Caesar Kleberg Wildlife Research Institute

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Current Research 2015–2016

The cover photo was taken by Trent Bryant on a ranch near Raymondville, Texas. We are calling it "The Family Portrait." We hope your quail season reflects this kind of productivity!

Editor Alan M. Fedynich, Ph.D.

December 2016

Report of *Current Research*

September 1, 2015 to August 31, 2016

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FOREWORD

Dear Friend of the Institute,

These past 20 years have gone by like a whirlwind. When I arrived at the Caesar Kleberg Wildlife Research Institute in 1996, I didn't really know where our program would be in 20 years. It has been a ride beyond any of my wildest dreams.

One of the key ingredients has been the tremendous encouragement and support we have received from each and every one of you. In some way, you contributed to our success with a donation, attendance at a conference, sharing our newsletter with a friend or family member, or simply saying nice things about us as you interact with those around you. We thank you for all of these endorsements that have made us who we are today. While we have seen the boom years and the bust years in wildlife populations, we have never lost your support. We are all thankful for that.

As I move into a new part-time role, I am excited about the future of the Caesar Kleberg Wildlife Research Institute. We have so much to learn about the conservation and management of wildlife populations and their habitat; we can't let up or slow down now.

From my heart, thank you for all you have done for us—what a blessing it has been for me to lead this, the very best research program of its kind in the nation.

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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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New Endowments

Stuart W. Stedman Endowment for White-tailed Deer Research

Tio Kleberg Endowment for Applied Wildlife Research

Helen and Curtis Pinnell Endowed Fund for Shorebird and Wading Bird Research

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Microhabitat Use for Selected Behaviors by Ocelots and Bobcats

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

In the United States, the ocelot and bobcat only overlap in their respective distributions within the Rio Grande Valley of South Texas. Habitat in this region is characterized by dense thornshrub with the ocelot preferring dense canopy cover that has more than 95% horizontal canopy cover.

Using Global Positioning Systems (GPS) collars, we are tracking ocelot and bobcat movements and analyzing vegetation use obtained from the GPS locations. This information will be used to determine differences in habitat selection between these species.

After 3 seasons of live trapping, we have placed GPS collars on 6 ocelots and 3 bobcats. Locations occupied by the collared cats will be used to describe which habitats and microhabitat structures are used when cats are active and nonactive. We will analyze the differences in vegetation characteristics to determine which elements influence habitat selection. Sampling of microhabitat structure began in summer 2016.

Habitat loss negatively affects the endangered ocelot populations in South Texas. Knowledge of the microhabitats preferred by ocelots could be incorporated into conservation plans and help guide restoration efforts for this species.

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

Partitioning of Cover Types between Ocelots and Bobcats

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

The ocelot ranges throughout Central and South America and into South Texas where it is sympatric with the bobcat. Ocelots and bobcats prey mostly on small mammals and birds, and are primarily nocturnal and crepuscular. Because of this ecological overlap, we expect to find evidence for habitat partitioning that would allow these species to coexist.

In 2011, we began an ocelot and bobcat radio telemetry study on the East El Sauz Ranch. To date, we have radio-collared and tracked 15 ocelots and 16 bobcats to characterize ocelot and bobcat habitat selection patterns. We used the synoptic computational model of space use. This model allows simultaneous estimation of home range and resource selection. We classified land cover types into several categories including grassland, forestland, and shrubland. Additionally, we included distance to nearest perennial water source as a variable in the model.

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

Our findings suggest that ocelots and bobcats use similar land cover types in South Texas and may competitively interact with each other. Ongoing collection of radio telemetry data and its interpretation will increase the robustness of this study.

Cooperative funding provided by the East Foundation, Brown Foundation, Annova LNG, Exelon Generation, Travis and Bettina Mathis, Feline Research Program of the Caesar Kleberg Wildlife Research Institute, and Wild Cat Conservation, Inc.

Distribution of Four Wild Cats in Northeast Mexico

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

The reported global distributional range of jaguars, ocelots, jaguarundis, and margays can vary depending on the particular literature source. Field guides, for instance, are often inconsistent in their interpretations of species distributions due either to a lack of precision or knowledge, or both. If distribution ranges are not accurately represented, future decisions for wild cat conservation, such as the creation of protected areas, may fail.

We are documenting the distribution of wild cats in northeastern Mexico using Class I and II records from 27 survey points. Class I records are considered to be the most credible class and consist typically of a carcass, camera-trap photo, or other unambiguous record. Class II records are less reliable, such as sightings that require greater scrutiny. Additionally, information has been

obtained from the literature, scientific collections, and records of personal communications that were deemed to be reliable.

Between 1980 and 2014, we documented location records of 41 jaguars, 31 ocelots, 32 jaguarundis, and 8 margays from northeastern Mexico. The information from this study appears to identify northeastern Mexico as the northeastern distribution limit for these species, except the ocelot, which still occurs in South Texas.

Our study will help to define the distributions of wild felids in northeastern Mexico. It is clear that portions of northeastern Mexico should be considered as conservation priority areas for wild cats because habitat modifications and anthropogenic activities may cause further disturbances that ultimately affect the distribution of these species.

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

Macrohabitat and Microhabitat Effects on Occupancy of Ocelots

Jason V. Lombardi, Michael E. Tewes, Tyler A. Campbell, Alfonso Ortega-Sanchez, Jr., Humberto L. Perotto-Baldivieso, and Justin P. Wied

Over the last century, intensive agriculture and urbanization have transformed the Tamaulipan thornshrub habitats of South Texas, which has impacted many wildlife species. The ocelot is a small, endangered subtropical felid that ranged throughout the Texas Gulf Coast region, primarily within thornshrub habitat. However, degradation and loss of thornshrub throughout the ocelot's range have led to a sharp decline in their population, resulting in 2 isolated small populations—one in Willacy County and one in Cameron County.

Previous research on ocelot habitat use has indicated that ocelots tend to select dense (more than 75%) closed canopy brush and thornshrub habitat. However, there has yet to be research examining whether other habitat variables affect ocelot occupancy.

We are conducting camera surveys on the East El Sauz Ranch to determine the effects of macrohabitat and microhabitat variables on site-specific occupancy of ocelots. This research will provide new information on what types of habitats are more likely to influence site-specific occupancy, colonization, localized extinction, and long-term persistence of ocelots. Data from this study will provide wildlife biologists with important insights into the types of macrohabitats and microhabitats that are critical for ocelot recovery.

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

Genetic Analysis of Bobcats in a Fragmented Landscape

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

Bobcats are wide-ranging, abundant, generalist carnivores. Bobcat adaptability in response to anthropogenic changes to the landscape makes them a valuable indicator species to study landscape connectivity, which is essential for maintaining genetic diversity within populations. The loss of genetic diversity can be used as an indicator that natural and anthropogenic forces are limiting connectivity among individuals.

Our research is using noninvasive fecal sampling and landscape genetics methods to determine if there is a relationship between habitat fragmentation and genetic diversity of bobcats in South Texas. We are collecting bobcat scat samples along roads and trails in study areas surrounded by various degrees of separation and land cover types. This noninvasive sampling strategy allows us to efficiently collect samples across large study areas without having to directly trap and handle bobcats. We are analyzing DNA extracted from scat samples to identify individual bobcats, and to document their relative genetic diversity.

CKWRI researchers are using genetic techniques to assess gene flow within landscapes that have fragmented habitats.

Our study's findings will be useful in assessing the vulnerability of bobcat populations and identifying which landscapes are most important for long-term species conservation. In particular, we will determine connectivity of habitat corridors that are of high concern for the remaining ocelot populations in the United States. Although not all patterns of gene flow in bobcats will result in similar responses in sympatric ocelots, we can expect barriers to movement for bobcats to also negatively affect ocelots.

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

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

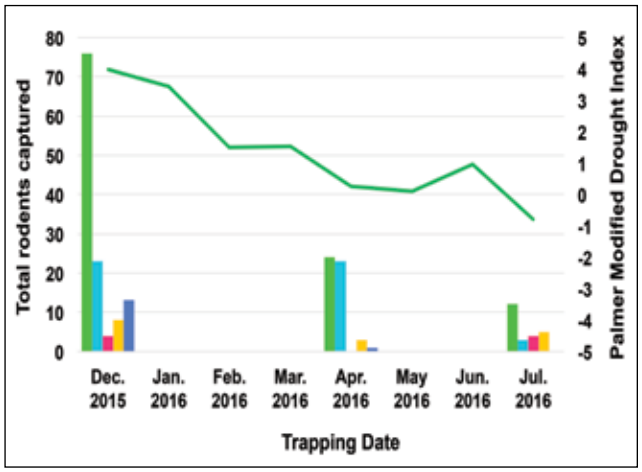
Justin P. Wied, Michael E. Tewes, Lon I. Grassman, Jr., Tyler A. Campbell, and Shelby Carter

Past CKWRI research has identified Southern Plains woodrats, hispid cotton rats, and Mexican spiny pocket mice as the largest constituents of ocelot and bobcat diets. We are monitoring rodent populations on the East Foundation's El Sauz Ranch to assess prey abundance, diversity, and food availability for ocelots and bobcats.

We have established 4, 1,000-ft^2 trap grids, each consisting of 100 Sherman live traps spaced 10 yards apart, within a different vegetation community where ocelots and bobcats are known to occur. Traps are checked over 4 consecutive days during a trap session. There are 4 trap sessions each year, corresponding to the climatic season. Trapped rodents are sexed, aged, and marked with an ear tag for identification of recaptures.

© Greg Lasley

The hispid cotton rat is one of the more common species that serve as prey for ocelots and bobcats.



Rodent captures by species on the Yturria Ranch in Texas compared to the Palmer Modified Drought Index from December 2015 through July 2016. Legend: hispid cotton rat; Southern Plains woodrat; northern grasshopper mouse; white-footed mouse; Mexican spiny pocket mouse; Palmer Modified Drought Index.

We caught 107 rodents in spring 2016, compared to 318 for the same session in 2015. Despite the decrease in overall numbers, hispid cotton rats continue to remain the most abundant species captured (65% of captures), followed by white-footed mice (22% of captures).

Long-term monitoring of rodents will allow us to track patterns in abundance of ocelot and bobcat prey. We will also analyze the abundance of rodent species in relation to the ecotype of each grid site. We will ultimately be able to identify which habitat types produce the highest abundance of preferred prey.

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

Jaguar and Ocelot Population Density Estimation in Tamaulipas, Mexico

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

Jaguars and ocelots can occur sympatrically in Mexico in areas of adequate forested habitat. Understanding the status and demographics of these populations is important for implementing appropriate conservation measures.

We are estimating population sizes of jaguars and ocelots using trail cameras in Rancho Caracol, located in the northern Sierra Tamaulipas, Mexico. Population density was estimated using capture-recapture models

of individuals identified by their unique coat patterns. Density was estimated using the program CAPTURE with 2 sampling area estimators: Maximum Mean Distance Moved (MMDM) and Half Maximum Mean Distance Moved (HMMDM).

Over 5,700 camera trap-nights of surveys found 9 jaguars (4 males, 4 females, and 1 unknown) and 34 ocelots (16 males and 18 females). Density ranged from 1.6 (MMDM) to 3.4 (HMMDM) jaguars per 38 mi^2 and 9.9 (MMDM) to 14.5 (HMMDM) ocelots per 38 mi^2.

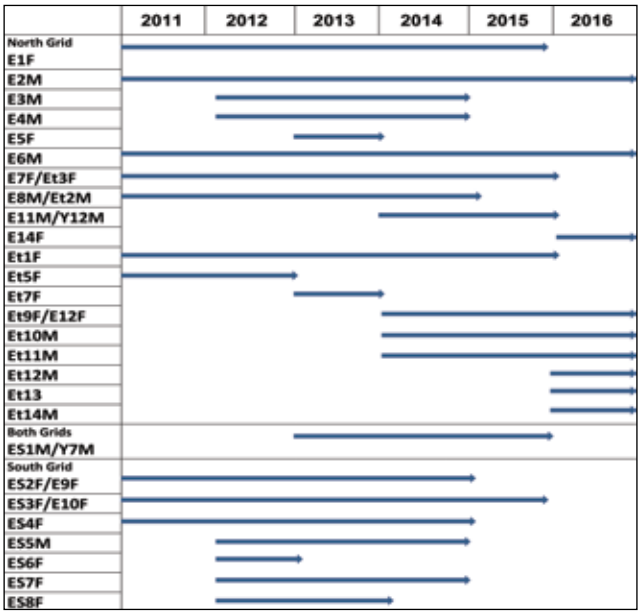
Jaguar and ocelot densities appear to be healthy in our study area. Consequently, the ocelot population in the Sierra Tamaulipas appears to be adequate to support the translocation of adults to Texas.

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

Relationship of Raccoon Density with Felid Occupancy on the East El Sauz Ranch

Jason V. Lombardi, Justin P. Wied, Michael E. Tewes, Tyler A. Campbell, Alfonso Ortega-Sanchez, Jr., Daniel R. Taylor, Shelby Carter, and Taylor Shirley

The northern raccoon is a mesocarnivore found in a wide range of habitat types across its geographic range. Raccoons are well known for their ability to transmit a variety of diseases to other species.



Ocelot occurrence on the East El Sauz Ranch in Willacy County from 2011-2016. Individual ocelots are listed in the vertical column (M = male, F = female).

© Larry Ditto

Ocelots may be negatively impacted by co-occurring species that can transmit diseases to them.

Because of possible disease and parasite transmission from raccoons to ocelots, we are examining the density of raccoons on the East El Sauz Ranch in Willacy County, Texas. Using a newly developed mark-resight method, we will use camera surveys on the East El Sauz Ranch within a pre-existing camera grid.

In spring 2016, we captured 20 raccoons and checked them for diseases and parasites, and placed customized identification collars on those individuals. The unique collars will be used to identify individuals in photographs taken during the camera surveys.

Raccoon density will be quantified in relation to parasite and disease prevalence and ocelot and bobcat presence. These data will provide valuable insights on raccoon population density and subsequent disease prevalence. Such findings may prove to play a role in ocelot recovery within South Texas.

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

Soil Characteristics of Habitat used by Sympatric Ocelots and Bobcats

Justin P. Wied, Michael E. Tewes, and Tyler A. Campbell

The endangered ocelot prefers dense thornshrub with a horizontal canopy cover greater than 95%, whereas the bobcat has a more flexible habitat tolerance. Soil characteristics have previously been linked to ocelot use at Laguna Atascosa National Wildlife Refuge (LANWR)

in Cameron County with Global Positioning Systems (GPS) derived data. We expanded on this work by comparing soil characteristics of thornshrub used by sympatric ocelots and bobcats on LANWR.

We have tracked ocelots and bobcats using VHF radio telemetry on LANWR. From these tracked locations, 4 soil samples were taken and analyzed for chemical and physical properties. Ocelots were most often found on sites with loamy clay soils, which had higher macronutrient content, lower pH, and low salinity, sodium, potassium, and sulfur. Bobcats used sites of varying soil textures, sometimes with higher levels of salinity and sodium.

In the present study, camera traps are located on 2 ranches in Willacy County, which allows us to track felid movements and collect soil samples where the cats occur. The chemical and physical attributes of a soil can influence the vegetation communities that grow on any given site. By understanding the soil attributes associated with locations used by ocelots, we can identify sites to manage or restore for ocelot habitat management.

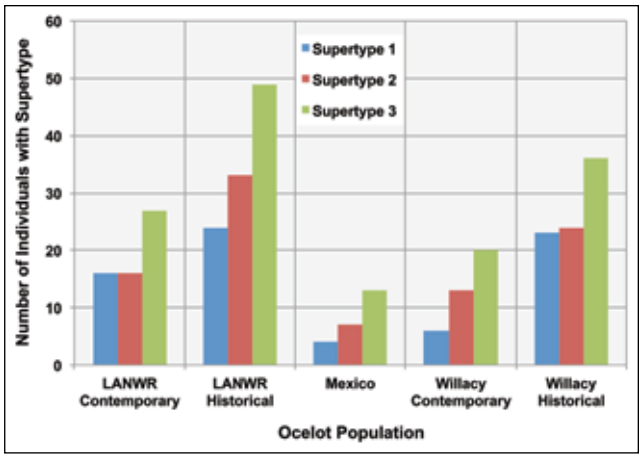
Cooperative funding provided by the James R. Dougherty Foundation, Tim and Karen Hixon Foundation, Feline Research Program of the Caesar Kleberg Wildlife Research Institute, Rachael and Ben Vaughan Foundation, East Foundation, and Wild Cat Conservation, Inc.

Major Histocompatibility Complex Allele and Ocelot Recovery in South Texas

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

Within the United States, 2 isolated ocelot populations occur in South Texas. Both populations are known to have experienced recent reductions in genetic diversity. Previous studies of ocelot genetic variation have examined neutral genetic variation, using either microsatellites or mitochondrial DNA sequences. However, neutral measures of genetic variation do not always provide a clear estimate of functional genetic variation. Using genetic samples collected over 3 decades in the United States and Mexico, we initiated a study to measure levels of genetic variation within the functionally-important Major Histocompatibility Complex (MHC).

The MHC genes are among the most diverse loci in vertebrate genomes. Within the MHC, the most polymorphic genes are those coding for antigen binding molecules. Antigen binding molecules bind to peptides derived from pathogens and present these peptides to T-cells to initiate an immune response. The structure and diversity of amino acid residues within these antigen binding molecules determines, to some extent, an organism's ability to mount a defense against pathogens when they invade a susceptible host.



Frequency of the 3 identified Major Histocompatibility Complex DRB gene supertypes in ocelots from Laguna Atascosa National Wildlife Refuge (LANWR) Contemporary, LANWR Historical, Mexico, Willacy County Contemporary, and Willacy County Historical. Supertypes were identified using the physiochemical properties of amino acids located at antigen binding sites within the DRB molecule.

A high diversity of MHC alleles in a population is believed to be crucial for population resilience by allowing a response to a wide variety of pathogens. Previous studies on isolated vertebrate populations found that, despite losing overall genetic variation through genetic drift, populations often retain high levels of MHC variation through stabilizing selection.

We have sequenced exon 2 of the DRB (one of the most polymorphic sites in the vertebrate genome) for 18 ocelots from Willacy County, 32 ocelots from Cameron County, and 3 ocelots from Mexico. Among all individuals sampled, we identified 16 unique alleles, including 6 alleles that have not been previously described in ocelots. All alleles identified coded for functional gene products of the expected length, with no alleles showing insertions, deletions, or premature stop codons.

We are preparing a second MHC sequence run for individuals not included in the first run. Our project will allow unprecedented insight into ocelot functional genetic variation and can help ensure optimal genetic diversity in future translocation efforts.

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

Noninvasive Fecal Sampling for Monitoring Bobcats and Ocelots

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

Additional survey tools are needed to aid conservation efforts for ocelots in South Texas. Current field research methods to monitor ocelots include live-trapping and camera stations. However, months of trapping efforts often lead to the capture of only a few individuals, and photos from camera stations lack the ability to gather valuable genetic information. Because ocelots, bobcats, and other carnivores are known to defecate along roads and trails within their home ranges, it may be possible to use noninvasive scat sampling as an additional monitoring tool for ocelots. This method has the added benefit of obtaining wild cat DNA.

We will evaluate the feasibility of the scat sampling effort needed to determine the abundance and density of ocelots and bobcats in areas where both species co-occur. Our 2 study areas are located on the East El Sauz Ranch in Willacy County. We are collecting carnivore scats along ranch roads adjacent to known ocelot habitat. Surveys for scat have averaged about 2 hours per day during each of 21 days along 10 miles of roads while driving an ATV.

We have collected 92 samples that are being analyzed for species identification through genetics. Ocelot and bobcat abundance estimated from scat collections will be compared with camera photo data that were collected throughout the same study areas during the scat collection periods.

Data from our long-term study should help with the identification of individual bobcats and ocelots that are missed using other techniques. This noninvasive method for monitoring elusive carnivores should greatly benefit conservation efforts for ocelots.

© Daniel Taylor

We are evaluating the use of scats as a noninvasive technique to identify individual bobcats and ocelots.

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

Long-term Effects of Drought on Population Dynamics of Ocelot Prey in South Texas

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

The climate in South Texas often oscillates between periods of abundant precipitation and periods of drought. Rodent species that comprise ocelot prey are dependent on vegetation and insect production, which is tied to precipitation output. Subsequent declines in abundance and diversity of prey species may affect ocelot ecology during periodic droughts.

As part of a long-term rodent monitoring project, we have established 5 transects, each with 50 Sherman live traps spaced approximately 1 yard apart. Four transects are located along the perimeters of the El Jardin and San Perlita conservation easements on the Yturria San Francisco Ranch. The fifth is located along a wildlife trail within the San Perlita easement. Traps are checked daily for 4 days per trap session, and there are 4 trap sessions per year, corresponding to the climatic seasons. Captured rodents are identified to species, sexed, aged, and checked for reproductive status. Each individual receives an identification ear tag before release to identify recaptured rodents.

Trapping data are analyzed to determine the abundance of each species. These abundance values are compared to the Palmer Modified Drought Index (PMDI) to assess drought effects on rodent population dynamics.

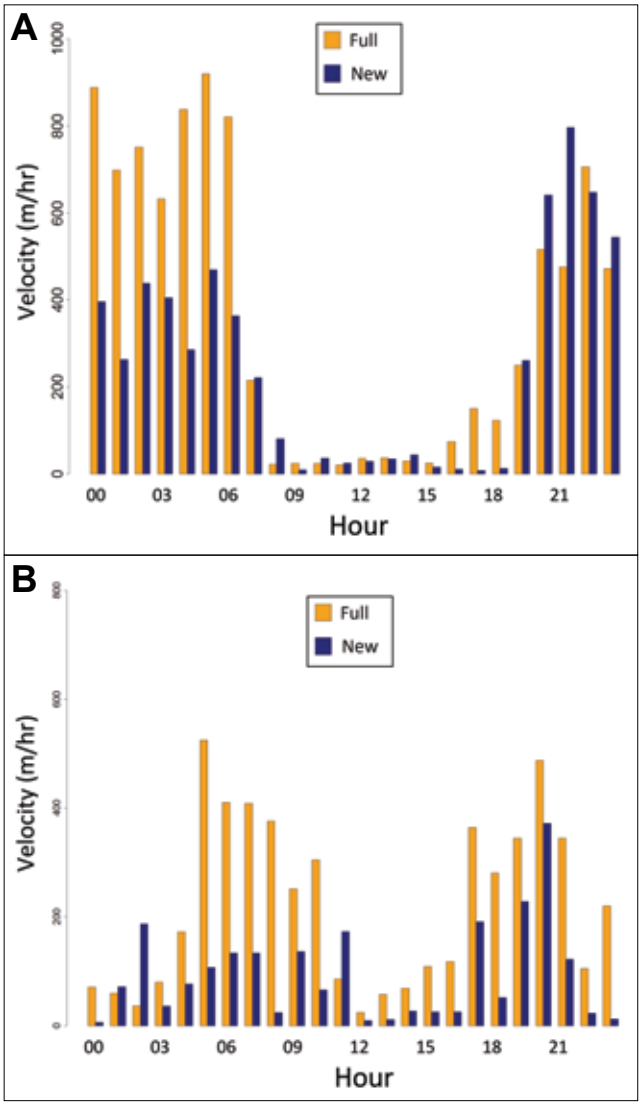
Hispid cotton rats have followed the rise in the PMDI (wetter conditions) through the past year to become the most abundant species captured, followed by white-footed mice. The length of the study will provide a strong metric to evaluate availability of preferred prey items and total prey species for ocelots. We anticipate a decrease in prey abundance as the El Niño pattern shifts toward drier conditions.

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

Activity Patterns of Sympatric Ocelots and Bobcats

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

The geographic ranges of ocelots and bobcats overlap in certain areas of South Texas and much of Mexico. Both felid species have been reported to feed primarily on small mammals and birds, occupy dense thornshrub habitats within Texas, and hunt at night and during crepuscular (twilight) periods. It is necessary to understand the degree to which ocelots and bobcats compete for the same limiting resources in order to effectively manage the remaining endangered ocelot populations in Texas.



A. GPS-derived velocity values averaged per hour and moon phase (full or new moon) for ocelot E6M. During each 30-minute time interval between high-frequency GPS points, travel distance was calculated in meters (3.3 feet) and velocity was determined by dividing travel distance by time lag in hours.

B. GPS-derived velocity values averaged per hour and moon phase (full or new moon) for bobcat EB8M. During each 30-minute time interval between high-frequency GPS points, travel distance was calculated in meters (3.3 feet) and velocity was determined by dividing travel distance by time lag in hours.

Temporal niche partitioning may be a mechanism by which ocelots and bobcats avoid competitive overlap. We have obtained activity data on ocelots and bobcats over 5 years of camera trapping on the Yturria Ranch and East El Sauz Ranch. In addition, Global Positioning Systems (GPS) locations from radio-collared ocelots (2 males, 2 females) and bobcats (2 males, 1 female) are allowing us to investigate temporal movement patterns 24-hours per day. In addition, 5 of the radio collars recorded activity data from biaxial accelerometers at 5-minute intervals to measure activity.

