Random Locations

Ryan M. Piltz, Carter G. Crouch, Ross O. Couvillon, and Leonard A. Brennan

This study will evaluate vegetation structure and thermal cover at nesting sites of northern bobwhites on 2 ranches in South Texas. One ranch will be located in the coastal prairie region and the other ranch farther south and more inland. Vegetation structure and temperature measurements will be recorded for each nest site and a paired random point within 50 to 100 yards of each nest.

Analyzing these data will allow us to determine what type of vegetation bobwhites are using at the nest site in relation to other available vegetation types. Information on thermal cover will allow us to determine if there are any differences in temperature between nest sites and random locations. Findings from this study will give wildlife managers insight regarding habitat conditions and will help form the basis for habitat management focused on creating suitable nesting cover for bobwhites in South Texas.

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

Occupancy, Survival, and Nest Success of Scaled Quail in the South Texas Plains

Richard H. Sinclair, II, Enrique F. Hernández, III, Holley N. Kline, Fidel Hernández, Timothy E. Fulbright, Eric D. Grahmann, and Leonard A. Brennan

Scaled quail populations are declining across their range. Our knowledge of their ecology in southern Texas where this decline has been most evident is incomplete. Across the South Texas Plains, reduced woody plant diversity from root plowing, the invasion by non-native grasses, and regional reductions in live-

CKWRI researchers are studying the ecology of scaled quail in South Texas to learn more about this species.

stock stocking rates might have contributed individually or cumulatively to decreased habitat for scaled quail. Our objectives are to (1) test the effects of these 3 factors on scaled quail occupancy and (2) document seasonal survival and nest success.

Our study is being conducted from April–August (2013 and 2014) on 2 sites in La Salle County, Texas. We are estimating occupancy and probability of detection of scaled quail using 30 presence-absence survey points on each site where vegetation variables are measured. We also are evaluating scaled quail survival and nest success by monitoring 54 quail 2 to 3 days per week using radio telemetry.

Preliminary results from 2013 revealed that scaled quail occupied 19% of survey points. Survival was 67% during April−September. Nest success was 41% during May−July, with a mean clutch size of 10 eggs (based on 26 nests). Our study may provide landowners and wildlife managers information that will help conserve scaled quail in South Texas.

Cooperative funding provided by South Texas Charity Quail Hunts, Inc., South Texas Chapter of the Quail Coalition, the Nueces Ranch, and the Hixon Ranch.

Habitat-Suitability Bounds of Woody Cover for Bobwhites

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

Woody vegetation cover is an important component of bobwhite habitat. It is widely used by bobwhites for loafing, escape cover, thermal cover, and food. Several researchers have reported woody cover requirements of bobwhites; however, their suggestions have often differed substantially.

Woody cover is being examined to learn more about which features are important to northern bobwhites.

Discrepancies in these recommendations for bobwhite habitat could be an artifact of inconsistent research methodologies, woody cover measurements obtained at different scales, and confoundment of woody cover estimates with other sources of suitable cover such as robust, tall herbaceous plants. The objectives of our research are to (1) determine the habitat-suitability bounds of woody cover for bobwhites by comparing woody cover use at 3 spatial scales (individual bobwhite locations, within home ranges, and at the pasture scale) and (2) quantify the relationship between bobwhite use of woody cover and robust, herbaceous vegetation.

Our study will take place on private ranches in Goliad, Real, and Zavala counties, Texas. We will monitor bobwhites using radio telemetry and sample vegetation April–August during 2014 and 2015. This research will have management implications for landowners managing bobwhite habitat with various coverage of woody and herbaceous plants.

Cooperative funding provided by Steve Lindley, Richard Lucas, and the D Bar J and Lucas ranches.

Developing Methods to Control *Aspergillus* for Bobwhite Feeding Programs

Brent C. Newman, Scott E. Henke, Greta L. Schuster, Alan M. Fedynich, and James Cathey

Approximately 6.2 million Americans provide supplemental feed to wild birds each year. In addition, there is an increasing effort by ranchers and wildlife managers to provide supplemental feed to northern bobwhites and other gamebirds because of population declines of these species within many areas of their historical geographic range.

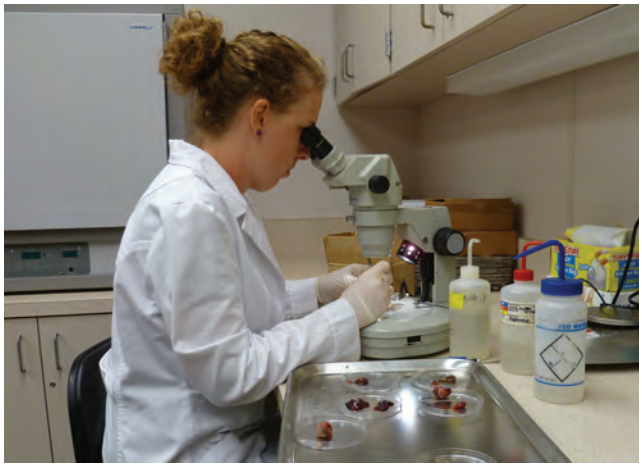
Unfortunately, poor sanitation of feeders can lead to the growth of *Aspergillus flavus*, which is a fungus that produces a toxic by-product called aflatoxin. Aflatoxin is known to cause cancer, mutations, and birth defects. It can affect metabolism, nutrition, and the immune system, and at high enough doses, can cause death.

Scant information is available about common household chemicals that will limit or kill the growth of this fungus. Historically, household bleach has been recommended for controlling fungal growth in

backyard bird feeders. It is unclear if other chemicals are effective in controlling fungal growth in the larger stationary feeders used on ranches that are constructed of various materials. In this study, we will determine the ability of various chemicals in killing the fungus.

Commonly available chemicals Shock®, household bleach, sodium bicarbonate, hydrogen peroxide, and isopropyl alcohol will be tested for their fungicidal properties. This project will provide information useful to bird enthusiasts and quail managers to enable them to properly clean feeders as a way to greatly reduce or prevent aflatoxin poisoning.

Cooperative funding provided by Texas A&M AgriLife Extension Service and Ben and Rachel Vaughan Foundation.



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Graduate student Kelsey Bedford is conducting a survey of the helminth parasites found in scaled quail.

Parasitological Survey of Scaled Quail from the Western Rolling Plains of Texas

Kelsey A. Bedford, Alan M. Fedynich, and Dale Rollins

The scaled "blue" quail has been declining since the 1960s. Though studies have focused on habitat restoration and predator-prey relationships, little research has been conducted on the role of helminths (internal parasites). Unfortunately, there are few parasitological surveys of scaled quail from Texas, pointing to a need for more information.

Our objectives are to (1) document the helminth species of scaled quail occurring within the Rolling Plains ecoregion and surrounding areas, (2) determine helminth prevalence, intensity of infection, and abundance, and (3) assess whether infections are influenced by host age, host sex, body weight, population density, location of collection, and precipitation.

Twenty-eight scaled quail were donated by hunters during the 2012–2013 hunting season and 73 were donated during the 2013–2014 season. In cooperation with a regional bobwhite disease study called Operation Idiopathic Decline (OID), funded by the Rolling Plains Quail Research Foundation, 13 scaled quail were trapped in 2012 and 15 in 2013, which were also included in this study. Additional scaled quail will be obtained during the upcoming 2014–2015 hunting season and examined for parasites.

To date, all scaled quail have been examined for eyeworms (*Oxyspirura petrowi*). Prevalence, intensity of infection, and mean abundance appeared to be lower in the 2012–2013 sample than in the 2013–2014 sample, but the number of birds examined in the first period was low, precluding robust interpretation.

Full necropsies are underway to determine helminth species after which statistical analyses will be performed for interpretation purposes. Upon completion of this study, we will have more information on the helminths of scaled quail including species currently found and whether any of these species are known to be harmful to quail.

Cooperative funding provided by the Rolling Plains Quail Research Foundation.

Summary statistics for the eyeworm *Oxyspirura petrowi* in OID-trapped and hunter-shot scaled quail from 2012–2014 in Texas.

Sample Type	Year	Sample Size	Prevalence	Mean Intensity	Range	Mean Abundance	Total
OID donated	2012	13	46%	4.5 ± 2.2	1–15	2.1 ± 1.1	27
	2013	15	13%	4.0 ± 1.0	3–5	0.5 ± 0.4	8
Hunter-shot	2012–2013	28	21%	2.7 ± 1.2	1–8	0.6 ± 0.3	16
	2013–2014	73	70%	6.1 ± 0.8	1–21	4.2 ± 0.7	309

Landscape Genetics of the Bobwhite in Texas and the Great Plains

Katherine S. Miller, Leonard A. Brennan, Randy W. DeYoung, Fidel Hernández, and X. Ben Wu

The northern bobwhite population decline is thought to be from habitat loss through fragmentation, which may isolate populations and alter their genetic structure. Local and regional studies have revealed weak genetic structure among bobwhite populations. Our objectives are to determine the genetic structure of bobwhite populations across Texas and the Great Plains and determine factors that isolate populations.

We collected 641 bobwhites from 23 populations representing 5 states, and used 13 microsatellite markers to assess population structure and genetic distance among populations in 2 regional areas (Great Plains-Central Texas and Coastal-Southern Texas). We developed isolation models built on geographic distance, barriers (roads and rivers), and cover, and tested their correlation to genetic distance.

Preliminary data analyses found bobwhite populations exhibited weak genetic structure, and most variation was within populations (97.5%). Populations were isolated by distance. In the Great Plains-Central Texas region, barriers also isolated populations, whereas cover was important for populations in Coastal-Southern Texas.

Findings suggest that a bobwhite would need to cross more barriers to travel among populations in the Great Plains-Central Texas region than in the contiguous quail country of Coastal-Southern Texas. Because some unknown but apparently biologically significant proportion of bobwhite gene flow may occur across long distances, it is critical that habitat corridors and other linkages are maintained on a landscape scale.

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

Translocation of Wild Bobwhites into the Rolling Plains of Texas

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

Northern bobwhite populations are declining throughout Texas. This decline is particularly disconcerting given that populations are decreasing in areas with apparently adequate habitat. Our goal is to examine the effectiveness of translocating wild-trapped bobwhites into recently depopulated habitat in the eastern Rolling Plains of Texas as a method for increasing the quail population. Translocation effectiveness will be evaluated based on population estimates made from spring male-whistle counts, fall covey-call counts, and helicopter surveys. Seasonal survival, site fidelity, and reproduction of radio-marked, translocated females also will be measured. This study will occur during January–August 2013–2015.

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Research is evaluating bobwhite translocation efforts within the Rolling Plains of Texas.

We translocated 202 wild northern bobwhites during March 2013 and 207 during March 2014 from several locations within the Rolling Plains to 2 well-managed release sites (approximately 1,000 and 650 acres, respectively) in Stephens and Shackelford counties. Of these translocated birds, 95 females were fitted with radio collars in 2013 and 91 in 2014. Their movements were monitored.

In 2013, 41% of the radio-marked females remained alive 6 months after translocation and 12% remained alive a year after translocation. Seventy-seven percent of translocated hens that entered the nesting season produced a nest, resulting in 72 nests with an average clutch of 12 eggs. Nest success was 42%, and hens nested at a rate of 1.2 nests per hen. Survival and nesting are being monitored for the 2014 field season.

A final translocation of approximately 200 bobwhites is planned for March 2015. This research will provide valuable insight on bobwhite population restoration techniques in the Rolling Plains of Texas.

Cooperative funding provided by the Rolling Plains Quail Research Foundation.

Evaluating the Extinction Threshold Hypothesis in Quail Declines

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

Habitat loss and fragmentation, the principal causes of bobwhite and scaled quail declines, occur at much broader scales than those traditionally used in research (i.e., a pasture or ranch), potentially invalidating inferences gained from these studies. Therefore, the need exists to investigate quail declines at an increased scale as well as determine an applicable scale of inference for relating landcover to quail populations.

In addition, quail populations may respond to habitat loss in a non-linear fashion, following a concept known as the extinction threshold hypothesis, where small changes in the amount of habitat can have a profound impact. Our objectives for this study are to determine the scale at which quail populations respond to habitat and evaluate the extinction threshold hypothesis as a possible explanation for quail declines in the southwestern United States.

We will determine quail trends and amount of habitat using data from the North American Breeding Bird Survey (BBS) and the National Land Cover Database (NLCD), respectively. Using a Geographic Information Systems (GIS) software platform, we will be able to determine the amount of habitat within multiple buffers of varying sizes centered on BBS routes. We will then calculate which buffer size yields the highest correlation between habitat and quail trends. Landscape composition within this appropriate buffer size will be determined and evaluated relative to quail trends to determine the linearity of the relationship.

Determining a consistent, applicable scale of inference for relating habitat to quail population trends would greatly enhance the inferential ability of future studies. If quail populations do respond non-linearly to habitat, then knowledge of these thresholds will aid in directing management decisions for quail habitat.

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

Our Invasive Grasses Research Program

David B. Wester

South Texas is a special place for many reasons, not the least of which is because this region represents the *Last Great Habitat*. Our landscape is nothing less than a sanctuary for native plants and animals. For example, the Lower Rio Grande Valley National Wildlife Refuge, covering just 141 mi^2, supports more species of plants and animals than are found in nearly 2,400 mi^2 of Everglades National Park. Opportunities for recreation—whether the passive enjoyment of bird- and butterfly-watching or the more active sports of quail and deer hunting—are as special to locals as they are an attraction to sportsmen throughout the nation, and the income that recreation brings to South Texas is essential to our economy. It is also true, however, that the *Last Great Habitat* is under constant and growing threats of invasive plants that act, hand-in-glove, with habitat fragmentation and continued economic development. The impacts of invasive plants on native habitats are pervasive, with effects reaching into the soil and extending from there into native plants and insects and the wildlife that depends on them. Here at the Caesar Kleberg Wildlife Research Institute, we are facing these challenges head-on with a comprehensive and innovative research program that addresses basic ecosystem processes as well as on-the-ground management practices designed to restore our native habitats. This work is an on-going commitment of our Institute that involves virtually all of our scientists and is gratefully supported by a growing number of landowners, foundations, organizations, companies, and both state and federal agencies.

Effects of Tanglehead on the Abundance and Spatial Distribution of Bobwhites

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

Although the northern bobwhite has been declining throughout much of its range, large tracts of rangeland in South Texas have maintained relatively stable populations. However, the suitability of habitat for bobwhites for a considerable portion of these rangelands has been reduced by the increase of non-native, invasive grasses.

Tanglehead is a native grass that has recently acted as an invasive species, increasing rapidly and forming high-density monocultures in areas of South Texas. Our objective is to evaluate the influence of tanglehead on northern bobwhite abundance and assess the spatial distribution of tanglehead within the South Texas region.

We will use autumn helicopter surveys to estimate bobwhite abundance and spatial distribution. Within this survey design, we will mark the location of coveys detected and determine covey size. We will conduct vegetation surveys at covey detection locations and paired random locations where we will measure tanglehead cover and native forb and grass diversity. This information will allow us to determine at what threshold of tanglehead cover bobwhite usage begins to decline.

Findings will provide insight into the level to which tanglehead is affecting the spatial distribution of quail, as well as its effects on the native vegetation. In addition, these findings will provide information regarding the management threshold level at which tanglehead becomes harmful to bobwhite populations.

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

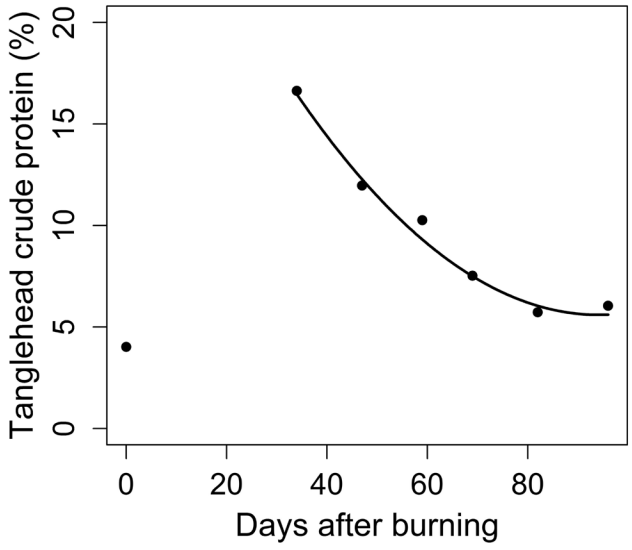
Effect of Cool Season Burns on Tanglehead Forage Quality and Seedling Density

Joshua L. Grace and David B. Wester

Recent decades have seen what can be described as a drastic increase in tanglehead throughout certain portions of South Texas. The Coastal Sand Sheet region, in particular, is experiencing a rate of increase in this grass that has land managers and researchers alike concerned about the species' potential effect on both livestock production and wildlife habitat.

Tanglehead matures quickly and loses livestock palatability and preference quickly. Consequently, the need for research using combinations of tanglehead control and management practices is of great importance.

This pilot study is assessing the effects of a cool season winter burn on (1) forage quality of tanglehead at 10-day intervals from the burn date to seed, (2) plant community composition and diversity, and (3) tanglehead mortality from the fire and subsequent seedling germination and establishment.



Protein content in regrowing burned tanglehead plants is high compared to non-burned plants. However, protein content decreases rapidly after burning.

Prior to burning, the study area had essentially no tanglehead seedlings emerging. Just 27 days later, some samples had as many as 140 seedlings per ft^2, while non-burned areas had little to no seedlings. Other aspects of this study are currently underway.

It is our hope to expand and replicate this research involving the combination of fire and grazing as a potential management tool for tanglehead. This research may enable us to develop specific recommendations to better manage tanglehead in South Texas landscapes, which will benefit landowners and ranchers seeking to provide cattle forage and maintain wildlife habitat.

Cooperative funding provided by the Brown Foundation and donors to the Caesar Kleberg Wildlife Research Institute's Invasive Grass Research Program.

Conversion of Bermudagrass Pasture to Native Grassland in Four Ecoregions

James P. Muir, Jeff R. Breeden, Forrest S. Smith, William P. Kuvlesky, Jr., Jamie L. Foster, Roger D. Wittie, and Ryan Rhoades

Large areas of the Cross Timbers and Prairies, Blackland Prairie, Post Oak Savanna, and Coastal Prairie ecoregions of Texas have been converted to bermudagrass pastures. The extent of bermudagrass pastures is one factor thought to contribute to the decline in abundance of northern bobwhites and grassland birds in these ecoregions. Land use changes, economic factors, and growing emphasis on managing for wildlife, especially bobwhites, have resulted in a widespread need for techniques that convert bermudagrass pastures to native grassland. In the past, many such efforts have failed, in part, because landowners and natural resources professionals lacked knowledge of the best techniques.

We will test a variety of techniques for converting bermudagrass pasture to native grassland in 4 ecoregions of Texas. Experiments will focus on identifying treatments that can be used to reduce or eliminate bermudagrass stands, prepare seedbeds and successfully reseed native plants, influence successional change without reseeding, and evaluate the resulting vegetation communities in providing suitable habitat for bobwhites and other grassland bird species. Economic analyses of all methods studied will also be compiled.

Results of this research will be provided to natural resources professionals and landowners throughout the 4 ecoregions. Using our findings in management plans will aid in benefiting wildlife across Texas.

Cooperative funding provided by the Texas Parks and Wildlife Department.

Old World Bluestem Response to Season of Burning in South Texas

Adam E. Toomey, Sandra Rideout-Hanzak, David B. Wester, and Terry L. Blankenship

Throughout South Texas, Old World bluestems are an increasing threat to native vegetation diversity and wildlife habitat. We have begun a long-term study to determine if either summer burning or winter burning

We are studying effects of season and frequency of burning on Old World bluestems.

holds an advantage for controlling the invasion and spread of these plants, as well as encouraging the growth of native vegetation.

This study is being conducted at 3 locations: the South Pasture Research Facility in Kleberg County, a private ranch in Jim Wells County, and the Welder Wildlife Refuge in San Patricio County. We have established permanent plots with grazing exclosures to investigate the influence of season of burning on the plant communities. Treatments include warm-season, summer burns and cool-season, winter burns; other plots will receive no burning treatment (serve as control plots).

Our early findings indicate summer burning kills more Kleberg bluestem than winter burning; however, after a single burning cycle, burning did not affect seedling establishment of Old World bluestems despite when the burn took place. There has been no effect on abundance of native species seedlings in the first year after burning. A second round of treatments is scheduled. Our findings will help managers determine the most effective means for controlling Old World bluestems.

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

Grassland Bird Use of Native Pastures and Coastal Bermudagrass Pastures

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

Grassland birds are one of the most imperiled groups of birds in North America. This has been caused by habitat loss and degradation from the conversion of native grasslands to non-native grasses. It is particularly a concern in South Texas.

© Kara Campbell

Graduate student Carter Crouch with one of the bobwhites monitored for habitat use on the San Christoval Ranch.

Coastal bermudagrass is a common species planted widely for cattle grazing in states bordering the Gulf of Mexico. It has decimated millions of acres of grassland bird habitat. This study was initiated to learn more about the negative impacts of coastal bermudagrass on grassland birds.

The objectives of our study are to document and compare (1) patterns of northern bobwhite habitat use, (2) density of bobwhites, (3) vegetation composition, and (4) winter bird species composition, abundance, and richness on coastal bermudagrass pasture, native shrubland, and pasture restored to bobwhite habitat in an area that was previously a coastal bermudagrass pasture. In addition, vegetation composition will be measured and compared on 2 other restored sites that are too small to estimate grassland bird abundance.

Data collection began during March 2014 and will continue for the next 3 years. Northern bobwhite density will be estimated using mark-recapture, whistle-counts, and helicopter surveys. Bobwhite habitat use will be documented by radio-tracking bobwhite movements on 3 sites. Vegetation will be randomly measured on 10 established permanent transects on 6 sites. Analysis using the computer program DISTANCE of data obtained from 5 line transects on 4 sites will be used to estimate and compare the wintering grassland bird community.

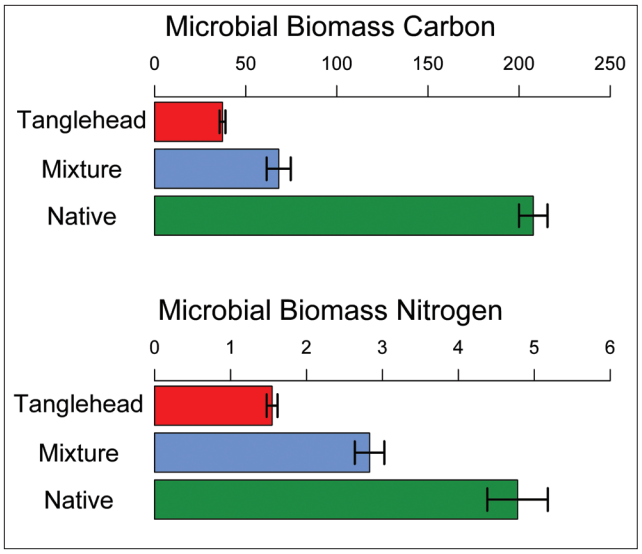
Coastal bermudagrass has destroyed and/or fragmented millions of acres of wildlife habitat across Texas and adjacent states. This is one of the first research projects to measure the extent to which bobwhites and other iconic grassland birds such as northern shrikes and American kestrels respond to efforts in restoring native vegetation in former coastal bermudagrass pastures.