Preliminary results suggest that ocelots are nocturnal, showing the highest activity during periods of darkness. In contrast, bobcats are nocturnal and crepuscular, with high activity levels during the early morning and late evening hours. Differences in activity patterns may explain the coexistence of these ecologically similar felids.

This research will provide insight into sympatric ocelot and bobcat activity patterns. The information will help ecologists, biologists, and wildlife managers gain a better understanding of temporal segregation between these felids that allows coexistence in the same habitats. Such information can be used to develop better conservation efforts for the endangered ocelot.

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

Backcasting Ocelot Habitat in South Texas from 1976–2016

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

The Rio Grande Valley (RGV) is one of the fastest growing urbanized areas in the United States. In addition to cropland and rangeland conversion, severe habitat loss and degradation of Tamaulipan thornshrub and hardwood forests have occurred throughout the RGV of South Texas.

The preferred habitat of the ocelot has declined sharply because of the loss of dense thornshrub

communities within the RGV. In 1986 about 1% of thornshrub habitat remained in the RGV; however, the exact amount of habitat lost prior to and since this time remains unclear.

This research will use current and historical LANDSAT data and historical aerial photographs to quantify the rate of land-cover change over the last 40 years. Based on the current amount of habitat remaining, we will use historical and current trends in land conversion to forecast future habitat loss. This information will provide wildlife managers and biologists with critical information for future habitat restoration and preservation efforts necessary for ocelot recovery in the RGV.

Cooperative funding provided by the East Foundation, Brown Foundation, Annova LNG, Exelon Generation, Travis and Bettina Mathis, and Feline Research Program of the Caesar Kleberg Wildlife Research Institute.

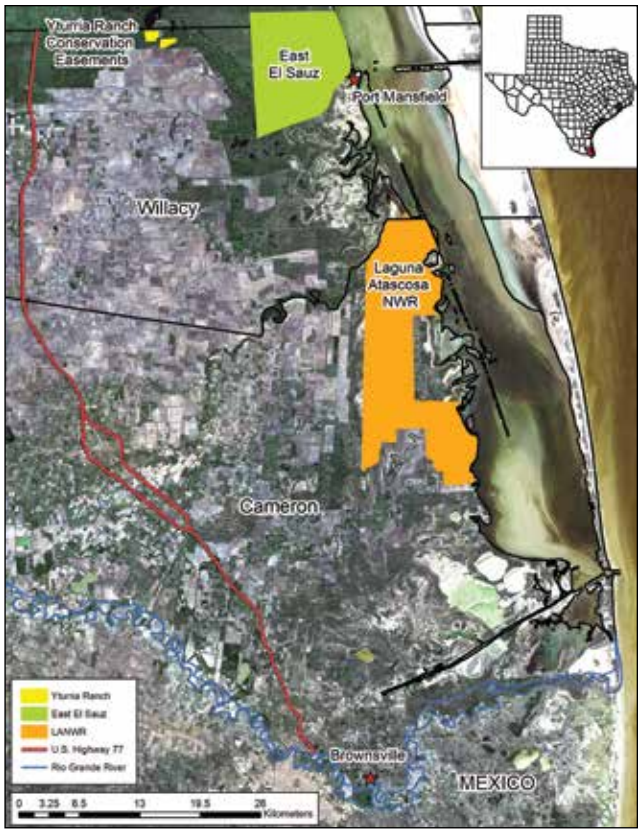
Genetic Pedigree Analyses for the Willacy and Cameron Ocelot Populations

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

Two ocelot breeding populations occur in the United States: one on the Yturria Ranch and East El Sauz Ranch in Willacy County and one on Laguna Atascosa National Wildlife Refuge in Cameron County. Although the Yturria Ranch and East El Sauz Ranch population share individuals, genetic research suggests that there is isolation between the Willacy County and Cameron County ocelot populations.

Analyses of a partial pedigree can identify migration between populations, determine if the loss of diversity is attributable to breeding by few individuals, and identify the level of inbreeding that has occurred. We are attempting to create a partial pedigree of individuals from both populations.

We are estimating parentage of ocelots using blood samples obtained in studies from 1984 through the present. We have assessed assignment of maternity or paternity for 140 offspring using the likelihood ratio approach in the program CERVUS. To date, development of a partial pedigree has identified 6 and 7 inbred relationships in the Cameron and Willacy populations, respectively. Mixing within the Yturria Ranch and East El Sauz Ranch population has been confirmed with several migrants or those of recent migrant ancestry being documented.



Aerial photo showing the Lower Rio Grande Valley in South Texas and the ocelot sampling locations: Laguna Atascosa National Wildlife Refuge (LANWR), Yturria Ranch, and East El Sauz Ranch.

Partial pedigree analyses will be important in guiding ocelot translocation strategies to reduce inbreeding and increasing genetic diversity. Information obtained in this study can be used to select individuals for within Texas translocations and track the genetic contribution of these translocated individuals.

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

The Comanche-Faith Deer Study Project

Charles A. DeYoung, Timothy E. Fulbright, David G. Hewitt, Lindsey M. Phillips, Don A. Draeger, Lindsay D. Roberts, Emily H. Belser, Onalise R. Hill, Justin P. Young, Jeffery H. Brooks, and Ryan M. Rothstein

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 and the first phase began in 2004. The current phase of research began in April 2013 with the same 6 enclosures on each ranch. In Phase II, treatments for enclosures are outlined in the table below. Numerous projects are being conducted within the overall experimental design. Some projects use all 12 enclosures while others use a subset.

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

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

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

Assessment of Overwinter Fawn Survival and Habitat Selection

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

Fawn recruitment is essential for ensuring the future productivity of a white-tailed deer herd. However, overwinter stress on fawns may occur following weaning because of poor nutrition. Since fawns are at the bottom of the social hierarchy, overwinter nutritional stress may increase if they are pushed into lower quality portions of the habitat. Our objective is to determine the effects of increased white-tailed deer densities and feeder densities on overwinter fawn habitat selection, nutrition, and survival.

Fawns captured during November 2014 and 2015 were fitted with Global Positioning Systems (GPS) collars and/or ear tags within treatments of 40 deer per 1 feeder, 60 deer per 1 feeder, and 60 deer per 3 feeders per 200 acres. Relocation data from GPS collars, survival estimates using trail cameras, and nutritional status using body measurements are being used to test our predictions.

Preliminary results show a high survival rate and no difference in nutritional status for fawns in all treatment groups. Habitat selection of fawns in the high density with 1 feeder treatment concentrated foraging efforts in open areas where high quality natural forage would be most prevalent. Our results suggest fawns increased search time for high quality forage in the presence of increased competition. However, results also show fawns in the high density multiple feeder treatment concentrated their foraging efforts in areas with lower quality forage.

Additional research on fawn use of feeders during winter will help to explain these results. Understanding how deer densities and feeder presence affects overwinter fawn nutrition will provide managers with important information for ensuring optimum productivity of their deer herds.

Evaluation of Water Consumption by White-tailed Deer

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

Water development for wildlife has been a commonly used management practice in the western United States for many decades. The lack of surface water in semiarid environments makes drinkable water a limiting factor for white-tailed deer during drought. Our objective is to assess how factors such as season, age, sex, and deer density affect water consumption.

We used 2 enclosures on each ranch, one containing 60 deer and one containing 20 deer. All 4 enclosures had a centrally located supplemental feeder. Five uniquely tagged bucks and 5 uniquely tagged does of varying ages were selected in each enclosure. Water consumption by the selected deer was recorded for a year using a tub of water on a scale monitored by video camera. The selected deer were divided into 3 age groups for analysis.

Preliminary results indicated that deer density affected water consumption of bucks and does in the oldest age class. Does in the high-density enclosure drank less than does in the low-density enclosure. Bucks in the high-density enclosure drank more than bucks in the low-density enclosure. Season had an effect only on does in the oldest age class. Does in the oldest age class drank more during summer than spring or winter.

Our data suggest that providing water for white-tailed deer could decrease the stress caused by summer temperatures during periods of gestation and lactation in does. Also, deer in the oldest age class are more susceptible to environmental stresses such as deer density and season.

Assessing the Effects of Deer Density on Antler Growth and Buck Movements

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

The goal of many white-tailed deer management programs is to produce a herd with a high percentage of mature bucks (greater than 5 years old) while maintaining herd density at or near carrying capacity of the habitat. However, little is known about how deer herds at high densities affect antler growth and movement patterns in mature bucks. Our objective is to determine if there is a density effect on antler growth and buck movement patterns.

We will be using the software BuckScore® to calculate gross Boone & Crockett antler scores for known-age bucks during growing years 2015–2016 and 2016–2017. We will then examine the gross Boone & Crockett scores by buck age class to determine if there is a density effect on antler growth.

We will place radio collars on 35 mature bucks in December 2016 in a low deer density enclosure (20 deer with 1 feeder) and 2 high deer density enclosures (one enclosure with 60 deer and 1 feeder and the other with 60 deer and 3 feeders). The collars will be collected approximately 1 year later to obtain the data that they recorded.

We will then analyze the data to see whether density affects frequency and timing of buck movements. We will also assess whether different densities cause a shift in habitat use by bucks during different times of the year. By determining if deer density affects antler growth and buck movements, wildlife managers will be able to determine the proper deer density to achieve their management goals.

Influence of Behavior on Feed Use by White-tailed Deer

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

Dominance hierarchies among white-tailed deer may limit accessibility to concentrated food resources for some age and sex groups of deer, particularly does and fawns. Enclosures with multiple feeders may

Studies are underway to evaluate the effects of supplemental feeding and deer density on antler growth.

provide more opportunities for subordinate deer to access feed than less dominant deer in enclosures with only a single feeder.

The proportion of each deer's diet composed of pelleted feed will be determined by analyzing stable isotope ratios in hair and blood samples taken several times a year. Additionally, we will assess the aggressive behaviors of individual deer using video cameras placed at feeders in enclosures with 20 deer per 1 feeder, 60 deer per 1 feeder, and 60 deer per 3 feeders.

Deer in the videos from 2-week periods in December 2014 and March, August, and December 2015 will be analyzed for aggressive interactions to determine the social hierarchy of the individually tagged deer within the selected enclosures. Stable isotope samples will be matched with dominant or subordinate deer categories using unique ear tag number and color combinations or antler characteristics.

Our goal is to compare feed consumption by individual deer to determine how social hierarchical standing affects accessibility to concentrated food sources. Based on the results of this study, we hope to determine the optimum feeder density that will ensure accessibility of concentrated food sources for all deer, including both dominant and subordinate individuals within the herd.

Effects of Deer and Supplemental Feeder Densities on Woody Species Composition

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

Researchers in North America have observed a decrease in preferred browse species and an increase in species not preferred by deer as elevated white-tailed deer densities cause a shift in plant species composition. Many land managers have incorporated supplemental feeding in an attempt to reduce the effects of deer foraging on plant species composition. There is, however, little evidence of a shift in composition toward plants less preferred by deer occurring in a highly variable environment such as South Texas.

In 2004, 20 transects were established in each enclosure. Beginning in June 2012 and continuing through 2017, canopy cover of woody plants will be estimated according to species. Species will be grouped into preferred and not preferred categories for analyses. Density of 3 highly preferred species (bush sunflower, orange zexmenia, and spiny hackberry) will be estimated according to 3 height categories along these pre-established transects.

Students are sampling woody and herbaceous vegetation on the Faith Ranch to assess use by white-tailed deer.

Our preliminary results suggest that increasing deer densities and supplemental feeder densities have no effect on the percentage of canopy cover of preferred and unpreferred woody browse species. Deer density and supplemental feeder density also had no effect on the density of bush sunflower, orange zexmenia, or spiny hackberry.

Through this research, we hope to determine the optimal white-tailed deer and supplemental feeder density to sustain a healthy deer herd for hunting without damaging the natural woody vegetation. Sustainable white-tailed deer management involves maintaining healthy deer populations through a balance of preferred and unpreferred browse species.

Summer Mast in White-tailed Deer Diets in South Texas

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

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

To quantify the disappearance rate of mesquite pods and prickly pear mast, we monitored 5 mesquite trees and 5 prickly pear plants within each of the enclosures during summer 2014 and 2016. Only prickly pear mast was monitored in 2015 because mesquites did not produce pods that year. We marked individual pods on each mesquite tree. Marked pods remaining on each mesquite and every fruit on each prickly

pear were counted weekly to determine disappearance rates. We also measured canopy cover and counted the mast of 20 mesquites and 10 prickly pear plants randomly chosen in each enclosure to determine mast production each summer.

Preliminary results show that mesquite mast disappeared sooner than prickly pear mast in 2014. Mast took longer to disappear in enclosures with high mast production than in enclosures with low production in 2014 and 2015. Biomass of prickly pear and mesquite mast in each enclosure varied from 7 to 1,328 pounds per acre in 2014 and from 0 to 794 pounds per acre in 2015, showing that mast production in South Texas can be highly variable between years and locations. Despite this variability, these 2 native plants can account for a vast food resource. Our findings suggest that it is important to maintain adequate mesquite and prickly pear in areas where managing for deer and other wildlife is a priority.

Effects of Deer and Supplemental Feeder Density on Fawn Feeder Use

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

Successful fawn recruitment is a vital component of a sustainable white-tailed deer population. Low fawn survival following weaning has been documented in South Texas, possibly because of poor fawn nutrition. How often and under what conditions fawn survival is low after weaning is unknown. The objective of our study is to determine whether varying deer densities and supplemental feeder densities affect overwinter feeder use by fawns, which could influence their nutritional status.

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Studies are underway to evaluate factors that influence fawn growth and survival in South Texas rangelands.

One hundred fifty-one fawns were captured and tagged in November 2014 and 2015 within 3 treatment densities: 40 deer with 1 feeder, 60 deer with 1 feeder, and 60 deer with 3 feeders. Trail cameras were placed at supplemental feeding sites in each enclosure to monitor the presence of the tagged fawns at the feeders and the frequency of visits to the feeders from November to April each year. Photos from the cameras are currently being analyzed.

Supplemental feed is used to address many white-tailed deer management issues; however, there may be problems with its application. Supplemental feed, for example, may not be equally accessible to all members of a deer population. Our research into the frequency of fawn feeder use will provide wildlife managers with a better understanding of how to achieve optimum fawn nutritional status, which will aid fawn recruitment.

Pelleted Feed Consumption by White-tailed Deer in South Texas

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

Providing pelleted feed as a nutritional supplement for white-tailed deer is a common management practice. However, as deer densities increase, feed may not be accessible to all deer because of competition at the feed site, which could limit the success of a feeding program.

Patterns of feed consumption may vary by season and amount of vegetation available, which is influenced by rainfall. Some feed may be lost to sources other than deer such as waste and consumption by non-target species. To test these assumptions, pelleted feed was provided year-round, *ad libitum* within each of the enclosures. Feed levels are measured when feeders are filled to determine feed disappearance.

Preliminary results show that feed disappearance varied among months, but feed disappearance was always affected by deer density. At lower deer densities, all deer likely had access to the feeder. However, as deer densities approached 45 deer per 200 acres, feed disappearance rates slowed down. This suggests that not all deer had access to feed sites at high deer densities. Feed loss to waste and non-target animals was not significantly different from zero, suggesting minimal loss. Additionally, rainfall did

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Deer population density and presence of feeders may influence antler growth in bucks.

not significantly affect feed disappearance for most months. The results of this study provide insight into diets of white-tailed deer in a variable environment, which can ultimately affect management goals.

Browse Species Responses to White-tailed Deer Densities

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

Wildlife managers traditionally expect the quality and quantity of forage to decline as deer density increases. In addition, plant defenses on browsed species such as thorns and tannins may also increase. An alternative idea is that growth and quality of browse may increase to some optimum deer density and then decline as deer density increases. Our objective is to test this hypothesis by determining regrowth and nutritional quality of blackbrush acacia, twisted acacia, and spiny hackberry in response to increasing white-tailed deer densities.

Starting July 2014, we measured shoots and thorns annually on marked stems for each shrub species in 200-acre enclosures containing 0, 20, 40, and 60 deer. Each enclosure contained a single supplemental feeder. Each July and October, leaf and twig samples were removed from a different set of plants of each shrub species for nutritional quality analysis of fiber, protein, and tannins. Measurements and samples were taken within the white-tailed deer's browsing zone (20 to 40 inches from the ground) in each cardinal direction on the plants.

Preliminary results indicate that these browse species were able to compensate growth and increase physical defenses to a threshold of 40 deer per 200 acres, but were less able to at a higher deer density even with the presence of supplemental deer feed. Further analyses will be conducted on nutritional quality.

Traditionally, managers have strived for deer densities low enough to avoid causing undesirable changes in the plant community. A more efficient approach may be to manage for deer densities that optimize browse quality and quantity simultaneously.

Effects of Deer and Supplemental Feed on Woody Plants

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

Recent increases in white-tailed deer densities in North America are impacting natural vegetation and ecosystem stability. The level at which deer herbivory becomes harmful to the natural vegetation is difficult to define, especially in a semiarid environment such as South Texas. Supplemental feeding is commonly used to alleviate the negative effects of deer foraging.

Pairs of blackbrush acacia and granjeno at 2 height categories (less than 5 feet and greater than 5 feet) and guayacan within each enclosure were selected in June 2013. One plant in each pair was selected to be caged, thereby eliminating deer browsing, while the other remained uncaged (i.e., exposed to browsing). Every July from 2013 through 2017, diameter measurements will be taken at specific height intervals on each plant, and the mean canopy volume above and within the reach of browsing deer will be determined. Fruit production of each plant will be estimated annually during peak mast production (April–June) by counting the number of fruits at specific height intervals in pre-determined directions.

Preliminary results show large granjeno plants have higher average canopy volume within the cages. Above the reach of deer on large uncaged plants, average granjeno canopy volume peaked at a density of 60 deer while blackbrush acacia peaked at a density of 40 deer. Increasing deer density appears to stimulate mast production of large granjeno plants. When making decisions, wildlife managers may need to account for variation in deer browsing among plant species.

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

Observation Rates and Sex Ratios from White-tailed Deer Helicopter Surveys

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

Helicopter surveys are often used to collect data for white-tailed deer management purposes. Animal counts and sex ratios are crucial components of surveys and are used to determine population size and composition relative to management objectives. Understanding influences on counts and ratios will improve reliability of the data collected. One potential influence on counts is daytime behavior of deer. Additionally, it is not known what the minimum number of observations is needed to gain stable fawn:doe and buck:doe ratios.

We used helicopters to survey deer in South Texas during 2011–2014. Each September, fixed-width transects were flown in 124 wildlife management areas totaling over 740,000 acres. For the count aspect, we quantified observation rate per mile during morning (0800–1100), midday (1101–1400), and afternoon (1401–1700) hours. For the ratio aspect, we used a running total of sightings to determine when fawn:doe and buck:doe ratios became stable.

Morning and afternoon hours had 20 to 24% higher deer observation rates per mile than midday hours. Assuming deer were equally present but unobservable during midday hours, the undercount typical of deer surveys is likely to be greatest during midday. Fawn:doe ratios became stable when 10 does were observed, whereas 19 bucks were needed to be observed for stable buck:doe ratios. Depending on acreage, deer density, and buck:doe ratios, some properties may have an insufficient number of bucks to obtain stable buck:doe ratios. These findings improve our understanding of the potential influences on data collected during helicopter surveys.

Cooperative funding provided by the East Foundation.

Effects of Heat on Food Consumption and Rumen Temperature of White-tailed Deer

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

White-tailed deer, like all mammals, must maintain body temperature, but consuming food generates heat, which may be a problem during hot summers in South Texas. Our study, conducted with captive white-tailed deer at the Alkek Captive Ungulate Facility located at Texas A&M University-Kingsville, will help determine the effect of high summer temperatures on food consumption and rumen temperature of mature bucks.

We randomly assigned 8 male deer to either an ambient temperature treatment or a treatment in which the deer could access a cooler environment. Monitors were placed into each animal's rumen to record rumen temperature. Using different dietary regimes during the summer and recording food and water intake, we seek to determine relationships among environmental temperature, rumen temperature, food intake, and water consumption.

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

DMP Pens Effect on Average White-tailed Deer Antler Size

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

Deer Management Permits (DMPs) are issued by the Texas Parks and Wildlife Department to land managers who wish to control breeding in resident

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CKWRI researchers are assessing the effects of using Deer Management Permits to increase antler scores.

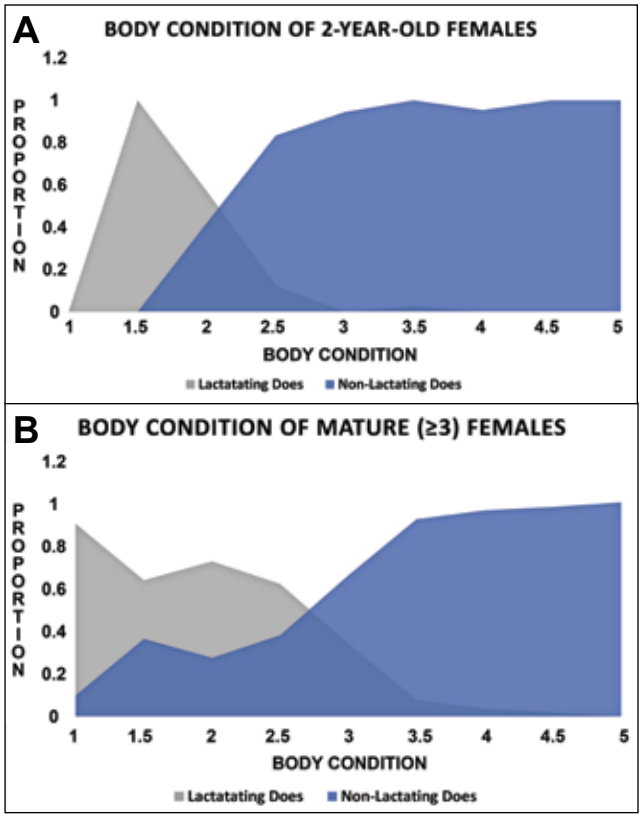
white-tailed deer for management purposes. This study is evaluating how the average Boone and Crockett (B&C) antler score of bucks can be affected by the use of DMP permits.

This research is being conducted on the Faith Ranch in Dimmit County, Texas. Two high fenced pastures were established in 2007 under identical management strategies including intensive supplemental feeding. Resident deer were removed from the treatment pasture prior to this study, and the pasture restocked with DMP sired offspring. The control pasture has resident deer that were present when the high-fence was constructed. DMP pens are stocked with native deer from the property.

Fawns are tagged in DMP pens and the control area each year with ear tags specific to year-of-birth. Each fall, marked bucks are captured via helicopter and measured. Antler size data are compared within age classes across each pasture.

In the fall of 2015, average B&C inches of DMP bucks differed from control pasture bucks as follows: 1.5-year-olds were equal; 2.5-year-olds, +6 B&C inches; 3.5-year-olds, +12 B&C inches; 4.5-year-olds, +12 B&C inches; 5.5-year-olds, +1 B&C inch; 6.5-year-olds, +12 B&C inches; 7.5-year-olds, +10 B&C inches; and 8.5-year-olds, +10 B&C inches.

Cooperative funding provided by the Faith Ranch.



A. Distribution of body condition scores of lactating and non-lactating 2-year-old female white-tailed deer captured on 4 East Foundation ranches during 2011–2015.

B. Distribution of body condition scores of lactating and non-lactating mature female white-tailed deer captured on 4 East Foundation ranches during 2011–2015.

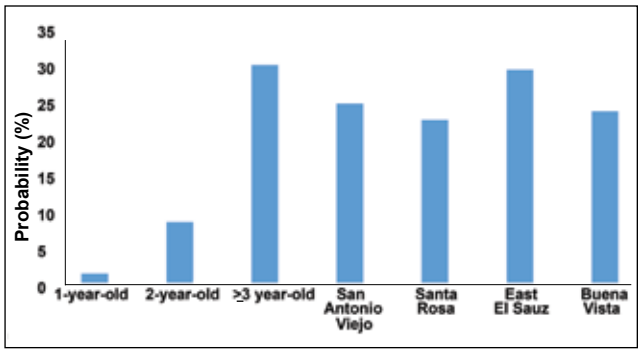
Productivity of Unmanaged White-tailed Deer in a South Texas Environment

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

Environmental variability influences recruitment of white-tailed deer in semiarid rangelands because of limited nutrition. Our objectives are to investigate the influence of precipitation, age class, and location on the probability of doe lactation and compare the effects of lactation on body reserves for white-tailed deer in South Texas.

We captured 1,862 adult (1 year or older) female deer during October–November 2011 through 2015 on 4 East Foundation ranches. The study sites on the ranches range from the Gulf Coast to 90 miles inland across a precipitation gradient where rainfall decreases east to west. The Palmer Modified Drought Index was used to model the changes in annual precipitation during the study.