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

Effects of Tanglehead on Ecosystem Processes and Native Ecosystems

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

The increasing rate of species loss and gains, globally and locally, is alarming in view of the importance of biodiversity to ecological functioning. Species



Native plant communities have more soil microbial biomass of carbon and nitrogen than plant communities that include tanglehead or communities that are dominated by tanglehead.

invasion is considered a major threat to biodiversity and ecosystem stability throughout the United States. It has been well documented that exotic and invasive grasses can alter various aspects of native vegetation communities and wildlife habitat.

South Texas plays host to several species of exotic and invasive grass species, which continue to increase throughout the region. Consequently, there is increasing concern among those wishing to maintain and enhance wildlife habitat. Adding to the apprehension warranted by these species is the rather recent increase of tanglehead throughout the Texas Coastal Sandsheet. Because of the worry regarding unwanted increases of tanglehead, we began this study in 2012 to determine the effects of tanglehead on native plant communities and wildlife habitat.

Our research is ongoing and will aid in determining the ecological mechanisms that may contribute to tanglehead's increased invasive behavior throughout the region. The objectives are to determine (1) whether tanglehead affects composition and structure of plant communities and whether they affect seasonal dynamics of foliar cover and biomass production of native species, (2) the effects of tanglehead on seed bank composition and dynamics, and (3) whether the presence of tanglehead, and its residual dry matter, alters the soil microbial community.

Preliminary findings from our study suggest that the presence of tanglehead alters soil microbial community size and composition. It is our goal to use this research, along with other research being completed through the Caesar Kleberg Wildlife Research Institute and its cooperative partners, to further develop our understanding of tanglehead in hopes of determining why and how it continues to increase in South Texas.

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

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

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

Ocelots, bobcats, and coyotes coexist on the East El Sauz Ranch. Remote camera stations are being used as part of a long-term effort to monitor the population of each species. The ocelot is a medium-sized, endangered felid that occurs in the thornshrub habitat of South Texas. Bobcats may affect sympatric felid species (e.g., ocelot) and small mammals, whereas coyotes may affect populations and the spatial and temporal aspects of many animals. Continual monitoring of ocelot, bobcat, and coyote populations will aid in determining the health and stability of these populations.

Two camera grids were installed in ocelot habitat. The north and the south grid had 15 and 13 camera stations, respectively. Each camera station consisted of 2 passive infrared cameras placed across from each other, which provided the ability to individually recognize animals from photographs.

From August 2013 to March 2014, cameras took 9,888 and 7,907 photographs on the north grid and south grid during 3 survey sessions, respectively. We obtained 195 ocelot, 209 bobcat, and 217 coyote photographs; 9, 9, and 10 individual ocelots were identified on the north grid during the 3 photo surveys, respectively. We obtained 62 ocelot, 111 bobcat, and 167 coyote photographs; 5, 3, and 4 individual ocelots were identified on the south grid during the 3 photo surveys, respectively.

Camera stations will be used to continue monitoring ocelot populations on the East El Sauz Ranch. The potential impacts of bobcats and coyotes on ocelots will be addressed, as needed.

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

Estimation of Jaguar and Ocelot Population Density using Camera Traps in Mexico

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

The jaguar and ocelot are federally endangered species in the United States and Mexico. In addition, they are classified by the Convention on International Trade in Endangered Species (CITES) as Appendix I species. To learn more about these species, we are conducting a population estimation study that will contribute to the knowledge of jaguar and ocelot populations in Tamaulipas, northeast Mexico.

We used a grid of camera traps deployed for 6 months to estimate the jaguar and ocelot populations in Rancho Caracol, located along the northern fringes of the Sierra of Tamaulipas, Mexico. This grid covered 35 mi^2 and contained 30 camera stations separated by at least 0.6 miles. Individual jaguars and ocelots were identified by their unique spotting pattern. Population density was estimated using capture-resight methods with the aid of the computer programs CAPTURE, SPACECAP, and DENSITY.

We calculated an effective study area size of 54 mi^2 for jaguars and 48 mi^2 for ocelots. After 6,335 camera-nights, we have photographed 9 (4 males, 4 females and 1 unknown) jaguars and 38 (17 males; 21 females) ocelots. We have calculated a population density of 6.3 jaguars per 35 mi^2 and 30.2 ocelots per 35 mi^2.

We consider the ocelot population in the Sierra of Tamaulipas robust enough to provide a potential source for ocelot translocations into Texas. Additional monitoring in the Sierra Tamaulipas would be recommended to determine the response, if any, that translocations would have on this ocelot population.

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

Using Fractal Analysis to Assess Fine-Scale Movement Patterns of Bobcats

Jennifer M. Korn, Michael E. Tewes, and Matthew J. Schnupp

Land management practices, such as brush manipulation, are used in Texas to modify habitat for game species, which may also alter predator use of the habitat. We used fractal analyses, a measure of tortuous (shorter and more twisted) movements, to assess the fine-scale movement patterns of bobcats in response to sculptured brush strip patches. The study took place on 3 pastures of the Santa Gertrudis Division of the King Ranch in Kleberg County, Texas. From June 2011 to January 2012, we trapped 9 bobcats and deployed Global Positioning Systems (GPS) tracking collars on 2 females and 6 males.

Average male bobcat home ranges (1.9 mi^2) were larger than female home ranges (1.1 mi^2). As home range sizes decreased, movement paths were more tortuous. Fractals may also indicate search intensity, thus the smaller home ranges and higher tortuosity for bobcats on this site may indicate abundant resources. Female bobcats used smaller patches and had more tortuous movements, whereas males used larger patches and made long, straight-line movements. Although 2 bobcats used brush strips in greater proportion than to their availability, there was no evidence that bobcats were affected by brush strips.

Bobcats are an integral part of an ecologically healthy and productive ecosystem, but are often overlooked in land management planning. Male and female bobcats moved through the habitat at different spatial scales, but still within the patch size of manipulated brush strips.

These results do not indicate that bobcats displayed a positive or negative response to brush strip habitat management methods. Additional research will be needed to clarify this relationship.

Cooperative funding provided by the Feline Research Center of the Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville Title V Promoting Postbaccalaureate Opportunities for Hispanic Americans Program, Friends of Laguna Atascosa National Wildlife Refuge, Gary Waggerman Memorial Scholarship, Michael and Charles Corbett Scholarship, and Wild Cat Conservation, Inc.

Assessing Chemical Immobilization of Wild Jaguarundis

Arturo Caso, Michael E. Tewes, Emilio Rendón, and Lon I. Grassman, Jr.

The jaguarundi is an endangered species in the United States, which was last documented in Brownsville, Texas in 1986. There is no information in the scientific literature on the chemical immobilization of free-ranging jaguarundis. One reason is that jaguarundis are extremely difficult to capture in the first place. Information on immobilization is critical for wildlife biologists and veterinarians who may have to anesthetize wild jaguarundis for research.

We chemically immobilized 20 jaguarundis at 2 sites in northeastern Mexico using a mixture of ketamine hydrochloride and xylazine hydrochloride. The induction time, duration of anesthesia, and recovery time were satisfactory for standard field research procedures including radio-collaring. Respiration and muscle rigidity were monitored during sedation with no observed adverse physiological effects; however, several individuals experienced early arousal followed by prolonged recovery. Individuals were released after full recovery and monitored using radio telemetry for 1–13 months with no observed damaging effects related to chemical immobilization.

It appears that ketamine hydrochloride and xylazine hydrochloride may be a safe and effective immobilization agent for free-ranging jaguarundis; however, further field research is needed regarding other drug combinations for this species. Chemical immobilization data will be collected as additional jaguarundis are captured during our field research studies.

Cooperative funding provided by the Dallas Zoo, Los Ebanos Ranch, Gladys Porter Zoo, and the Feline Research Center of the Caesar Kleberg Wildlife Research Institute.

Chronobiology and Factors Affecting Bobcat Activity in South Texas

Justin P. Wied, Michael E. Tewes, Eric L. Rulison, John A. Leonard, and Gordon W. Watts, III

Chronobiology is a discipline that enables researchers to understand behavioral, ecological, and physiological patterns of a species. There are many cues that influence these patterns, and they can have a profound effect on the interpretation of the study variables.

We have used information collected from over 10,000 camera-nights from 7 ranches over the past 4 years to assess bobcat activity patterns in South Texas. Activity occurred primarily during dusk, dawn, and nighttime periods. The role of external factors such

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The bobcat is a very adaptable predator that is commonly found in South Texas landscapes.

as light, photoperiod, temperature, and lunar phase are correlated with the observed patterns. In addition, the influence of 24-hour periods and lunar cycles will be explored in this study.

Activity patterns of carnivores typically involve physical influences such as competition and resource partitioning of prey. This study is unique in that it will measure the effects of other rarely examined external factors potentially responsible for influencing bobcat activity patterns in South Texas.

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

© Christina Tewes

Dr. Michael Tewes is inspecting a rodent live trap—a tool used to evaluate the abundance of ocelot prey.

Population Dynamics of Rodents in Response to Drought in South Texas

Jennifer M. Korn, Michael E. Tewes, Lon I. Grassman, Jr., John H. Young, and Andrea R. Litt

The northern limit of the ocelot's geographic range occurs in South Texas, an area where rainfall and drought severity fluctuate over time. Understanding the response of rodents to changes in rainfall and drought may aid conservation strategies for the ocelot.

The Yturria Ranch in Willacy County and the Laguna Atascosa National Wildlife Refuge (LANWR) in Cameron County have 2 of the remaining ocelot populations in Texas. We sampled from July 2009 to March 2013 on the Yturria Ranch using 5 transects of 60 Sherman traps. From June 2010 to May 2012, 4 transects of 50 traps were used on LANWR to sample sites proposed for primary release of ocelots from translocation, while 3 transects of 50 traps were used at secondary release sites. Traps were set for 4 consecutive nights and individual rodents given unique numbered metal ear tags to identify recaptures.

We captured 1,513 individuals of 11 species on the Yturria Ranch and 1,001 individuals of 6 species on LANWR. Hispid cotton rats, deer mice, and Mexican spiny pocket mice were the most common rodents captured at both sites. The rodent population on the Yturria Ranch remained stable through prolonged droughts, which resulted from periodic localized rainfall. During periods lacking localized rainfall, captures were mainly comprised of herbivorous species such as the Mexican spiny pocket mouse.

Continued long-term monitoring of rodent populations on the Yturria Ranch and LANWR is essential to the management and conservation of ocelots in South Texas. Additional research is needed to determine the response of more energetically profitable prey items such as rabbits during drought conditions.

Cooperative funding provided by the Feline Research Center of the Caesar Kleberg Wildlife Research Institute, George C. "Tim" and Karen Hixon Foundation, Title V Promoting Postbaccalaureate Opportunities for Hispanic Americans Program, Friends of Laguna Atascosa National Wildlife Refuge, Gary Waggerman Memorial Scholarship, Michael and Charles Corbett Scholarship, and Wild Cat Conservation, Inc.

Habitat Use Factors Affecting Ocelot and Bobcat Coexistence

John P. Leonard, Eric L. Rulison, Justin P. Wied, and Michael E. Tewes

The ocelot is a federally-listed endangered species confined to isolated breeding populations in South Texas within the United States. Throughout its range in the United States, it is sympatric with bobcats. In South Texas, ocelots and bobcats are of relatively similar size, consume similar sized prey, and are primarily active at night and during dawn and dusk. Therefore, we expect to find evidence for habitat partitioning between the 2 species that would allow for their coexistence.

Previous studies have found that ocelots select dense stands of native Tamaulipan thornshrub, whereas bobcats will often use more open areas. We initiated this study to learn more about how these co-occurring wild cats use habitat. We combined 3 years of telemetry data from both ocelots and bobcats obtained on the

East El Sauz Ranch to examine home range overlap occurring between ocelots and bobcats, and to test for the presence of fine-scale niche partitioning. Using a land classification scheme developed by the Coastal Change and Analysis Program (C-CAP) at the National Oceanographic and Atmospheric Administration, we created home ranges for individual ocelots and bobcats and overlaid these ranges onto the C-CAP layers.

We found that bobcats and ocelots used forest and shrub cover types in greater proportion than to their availability and avoided grassland areas. Male bobcats used wetland areas in proportion to the availability of this habitat, whereas ocelots and female bobcats avoided wetland habitats.

We will continue to gather conventional radio telemetry data to supplement these ongoing analyses. Furthermore, future use of Global Positioning Systems (GPS) tracking collars on wild cats will allow us to search for evidence of fine scale spatial or temporal partitioning in individuals with overlapping home ranges.

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

Major Histocompatibility Complex Allele and Ocelot Recovery in Texas

John A. Leonard, Michael E. Tewes, Randy W. DeYoung, Jan E. Janecka, and Eric L. Rulison

Previous studies have found reduced genetic variation at neutral microsatellite markers within Texas ocelot populations. Reduced genetic variation is expected to lead to a gradual reduction in population fitness as genetic drift leads to fixation of detrimental alleles. Although microsatellite markers are widely used to measure genetic diversity, studies have shown that microsatellite diversity does not always correlate well with functional genetic diversity.

© Larry Ditto

CKWRI researchers are examining the genetic variation of ocelots, which will aid in the conservation of this wild cat.

To investigate the level of functional genetic diversity occurring in contemporary and historical ocelot populations, we focused on the Major Histocompatibility Complex (MHC), which is a large genomic region involved with the immune response. The MHC alleles are subject to stabilizing selection. Therefore, we expect to find higher levels of heterozygosity at MHC loci than at microsatellite loci. Genetic sequencing within the ocelot populations in Cameron and Willacy counties of Texas and Tamaulipas, Mexico will help guide future translocation efforts by allowing selection of individuals for translocations from Mexico with the highest probability of bolstering genetic diversity in the remaining Texas populations.

We are analyzing the results to determine the degree that the ocelot populations in Willacy and Cameron counties have lost MHC diversity. Because MHC diversity is an important indicator of genetic health, this research will play an important role in the guidance and management of future translocation efforts.

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

Soil Characteristics of Habitat used by Sympatric Ocelots and Bobcats

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

Ocelots and bobcats occur in patches of thornshrub habitat in the Lower Rio Grande Valley of South Texas. Survival of the endangered ocelot depends on maintenance of existing dense thornshrub habitat and creation of new habitat sites. Past analyses have determined soil types associated with ocelot habitat at Laguna Atascosa National Wildlife Refuge.

We analyzed soil samples from several sites used by radio-collared ocelots and bobcats. Ocelots preferred loamy clay soils, whereas bobcats ranged across a variety of soil types and were the only species found on sandy clays. Mean soil characteristics differed significantly between ocelots and bobcats for pH, salinity, and sulfur. Ocelots generally chose soils with higher macronutrient content and soils that were slightly more

Dr. Michael Tewes taking samples to evaluate soil type and structure, which can aid in identifying ocelot habitat.

acidic with lower salinity, sodium, potassium, and sulfur levels. Bobcats tolerated sites with much higher levels of salinity and sodium.

An understanding of soil characteristics can be used to inform wildlife managers of potential locations for the improvement of habitat sites for wild cats. We will continue to gather and map soil data to build a more complete profile of potential habitat types for ocelots and bobcats.

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

Genetic Pedigree and Current Population Structure of Ocelots in Texas

Jennifer M. Korn, Jan E. Janecka, Randy W. DeYoung, Arturo Caso, Michael E. Tewes, Linda L. Laack, Jody Mays, Alfonso Ortega-Sanchez, Jr., and Daniel J. Kunz

Habitat loss and fragmentation of Tamaulipan thornshrub have reduced gene flow and caused a loss of genetic diversity for the endangered ocelot in Texas. Previously known to occur as 2 isolated populations on the Yturria Ranch in Willacy County and Laguna Atascosa National Wildlife Refuge (LANWR) in Cameron County, a third population has been found on the East El Sauz Ranch in Willacy County.

We assessed genetic diversity and structure of the East El Sauz population, genetic differentiation among the 3 populations, and estimated changes in diversity over time. A genetic pedigree of individuals sampled over 30 years was used to determine levels of inbreeding and possible gene flow among locations. We sampled 177 ocelots between 1987 and 2013, and used 16 microsatellite loci to construct genotypes.

The current ocelot population on LANWR has lost an additional 10% in genetic diversity, continues to have the lowest diversity and severe genetic drift of all 3 sites, and is highly differentiated from the Willacy County population. The East El Sauz population retained the highest levels of diversity and had moderate gene flow with the Yturria population. The pedigree analysis revealed inbreeding events in all 3 populations. In over 30 years of monitoring, only a single probable parent-offspring occurrence was found between the Willacy County and LANWR populations.

Gene flow among ocelot populations should ease the effects of genetic drift and inbreeding. Higher levels of diversity and substructure may indicate the individual ocelots on East El Sauz are part of a larger population in Willacy County. These individuals may be an important source population in future conservation management strategies.

Cooperative funding provided by the Feline Research Center of the Caesar Kleberg Wildlife Research Institute, George C. "Tim" and Karen Hixon Foundation, Title V Promoting Postbaccalaureate Opportunities for Hispanic Americans Program, Friends of Laguna Atascosa National Wildlife Refuge, Gary Waggerman Memorial Scholarship, Michael and Charles Corbett Scholarship, and Wild Cat Conservation, Inc.

Bobcat Density and Abundance on Three East Foundation Ranches

Gordon W. Watts, III, Lon I. Grassman, Jr., Justin P. Wied, Arturo Caso, Sasha Carvajal-Villarreal, and Michael E. Tewes

Habitat diversity and environmental productivity are 2 common metrics of ecosystem health. The large area requirements and upper trophic position of carnivores allow them to serve as indicators of community health for the habitat they occupy. The generalist resource selection of bobcats makes them a suitable indicator of lower trophic level community health.

In February 2012, we began camera surveys of the carnivore communities on 3 ranches of the East Wildlife Foundation: Buena Vista, San Antonio Viejo, and Santa Rosa. Each sampling grid is composed of 24 to 30 camera stations separated by a distance of 2,000 to 4,000 feet. Our main objective is to examine bobcat abundance among the 3 ranches, which will be used to make inferences about ecosystem health.

We have surveyed about 70,000 camera-nights and have obtained 537 bobcat photos. We have also obtained 4,202 photos of coyotes, the most abundant carnivore on the 3 ranches and one of the main competitors of bobcats in South Texas. In addition, uncommon carnivores such as badgers and hog-nosed skunks have been photographed.

By monitoring fluctuations in bobcat populations over time and by ranch, we can examine the influence of varying precipitation patterns, habitat, and competing carnivores on bobcats in South Texas. Abundance and resource information will also assist in establishing management and conservation strategies for mammalian carnivores. At a broader level, this information will be relevant to landowners who want to manage for biodiversity.

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

Local Spatial Avoidance of the Ocelot and Jaguarundi in Mexico

Arturo Caso and Michael E. Tewes

There is little information on the ecology of sympatric ocelots and jaguarundis. Thus, potential competition and interspecies interactions remain unknown. This study was conducted on the Los Ebanos Ranch in Tamaulipas, northeast Mexico to assess home range size, habitat use, and activity patterns of these sympatric felids.

We captured 21 jaguarundis (13 males; 8 females) and 22 ocelots (9 males; 13 females) and attached a VHF radio-collar to them to assess their movements. From these data, we evaluated home range size, core areas, and activity patterns. Availability of habitat was contrasted with observed habitat use for both species.

The mean home range size for male and female ocelots was 5.8 mi^2 and 3.2 mi^2, respectively. The mean home range size of male and female jaguarundis was 6.2 mi^2 and 4.6 mi^2, respectively. Home ranges of both species overlapped, however, core area overlap was greatly reduced.

Ocelots were predominantly active during nighttime, whereas jaguarundis were predominantly active during daylight periods. Ocelots used the mature forest more intensively than open habitats available in their home ranges, whereas jaguarundis used mature forest and pasture-grassland similarly.

Further trapping and radio telemetry efforts are needed to clarify ecological patterns when there are different cat densities, different prey densities, and varying environmental changes (e.g., drought). We will continue to pursue field research to study ocelots and jaguarundis.

Cooperative funding provided by the Dallas Zoo and Los Ebanos Ranch.

Mange Prevalence in Carnivores and the Potential Risk to Ocelots

Gordon W. Watts, III, Sasha Carvajal-Villarreal, Alfonso Ortega-Sanchez, Jr., Arturo Caso, Daniel J. Kunz, and Michael E. Tewes

Mange is a serious, communicable skin disease that can occur in many mammal species, including the endangered ocelot. Ocelot populations in South Texas are extremely vulnerable to the effects of mange because of the ocelot's small population size and difficulty in recovering from the additive mortality that a mange outbreak can cause.

In July 2011, we began a remote sensing camera survey for ocelots and other carnivores on the East El Sauz Ranch in Willacy County, Texas. Our survey consisted of 15 paired camera stations that were operated for 8,329 camera-nights. We documented mange in 32% of 538 coyote photo events. Mange was also detected in a male and a female bobcat, but not in ocelots despite their high density and spatial overlap with these other species.

In addition, we conducted camera surveys at 3 other ranches managed by the East Wildlife Foundation (San Antonio Viejo, Buena Vista, and Santa Rosa). We surveyed these ranches for 38,815 camera-nights. Coyote mange prevalence varied between 5% and 12% among these ranches despite similar abundance indices.

We plan to continue monitoring mange on the East El Sauz Ranch and other East Wildlife Foundation ranches. The occurrence of mange under varying habitats and seasonal stresses, as well as sympatric carnivore abundance, will be examined to assess cause and effect of mange.

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

The Comanche-Faith Project

Charles A. DeYoung, David G. Hewitt, Timothy E. Fulbright, Kim N. Echols, Don A. Draeger, Nathan S. Cook, Blaise A. Korzekwa, Lindsey M. Phillips, Lindsay D. Roberts, John H. Clark, Emily H. Belser, Ty E. Higginbotham, and Levi J. Heffelfinger

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

Phase I

The first phase of this long-term study lasted from March 2004 through March 2013 (9 years). During this time, each ranch had 2 enclosures stocked at a low density (1 deer per 20 acres, or 10 deer), 2 at medium density (1 deer per 8 acres, or 25 deer), and 2 at high density (1 deer per 5 acres, or 40 deer). It is important to note that these are real densities and not equivalent to observed densities from a helicopter survey. At each of the density treatments on each ranch, one enclosure had year-round supplemental feed, whereas the other did not have supplemental feed. All enclosures had water at a central location and supplemented enclosures had 2 feeders near the water trough.

Phase II

This phase began in April 2013 and uses the same 6 enclosures on each ranch. During Phase II, the enclosures will receive treatments on each ranch as outlined in the table below.

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

Numerous projects were conducted during Phase I within the overall experimental design. Some projects use all 12 enclosures while others use a subset. The same will be true using the new design during Phase II.

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

Supplemental Feed and Density Effects on Deer Habitat Selection in South Texas

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

Supplemental nutrition is a prominent deer management practice in South Texas. A by-product of this management strategy is often an unnatural increase in deer density. Increasing deer densities can influence native food availability, cause social stress, and may ultimately impact individual deer habitat selection. Therefore, managers need to consider all factors involved when implementing a supplemental feeding program. Our objective was to examine the effects of deer density and supplemental feed on habitat selection throughout the year.

Between December 2009 and December 2010, we attached Global Positioning Systems (GPS) collars to 2 bucks and 2 does in each of 8 enclosures. Four enclosures had high deer density (40 deer) and 4 had low deer density (10 deer) with free choice pelleted feed available in 2 enclosures at each density level. Deer locations will be plotted from data collected every 30 minutes by the GPS collars. Open and brush habitat types will be classified and the information incorporated into a database. For each enclosure, we will compare used versus available habitats.

Because supplemental feeding of white-tailed deer is so widespread in South Texas, it is essential that we understand how increasing deer densities impact deer social interactions and habitat choices. A better understanding of deer habitat choice will aid wildlife managers with their land management decisions and optimizing deer density.

Influence of Varying Deer Densities on Supplemental Feed Visitation Rates

Levi J. Heffelfinger, David G. Hewitt, Timothy E. Fulbright, Charles A. DeYoung, Kim N. Echols, and Don A. Draeger

Supplemental feeding of white-tailed deer is a common practice throughout South Texas. Feed sites can be aggressively defended by some deer, thereby creating a dominance hierarchy that affects an individual's access to the resource. Mature bucks are dominant over younger bucks and mature does, which are subsequently dominant over younger does and fawns. The defense of these nutritional resources and exclusion of subordinate individuals may intensify as deer density increases.

Our objective is to determine whether varying deer densities affect individual deer access to feed as a result of social hierarchies. We will use trail cameras placed at feeders in 200-acre enclosures containing 20 deer and 1 feeder, 60 deer and 3 feeders, and 80 deer and 4 feeders replicated on both study ranches to determine visitation while the deer-to-feeder ratio remains constant. Photos will be examined from 2 predetermined days every week from May to August 2014. Deer will be counted and grouped into sex and age classes, and visitation time of individuals will be recorded. We will use the average time between visitations, time of visitations, sex ratios present at the feeder, and specific feed sites used by deer to determine whether density affects feeder visitation rates.

We predict that as deer density increases, individual deer accessibility to the feed will decrease, despite the increase in feed sites. This research will offer wildlife managers insight on how deer density influences a deer's access to feed sites. Findings will also provide direction for determining the ideal deer density for a given management program.

White-tailed Deer Fawn Use of Supplemental Feed Sites

Blaise A. Korzekwa, David G. Hewitt, Timothy E. Fulbright, Charles A. DeYoung, Kim N. Echols, and Don A. Draeger

Productive deer populations rely heavily on fawn recruitment to thrive. Fawn use of supplemental feed sites possibly increases survival and may allow fawns to reach their maximum genetic potential. Fawns are able to use supplemental feed sites at an early age, but

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CKWRI researchers are evaluating fawn use of supplemental feeders.

they might have restricted access because they are low in the feeding hierarchy. Our objective is to determine the effects of deer and feeder density on fawn visitation rates at supplemental feed sites.

We captured fawns and ear-tagged them with unique color and number combinations so that individuals could be identified in photos. Camera surveys were conducted biweekly from September 2013 to March 2014. Fawns per doe will be calculated for each camera survey week. Beginning in January, we will estimate the intensity of supplemental feed use by individually marked fawns.

Preliminary data suggest that at high deer densities, multiple feed sites may be necessary to ensure that fawns have access to supplemental feed. A high plane of nutrition is important for a productive deer population, and good nutrition is especially critical for fawns. Knowing the proportion of fawns that gain access to supplemental feed will help wildlife managers understand how their deer program is influencing fawn survival and growth.

Effects of Deer and Feeder Densities on Deer Populations

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

White-tailed deer populations operate following density dependence models in the northern and southeastern United States. However, in variable landscapes such as South Texas, populations may not function in this manner. Also, limited research has been conducted to investigate the effect of supplemental feed on white-tailed deer population dynamics at high densities, despite the popularity of feeding programs.

Each October and January, mark-resight techniques using photographs will be used to estimate the number of bucks, does, and fawns. We will estimate population rates of change for deer in each enclosure using these data, along with population reconstructions.

Population adjustments will occur annually in December and March to maintain target densities of deer within each enclosure. During each adjustment period, we will collect information on sex, age, live mass (weight), dressed mass, body condition score, body length, hind foot length, antler measurements, and pregnancy and lactation status for comparison among deer density and feeder density treatments.

Many landowners provide supplemental feed to increase body weights, antler sizes, and fawning rates. However, increased fawn production could eventually lead to decreased birth rates and overall deer size because of density-dependent effects. Maintaining artificially high densities could conflict with management goals aimed at preserving healthy herds and producing trophy deer. Therefore, it is necessary to have a better understanding of the relationship between deer population dynamics and supplemental feeding.

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The white-tailed deer is an important game species for sport hunting, generating thousands of dollars in hunting leases.

The Effect of Deer Density on Female Fawning Season Home Ranges

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

In some regions, female white-tailed deer socially and spatially isolate themselves during the fawning period and actively defend fawning territories. This behavior was not observed in one study in southern Texas and could have been due to low fawn survival.

Social isolation is necessary for proper imprinting in white-tailed deer and could be negatively affected by high densities. Inadequate imprinting could lead to decreased fawn survival. A decrease in size of fawning areas could reduce nutrition of lactating does and newborn fawns, causing long-lasting physiological setbacks affecting entire cohorts.

To better understand territoriality during fawning, we fitted 9 does in 2 enclosures per ranch with Global Positioning Systems (GPS) collars in March 2014. Each ranch has an enclosure containing 20 deer and an enclosure containing 60 deer with a central feeder and water source. The collars will record a location every 30 minutes and will be removed in October 2014. We

will estimate 50% core home ranges and compare ranges before parturition, in the 6 weeks following parturition, and in the last 6 weeks of collar attachment to determine whether percentage overlap and size of home ranges vary by reproductive status. Core home range sizes will also be compared to investigate the impact of deer density on fawning area sizes.

Our findings will provide insight regarding the densities at which optimum fawn development occurs. This information will help wildlife managers optimize deer population levels when using supplemental feed.

Behavior and Feed Use of White-tailed Deer in South Texas

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

Research from Phase I showed that concentrated food resources are not equally accessible to all age and sex groups of deer when population density increases, largely because of dominance hierarchies. In Phase II, there are different densities of concentrated food sources within selected enclosures, which may provide more opportunities for subordinate deer to access supplemental feed.

Using stable isotope ratios in the pelleted feed along with hair and blood samples taken twice a year from individual deer, we will determine the proportion of each deer's diet composed of pelleted feed. Also, we will assess the aggressive behaviors of individual deer. Deer will be identified by their ear tags or antler characteristics. Each deer will be classified as dominant or subordinate, based on observations from digital trail cameras placed at the concentrated food sources. This allows dominant and subdominant individuals to be matched with their respective stable isotope samples.

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Ph.D. student Emily Belser measures stable isotopes of carbon in deer blood to learn about feeding behavior.

Ultimately, individual feed consumption by both dominant and subordinate deer may provide insight into how behavior affects accessibility to concentrated food sources. The results of this study will help deer managers optimize their concentrated food site densities to maximize each deer's feeding opportunities based on deer densities.

Summer Trends in White-tailed Deer Diets in South Texas

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

Previously published research suggests that the summer diets of white-tailed deer in South Texas consist largely of mesquite beans and prickly pear mast when these items are available. During this same period, deer consumption of pelleted feed typically decreases. However, little is known about the relationship between mast disappearance and a decline in feed consumption.

In this study, we will quantify the disappearance rate of mesquite beans and prickly pear mast. We will be monitoring 5 mesquite trees and 5 prickly pear plants within each enclosure on both ranches during the summers of 2014, 2015, and 2016. On each mesquite tree, 20 individual beans will be marked. Marked beans remaining on each mesquite tree as well as every fruit on each prickly pear will be counted weekly to determine disappearance rates. Pelleted feed consumption will be measured throughout the summer to provide a contrast to mast consumption.

The results of this study will provide insight regarding the dietary trends of white-tailed deer in South Texas. This information will help deer managers understand the value of mesquite and prickly pear.

Feed Site Visitation of Female Deer During and Post Pregnancy

Ty E. Higginbotham, David G. Hewitt, Timothy E. Fulbright, Charles A. DeYoung, John H. Clark, Kim N. Echols, and Don A. Draeger

Supplemental feeding provides extra nutrition during and after pregnancy when nutrient needs of white-tailed deer does are high. We hypothesize that

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Having a basic understanding of how pregnant does use supplemental feeders will aid deer management.

does will visit feed sites more during the later stages of pregnancy because of fawn growth and space constraints within the doe's body cavity. Furthermore, we hypothesize that visitation frequencies will be lower after parturition because does will remain in the vicinity of their fawns.

In addition, we will have movement data for each doe that has been collared with a Global Positioning Systems (GPS) tracking unit. This information will allow us to assess the frequency of feed-site visitation as a function of the distance between the doe's core area of use and the feed site she visits.

We will place a trail camera at the only feed site in each of the 20-deer and 60-deer density enclosures (on both ranches). The 4 enclosures currently contain 9 pregnant does. Each of these does were equipped with GPS collars in March 2014. Trail cameras will take pictures when deer are at feed sites from May through August 2014. Locations from GPS collars will be analyzed to estimate each doe's parturition date. Using the estimated parturition dates, we will read photos taken on 2 selected days of every week for 3 weeks before parturition and 3 weeks after parturition. Visitation frequencies of the collared does will be compared between the 2 periods to determine whether there are differences in feeder usage.

This study will provide insight on whitetail doe feeding frequency requirements during and after pregnancy. This information is needed to help deer managers better understand the importance of supplemental feeders to does during the critical 6-week period around parturition.

Effects of White-tailed Deer Foraging on Browse Quality

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

Researchers working in African shrub communities discovered that heavy browsing stimulates shrubs to produce leaves higher in quality than plants that are not browsed. If ecosystems in South Texas function similar to those in Africa, then there may be an optimal deer density at which elevated browse quality can be maintained through browsing. In contrast to the results of African studies, some of our previous research in the South Texas region indicates browsing may increase secondary plant compounds that reduce diet quality.

It is possible that browsing at any deer density reduces browse quality instead of increasing it. Our objective is to determine the relationship between white-tailed deer density and nutritional quality of browse produced by blackbrush acacia, twisted acacia, and spiny hackberry.

Leaves and twigs of shrubs in enclosures containing 0, 20, 40, and 60 deer (1 supplemental feeder in each enclosure) will be sampled during July (regrowth period with light browsing) and October (heavy browse period). We will sample 20 individuals of each plant species per enclosure on each ranch; plant samples will be removed within the browsing zone (20–40 inches from the ground) in each cardinal direction. Nitrogen, tannin, and fiber content analyses will be performed on each sample, and the results will be compared between the 2 browse periods.

Our findings will help deer managers in making decisions about appropriate white-tailed deer densities for shrub communities in South Texas. In addition, understanding the interactions between shrubs and deer will provide greater insight into the nutritional ecology of white-tailed deer in South Texas.

Mortality and Habitat Use in White-tailed Deer Fawns

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

Recruitment is a large component of ensuring the future productivity of a white-tailed deer herd. Annual deer counts are typically made during autumn. Harvest recommendations are usually made on the assumption that most of the fawns present during autumn counts

will survive until the following year. However, considerable mortality may sometimes occur during late winter. Our objective is to determine if white-tailed deer density and number of feeders influence late winter fawn survival.

Fawns will be fitted with either Global Positioning Systems (GPS) collars or ear tag transmitters in late October 2014. They will be given uniquely colored and numbered ear tags and be contained within enclosures with 40 deer per 1 feeder, 60 deer per 1 feeder, and 60 deer per 3 feeders on both the Comanche and Faith ranches. GPS and ear tag transmitters will be equipped with mortality sensors to enable us to estimate survival. To provide data to help us interpret and explain our results, we will use GPS collars to collect data on daily activity, including percentage of the day a fawn is moving versus resting, home range size, core area size, and habitat selection. Photos from trail cameras placed at the feeders will be examined to identify ear-tagged fawns to evaluate fawn usage of supplemental feed.

Our results will provide information on the influence of deer densities, feeder presence, and available habitat on fawn survival. Understanding the conditions and habitats of South Texas in which fawns are more likely to survive will provide deer managers with important information on how to increase recruitment of fawns.

Compensatory Growth of White-tailed Deer Browse Species

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

Researchers previously formulated the grazing optimization hypothesis to explain how grazing may benefit both plants and grazing animals. We are extending this idea to woody plants with the browsing optimization hypothesis.

We propose browsing stimulates shrubs to produce new and longer twigs, and that this production increases with white-tailed deer density to some maximum point. Conversely, shrubs may allocate more of their resources to defenses such as thorns, rather than to growth, as deer densities increase. We are testing this hypothesis by determining the relationship between white-tailed deer density and the growth of blackbrush acacia, twisted acacia, and spiny hackberry.

We are measuring lengths of outer shoots, thorn length, and number of thorns on 10 plants of each shrub species in enclosures with 0, 20, 40, and 60 deer (1 supplemental feeder in each enclosure). Shoots will be permanently marked and re-measured annually during July (regrowth period with light browsing) and October (heavy browsing period). Measurements will be made in each cardinal direction within the browsing zone (20–40 inches from the ground) of white-tailed deer. Evidence of browsing will be noted, and lignified and non-lignified plant growth recorded.

Our results will provide information on the effects of deer browsing on selected shrub species in South Texas. Shrubs may compensate for increased browsing by producing more foliage. Alternatively, these shrubs may become more defensive against browsing, thereby reducing their value to deer. Understanding these interrelationships will help wildlife managers determine optimal deer densities so that habitats can produce the highest quantity and quality forage for white-tailed deer.

A Test of the Browsing Optimization Hypothesis

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

Ecologists during the late 20th century developed the idea that as grazing intensity increases, plant growth is increasingly stimulated until a point is reached at which plant growth begins to decline with further increases in grazing intensity. We refer to this idea as the "browsing optimization hypothesis." Our objective is to determine if canopy volume of browse shrubs increases with deer density up to a point, and then declines at high deer densities. A sec-

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CKWRI students monitoring a wire "control" exclosure to determine how shrubs grow in the absence of browsing.

ondary objective is to determine how feeder density influences deer impacts on woody vegetation canopy volume and mast production.

In June 2013, similar pairs of blackbrush acacia, granjeno, and guayacan were located within each enclosure. One plant from each pair was enclosed using cattle panels to protect against deer browsing. Detailed diameter measurements will be taken June 2013–2018 to estimate overall canopy volume for each plant. During April–July 2014–2018, mast production will be estimated for each plant.

We predict that at lower white-tailed deer densities, woody plant canopy volume will increase, but at higher deer densities, a browsing line will become apparent. We further predict that plants will allocate resources to leaf and stem growth with increasing browsing pressure rather than to reproduction, thereby resulting in reduced mast production.

Knowledge of the relationships between browsing pressure and plant canopy volume will aid in determining deer densities that can be supported without damage to the habitat. This will allow deer herd management at optimal levels without creating negative consequences for natural habitats.

Does Increasing Deer and Feeder Density Reduce Woody Plants?

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

The optimal white-tailed deer density for the southwestern Texas landscape is presently unclear. Over utilization of the landscape and negative impacts on the vegetation are potential consequences for exceeding optimal deer densities.

The provision of supplemental feed for white-tailed deer appears to have little influence on vegetation responses to deer browsing. The objectives of this study are to determine (1) the maximum number of supplementally-fed deer that can be supported without damaging the vegetation and (2) how feeder density influences deer impacts on vegetation.

During June 2013–2018, pre-established vegetation transects will be sampled on each ranch using the line intercept and belt transect methods to determine the effects of increasing white-tailed deer densities on the percentage of woody plant canopy cover and on the plant density of orange zexmenia, awnless bush sunflower, and granjeno. We selected these 3 species because they are palatable to white-tailed deer. We predict that as deer densities increase, woody plant canopy cover and density will decrease, with a browse line becoming more apparent. However, increasing supplemental feeder density may reduce the negative effects of deer browsing.

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Many white-tailed deer management programs in South Texas use supplemental feed to increase carrying capacity.

By measuring the effects of deer browsing on preferred species of woody vegetation at different deer and supplemental feeder densities, wildlife managers can determine the most appropriate deer population size for their land and the efficiency and effectiveness of a supplemental feeding program. Information obtained from this study could be used by wildlife managers to increase deer densities for better hunting opportunities without negatively impacting the habitat.

Effects of Varying Feeder and White-tailed Deer Densities on Herbaceous Vegetation

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

When available, forbs constitute a large portion of white-tailed deer diets in southwest Texas; however, little is known about the effects of varying deer densities and the use of supplemental feed on forb communities in semiarid regions. Our objective is to determine the maximum number of deer that can be supported in South Texas thornscrub without causing a decline in palatable forbs or an increase in unpalatable forbs in a nutritionally supplemented system.

Each March and May during 2013–2015, forbs and grasses will be harvested in paired caged and uncaged plots to determine the effects of deer density on standing crop. During June 2013–2015, canopy cover will

be estimated in pre-established transects and sampled on each ranch using multiple methods. In addition, 2 palatable perennial forbs will be monitored monthly during 2014–2015 to determine their survival.

We predict that use of forbs by white-tailed deer, measured by the difference between standing crop inside and outside cages, will increase as deer densities increase. Based on traditional ideas about deer foraging, palatable forbs are expected to decline with increasing deer density. Conversely, variation in rainfall may have more influence on forb communities in southwestern Texas than does deer density and supplemental feeding. Wildlife managers may use this information to provide greater hunting opportunities while avoiding excessive use by deer of the habitat, which could change plant communities and ultimately cause habitat degradation.

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

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

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

Deer Management Permits (DMPs) are issued by the Texas Parks and Wildlife Department to qualified property owners for the purpose of confining and breeding a buck with large antlers with up to 20 does. Subsequently, the buck, does, and fawns are released from confinement. In this study, we are evaluating how DMPs can affect antler size within a population.

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Researchers are examining how the deer herd can be improved using deer management permits.

The study is being conducted on the Faith Ranch in Dimmit County, Texas. Two, 1,100-acre treatment and control pastures surrounded by high fence were established in 2007. Both pastures are under identical supplemental feeding programs.

Resident deer were removed from the treatment pasture prior to this study, and it has been replenished with DMP sired offspring. The control pasture has resident deer that were enclosed when the high fence was constructed. DMP pens are stocked with native deer from the property. Fawns are marked in DMP pens and the control area each year with ear tags specific to year-of-birth. Each fall, marked bucks that are DMP offspring and marked bucks in the control area are captured via helicopter. Antler size is being compared within age classes.

In 2013, there was a +5 inch difference in Boone and Crockett (B&C) score between treatment yearlings (1.5 years) and control yearlings. Also, treatment bucks compared to controls averaged as follows: 2.5-year-olds +16 B&C inches, 3.5-year-olds +6 B&C inches, 4.5-year-olds +11 B&C inches, 5.5-year-olds +27 B&C inches, and 6.5-year-olds -2 B&C inches. The research will continue for several more years.

Cooperative funding provided by the Faith Ranch.

Determining Dietary Overlap of Cattle, Nilgai, and Deer using Stable Isotopes

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

Many studies have been completed in North America regarding the diet overlap of cattle and white-tailed deer. To our knowledge, no studies have examined competition of cattle and deer with nilgai. The majority of diet studies have used fecal analysis and bite-counts, which can be biased because of differential digestion rates of forages by species and observer error, respectively. Stable isotope analysis has become popular in wildlife ecology because it provides a way to track resource use and niche partitioning among wildlife species and reduces biases. Our objective is to determine dietary niche overlap between cattle and nilgai during autumn and among cattle, deer, and nilgai during autumn, winter, and spring.

Twenty randomly selected fresh fecal samples from cattle, nilgai, and deer will be collected during the 2 weeks post-autumn season, spring growing season,

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The dietary overlap of nilgai, cattle, and white-tailed deer within South Texas is not well understood.

and winter non-growing season from 2012 to 2015. In addition, blood and hair samples from 30 cattle and nilgai will be collected every year at the end of autumn from 2012 to 2014.

Preliminary findings indicate that nilgai and deer diets strongly overlapped during the autumn growing season peak in 2012. Cattle and nilgai diets did not overlap. Cattle and deer diets overlapped at 1 of 6 study sites. The diet overlap occurred because grass was lacking, and cattle had to forage on browse plants to survive.

Results of our study will assist managers in assessing conditions under which competition among cattle, deer, and nilgai may occur in South Texas. It will also provide insight for researchers into the use of stable isotopes in wildlife ecology.

Cooperative funding provided by the East Wildlife Foundation, Texas A&M University-Kingsville Title V Promoting Postbaccalaureate Opportunities for Hispanic Americans Program, and the South Texas Chapter of the Quail Coalition.

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 selective culling on ranch-sized areas. We are conducting a 10-year buck culling study on large acreages to determine results that managers can expect from long-term buck culling.

During the first 7 years, bucks were captured annually at random on 3 areas of the Comanche Ranch in Maverick County, Texas using a helicopter and net gun. Each buck was aged and measured for Boone and Crockett (B&C) score. 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 for identification of the buck if recaptured in future years.

On one area, we culled yearlings with less than 6 points, 2-year-olds with less than 8 points, 3- and 4-year-olds with less than 9 points, and 5-year-olds and older with a gross B&C score less than 145. On another area, all yearlings and 2-year-olds were released and older deer culled by the same criteria as above. Finally, a third area served as a control and all bucks captured were released.

After 7 years of culling white-tailed deer on the study sites, the intensive site had a widening sex ratio and signs that yearling buck antlers might be declining, possibly due to environmental influences on late-born yearlings. Beginning in year 8 (2013), we have ceased culling on all areas, but continued capturing deer and collecting data.

After 8 years, 3,971 bucks have been caught, of which 1,305 have been culled and 2,666 released. There have been 1,533 bucks recaptured. The study will continue for 2 more years.

Cooperative funding provided by the Friedkin Conservation Fund.

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

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

Selective harvest (“culling”) is a widely practiced management technique where males with undesirable antler characteristics are removed from the population. However, the effects of culling on deer behavior have received little attention.

Depending on the intensity of removal and the manager’s definition of a “cull,” culling may influence population age structure and sex ratios, which in turn may affect how mating success is distributed within

the population. The proportion of offspring sired by bucks with desirable antler characteristics and the total number of offspring produced in their lifetime will determine if culling can affect the genetic potential for antler development in wild deer.

We are using genetic parentage techniques to evaluate the mating success of whitetail bucks in 2 managed populations that differ in intensity and timing of culling and will compare the findings to an unmanaged control site. We captured bucks each autumn during the past 8 years, estimated age, and measured antler size. Bucks that do not meet the criteria are removed; the remaining bucks are marked with a microchip for later identification and released.

We have collected over 3,000 tissue samples during the past 8 years. We have extracted DNA from 1,700 samples and have begun the collection of genotype data for parentage analyses.

The white-tailed deer capture and sampling phase of this study will continue for an additional 2 years. The resulting information should have important deer management implications for landowners and wildlife biologists engaged in culling activities.