Age influenced the probability of lactation because mature females (3+ years old) had a 31% probability of lactating, whereas 1- and 2-year-old females had 1% and 9% probability of lactating, respectively. The probability of lactation was also influenced by precipitation. During the wettest year, the probability of lactation was 46%, compared to 19% during the driest year. In addition, females captured on the site



Influence of age and lactation on the probability of lactation for female white-tailed deer captured on 4 East Foundation ranches during 2011–2015.

along the coast, where rainfall is less variable, had the highest probability of lactating. Lactating females had lower body condition scores than non-lactating females. This pattern was more pronounced in 2-year-olds than mature females.

Nutrition is limiting for lactation during dry years; however, physically mature females are less sensitive. Deer managers should consider the age of females, effects of drought on recruitment, and consequences of lactation on female body condition when implementing doe harvest plans.

Cooperative funding provided by the East Foundation.

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

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

The debate regarding whether cattle grazing impacts on deer are positive or negative is centuries old. In 1933, Aldo Leopold, in his book *Game Management*, suggested cattle could be used as a habitat management tool. Since then, researchers have conducted studies regarding cattle and deer interactions throughout North America. However, results are conflicting and there is no consensus on the effectiveness of cattle as a habitat management tool.

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

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The existing literature regarding the benefits of using cattle for deer habitat management is mixed.

To date, we have reviewed 2,685 peer-reviewed manuscripts on cattle-deer interactions in North America. We extracted data from 102 of the manuscripts that met the following criteria: (1) cattle were the only livestock species, (2) there was no disturbance within 2 years of data collection, and (3) they were conducted on non-cultivated lands.

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

Cooperative funding provided by the East Foundation.

Effects of Culling on Male Mating Success in White-tailed Deer

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

Selective harvest, or culling, is a widely practiced strategy aimed at increasing antler size in managed populations of white-tailed deer. However, the effects of culling on deer populations are poorly documented. Culling based on age and antler size of male deer may change the population sex ratio and age structure—factors that influence the distribution of male mating success and, ultimately, genetic variation.

The goal of this study is to define effects of culling on the demographic traits and distribution of male mating success in white-tailed deer from southern Texas. We established 3 culling treatments: (1) intensive culling of all age classes, (2) moderate culling—only bucks 3.5 years old or older, and (3) no culling (control site).

We captured 4,264 bucks, including recaptures, during 2006–2014 using a helicopter and net-gun; of these, 1,313 deer met the culling criteria. We assigned sires for 850 of 1,212 male offspring (70%) produced by 725 successful bucks (1.2 offspring per sire). Culling resulted in a female-biased sex ratio, and the age structure of candidate sires was skewed toward

adult age classes. Most offspring were sired by adult males (3.5 years old or older) even in the intensive treatment where the buck:doe ratio approached 1:5. Most of the breeding was done by males with desirable antler characteristics, but few of their offspring became sires.

Ongoing analyses will quantify the potential for culling to affect genetic potential for antler size in wild populations. Our study's findings will have important implications for harvest management strategies of white-tailed deer.

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

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

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

The increased popularity of hunting has resulted in landowner interest in enhancing habitat for wildlife. Aldo Leopold, in his book *Game Management*, considered cattle as one of the tools that can be used to improve habitat. However, he warned that with improper management of herbivory, one also could damage the habitat.

Studies in humid and sub-humid climates have found that there is an increase in plant species richness in situations where there are high levels of plant biomass and low-to-moderate grazing intensity. In the process of increasing grazing intensity past what is considered a moderate level, plant species richness and biomass start to decline. Studies of grazing effects on the interrelation of biomass of grasses and forbs in semiarid climates have been inconsistent. We are conducting a study to learn more about this topic.

There is a lot of interest in determining whether cattle can be used as a tool for managing deer habitat.

Three hundred grazing exclosures, with a paired t-post identifying a point with similar forage production and botanical composition, were placed on 6 sites (50 per site) of approximately 6,200 acres throughout South Texas. Every autumn and spring, vegetation will be clipped; forbs will be categorized as preferred and non-preferred for white-tailed deer and grass species will be determined.

From the data collected, we will evaluate the effect of grazing use on autumn standing crop, percentage cover, plant species richness, and the effects of prior year's grazing on spring standing crop. The information from our study will be useful to help ranch managers design grazing management strategies to optimize vegetation productivity and composition for cattle and white-tailed deer.

Cooperative funding provided by the East Foundation.

Population Parameters of White-tailed Deer in a Variable South Texas Environment

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

Local animal populations are usually determined by the geographic origin of sampled individuals. However, the spatial proximity of individuals is not always representative of the patterns of genetic makeup, size, and spatial extent of a population. Furthermore, populations that are continuously distributed across a landscape, such as ungulate populations, make it difficult to clearly identify local populations.

Factors such as landscape features, behavioral patterns, and unidentified barriers to gene flow influence genetic structuring in discrete ways. The objectives of this study are to examine the extent of local white-tailed deer populations and their genetic structure in South Texas.

We captured over 450 deer during October–November 2015 across 4 East Foundation ranches in South Texas that span from the Gulf Coast to 90 miles inland. Sites vary in annual precipitation and vegetative communities. Low fences and minimal high fencing occur around each ranch, which allows free

movement of deer. In addition, minimal hunting pressure throughout these sites and light hunting pressure on surrounding properties enables us to study populations that follow relatively natural dispersal behaviors and population structure. We will use tissue biopsies collected from each deer to conduct genetic analyses, which will allow us to describe population dynamics and population structure.

Information regarding the fine-scale population structure on these ranches will aid in identifying effective deer management units. Our study will provide insight regarding the dispersal limitations and patterns of deer in South Texas.

Cooperative funding provided by the East Foundation.

Body Mass Loss in Male White-tailed Deer during the Rut

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

Competition for mates is energetically expensive, so the optimal strategy for allocation of mating effort may change throughout a male's lifetime. Presently, it is unknown how much effort is put forth by male white-tailed deer during the rut and whether the effort to reproduce varies as males transition from young age to prime age to old age.

We evaluated mating effort relative to age class in white-tailed deer using 7,199 males harvested from a free-ranging population on the King Ranch in Texas over a 22-year period. We used changes in body mass of harvested bucks relative to harvest date during rut as an index of male mating effort.

Pre-rut body mass increased from 1–4 years old, peaked at age 5, then declined 2% annually in bucks 6–10 years old. The loss of body mass peaked at 5 years old (24% of pre-rut mass). However, bucks 6–10 years old continued to invest heavily in mating activities (21% body mass loss) despite the decline in pre-rut mass. Surprisingly, physically immature bucks (2–3 years old) also invested a significant effort in mating activities (13–16% body mass loss).

Unlike other ungulates, male white-tailed deer can maintain reproductive effort late in life because the energetic cost of mating consists of mate-searching rather than fighting. Bucks probably lose body mass because time is allocated to mate-searching versus foraging, and they rely heavily on fat reserves to sustain mating activities during this period. Young and old (11+ years old) males enter the rut with fewer fat reserves and may have to allocate less time towards mating activities.

During the rut, bucks spend a lot of energy searching for mates at the expense of foraging.

Cooperative funding provided by the East Foundation.

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

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

Data are limited on effects of selective culling of bucks by hunters. We are conducting a long-term buck culling study on large acreages to determine results deer managers can expect.

Bucks are captured annually at random on 3 areas of the Comanche Ranch in Maverick County, Texas by helicopter and net gun, 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 to identify them in future recaptures.

On one area, we culled yearlings with less than 6 points, 2-year-olds with less than 8 points, 3- and 4-year-olds with less than 9 points, and 5-year-olds and older with a gross B&C score of less than 145. On another area, all yearlings and 2-year-olds were released and older deer 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, we saw no response except the deer population in the intensive cull area had a widening sex ratio and there were signs yearling buck antlers might be declining. We speculated this was possibly because of environmental influences on late-born yearlings. Beginning in year 8 (2013), we ceased all culling, but continued capturing and measuring deer to determine if there is a lag in the influence of culling.

After 10 years of study on this topic, we have found no obvious effects of culling. Bucks captured have numbered 4,854, including 2,158 recaptures. Bucks culled have totaled 1,333. The study will continue for 3 more years.

Cooperative funding provided by the Friedkin Conservation Fund.

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

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

The stress response is a key mechanism enabling vertebrates to respond to changing environments. It can be activated by predictable daily and seasonal rhythms and reproductive stages, or by unexpected events such as social encounters, drought, or predation attempts. Elevated stress may influence energetic requirements, reproductive capacity, health, or behavior of an individual.

In the semiarid rangelands of South Texas, stress levels in white-tailed deer may be influenced by rainfall, high temperatures, limited resources, social encounters, and reproductive events. Our objectives are to (1) investigate 4 methodologies for quantifying stress hormones and (2) identify environmental factors that influence stress in white-tailed deer.

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Samples are being taken from captured wild deer to measure their hormonal response to stress.

Over 150 white-tailed deer will be sampled for stress hormones annually during autumn 2015–2016 on 4 East Foundation ranches in South Texas. These sites range from the Gulf Coast to 90 miles inland. Precipitation decreases along an east to west gradient, and vegetation communities and soil profiles vary across the ranches. Hunting and common management techniques for wildlife are not implemented on the ranches, which allow us to study relatively undisturbed deer.

Blood, saliva, fecal, and hair samples will be used to quantify stress hormones from captured individuals. Stress levels will be compared to the time of day an individual was pursued by a helicopter, duration of time spent in a transport vehicle, behavioral disposition, and body temperature. We will also use precipitation indices, body condition, age, sex, lactation status, study site, and year to interpret stress levels of deer. This project provides unique opportunities to better understand the physiological responses of white-tailed deer to capture procedures and environmental stressors in South Texas.

Cooperative funding provided by the East Foundation.

Assessing Response to Selection in Managed Populations of White-tailed Deer

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

Selective harvest, or culling, is often practiced to increase the genetic potential for antler size in populations of deer. The response of phenotypic traits to selection is affected by the heritability of the trait, the intensity of selection, and the number of generations that selection is applied. The intensity and time required to produce a meaningful response to culling is unknown.

We are investigating the effects of culling at 3 sites subjected to different intensities of culling: (1) an intensive treatment, where bucks of all age classes were culled; (2) a moderate treatment, where bucks 3.5 years old or older were culled; and (3) no culling (control). Each autumn during 2006–2016, we used the helicopter and net-gun method to capture

Long-term monitoring is providing information about antler growth relative to age and environmental conditions.

deer at the 3 sites. We estimated age, measured antler traits, and collected a tissue biopsy for genetic analyses. Deer meeting the culling criteria were sacrificed during 2006–2012.

We recorded 4,855 captures of 2,691 individual deer and conducted parentage analyses. We will estimate heritability of antler traits based on similarity of antler traits between sires and offspring.

The difference between the average antler size of the population before and after selection will be used to estimate selection intensity. We will combine this information with the number of offspring per sire and the generation time to predict the response to selection on antler traits under real-world conditions. The results of our study will have important implications for strategies that include culling and selective harvest to achieve management goals.

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

Quail Outreach Program at the Caesar Kleberg Wildlife Research Institute

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

South Texas has been coined the "Last Great Habitat" because it encompasses millions of acres of wildlife habitat—habitat that supports strong populations of northern bobwhites and scaled quail. The Quail Outreach Program was initiated in 2013 to provide science-based information to landowners and quail enthusiasts. The objectives of the program are to (1) provide science-based information on quail and their management to landowners, managers, and quail enthusiasts through free ranch visits and presentations and (2) expand our focus to areas of South Texas where quail research activity has been minimal or nonexistent.

Since August 2013, Dr. Eric Grahmann, our research scientist directing the program, has visited 96 ranches, which encompass about three quarters of a million acres. The location of these ranches ranges from Matagorda to Crockett and from Mason to Starr counties. Quail management plans have been written for 62 of these ranches. He has given over 60 quail management presentations across the state. Finally, the quail research capacity of the CKWRI has increased by 5 projects, located on the northern and western peripheries of South Texas. Through our program, we are providing a service to keep South Texas the leading region for quail conservation and hunting.

Cooperative funding provided by San Antonio Quail Forever, South Texas Chapter of Quail Coalition, San Antonio Chapter of Quail Coalition, Hill Country Chapter of Quail Coalition, South Texas Charity Weekend, Inc., Dr. Lacy Williams, James Barrow, Henderson-Wessendorff Foundation, and the Richard M. Kleberg, Jr. Center for Quail Research.

Hixon Ranch Bobwhite Habitat Restoration Project

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

Invasive, non-native grasses such as Old World bluestems and buffelgrass have been linked to habitat loss and fragmentation for quail and other species in South Texas. Connecting corridors of restored habitat may help create large areas of contiguous habitat. The Hixon Ranch is the site of the first large-scale research attempt at restoring a large quail habitat corridor previously dominated by non-native grasses, and the largest restoration project attempted in South Texas.

In 2008, we started a 5-year pilot study to determine the best restoration treatment for restoring native grassland in an area dominated by non-native grasses. Results indicated that the best treatment was a series of repeated disking and herbicide applications followed by planting native grasses and forbs.

In 2013, we selected a 300-acre pasture dominated by non-native grasses to restore using the above methodology while a nearby pasture of similar size and composition served as an experimental control for comparison. Data on vegetation composition, wildlife abundance, and bobwhite use were collected on both sites. The restoration treatment began in January 2014 with a prescribed burn and brush removal to prepare the site for cultivation while 27 acres of mesquite mottes were left to provide loafing and thermal cover for wildlife. Thus far, the site has been disked 5 times and sprayed with herbicide 2 times.

The next step will be sowing seeds of locally adapted native grasses and forbs. To ensure that all habitat components are met for northern bobwhites, we also will establish mottes of locally adapted woody plants and cacti. Monitoring will continue until 2019 to determine the long-term effects that restoration may have on wildlife.

Cooperative funding provided by George C. "Tim" Hixon, Hixon family, Hixon Ranch, Texas Parks and Wildlife Department, South Texas Chapter of Quail Coalition, Coastal Bend Audubon Society, Rotary Club of Corpus Christi (Harvey Weil Sportsman Conservationist Award Trust), and ExxonMobil Summer Jobs Program.

Measuring Northern Bobwhite Response to Post-grazing Vegetation Recovery

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

Northern bobwhites require habitat structure with substantial grass cover for nesting, predator avoidance, and thermal refuge. During the past 2 decades, many land managers have reduced or eliminated livestock across South Texas rangelands with the goal of improving bobwhite habitat. Our objective is to

investigate how bobwhites respond to the vegetative changes following removal of grazing.

Our study occurs on a ranch in Jim Hogg County with 3 different areas of post-grazing habitat recovery: a 3,843-acre area rested from grazing for 15 years; a 2,800-acre area rested 3 years from high intensity grazing (17 acres per Animal Unit [AU]); and a 3,098-acre area rested 3 years from moderate grazing (34 acres per AU). We will monitor bobwhite density, breeding season survival, and nesting success. We hypothesize these factors will be highest on the recovered site and lowest on the heavily grazed site.

In 2015, nesting success on the 15 years post-grazing area was 63% compared to 40% on the recently grazed area, though confidence intervals overlapped (indicating no statistical difference). Breeding season survival was 58% on the 15 years post-grazing site and 44% on the 3 years post-grazing site with overlapping confidence intervals. Estimated winter bobwhite density was 0.95 birds per acre on the 15 years post-grazing area, 0.73 birds per acre on the 3 years post-grazing moderate intensity area, and 0.40 birds per acre on the 3 years post-grazing high intensity area. Additional surveys will be conducted in 2016, focusing on identifying potential differences resulting from grazing and developing restoration strategies.

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

Bobwhite Use of Coastal Bermudagrass Restored to Native Vegetation

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

Conversion of diverse native rangelands to simplified pastures dominated by non-native grasses can lead to degraded habitat for grassland birds, including bobwhites. Coastal bermudagrass is an introduced grass planted widely for cattle grazing. The objectives of this study are to compare bobwhite abundance and bobwhite habitat on coastal bermudagrass pastures, a native shrubland, and a pasture restored to bobwhite habitat, which was previously a coastal bermudagrass pasture with kleingrass strips planted throughout.

In 2014, trap success was 0.01 bobwhite per trap day in the combined bermudagrass sites, 0.40 in the 2005 restored site, and 0.07 in the native site. In 2015, trap success was 0.13 bobwhite per trap day in the combined bermudagrass sites, 0.43 in the 2005 restored site, and 0.10 in the native site. The habitat was also drastically different in 2014 and 2015. In 2014, both bermudagrass sites were near minimal recommended nesting clump density or below, but in 2015, both sites were well above the recommended level. The restored site was well above this level in both years, while the native site, which is dominated by brush and perennial forbs was below this level in both years.

This study helps show that while bermudagrass pasture typically provides poor quality habitat for bobwhites, it can be converted by active restoration practices. It can also be improved by ceasing active management such as fertilization. This, coupled with drought, can allow for the establishment of other grasses and forbs at the expense of bermudagrass.

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

Influence of Woody Cover on Northern Bobwhite Seasonal Survival

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

Northern bobwhites have relatively low annual and breeding season survival rates. High mortality rates from predation are a main factor contributing to low bobwhite survival. Woody cover may influence bobwhite survival because it serves as escape cover and screening cover. Even though many researchers

Bobwhites seek cooler environments such as shaded brushy areas during summer heat.

have attempted to determine the woody cover requirements for bobwhites, few have attempted to study how woody cover may influence bobwhite survival.

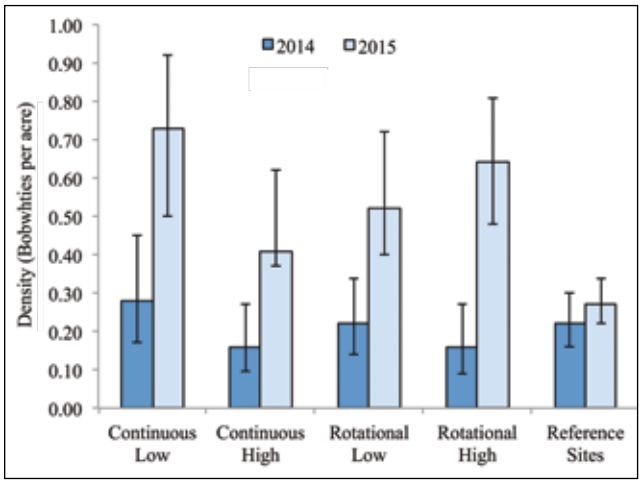
Our objective is to determine if bobwhite seasonal survival (March–August) is correlated with the amount of woody cover used at both the organism-centered and home range scales. The study is being conducted on 5 ranches in Goliad, La Salle, Zavala, and Real counties. We also are incorporating data from a long-term research project conducted in Brooks County. Radio-marked bobwhites are located 3 times per week to monitor survival and estimate home ranges. We are using Geographic Information Systems (GIS) software to measure woody cover use within home ranges and around tracking locations. Data are currently being analyzed, and the study will conclude in 2016.

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

Northern Bobwhite Densities in Relation to Experimental Grazing Regimes

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

Explaining the interaction between grazing and wildlife on rangelands requires isolating effects within a complex biophysical system. Variables such as weather and range site productivity are further confounded by human decision making in real-world grazing operations. In South Texas, bobwhites commonly occur on lands where grazing and hunting are integral parts of the ranch's viability and longevity.



Pretreatment bobwhite density (bobwhites per acre) estimates and 95% confidence intervals on 4 treatment sites (continuous low and high; rotational low and high) and pooled reference sites for December 2014 and 2015 on the San Antonio Viejo Ranch, Jim Hogg County, Texas.

A large-scale project was developed to assess the impact of different grazing regimes on bobwhite density in 4 treatment pastures (18,989 acres; continuous and rotational at medium and low stocking rates) and 3 reference sites (10,789 acres) on the San Antonio Viejo Ranch in Jim Hogg County, Texas. Our primary objectives are to compare (1) bobwhite densities and (2) vegetation parameters pre- and post-treatment on each site from December 2014–2017.

We estimated pre-treatment density using line-transect distance sampling December 2014 and 2015. Cattle were stocked on treatment sites in late December 2015. We obtained measurements of vegetation structure, forage standing crop, and grazing intensity during the fall and summer 2014–2016.

Across the pooled treatment areas, density estimates increased by 175% from 2014 (0.20 quail per acre) to 2015 (0.55). Density estimates within years between the 4 treatments were similar. On the reference sites, bobwhite density increased less by 35% from 2014 (0.20) to 2015 (0.27). Vegetation and precipitation will be analyzed to explain density fluctuations. This study will aid managers in understanding how grazing practices and weather interact to affect bobwhite densities on a population-wide scale.

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

Habitat, Weather, 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

Landscape-level patterns such as habitat loss and fragmentation are primarily responsible for the declines in northern bobwhites and scaled quail. These landscape processes generally occur at a scale beyond that of traditional quail studies and may involve not only habitat loss and fragmentation but also broad-scale changes in weather trends and predation risk.

A multi-scale approach is needed to understand how different factors may be influencing quail population trends across spatial scales. The objectives of this study are to determine (1) to what degree habitat loss

and fragmentation are affecting quail populations on southwestern rangelands, (2) how other factors such as weather and predators may be compounding these effects, and (3) how these relationships vary at multiple scales.

Our area of focus spans the southwestern portion of the bobwhite's range and the entire range of the scaled quail (TX, OK, KS, NE, NM, AZ, and CO). We will examine the relative contributions of 3 general factors (habitat, weather, and predators) on quail populations at multiple scales (ranch, route-level, and landscape). Specifically, these factors include total habitat amount, degree of fragmentation, raptor relative abundance, temperature, and precipitation. We will obtain data from multiple sources to determine quail trends (Breeding Bird Survey and ranch-level data) and relate landscape patterns (National Land Cover), raptor population trends (Breeding Bird Survey), and weather (PRISM). Understanding scale-dependent contributions of multiple factors on quail population trends will be highly important in focusing both our management and research in the future.

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

Montezuma Quail Calling Phenology in the Edwards Plateau

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

The Montezuma quail is a secretive gamebird in Texas (with a closed season) that inhabits the southern Edwards Plateau and mountains of the Trans-Pecos. Because of its secretive nature, surveying Montezuma quail populations is difficult. Consequently, estimates of population size and density are unavailable. In April 2015, we initiated a study to quantify factors influencing responses and calling rates of the Montezuma quail (among other objectives) to refine sampling techniques.

We established 60 survey locations across 9 ranches occupied by Montezuma quail. Call back surveys were conducted at these locations during a variety of conditions twice per month from March–August 2015. During each call back survey, we measured temperature, relative humidity, wind speed and direction, cloud cover, and atmospheric pressure.

Montezuma quail are extremely secretive and, as a consequence, it is difficult to assess their population status.

About half of the responses were heard during a narrow window when temperatures were mild (70–80° F), relative humidity was greater than 90%, wind speeds were less than 5 mph, and atmospheric pressure ranged between 940–955 hPa. Understanding the weather conditions in which Montezuma quail respond to calls will allow us to increase survey efficiency and refine sampling techniques for this species. This study will conclude in 2017.

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

Northern Bobwhite Response to Habitat with Water Supplementation

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

Northern bobwhite populations in South Texas are influenced by rainfall patterns where more rainfall during certain time periods translates to more bobwhites. Providing standing water for quail to drink does not provide them any major benefit. However, maintaining habitat through irrigation may negate drought effects by providing oases of lush vegetation with high populations of arthropods needed for food.

Our study is in its third year investigating whether adding supplemental water to the landscape through irrigation during dry conditions can maintain or

increase bobwhite productivity and abundance. Hens are tracked during the breeding season to record movements, breeding season survival, nesting success, nesting rate, and nesting season length. Arthropod abundance at watered areas, random points in the pasture, and at brood foraging sites will be studied to determine if irrigation provides more food to nesting hens and young chicks. Furthermore, brood foraging habitat will be assessed to determine needs of chicks and to see if these needs are met at watered areas.

Our arthropod samples in 2015 showed a higher biomass and/or number of some arthropods at watered areas than at random locations or brood foraging locations. While there were some differences, preliminary results suggest no clear pattern in the effect of irrigation on arthropod biomass or numbers.

This study seeks to investigate mechanisms linking northern bobwhite productivity and rainfall. Additionally, we will provide recommendations on the use of irrigation as a quail management practice.

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

Genetic Basis for Plumage Color Variation in New World Quails

Damon L. Williford and Randy W. DeYoung

Plumage coloration of birds plays an important role in camouflage, species recognition, and courtship displays. The melanocortin-1 receptor (MC1R) gene is one of many genes that contributes to coloration in birds. Activation of MC1R leads to an increase in the synthesis of eumelanin and darker coloration. Decreased MC1R activity results in greater synthesis of phaeomelanin resulting in reddish or yellowish coloration. Recent research indicates that sexual selection has influenced the evolution of MC1R and plumage coloration in galliforms. To gain greater understanding of the genetic basis for color variation in the northern bobwhite and other species of New World quails, we sequenced 739 base pairs of MC1R from 11 bobwhites (including 3 masked bobwhites and a leucistic Texas bobwhite), 8 scaled, 5 California, 5 mountain, 5 Montezuma, and 4 Gambel's quails.

We observed 3 nonsynonymous substitutions—mutations that alter the amino acid sequence of the protein and the expression of traits. Only 1 of these mutations was clearly associated with plumage differences, and separated Montezuma quail from the other species. Tests for positive selection were not significant. However, tests for purifying selection were statistically significant for northern bobwhite, scaled, and Gambel's quails. Phylogenetic analysis of the MC1R sequences revealed that bobwhites, scaled, Gambel's, and California quails could not be differentiated. Our preliminary results suggest that among New World quails MC1R is not associated with plumage variation, is highly conserved because of selection against mutations that change plumage color, and is not a useful phylogenetic marker in New World quails.

Dave Menke, USFWS NCTC Image Library

The California quail is one of the New World quail species studied to determine the genetics of plumage coloration.

Evaluating Methods for Monitoring Northern Bobwhite Populations

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

Wildlife managers and researchers monitor bobwhite populations using indices and density estimators. Indices such as spring cock call counts, fall covey counts, and roadside counts provide measures of relative abundance (e.g., bobwhites per mile) and are assumed to be proportional to the actual population size. Density estimators, on the other hand, such as distance-based helicopter surveys and mark-recapture trapping provide estimates of actual population size (i.e., birds per acre). Indices generally are less expensive and easier for wildlife managers to implement than density estimators, but often are less reliable. Our objectives are to (1) determine which index

is the best predictor of fall hunting populations and (2) evaluate whether helicopter surveys are comparable to mark-recapture estimates in the Rolling Plains.

Our study is being conducted on the Rolling Plains Quail Research Ranch in Fisher County, Texas using population data collected from 2008 to 2017. We will compare spring cock call counts (cocks per point), fall covey counts (coveys per point), and roadside counts (birds per mile) to density estimates provided through mark-recapture methods. Data are currently being collected, and the study will conclude in 2017.

Our expected findings will provide wildlife managers with important information on the reliability of indices and helicopter surveys as predictors of fall hunting populations. This information can be used to provide recommendations for best practices in monitoring bobwhite populations.

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

Assessing the Use of GPS Transmitters on Northern Bobwhites

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

Advances in technology have increased the capabilities of radio-telemetry transmitters including the use of Global Positioning Systems (GPS) transmitters. The use of these transmitters in wildlife studies is extensive for large-bodied animals that are able to carry the additional weight. However, size and weight of these transmitters have limited the usefulness of this technology for bobwhites. Bobwhites require radio transmitters that weigh less than 0.25 ounces. This weight restriction has limited bobwhite telemetry studies to Very High Frequency (VHF) transmitters, and requires researchers to track and approach radioed animals to obtain location information.

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VHF transmitters require researchers to periodically check the location of radioed animals.

We are experimenting with GPS transmitters that weigh less than 0.25 ounces. These transmitters offer advantages for researchers by collecting and storing location data that can be downloaded once the transmitter has been recovered. GPS transmitters allow data to be collected without the researcher physically finding the animal in the field. This new technology may improve our understanding of bobwhite site use and movements. Our objectives are to conduct a trial study using GPS transmitters on 10 bobwhites to (1) measure bobwhite site selection and movements and (2) measure differences between locations obtained by VHF technology and GPS technology.

We will deploy 10 GPS store-on-board data transmitters. Each GPS transmitter will obtain 6 locations evenly throughout each day for 20 days while we will simultaneously gather locations on the birds using VHF technology. After 20 days, the birds will be recaptured to remove the GPS units and collect the data. We aim to determine if GPS transmitters will be a viable option for quail researchers compared to traditional VHF transmitters.

Cooperative funding provided by George C. "Tim" Hixon, the Hixon family, Hixon Ranch, Texas Parks and Wildlife Department, South Texas Chapter of Quail Coalition, Coastal Bend Audubon Society, Rotary Club of Corpus Christi (Harvey Weil Sportsman Conservationist Award Trust), and ExxonMobil Summer Jobs Program.

Impacts of Eagle Ford Shale Exploration on Quail Space Use

Kelsey R. Davis, William L. Lutz, Jr., Eric D. Grahmann, Fidel Hernández, Timothy E. Fulbright, Chase Currie, David B. Wester, and Fred C. Bryant

Northern bobwhites and scaled quail have been declining across their ranges for decades because of habitat loss. Since 2008, the Eagle Ford Shale has been rapidly developed in nearly 30 counties in Texas. Our objective is to determine how bobwhites and scaled quail respond to localized disturbance caused by oil and gas exploration activities.

© Kelsey Davis

Assessments are being conducted to determine what effect oil and gas exploration activities have on quail populations.

Our study is located on 2 ranches in Dimmit and Maverick counties. Study sites consist of 2 areas along an oil and gas exploration corridor (disturbed area) and 2 areas along corridors where no exploration activities have occurred (undisturbed area). Ambient sound levels were recorded using a sound level meter, and traffic rates were measured using single road tube accumulators. Information on site use by quail were collected using radio telemetry.

Mean maximum sound levels were similar in undisturbed areas (61 decibels), compared to disturbed areas (67 decibels). Overall, mean traffic rates were 957 vehicle passes per week on primary exploration roads in disturbed areas, compared to 31 vehicle passes per week on primary roads in undisturbed areas. Mean home range sizes of scaled quail were not different among disturbed (56 acres) and undisturbed areas (56 acres). We were unable to calculate enough bobwhite home ranges for comparison between areas.

We calculated mean distance of quail locations to the exploration corridor to assess use of these sites. Scaled quail appeared to avoid the exploration corridor (moved greater distances from corridor in disturbed area) while bobwhites appeared to select for the exploration corridor (moved greater distances in the undisturbed area).

In addition to direct habitat loss from development, preliminary analyses suggest scaled quail space use may be affected by exploration activities. Our study will conclude in 2017.

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

Development of a Predictive Macrohabitat Model for Montezuma Quail

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

During the past century, Montezuma quail in the Edwards Plateau nearly disappeared because of incompatible land use practices and woody plant encroachment. Understanding this bird's distribution and population status is critical for their conservation. Determining areas of suitable habitat may aid in the recovery of the species.

In April 2015, we initiated a study to identify macrohabitat variables linked to Montezuma quail occupancy, which will allow us to develop a predictive habitat suitability map within the Edwards Plateau. During March through August (2015–2016) we conducted call back surveys at 60 points, twice per month, across 9 ranches occupied by Montezuma quail. At these points, we determined macrohabitat variables such as elevation, terrain type, ecological type, percent slope, aspect, soil series, and juniper coverage.

Suitable ranges of the above variables will be used to develop a predictive habitat model of sites occupied by Montezuma quail and potential suitable sites for restoration within the Edwards Plateau. Our study will conclude during 2017.

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

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

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

Non-native, invasive grasses have been shown to reduce usable space for bobwhites throughout South Texas rangelands. Tanglehead, a native grass, recently has increased rapidly in the western Coastal Sand Plain of South Texas, and similar to non-native grasses, has formed high-density monocultures. The objectives of our research are to (1) determine selection-avoidance of habitat features by bobwhites and (2) determine the effects of tanglehead cover on vegetation characteristics.

We obtained 488 covey locations across 50,000 acres of rangeland using helicopter surveys during December 2014 in Jim Hogg and Duval counties, Texas. We then measured 6 vegetation characteristics (grass and forb species richness, vegetation height, tanglehead cover, and non-native grass cover) at the covey detection locations and an equal number of random locations during spring 2015.

Bobwhites avoided areas of canopy cover greater than 20% tanglehead, as well as similar coverages of non-native grasses such as buffelgrass and Lehmann lovegrass. We also found that forb species richness, grass species richness, and bare ground decreased with increasing cover of tanglehead.

Our preliminary results demonstrate the negative effects of increased tanglehead cover on native rangeland habitats in relation to both overall diversity and usability for bobwhites. Further expansion by tanglehead has the potential to significantly reduce usable space for bobwhites in South Texas. Our results are based on the first of 2 years of study. Additional helicopter surveys for bobwhites and vegetation measurements were conducted in December 2015 and spring 2016, respectively, and are being analyzed.

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

Influence of Initial Nest Fate on Subsequent Northern Bobwhite Nests

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

The northern bobwhite is an important and highly studied gamebird. There are many studies that have looked at bobwhite nesting ecology; however, relatively little is known regarding how renesting behavior is influenced by prior nest predation. Our research objectives are to compare how the fate of initial nests influences the concealment and placement of subsequent bobwhite nests.

Our study was conducted on 5 sites across South Texas in Brooks (2000–2008), LaSalle (2009–2011), and Goliad, Real, and Zavala counties (2014–2015). We collected information on nest fate and nest vegetation characteristics (nest substrate volume, bunchgrass density, radius of visual obstruction, and percent herbaceous cover), and measured distance between initial and subsequent nests.

We found no difference in nest vegetation characteristics between subsequent nests and nests that were depredated during the first nesting attempt. We did find that bobwhites with initial failed nesting attempts moved further (average 184 yards) to renest compared to birds with successful initial nesting attempts (average 124 yards). Greater distances moved for subsequent nest placement after initial nest failure could signify a behavioral strategy of predator avoidance to improve nest success.

Cooperative funding provided by Russel Gordy, South Texas Charity Weekend, Inc., South Texas Chapter of Quail Coalition, various donors of the South Texas Quail Research Project, and San Antonio Chapter of Quail Forever.

Ecological Niche Modeling of New World Quails in Western North America

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

The geographic distribution and range limits of terrestrial species are heavily influenced by temperature and precipitation. Ongoing change to weather and climate will lead to short- and long-term changes in temperature and precipitation norms. It is known that bobwhites respond strongly to precipitation in semi-arid regions. Therefore, changes in timing, amount, and duration of temperature and precipitation will have direct and, possibly, negative impacts. Ecological niche models (ENMs) can be used to predict how a species responded to past climate changes, and how it might respond in the future to changes in climate.

Understanding how New World quail species respond to long-term climate change will aid management strategies.

We are constructing ENMs for Montezuma, mountain, scaled, Gambel's, and California quails. We will use temperature and precipitation variables representing the current climate and occurrence data to construct an initial model for each species.

The models will be used to predict the past distribution under the conditions of the Last Glacial Maximum (21,000 years ago), the Last Interglacial (130,000 years ago), and the Mid-Holocene (6,000 years ago). The Last Glacial Maximum was much cooler than the present, while the Last Interglacial was warmer than today's climate (which stabilized in the Mid-Holocene). Next, we will predict the future distribution of these species in 2070 under 2 climate regimes. Our results will help prioritize management and conservation efforts, and will help us understand some of the reasons behind population declines.

Northern Bobwhite Thermal Resource Selection in South Texas

Benjamin R. Olsen, Timothy E. Fulbright, Fidel Hernández, Eric D. Grahmann, David B. Wester, Humberto L. Perotto-Baldivieso, Michael W. Hehman, Forrest S. Smith, Simona Hodis, and Monika L. Burchette

Operative temperatures exceeding 104˚ F can decrease usable space for bobwhites. Operative temperature incorporates the energy flow between an organism and its environment by combining the effects of long- and short-wave radiation, ambient temperature, wind speed, and humidity.

Operative temperature can be recorded using black globe thermal units. These units have been used to measure thermal data at the plant community level. However, advances in technology have made handheld devices capable of measuring organism-centered operative temperature. Our objectives are to (1) compare organism-centered and community based thermal measurements to predict habitat selection of bobwhites and (2) compare thermal resource selection at individual, home range, and landscape scales.

Since 2013, we have monitored more than 40 bobwhites each year from May–August. Using radio telemetry to locate marked bobwhites, we recorded bobwhite activity, plant community, ground surface and handheld black globe temperature, and light intensity at used and random sites for each bird 2 to 3 days per week. During 2013–2014, we placed 80 black globes in 5 plant communities, which collected temperature measurements from April–October.

Direct solar radiation increases soil surface temperatures causing bobwhites to avoid bare ground that is too hot.

Preliminary findings indicate that organism-centered ground surface temperature was the best measurement used to predict bobwhite thermal resource selection followed by organism-centered and community black globe temperatures. Upon project completion, we will have a better understanding of bobwhite thermal resource selection and will be able to provide recommendations to wildlife managers regarding the provision of thermally suitable sites for bobwhites.

Cooperative funding provided by George C. "Tim" Hixon, Hixon family, Hixon Ranch, Texas Parks and Wildlife Department, South Texas Chapter of Quail Coalition, Coastal Bend Audubon Society, Rotary Club of Corpus Christi (Harvey Weil Sportsman Conservationist Award Trust), and ExxonMobil Summer Jobs Program.

Examination of the Extinction-Threshold Hypothesis in Describing the Quail Decline

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

A long held concept in ecology is that populations respond linearly to the total habitat amount. This proportional area hypothesis suggests that population size is directly linked to available habitat, and population changes are proportional to the amount of habitat lost or gained. The extinction-threshold hypothesis suggests that small changes in habitat amount can have dramatic effects on population size. Both hypotheses hold for a wide range of habitat amounts, but depart once a "threshold" point in habitat amount is reached.

The loss, and associated fragmentation of habitat, has been the ultimate cause of declining populations. Across the southwestern United States, wide expanses of rangeland habitat suitable for bobwhites and scaled quail still exist. However, considerable declines within portions of these regions have occurred rapidly in recent years. Our objective is to evaluate the extinction-threshold hypothesis as an explanatory factor in the declines of northern bobwhites and scaled quail in rangelands of the southwestern United States.

Our focus is on the southwestern portion of the bobwhite's range and the entire range of the scaled quail. We will use data from the Breeding Bird Survey to determine population trends and the National Land Cover Database to determine habitat amount. This will allow us to determine if a "threshold" point exists in quail habitat amount. Determining the validity of the extinction-threshold hypothesis will allow focused management at a landscape-scale with the goal of providing ample habitat to maintain quail populations.

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

Influence of Predator Abundance and Nest Detectability on Bobwhite Nest Success

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

The nesting ecology of the northern bobwhite has been studied extensively, compared to other avian species. However, despite this body of knowledge there is more to understand regarding how predator abundance and nest detectability influence nest fate. The objective of our research is to determine how nest predator abundance and visual and olfactory cues at nest sites can influence nesting success.

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We are evaluating the influence of predator abundance on bobwhite nesting success.

Our study was conducted on 4 sites across South Texas in Brooks (2000–2008) and Goliad, Real, and Zavala counties (2014–2015). Nest fates (successful or depredated) were determined by using radio telemetry; visual and olfactory variables were sampled using nest scent stations. Surveys were conducted for 3 consecutive days per month to determine relative predator abundance.

Using data from 475 nests and their paired predator monitoring stations, we found no relationship between visual and olfactory cues and relative predator abundance on bobwhite nest success. Within the relative predator abundance values observed during our study, bobwhite nest depredation seems to be compensatory, whereby the same percentage of nests may be depredated regardless of predator density. Bobwhite nest success may be more dependent on factors such as the availability of buffer prey species for predators or weather. Our study concludes in 2016.

Cooperative funding provided by Russel Gordy, South Texas Charity Weekend, Inc., South Texas Chapter of Quail Coalition, various donors of the South Texas Quail Research Project, and San Antonio Chapter of Quail Forever.

The Effects of Scale, Location, and Slack on Woody Cover Selection by Bobwhites

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

Woody vegetation cover is an important habitat component for northern bobwhites because it provides protection from predators, thermal refugia, and food, and can be used as a nesting substrate. However, researchers have often disagreed on the optimum amount of woody cover for managing bobwhite habitat. These discrepancies may occur because of the scale at which observations are made. It has also been suggested that bobwhite use of woody cover may vary based on the amount of herbaceous cover present.

We are determining how bobwhites select woody cover at 3 scales: pasture, home range, and organism-centered. We are also examining the relationship between bobwhite use of woody and herbaceous cover at the organism-centered scale. Our study sites are

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Understanding how bobwhites use woody cover at multiple scales is essential for developing better management plans.

on ranches located in 5 counties (Brooks, Goliad, La Salle, Zavala, and Real) across South Texas.

Preliminary findings suggest bobwhites use low amounts of woody cover at the pasture scale. However, use of woody cover at the home range and organism-centered scale depended on locality and year. Use of woody cover at the organism-centered scale was influenced by herbaceous cover and vise-versa.

Our research suggests that the optimum range of woody cover may be dynamic and is dependent on many factors. Data are currently being analyzed, and the study concludes in 2016.

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

Influence of Cover and Precipitation on Northern Bobwhites in the Rolling Plains

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

Landscapes that support high densities of northern bobwhites consist of an interspersed mixture of woody and herbaceous plant cover. Maximum bobwhite densities may be achieved within some range of these cover types, which represents the concept known as "slack." Thus, landscapes with 10% versus 40% brush cover could potentially support comparable densities of bobwhites. Recent research in South Texas suggests that landscapes with greater amounts of brush express less variation in the relative abundance of bobwhites during wet and dry years. Woody cover seemed to cushion bobwhite populations during drought years. Our objective is to examine associations of bobwhite abundance, woody cover, and precipitation in the Rolling Plains of Texas.

Our study is being conducted on the Rolling Plains Quail Research Ranch in Fisher County using trapping data (296 traps) collected from November 2008 to March 2017. We will calculate relative abundance at each trap site (number of bobwhites caught per trap effort). Additionally, we will quantify the amount of woody cover surrounding trap sites and obtain precipitation data from on-site weather stations.

Our goal is to determine the influence of woody cover and precipitation on bobwhite abundance. Findings will provide wildlife managers with an estimate of optimal woody cover for high densities of bobwhites in the Rolling Plains for wet and dry years.

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

Montezuma Quail Occupancy and Habitat in the Edwards Plateau

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

Montezuma quail were likely once widespread across the Edwards Plateau and Trans-Pecos regions of Texas. However, in the Edwards Plateau after more than a century of overgrazing, fire suppression, and juniper encroachment, Montezuma quail are now restricted to 5 counties south and west of Rocksprings. Landowners in this region are interested in rehabilitating habitat for the species, but little information exists regarding essential habitat components or best management practices. Our objectives are to quantify macrohabitat and microhabitat components needed by Montezuma quail in the Edwards Plateau.

Beginning in April 2015, we established 60 survey points encompassing a variety of terrain types, slopes, juniper coverages, and elevations on 9 ranches occupied by Montezuma quail. Call back surveys were conducted twice per month from March–August 2015 to determine occupied habitat. Vegetation and soils were sampled at these locations along transects.

During the 2015 field season, 18 of 60 (30%) survey locations were occupied by Montezuma quail. Fifty-six percent of sites occupied were located on hillsides and areas with less than 20% juniper coverage.

Identifying patterns in macrohabitat and microhabitat characteristics at sites used by Montezuma quail will allow us to provide landowners and quail enthusiasts with information on how to best manage and restore habitat for this bird. Our study will conclude in 2017.

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

Converting Bermudagrass to Native Grasslands to Benefit Bobwhites

Anthony D. Falk, Forrest S. Smith, Keith A. Pawelek, James Muir, Jeff R. Breeden, William P. Kuvlesky, Jr., Jamie L. Foster, and Ryan Rhoades

Bermudagrass is a non-native grass used as livestock forage and hay production throughout Texas. Although an excellent livestock forage, it is poor habitat for bobwhites. Bermudagrass pastures lack bare ground needed by bobwhites to forage, and the lack of shade or structural diversity in bermudagrass monocultures leads to a poor thermal environment for quail. In addition, dense growth of bermudagrass limits forbs, in turn limiting the availability of bobwhite foods including seeds, insects, and leafy greens.

Landowners throughout Texas desire to convert bermudagrass pastures to native grassland for bobwhites. *South Texas Natives* is collaborating with Tarleton State University, Texas AgriLife Research, and Texas Parks and Wildlife Department to evaluate 48 treatment combinations in order to determine the best management practices for replacing existing bermudagrass pastures with native grassland communities.

This study is replicated in 4 Texas ecoregions. Treatments began in autumn 2015 and included planting a cool season cover crop, repeated glyphosate herbicide sprayings, mowing in addition to repeated glyphosate treatments, and imazapyr herbicide application followed by glyphosate applications. Bermudagrass removal treatments will continue through 2016, and will be followed by a variety of native plant seeding treatments in spring 2017, followed by management treatments through summer 2019. Our goal is to provide concise guidance to landowners on the best methods to remove bermudagrass pastures and establish native grasslands for bobwhites.

Cooperative funding provided by the Texas Parks and Wildlife Department and donors to South Texas Natives and Texas Native Seeds.

Analysis of Adaptive Genetic Variation among Bobwhite Populations

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

The northern bobwhite has undergone severe range contractions and population declines. Management of this species would benefit from a greater understanding of how adaptive genetic variation is partitioned throughout the species' range.

Restriction site-associated DNA sequencing can discover thousands of single nucleotide polymorphisms (SNPs) in an organism's genome. Analysis of SNPs can reveal patterns of genetic variation invisible to most commonly used neutral markers.

To assess genetic diversity, population structure, and adaptive variation among bobwhite populations, we obtained samples of hunter-harvested bobwhites from Iowa, Missouri, Kansas, Oklahoma, Texas, and Sonora, Mexico (masked bobwhites). We identified over 2,000 SNPs from the sampled bobwhites that were variable and present at all locations.

Bobwhites in the United States had similar levels of genetic diversity in the SNP markers, but diversity was lower in masked bobwhites. Analyses of population structure revealed that masked bobwhites are genetically distinct from those in the United States, but populations in the United States were relatively undifferentiated. Tests for selection indicated that 2 genes (IL1RAPL2, involved in the immune response and YTHDC2, involved in brain development) might be under selection.

Our results corroborate previous studies based on mitochondrial DNA and microsatellite DNA markers. Although most genetic differentiation among bobwhites is driven by genetic drift and demographic processes, our results indicate that natural selection has also played a role. Ongoing analysis will explore the potential for adaptive variation in greater detail.

Cooperative funding provided by a TAMUK University Research Award.

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

Forrest S. Smith

South Texas Natives (STN) began in 2001 at the urging of landowners desiring native seed supplies for use in South Texas. From a founding grant by the Robert J. Kleberg, Jr. and Helen C. Kleberg Foundation that same year, STN has grown into one of the nation's leading programs dealing with native plant restoration.

With the support of many collaborators and donors, we have developed 30 "Texas Selected Native" seed releases. Since summer 2016, 27 releases have been commercialized. STN has conducted almost 100 research and demonstration restoration projects across South Texas and provided recommendations to thousands of landowners and various agencies.

Through our outreach and educational efforts, thousands have been informed about native plant conservation and restoration. In addition, efforts by the STN have resulted in major changes to reseeding mixtures used in South Texas, particularly those mixtures required by the Texas Department of Transportation, which now consist of only native plants.

In 2015, we were invited to present our work at the 6th World Conference on Ecological Restoration held in Manchester, United Kingdom. In 2016, we were invited to give presentations to peers looking to replicate our efforts in Oklahoma and north-central United States. In addition to being in the international and national spotlight last year, we conducted many regional educational efforts, including 20 invited presentations to conservation audiences in South Texas and hosting 2 field days. STN will continue working toward conservation of native plant communities in South Texas and elsewhere for years to come.

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

Restoring Habitat for Monarch Butterflies on Public and Private Lands in Texas

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

Concern about the importance of pollinators and the decline of the monarch butterfly has spurred interest in restoring pollinator habitat. Most seeding recommendations for benefitting pollinators focus on restoration of native plant diversity, as well as providing plants critical to migrating pollinators, such as native milkweeds for the monarch. To determine how best to achieve this type of habitat restoration, demonstrate its potential, and evaluate several potential pollinator seed releases, *South Texas Natives* (STN) and Texas Parks and Wildlife Department are conducting a 65-acre pollinator habitat restoration project on the Longoria Unit of the Las Palomas Wildlife Management Area in the Lower Rio Grande Valley.

Our project will be instrumental in developing seed mixes of native plants that will be beneficial to a variety of pollinators. Included in this planting will be several native milkweed selections being developed by STN as well as new selections of Indian blanket, basketflower, frostweed, and tropical salvia, which are being considered for release.

Specialized native seed drills will be used to plant the seed mix in abandoned crop fields that have had non-native grasses removed through a combination of cultivation and herbicide applications. We hope this restoration site will increase pollinator habitat in the area as well as serve as a potential stop for monarch butterflies during migrations. The site will be available to demonstrate pollinator habitat restoration to private landowners and agencies by spring 2017.

Cooperative funding provided by the Texas Parks and Wildlife Department, National Fish and Wildlife Foundation, and donors to South Texas Natives.