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

Cattle Grazing Impacts on Growth of Forbs Preferred by White-tailed Deer

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

Grazing by cattle is commonly recommended as a habitat management tool based on the assumption that grazing will reduce grasses and increase forbs. Our objective is to determine the relationship between intensity of cattle grazing and biomass of forbs that are preferred by white-tailed deer.

In this study, we installed 50 vegetation enclosures and outside paired grazed plots at each of 6 study sites that are 6,000 acres each on 4 East Wildlife Foundation ranches. Information from monitoring these plots will be used to assess the relationship between cattle grazing intensity and abundance of forbs preferred by white-tailed deer.

Every autumn and spring, grazable forage will be identified to species, when possible. Every autumn, vegetation biomass will be determined in the following categories: (1) grasses, (2) forbs preferred by deer, and (3) forbs not preferred by deer. From this data, we will be able to determine the effects of cattle grazing intensity on forb biomass.

To date, 2 of the 3 years of data have been analyzed. Our findings suggest that cattle grazing intensity had no effect on biomass of forbs not preferred by deer in 2012 or 2013 and on biomass of forbs preferred by deer in 2013. However, biomass of forbs preferred by deer declined with increasing cattle grazing intensity in 2012.

The lack of an influence of cattle grazing intensity on biomass of forbs preferred by deer in 2013 resulted, in part, from below average rainfall received for most months from September 2012 through August 2013. At the conclusion of this study, we will have sufficient information needed for wildlife managers to determine whether cattle grazing should be a part of their deer habitat management program.

Cooperative funding provided by the East Wildlife Foundation, Texas A&M University-Kingsville Title V Promoting Postbaccalaureate Opportunities for Hispanic Americans Program, and the South Texas Chapter of the Quail Coalition.

Digestibility of Standard and Low-Energy Diets for Nutritional Research on Deer

Jose Mata, Brandon Mitchell, David G. Hewitt, Randy W. DeYoung, Ryan L. Reitz, and Donnie Frels

Many wildlife managers provide supplemental feed to white-tailed deer in South Texas to counteract the effects of recurring droughts. Most managers focus on provision of high-protein supplements on the premise

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Studies on nutritional diets of white-tailed deer are essential for effectively managing wild populations.

that protein is limiting in the natural diet. However, deer may be more limited by energy than protein in South Texas environments.

The Texas Parks and Wildlife Department recently implemented a long-term study in the captive deer herd at the Kerr Wildlife Management Area. Their study is designed to better understand the effects of diets low in energy.

The amount of energy in an animal's diet can be predicted from the feed components, but an empirical estimate of digestibility is needed to substantiate the basis for treatment effects. For instance, animals can adjust their intake or metabolism under conditions of limiting nutrition. In addition, differences in body size among the sexes may affect the animal's ability to digest fiber. As a result, we must study the diet of the animals to properly quantify the nutritive value of the feed they consume.

We are evaluating digestible energy in the diets of white-tailed deer housed within the Alkek Captive Facility at Texas A&M University-Kingsville. We are providing different diets to deer housed in metabolism crates, where the amount of food consumed and feces produced can be closely monitored. The ongoing analyses will quantify the digestible energy in the feed, which is an important part of the long-term study on deer diets.

Cooperative funding provided by the Caesar Kleberg Wildlife Research Institute Deer Associates and the Texas Parks and Wildlife Department.

Aldo Leopold's Cow: Can Cattle be used as a Deer Habitat Management Tool?

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

The debate regarding whether deer are affected by cattle grazing is centuries old. Although many studies have been completed in North America on interactions between cattle and deer, there is no clear consensus that cattle grazing can be used as a habitat management tool for deer.

Our objective is to summarize the literature on cattle and deer interactions to determine under what conditions cattle are useful as a deer habitat management tool. To achieve this objective, we will build statistical models that address the following: (1) cattle and deer diet overlap, (2) degree of deer habitat shift and avoidance of cattle, (3) cattle grazing effects on deer diet intake of vegetation, and (4) cattle grazing effects on vegetation biomass and recruitment based on data reported in the literature.

© Randy DeYoung

Despite the historical foundation of using cattle for deer management, there are still questions as to its effectiveness.

We have reviewed over 2,600 titles, abstracts, and content of peer-reviewed articles regarding cattle and deer interactions and cattle grazing impacts on vegetation in North America. Data extracted from papers that meet our criteria for each model will be analyzed and used to generate the best models.

We hope to tease apart the contradictory findings of cattle and deer interactions in the published literature. Our results will assist wildlife and ranch managers in determining under what conditions cattle can be used as a habitat management tool to enhance deer habitat in North America.

Cooperative funding provided by the East Wildlife Foundation, Texas A&M University-Kingsville Title V Promoting Postbaccalaureate Opportunities for Hispanic Americans Program, and the South Texas Chapter of the Quail Coalition.

Antlers as a Model for Human Bone Injury and Disease

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

Antlers have been important to human societies throughout history for practical, religious, medicinal, and sporting reasons. Although medical uses of antlers are usually associated with ancient Asian medical

practices, antlers have found their way into the high-tech laboratories of modern medicine.

Information on cellular processes and genetic mechanisms of antler growth could be used to develop therapeutic strategies for addressing human bone disease and injury. Unfortunately, the physiology of antler growth is poorly understood.

Our objective is to sequence RNA in deer antlers and other relevant tissues and compare the RNA profiles to the deer's genomic sequence to identify genes involved in antler growth and regeneration. Once candidate genes have been identified, we will compare the genetic sequence of those genes among deer with divergent antler characteristics to gain an understanding of each gene's role.

The information obtained in this study could be used to formulate novel treatments for human bone disease, improve strategies to repair broken bones, and perhaps even regenerate limbs. In addition, the knowledge gained will be valuable in understanding the fascinating process of how deer grow a new set of antlers each year and the factors influencing the characteristics of antlers.

Cooperative funding provided by the Baylor College of Medicine.

Courtesy Texas Parks and Wildlife Department

Native Seed Sources for Use in Gamebird Food Plots

Anthony D. Falk, Keith A. Pawelek, Forrest S. Smith, Matthew J. Schnupp, Robert Sanders, Aaron Cantu, Terry Hanzak, and Rudy Gonzalez

Planting and cultivating seed bearing crops to attract gamebirds for harvest is a common land management practice in South Texas. Gamebirds often seek out native food sources over high input crops. Native plants may be a better option for many food plots on arid rangelands in South Texas because of their ability to produce a quality seed crop under marginal growing conditions.

In summer 2014, personnel from *South Texas Natives* seeded 6 native species known to be consumed by doves and quail in 6 food plots located throughout South Texas. Each species was planted as a monoculture plot within a larger food plot to determine the native plant species preferred by gamebirds. Half of the sites were irrigated. Species established were Oso Germplasm Hall's panicum, Venado Germplasm awnless bushsunflower, Zapata Germplasm Rio Grande clammyweed, Balli Germplasm prostrate bundleflower, Rio Grande Germplasm prairie acacia, and Catarina Blend bristlegrass.

The vegetation in each food plot will be measured in autumn 2014 to identify the native plant species that performed best at each location. Along with vegetation measurements, we will be collecting the crops of gamebirds harvested from the plots. Examination of the crop contents will allow us to determine what the birds are actually feeding on and which plant species are preferred.

Cooperative funding provided by the Caesar Kleberg Partners.

Update on Activities and Accomplishments of the *South Texas Natives* Project

Forrest S. Smith

South Texas Natives began in 2001 through a founding grant provided by the Robert J. Kleberg, Jr. and Helen C. Kleberg Foundation. Grants from the Texas Department of Transportation and donations from landowners, foundations, and the oil and gas industry also sustain the program. The mission of *South Texas Natives* is to develop and promote native plants for the restoration and reclamation of public and private lands within South Texas.

Over the past 13 years, *South Texas Natives* and its collaborators have improved the availability of native seed sources for South Texas and enhanced restoration knowledge in the region. This work has been accomplished through 24 native seed releases and the installation and monitoring of over 40 demonstration and research projects.

Future emphasis for seed source development is focused on high value native grass species for restoration of specific, quality habitats for wildlife. Two pressing needs are (1) seeds of species common on sandy soils in the Sand Sheet and (2) seeds of species tolerant of saline and alkaline soils that are common in grasslands in western South Texas and the Eagle Ford Shale. Species being developed for commercial seed release include yellow Indiangrass, big bluestem, sand dropseed, red lovegrass, spike dropseed, switchgrass, silver bluestem, and brownseed paspalum.

Research on restoration techniques is currently focused on 2 landscape scale needs: (1) restoration of lands impacted by oil and gas or other energy exploration and production activities and (2) restoration of cropland and pastureland. *South Texas Natives* will continue working toward making a positive impact on native plant restoration activities in South Texas.

Cooperative funding provided by Robert J. Kleberg, Jr. and Helen C. Kleberg Foundation, Lee and Ramona Bass Foundation, A. E. Leonard Family Giving Counsel, Joan and Herb Kelleher Charitable Foundation, Hixon Ranch, Caesar Kleberg Partners, ExxonMobil, ConocoPhillips, and donors to South Texas Natives.

Comparing Techniques for Conserving an Endangered Plant

Ashley C. McCloughan, Sandra Rideout-Hanzak, and David B. Wester

Slender rush-pea is a small herbaceous plant that is classified as Endangered Without Critical Habitat. Endemic only to Kleberg and Nueces counties, Texas there are only 2 confirmed populations. Its former short-grass prairie habitat has been encroached upon by non-native invasive grasses, which out-compete the slender rush-pea. We are comparing management techniques for conserving the remaining slender rush-pea populations.

We are studying slender rush-pea at the St. James Catholic Cemetery in Nueces County. We marked 133 individual plants for manipulation and monitoring. We have manipulated the micro-sites within a 3.3 foot diameter circle of these plants to reduce competition. For 33 plants, we have cut vegetation within the circle to reduce the above-ground height of neighbors, while neighboring vegetation of 34 plants was treated with herbicides to eliminate both above- and below-ground competition. Small plots were burned around 33 plants in August 2013. This treatment included the target plant itself. Micro-sites of 33 slender rush-pea plants received no treatment (serve as control plants). For the target plants, we are recording the number of main stems, length of the longest stem, number of leaves on the longest stem, and the number of flowers and seed pods.

In the first spring after burning, results indicated that burning resulted in more stems, longer stems, and more flowers than found in the other treatments. Our findings can be used to determine the best course of action for conserving populations of slender rush-pea.

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

Texas Native Seeds: TxDOT Right-of-Way Managers Plant Field Guide

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

A plant identification field guide designed for Texas Department of Transportation (TxDOT) right-of-way managers and contractors is being developed as part of the *Texas Native Seeds* project. The field guide is intended for a non-technical audience more knowledgeable with highway engineering than botanical terminology. TxDOT personnel will be able to use the field guide for identification of seeds that are about to be planted as part of the revegetation work on a construction project. Contractors could use the guide for developing appropriate planting rates for revegetation work and identifying emerging seedlings in completed planting projects.

Currently, over 100 plant species are being included in the field guide. The book focuses on existing plant releases from *South Texas Natives*, plants being developed for commercial production through the *Texas Native Seeds* project, and other native plants that are used in right-of-way plantings.

Information for each species includes a distribution map, a brief description of the plant characteristics as well as information on seeding rates, number of seeds per pound, descriptions and range of adaptation for existing varieties, and information on the types of soils the plant can tolerate. The guide also includes photos of the plants at all stages: seed, seedling, mature plant, and flowering. Completion of the field guide is expected in early 2015.

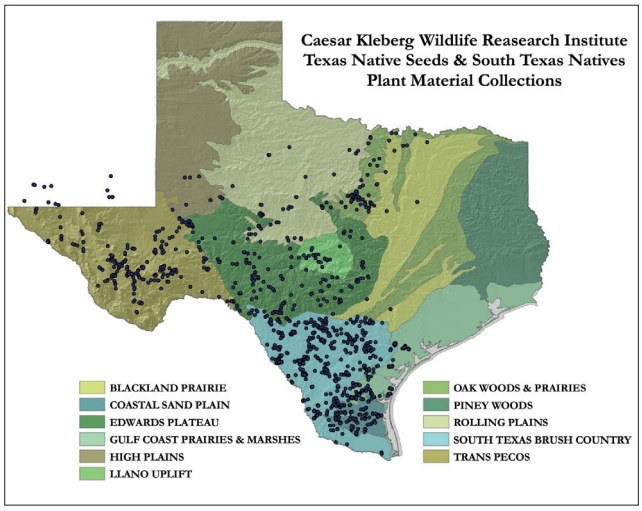
Cooperative funding provided by the Texas Department of Transportation.

Update on Activities and Accomplishments of the *Texas Native Seeds* Project

Forrest S. Smith

Texas Native Seeds began operations in September 2010 through a founding grant provided by the Texas Department of Transportation. Donations from landowners, foundations, and the oil and gas industry also support the program. The mission of *Texas Native Seeds* is to develop native seed sources for habitat improvement and restoration in Texas, specifically focusing on Central and West Texas, at present.

Recent emphasis for the *Texas Native Seeds* project has been obtaining the necessary seed collections of native species of interest from wild populations to allow population selection and seed increase of desired species. Over 1,000 native seed collections have been obtained to date, primarily from private lands because of extensive collaboration by landowners.



Native seed collection locations for the *South Texas Natives* and *Texas Native Seeds* projects, 2001–present.

Another area of emphasis has been developing infrastructure for evaluation and seed source development in each region. In Central Texas, through partnerships with the Texas A&M AgriLife Research and Extension Station-Stephenville, Tarleton State University, and the USDA Natural Resources Conservation Service James E. "Bud" Smith Plant Materials Center, evaluation locations have been developed and projects are underway at Stephenville and Knox City.

In West Texas, infrastructure development for our research program has been a ground up process. Over the past 2 years, in collaboration with the Borderlands Research Institute, we developed a field research facility near Alpine on the Sierra la Rana Ranch and near Odessa on the Railway Ranch. Because of progress made, *Texas Native Seeds* will release its first seed selections for commercial production in 2015, followed by additional releases annually thereafter.

Cooperative funding provided by the Texas Department of Transportation, Lee and Ramona Bass Foundation, Ewing Halsell Foundation, Pioneer Natural Resources, Shell Oil Company, Caesar Kleberg Partners, and the Dan L Duncan Endowment.

Wilson County Eagle Ford Shale Pipeline Restoration Trial

Keith A. Pawelek, Anthony D. Falk, Forrest S. Smith, and Ryan L. Darr

Restoration of oil and gas pipeline right-of-ways is a need of private landowners in and adjacent to the Eagle Ford Shale region of Texas. To provide information to landowners and oil and gas operators about the best techniques for restoration, we are conducting research on a pipeline right-of-way at the Buen Vecino Ranch in Wilson County, Texas. One objective of this experiment is to examine the differences in native plant restoration results when using a Truax seed drill and a Truax Trillion seeder. Our secondary objective is to compare restoration results when using a "low diversity" seed mix (10 species) of locally adapted native grasses and a "high diversity" locally adapted native seed mix (31 species of grasses, forbs, and legumes) that could additionally serve as a food plot for wildlife.

Restoration of pipeline right-of-ways with locally adapted native seed is being studied by *South Texas Natives*.

Plantings were replicated across 2 soil types. No differences occurred in vegetation establishment between the 2 planting methods, supporting the hypothesis that planting locally adapted seed and proper land preparation are better drivers of success than the planting method. Cover establishment of seeded plants averaged 52% in the low diversity mix and 62% in the high diversity mix. As expected, plant diversity was almost double in plots planted with the high diversity seed mix (10 species were established in the low diversity mix and 19 species with the high diversity mix).

Cooperative funding provided by the Rotary Club of Corpus Christi (Harvey Weil Sportsman Conservationist Award Trust), Buen Vecino Ranch, and the numerous donors to South Texas Natives.

Texas Native Seeds – Central Texas Update on Evaluation Projects

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

As the *Texas Native Seeds* project moves into its 4th year of operation in Central Texas, 15 native plant species are in various stages of evaluation. Ongoing field trials are located at the Texas A&M AgriLife Research Center in Stephenville and the USDA Natural Resources Conservation Service Plant Materials Center in Knox City. These evaluations will ultimately lead to new native seed releases for use in restoration activities within Central Texas.

Currently, we are evaluating multiple populations of 12 species of grasses, 2 legumes, and 1 forb at both research locations. In spring 2014, we added 8 of these species to our efforts, including bundleflower, hooded windmillgrass, sand dropseed, slim tridens, hairy grama, dotted gayfeather, golden prairie clover, and plains bristlegrass.

Monthly field evaluations of all plants will occur at both locations for the next 3 years; seed will be collected for quality testing as it is produced. Evaluation data collected on populations of each species being screened will guide identification of the best populations of each species adapted for Central Texas for restoration use, release, and eventual commercialization. We hope to make the first of many releases from the program in 2015.

New seed sources developed through these efforts will help meet the growing demand for native plant materials. These extensive evaluation efforts will ensure provision of high quality seeds, greater diversity in market options for native seeds, and improved native seeding success in Central Texas.

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

Advanced Evaluation and Seed Increase of White Tridens

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

White tridens is a widespread perennial warm season grass that is adapted to clayey soils and moist soil conditions. These characteristics make it an excellent candidate for revegetation of right-of-ways, particularly bar ditches that control the flow of water and are subject to flooding. White tridens is also competitive with invasive Old World bluestems that also grow well in similar soil conditions.

Following 2 years of plot evaluations from collections made throughout the state, 5 promising collections originating from South, Central, and West Texas were selected for advanced evaluation and seed increase. Selections were based on white tridens' drought hardiness, biomass production, and active seed germination features.

This spring, we established initial seed increase plots of 100 plants of each selected population in isolation to preserve the integrity of each original collected population. *Texas Native Seeds* plans to intensively produce seed from each of these 5 collections and increase plot sizes to around 1,500 plants per population. Pending successful seed production and research to determine economical and practical commercial production methods, we hope to make a seed release of white tridens in 2015. At that time, seed will be made available to commercial seed growers for large-scale production.

© Forrest Smith

White tridens may be an important component of roadside seeding mixtures in Texas.

Cooperative funding provided by the Texas Department of Transportation, Lee and Ramona Bass Foundation, Robert J. Kleberg, Jr. and Helen C. Kleberg Foundation, Ewing Halsell Foundation, Faye L. and William L. Cowden Foundation, Dixon Water Foundation, Caesar Kleberg Partners, Will Harte, and donors to South Texas Natives and Texas Native Seeds.

Texas Native Seeds – West Texas Evaluation Site Expansion

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

Construction has begun on a new plant evaluation and research site on the Railway Ranch in Upton County, just south of Odessa, Texas. Ranch owner Stan Smith has been a collaborator with the *Texas Native Seeds* West Texas program since the project began in 2011. Mr. Smith generously agreed to donate use of a 5-acre plot on the ranch as an expansion site for plant materials research and evaluation in West Texas. New irrigation infrastructure and fencing are under construction with the expectation that the site will be fully operational in 2014.

The Railway Ranch location will complement ongoing plant materials research at the existing Sierra la Rana Plant Evaluation and Research Facility located in Alpine, Texas. The availability of 2 plant research

facilities for the *Texas Native Seeds* West Texas program will allow plant material evaluations across different climatic and soil environments. The Railway Ranch site will be more representative of the climate and soils found on the western Edwards Plateau, the Southern Rolling Plains, and the Southern High Plains regions of Texas. This will allow *Texas Native Seeds* researchers to make more informed decisions regarding regionally-based plant material releases from research conducted on local plant and seed performance.

The Railway Ranch site is located in the heart of the booming Permian Basin oil and gas production region. This location will facilitate collaborative research and program development opportunities with energy companies and landowners looking for technical expertise on energy-related land stewardship.

Cooperative funding provided by the Texas Department of Transportation, Ewing Halsell Foundation, Will Harte, Dixon Water Foundation, Faye L. and William L. Cowden Foundation, Stan Smith, and the Railway Ranch.

Restoration of Mixed Soils Associated with Pipeline Construction

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

Thousands of miles of pipelines have been constructed to transport oil and gas being extracted in Texas. Although topsoil and subsoil are generally separated during the trenching phase of the operation, completion of a pipeline often results in mixing both topsoil and subsoil. We call these "mixed soils," and they can pose formidable challenges for site restoration because the subsoil is generally unsuitable for plant growth. We are studying ways to restore mixed soils through a combination of physical and chemical amendments, coupled with an assessment of plant species adaptation.

Temperatures at the bare surface of recently constructed pipelines can exceed 140° F and can worsen soil water loss through evaporation. We are using erosion control mats to help moderate these forbidding conditions. Also, mixed soils can present chemical problems for plants. For example, soil salinity is often higher in mixed soils than in undisturbed soils. We are investigating the effectiveness of humic substances as a chemical amendment for mixed soils. Finally, we have selected 10 native plant species to evaluate their adaptability to mixed soils.

Topsoils that are removed before trenching are often mixed with subsoils when pipeline construction is completed.

Preliminary results indicate that with adequate rainfall, seedling emergence takes place in bare mixed soils, but is enhanced with erosion control mats. Additionally, early seedling survival is prolonged with erosion control mats, likely attributable to moderated soil temperatures and reduced soil water loss. Findings will be used to develop guidelines for restoration of pipeline right-of-ways.

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

Development of Seeding Specifications for the Texas Department of Transportation

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

The Texas Department of Transportation (TxDOT) manages over 1 million acres. The agency's seeding specifications directly influence the commercial seed industry and seed markets because of seed use in right-of-way seeding projects, and indirectly because many entities voluntarily follow the agency's specifications.

Restoration of 70% of the adjacent ground cover using perennial vegetation is required of TxDOT by the federal Clean Water Act following construction or maintenance activities impacting an acre or more along roadways. Other provisions encourage the use of native plants whenever possible. Unfortunately, in many areas of Texas, native seeding projects have historically had low success rates.

To identify the best native seeds for TxDOT to use in their restoration efforts, we evaluated the performance of a wide variety of seed sources at 7 locations across Texas from 2010–2014 and compared them to other native and exotic seeds currently used by TxDOT. Performance traits measured included seedling emergence, cover potential, survival, height, and plant biomass production.

Using the data obtained in our study and information on commercial availability, we developed specification guidelines for use in all rural seeding projects in TxDOT districts within South, Central, and West Texas. These new specifications, which remove exotic species and include only native plants, will be published in TxDOT's 2014 specification book and will go into effect in winter 2014–2015. Construction projects that are bidden after this date should use native seeds exclusively for restoring vegetation cover in rural areas of South, Central, and West Texas.

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

Assessing Habitat Suitability for South Texas Ambrosia Populations

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

South Texas ambrosia is a perennial plant, which historically occurred in Jim Wells, Nueces, Cameron, and Kleberg counties of South Texas, and in the state of Tamaulipas, Mexico. However, the loss of coastal prairie habitat has led to a decline of South Texas ambrosia. Today, there are only 6 confirmed sites where South Texas ambrosia occurs. Considerable interest in identifying possible sites for unconfirmed populations and for restoration of the species has highlighted the need for a spatial model that identifies suitable habitats for South Texas ambrosia.

South Texas ambrosia is a rare species in which researchers are focusing on ways to ensure its persistence.

Our goal is to use locations of known populations to identify the key habitat features needed by South Texas ambrosia. Using this information, we plan to build a spatial model to identify areas of potentially suitable habitat within its historical range, which will be valuable in promoting restoration efforts of South Texas ambrosia within those areas.