Assessment of Habitat Suitability for South Texas Ambrosia

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

Virtually nothing is known about South Texas Ambrosia, which is a perennial herbaceous plant endemic to South Texas. In fact, only anecdotal evidence and extrapolations from other plants in the same taxonomic family can be found in a 5-year report by the U.S. Fish and Wildlife Service describing South Texas Ambrosia ecology and biology.

Currently, there is no peer-reviewed literature published on this species. However, we know that historically South Texas Ambrosia occurred in coastal prairie habitats, and the loss of coastal prairie habitat has likely led to a decline of the South Texas Ambrosia

population. Today, there are only 6 confirmed sites where South Texas Ambrosia occurs.

Considerable interest in identifying possible sites for unconfirmed populations and for restoration has highlighted the need for a spatial model that identifies potential suitable habitats for South Texas Ambrosia. Additionally, new information related to the species' management needs, including responses to fire and mowing, has increased interest in identifying sites for South Texas Ambrosia reintroductions that can be managed using these techniques.

Our goal is to use locations of known populations to identify specific habitat features that may serve as predictors of South Texas Ambrosia presence. With this information, we plan to build a spatial model to identify areas of potentially suitable habitat within the historical range of the species to consider for restoration efforts.

Texas Native Seeds—Central Texas Plant Evaluations

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

The Central Texas project of *Texas Native Seeds* is currently evaluating native plants at 2 locations: Texas A&M AgriLife Research Center in Stephenville and the USDA Natural Resources Conservation Service James E. "Bud" Smith Plant Materials Center in Knox City. Current research includes plantings made in 2014 and 2016.

In 2014, 4 grass, 1 forb, and 1 legume species were planted at both Central Texas evaluation sites. These plantings represent collections of 322 plant populations including 22 populations of plains bristlegrass, 97 populations of slim tridens, 48 populations of sand dropseed, 60 populations of hooded windmillgrass, 27 populations of golden dalea, and 68 populations of bundleflower. These evaluations originate from plant materials collected from 67 counties in the Central Texas program area.

In May 2016, 3 grass species were added to both evaluation site locations. These consisted of 110 populations of little bluestem, 72 populations of tall dropseed, and 42 populations of silver bluestem.

Data will be collected at each location on a monthly basis. Seed will be collected throughout the growing season. Plant performance data and seed quality results will be used to make selections of the best populations of each species for increase and commercialization. Our project should eventually lead to regionally adapted native seed sources to benefit restoration efforts throughout Central Texas.

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

The Effects of Patch Burning in Cordgrass Rangelands on Ungulate Distribution

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

Gulf cordgrass and seacoast bluestem are native grasses that provide forage for wildlife and livestock in the Texas Gulf Coast Prairies region. While little research has been conducted on the nutritional value of seacoast bluestem, gulf cordgrass loses value and becomes undesirable as forage when not subjected to periodic defoliation. In our study, prescribed fire is being applied in winter and summer to determine (1) effects of seasonal burning on the nutritional value of gulf cordgrass and seacoast bluestem, (2) distribution patterns of animals prior to and following each burn, and (3) the impact of utilization intensity on nutritional levels within burned patches.

Our study consists of 10 patches (roughly 500 acres each) with 2 patches to be burned each treatment season for a 2-year period. Burning began February

We are studying the effects of burning gulf cordgrass on plant nutrition, animal distribution, and intensity of use.

2016 on the East Foundation's El Sauz property in Willacy County, Texas. Immediately following burning, 4 grazing exclosures were established in each burned patch to monitor the rate of maturation through time with no disturbance. Forage clippings were taken every third day for 7 weeks, and then every 7 days for the following 8 weeks within the burned patches while unburned patches were clipped occasionally to determine crude fiber, protein, and fat levels. The movements of 30 cattle are being monitored using Global Positioning Systems (GPS) collars while ground-based visual counts are being made to assess movements of white-tailed deer and cattle. While preliminary data are not yet available, our goal is to develop prescribed burning recommendations to optimize use of cordgrass rangelands within the Gulf Coast Prairies on a sustainable basis.

Cooperative funding provided by the East Foundation and the Texas and Southwestern Cattle Raisers Association.

Development of Milkweed Seed Supplies for Texas

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

The potential for the monarch butterfly to be listed as a threatened species under the Endangered Species Act is of great concern within conservation and agriculture communities. Monarchs lay their eggs and complete their larval stage on milkweeds. This reliance on milkweeds has made restoration of these plants a high priority for many agencies. It is difficult to produce milkweed seed for commercial purposes, resulting in prohibitively expensive seed that is impractical for use in large-scale restoration projects.

Several species of milkweed are common in South, Central, and West Texas, but the most geographically widespread species are zizotes, green antelopehorn, and antelopehorn milkweeds. Of these species, zizotes milkweed has the growth form and seed production ability most conducive to large-scale seed production.

We began work in 2015 to determine better techniques to produce more affordable milkweed seeds and make seed source selections to enable large-scale seed provision to meet agency demands. In 2016, we selected 2 top-performing zizotes milkweed populations, grew 800 plants for establishment of seed production plots, and began harvesting the seeds.

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Zizotes milkweed plants in the *South Texas Natives* greenhouse for use in establishing seed increase plantings.

Pending successful refinement of harvest and seed cleaning procedures, we hope to start distributing zizotes milkweed seeds to commercial seed companies by spring 2017 to enable large-scale seed production. We have also determined that some secondary milkweed species may have commercial potential, especially slim milkweed. Other milkweed species are being evaluated for commercialization potential. Commercial availability of regionally adapted and affordable seed sources of native milkweeds will enable efforts to restore and enhance monarch butterfly habitat throughout Texas.

Cooperative funding provided by the U.S. Fish and Wildlife Service, Texas Parks and Wildlife Department, USDA Natural Resources Conservation Service, and donors to South Texas Natives and Texas Native Seeds.

Season of Burning in Coastal Cordgrass Communities

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

Coastal prairies are valued landscapes in South Texas, providing thousands of acres of wildlife habitat and potential grazing lands for livestock. Gulf cordgrass is a native bunchgrass species that occurs in discrete patches throughout the coastal prairies. Although highly productive and active for most of the year, mature gulf cordgrass is generally considered to be poor forage because of its low nutritional quality.

Past research has demonstrated that prescribed burning can temporarily enhance the forage quality of gulf cordgrass by promoting young nutritious growth. The purpose of our research is to determine which season of burning optimizes both wildlife habitat and livestock forage in gulf cordgrass communities.

This study is being conducted at the East Foundation's El Sauz Ranch in Willacy County, Texas. We established 10, 500-acre burn units that encompass cordgrass patches, which were randomly assigned winter burn, summer burn, or control (no burn) treatments.

We implemented first-year burning treatments in February and July 2016 and sampled vegetation before and after burning for gulf cordgrass mortality and recruitment, species composition, association, diversity, and production. Data collection continued at regular intervals for 90 days following treatment. By studying the effects of different seasons of prescribed burning, we hope to improve the current management techniques for gulf cordgrass communities.

Cooperative funding provided by the East Foundation.

Texas Native Seeds—West Texas Seed Increase

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

Two new plant material releases for West Texas have been planted in seed increase plots in Alpine, Texas. Four accessions of whiplash pappusgrass and 3 accessions of silver bluestem will be part of the first 2 plant material releases for West Texas from *Texas Native Seeds* (TNS). The development of these plant materials has been over 5 years in the making.

© Jameson Crumpler

Seed increase plots near Alpine and Odessa will benefit restoration and reclamation activities in West Texas.

Initial plantings of 50 accessions of silver bluestem and cane bluestem and 22 accessions of whiplash pappusgrass were installed in Alpine in 2014. These plantings were the result of plant material collections that took place beginning in 2011 when TNS started work in West Texas.

Data analysis from the initial evaluation plantings led to the selection of 9 top performing accessions from each species. Advanced evaluation plantings of these accessions began in 2015 at both the Sierra la Rana Plant Evaluation and Research Facility in Alpine and the Railway Ranch Plant Evaluation and Research Facility near Odessa. Accessions with consistent plant and seed production characteristics were selected from these advanced evaluation plantings.

Four accessions of whiplash pappusgrass from Hudspeth, Brewster, Martin, and Tom Green counties and 3 accessions of silver bluestem from Kinney, Reeves, and Brewster counties were selected for seed increase and plant material release. The commercial release of silver bluestem and whiplash pappusgrass by TNS will be the first release of locally adapted native plant materials for habitat restoration and reclamation in West Texas in nearly 30 years.

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

Effects of Tanglehead on Native Ecosystems in South Texas

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

Tanglehead is a native perennial bunchgrass that is believed to have been a part of South Texas rangelands since the early 1900s. During the past 20 years, however, this native grass has increased dramatically in localized areas of the South Texas Coastal Sandsheet. Recent research conducted by CKWRI faculty and students suggests that increasing tanglehead density may have detrimental effects on wildlife habitat.

With the cooperation of several CKWRI partners, we initiated a project to investigate tanglehead's role in native rangeland ecosystems. This research is

assessing the effects of tanglehead on aboveground and belowground ecological aspects including (1) plant community composition, structure, species richness, and diversity; (2) seed bank composition, richness, and diversity; and (3) microbial communities within the soil.

The research began in 2012 and is currently near completion. Field sampling occurred continuously for over 3 years and concluded in May 2016. Analysis of field data and interpretation of research results are underway. We hope this research will provide insight into some of the ecological factors allowing the continued expansion of tanglehead and provide management recommendations to South Texas landowners for controlling tanglehead.

Cooperative funding provided by the George and Mary Josephine Hamman Foundation, Brown Foundation, and the numerous donors to CKWRI's Invasive Grasses Program.

Update on the Efforts and Goals of the *Texas Native Seeds* Project

Forrest S. Smith

Texas Native Seeds (TNS) started in 2010 through support from the Texas Department of Transportation (TxDOT). Operations are underway throughout Central and West Texas to develop certified, locally-adapted native seed sources for TxDOT and others' restoration needs in these regions.

From 2010–2014, native seed collection efforts were undertaken in both regions. From 2013–2016, we conducted evaluation studies to identify and select suitable populations for releases. Evaluations are being conducted in Central Texas at the Texas AgriLife Research and Extension Center in Stephenville and at the USDA Natural Resources Conservation Service James E. "Bud" Smith Plant Materials Center in Knox City. In West Texas, evaluations are being conducted at the Railway Ranch near Odessa and the Sierra la Rana Ranch near Alpine.

Evaluations of native plant populations for West Texas seed selections are being conducted at the Railway Ranch.

In 2016, selections of populations of common plants in both regions are being increased for release. Two releases for Central Texas are being grown near San Antonio: Menard Germplasm purple threeawn and Guadalupe Germplasm white tridens. Selections of 2 common West Texas native grasses, whiplash pappusgrass and silver bluestem, are being grown in large fields near Alpine.

In each of the coming years, 2 to 3 additional native seed releases are planned for Central and West Texas. As seeds become available, substantial demonstration efforts to promote restoration and educate constituents will be initiated. TNS will continue its efforts to aid in the restoration of native plant communities in Central and West Texas. Our long-term vision is to serve other regions of Texas with similar restoration seed source needs in future years.

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

Mapping the Spatial Distribution of Tanglehead in South Texas

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

Tanglehead is a grass native to southwestern U.S. rangelands. However, it is acting like an invader species in some South Texas rangelands. Large areas of monotypic tanglehead stands have emerged in Jim Hogg, Duval, Brooks, and Kleberg counties with potentially negative effects on wildlife habitat and populations. The goal of this project is to determine the spatial and temporal distribution of tanglehead in the Sand Sheet of South Texas and assess the potential effect of tanglehead on wildlife habitat.

Areas dominated by tanglehead have been identified using high-resolution aerial photographs taken in 2014 and from field verification, ranch information, and data collected from previous research. We are using

remote sensing techniques to differentiate tanglehead patches from other herbaceous vegetation. We are currently mapping Jim Hogg and Brooks counties using 24 digital color-infrared aerial photographs obtained from the National Agriculture Imagery Program. We will also use historical aerial photographs to map and assess expansion and spatial distribution of tanglehead between 1996 and 2004.

We plan to evaluate the role of roads and soil series in tanglehead expansion. In addition, we will quantify landscape structure changes to evaluate how characteristics of northern bobwhite habitat could be affected by expanding populations of tanglehead. Our findings will be beneficial in identifying target areas where tanglehead invasions have been significant and as a baseline to develop management and restoration strategies for wildlife habitat in these areas.

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

Influence of Cattle Grazing on Economics, Environment, and Human Dimensions

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

Effective extension programs to promote good management practices and simultaneously improve the environmental health, profitability, and well being of ranchers are lacking in certain geographic regions. Our objectives will be to (1) identify the main social factors that influence the decisions of ranchers, (2) measure environmental response of a planned behavior-influencing strategy focused on best grazing management practices, and (3) estimate profitability changes with the use of best management practices and assess its effect on changes in human behavior.

Surveys of ranchers of the Chihuahuan Desert region in Mexico will be used to identify the main social influences of rancher behavior towards ranching. These findings, along with data of each ranch's environmental and economic baseline, will be used to develop a structured behavior-influencing strategy for 13 ranchers in order to facilitate the implementation of best grazing management methods and range management practices.

We will measure the change in soil cover, soil carbon sequestration, underground water levels, and wind erosion. The change in profitability of the ranches will also be monitored.

Sustainable grazing management practices maintain proper cover of herbaceous vegetation and protect the soil.

Understanding the main factors influencing attitudes and the decision making process used by ranchers in the Chihuahuan Desert of Mexico will be the basis for developing a sound and effective extension program. Such a program will be useful in increasing environmental health, profitability, and welfare of rural populations in this part of the country.

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

Texas Native Seeds—West Texas Facility Expansion

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

A third seed increase and evaluation facility is being developed for West Texas to meet the needs of the region. Sul Ross State University, a significant collaborator with *Texas Native Seeds* (TNS) in West Texas, has designated the use of a 2.5-acre site located on their campus in Alpine. The site will provide an additional needed location for seed increase fields as well as a site for research evaluations.

The new facility will allow TNS to conduct seed increase operations of up to 4 populations of the same plant species without genetic crossover between populations. This is an important feature needed for producing plant material releases comprised of multiple populations of the same species.

When completed, the evaluation facility will have a new water well and irrigation infrastructure. This site will have a new greenhouse, shade structure, and a multipurpose building to house offices in addition to workshop, storage, and lab facilities.

The new facility will more than double the available greenhouse space for the production of native plants as well as provide a much needed home base for TNS operations in the West Texas region. This new facility is being developed in partnership with the Borderlands Research Institute at Sul Ross State University. Initial fund raising for the facility will be part of the Borderlands Research Institute Capital Campaign and the Centennial Capital Campaign for Sul Ross State University.

Cooperative funding provided by Shell Oil Company, Borderlands Research Institute for Natural Resources Management at Sul Ross State University, and donors to Texas Native Seeds.

Development and Increase of Little Barley for Use as a Native Winter Cover Crop

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

Little barley is an early successional, cool-season grass with excellent seed quality and ability to establish in disturbed areas on a wide variety of soils throughout the state. This species is being considered for use as a temporary cover crop along highways by the Texas Department of Transportation (TxDOT).

TxDOT is interested in this species because it may have utility as a native cover crop that does not attract wildlife or limit wildflower growth. Another positive is that, unlike cool-season grains currently used for temporary winter cover, little barley does not produce large amounts of biomass. This feature is beneficial since species that produce a lot of biomass can interfere with interseeding or necessitate mowing.

Four populations of little barley have been selected from an evaluation of 30 native populations based on origin, seed quality, and growth habit. Seed production plots of each selection have been grown for the last 3 winters.

In 2014, little barley in our plots failed to make seed because they were planted too late in the winter. In 2015, 50 plant increase plots were established in Kingsville, yielding 2 to 5 pounds of seed of each accession. In 2016, we used this seed to grow transplants and establish larger seed increase fields of up to 0.03 acres of each accession in Kingsville. Harvests have been made throughout spring 2016. The seed produced from these plots will be provided to a commercial seed grower for use to establish large-scale seed production by late 2016.

A seed release of little barley is being considered for use as a cool season cover crop on roadsides.

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

Commercial Seed Production of Native Seed Releases

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

Commercial production of native seed releases is vital in putting seed in the hands of private landowners and agencies engaged in native habitat restoration. The past year was extremely rainy, and while the moisture was great for seed production, it negatively affected the ability to harvest the seed in the production fields.

Even with the difficulties caused by flooded seed production fields, commercial seed companies were able to produce seed of 27 *South Texas Natives* (STN) and USDA Natural Resources Conservation Service E. "Kika" de la Garza Plant Materials Center seed releases in 2015, with a harvest of over 41,000 pounds. Sales of these native seeds dipped slightly compared

to 2014, but overall demand stayed strong and was well above projections for annual demand made when STN began.

Four plants (Goliad Germplasm orange zexmenia, Ramadero Germplasm spike lovegrass, Nueces Germplasm sand dropseed, and Duval Germplasm red lovegrass) were produced commercially for the first time in 2015. Several species that are currently being commercially produced have had additional production acres added, including Carrizo Germplasm little bluestem, Rio Grande Germplasm prairie acacia, and Hidalgo Germplasm four-flower trichloris.

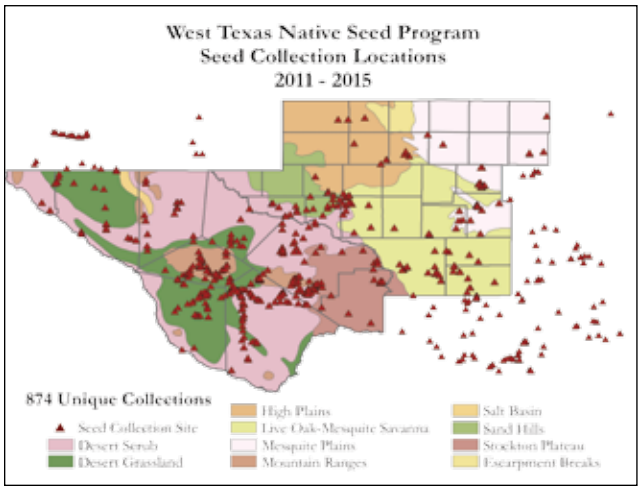
Significant inventories of most seed sources have been built by commercial seed companies, and supplies are now being provided year-round. Even so, for large projects exceeding several hundred acres, consumers are encouraged to give cooperating seed companies advanced notice so that specific requests and needs can be met.

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

Texas Native Seeds—West Texas Plant Material Collections

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

Extensive collaboration with private landowners and natural resource agencies granting access to their properties has led to nearly 900 new native seed collections across the 37-county West Texas program region of *Texas Native Seeds* (TNS). TNS West Texas staff has accessed over 65 properties and collected plant material for use in the development of native seed sources.



Seed collection locations for the *Texas Native Seeds* program in West Texas spanning 2011–2015.

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

The abundant precipitation across the state has set the stage for an unusually productive 2016–2017 seed collection season. Our seed collection efforts will lead to the eventual release and subsequent commercial availability of ecotypic native seed for use in restoration efforts across West Texas.

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

Restoration of Native Grasses and Pollinator Habitat on National Guard Properties

Forrest S. Smith, Aaron Gilfillan, Linda Brown, Keith A. Pawelek, and Anthony D. Falk

Native habitat restoration and provision of pollinator habitat is an important land management goal on Texas Army National Guard properties. To address needs associated with this goal, we are working to restore native grasslands and enhance pollinator habitats on 3 sites in Central Texas.

In August 2016, we implemented a 103-acre restoration project on a blackland prairie ecological site at Martindale Army Airfield near San Antonio. Following control of invasive plants and seedbed preparation, we will plant a diverse, locally adapted native seed mix with an emphasis on including pollinator plants. This project will facilitate the first large-scale evaluation of several planned seed releases of the *Texas Native Seeds* effort. Restoration of native grassland should help meet environmental goals, and alleviate bird strike concerns associated with past use of this area as farmland. Following restoration, we will evaluate invasive species control techniques, measure restoration outcomes, and assess seed source performance.

We will evaluate existing plant communities and site conditions in order to develop guidance for pollinator habitat restoration at Camp Bowie and an armory site in Fredericksburg. Subsequent management plans to be drafted will include seed mixture recommendations and management plans for pollinator habitat at each site. In addition to increasing the availability of pollinator habitat in Central Texas, we hope the results of these restoration efforts can provide much needed information to agencies and the public on the outcomes of native grassland and pollinator habitat restoration efforts in this region.

Cooperative funding provided by the Texas Military Department.

Seed Increase of Ecotypic Native Seed for Commercialization in South Texas

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

In 2015 and 2016, we implemented a new seed increase strategy aimed at incorporating commercial growers into seed production efforts before release of selections. Through these partnerships, we hope the primary result will be much larger supplies of breeder and foundation seed. A secondary result will be to educate seed companies and their growers about new releases without financial risk to the growers. Finally, these efforts should help us more accurately determine the adaptation of our releases to various production locations and scenarios.

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Seed increase field of Nueces Germplasm sand dropseed, which will provide seed for commercial production.

Under this new production system, commercial growers are allowing us to use their land and equipment to establish larger seed increase fields of species that are nearing release, and *South Texas Natives* (STN) pays production expenses based on seed produced.

In the last year, releases of sand dropseed, spike lovegrass, red lovegrass, and white tridens and future releases of yellow Indiangrass and big bluestem were grown. Successful seed increases of all were achieved, and the released species have subsequently been commercialized in less than a year after release.

We also maintain initial seed increase plots of all released species at the STN farm at the Tio and Janell Kleberg Wildlife Research Park, as well as at the USDA Natural Resources Conservation Service E. "Kika" de la Garza Plant Materials Center. Current seed production projects at these locations include white tridens, purple threeawn, little barley, slim tridens, and tropical neptunia. In total, we currently have about 29 acres in production for native seed increase. Our seed increase efforts have a direct benefit on the commercial availability of native plants for restoration projects on public and private lands in Texas.

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

New and ongoing plant material evaluations for West Texas continue at both the 25-acre Sierra la Rana Plant Evaluation and Research Facility located south of Alpine and the 5-acre Railway Ranch Plant Evaluation and Research Facility near Odessa. As of 2016, 24 plant species have been planted for evaluation of seed source development potential at both research sites.

Evaluations of cane and silver bluestem as well as whiplash pappusgrass have been completed followed by seed increase operations in spring 2016. Second year evaluations include advanced evaluation plantings of sideoats grama and initial evaluations of black grama, skeletonleaf goldeneye, American basketflower, and buffalograss. Five species are in the third year of initial evaluation, including blue grama, sand

dropseed, tobosa grass, slim/rough tridens, and Hall's panicum. Plant production data and seed germination test results are being used to select populations of these species for increase and commercialization of seed for use in West Texas.

First year evaluation plantings of Tahoka daisy and Gregg's mistflower were made at both evaluation locations in 2016. These forb species have significant potential as pollinator plants for West Texas. Plant material from our evaluations will become the first commercially available seed sources developed specifically for restoration and reclamation projects in West Texas.

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

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Goliad Germplasm orange zexmenia was successfully commercialized and offered for sale in 2016.

Development of Seed Supplies of Native Pollinator Plants for Texas

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

The decline of pollinators such as bees and butterflies is an important topic among ecologists and concerned citizens across the country. Pollination is critical to food production for humans, and is required for reproduction of many wild plant species. One factor suggested for pollinator declines is the loss of native plant communities and native flowering plants. Unfortunately, restoring many pollinator plant species is difficult because of the lack of affordable, large-scale commercial seed supplies.

In collaboration with the USDA Natural Resources Conservation Service E. "Kika" de la Garza Plant Materials Center, we are working to develop seed releases for commercial production of a number of flowering native plant species from Texas. Our current efforts center on 12 prolific pollinator plants, 5 of which are already in commercial production: Goliad Germplasm orange zexmenia, Balli Germplasm prostrate bundleflower, Venado Germplasm awnless bush-sunflower, Rio Grande Germplasm prairie acacia, and Zapata Germplasm Rio Grande clammyweed. We are working with commercial growers to establish additional acres of production for these selections and provide the necessary breeder seed to facilitate these plantings on a larger scale.

New seed increase plots of other pollinator plants were established in spring of 2016. These include 250 plants of tropical salvia, 100 plants of frostweed, 200 plants of skeleton leaf goldeneye, 200 plants of golden dalea, and 800 plants of zizotes milkweed.

Our efforts should lead to commercial availability of additional species for use in pollinator plantings throughout Texas. The plants also have considerable utility in wildlife habitat restoration plantings and efforts to diversify stands of non-native grasses.

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

Creating Nesting Habitat for the Colonial Breeding Reddish Egret

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

The reddish egret was nearly extirpated from much of its range in North America by the early 1900s because of the unregulated plume trade that occurred during that period. The population has never fully recovered. Currently, there are less than 5,000 breeding pairs worldwide. Nearly half of the United States' breeding population of reddish egrets occurs within the Laguna Madre of Texas.