Biological Characteristics of Stockpiled Topsoils in the Western Rio Grande Plains

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

A common practice in Texas associated with well and drill-pad construction involves removing topsoil and setting it aside for later use. Topsoils can be high in organic matter and contain a rich seed bank; both resources are valuable in future restoration efforts. There is little information, however, on biological changes that take place as stockpiles age on the landscape. Our two-part study on stockpiled topsoils includes an assessment of seed bank characteristics and microbial processes.

Stockpiles in 2 counties in the western Rio Grande Plains have been sampled since their construction in early 2013. We have collected soil samples at different depths, and in adjacent undisturbed soils at 4- to 6-month intervals.

Seed bank studies are being conducted in a greenhouse. The number of seedlings that emerge depends on depth of soil sampling as well as age of the stockpile. More seedlings emerge from the surface as the stockpile ages, a response likely explained by longer opportunities for rain to trigger seed emergence and potential induced dormancy of seeds at deeper depths.

We have also detected differences in seed bank composition related to depth and age of the stockpile. Additionally, soil microbial processes are affected by stockpiling. Soil microbial biomass carbon and nitrogen, as well as microbial community composition, are affected the very day that stockpiles are constructed, and they continue to change as stockpiles age.

© David Wester

Topsoil from this well pad site is being stockpiled for future use.

Stockpiling topsoils can be crucial for restoring rangeland sites that are disturbed by energy extraction. Our results will be used to develop guidelines to more effectively manage this valuable resource.

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

Commercial Seed Production of *South Texas Natives* Seed Releases

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

Commercial seed producers set records in production and sales of native seeds that have been released by *South Texas Natives*, the USDA Natural Resources Conservation Service E. "Kika" de la Garza Plant Materials Center, and Texas A&M AgriLife Experiment Research Station-Beeville. Commercial growers produced seed of 22 species, and total production was just short of 50,000 pounds of South Texas native plant seed releases in 2013. Seed companies are reporting a strong market with major seed use sectors including reclamation needs in the Eagle Ford Shale and wildlife habitat restoration on privately owned rangelands.

Weather permitting, seed production in 2014 should reach new milestones. Douglass King Seed Company continues to increase acreage of our most recent seed releases, including a number of grasses and several forb and legume seed releases such as awnless bush-sunflower, bundleflower, redseed and Hookers plantains, and Rio Grande clammyweed. Douglass King Seed Company is also working with *South Texas Natives* personnel to add more acreage of some of the most highly sought after species, including pink pappusgrass, whiplash pappusgrass, and multiflowered false Rhodesgrass.

In spring 2014, a multi-acre seed increase of a new release, Carrizo Germplasm little bluestem, was established. Limited amounts of seed of this selection should be marketed as early as the spring of 2015. With the increase in production scale, seed prices have seen a slight drop in unit price; however, demand has resulted in some leveling in seed prices in the last year.

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

Texas Native Seeds – Central Texas Seed Collection Update

Mia A. McCraw, Forrest S. Smith, Keith A. Pawelek, Anthony D. Falk, Colin S. Shackelford, Dennis K. Markwardt, Fred C. Bryant, Cary Choate, Bonnie J. Warnock, James P. Muir, and Jeff R. Breeden

Since the project began in 2010, one of the main priorities of *Texas Native Seeds* has been to obtain quality seed collections from native populations of species for which there is a need for commercial seed supplies. The Central Texas portion of the project includes 67 counties and numerous ecoregions. Native seed collections made in this area will provide our researchers with the materials needed to grow, evaluate, and select populations to develop and release to the commercial seed market for large scale production.

As the extreme drought of 2011–2012 eased in parts of Central Texas, collection numbers have grown to a current total of 632 seed collections comprised of 510 grass species and 122 legumes and forbs. Private land access has been integral to the success of *Texas Native Seeds* project collection goals. Overwhelming support for the project has been received from private landowners in response to presentations, field workshops, and publications developed by the staff of *Texas Native Seeds*. Personnel from USDA Natural Resources Conservation Service and Texas Parks and Wildlife Department have also facilitated valuable landowner contacts and access. With the increase in consistent rainfall across much of the Central Texas region in 2014, the staff of *Texas Native Seeds* hopes to double collection numbers by the end of 2014.

New native seed collections are being made through the support and access provided by private landowners, conservation professionals, and various agencies. Such collaborations have a huge impact on improving the commercial availability of native seeds for restoration projects in the Central Texas region.

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

Little Barley Seed Increase and Advanced Evaluation

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

Little barley is a common cool-season annual found across Texas and most of the United States. Growing up to 14 inches tall, this grass is readily found among spring wildflowers and in heavily degraded or overgrazed areas across various soil types. These characteristics could prove to be valuable for using this species in cool season restoration projects.

In early 2013, 33 accessions of little barley were propagated in a greenhouse and then transplanted into 5 irrigated research sites across South, Central, and West Texas. Monthly plant evaluation data and germination testing of seeds collected from these transplants provided information necessary to select 4 accessions with superior traits for use in restoration.

In early 2014, the seed from the original collections was planted in a greenhouse from which plants were transplanted into irrigated and isolated seed increase plots at the Texas A&M AgriLife Research Center in Stephenville, Texas. An advanced evaluation plot was also planted in Kingsville, Texas. Irrigation will be provided to the seed increase plots to encourage growth and maximum seed production. The seed produced will be harvested, cleaned, and used for further testing and increase.

The above evaluation process will lead to larger seed production blocks and eventually a named and certified release for commercial production of seed. Little barley may benefit the Texas Department of Transportation's roadside revegetation projects by providing cool season cover and erosion control that will also allow wildflower displays along roadways.

Cooperative funding provided by the Texas Department of Transportation.

Evaluation of Native Plants for Future Seed Releases in South Texas

Anthony D. Falk, Keith A. Pawelek, and Forrest S. Smith

South Texas Natives continues to work to evaluate various native plant species for potential release of restoration seed products. While 24 native plant seed releases have been made by the program to date, over 2,000 plant species occur in the region.

Ongoing evaluations to meet the needs of South Texas include seacoast bluestem and tropical neptunia. Seacoast bluestem and tropical neptunia evaluations are focused on the development of a seed production methodology for these desirable species.

New evaluation projects started in 2013 and 2014 included southern witchgrass and tropical sage. Southern witchgrass is a colonizing, early successional grass that is well adapted to sandy soils. This species germinates readily from seed, produces forage that is consumed by cattle, and provides copious amounts of seeds that are eaten by gamebirds. Southern witchgrass is also of interest because of the need for additional native seed sources for use on sandy soils to improve restoration success on those sites. We are evaluating 7 accessions of this species from 5 counties.

Tropical sage is an attractive forb with showy red flowers that grows well on heavy clay soils throughout South Texas. This plant is a good source of nectar for many butterfly and hummingbird species. Tropical sage has demonstrated excellent seed production, germination, and establishment characteristics.

Each of these plant species being evaluated by *South Texas Natives* is likely to be considered for release to commercial producers in coming years.

Southern witchgrass is being evaluated for a potential seed release for use on sandy soils in South Texas.

This will result in commercially available, ecotypic seed for use in native habitat establishment and restoration projects within South Texas.

Cooperative funding provided by numerous donors to South Texas Natives.

Texas Native Seeds – West Texas Plant Evaluations

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

Construction was completed in early summer 2013 on the 25-acre Sierra la Rana Plant Evaluation and Research Facility south of Alpine, Texas for the West Texas program region of *Texas Native Seeds*. New farm equipment, irrigation infrastructure, and fencing now make the site fully operational.

The first evaluation plantings of sideoats grama, silver bluestem, and Hall's panicum were completed in July 2013. A second round of evaluations was completed in June 2014. Species planted in this evaluation round include blue grama, sand dropseed, tobosa grass, vine mesquite, whiplash pappusgrass, slim tridens, and rough tridens. Nine grass species are currently under evaluation. These evaluations originate from plant materials collected from across the 37 counties included in the West Texas program area.

Plant species are evaluated for differences in hardiness, biomass production, seed production, and germination rates. At the end of the 2-year evaluation process, plants with the best performance will be selected for further evaluation.

© Colin Shackelford

Research to develop locally adapted native seeds is ongoing in West Texas at the Sierra la Rana Research Facility.

Seeds based on these evaluations will be the first commercially available for restoration and reclamation projects in West Texas. Consumers will soon have price competitive, regionally adapted plant materials with proven performance.

Cooperative funding provided by the Texas Department of Transportation, Ewing Halsell Foundation, Will Harte, Dixon Water Foundation, Faye L. and William L. Cowden Foundation, the Rotary Club of Corpus Christi (Harvey Weil Sportsman Conservation Award Trust), CF Properties, and the Sierra la Rana development.

Seed Increase of Native Seed Releases for South Texas

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

The year 2014 marks a decade-long partnership of seed increase efforts between Rio Farms in Monte Alto, Texas and *South Texas Natives*. Seed production in 2013 was down considerably from past years because of the continuing drought and limited irrigation water availability. However, with a wet winter and early spring in 2014, much progress is being achieved in producing needed quantities of foundation seed for the *South Texas Natives* program releases.

This spring, seed increase fields of red lovegrass and sand dropseed were enlarged, and many other releases including Maverick Germplasm pink pappusgrass and South Texas germplasm sideoats grama are being maintained at past acreage sizes. At present, with Rio Farms help, we are actively managing 15 acres of native seed production fields in the Lower Rio Grande Valley.

In Kingsville, at the Tio and Janell Kleberg Wildlife Research Park, the *South Texas Natives* farm was able to successfully expand several new seed increase fields to allow commercial production of upcoming releases. Seed increase fields of Goliad Germplasm orange zexmenia as well as slim and rough tridens were enlarged so that commercial growers can begin production of these species next year. The first increases of selections of plains lovegrass, white tridens, and purple threeawn were also planted.

Cooperative funding provided by the Lee and Ramona Bass Foundation, Robert J. Kleberg, Jr. and Helen C. Kleberg Foundation, Rio Farms, Inc., USDA Natural Resources Conservation Service, Joan and Herb Kelleher Charitable Foundation, and numerous donors to South Texas Natives.

Advanced Evaluation and Seed Increase of Purple Threeawn

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

Purple threeawn is a widespread, warm-season colonizing native grass. Historically, managers have placed low value on the plant as it is often an indicator of poor range condition and has low grazing value.

In response to the need for early successional native grasses for restoration, *Texas Native Seeds* began collecting and evaluating purple threeawn for 3 reasons. First, it is ideal for reclamation efforts along roadsides because it is a short plant that grows on nearly every soil type. Second, on many shallow soil or sandy soil sites, purple threeawn is a dominant plant species. Third, on many rangelands, it is used for nesting bobwhites in the absence of other perennial grasses.

After 2 years of evaluations at several sites, we chose 6 collections originating from South, Central, and West Texas for advanced evaluation and seed increase. These collections were selected based on origin attributes, survival at multiple sites, growth form, seed production, and active seed germination. Seed increase plots of these 6 selections were initiated this spring, which consisted of 100 plants of each collection grown in isolation. From these 100 plants, we will increase each seed production plot to 1,500 plants next spring to produce seed needed to support a commercial release. We hope to release a blend of purple threeawn seed and/or regional ecotype selections of the species in 2015 to meet reclamation needs.

Cooperative funding provided by the Texas Department of Transportation, Lee and Ramona Bass Foundation, Robert J. Kleberg, Jr. and Helen C. Kleberg Foundation, Ewing Halsell Foundation, Faye L. and William L. Cowden Foundation, Dixon Water Foundation, Caesar Kleberg Partners, Will Harte, and donors to South Texas Natives and Texas Native Seeds.

Texas Native Seeds – West Texas Seed Collections

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

Plant material collections have continued across the 37-county West Texas program region of *Texas Native Seeds*. From 2011–2014, project personnel accessed over 50 properties resulting in 650 new native seed collections for use in our seed source development research. These collections are the product of extensive collaboration with private landowners and natural resource agencies.

Texas Native Seeds **personnel collecting native seeds on a private ranch in south Brewster County.**

Regional collections are focused on a list of 37 grasses and 40 forbs representing annual and perennial plants from multiple ecological communities and various stages of plant succession. Collection lists were developed by local technical committees of resource professionals, academic partners, and interested landowners. Collection data are continually compiled and mapped for use in prioritizing future seed collection efforts. Collection efforts will continue until suitable numbers of collections (approximately 30) are obtained for each species of interest.

Our goal is to obtain at least 2 collections of each species from each county throughout the Trans Pecos. These collections are the basis of the rigorous plant evaluation research that takes place for each plant material release.

A number of new landowner partnerships, especially new landowner contacts in the booming Permian Basin oil and gas region, and early seasonal precipitation across much of West Texas bodes well for a productive 2014–2015 collection season. These seed collection efforts will lead to the eventual release and subsequent commercial availability of ecotypic native seed for use in restoration efforts in the Trans-Pecos ecoregion of Texas.

Cooperative funding provided by the Texas Department of Transportation, Will Harte, Dixon Water Foundation, Faye L. and William L. Cowden Foundation, and the Rotary Club of Corpus Christi (Harvey Weil Sportsman Conservation Award Trust).

Impacts of Wind Energy on Wintering Redheads Along the Lower Texas Coast

Corey J. Lange, Bart M. Ballard, and Daniel P. Collins

The need for alternative energy sources has ignited an intense push for wind energy. Because the winds along the lower Texas coast are favorable for wind energy, there have been several wind farms constructed and more are being proposed.

Because this region also supports the majority of the continent's redheads each winter, we felt it prudent to understand the effects of wind farms on this migratory waterfowl species. This information will allow us to be informed on ways to reduce impacts on redheads from future development, or possibly using habitat management to reduce impacts from already established wind farms. To investigate the potential effects of wind farms on wintering redheads, we are using spatial datasets and information from 5 years of aerial surveys that provide location and movement data of 20 redheads marked with Global Positioning Systems (GPS) satellite transmitters.

Preliminary results suggest that use of coastal ponds by redheads in the vicinity of the wind farm declined by more than 70% following construction. Also, coastal pond availability (standardized by the Palmer Drought Severity Index) within the boundary of the wind farm declined by 50% following construction. All radio-marked redheads remained farther than 4 miles away from the wind farm.

Initial analyses suggest that, for the most part, redheads are avoiding foraging areas and coastal pond drinking sites near the wind farm. Future research should investigate the effects of the reduction in available foraging areas and coastal pond drinking sites on wintering redheads.

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

Breeding Ecology of the Reddish Egret Along the Texas Coast

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

The reddish egret is a charismatic wading bird that breeds in mixed-species colonies of waterbirds. It is listed as a species of concern because of its small population size. In addition, it is a species that we know very little about relative to other waterbirds. We do know that the reddish egret has specific habitat requirements within a restricted range along portions of the Gulf of Mexico, the northern Caribbean, and Pacific Coast of Mexico.

To better understand reddish egret breeding ecology, we attached Global Positioning Systems (GPS) satellite transmitters to 30 adults in the Texas Laguna Madre. We plan to monitor them throughout the breeding season to determine their fidelity to breeding colonies, characteristics of their habitats on nesting islands, and characteristics of foraging sites in relation to breeding colonies.

Information from this study will contribute to our limited knowledge of reddish egret ecology. In addition, we will be able to identify important breeding and foraging areas of reddish egrets that can be incorporated into habitat conservation management plans for this important coastal wetland species.

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

Prioritizing Mottled Duck Habitat Along the Western Gulf Coast

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

The mottled duck is a year-round resident of the Gulf of Mexico Coast. It is the only duck species in the contiguous United States that does not migrate south for the winter. Its steady population decline has earned it a "Red" status on the Audubon WatchList. Habitat loss and degradation have been the main factors in the decline of the Western Gulf Coast population. Gaps in our knowledge need to be addressed in order to preserve important habitats in the face of growing threats.

In this study, we are using a decision support system to develop a model intended to aid waterfowl managers in prioritizing habitats for conservation and management of the mottled duck. We expect to produce an interactive spatial dataset that identifies (1) currently suitable mottled duck nesting and brood-rearing habitat that should be prioritized for protection, (2) patches of nesting habitat where management is needed, and (3) wetlands that require management to become suitable. Preliminary results from the Chenier Plain

region of Texas and Louisiana indicate that our model will be an effective tool to prioritize areas for mottled duck conservation.

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

Modeling Sea Level Rise Along the Lower Texas Coast

Corey J. Lange, Bart M. Ballard, Kris L. Metzger, and Daniel P. Collins

The Laguna Madre, located along the lower Texas coast, winters the majority of North American redheads. Redheads feed almost exclusively on shoalgrass in the Laguna Madre, but make daily flights to coastal freshwater ponds to reduce excess salt ingested while foraging. Most coastal ponds used by redheads adjacent to the Laguna Madre are close to sea level; thus, rising sea levels could have a severe effect on the distribution of available ponds.

We are developing a model using spatial data layers to identify areas adjacent to the Laguna Madre that will be most affected by rising sea levels. These results can be used in combination with a concurrent project to prioritize coastal ponds based on their importance to wintering redheads. By understanding potential impacts to important areas for redheads, proactive conservation and management can be implemented to protect or enhance remaining areas so freshwater drinking sites are available for redheads in the future.

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

Nocturnal Roosting Habitat of Reddish Egrets

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

The reddish egret is currently a species of concern according to the U.S. Fish and Wildlife Service and is state-listed as threatened in Texas. The Texas population may account for 40 to 50% of the total U.S. population, which is estimated at approximately 2,000 breeding pairs. Information about habitat requirements of reddish egrets has focused on breeding and foraging and, therefore, wildlife managers may be lacking important information on the range of habitats necessary during all portions of the annual cycle. For example, roost sites are important for survival during nocturnal hours.

Our objectives are to examine roosting behavior of reddish egrets and determine factors that affect roost site selection. We attached Global Positioning Systems (GPS) satellite transmitters to 30 adults that were breeding in the Laguna Madre of Texas and tracked their movements daily.

Preliminary results show that reddish egrets exhibit fidelity to roost sites within and among years. Using the locations obtained from the transmitters, we will be able to identify important roost sites and examine the parameters that may affect roost site selection by reddish egrets. This dataset will contribute to the conservation of habitats vital to reddish egrets.

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

Connecting the Knots: Migratory Strategies of a Long-Distance Migrant

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

The red knot is a Holarctic-breeding shorebird with 3 recognized subspecies occurring in North America. Of those, 2 spend the nonbreeding phase of their lifecycle in the western hemisphere though they are indistinguishable in field or hand. Texas is roughly mid-way between wintering areas of the Atlantic and Pacific groups north of the Equator. Most of these birds probably migrate though the mid-continent, but

Many arctic-breeding red knots rely on South Texas beaches and the Laguna Madre for part of the year.

recent research indicates some exchange or overlap is occurring among birds from all 3 flyways in Texas, suggesting novel migratory strategies. Since highly migratory species often depend on a matrix of geographically distant wetland systems, understanding migratory connectivity is essential for conservation.

We will use a combination of analytical techniques to assess migratory connectivity of red knots occurring in Texas during the fall, winter, and spring. Genetic analysis will be used to characterize birds of known flyway affinity and wintering area as well as birds of unknown affinity. Primary covert feathers will be analyzed to establish a stable isotope profile that will help us determine the area of flight feather molt and aid in the determination of the bird's migratory route. A subset of feather samples will be analyzed for a profile of up to 35 trace elements, the results of which may provide resolution of molting area at a finer spatial scale. Our findings will provide insight into the migration strategy of the red knot and aid in the management of this species.

Cooperative funding provided by the Coastal Bend Bays and Estuaries Program.

Developing a Favorability Analysis for Redheads Along the Lower Texas Coast

Corey J. Lange, Bart M. Ballard, Barry C. Wilson, Daniel P. Collins, and J. Dale James

An estimated 80% of the world's redheads winter in the Laguna Madre each year. Freshwater ponds near the Laguna Madre provide an important and heavily used source of water for redheads. Consequently, the distribution and abundance of freshwater ponds have a large effect on the winter ecology of redheads.

We conducted weekly aerial surveys to monitor redhead use of coastal ponds adjacent to the Laguna Madre for 5 winter periods. With this dataset, we are developing a conservation plan for freshwater ponds based on their value to redheads.

Each pond will be ranked based on the following 3 criteria: (1) the amount of foraging area within the maximum flight distance from coastal ponds (higher ranks going to ponds near more foraging areas), (2) pond proximity to other suitable ponds (higher ranks going to more isolated ponds), and (3) pond water regime (higher ranks going to ponds that have more permanent water). Ponds will be ranked by their importance for protection or enhancement. The pond ranks will be transferred to flight corridors between coastal ponds and foraging areas to develop a favorability analysis profile for the lower Texas coast.

Freshwater ponds adjacent to the Laguna Madre serve as important drinking sites for wintering redheads.

The results of our study will provide waterfowl biologists with the information they need to prioritize coastal pond conservation and management for wintering redheads along the lower Texas coast. Such information can be used to ensure that redheads have the critical freshwater ponds that they need on the wintering grounds associated with the Laguna Madre.

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

Wetland Habitat Selection by Mottled Duck Broods in Texas

Anastasia I. Krainyk, Richard S. Finger, Russell H. Terry, Bart M. Ballard, and M. Todd Merendino

The Texas coast provides important habitat for the mottled duck. However, many of the wetlands throughout the coastal plain of Texas have been lost or degraded due to human activities. The loss of nesting and brood-rearing habitat is thought to be the main culprit in the long-term decline in mottled duck abundance in Texas.

Understanding the requirements of mottled duck broods to increase recruitment has been cited as a key element to the recovery of the population. However, little research has been conducted on wetland habitat selection by mottled duck broods. We are investigating

habitat selection by a sample of radio-marked female mottled ducks with broods, as well as from a 2-year dataset of replicate aerial surveys along the entire Texas coast.

Preliminary results indicate that mottled duck hens with broods select freshwater and estuarine wetlands with semipermanent and seasonally flooded water regimes having persistent emergent vegetation. Our radio-marked mottled duck hens moved an average of about 1 mile between the nest site and the first brood-rearing wetland. As brood survival is a major factor in mottled duck recruitment, creating favorable wetlands or managing existing wetlands for these key characteristics may help increase recruitment rates and lead to better management of mottled ducks in Texas.

Cooperative funding provided by the Texas Parks and Wildlife Department.

Migratory Strategies of Adult Reddish Egrets

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

The reddish egret is the rarest heron found in North America. There is little information on the life history strategies of the reddish egret, including its migratory movements to more southerly wintering areas. To determine the movements of reddish egrets, we attached Global Positioning Systems (GPS) satellite transmitters to 30 adults that were breeding in the Laguna Madre of Texas. We are tracking their movements daily throughout the year.

© Bart Ballard

The reddish egret has a dark color morph (pictured above) and a white morph that has all white plumage.

Initial observations from our study suggest that the reddish egret has a partial migration strategy: a portion of the population resides in the Laguna Madre throughout the year and a portion of the population migrates to southerly locations throughout Mexico to spend the winter. Our future analyses will examine migratory strategies of reddish egrets including timing of migration, overwintering site fidelity, and use of stopover sites during migration.

Our research will identify important migratory stopover sites and link wintering areas in Mexico with breeding areas in Texas. In addition, it will provide new information on the life history strategies of reddish egrets along the Laguna Madre, which can contribute to conservation efforts of the species.

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

Diet and Nutrition of Female Northern Pintails Along the Texas Coast

Nathaniel R. Huck, Bart M. Ballard, Kevin Kraai, and Matt R. Kaminski

The Texas coast is an important wintering area for pintails, but the amount of wintering habitat has been reduced over the last several decades due to changes in land use. This reduction in habitat likely influences the ability of pintails to meet their energy demands.

Our goal is to estimate the composition and energy content of the diet of female pintails wintering in freshwater and saltwater habitats along the upper, central, and lower portions of the Texas coast. To date, we have sampled upper digestive tract contents of 228 female pintails for foods consumed.

Shoalgrass and *Bittium* spp. (a small snail) were the most common foods found in diets of pintails foraging in saltwater. In freshwater habitats, female pintails primarily consumed wetland plant seeds, particularly smartweed and millet.

We are continuing to sample female pintails during winter throughout the Texas coast to better understand the foods and resulting quality of the diet as it relates to nutrients and available energy. This research will provide information to guide wildlife managers, particularly as wetland habitats important to pintails become less available in the future.

Cooperative funding provided by the Texas Parks and Wildlife Department.

Changes in Bird Migration Relative to Distance Inland from the Texas Coast

Suzanne Contreras and Bart M. Ballard

Quantifying bird movements has been the focus of recent migratory bird research given the increasing pressure for wind energy development in many regions. Coastlines are geographic features known to funnel large concentrations of birds during migration. The Texas coastline serves to direct the movement of millions of birds between their breeding and wintering areas each year. Despite this knowledge, little is known about the extent of bird migration to inland areas from the coast.

We are using radar technology to assess bird migration characteristics at coastal and inland sites along the lower Texas coast. We are collecting data on the timing, magnitude, flight direction, and flight altitude of bird migration at 4 sites in Kenedy County; one is located on the coast and each of 3 are positioned at 10-mile increments inland.

Preliminary results have shown that the magnitude of migration decreased 75% from the coastline to 10 miles inland, remained steady between 10 to 20 miles inland, and decreased by 57% from 20 to 30 miles inland. We will continue our radar monitoring during fall 2014.

Our study provides detailed data on bird migration to help guide management strategies for migratory birds along the lower Texas coast. This information will provide insight into how migration patterns vary in relation to the coastline. Findings can be used to select sites for wind energy development that minimize impacts to migratory birds along the Texas coast.

Cooperative funding provided by the Robert J. Kleberg, Jr. and Helen C. Kleberg Foundation and the Texas A&M University-Kingsville University Research Award.

A Long-Term Wildlife Monitoring Program for the East Wildlife Foundation

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

The East Wildlife Foundation (EWF) encompasses over 215,000 acres across 6 properties in South Texas. The EWF, since its creation in 2007, has broadened its focus from exclusively ranching to including wildlife conservation and research as major program objectives. The overriding mission of the EWF is to demonstrate the relationships among wildlife conservation, ranching, and private land stewardship.

The EWF has deemed it a priority to develop and implement a long-term monitoring program to evaluate trends in the distribution and abundance of plants and animals across its properties. Our initial steps are to develop and test sampling designs for collecting data on a broad set of monitoring targets.

In our first field season, we have conducted mark-recapture trapping for small mammals at 26 sites. We have collected vegetation data using Whittaker-type plots and line-point intercept methods at 57 sites. Lizard occupancy data have been completed at 61 sites using time-constrained searches. We surveyed for owls and nightjars using call-back surveys at 48 points along 7 transects. We conducted point count surveys for breeding birds at 105 points along 7 transects. To complete the first year of our pilot study, we will continue to record bat echolocation calls from fixed points and with truck-based mobile transects. We will also be starting point counts for raptors and songbirds in the fall of 2014.

These data will be analyzed to estimate precision of occupancy or abundance estimates and detection probabilities, which will be used to drive changes in our methods for the 2015 field season. Our results will be used to identify the most effective and cost efficient methods for long-term monitoring.

Cooperative funding provided by the East Wildlife Foundation.

Spatial Analysis of Rio Grande Turkey Roosts Relative to Food and Water

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

Roosting structures, such as mature live oak and hackberry trees, are essential Rio Grande wild turkey habitat components in South Texas. Unfortunately, the recent drought has resulted in the loss of these large tree species throughout the region, potentially limiting critical roosting habitat for wild turkeys.

Landowners and land managers have recognized that the loss of mature trees could lead to reduced wild turkey populations, and they have constructed roosts

consisting of old utility poles in areas frequented by wild turkeys. However, not all constructed roosts are used by wild turkeys. It is possible that the proximity of food and water to turkey roosts is an important determinant in wild turkey use of roosts. Therefore, our research hypothesis is that roost sites closer to sources of food and water are more likely to be used by wild turkeys than roost sites located greater distances from sources of food and water.

Over 70 constructed roosts have been identified. Global Positioning Systems (GPS) locations are being obtained for these roosts, and opportunistically for active natural roosts, as well as sources of food and water on 9 ranches distributed throughout South Texas. Geographic Information Systems (GIS) software will be used to analyze the GPS location data.

We anticipate that the results from this study will facilitate placing constructed roosts on the landscape in away that will encourage their use by wild turkeys. The findings may enable landowners to provide constructed roosts where natural roosts are declining, limited, or absent, thereby providing a critical habitat component that would improve wild turkey populations in South Texas.

Cooperative funding provided by ExxonMobil and the XXI Energy Lease.

Suitability of Short-Distance Translocation for Maritime Pocket Gophers

Tara Hansler, Jon Baskin, Clayton Hilton, Christine Hoskinson, and Scott E. Henke

Maritime pocket gophers are a genetically distinct subspecies of pocket gopher that only occurs in deep sandy soils located in Nueces and Kleberg counties of southern Texas. The U.S. Fish and Wildlife Service has considered recommending the Maritime pocket gopher for federal listing status. Unfortunately, pocket gophers can be a nuisance by digging burrows and mounds in golf courses, lawns, and athletic fields. Kill traps and poisons are not a management option for this species, especially if their status is upgraded and provided federal protection.

Short-distance translocation could be a management option, but research is lacking to determine the viability of such an option. We plan to capture gophers from athletic fields, fit them with radio transmitter implants, relocate them to private property, and monitor them for 1 year to determine if their behavior and activity vary from that of non-relocated gophers. This research will determine if short-distance translocation is a viable management option when nuisance gophers are encountered.

Evaluation of Survey Techniques and Sightability for Pronghorns in Texas

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

Pronghorns are native to Texas and are currently found in the Panhandle and Trans-Pecos regions. The Texas Parks and Wildlife Department issues harvest permits based on annual aerial surveys of pronghorn range. Unfortunately, aerial surveys underestimate the true population size because terrain, weather, animal activity, group size, and distance of animals from the survey line affect the probability that the animal or group is seen. However, population estimates from aerial surveys can be corrected if the probability of sighting an animal under different conditions is known.

We captured 50 adult pronghorns, 25 at each of 2 sites near Pampa and Dalhart, Texas during March 2014. Each pronghorn was fitted with a Global Positioning Systems (GPS) collar programmed to take a location point every 5 to 15 minutes during the survey period. We conducted a series of aerial surveys during June and recorded the number, sex, and age of pronghorns seen, group size, activity, habitat type, brush cover, terrain, and the perpendicular distance from the survey line. GPS collared pronghorns were identified, and any collared pronghorn not seen was located after the survey to determine its location

Photo by Joachim Treptow, TPWD Biologist

CKWRI researchers are refining aerial survey methods for pronghorns in the Texas Panhandle region.

and group size. We will retrieve the GPS collars in September and use the data from them to determine how habitat, terrain conditions, and activity (running or stationary) affected the probability of sighting the animal during the survey.

The study will continue during 2015 at 2 sites in the Trans-Pecos region. The resulting information will be used to develop a sighting probability model that will allow wildlife managers to gain more precise estimates of pronghorn population size, which will allow greater flexibility in harvest and management decisions for this species.

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).

Landscape Characteristics Associated with Wild Turkey Use of Constructed Roosts

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

Roosting habitat is an essential requirement of Rio Grande wild turkeys. Typically, large trees such as live oak and hackberry serve as roosts. These trees are not abundant in the western half of the Rio Grande Plains, and it appears that live oak and hackberry mortality has increased as a consequence of the recent drought. Therefore, roosting habitat may become limited in South Texas. This could result in the decline of the wild turkey and/or local extirpation. Wild turkeys use structures constructed by humans, such as transmission towers, telephone poles, and constructed roosts where natural roosts are limited.

We initiated a project during summer 2014 to quantify specific landscape and vegetation community characteristics associated with existing wild turkey constructed roosts to determine the most appropriate sites to erect constructed roosts. The objective of this 3-year project is to use constructed roosts as a way of improving wild turkey roosting habitat, thereby increasing turkey use of landscapes where populations are presently limited or absent.

Specific attributes of 71 used and unused constructed roosts, as well as numerous natural roosts were measured during summer 2014. Data will be analyzed to isolate important attributes preferred by wild turkeys; these attributes will be used to select sites for erection of constructed roosts. Radio telemetry monitoring of marked turkeys and cameras will be used to evaluate use of existing constructed roosts and randomly placed constructed roosts. Comparing purposely placed and randomly placed constructed roosts will enable us to determine if constructed roosts were situated appropriately throughout the landscape.

Wild turkeys use large trees for roosting sites, but will also use constructed roosts where preferred trees are scarce.

Cooperative funding provided by Las Huellas, Mr. Renato Ramirez, Mr. Ricardo Ramirez, Mr. Luis Jaime Gonzales, Mr. Daniel Crisp, Mr. Jose Guevara, and the Energy XXI Lease.

Drought, Grazing, and Rangeland Bird Populations

Maia L. Lipschutz, Leonard A. Brennan, and Thomas M. Langschied

This study will use breeding bird data from 2005 to the present and wintering bird numbers dating from 2008 to the present to examine the relationships between rangeland bird numbers, grazing, and drought. Counts for this study are being conducted on 4 King Ranch divisions and 3 East Wildlife Foundation ranches. Combined, these 7 areas span a large portion of South Texas. The climate and vegetation of the study area are highly variable and subject to periods of extreme heat and drought. Grazing is a common land use throughout the area.

We hypothesize that grassland bird abundance and diversity in South Texas will be related to annual and seasonal rainfall. We predict that responses to different grazing intensities and rotations will be highly dependent on individual species and feeding guilds.

We predict species that feed and nest in open habitats will respond positively to higher grazing intensities, while those that require more vegetation cover will respond negatively to higher grazing pressure.

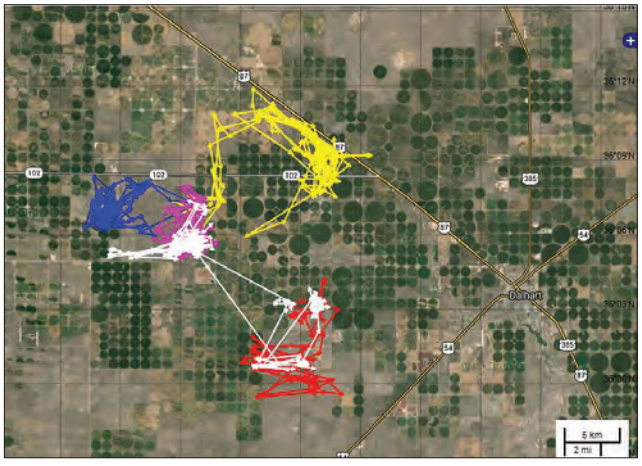
Bird counts are conducted using 3-minute standing counts in summer and 0.3 mile walking counts in other months. Bird numbers will be compared to climate data from the National Oceanic and Atmospheric Administration (NOAA) and grazing data from King Ranch stocking reports. We will look for changes in numbers of common species. It is our hope that this study will lead to recommendations for interested landowners on integrating cattle grazing and grassland bird conservation in a fluctuating environment.

Cooperative funding provided by the East Wildlife Foundation, Texas A&M University-Kingsville Title V Promoting Postbaccalaureate Opportunities for Hispanic Americans Program, Quail Associates Program, and the Richard M. Kleberg, Jr. Center for Quail Research.

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

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

Pronghorns are prairie specialists that were once widespread throughout the grasslands of central and western North America. The pronghorn has declined in range and total numbers because of changes in land-use practices and shrub invasion, yet this species remains viable on rangelands in the Trans-Pecos and Panhandle regions of Texas. Pronghorn management is performed on a large-scale, herd-unit basis because pronghorns have large home ranges and they are capable of daily and seasonal long-distance movements.



Movement paths of 5 GPS-collared pronghorns near Dalhart, TX in April 2014 (each color represents a specific animal). Pronghorns made long-distance movements in and through crop fields and 1 individual crossed Hwy 87.

Net-wire fencing and major highways are barriers to pronghorn movements, but little is known about how pronghorns use mosaics of irrigated agriculture adjacent to rangelands. Pronghorns have minimal effects on livestock production, but human-wildlife conflicts occur over damage to crop fields.

During March 2014, we captured and fitted 20 pronghorns (10 near Dalhart and 10 near Pampa) with Global Positioning Systems (GPS) satellite collars, which allow near real-time monitoring of animal movements. Preliminary data showed that U.S. Route 87 in Dalhart served as a partial barrier, though 1 male and 1 female crossed the highway 25 and 21 times, respectively. Six of the 10 collared pronghorns near Pampa approached State Highway 70, but never crossed. However, all pronghorns crossed county and farm-to-market roads readily. All 10 collared pronghorns in the Dalhart area used agricultural fields. Traffic volume and net-wire fencing inhibited pronghorn movements near both sites.

Thus far, it appears that availability of agricultural fields influences pronghorn home range size and movements. Additional analyses will provide finer scale information on resource selection, movements, and home range sizes.

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).

Evaluation of an Avian Radar System to Monitor Bird Movements

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

Radar has been used to examine migratory birds for several decades and has contributed significantly to our understanding of bird migration dynamics. Radar is an effective method to monitor the movements of migrating birds since many species migrate at night or at relatively high altitudes. Recent advances in technology have enabled continuous monitoring using avian radar systems that can automatically detect and track birds within the airspace.

Although avian radar systems have greatly advanced our capability to examine bird movements, few assessments have tested the ability of avian radar

systems to monitor migratory birds. This study aims to investigate the performance of detection and tracking abilities of an avian radar system.

Our main objective is to determine the types of bird targets (size, orientation to radar, distance from radar, etc.) and environmental conditions that result in undetected targets by the avian radar system. Similarly, we propose to evaluate the radar unit's ability to differentiate bird targets into specific categories (i.e., songbirds, waterbirds, ducks, etc.). We will be conducting ground-truthing exercises during bird migrations that will aid in our interpretation of the data.

Avian radar systems can increase our understanding of how migratory birds are using the airspace during migration. With the increasing use of radar technology as a method to understand bird relationships with newly emerging coastal development, assessment of the avian radar system will enhance our ability to quantify bird movements more effectively and aid in the management of migratory birds.

Cooperative funding provided by the Robert J. Kleberg, Jr. and Helen C. Kleberg Foundation.

Development of Large Mammal Aerial Surveys

Mary K. Annala, David G. Hewitt, Randy W. DeYoung, Charles A. DeYoung, and Tyler A. Campbell

Population estimation accuracy is crucial for carrying out responsible management decisions. Aerial surveys are used for counting animals over large areas. However, during aerial surveys, only 15 to 80% of the population is actually counted, which results in low and variable population estimates.

© Randy DeYoung

An accurate aerial survey technique for large mammals such as this feral hog is needed to meet management goals.

Distance sampling can be used to account for animals not seen, with the assumption that all animals on the survey transect are observed. Because sightability on the transect is not 100% during aerial surveys, distance sampling conducted in conjunction with a double observer technique is an approach that has been used to correct for the under-count in various species including white-tailed deer. The East Wildlife Foundation (EWF) seeks to use this type of aerial survey to monitor large mammals on their lands in South Texas.

The approach of using double sampling combined with distance sampling can be achieved by recording separate observations from the front and rear observers in an aircraft. To execute this technique, we will fly surveys for 3 years on the EWF lands. White-tailed deer, nilgai, cattle, feral hogs, and collared peccaries will be counted. We will record species, sex, age class, group size, activity level, Global Positioning Systems (GPS) location, and perpendicular distance of the animal from the transect line.

At the conclusion of the surveys, detection functions and population estimates will be determined, and observations will be compared by habitat type, season, and survey intensity. Knowledge obtained during these surveys will be used by the EWF to establish a long-term monitoring program for large mammals.

Cooperative funding provided by the East Wildlife Foundation.

Wintering Movements of Rio Grande Wild Turkeys in South Texas

Jay R. Kolbe, Brandon Mitchell, J. Alfonso Ortega-Santos, William P. Kuvlesky, Jr., and Leonard A. Brennan

The movement patterns of Rio Grande wild turkeys fluctuate from season to season. Large winter concentrations of hens and juveniles dissolve during the spring and separate into cohorts and sexually segregated groups. Fertilized hens become solitary when they search for nest sites and remain that way through the nesting and brood rearing season.

Research in South Texas has examined spring and summer movements of wild turkeys, particularly focusing on hens. However, little research has been conducted on wild turkey movements during the fall, winter, and early spring when turkey hens and juveniles congregate into large wintering groups and mature and

young gobblers form smaller flocks. Unfortunately, wild turkey movements and habitat use during this period is not well understood in South Texas.

We are initiating a study that will quantify the movements and habitat use of Rio Grande wild turkeys from fall through early spring in Jim Hogg County. Wild turkeys will be captured on several study sites and equipped with VHF radio telemetry backpack transmitters. These radio-marked turkeys will be located several times a week to obtain locations of individual birds and their flocks. Geographic Information Systems (GIS) software will be used to map and analyze the telemetry locations to quantify wild turkey movements and habitat use during fall, winter, and early spring.

We predict that Rio Grande wild turkey movements will be more restricted during these months compared to the spring and summer. This study will permit landowners and wildlife managers in South Texas to improve turkey habitat. Such improvements should discourage wild turkeys from traveling long distances during this period to find suitable habitat.

Cooperative funding provided by the Energy XXI Lease.

South Texas Birds: Conservation through K–12 Education and Citizen Science

Janel L. Ortiz, April A. Torres Conkey, and Leonard A. Brennan

Over 540 bird species have been recorded in South Texas, making this a prime location for birdwatchers and wildlife enthusiasts. To document these bird species, the South Texas Wintering Birds website, sponsored by the Elizabeth Huth Coates Charitable Foundation, has acted as a depository for these sightings during the past 7 years. To further this effort, we will create an educational outreach component to increase the involvement of K–12 students.

Public schools do not emphasize natural history or wildlife in their curricula nor do many teachers have the background to integrate these subjects into their classroom teaching. This project will help alleviate this issue by providing wildlife education opportunities that will enhance student knowledge of birdlife in South Texas.

For this project, a wild bird education curriculum, aligned with state standards, will be developed for use in elementary, middle, and high school classrooms and assessed for the students' interest and understanding. Teachers will be invited to participate in workshops to gather the background information they need to conduct lesson plans successfully. In addition, students and the community will be further introduced to the South Texas Wintering Birds website as a citizen science opportunity to document bird sightings. Lessons and activities created by our program will provide teachers with additional tools to incorporate wildlife and the environment into their classrooms and for students to be given the opportunity to apply science concepts to the real world.

Graduate student Janel Ortiz is developing an avian education curriculum that can be used for students in K–12.

Cooperative funding provided by the Cornell Laboratory of Ornithology and the Elizabeth Huth Coates Charitable Foundation.

The Comanche-Faith Project

Charles A. DeYoung, David G. Hewitt, Timothy E. Fulbright, Kim N. Echols, Don A. Draeger, Randy W. DeYoung, Nathan S. Cook, Blaise A. Korzekwa, and Jay R. Kolbe

The Comanche-Faith Project is named after the 2 ranches in Dimmit County where the study is replicated. The overall objective of the project is to determine the best combination of deer density and supplemental feed while maintaining the native habitat.

The first phase of this long-term study lasted from March 2004 through March 2013 (9 years). On each ranch, we used 6 high-fenced enclosures of 200 acres each, which were constructed in 2003 with research beginning in 2004. Each ranch had 2 enclosures stocked at low density (1 deer per 20 acres, or 10 deer), 2 at medium density (1 deer per 8 acres, or 25 deer), and 2 at high density (1 deer per 5 acres, or 40 deer). It is important to note that these are real densities and not equivalent to observed densities from a helicopter. At each of the density treatments on each ranch, one enclosure had year-round supplemental feed, whereas the other did not. All enclosures had water at a central location, and enclosures where feed was available had 2 feeders near the water trough. The following research summaries represent projects that have been completed to date.

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

Effects of Density and Supplemental Feed on White-tailed Deer Activity Patterns

Blaise A. Korzekwa, Timothy E. Fulbright, David G. Hewitt, Charles A. DeYoung, Kim N. Echols, and Don A. Draeger

Many ranches in South Texas construct high fences and provide supplemental feed to white-tailed deer, often resulting in higher deer densities compared to low fence ranches. It is unknown how these factors influence the natural activity patterns of deer. Our objectives were to determine the effect of deer density and provision of supplemental feed on movement patterns and degree of sexual segregation.

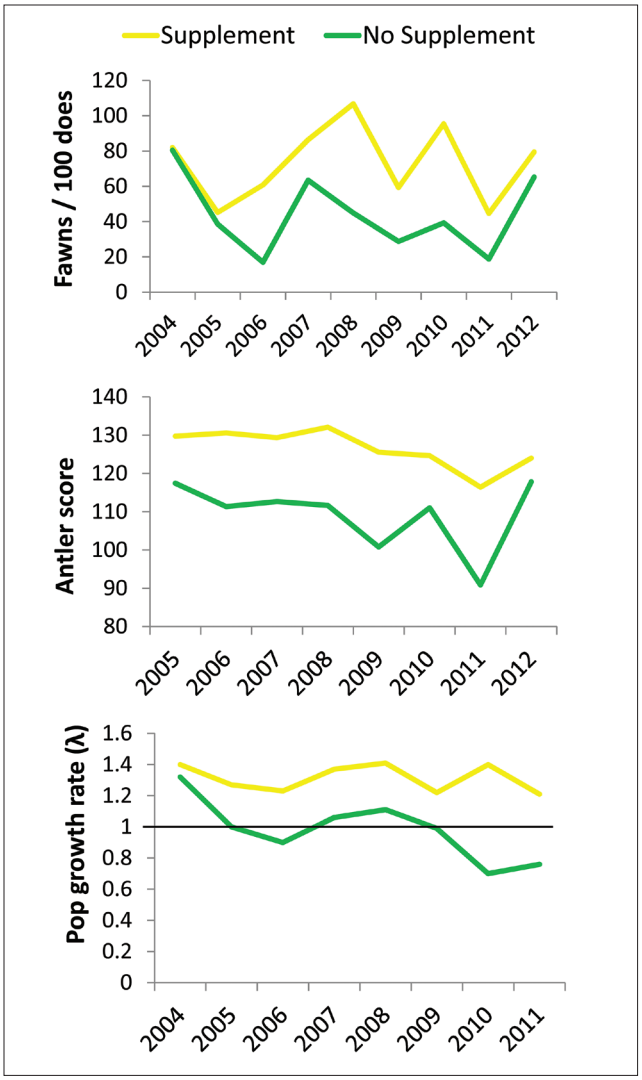
In December 2009, Global Positioning Systems (GPS) tracking collars were placed on 32 adult white-tailed deer, which logged GPS coordinates every 30 minutes until December 2010. We analyzed the data based on reproductive season, period of day, provision of supplemental feed, deer density, and sex.