Within the Laguna Madre, placement of dredge spoil from routine maintenance dredging of the Gulf Intercoastal Waterway is always a contentious issue. This is because negative ecological consequences can occur in areas where the spoil is deposited. Waterbirds breeding in the Laguna Madre have capitalized on some islands constructed with the dredge material. Consequently, devising a plan to strategically place dredge spoil within the Laguna Madre may balance the need for spoil placement sites and the need for creating additional waterbird nesting islands.

We are developing a model to identify areas within the Laguna Madre that will be ideal for island creation, based on several ecological requirements of the reddish egret. Coordination and cooperation among conservation agencies and the U.S. Army Corps of Engineers could potentially benefit the reddish egret and provide habitat for other nesting colonial waterbirds that are an important part of the dynamic Laguna Madre ecosystem.

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

Autumn Migration Ecology of Midcontinent Greater White-fronted Geese

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

The greater white-fronted goose is an Arctic-breeding species that makes a transcontinental migration during autumn to wintering grounds in the southern United States and Mexico. Although the breeding ecology of this species has been studied, there is little information regarding autumn migration ecology of greater white-fronted geese in North America.

The objectives of this study are to determine migration routes, migration chronology, stopover areas, duration of time spent at stopover areas, and the effects of environmental conditions on the movements of individually tracked white-fronted geese. Additionally, we plan to assess habitat use and habitat availability at migratory stopover areas and use this information to help explain variation in duration of stay at stopover areas.

Solar powered Global System for Mobile communications (GSM)-Global Positioning Systems (GPS) tracking devices will be attached to 60 adult greater white-fronted geese during the winter in Texas. We will distribute our capture efforts primarily along the Texas coast, but will also attempt to capture geese in the Rolling Plains and South Texas Brushlands of Texas. The tracking devices provide accurate locations at 15-minute intervals throughout the autumn migration period.

We will use several geospatial datasets to help inform us on specific habitat types greater white-fronted geese are occupying at their migratory stopover sites. This information will help us understand the movement ecology of greater white-fronted geese during autumn migration. Additionally, it will aid state and federal agencies in their efforts to more finely tune management in regards to exposure to harvest for different segments of the midcontinent greater white-fronted goose population.

Cooperative funding provided by the Texas Parks and Wildlife Department.

Investigating the Winter Season Ecology of Reddish Egrets

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

Much of the research examining waterbird ecology has focused on the breeding season and reproductive success. However, knowing the habitat requirements and conditions at wintering sites is critical in understanding the complete annual cycle and potential limiting factors. There is a paucity of information on the winter ecology of the reddish egret, which is listed as a threatened species in Texas.

To examine winter habitat use, we attached Global Positioning Systems (GPS) transmitters to 30 adult reddish egrets that were breeding in the Laguna Madre of Texas. The transmitters recorded 6 locations per

day—2 in the morning and 2 in the evening (foraging locations), and 2 during the night (roosting locations). By using the Geographic Information Systems (GIS) software platform to integrate egret locations with habitat datasets, we are able to examine habitat use of reddish egrets.

Eleven reddish egrets migrated out of Texas for the winter. Egrets selected sites for foraging and roosting with unconsolidated sediment substrates that were relatively far (about 1.2 miles) from the mainland. Reddish egrets also exhibited a high degree of fidelity to their winter sites, most returning to the exact site in subsequent winters.

Our research is the first comprehensive study on the winter ecology of the reddish egret. Information obtained can aid scientists involved with the Reddish Egret Conservation Action Plan in making decisions for improving habitat for the reddish egret.

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

Winter Habitat Selection by Gulf Coast Sandhill Cranes

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

The Texas coast has experienced landscape-scale changes over the last 20 years including urban expansion, development of large wind farms, and changes in agricultural practices (e.g., decline in rice agriculture). Such changes have likely influenced habitat use and distribution of sandhill cranes in the region.

Our goal is to estimate current habitat use and selection throughout winter at multiple spatial scales and forecast future sandhill crane distribution based on projected land-use changes. This information is needed to help guide land management decisions and increase our understanding of how current landscape changes may be impacting sandhill crane distribution and habitat availability.

We will attach Global Positioning Systems (GPS) satellite transmitters to 30 adult sandhill cranes captured throughout the Texas coast during winter. Each transmitter provides 4 GPS locations each day to include peak foraging times in the morning and afternoon, midday resting times, and nighttime roosting. The locations will be used in conjunction with digitized maps delineating habitat types and other important landscape variables, which will allow us to estimate habitat use and selection. We will also predict habitat availability into the future with a landscape pattern analysis based on the recent dynamics of landscape changes throughout the region. This information will be used to forecast future sandhill crane distributions based on predicted landscape features.

This research project will increase our understanding of how sandhill cranes select habitats within the landscape, and possibly enable us to predict future sandhill crane distribution given recent changes in land use within their Gulf Coast wintering range. Findings can be used for the development of proactive management strategies for sandhill cranes wintering along the Texas coast.

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

Breeding Season Ecology of the Reddish Egret

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

The reddish egret is the rarest heron in North America with the global population estimated to have up to 4,250 breeding pairs. The reddish egret is also the least studied heron in North America. There is much to be learned about habitat use during the breeding season. In our study, we are using Global Positioning Systems (GPS) satellite transmitters to track the movements of adult reddish egrets.

We attached GPS transmitters to 30 adult reddish egrets that were breeding in the Laguna Madre. The transmitters recorded 6 locations per day, every day.

An adult reddish egret (white morph) at nest with 2 nestlings. Young will remain in the nest 4 to 5 weeks.

Sex (M = male, F = female), migration status (year-round resident, short distance migrant [100–500 miles], long distance migrant [greater than 500 miles]), and average breeding season initiation date of adult reddish egrets nesting in the Laguna Madre, Texas.

Bird No.	Sex	Migration Status	Average Initiation Date	Years Breeding
1	M	Resident	29 March	4
2	M	Resident	20 April	3
3	F	Resident	29 March	5
4	F	Resident	15 April	1
5	M	Resident	27 March	1
6	F	Resident	18 April	2
7	F	Resident	3 April	2
8	M	Short-dist	21 March	4
9	M	Short-dist	9 April	2
10	M	Long-dist	8 May	3
11	M	Long-dist	10 April	3
12	M	Long-dist	14 April	1
13	M	Long-dist	28 April	2
14	F	Long-dist	27 April	1

Using these locations, we have identified 63 breeding attempts within 14 separate nesting colonies along the Texas coast. Fourteen of the reddish egrets provided information across multiple years and exhibited relatively high levels of breeding site fidelity. Two adults used the same colony each breeding season, and 12 adults nested in more than one colony across years, but used colonies in close proximity within the Laguna Madre. Preliminary analyses show that the average distance adult reddish egrets traveled from their nest site to foraging areas ranged from 1 to 14 miles and that the egrets tended to use the same foraging areas across years.

Future analyses are planned that will examine the microhabitat at foraging locations, assess colony dynamics in relation to the amount of available foraging habitat, and quantify the timing of breeding and nest success as it relates to migratory status. The results of this study will contribute to our knowledge regarding the ecology of reddish egrets and aid in directing conservation strategies for this species breeding in Texas.

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

Migration Ecology of the Midcontinent Population of Sandhill Cranes

Emily D. Wells, Bart M. Ballard, Shaun L. Oldenburger, and Daniel P. Collins

The midcontinent population of sandhill cranes is the largest population and incurs the heaviest harvest pressure of any population of sandhill cranes in North America. The Gulf Coast subpopulation is 1 of 2 subpopulations comprising the midcontinent population and has been studied to a much lesser extent than the larger western subpopulation. Our goal is to increase our understanding of autumn migration chronology, use of staging areas, and exposure to harvest by the Gulf Coast subpopulation of sandhill cranes.

We plan to attach 30 Global Positioning Systems (GPS) satellite transmitters to adult sandhill cranes during winter along the Texas coast. The transmitters will monitor individuals as they migrate from breeding locations in Manitoba, Saskatchewan, and the Northwest Territories to wintering areas in Texas. We will investigate the timing and duration of stay at stopover sites and migration chronology in relation to the sandhill crane hunting season.

Our study will provide insight about migration chronology of the Gulf Coast subpopulation. This information can be used by state and federal agencies

Migratory routes (yellow lines) and breeding ground affiliation (yellow circles with black dots) of adult sandhill cranes captured along the Texas coast (dark dots) during November 2015 to January 2016.

© Bart Ballard

We are studying migration patterns of sandhill cranes to better manage this important gamebird.

in developing harvest regulations to balance hunting opportunities and crop depredation by cranes.

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

Genetic Basis for Plumage Color Variation in Reddish Egrets

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

The reddish egret has dark and white color morphs. The melanocortin-1 receptor (MC1R) gene is a gene that influences plumage coloration. Activation of this gene leads to an increase in the synthesis of the pigment eumelanin and darker plumage, but certain mutations in MC1R can reduce the synthesis of melanins, resulting in white plumage. To investigate the relationship between MC1R genetic variation and plumage dimorphism in the reddish egret, we sequenced 852 base pairs of MC1R from 3 white and 6 dark morphs and compared these to an MC1R sequence from the European little egret.

Only 1 mutation that changed the amino acid composition of the protein product occurred among reddish egrets, but it was not associated with plumage coloration. Six additional mutations separated the little egret from the reddish egret, but these sites were not variable in reddish egrets. Tests for selection that included little egrets and reddish egrets were statistically significant, whereas tests for selection among reddish egrets were not statistically significant.

Our results indicate that the MC1R gene is not the genetic basis for the dark and white color morphs in reddish egrets. The nonsynonymous mutations separating reddish and little egrets suggest that selection on MC1R might have played a role in speciation of egrets. We are obtaining samples of other species of egrets to explore how variation of MC1R relates to interspecific plumage variation.

Implications of Spring Migration Decisions by Greater White-fronted Geese

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

Spring migration of greater white-fronted geese has changed in terms of timing and the stopover areas used in recent years, but the cause and implications of these shifts are yet to be determined. An understanding of spring migration ecology is important because many Arctic-nesting species use nutrients and energy acquired from spring staging areas for breeding activities. Thus, activities of birds and the conditions of habitats used during spring may influence reproductive success to some degree in these species.

Our objectives are to determine the chronology and duration of spring migration, identify important stopover areas, and link decisions made during migration to individual migration strategies and subsequent reproductive success. We plan to capture 60 adult greater white-fronted geese during winter from the Texas coast, Rolling Plains, and South Texas Brushland regions of Texas.

Martyne Reesman, Oregon Department of Fish and Wildlife; https://commons.wikimedia.org

The white-fronted goose nests in the Arctic tundra and winters in Texas.

Adults will be marked with Global System for Mobile communications (GSM)-Global Positioning Systems (GPS) transmitters that provide location and behavioral information (resting, feeding, flying) via on-board accelerometers. The accelerometers should allow us to estimate behaviors and energy expenditures during migration, thereby enabling us to relate decisions geese make during migration with reproductive success on the breeding grounds.

Our study will be one of the first to link decisions made by greater white-fronted geese during spring migration to their reproductive success. Results will allow a better understanding of where, when, and how to deliver management actions to facilitate an efficient migratory journey for this goose population.

Cooperative funding provided by the Texas Parks and Wildlife Department.

Migratory Behavior of Adult Reddish Egrets

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

The reddish egret is thought to be a year-round resident throughout much of its range, and is described as only a 'weakly migratory' species. Several adult reddish egrets banded in Texas have been resighted in Mexico, Guatemala, and El Salvador. However, the extent of migratory behavior and the overwintering areas of reddish egrets that breed in Texas are largely unknown. To learn more about migration strategies in reddish egrets, we attached Global Positioning Systems (GPS) satellite transmitters to 30 adults that were breeding in the Laguna Madre of Texas and monitored their movements.

Migration routes and wintering areas of monitored reddish egrets that nested in the Laguna Madre, Texas. About 40% of our monitored birds migrated to areas south of Texas.

Sixteen of the reddish egrets were year-round residents in the Laguna Madre and did not migrate, 10 wintered in Mexico, and 1 in El Salvador. This suggested that the species exhibits a partial migration strategy. We found that available foraging habitat in the Laguna Madre decreases during winter months. Preliminary results have also shown that reddish egrets exhibit strong fidelity to stopover and wintering sites, and that migratory routes are very similar during spring and autumn migrations.

Future analyses will include examining various aspects that influence the timing of migration and its potential influence on breeding success. Understanding the migratory strategies of reddish egrets and habitat use during migration will aid in implementing range-wide conservation efforts for the species.

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

Habitat Use and Movements by Greater White-fronted Geese during Winter

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

The midcontinent population of greater white-fronted geese has been relatively stable in recent years, which is currently estimated at over one million individuals. It is well established that Texas is ecologically important to wintering white-fronted geese as a large portion of the midcontinent population winters there.

Recent winter survey information has shown large changes in the winter distribution of white-fronted geese in Texas, but there is little indication as to their movement patterns. Several significant land-use changes (e.g., reduction in rice production along the coast) are likely the stimuli for much of this redistribution. However, the implications of this change in distribution to the winter ecology of greater white-fronted geese in Texas are unknown.

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Ph.D. student Jay VonBank with a white-fronted goose that was collared with a GSM-GPS unit and released.

Our research aims to further understand several aspects of white-fronted goose winter ecology. We will capture 60 adult white-fronted geese during fall and winter 2015 through 2017 and attach Global System for Mobile communications (GSM)-Global Positioning Systems (GPS) tracking devices. Locations are recorded by these devices every 15 minutes and will be used to identify habitats used and movements made throughout the winter period. With the aid of geospatial datasets, we will also be able to quantify landscape changes that may be driving changes in goose distribution. We also will investigate any relationships between wintering region and breeding population affiliation.

An understanding of factors that elicit changes in the distribution of white-fronted geese will aid resource managers in predicting distribution shifts in abundance. Evidence of segregation during winter by white-fronted geese coming from distinct breeding populations exhibiting different population trajectories may warrant consideration of separate harvest management strategies.

Cooperative funding provided by the Texas Parks and Wildlife Department.

A Harvest Model for American Alligators in Texas

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

The American alligator is a wildlife species in Texas that is harvested for both recreational and commercial purposes. Although this species is intensely managed, many of the harvest and population management strategies are based on assumptions instead of scientific evidence. The current policy of Texas Parks and Wildlife Department is to allow 100% of the eggs to be collected from 50% of the alligator nests that are located. However, such a management strategy may reduce the gene pool (negatively impacting the viability of alligator populations) when egg harvesting is concentrated only on nests located in areas easily accessible by egg collectors.

The objectives of this study are to (1) determine the effect of current harvest levels on alligator population dynamics and density; (2) develop a theoretical and conceptual model to outline, explain, and predict these effects; and (3) use this information to guide management strategies to promote sustainable alligator populations throughout Texas and the southeastern United States. Our hypothesis is that current harvest levels are not sustainable and that egg harvest has the greatest effect on the overall population.

We will use the dynamic systems software Vensim to simulate current and potential harvest levels in a theoretical alligator population. The proper harvest of wildlife species is critical in the implementation of management strategies. Findings from our study can be used by agency biologists in implementing harvest management strategies.

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

Winter Ecology of American Kestrels in South Texas

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

The American kestrel is the most common species of falcon in North America. However, like many grassland birds, this species is declining in various parts of its geographic range.

Little is known about wintering kestrels in South Texas. To learn more, we initiated this study to estimate wintering territory size, survival, and site fidelity. In addition, we have come across some unexpected information that has not been previously reported.

Over the past 2 years, we have trapped 65 kestrels along county roads in agricultural areas. Kestrels were trapped using a bal chatri trap baited with a captured wild rodent. We marked kestrels using color bands and non-toxic fabric dye on their breast feathers. These unique markings allowed us to resight kestrels throughout the winter.

In the first year, for kestrels that we sighted at least 10 times, average maximum distance between detections of a bird was 2,425 feet. This is a surprisingly small territory size for a bird of prey. In the second year, 62% of the kestrels that had a territory the previous year returned to the same area. In addition, we have discovered a number of kestrel roost sites. In October 2016, we caught a kestrel that was previously banded near Moose Jaw, Saskatchewan as a chick. This is a distance of 1,586 miles from where we caught her on her winter territory.

To our knowledge, this is the first study to estimate wintering survival and territory size of American kestrels in South Texas. Understanding their wintering ecology will allow researchers to have a better insight as to where and why American kestrels are declining in many parts of their range.

Cooperative funding provided by San Christoval Ranch and the Richard M. Kleberg, Jr. Center for Quail Research.

Home Range Size of Pronghorns in the Trans-Pecos and Panhandle of Texas

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

Pronghorn antelope are grassland specialists that were once widespread throughout the prairies of central and western North America. Pronghorns have experienced a decline in geographic range and total numbers during the past century because changes in land-use practices have affected their habitat and influenced their movement patterns.

In Texas, pronghorn populations remain on rangelands in the Trans-Pecos and Panhandle regions. Pronghorns are capable of daily and seasonal

long-distance movements, and their populations are managed on a large-scale, herd-unit basis. Man-made features, such as fencing and highways, may restrict movements of pronghorns.

We captured and fitted pronghorns with Global Positioning Systems (GPS) collars at 2 sites in the Texas Panhandle and 2 sites in the Trans-Pecos during 2014 and 2015, respectively. We deployed 25 collars at each site during the spring, and the collars recorded location data every 2 hours until September, when the collars were retrieved.

Our analyses show that home range sizes of pronghorns did not differ between males and females, but home ranges differed between regions. The average home range size of pronghorns in the Panhandle was 3,098 acres, about 2.3 times larger than in the Trans-Pecos (1,306 acres).

Preliminary results suggest that net-wire fencing and brush encroachment may limit home range size of pronghorns in the Trans-Pecos, while availability of agriculture may increase home range size in the Panhandle. Additional analyses will provide more definitive and fine-scale information on resource selection to explain the differences between the 2 Texas pronghorn populations, which can aid in the management of 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).

Evaluation of Welder Wildlife Foundation's Rangeland Curriculum

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

Current students are thought to be less in touch with the outdoors, and it may be because they spend more time with the many technologies of today. Whatever the technology, children are spending less time with nature and more time inside. Thus, there is a need to provide educational and outdoor experiences to mend this separation from the outdoors.

The Rangeland Curriculum, designed for kindergarten through 5th grade students, was created by the Rob and Bessie Welder Wildlife Foundation to teach the basics of natural resources and ecosystems of Texas rangelands. Teacher workshops have been held at Texas Education Service centers, which resulted in lessons being used in schools throughout all 20 Texas Education Service Center regions. The creators of the curriculum would like to see how the curriculum is performing. There is an interest in promoting the curriculum beyond the regional level.

To evaluate the curriculum, we propose giving a survey to participating teachers and pre- and post-tests to their students. The surveys and pre- and post-tests will provide information on knowledge gained by the students while using the lessons and gage their attitudes and opinions about the curriculum.

By examining the data, we can determine the impact of the curriculum on academic achievement, along with the curriculum's effect on the behaviors, attitudes, and goals of both students and teachers. With these lessons, we hope to create a new appreciation of our rangelands for generations to come.

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

Landscape Characteristics for Wild Turkey Habitat

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

The Edwards Plateau of Texas consists of ecological sites historically considered excellent Rio Grande wild turkey habitat. However, long-term data from the Texas Parks and Wildlife Department show a steady decline of turkeys in portions of Bandera, Kerr, and Real counties when compared to the remainder of the Edwards Plateau.

The Rio Grande wild turkey is an important gamebird in the more arid regions of Texas.

Potential negative factors affecting Rio Grande wild turkey populations in the Edwards Plateau include unsuitable woody areas and disturbance, which could lead to decreased availability of foraging resources and/or increased predators and risk of diseases. Open areas, interspersed with woody cover and roosting sites, are important habitat.

The objective of our study is to quantify and compare landscape characteristics that occurred in 1995 to those that occurred in 2014 using sites with both stable and declining populations of Rio Grande wild turkeys in the Edwards Plateau. We will use landscape features, which delineate vegetation spatial structure, to evaluate the changes between sites and across time. This analysis may provide a better understanding as to why their numbers have decreased in the southern portion of this region.

We have analyzed aerial photographs from 1995 and are currently analyzing spatial data from 2014. Initial results indicate that woody cover and habitat disturbance are likely factors affecting Rio Grande wild turkey populations in the Edwards Plateau. The findings from our study will be useful to wildlife managers who are interested in increasing usable space instead of improving areas currently occupied by Rio Grande wild turkeys.

Cooperative funding provided by the TAMUK Council for Undergraduate Research.

The Effects of Agriculture on Mule Deer in the Texas Panhandle

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

Row-crop agriculture is a prevalent and essential industry, but farming can fragment wildlife habitat and change animal behavior and ecology. Wildlife may feed on crops, especially when natural forage is scarce or nutritional quality is low. Mule deer forage on crops in the Texas Panhandle. However, little is known about the effects of crop use on mule deer movements and survival in this region.

In October 2015, we fitted 43 adult mule deer with Global Positioning Systems (GPS) collars and 30 fawns with standard radio collars near Turkey, Texas. Presently, these deer are being tracked using radio telemetry methods. In addition, agricultural crop growth stages at the study site are being assessed monthly. Monitoring will continue at this site for another year. An additional study site near the Canadian River Breaks will be added. Correlating deer location data from collars with timing of crop growth stages will reveal the growth stage deer prefer. By comparing mule deer that use crops to those that do not, we can identify differences in movements and survival between the 2 groups.

© Laura Warner

CKWRI researchers are studying how mule deer exploit agricultural crops in the Texas Panhandle.

Knowing how mule deer move in response to crop fields will help to correct survey data and provide appropriate harvest recommendations in areas where agriculture is prevalent. An increase in mule deer survival rates as a response to crop use may indicate a need to increase quality or quantity of natural forages. Obtaining survival rate information will allow us to better predict changes in mule deer populations as a result of changes in crops and timing of planting in the Texas Panhandle.

Cooperative funding provided by the Texas Parks and Wildlife Department and the Mule Deer Foundation.

Rancher Perspectives Concerning Predator Control to Offset Livestock Losses

Kyle Brewster, Scott E. Henke, John Tomecek, J. Alfonso Ortega-Santos, Stephanie Shwiff, and Ben Turner

Coyotes often are implicated in livestock depredations. Within a national 2010 report, Wildlife Services stated that 4 cattle per 10,000 head and 62 calves per 10,000 born were lost to predators, with coyotes accounting for nearly one-third of those losses.

Certain groups state that such coyote numbers are greatly exaggerated because some livestock may have died from illness or injury and then scavenged rather than killed, or animal signs (tracks and scats) found around the carcass may be misidentified as being from coyotes. Others will argue that the losses attributed to coyotes are underestimated. Therefore, our objectives are to (1) gauge livestock losses because of predators and (2) assess rancher perceptions of coyotes.

The Texas ranching community attending AgriLife Extension seminars and workshops will be asked to participate in a questionnaire concerning their attitudes and knowledge of predation on livestock. The survey will be used to determine if a person's age, size of livestock operation, ranch location, and longevity as a ranching family influence their perception. The results of our survey can aid in the development of educational pamphlets about predatory habits of coyotes that can help a rancher make informed decisions concerning animal husbandry practices.

Cooperative funding provided by the Texas AgriLife Extension Service.

Citizen Science in the Undergraduate Classroom

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

Citizen science is defined by the public's involvement in scientific research, usually participation by volunteers of all ages and all experience levels. Citizen science data can provide important information regarding the changes in wildlife distribution and patterns across the landscape.

© Zach Pearson

The great kiskadee is a South Texas resident that is easily seen by novice and experienced bird watchers alike.

The South Texas Wintering Birds (STWB) program is a project of the Caesar Kleberg Wildlife Research Institute working in collaboration with the Cornell Lab of Ornithology and the National Audubon Society. STWB is aimed specifically at documenting the presence of birds within the South Texas region while keeping sighting locations private. To gather more information about the birdlife surrounding us in the South Texas region, undergraduate students enrolled in the Wildlife Management Techniques course at Texas A&M University-Kingsville will develop a research question and obtain data to answer that question through their project in which they will contribute to STWB.

Undergraduate students will be tested on bird identification of 20 resident and seasonal bird species, asked to define citizen science, and report their attitudes and confidence towards scientific writing, use of STWB, data collection, and experimental design. They will be given a pre-survey prior to the start of the project and a post-survey after completion of their scientific report stating their findings.

We expect improvement in the students' identification and study design skills and changes in their perceptions of research components. We hope this in-the-classroom educational study engages undergraduates in citizen science, increases awareness of local birdlife, and prepares them with skills needed for future wildlife careers.

Cooperative funding provided by the Elizabeth Huth Coates Charitable Foundation of 1992.

Use of Ground Juniper in Wildlife and Livestock Feeds

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

Rising feed costs, often associated with drought, have necessitated the need for alternative feed resources. Past research has shown successful use of woody plant species, such as quaking aspen, as an alternative roughage ingredient in livestock feeds. Currently, several juniper species are invading rangelands within Texas and the western United States. Using juniper as a roughage ingredient could help reduce the cost of feed and prove useful in the restoration efforts of juniper-invaded rangelands.

Our objectives are to evaluate (1) growth performance of Spanish x Boar kid goat crosses fed feedlot diets containing ground juniper or mesquite as the roughage ingredient, (2) consumption of pelleted supplement with ground juniper as a roughage ingredient by free-ranging white-tailed deer, and (3) effectiveness of ground juniper in pelleted supplements to deter non-target animal consumption. Research conducted to date has demonstrated use of 4 juniper species as a roughage replacement for cottonseed hulls in Spanish x Boar kid goat cross feedlot diets.

We conducted a pen study evaluating consumption of juniper-based pellets by feral swine, a non-target species. We are currently assessing consumption of the same pelleted feed by free-ranging white-tailed deer and feral swine. Findings from the latter 2 studies will indicate if inclusion of juniper as the source of roughage in the feed formulation could potentially decrease economic losses associated with supplementing white-tailed deer.

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

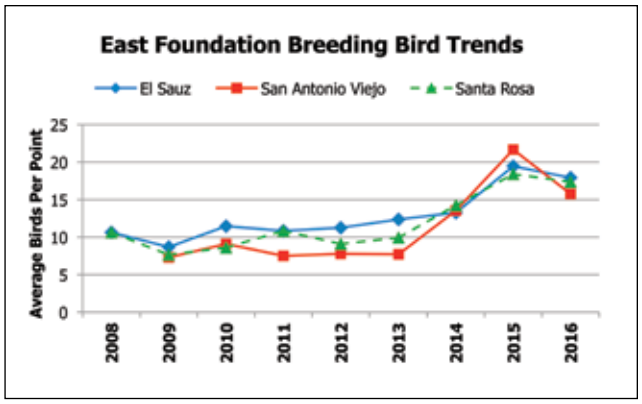
Breeding Bird Diversity and Abundance on the East Foundation Ranches

Janel L. Ortiz, April A. Torres Conkey, Leonard A. Brennan, Humberto L. Perotto-Baldivieso, and Tyler A. Campbell

Breeding bird surveys on the East Foundation ranches have been conducted since 2008 (Santa Rosa and El Sauz) and 2009 (San Antonio Viejo). These surveys occur during May and June and consist of point counts along roads in which individuals of all species are counted at each point by sight and sound for 3-minute periods.

© Angelica Arredondo

Ph.D. student Janel Ortiz is conducting surveys to learn more about the distribution and abundance of bird species.



Annual averages of individual birds detected per point during breeding bird surveys on 3 East Foundation ranches in South Texas.

To be successful, breeding birds must select sites that are most suitable in needed resources for themselves and their young. Considering the needs of reproductive birds, habitat and productivity can be considered important factors in the number of birds and species found in an area. Each bird species has specific requirements of their habitat. This feature allows each species to be successful in finding food and shelter, evading predators, and raising offspring.

One of the ways to quantify habitat is to assess productivity. We will use the Normalized Difference Vegetation Index to evaluate the landscape's "greenness," which serves as a measure of productivity. With our long-term and ongoing dataset, we hope to see how bird numbers and diversity change over time and space, as reflected by the productivity and habitat found on the East Foundation study sites.

For the 2016 breeding season, 4,090 individual birds representing 74 species were documented on our study sites. Using habitat characteristics and productivity measurements, we hope to see how these breeding birds rely on the landscape and are affected by environmental changes such as drought. In addition, bird surveys serve as a monitoring tool to track avian diversity and numbers on the East Foundation ranches during periods of migration, spring and summer residency, and breeding.

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

Ecology of the Texas Tortoise on Managed South Texas Rangelands

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

The Texas tortoise occurs in southern Texas and northern Mexico. Little is known about this species, and our knowledge about this species has come from only a handful of studies. Within thornscrub communities, Texas tortoises appear to occupy a variety of vegetation associations.

We are currently investigating Texas tortoise habitat use on a private hunting lease in Jim Hogg County. Tortoises will be tracked during their active season (April 15th through October 15th) to determine habitat use. This information will show how tortoises use areas manipulated through common habitat management practices such as prescribed burning, mechanical alteration, grazing, and herbicide application. In addition, thermal and microhabitat characteristics will be assessed when tortoises seek shelter from the heat of the day, which will inform us about this aspect of living in a high heat environment.

In the first year of the study, we found that home range size was highly variable between males and females; males tended to have larger home ranges. We have found the largest number of tortoises in areas where brush mottes are located close together.

Texas tortoises are listed as threatened by the Texas Parks and Wildlife Department, but large land holdings in South Texas provide needed habitat to maintain a relatively stable population. Our goal is to identify the landscape features important to Texas tortoises—information that can be used to ensure South Texas retains a healthy tortoise population. Additionally, this information may be used to mitigate the effects of habitat fragmentation in other areas of their range.

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

Full STEAM Ahead Educational Outreach Program

George Vargas, April A. Torres Conkey, and Mary E. Green

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

Art exhibit of Driscoll ISD 4th and 5th graders' artwork featuring snakes in South Texas.

Several activities for the students participating in the program were planned. Driscoll students took a field trip to TAMUK where they toured the John C. Perez Serpentarium and the plant garden at the A. E. Leonard Family Native Plant Garden located within the Tio and Janell Kleberg Wildlife Research Park. The students were tasked with painting a native South Texas snake and the artwork had to include a plant, a plant-eating animal, and a carnivore.

Dr. George Vargas, art professor at TAMUK, gave the students lessons for 4 weeks on how to use acrylic paints for their artwork. Upon completion of their paintings, students created a video describing their artwork. The video was linked to their artwork using the Aurasma app. The finished products were featured in an interactive exhibit at the Driscoll ISD library and at the Ben Bailey Art Gallery (on the TAMUK campus) where exhibit viewers could download the app, hold their smart-phone or tablet over the student's painting, and see the student's video play in augmented-reality fashion over the artwork.

The students' pre-activity drawing and final painting are being evaluated to measure the success of meeting the learning objectives of the program in addition to the results from a pre- and post-project

questionnaire. We expect that students who participated in the program will express a greater appreciation for both the arts and the natural environment upon program completion.

Cooperative funding provided by the Texas Women for the Arts.

Growth Dynamics of Hatchling Alligators in Captivity

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

American alligator growth rates vary by geographic region, alligator density, and habitat quality. These effects on growth rate are widely assumed. However, little research has been conducted to test and verify this assumption. Variation in growth rates and offspring sizes among different populations and among siblings of the same clutch has been documented in other crocodilian species.

It has been postulated by some scientists that the environment young crocodilians are exposed to early in life is just as important as genetic factors in terms of their growth rates and long-term fitness. However, this has not been tested for the American alligator. Therefore, the objectives of our study are to determine the influence of diet, stocking density, and clutch origin on the growth and survival of hatchlings.

Twenty hatchling alligators will be obtained from coastal areas in Texas and housed in 700-gallon capacity tanks. Morphological features of each alligator will be measured weekly. Information from this project will be an integral part of a larger computer simulation and mathematical modeling study of American alligator population dynamics.

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Ph.D. student Cord Eversole is studying the growth rates of hatchling alligators.

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

Habitat Associations of Birds during Migration

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

Many species of passerines migrate between their breeding grounds in the United States and Canada and their wintering grounds in Central and South America. These birds face environmental and physiological challenges along the way, and most rely on areas to stop, rest, and feed to acquire the energy needed to continue their journey. Thus, spatial distribution of these stopover habitats is important to the success of birds in reaching their breeding and wintering areas.

The lower Texas coast provides important stopover habitat for many trans-Gulf migrants. We are examining habitat characteristics that drive bird species richness and abundance in habitats used as migratory stopover locations along the lower Texas coast.

We have bird survey data from 2 previous studies and are planning to use this information to investigate the influence of fine-scale habitat characteristics on bird species richness and abundance. In addition, landscape level habitat characteristics, measured from geospatial datasets, will be used to analyze those characteristics that influence the occurrence and abundance of certain bird groups. Understanding characteristics of important stopover habitats for migratory birds will be useful in aiding future conservation efforts, which will help reduce the negative impacts on these habitats resulting from future human development.

Wild Bird Conservation Curriculum Program for Grades K-12

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

Natural history and wildlife are topics put aside by teachers in the classroom because of the lack of time, resources, and priority preparation for state testing.

Nor do many teachers have background knowledge in wildlife. This project aims to alleviate this issue and provide the community with wildlife education to enhance the knowledge of South Texas birdlife while reducing the disconnect with the outdoors.

The Wild Bird Conservation Curriculum Program began with educator training workshops that focused on 5 lesson plans: bird identification, mist-netting, citizen science, quail parasites, and habitat fragmentation. These free lesson plans, aligned with state standards, are providing local teachers with tools to include wildlife topics in the classroom and introduce students to a science, technology, engineering, and mathematics (STEM) career.

Three workshops have been held with 31 educators consisting of 3rd–12th grade teachers and environmental educators from the Coastal Bend region. Educator participation has allowed the curriculum to potentially reach over 5,000 students. Students from 6th grade classrooms at Riviera ISD and Kenedy County-Wide CSD schools have participated in the curriculum evaluation, reaching 31 students. We are planning to reach more students in the upcoming school year.

The program has been well received by students and their teachers and has triggered an increased awareness and interest in identifying birds. This heightened mindfulness of the surrounding environment is a goal of the curriculum, and it seems to be working.

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

The Human Dimensions of Conservation Photographers in Wildlife Management

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

Conservation photography has become an important tool that invokes awareness using photographs of wildlife (often threatened or endangered species) and/or critical habitat. These images allow the public to have access to wildlife and places that they would otherwise never be able to see or visit.

By using conservation photography, several organizations attempt to champion different environmental causes or, at best, educate the public about conservation issues. Organizations, such as *The Valley Land Fund*, *Images for Conservation Fund*, and *Wildlife in Focus* concentrate on regional locations and offer monetary prizes to draw attention to conservation issues. Landowners unite with photographers to capture images that reflect the beauty found in the natural world. Photographers' skills range from novice to professional while landowners may own small ranches/farms, large ranches, or conservation areas.

© William Colson

A winning photograph of a tortoise is featured in the *Wildlife in Focus* Book VIII.

By using an online survey, basic demographic information will be obtained from photographers and landowners who participate in *Wildlife in Focus* as well as other contests. Additionally, questions will be asked concerning their viewpoints on conservation including their participation, or lack thereof, in conservation outreach. Furthermore, this study will attempt to learn whether photographers and landowners participate in other conservation-related activities besides photography such as hunting, fishing, wildlife management and conservation, or habitat restoration.

Development of an Oral Toxicant for Feral Swine in the United States and Australia

Nathan P. Snow, Justin A. Foster, Michael J. Lavelle, John C. Kinsey, Linton D. Staples, Simon T. Humphries, David G. Hewitt, and Kurt C. VerCauteren

Invasive feral swine are causing extensive damage to agricultural and wildlife resources throughout the United States and Australia. Development of microencapsulated sodium nitrite as an orally delivered toxicant is underway to help curtail the damage and expansion of feral swine. We are conducting field and

pen experiments to test for lethality, humanness, secondary hazards, bait acceptance, and specific delivery devices as we work toward product registration.

Our initial findings indicate we are achieving high rates of lethality, intoxication from sodium nitrite does not elicit symptoms of severe or prolonged distress, and the average time-to-death is less than 3 hours. Tests of potential secondary hazards reveal that residual levels of sodium nitrite are low in most tissues that scavengers would consume. In a field test of 3 potential baits, one did perform well.

Preliminary testing with a prototype bait station indicates that most non-target species can be excluded. Our results provide promising evidence for the continued development of a safe and effective orally-administered toxicant for controlling feral swine.

Cooperative funding provided by the Association of Fish and Wildlife Agencies, Invasive Animals Cooperative Research Center, Texas Parks and Wildlife Department, USDA Animal and Plant Health Inspection Service Wildlife Services National Feral Swine Damage Management Program, and USDA Animal and Plant Health Inspection Service Wildlife Services National Wildlife Research Center.

Behavioral Ecology of Free-ranging Ethiopian Hedgehogs in Qatar

Mohammad A. Abu Baker, Nigel Reeve, Ivan Mohedano-Mendez, April A. Torres Conkey, David W. Macdonald, and Nobuyuki Yamaguchi

The State of Qatar, located in the Middle East, is one of the fastest growing and richest economies in the world. However, basic ecological information on many native species is lacking. To effectively manage and conserve species and natural resources, this gap in our knowledge must be addressed.

The Ethiopian hedgehog is a common and charismatic species that can serve as a good study subject to aid in understanding local ecosystems and raise public awareness about biodiversity and conservation. It occurs in desert habitat across North Africa and the Arabian Peninsula. This species is of interest because of adaptations and behavioral differences associated with its ability to survive in the desert climate.

Free-ranging Ethiopian hedgehogs were caught in January 2014 at an agricultural research station in northern Qatar. A temperature-sensing radio transmitter was attached on their back to study activity, habitat use, and behavior. The sensor measured air temperature immediately surrounding the hedgehog.

© Ivan Mohedano-Mendez

A partially hidden radio-marked hedgehog is exposing part of its body to the sun during winter daytime resting.

Preliminary data yielded hedgehog temperatures higher than ambient temperatures throughout the day during winter, and several hedgehogs were observed basking with their radio-tags exposed to direct sunlight. This is the first report of basking in the hedgehog family. We suggest that winter basking may be beneficial for hedgehogs in the desert where sunlight is plentiful and predators are few. Data collection and analysis on reproductive behaviors, home range sizes, and movement patterns are ongoing.

Cooperative funding provided by the Qatar Foundation.

Impacts of Eagle Ford Shale Exploration on Avian Nest Density

Kelsey R. Davis, William L. Lutz, Jr., Daisy J. Castillo, Eric D. Grahmann, Fidel Hernández, Timothy E. Fulbright, Chase Currie, David B. Wester, and Fred C. Bryant

Since 2008, exploration of the Eagle Ford Shale has expanded to nearly 30 counties in Texas. Disturbance from oil and gas exploration and development above this formation has the potential to negatively impact bird species. Our objective is to determine how localized oil and gas disturbance impacts nest density.

The study is being conducted on 2 ranches in Dimmit and Maverick counties. Our study sites consist of 2 areas along an oil and gas exploration corridor (disturbance area) and 2 areas along corridors where no exploration activities have occurred (no disturbance area).

In 2015, we counted bird nests on transects (16 in both the disturbance and nondisturbance areas). Ambient road sound levels were recorded using a sound level meter. We also measured traffic rates on both areas using single road tube accumulators.

We found mean nest densities were statistically similar between areas with and without oil and gas exploration disturbance (0.54 and 0.68 nests per acre, respectively). Mean maximum sound levels were similar in areas with and without oil and gas exploration disturbance (67 and 61 decibels, respectively). However, mean traffic rates were 957 passes per week along primary oil and gas exploration roads, compared to 31 passes per week along primary roads in areas without such energy-related traffic.

Aside from outright habitat loss, preliminary data suggest that noise and traffic from oil and gas exploration may not negatively impact avian reproductive effort in this region. Our study will conclude in 2017.

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

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

Huntable populations of pronghorns occur in the Panhandle and Trans-Pecos regions of Texas. The Texas Parks and Wildlife Department issues harvest permits directly to landowners based on annual aerial surveys of pronghorns. Aerial surveys are known to be inaccurate because the probability of sighting animals depends on animal behavior and habitat features. More accurate population estimates would allow managers to provide additional harvest opportunities and ensure the sustainability of pronghorns.

Survey accuracy is essential to estimate pronghorn populations, which provides better management.

We captured 50 adult pronghorns in the Panhandle and 44 in the Trans-Pecos during spring of 2014 and 2015, respectively. Pronghorns were fitted with Global Positioning Systems (GPS) collars, which take locations every 5 to 15 minutes. In June, aerial surveys were flown over herds that contained collared animals. Observers recorded the number, sex, group size, activity, habitat type, brush cover, terrain, and perpendicular distance from the survey line for all pronghorns encountered. Collared animals not observed were located after the survey to determine their location and group size. We retrieved collars after surveys were complete, and used the GPS data to quantify the probability of sighting a pronghorn.

Animal activity, brush cover, vegetation color (green versus brown), and distance from the survey line influenced detection of pronghorns. Population estimates adjusted for these factors were 33 to 38% higher than the uncorrected counts. Ongoing analyses will determine the optimum correction of survey data for pronghorns based on probability of sighting animals relative to habitat and distance from the observer. More accurate population estimates will allow greater flexibility in harvest and management decisions.

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).

Temporal Landscape Changes and Avian Community Dynamics

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

Over time, landscape structure and vegetation composition changes. Change may be from human activities or from environmental factors such as successional growth, invasive plants, and woody encroachment. Migratory bird species differ in their preference and use of habitat types during migration and, therefore, are affected by changes in habitat structure. Our goal is to assess changes in migratory bird communities

© Aaron Tjelmeland

The scissor-tailed flycatcher is a migrant that occurs in South Texas landscapes.

given recent changes in habitat types throughout South Texas.

We estimated densities of migratory bird species for 10 major terrestrial habitat types during 1991–1993 and again 15 years later during 2006–2008. Surveys took place during late September through October and mid-April through May to coincide with peak migration periods. Habitat type was characterized by the amount of woody canopy cover and dominant plant species. We visited the same transects during each survey period to document changes in species composition and density. We will use satellite imagery to identify availability of habitat types during both survey periods throughout Kleberg and Kenedy counties and to investigate habitat changes that took place during the 15 years.

Our findings will provide insight into how bird communities are influenced by habitat changes and aid in our understanding of how changes to the landscape lead to changes in use by migratory birds. Further, information gained will aid conservation efforts in identifying important bird habitats in South Texas.

Cost-to-Benefit Analysis of Coyote Removal in Cattle Ranching

Kyle Brewster, Scott E. Henke, John Tomecek, J. Alfonso Ortega-Santos, Stephanie Shwiff, and Ben Turner

Coyotes are reported as the top predator of cattle and calves in Texas. Thus, coyote control measures often are conducted in conjunction with cattle production, despite knowledge that coyotes play a keystone role in grassland ecosystems.

While cost-to-benefit analyses of coyote removal exist, our analysis will include the ecological benefits of coyotes. For example, continuous coyote removal allows the black-tailed jackrabbit population to increase, which can negatively impact forage for livestock production (30 jackrabbits consume and destroy as much forage as 1 Animal Unit). Thus, reduced cattle stocking rates above and beyond the culling estimate because of drought are required to account for the additional Animal Units and prevent overgrazing. Also, estimates of killed versus scavenged cattle and calves will be included in the analysis because of the frequency of misdiagnoses between killed animals and scavenged carcasses.

We will develop a cost-to-benefit analysis to include the previously mentioned components as well as the cost of coyote removal efforts, coyote density, livestock market values, seasonal coyote food habits, and coyote predation rates on cattle. Our results will benefit the cattle ranching community in Texas by identifying the most economical methods, season, and timing to reduce cattle losses from coyotes.

Cooperative funding provided by the Texas AgriLife Extension Service and USDA Animal and Plant Health Inspection Service Wildlife Services.

Depredation of Wild Turkey Nests by Feral Swine

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

Feral swine are continuing to expand their geographic range throughout North America, which has severe economic and ecological consequences. Feral swine have been observed depredating the nests of various ground nesting birds, including the wild turkey. However, little is known about whether feral swine have specific foraging strategies that they employ during the nesting season, which increases their chances of finding a nest or what the effects of feral swine depredation have on overall nest success.

Our study examines the negative effects of feral swine on wild turkey nests. The objectives are to (1) quantify changes in feral swine habitat selection in response to seasonal availability of wild turkey nests and (2) quantify the impact of feral swine depredation on wild turkey nests relative to other nest predators.

Thirty-five feral swine were equipped with Global Positioning Systems (GPS) collars in the Edwards Plateau region of Texas and monitored at 15-minute intervals from March–July 2015. Artificial turkey nests were deployed in nesting areas within collared feral swine home ranges using 3 treatment densities: control (no nests), low nest density (64.7 nests per mi^2 of ideal nesting habitat), and high nest density (129.5 nests per mi^2 of ideal nesting habitat). Nests were placed during early, peak, and late nesting blocks to replicate natural nesting chronology of the wild turkey in the region. Nests were monitored using remote cameras and manually checked for depredation every 7 days.

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

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

Impacts of CWD on Deer Populations in South Texas: A Population Model

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

The recent discovery of chronic wasting disease (CWD) in captive deer within Texas has generated concern about potential impacts on free-ranging white-tailed deer. South Texas is semiarid with marginally productive rangelands. Deer productivity is not high and consistent; therefore, deer populations may decline after the introduction of a fatal disease. Because of the impracticality of conducting field experiments, we used a modeling approach to assess the impact of CWD on deer populations in South Texas.

We built a population model to predict deer population sizes on 135,000 acres of South Texas rangeland under 4 scenarios: (1) no CWD, (2) CWD with no deer harvest, (3) CWD with male harvest only, and (4) CWD with harvest of both males and females. Empirical data on age- and sex-specific survival rates and fawn recruitment rates were obtained from research conducted in South Texas. We then incorporated age- and sex-specific prevalence rates, empirically derived increases in prevalence rate, and survival rates of infected deer using data from Wisconsin and Wyoming where CWD is present.

Preliminary results indicated CWD had a negative effect on deer population size, even when hunting was absent. Further, our models predicted a decline in the number of mature (greater than 5.5 years old) males, a class of deer especially susceptible to CWD. Our models suggest that preventative measures should be taken to keep CWD from being introduced into free-ranging populations.

Disease Surveillance of Relocated Turkeys in Southern Texas

Clayton D. Hilton and William P. Kuvlesky, Jr.

The Rio Grande wild turkey is a native gamebird that plays an important role in the ecosystem by consuming native vegetation and invertebrates and by serving as prey for various predators. Unfortunately, turkey populations in Texas have declined over the past decade. To re-establish populations, turkeys are translocated across Texas. When turkeys are moved from one locale to another the potential exists to introduce diseases to a new area and/or to turkeys that might not have previously been exposed to specific diseases.

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

A significant outcome of the study includes a broad and comprehensive survey of disease agents of wild turkeys in South Texas. The information generated can be used by state and federal game and animal health agencies with respect to turkey translocation and wildlife management.

Cooperative funding provided by a TAMUK University Research Award.

Potential Transmission of the Raccoon Roundworm in Endangered Ocelots

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

Baylisascaris procyonis is a large nematode found in the small intestine of its definitive host, the raccoon. The adults are not particularly pathogenic to raccoons; however, larvae in intermediate hosts can cause blindness, paralysis, and death. Humans serve as dead-end hosts and pathological responses are similar as those found in other infected intermediate hosts. Infected raccoons expose intermediate hosts through their feces, which can contain millions of *B. procyonis* eggs.

Recently, a CKWRI study demonstrated a single *B. procyonis*-infected raccoon could contaminate 0.25 acres per year with *B. procyonis* eggs. Such a calculation is considered a conservative estimate because it assumes every square inch of ground would become contaminated, which is unlikely because raccoons do not defecate in an evenly distributed manner nor would they have to in order for potential intermediate hosts to come into contact with contaminated areas. It seems clear that *B. procyonis* represents a risk to potential hosts, especially threatened and endangered species, in areas where infected raccoons and intermediate hosts co-occur.

One such endangered species, the ocelot, co-occurs with raccoons within southern Texas. Ocelots could

acquire *B. procyonis* infection by coming into contact with raccoon feces, by ingesting infected prey such as rabbits or birds, and because cats frequently scratch the ground after urinating or defecating, by picking up *B. procyonis* eggs on their paws and then ingesting the eggs during self-grooming. Therefore, the potential exists for ocelot exposure to *B. procyonis*.

We propose to collect mammalian scat from locations where ocelots and raccoons are known to co-occur. Scats will be identified, location recorded and mapped, and analyzed for the presence of *B. procyonis* eggs. This study will determine if *B. procyonis* infection should be considered a potential and substantial morbidity or mortality factor of endangered ocelots.

Cooperative funding provided by the East Foundation.

Nilgai Movement Patterns—Implications for Cattle Fever Tick Management

Aaron M. Foley, John A. Goolsby, Alfonso Ortega-Sanchez, Jr., J. Alfonso Ortega-Santos, Adalberto Perez de Leon, David G. Hewitt, and Tyler A. Campbell

The cattle fever tick (CFT) is the vector for the disease agent that causes bovine babesiosis, which is lethal to cattle. Efforts to eradicate CFTs from the United States have been successful. However, a quarantine area remains between Texas and Mexico. The quarantine area is necessary because CFTs are still prevalent in Mexico, and wildlife and stray cattle that carry CFTs can freely cross the border.

There has been an increase in CFT infestations outside of the quarantine area. Nilgai that carry CFTs are of interest in terms of understanding how CFTs may be spread throughout the landscape by this host species.