- During the morning hours of the breeding season (pre-rut, rut, and post-rut), supplementally-fed males and females traveled over twice as far and 88% as far, respectively, when compared to their unsupplemented counterparts.
- Male and female white-tailed deer with access to supplemental feed traveled up to 54% farther during the evening and nighttime hours of the breeding season than their counterparts that did not have access to supplemental feed.
- Males in low deer density enclosures traveled farther than males in high-density enclosures.
- Males and females in high deer density enclosures with supplemental feed were less sexually segregated than deer in the other enclosures.
- Supplementally-fed males and females were 27% and 15% closer in proximity during night and evening hours, respectively, than deer in enclosures without supplemental feed.
- Although deer with access to supplemental feed were active during nighttime, hunters may have an opportunity to harvest evasive deer during the peak crepuscular activity periods.

Population Dynamics as Influenced by Density and Supplemental Nutrition

Nathan S. Cook, Charles A. DeYoung, David G. Hewitt, Timothy E. Fulbright, Randy W. DeYoung, Kim N. Echols, and Don A. Draeger

Optimum management of white-tailed deer herds is important to many stakeholders in South Texas. Our objectives were to analyze population dynamics as influenced by deer density and nutrition and model the population dynamics on simulated 5,000-acre pastures to determine the effects on trophy buck (Boone and Crockett score over 160) production. Three target densities were analyzed with supplemental feed provided to half the populations.



Providing supplemental feed to white-tailed deer in western South Texas improves reproduction, antler size, and population growth, but the consistent, high quality nutrition does not dampen annual fluctuations. Even with supplementation, productivity of deer populations still declines during drought (note: antler score in figure above is Boone and Crockett score).

- Supplemental feed had a positive effect on all demographics except yearling antler growth.
- Density dependence was displayed in the indigenous nutrition enclosures as mature deer body mass decreased with increased density from medium to high. Population growth rate, fawn to doe ratios, fawn and yearling growth rate, fawn survival, and adult survival did not display density dependence.
- Both enhanced and indigenous nutrition populations displayed a constant growth rate over the range of densities analyzed. However, there was a 30% higher population growth rate in the enhanced nutrition treatments.
- In modeling the population dynamics, pastures that had supplemental feed showed a direct relationship between density and number of trophy bucks produced, whereas in the indigenous nutrition pastures, medium deer density produced the most trophy bucks.
- In South Texas's highly variable nutritive environment, a decrease in mature buck body mass may be the first indicator of density-dependence noticeable by wildlife managers.
- Nutrition is clearly limiting in the South Texas landscape, and improving nutrition with pelleted feed improved performance of individual deer and their populations.

Effect of Deer Experience in Response to a New Supplemental Feed Program

Jay R. Kolbe, David G. Hewitt, Timothy E. Fulbright, Charles A. DeYoung, Kim N. Echols, and Don A. Draeger

Supplemental feed can influence productivity and survival of white-tailed deer. Transplanting deer is an increasingly common management technique, and access to supplemental feed will likely increase success of transplant programs. However, transplanted deer may be subordinate to established deer and, thus, have poor access to supplemental feed. Furthermore, deer with no history of using supplemental feed may be slow to use supplemental feed.

The objective of this study was to assess feed-site visitation as influenced by a deer's prior experience with supplemental feed and whether the deer had been transplanted. In March 2013, deer with previous expe-

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Understanding the dynamics of how deer use feeders is important for proper deer management in South Texas.

rience eating supplemental feed and others with no such experience were placed into research enclosures that already contained deer.

We conducted camera surveys in 4 enclosures during 1-week periods every other week for 10 weeks beginning in May 2013. Cameras were placed in 4 enclosures with 48 deer in each that had either 1 or 3 feed-sites. The number of visitations to feed sites by all tagged deer was tallied.

- Deer that had not been previously exposed to supplemental feed and had been moved occurred most frequently at feed sites.
- Our results suggest that 2 months after translocation, deer that have been translocated will not have difficulty accessing supplemental feed sites.
- Deer without previous access to supplement may use feed sites at a higher rate, perhaps because their body condition is lower, thereby providing high motivation to visit feed sites.

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

Population Estimates, Movements, and Modeling of Deer in Fair Oaks Ranch

Kara B. Campbell, Charles A. DeYoung, Randy W. DeYoung, David G. Hewitt, Richard Heilbrun, and Ryan Schoeneberg

Fair Oaks Ranch, Texas is 27 miles north of San Antonio and has a white-tailed deer population judged overabundant. We conducted a 2-year study to estimate deer population size and deer movements throughout the city and adjacent landholdings. After fieldwork, we modeled different management practices that were designed to reduce the deer population.

© David Hewitt

Urban white-tailed deer have become a management problem within Texas.

- An average of about 1,500 deer was estimated within Fair Oaks Ranch using both mark-resight and distance sampling methods. For future population estimates, distance sampling would not require marking deer.
- Buck home ranges averaged 80 and 160 acres in 2012 and 2013, respectively.
- Doe home ranges averaged 41 and 46 acres in 2012 and 2013, respectively.
- Radio-tracked deer did not leave the city limits unless their home range overlapped city edges.
- Our modeling efforts predicted the Fair Oaks Ranch white-tailed deer population could be reduced faster with the Trap, Transport, and Process permit or by sharpshooting than other methods such as surgical sterilization or immunocontraception.
- Lethal methods such as the Trap, Transport, and Process permit had a lower cost than surgical sterilization or immunocontraception.

Cooperative funding provided by the City of Fair Oaks Ranch.

Management of Deer in the Cattle Fever Tick Quarantine Area of Zapata County

Hank C. Birdsall, David G. Hewitt, Greta L. Schuster, Timothy E. Fulbright, and Daniel R. Baca

Cattle fever ticks (CFT) carry a parasite that causes cattle fever, an important livestock disease. Cattle fever ticks were extirpated from the United States except in a narrow zone of the Rio Grande from Del Rio to Brownsville, Texas.

Because white-tailed deer are hosts for CFT, high deer densities in Zapata County, Texas have complicated tick eradication efforts. The objective of our project was to influence deer management in Zapata County to assist federal efforts in controlling CFT.

- Landowner conferences were held in Zapata County during July and September 2012 featuring deer biologists from the Caesar Kleberg Wildlife Research Institute and the Quality Deer Management Association. The 20 to 30 landowners who attended the conferences learned about

© Daniel Baca, APHIS

Cattle fever ticks that occur on both deer and cattle along the Texas-Mexico border are a management concern.

white-tailed deer management and the benefits of maintaining an appropriate deer density.

- Several articles were published in the Wildlife Professional that informed biologists of the role of wildlife in CFT control.
- Helicopter surveys for deer were flown in February and December 2012 and in February 2014 on private properties and government-owned land adjacent to Falcon Reservoir. We documented high deer densities in many areas and skewed deer population demographics.
- We organized a youth hunt to reduce deer density on federally controlled land adjacent to Falcon Reservoir. Thirteen youth harvested 16 deer.
- The federal agency that approved the youth hunt is considering additional hunts in future years as a way to reduce deer populations in the area.
- Data from a previous project conducted in Zapata County were analyzed using new techniques and showed that female deer visited medicated bait sites about half as often as male deer, except in the winter when male visitation declined.

Cooperative funding provided by the USDA Animal and Plant Health Inspection Service Veterinary Services.

Restoration of Plugged and Abandoned Oil and Gas Well Pad Sites

Anthony D. Falk, Forrest S. Smith, Keith A. Pawelek, and Verl Cash

Not knowing how to return plugged and abandoned oil and gas well pad sites to wildlife habitat is a concern of many landowners. To examine the ability of commercially produced, locally adapted native seeds to fill this information gap, *South Texas Natives*, in cooperation with ExxonMobil and the King Ranch, restored and monitored 4 former pad sites on the Santa Gertrudis Division of the King Ranch.

Following removal of the wells and infrastructure, caliche pads were removed during the summer of 2011. We then seeded each site with a diverse native seed mix using a Truax native seed drill in September 2011. Vegetation data were collected biannually from autumn 2011 through summer 2014.

- In just 6 months after seeding, all 4 former pad sites were returned to suitable wildlife habitat.
- Twenty of 24 seeded native plant species were established by 2 years after planting, with an increasing occurrence of highly desirable species such as little bluestem as time since planting increased.
- Basal cover of seeded native species ranged from 75 to 90% during the time since seeding.
- The sites have been subjected to moderate livestock grazing pressure throughout the monitoring period, as well as extreme to moderate drought conditions. Even so, successful achievement of the restoration objectives was obtained.
- All 4 pads have different species compositions; findings demonstrate the need for using diverse native seed mixes to cover multiple sites and to account for minor variations in soil features.

Cooperative funding provided by ExxonMobil.

Development of Additional Seed Production Acreage at the *South Texas Natives* Farm

Keith A. Pawelek, Forrest S. Smith, and Anthony D. Falk

The *South Texas Natives* farm at the Tio and Janell Kleberg Wildlife Research Park in Kingsville, Texas has been an instrumental facility for the success of *South Texas Natives* and *Texas Native Seeds* projects. Research activities at the farm include the evaluation and selection of new collections of native species for future seed releases, advanced evaluation of potential releases, and seed increase for commercialization of releases. The site is also used for experimental plot studies, equipment storage, seed cleaning, seed storage, and as a site for greenhouses and shade houses. With all these activities occurring on the 10-acre site, space was becoming limited.

In 2013, *South Texas Natives* was granted a request to develop additional adjoining land for research. The following was completed over the winter and spring of 2013–2014.

- After elevation studies and soil analyses, 9 acres were cleared of brush and other vegetation.
- The new acreage was precision leveled to allow flood irrigation and site drainage; then, the site was deep-ripped to alleviate soil compaction and improve soil tilth.
- Underground irrigation was installed to allow for both flood and sprinkler irrigation systems.
- The added acreage was bedded for planting, assigned to various research blocks and, depending on the projected use, planted with a cover crop or established as new seed increase fields.

Cooperative funding provided by the Lee and Ramona Bass Foundation, Pioneer Natural Resources, Inc., and the Hixon Ranch.

Vegetation and Arthropod Responses to Brush Reduction by Grubbing

Carter G. Crouch, J. Alfonso Ortega-Santos, Leonard A. Brennan, Fidel Hernández, Greta L. Schuster, and David B. Wester

Grubbing is a mechanical brush reduction technique that allows targeting of mesquite and huisache, and can be used to clear brush and open lanes for hunting bobwhites. This study was conducted on the Santa Gertrudis Division of the King Ranch to determine the effects of grubbing and stacking on vegetation and arthropod communities known to be important to bobwhites. We hypothesized that soil disturbance would lead to improved brooding, feeding, and nesting habitat for bobwhites by increasing herbaceous food plants and arthropods as well as an increase in nesting cover. We also hypothesized that disturbance would lead to an increase in invasive grasses and goldenweed.

Vegetation was sampled before treatment in July 2012 and after treatment in November 2012, March 2013, and July 2013. Arthropods were sampled before treatment in July 2012 and monthly after treatment until July 2013—a year marked by extreme drought.

- We did not detect a treatment effect on forbs considered to be food for bobwhites.
- A positive response was observed for quail food grasses a year after initial treatment and an increase in forb species richness 3 months after stacking.
- No treatment effect was found for invasive grasses, but a decrease in goldenweed cover was detected. Future studies should investigate the long-term effects on these species.
- No effects due to treatment were found for bobwhite nesting cover.
- Treatment did not affect total arthropod abundance; however, fluctuations of arthropod biomass were found as well as effects on individual orders.
- Additional research should be conducted to evaluate the effect of grubbing when moisture availability is not a limiting factor.

Cooperative funding provided by King Ranch, Inc.

Maximum Growth Potential of Available Native Seed Sources for Roadside Plantings

Anthony D. Falk, Keith A. Pawelek, Forrest S. Smith, Dennis K. Markwardt, Colin S. Shackelford, Mia A. McCraw, James P. Muir, Louis A. Harveson, and Chase Murphy

The Texas Department of Transportation (TxDOT) is required by the federal Clean Water Act to reseed areas of soil disturbance larger than an acre. It is also subject to federal mandates that encourage the use native species. To meet these requirements, TxDOT uses native plant material that has long-term survival, provides adequate soil coverage to prevent erosion, remains lower in stature to save mowing costs, and does not create a safety or visibility hazard.

From 2010–2014, we evaluated commercially available native and exotic plants for traits important for roadside use. Evaluations used transplant plots at 6 sites representative of conditions found in South, Central, and West Texas.

- Survival of transplanted species varied widely from site to site with the lowest being observed at Imperial (West Texas) with only 12% of the native species surviving longer than a year; the highest survival occurred in Kingsville with 65% of the species surviving.
- Despite good survival at 5 of 6 locations, just 10 to 20 native species out of the 60 tested met TxDOT's height and canopy cover needs at each site.
- At each location, only about 50% of the species that met the vegetative performance criteria produced seed that had higher than 50% viability. This indicated poor adaptation of plants from seeds obtained from various seed sources, despite plant survival.
- Findings were used to help draft new rural seeding specifications for TxDOT that will impact South, Central, and West Texas beginning in 2015.

Cooperative funding provided by the Texas Department of Transportation.

Evaluating Pipeline Restoration Techniques in the Eagle Ford Shale

Anthony D. Falk, Forrest S. Smith, Keith A. Pawelek, Dale Rankin, Megan K. Clayton, Kason Haby, and Wallace Nichols

The Eagle Ford Shale (EFS) is an economic boost to South Texas; however, there are some downfalls. One of these is the number of pipelines required to move oil and gas products to market, and the impact installation of these lines has on native habitat for wildlife, livestock forage, and soil stabilization. Most landowners affected by new pipeline right-of-ways would like to return these areas back to native habitat as quickly as possible by requiring pipeline companies to reseed with desirable native grasses and forbs.

Restoration of Eagle Ford Shale pipeline right-of-ways was accomplished using a variety of seeding techniques.

To determine the most effective restoration planting methods to reach the above goal, we compared 3 common seeding techniques (drill, broadcast, and hydro seeding) using a diverse mix of locally adapted native seed on 3 ecological sites along a Live Oak County EFS pipeline right-of-way from 2012–2014.

- All 3 seeding techniques were equally effective at establishing a diverse stand of native grasses and forbs on each ecological site along the right-of-way. Each technique achieved plant densities greater or equal to 0.5-seeded plants per ft^2 after 6 months.
- Species composition varied on each ecological site despite using the same seed mix, demonstrating the need for diverse mixes to account for soil variation.
- Restoration of the pipeline right-of-way was successful and rapidly achieved using the 3 planting techniques and locally adapted native seeds.

Cooperative funding provided by donors to South Texas Natives, Texas A&M AgriLife Extension Service, USDA Natural Resources Conservation Service, Dobie Ranch, and the Live Oak County Soil and Water Conservation District.

Release of Carrizo Germplasm Little Bluestem

Anthony D. Falk, Keith A. Pawelek, Forrest S. Smith, John Lloyd-Reilley, Shelly D. Maher, Andrew W. Scott, Jr., Juan Garza, Dean N. Williams, and Keith J. Walters

South Texas Natives, in collaboration with the USDA Natural Resources Conservation Service E. "Kika" de la Garza Plant Materials Center, completed formal release of an ecotypic seed source of little bluestem for South Texas in the fall of 2014. Little bluestem is a highly desired late successional warm-season bunchgrass. Research has shown that this species is an important nesting substrate for bobwhites, is excellent cover for wildlife, and provides high quality cattle forage on many rangelands.

Release of Carrizo Germplasm little bluestem will provide the first ecotypic seed of little bluestem for South Texas.

Historically, little bluestem was a dominant plant species on sandy soils across South Texas, but has declined in many areas. There is a need for regionally adapted little bluestem because of poor survival and establishment characteristics of commercially available non-ecotypic little bluestem.

- Carrizo Germplasm little bluestem is comprised of 2 collections chosen from evaluations of over 70 regional collections. Collections in the release originated from Zavala and Bexar counties, Texas.
- Carrizo Germplasm little bluestem has shown excellent adaptation to the South Texas climate and has demonstrated consistent superior performance compared to commercial sources of little bluestem when planted in this region.
- Based on field planting results, this release should be excellent for restoration of native grasslands on sand, loamy sand, and sandy loam soils within South Texas.
- The commercial seed of Carrizo Germplasm little bluestem should be available from Douglass King Seed Company in spring 2015.

Cooperative funding provided by numerous donors to South Texas Natives.

Restoring Native Plant and Arthropod Communities following Disturbance

Adam B. Mitchell, Andrea R. Litt, Anthony D. Falk, and Forrest S. Smith

Old World bluestem grasses (OWBs) alter native plant and wildlife communities by forming dense monocultures and altering soil chemistry. Modifying soil properties may help restore grasslands impacted by OWBs.

In June 2011, we applied 10 treatments (pH increase, pH decrease, adding carbon, mycorrhizal fungi, soil disturbance alone, and each of these combined with seeding of native plants) to 50 study plots (5 plots per treatment) during severe drought. We compared soil, plant, and arthropod characteristics among treatments

to 5 undisturbed plots dominated by OWBs during summers 2011–2013. We also completed a potted-plant study in 2013 to assess treatments in the absence of drought conditions.

- Treatments did not alter soil chemistry substantially because soils had high buffering capacities. In addition, presence/absence of drought did not alter treatment effects on plant communities.
- Soil disturbance and seeding reduced dominance of OWBs and increased species richness and cover of native plants; this finding mirrored the results of the potted-plant study.
- Although differences in plant communities after adding seed occurred, we observed few plants from the seed mix. We found seed predators (e.g., harvester ants) only in plots with added seed. We hypothesize that these seed predators could have consumed the added seeds, potentially allowing plants in the seed bank to establish.
- Although arthropods were more abundant in plots with OWBs than in treated plots, it was mainly due to invasive arthropods. Decreasing OWBs in treatment plots reduced dominance of invasive arthropods and increased diversity.
- Findings suggest that shifts in the composition of the arthropod community can alter food availability for wildlife.

Cooperative funding provided by the Rob and Bessie Welder Wildlife Foundation, TAMUK University Research Award, Rotary Club of Corpus Christi (Harvey Weil Sportsman Conservation Award Trust), Montana State University, South Texas Natives, Texas Parks and Wildlife Department, and Pittman-Robertson Grant Funds (TX W-132-R-9).

Establishment of Restoration Seed Sources for Roadside Plantings

Anthony D. Falk, Keith A. Pawelek, Forrest S. Smith, Dennis K. Markwardt, Colin S. Shackelford, Mia A. McCraw, James P. Muir, Louis A. Harveson, and Chase Murphy

Seeding projects conducted by the Texas Department of Transportation (TxDOT) are usually carried out in harsh conditions because of the nature of highway construction. Additive to these conditions is the requirement that projects are reseeded immediately following job completion, despite rainfall potential, time of year, or current conditions. Furthermore, very few regionally adapted native seeds are available for TxDOT in much of Texas. To identify the best available native seed materials to meet TxDOT's needs, we planted replicate plots of 60 native seed varieties and compared their emergence and establishment at 6 sites across South, West, and Central Texas.

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Seedling emergence was found to be a limiting factor in roadside seeding success in many areas of Texas.

- No species tested met emergence and establishment criteria at all 6 sites, demonstrating the need for locally adapted native seed and different seed mixes for each region.
- At 1 of the test sites (Imperial, Texas – Trans Pecos ecoregion), none of the native species planted met emergence and establishment needs of TxDOT.
- At 5 of the 6 test sites, 5 to 9 native species met emergence and cover requirements for TxDOT, indicating that in many areas of South and Central Texas, there are at least some commercially available native seeds suitable for TxDOT's needs.
- The plant species that germinated and formed suitable stands (more than 1 plant per ft^2) persisted for all 3 years of the study, despite exceptional drought at all locations.
- Our findings support the hypothesis that initial establishment ability of plants from many commercial seed sources is an important limiting factor to successful native seeding projects.

Cooperative funding provided by the Texas Department of Transportation.

Duration of Marking Tags on American Alligators

Cord B. Eversole, Scott E. Henke, David B. Wester, Randy L. Powell, and Bart M. Ballard

Tagging techniques on crocodilians have included passive integrated transponder tags, foot webbing tags, and tail tags. Tag retention can be compromised if tags become detached as a result of entanglement with numerous underwater obstructions. Tag loss would ultimately bias estimates of survival and population size based on mark and recapture census methods.

Our objectives were to determine retention rates of commonly used tags for American alligators, and to determine the most cost and time effective tagging strategies. Alligators were captured at Brazos Bend State Park during 2012 and marked with a numbered and colored tag inserted in the tail, a numbered Kemco tag placed in the foot webbing, a passive integrated transponder (PIT) tag inserted subcutaneously at the base of the tail, and a numbered and colored T-bar anchor fish tag inserted at the base of the skull.

- In 2013, 43 of the original 206 alligators were recaptured and assessed for tag retention.
- PIT and fish tag retention on American alligators was 97% and 93%, respectively.
- Fish tags were 7 to 18 times faster to place on alligators than the other tags. Fish tags were visible without recapture of the alligator, and the cost per tag for fish tags was not considered prohibitive.
- We recommend fish tags as the primary tagging strategy for alligators.

Cooperative funding provided by the Harry L. Willet Foundation, Brazos Bend State Park Volunteer Organization, and East Texas Herpetological Society.

Reproductive Success of the American Oystercatcher in Texas

Lianne M. Koczur, Alexandra E. Munters, Susan A. Heath, Bart M. Ballard, M. Clay Green, Stephen J. Dinsmore, and Fidel Hernández

The American oystercatcher is listed as a Species of High Concern in the U.S. Shorebird Conservation Plan. Previous studies have focused on the Atlantic Coast population; however, little is known about the reproductive success of the western Gulf Coast population. Our study examined nest and brood survival of American oystercatchers in Texas.

- We monitored 337 nests and 121 broods during 2011–2013 of which 126 (37%) nests successfully hatched at least 1 egg and 76 (63%) broods successfully fledged 1 or more chicks.
- Based on data modeling, linear time trend, foraging habitat, island size, and nest age were the variables that best explained variation in nest survival. The probability of a nest surviving from mean initiation date to hatching was 38%.
- Factors best explaining variation in brood survival included year, coastal region, linear time trend, and brood age. The probability of a brood surviving from mean hatch date to fledging ranged from 40% in 2013 to 89% in 2011.
- Known causes of nest and brood loss included beach over-wash, depredation, and starvation.
- This study provides the first estimates of nest and brood survival of the American oystercatcher along the western Gulf Coast.

Cooperative funding provided by the National Fish and Wildlife Foundation, ConocoPhillips, U.S. Fish and Wildlife Service Coastal Program, Hershey Foundation, George and Mary Josephine Hamman Foundation, Trull Foundation, and the Coastal Bend Audubon Society Bird Conservation Research Award.

Evaluation of the D-Vac and Sweep Net Insect Sampling Techniques

Carter G. Crouch, J. Alfonso Ortega-Santos, Leonard A. Brennan, Fidel Hernández, Greta L. Schuster, and David B. Wester

Sweep net sampling and D-Vac sampling are commonly used techniques for sampling arthropods that represent food sources for various species of birds. However, differences in the arthropods sampled using each method will likely give different representations of the arthropod populations and communities.

We initiated this study to compare the efficiency of the 2 methods in sampling different groups of arthropods in the mixed brush community of South Texas. Twenty paired transects were sampled using a sweep net and a D-Vac monthly from July 2012 to July 2013. Abundance and average weight for the phylum Arthropoda and classes Arachnida and Insecta

were compared between the 2 sampling methods. Also, Insecta order richness estimates were compared as well as abundance estimates for 3 Insecta orders (Coleoptera, Hemiptera, and Orthoptera).

- Differences were found between the 2 sampling methods for abundance of Arthropoda, Arachnida, Insecta, Coleoptera, Hemiptera, and Orthoptera.
- The D-Vac was more efficient at sampling Coleoptera, while sweep net sampling was more efficient at sampling Orthoptera.
- Differences were observed in the average weight of Arthropoda, Arachnida, and Insecta. All differences observed, with the exception of the average weight of the Arachnida sampled, depended on date.
- The average weight of the Arachnida was 200% heavier using the sweep net compared to the D-Vac.
- Because of differences found and the fact that most differences depended on date, a combination of the 2 sampling methods would likely yield a more accurate estimate of the arthropod community than either method alone.

Cooperative funding provided by King Ranch, Inc.

Determining the Suitability of the Jamaican Boa for Short-Distance Translocation

Brent C. Newman, Scott E. Henke, David B. Wester, Randy L. Powell, and Susan E. Koenig

The Jamaican boa once had a wide distribution throughout Jamaica. Currently, this species is listed by the International Union for the Conservation of Nature as a vulnerable species and as a foreign endangered species by the U.S. Fish and Wildlife Service. The National Environment and Planning Agency of Jamaica proposes short-distance translocation to remove Jamaican boas from areas of development; however, this strategy has not been tested. We assessed home range size, survivability, and microhabitat selection of 7 non-translocated and 7 short-distance translocated female Jamaican boas in Cockpit Country Conservation Area, Jamaica.

- Home range size for resident boas was 7.3 acres and 1.1 acres for the 95% and 50% home range size estimates and 16.1 acres and 1.8 acres for the 95% and 50% home range size estimates for short-distance translocation boas.
- While all short-distance translocation boas survived translocation, 3 boas returned to within 542 yards of their initial capture site.
- Both Jamaican boa groups showed a strong preference for tall, large (circumference) trees with greater canopy-crown connectivity and epiphyte (plants that grow upon another plant) and vine densities than random trees.
- Instead of engaging in both active and ambush style foraging, short-distance translocation boas altered their foraging behavior in unfamiliar areas to strictly ambush style predation, likely to minimize energy use while still selecting areas with greater rock cover to facilitate thermoregulation.
- Short-distance translocation may be a management strategy to aid in the conservation of Jamaican boas when human-boa conflicts arise.

Cooperative funding provided by the Fulbright Scholarship Program of the United States, U.S. Fish and Wildlife Service, Wildlife Without Borders Grant, Windsor Research Centre, National Environment and Planning Agency of Jamaica, and the U.S. Forest Service.

Growth, Condition, and Age of American Alligators in a High-Density Population

Cord B. Eversole, Scott E. Henke, David B. Wester, Randy L. Powell, and Bart M. Ballard

American alligators are assumed to grow approximately 1 foot per year. However, this assumption has not been tested on alligators from Texas. We present results of growth, condition, and age of American alligators from low, medium, and

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Although alligators are often found in coastal areas within Texas, little is known about their ecology in the state.

high-density populations in Texas. Alligators were divided into the following annual growth sizes based on total length (TL): (1) less than 1.5 feet TL, (2) 1.5–4 feet TL, (3) 4–6 feet TL, (4) 6–9 feet TL, and (5) greater than 9 feet TL.

- Mean annual growth for size classes 1, 2, and 3 were 12 inches, 5 inches, and 6 inches, respectively, suggesting alligator growth tended to slow with age in our study area.
- Female alligators in size class 2 had 32% lower mean body condition in medium-density populations than in high-density populations; females in size class 4 had 22% lower mean body condition in high-density populations and medium-density populations than in low-density populations.
- Male alligators in size class 2 within high-density populations had 19% higher mean body condition than females and males in size class 3 within high-density populations.
- Females in size class 2 from high-density populations had higher mean body condition than females in size classes 3, 4, and 5.
- Age estimates of alligators less than 6 feet TL ranged from 0.03 years to 13.6 years.
- These results substantiate the need to focus on site-specific management strategies and research, rather than rely on a 'one-size-fits-all' approach.

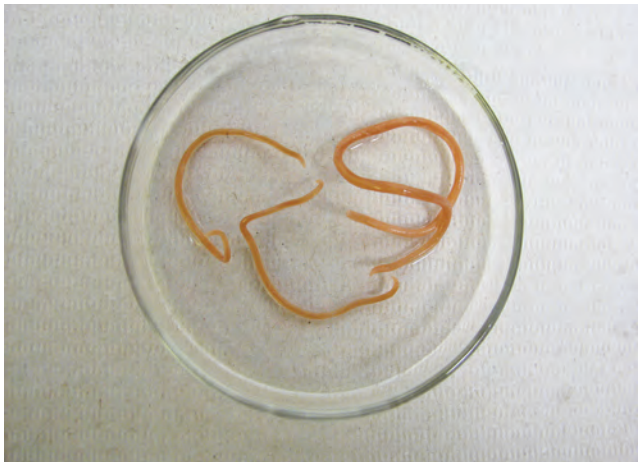
Cooperative funding provided by the Harry L. Willet Foundation, Brazos Bend State Park Volunteer Organization, and East Texas Herpetological Society.

Effect of Extreme Temperatures on the Viability of *Baylisascaris procyonis* Eggs

Jacob L. Ogdee, Scott E. Henke, and David B. Wester

Baylisascaris procyonis is a common nematode of raccoons and is considered an emerging zoonotic threat to humans. This roundworm occurs throughout much of the United States, with major hot spots occurring in the Midwestern United States, northeast Atlantic states, Pacific western states, and Texas.

The potential for human infection with *B. procyonis* can be high. For example, raccoons are known to enter attics of houses, use pet doors, live in garages, and forage in vehicles if windows are not closed. Infected raccoons that defecate in such areas greatly enhance the risk of exposure to humans. The lethal temperature for *B. procyonis* eggs is 150° F.



Raccoon roundworms produce eggs that persist in the environment, thereby increasing exposure risk to humans.

We investigated the viability of *B. procyonis* eggs placed in garages, vehicles, woodpiles, and attics with and without exhaust fans within the southern Texas environment. Temperature and humidity data loggers recorded measurements at these locations every 30 minutes throughout the year. Our hypothesis was that locations where temperatures exceed 150° F will kill *B. procyonis* eggs, which would eliminate the health risk to humans.

- Differences in extreme temperatures occurred between locations, but only vehicles that were parked in the sun with windows closed exceeded 150° F at any recorded interval.
- Readings exceeded 150° F only in July and August.
- Thermal conditions needed to kill all *B. procyonis* eggs did not occur in attics, garages, and woodpiles within the southern Texas environment. Therefore, *B. procyonis*-infected raccoons that defecate within or near human dwellings pose a health risk.

Cooperative funding provided by the Harry L. Willet Foundation.

Use of Human Hair as a Wildlife Deterrent: Fact or Fiction?

Justin Plata, Jesse Alegria, and Scott E. Henke

Hunting camp lore states that human hair can be used as a deterrent to wildlife. This concept was in the Hollywood movie "The Rookie" starring Dennis

Quaid, in which human hair was used to keep deer from grazing a newly-planted baseball field.

To test this theory, we placed sling feeders that dispensed corn 4 times daily at 4 sites in southern Texas and mounted infrared cameras at each site to obtain photographs with dates and times of every animal that approached. Two sites were randomly selected for scattering human hair on the ground around the feeders. Wildlife species, number of visits per night, and time spent at the feeders by each species were recorded and analyzed.

- Javelinas, white-tailed deer, and raccoons were common visitors to the feeders; however, no species was deterred by the placement of human hair.
- The number of animal visits per night and the number of animals per visit increased with subsequent nights.
- Photographic evidence highlighted that deer and javelinas consumed human hair.
- Therefore, the myth of human hair as a wildlife deterrent is fictional at least for these species.

Cooperative funding provided by the TAMUK University Undergraduate Research Award.

The Effects of Habitat Quality on Northern Pintail Sex Ratios

Nathaniel R. Huck and Bart M. Ballard

Birds can experience skewed sex ratios for a variety of reasons. These reasons can include different survival between males and females, different dietary needs between the sexes, differential migration patterns where one sex migrates to different areas than the other, and habitat segregation.

Male and female northern pintails appear to have varying migration strategies that influence where they overwinter.

Understanding the factors that influence sex ratios of a species can provide important insight for management. For instance, because northern pintails are an important gamebird, temporal and spatial differences in abundance between the sexes can have important implications for harvest and population dynamics. We collected sex ratio information from 897 flocks of northern pintails in freshwater and coastal habitats throughout the Texas Coastal Plain between 1997 and 2013.

- Male pintails were more common than female pintails in all years.
- In years where drought was severe, sex ratios became more skewed towards males, particularly in October and November when pintails arrive on the Texas coast.
- Female pintails may arrive on the Texas coast and assess the habitat. Then, they may settle along the Texas coast or move on to other habitats, depending on habitat quality.
- Female pintails could choose to head to southwestern Louisiana or to continue into Mexico.
- A better understanding of why pintails choose to winter in specific regions could aid waterfowl managers in implementing habitat improvements.

Cooperative funding provided by the Texas Parks and Wildlife Department.

Age and Site Specific Responses of the Alligator to Environmental Conditions

Cord B. Eversole, Scott E. Henke, David B. Wester, Randy L. Powell, and Bart M. Ballard

Precise monitoring of wildlife populations is crucial for species management and conservation. If management practices are based on data that are not accurate, wildlife managers may not be implementing management strategies appropriately, which may lead to devastating ecological consequences.

We developed statistical models to predict and explain American alligator activity and detectability within inland freshwater lakes. Models were built for each alligator age class (based on total length, TL) and included hatchling (less than 1.0 foot TL), sub-adult (1 foot to 6 feet TL), and adult (greater than 6 feet TL).

Independent variables included both temporal and environmental parameters that were measured during nighttime surveys.

- We conducted 135 nighttime alligator surveys and recorded 7,689 observations of alligators at 3 of our study lakes.
- Alligator activity was highly variable among age classes and lakes.
- Models incorporating all age classes of alligators and all measured environmental conditions were only fair, but greatly improved if age classes were separated and environmental conditions were based on individual lakes.
- These results show that alligator behavior and activity are multifaceted and complex ecological features. Survey techniques should be developed to be age and population-specific.
- Managers and scientists should target particular age classes during surveys based on prevailing environmental conditions.

Cooperative funding provided by the Harry L. Willet Foundation, Brazos Bend State Park Volunteer Organization, and the East Texas Herpetological Society.

Cybersafari: Effect of Apps on Visitor Learning at the San Antonio Zoo

Marybeth Green and April A. Torres Conkey

Many zoological parks have focused their efforts to educate visitors about wildlife and conservation using traditional informational signs; however, most zoo patrons do not stop to read these educational signs. To meet this challenge, some zoos try to integrate educational activities into the exhibit itself. But "digital natives" (people born after 1982) are more likely to engage in activities if there is a technological component. Thus, we created 2 iPad apps focused on the Komodo dragon and the hippopotamus exhibits at the San Antonio Zoo to test learning and satisfaction of adult visitors at the zoo.

Augmented reality apps for smart-phones and tablets can be used with zoo and museum exhibits to enhance learning.

Augmented reality apps use smartphones or tablets with cameras to superimpose a digital image onto the background image that the camera is viewing. Two styles of 3-D augmented reality apps (inquiry/questioning-based and information-based) were created for each exhibit to test for learning. TAMUK students demonstrated the apps to zoo patrons on 2 weekends in November 2012. Adults who viewed the apps were asked to complete a short survey to assess learning and satisfaction.

- Those patrons who viewed the inquiry-based app, where a question was posed and the person had to stop and analyze the animal, were better able to remember the facts than those who viewed the information-based app, where the same facts popped up on the screen.
- There was no difference in satisfaction between the 2 apps. Both test groups stated they enjoyed using the app and felt they learned from it.
- Zoos and museums may wish to use inquiry-based apps as fun interactive entertainment that helps to achieve education goals.

Cooperative funding provided by the TAMUK University Research Award.

Rate of Decay of Raccoon Scats Infected with *Baylisascaris procyonis* Eggs

Jacob L. Ogdee, Scott E. Henke, and David B. Wester

Baylisascaris procyonis is a large nematode that occurs in the small intestine of raccoons. The lifecycle of the parasite requires a secondary host, typically rodents. Adult female worms produce eggs, which are shed in the feces of infected raccoons. More than 1 million eggs per day per infected raccoon can be shed.

Adult parasites do not cause major harm to their raccoon hosts; however, the larvae in secondary hosts can cause liver damage, blindness, paralysis, and death. Prevalence of *B. procyonis* in humans is unknown,

but potentially can be high, especially in areas where suburban sprawl increases the likelihood of frequent human contact with raccoons and their feces. We investigated the length of time and weather conditions necessary for raccoon feces to decay, and we determined the likelihood of infected raccoons contaminating the environment with *B. procyonis* eggs.

Raccoons were captured and maintained in captivity to determine the frequency of defecation. In addition, a 136-acre study area was systematically searched each week for 8 weeks, and the number and location of raccoon scats found were recorded using a Global Positioning Systems (GPS) recorder. Also, 25 fresh scats containing *B. procyonis* eggs were placed on level terrain in southern Texas and monitored to determine the rate of decomposition.

- On average, raccoons produced 1 scat per day.
- Only 5% of the 884 located scats were identified as 'latrine' sites.
- The fresh raccoon scats decayed in direct relation to the amount of rainfall (8 inches of rainfall needed for complete decay).
- Eggs of *B. procyonis* from decayed scats were found up to 20 inches from where the scat was originally located.
- Based on these findings, a single *B. procyonis*-infected raccoon can contaminate 0.07 acres per year with *B. procyonis* eggs.

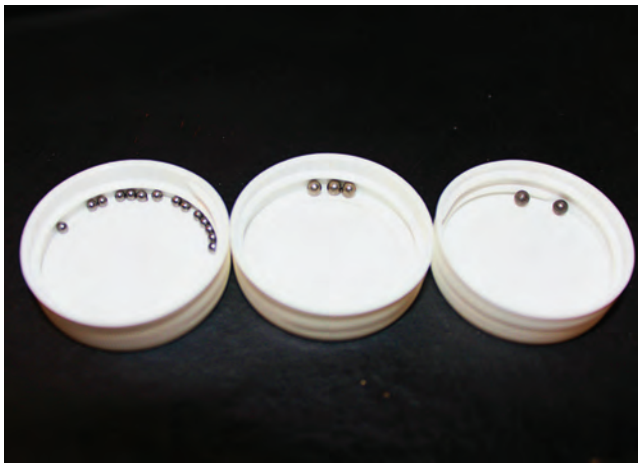
Cooperative funding provided by the Harry L. Willet Foundation.

Shot Ingestion of Wintering Female Northern Pintails

Nathaniel R. Huck, Bart M. Ballard, Kevin Kraai, Alan M. Fedynich, and Mauro E. Castro

Poisoning from lead shot ingestion has been a significant health issue affecting waterfowl in North America. In 1991, lead shot was banned for use in waterfowl hunting in the United States followed by Canada in 1997. However, it is important to understand how and if lead shot remaining in the environment will continue to affect waterfowl. Our goal was to estimate lead and nontoxic shot consumption by female pintails wintering along the Texas coast.

- We found shot in the gizzards of 39 (17%) of 227 female northern pintails collected along the Texas coast. Of these, lead shot was found in 7 gizzards, steel shot was found in 24 gizzards, and other nontoxic shot was found in 20 gizzards.
- Some female pintails consumed multiple types of shot (lead and nontoxic shot).
- Overall shot (lead and nontoxic combined) ingestion rates were similar to those found prior to the lead ban in Texas (14%) and Louisiana (17%); however, lead ingestion rates were considerably lower, suggesting that lead is becoming less available over time.
- All pintails that had lead shot in their gizzards were collected from coastal habitats.
- While it appears that lead consumption by northern pintails has decreased, monitoring lead consumption rates from different geographic regions will provide insight into lead's resilience and prevalence in various habitats and under different environmental conditions.



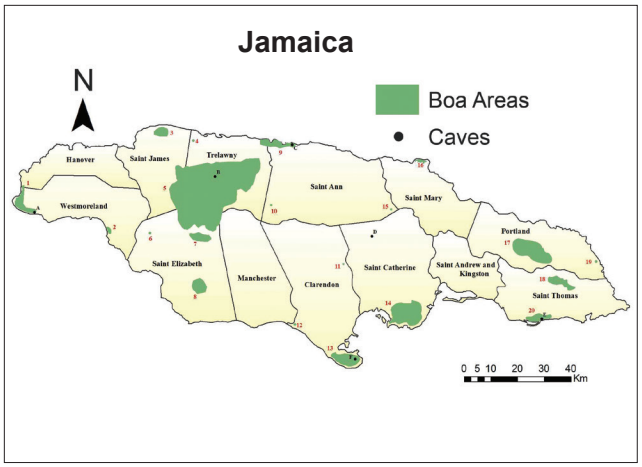
Lead, steel, and tungsten shot (left to right) can be ingested by waterfowl when they feed in wetlands.

Cooperative funding provided by the Texas Parks and Wildlife Department.

The Distribution and General Habitat Preference of the Jamaican Boa

Brent C. Newman, Scott E. Henke, Randy L. Powell, and Susan E. Koenig

Jamaica is an island country located in the West Indies. It is approximately 90 miles south of Cuba and has a land mass of approximately 4,200 mi^2. The



Map of Jamaican boa distribution within parish boundaries in Jamaica based on available published data.

island was once heavily forested. Currently, much of Jamaica's primary forests and natural vegetation communities are severely degraded from human-related activities; the island has a population of over 2.7 million people.

These environmental changes in the vegetation structure have also affected Jamaica's largest native terrestrial predator, the Jamaican boa. In this study, we conducted a habitat availability analysis for the Jamaican boa to better understand its vulnerability to landscape changes in Jamaica.

- We developed an up-to-date distributional map for the Jamaican boa, and determined habitat use by these snakes was not random. Jamaican boas used approximately 9% of the island.
- Of the 21 habitat types possible on Jamaica that boas could use, water bodies, fields, secondary forest, woodland/savanna, and closed broadleaved forest (i.e., primary forest) were used in greater proportion than expected. This indicated that boas preferred these habitats.
- Jamaican boas tended to avoid areas associated with human activities related to agriculture, infrastructure, and mining.
- Cockpit Country, Jamaica is the largest contiguous area of Jamaican boa habitat consisting of 64% of the habitats used in greater occurrence than what was available for use. This area also comprised 39% and 15% of habitats used in greater occurrence than available within known boa areas and within all of Jamaica, respectively.
- Highly used habitats by Jamaican boas occurred in isolated pockets along the center of the island in an east-west orientation.
- We recommend the Jamaican Forestry Department create connecting corridors to enable boa migration, thereby allowing genetic exchange among currently isolated populations of Jamaican boas.

Cooperative funding provided by the Fulbright Scholarship Program of the United States, U.S. Fish and Wildlife Service, Wildlife Without Borders Grant, Windsor Research Centre, National Environment and Planning Agency of Jamaica, and the U.S. Forest Service.

Temporal Influences on American Alligator Nighttime Surveys

Cord B. Eversole, Scott E. Henke, David B. Wester, Randy L. Powell, and Bart M. Ballard

Nighttime surveys are a common method for monitoring crocodilian populations because there is an established protocol, they are cost-effective, and they provide information about abundance, distribution, and size composition. Understanding the factors that contribute to variation in activity enables managers and scientists to predict optimal times and conditions for conducting surveys that will lead to higher detection rates and more precise density estimates.

Our objective was to determine how time of night and time of year affect estimated density of alligators from nighttime surveys. The study was conducted at Brazos Bend State Park in Fort Bend County, Texas.

- The number of hatchlings observed was unaffected by survey time; however, sub-adult and adult alligators were observed more readily during later survey times (3 to 6 hours after sunset) than during early survey times (1 to 3 hours after sunset).
- We found monthly differences in the density of alligators observed across age classes; alligators were more readily observed in August, January, May, July, and November, followed by February and March, April, September, and October, then June, and finally December.
- Based on our findings, surveys should be conducted at least 3 hours after sunset to obtain the most accurate estimates of alligator density. Also, if annual surveys are conducted, then surveys should be performed during the same month (i.e., August is recommended) to be comparable among years.

Cooperative funding provided by the Harry L. Willet Foundation, Brazos Bend State Park Volunteer Organization, and East Texas Herpetological Society.

Assessment of Parasites in Bobwhites Across the Rolling Plains Ecoregion

Andrea Bruno, Alan M. Fedynich, and Dale Rollins

In the past few decades, northern bobwhites have been experiencing a long-term decline throughout their native range in Texas. Consequently, there is interest in examining factors that may negatively impact bobwhite individuals and populations.

Of recent interest are the parasites and diseases caused by them. Studies on parasitic infections in bobwhites from the Rolling Plains ecoregion are lacking. We conducted a survey for *Trichomonas gallinae* (a protozoan), assessed helminth prevalence, intensity, and abundance, and documented tissue damage caused by eyeworm infections.

- All 506 samples were negative for *T. gallinae* using the polymerase chain reaction (PCR) technique.
- Northern bobwhites were infected with 13 species of helminths of which *Dispharynx nasuta*, *Tetrameres pattersoni*, and *Eucoleus contortus* were found; these 3 species are known to be harmful to bobwhites and other Galliformes; however, these species rarely occurred and when they did, were represented by only a few individuals.
- The 2 most common species were the cecal worm (*Aulonocephalus pennula*), which was found in 73% of the bobwhites and the eyeworm (*Oxyspirura petrowi*), which occurred in 40% of bobwhites.
- Prevalence and abundance of the cecal worm and the eyeworm were greater in adult birds compared to juveniles suggesting that infections increased with age. Prevalence and abundance of eyeworms were greater in years where the drought index was lower (wetter) suggesting drought impacts transmission dynamics.
- Spatially, the abundance of the 2 common helminth species was higher in the southern portion of the study area compared to the northern portion of the study area. Additional information is needed to explain this relationship.
- Histopathology showed that eyeworms are capable of causing inflammation and scarring of the cornea; eyeworms in the intraorbital glands elicit a host immune response and likely cause a decrease in lubrication of the eye surface, which could lead to more eye damage.

Cooperative funding provided by the Rolling Plains Quail Research Foundation.

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