Thirty nilgai were fitted with Global Positioning Systems (GPS) radio collars on the East Foundation's El Sauz Ranch near Port Mansfield, Texas in April 2015. We will calculate home ranges and monthly movement rates for each nilgai and identify potential influences of age and sex with respect to large distance movements. Also, because nilgai are reportedly sensitive to human disturbance and may relocate to new areas, we will assess how nilgai respond to helicopter activities including (1) cattle gatherings, (2) deer captures, (3) large mammal surveys, and (4) nilgai harvests. Lastly, we will assess potential barriers to nilgai movements. A crossing index will be created for fences paralleling paved highways, boundary property fences, and interior property fences.

The spatial ecology of nilgai is poorly understood. Documenting nilgai movement patterns and their response to human disturbances and barriers to movements will benefit stakeholders concerned about CFTs.

Cooperative funding provided by the USDA Animal and Plant Health Inspection Service, USDA Agricultural Research Service, Texas Animal Health Commission, and the East Foundation.

Potential Sarcoptic Mange Spillover in White-tailed Deer

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

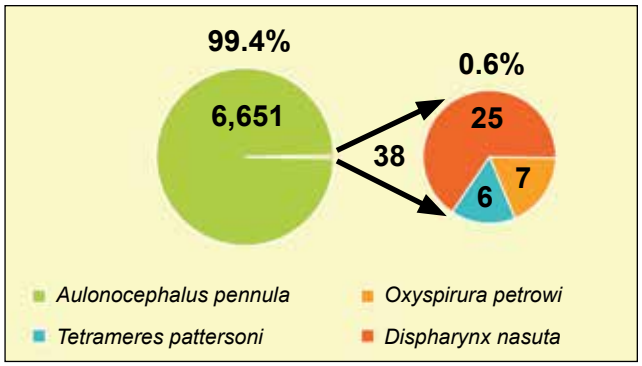
Sarcoptic mange is a common, highly contagious skin disease of mammals caused by the mite *Sarcoptes scabiei*. Sarcoptic mange has been reported from more than 100 species of mammals, including humans, but it is most notable in canid species. Although sarcoptic mange is known to occur in other species of deer, it has not been reported in white-tailed deer.

Recently, we demonstrated that sarcoptic mites were present on coyotes, feral hogs, and livestock in southern Texas. We hypothesize that sarcoptic mange in white-tailed deer may incidentally occur when wildlife densities and mange prevalence become regionally high. Cross transmission of sarcoptic mange between some hosts is possible. Therefore, we propose to determine the prevalence and severity of sarcoptic mites in selected wildlife species known to be mange reservoirs in southern Texas and compare those results to findings within white-tailed deer.

© David Hewitt

CKWRI researchers are determining whether the mange mite *Sarcoptes scabiei* occurs in deer within South Texas.

We believe that white-tailed deer will become a 'spillover' species for sarcoptic mange in areas where high densities of known mange reservoirs, high prevalences of mange, and high densities of white-tailed deer overlap. Further, we hypothesize that mange-infested white-tailed deer will appear asymptomatic and, therefore, go unnoticed by the typical deer hunter. If we are correct, information from this study can alert hunters to the potential presence of a zoonotic agent.



Nematode distribution in 124 bobwhites collected from South Texas during the 2014–2015 hunting season. The cecal worm (*A. pennula*) dominated numerically accounting for almost all parasite individuals, whereas the eyeworm (*O. petrowi*) and proventricular worms (*T. pattersoni* and *D. nasuta*) rarely occurred.

Helminth Parasites in Northern Bobwhites from a Legacy Landscape

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

Wildlife biologists and citizens share an interest in quail because of their ecological and recreational importance. Populations of northern bobwhites experience boom and bust cycles. However, little is known about the role parasitism and disease may play in bobwhite population dynamics. In addition, there are few studies on bobwhite parasites in South Texas—a region that was recently designated a Legacy Landscape of National Significance for Northern Bobwhite Conservation.

This long-term study was initiated to assess parasites infecting bobwhites in South Texas and to evaluate several potential factors contributing to avian-parasite dynamics. The objectives are to (1) survey helminth parasites infecting bobwhites in South Texas; (2) determine the prevalence, intensity, and abundance of parasites found; (3) analyze whether infections vary by host age, sex, their interaction, and/or body weight; and (4) determine the effect of bobwhite density and precipitation on parasite infections.

During the 2014–2015 hunting season, 124 bobwhites were collected and examined for helminth parasites. The cecal worm was the most prevalent (80% of birds infected) and dominated numerically (averaged 67 worms per infected bird and contributed 6,651 individual worms of 6,723 worms total). The remaining 7 species found were rare (less than 25% occurrence) and contributed few individuals (72 individual worms of 6,723 worms total).

The 2015–2016 sample consisted of 232 bobwhites, from which the parasites found are being identified and counted. We plan to use bobwhite density data collected by several ranches to analyze the potential effect of bobwhite density and precipitation on parasite infections. Ultimately, our study will help us understand the impact helminth parasites may have on bobwhites at the individual and population level.

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

Prevalence (% birds infected), mean intensity (average number in infected birds), and mean abundance (average number in host sample) of helminths from 124 bobwhites collected during the 2014–2015 hunting season in South Texas.

	Prevalence	Intensity of Infection		Abundance		
Helminth Species	*n* (%)	mean ± SE	Range	Mean ± SE	Total	% of Total
Aulonocephalus pennula	99 (80)	67.2 ± 11.5	1–635	53.6 ± 9.5	6,651	99
Oncicola canis	5 (4)	4.0 ± 2.3	1–13	0.2 ± 0.1	20	<1
Oxyspirura petrowi	5 (4)	1.4 ± 0.3	1–2	0.1 ± <0.1	7	<1
Rhabdometra odiosa	5 (4)	1.4 ± 0.2	1–3	0.1 ± <0.1	7	<1
Tetrameres pattersoni	4 (3)	1.5 ± 0.3	1–2	0.1 ± <0.1	6	<1
Raillietina sp.	4 (3)	1.0 ± 0.0	1	<0.1 ± <0.1	4	<1
Mediorhynchus papillosus	2 (2)	1.5 ± <0.1	1–2	<0.1 ± <0.1	3	<1
Dispharynx nasuta	1 (1)	25.0 ± N/A	25	0.2 ± 0.2	25	<1

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

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

Chronic wasting disease (CWD) is a transmissible spongiform encephalopathy that affects members of the deer family, including elk, mule deer, and white-tailed deer. It is not bacterial or viral, but instead caused by malformed proteins, called prions, which transform normal prions into the abnormal form.

After ingestion of the prions, there is a chain reaction that causes accumulation of the malformed proteins in the brain, ultimately causing death. The prions are resistant to breakdown by the body and may persist in the environment for decades. The disease is always fatal, but certain mutations in the prion protein gene affect the progression of the disease.

A mule deer with a prion protein allele that has the amino acid serine instead of phenylalanine at codon position 225 may take up to twice as long to show signs of the disease. Although the animal will live longer, this also means a longer time from obtaining the prion until the disease can be detected. The extended lifespan also means the animal has more time to spread the disease agent.

Texas Parks and Wildlife Department personnel have collected over 1,500 tissue samples from hunter-harvested mule deer since 2012. We are sequencing the prion protein gene to determine what allele forms are present in Texas mule deer.

Preliminary results suggest that the mutated allele is not common. The results of this study will have implications for management of CWD in populations of Texas mule deer.

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

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

Christine Hoskinson, Clayton D. Hilton, Andrew N. Tri, Michael E. Tewes, Jerry Belant, and Scott E. Henke

American black bears are the most widely distributed bear species in North America, yet their populations have been reduced, and their distribution has greatly declined and become sporadic in the southeastern United States. A small recolonizing population of black bears is making a comeback in Mississippi.

Graduate student Christine Hoskinson with sedated black bear from which samples were taken to assess health issues.

Although parasites and diseases are typically not reported as having a large effect on the regulation of bear populations, such morbidity and mortality factors can become regulatory when populations are under a threshold level. Therefore, we will trap black bears using culvert traps and modified Aldrich foot snares to obtain biological samples to determine the presence of antibodies to 4 pathogens: canine distemper virus, canine adenovirus, *Leptospira* spp. and *Toxoplasma gondii*. Although the extent of the presence of these pathogens in wild bears is not well studied, historical evidence has shown the species to be susceptible. Also, because of the omnivorous tendencies of bears, they could serve as indicators for the prevalence of infectious diseases of concern in other wildlife species they are exposed to while foraging.

As the Mississippi bear population continues to increase, it is likely that the incidence of human/bear and domestic animal/bear conflicts will increase. Knowledge of pathogen exposure in bear populations allows wildlife biologists to better monitor the health of the population and make well-informed management decisions when conflicts or questions arise.

The Comanche-Faith Deer Study Project

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

The Comanche-Faith Project derives its name from the 2 ranches in Dimmit County, on which the long-term South Texas research project is being conducted. The purpose of this research is to determine the best combination of deer density and supplemental feed while providing for the continued conservation of the natural habitat. Phase II of this study began in the spring of 2013, using the same 200-acre enclosures on each ranch that were used in Phase I (2004–2013), but employing a new experimental design. For Phase II, the new design includes a control enclosure (no deer), and 5 enclosures with varying densities of deer in conjunction with varying feeder densities as outlined in the table below. All deer in this new phase are provided with *ad libitum* supplemental feed. The 2 summaries that follow represent completed research from this project.

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

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

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

Drought and Spatial Variation Masks Effects of Deer on Plants

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

Traditional theory predicts that herbivores will forage on the most palatable and nutritious plants in the environment. Palatable plants are expected to decline in abundance with increasing deer density. As the palatable plants decline, plants that are less palatable to deer or grazing tolerant are expected to increase in abundance.

Our objective was to determine if the relationship between herbaceous plant canopy cover and density of a palatable forb with increasing white-tailed deer density followed predictions of traditional theory. We estimated percent canopy cover of forbs and subshrubs during June 2012–2014 using 60 8-inch x 20-inch sampling frames in each enclosure. We estimated orange zexmenia density in 20 10-foot x 100-foot transects in each enclosure. We constructed 15 grazing exclusion cages in each enclosure and sampled standing crop of palatable forbs and unpalatable forbs inside and outside each exclusion cage using 20-inch x 20-inch sampling frames. We harvested palatable and unpalatable forbs inside and outside the exclusion cages during 2014–2015.

- Percent canopy cover of forbs, subshrubs, and density of orange zexmenia was similar among the various deer densities.
- Drought during 2013 and 2014 reduced canopy cover and density of forbs and subshrubs in all treatments and was probably a major reason for the lack of differences in vegetation characteristics among deer densities.
- Differences in standing crop of palatable and unpalatable forbs depended on productivity of the patch

where sample plots occurred. Most forb patches supported less than 200 pounds per acre of forbs.
- Standing crop of palatable forbs in highly productive patches was lower outside grazing exclosures than inside in enclosures with deer compared to those with no deer.
- The variation in cover and standing crop of vegetation resulted from differences in productivity across the landscape.
- The annual variation in rainfall can complicate detecting the effects of deer on plant communities in South Texas.

Deer, Feed, and Weather Effects on Two Perennial Forbs

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

Weather is often accepted as the absolute driver of vegetation responses in semiarid environments, particularly for herbaceous plants. When forbs are available, they comprise a large proportion of white-tailed deer diets.

We examined the connections between deer densities, forb characteristics, and weather conditions at the individual plant scale by monitoring 2 palatable, perennial forb species. We made monthly observations from April 2014 through May 2015 of the characteristics of presence, senescence, and grazing of low menodora and blackfoot daisy (20 individuals of each species per enclosure).

- Both weather and deer density similarly influenced low menodora senescence and blackfoot daisy presence and senescence.
- Weather was the dominant factor influencing low menodora and blackfoot daisy characteristics, although blackfoot daisy presence in the 80 deer and 4 feeder treatment was less than 50% of that of the control enclosure, which did not contain deer.
- While being a major driver of herbaceous community dynamics, weather may not necessarily override the influence of deer densities on herbaceous vegetation, but rather obscure deer density and plant interactions.

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

Effects of the Thermal Environment on Growth and Health of Deer Fawns

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

The high summer temperatures in South Texas can negatively influence the growth of deer, but the magnitude of those effects is unknown. This study, conducted with captive deer at the Alkek Captive Ungulate Facility, helped determine the effect of high summer temperatures on growth and food consumption of white-tailed deer fawns.

During July–October 2015, we used 11 male and 6 female fawns to study the effects of temperature on feed consumption and growth of fawns. Treatment fawns had access to a cooled environment while control fawns were held in the ambient temperature. Food consumption, growth, and activity were measured.

- Fawns in the treatment group weighed 2.4 pounds more than the control fawns at weaning.
- Treatment fawns consumed more milk during the first 5 weeks after birth and ate 4.3 pounds per week more pelleted feed.
- No differences occurred in activity between fawns in a cool environment and those in a hot environment.
- During hot summers, even with access to nutritious food, fawns are likely to grow slower than during cool summers.
- Management actions that enable fawns to avoid excessive heat, such as providing brush for thermal cover and protecting riparian corridors that remain cooler than their surroundings, could help fawns alleviate problems with hot summers.

© David Hewitt

Fawns can be dramatically affected by the hot temperatures experienced in South Texas.

- Our results aid in understanding how environmental constraints influence the growth of white-tailed deer fawns in South Texas.

Cooperative funding provided by a TAMUK University Research Award.

Effects of Lactation on the Stable Isotope Ratios in Tissues of Deer Fawns

Kory R. Gann and David G. Hewitt

Stable isotopes are naturally-occurring, non-radioactive forms of an element. They can vary in abundance and behavior during physiological processes causing them to move through the environment in a predictable manner, which can be used to reconstruct diets. Previous research in reconstructing diets has focused on adults, but little is known about how lactation affects the stable isotope ratios in tissues of fawns.

Understanding the effects of lactation on the stable isotopes of carbon and nitrogen will help to determine if dietary reconstruction using stable isotopes is viable for free-ranging fawns. We fed pelleted diets with known stable isotope ratios to pregnant and lactating white-tailed deer at the Alkek Captive Ungulate Facility and measured stable isotope ratios in the blood and hair of the mothers and fawns.

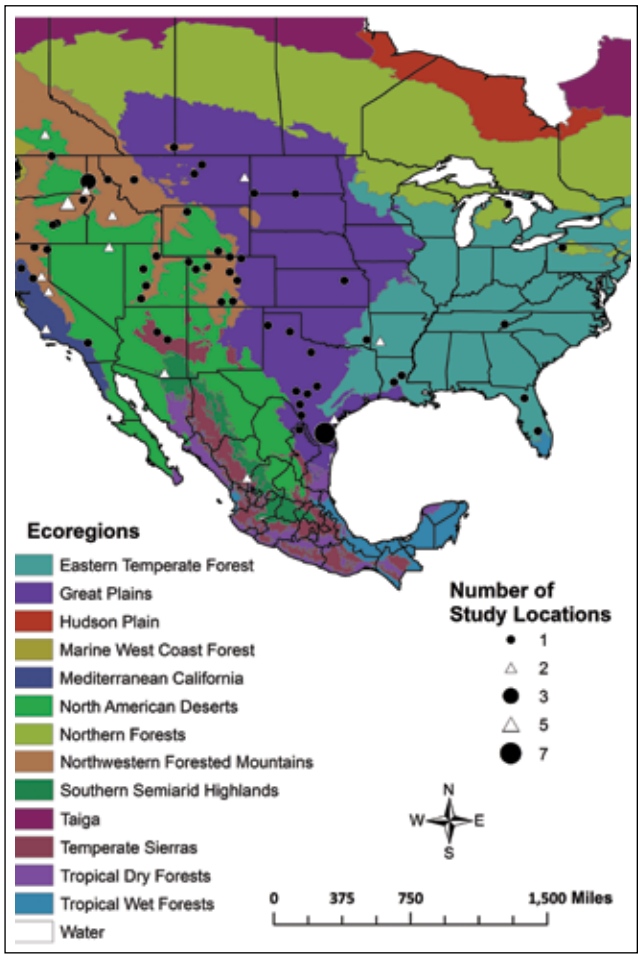
- At 8 weeks post birth, the carbon isotope ratio of fawn serum and red blood cells differed from lactating females by -0.56 and -0.54 stable isotope ratio units, respectively.
- At 8 weeks post birth, the nitrogen isotope ratio of fawn serum and red blood cells differed from lactating females by -1.25 and -0.34 stable isotope ratio units, respectively.
- Hair of weaned and unweaned fawns differed by 0.16 and 0.37 stable isotope units for carbon and nitrogen, respectively.
- The carbon stable isotope ratio found in fawn tissues may be useful in reconstructing fawn diets, but will reflect the mother's foraging (through milk passed to the fawn) and the fawn's foraging.
- Fawns cannot be detected at a different trophic level than lactating females, making it unlikely that the ratio of nitrogen stable isotopes in fawn tissues can be used to determine when fawns were weaned.

Cooperative funding provided by the East Foundation and ExxonMobil.

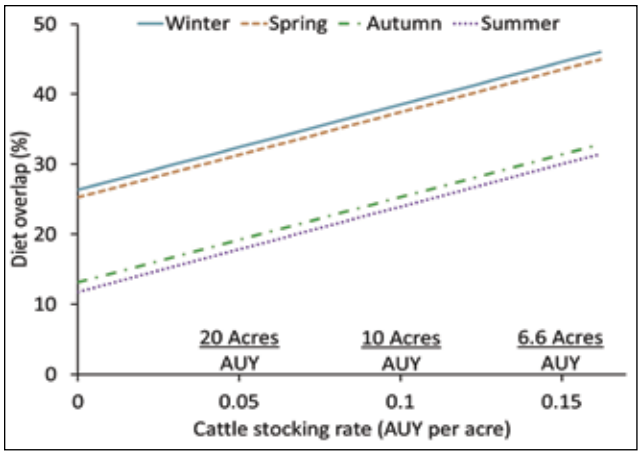
A Quantitative Review of Cattle-Deer Compatibility Across North America

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

Based on a comprehensive review, literature on cattle-deer interactions (2 of the most economically important species on North American rangelands) is nonexistent. We determined the effects of grazing by cattle on rangelands across North America on deer and their habitats by quantitatively evaluating publications that reported (1) influence of cattle grazing on forb availability because of the importance of forbs in deer diets, (2) woody plant responses to cattle grazing because deer use woody plants as food and cover, (3) cattle effects on deer space use, and (4) cattle-deer diet overlap because increasing space use (i.e., home range size) and increasing diet overlap may result from or indicate potential competition between the



Locations of 85 studies on interactions between cattle and deer, 1929–2014. Research spanned 85 years and may have been conducted at the same location for more than 1 publication or more than 1 location for a single publication.



Seasonal diet overlap (%) between cattle and deer as it relates to cattle stocking rate expressed as animal unit year (AUY) per acre reported in 26 publications 1947–2001. Cattle consume 5x more forage daily than deer consume; thus, at 20% diet overlap, consumption represented by 1 AUY (cow-calf pair) is the daily equivalent of forage of a single deer.

species. We extracted data from 85 papers on cattle-deer research conducted in North America, spanning the period 1929–2014.

- Forb response was not related to cattle stocking rate, but was related to geographic location. In the northern and eastern North American ecoregions (wetter ecoregions), forbs have a higher probability of responding to cattle grazing.
- Cattle in forested ecoregions, compared to grassland and desert ecoregions, have a higher probability of adversely affecting deer because grazing reduced potential woody cover and browse for deer. Trends indicated that increasing cattle stocking rate increased the probability of deer altering their space use.
- Cattle-deer diet overlap increased with increasing cattle stocking rate and was greater during seasons in which grasses were not in peak growth.
- Our results indicate that cattle and deer are compatible on North American lands with the implementation of conservative management practices.
- Adjusting cattle stocking rate to sustain vegetation important to both cattle and deer can be accomplished by balancing use with vegetation recovery.

Cooperative funding provided by the East Foundation.

Seedbank Dynamics on Stock-Piled Topsoils in the Western Rio Grande Plains

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

The topsoils of our rangelands in South Texas are critical components of habitat within the region, in part, because of the seedbanks they support. These seedbanks can be useful for restoration following energy extraction. We completed a 2-year study of seedbank dynamics of stock-piled soils at 2 study sites in the western Rio Grande Plains of Texas.

- Soil seedbanks differed between study sites (expected given differences in soils, past and present management, and surrounding vegetation). Soil seedbanks also differed across sampling times (also expected given phenological changes in surrounding vegetation and weather influences).
- Stockpile age did not affect seedbank characteristics; however, we documented differences between stock-piled soil and intact soil and among depths on stockpiles that varied between sites.
- Seedbank diversity was generally unaffected by sampling depth in the stockpile, and species richness and number of emerged seedlings decreased with increasing sampling depth at both study sites.
- Mean seedling densities varied between sites, ranging from 1 to 6 per 1.4 ft^2, which meets standards for restoration success (0.5 to 1 plant per ft^2).
- Because ranges in seedling establishment generally fall within recommended plant establishment guidelines, and it is reasonable that seed rain from adjacent vegetation will also contribute to colonization of the re-spread soil, there would be little reason to reseed these stockpiles.

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

Invasive Grass Distributions at Well Pad Sites in South Texas

Forrest Cobb, Forrest S. Smith, and Susan Stuver

The association of well pads with non-native grasses is of growing concern to South Texas landowners. In addition to the thousands of pad sites built prior to 2008, over 19,000 additional pad sites have been established in the Eagle Ford Shale region. Statewide, over 435,000 pad sites exist.

We measured canopy cover of non-native grasses at 5 distances along 3 transects radiating from 18 well pads averaging 34 years since construction and 18 control points unaffected by oil and gas exploration. Our data come from a single soil series at the Shape Ranch near Carrizo Springs.

- When data collected in our study were pooled across sampling distances, we found non-native grass canopy cover was significantly higher (33%) within 200 feet of well pads than within 200 feet of control survey points (26%).
- Canopy cover of Lehman lovegrass was similar at control and pad sites, whereas buffelgrass canopy cover was 13-fold higher within 200 feet of well pads (11%) than control sites (less than 1%) and 46-fold higher (37%) within 10 feet of pads than control sites.
- Kleberg bluestem did not occur at any control point, but was found within 100 feet of 3 of 18 well pads that we sampled.
- Our study indicates that well pads have significant and long-lasting effects on the distribution of non-native grasses in South Texas rangelands, and it shows well pads allow establishment of some non-native grasses in areas where they are otherwise scarce or nonexistent.
- Efforts to eliminate these unintended consequences of well pads would be important for conservation of native plant communities on South Texas rangelands affected by oil and gas exploration.

Cooperative funding provided by Texas General Land Office, Coastal Impacts Technology Program, and the Texas A&M Institute for Renewable Natural Resources.

The Value of Shrub Mottes for Wintering Birds during Grassland Restoration

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

Millions of acres of native grasslands in Texas have been imperiled by the spread of non-native grasses. Non-native grasses such as buffelgrass and Old World bluestems spread rapidly, out-compete

native vegetation, and threaten native wildlife. Prior research on the subject has demonstrated that non-native grasses negatively affect breeding bird populations and bird diversity. However, little is known regarding how wintering birds respond to or use non-native vegetation. Habitat restoration offers rangeland managers an opportunity to reverse the spread of non-native grasses and learn about managing wintering birds during the restoration process.

A large-scale (300 acre) native grassland restoration project was initiated in La Salle County, Texas to restore a buffelgrass-dominated grassland to native vegetation. The restoration process was comprised of a prescribed burn, brush removal, repeated disking, and spraying of herbicides. We left some brush mottes to serve as habitat refugia for wildlife during the restoration process. We surveyed wintering birds on the restoration area during December–January pre-restoration (2013) and during restoration (2014).

- Shrub cover on the restoration area decreased from 40% pre-restoration to 0.4% during restoration.
- Total bird species diversity decreased from 22 species during the pre-restoration period to 9 species during restoration.
- The greatest decrease was for wintering grassland birds, which decreased from an average of 6 birds per survey point pre-restoration to 1 bird per survey point during restoration.
- However, we found no significant change in shrubland birds between pre-restoration and during restoration (both averaged 1 bird per survey point).
- By maintaining brush mottes during restoration, we were able to preserve a wintering shrubland bird presence on our restoration area.

Cooperative funding provided by the Hixon Ranch, George C. "Tim" and Karen Hixon, Texas Parks and Wildlife Department, South Texas Chapter of Quail Coalition, and the Coastal Bend Audubon Society.

Use of Mulching Material in Pipeline Restoration Sites

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

Texas has over 430,000 miles of pipeline associated with energy production and transportation activities. Between 2012 and 2015, miles of pipelines increased 6% in the state. Restoration following pipeline construction can be challenging because of the mixing that occurs between topsoil and subsoil material. These "mixed soils" offer less-than-ideal conditions for seedling germination and establishment.

Understanding how to better improve soils that have been disturbed and the ability to enhance seedling survival is a prerequisite to restoring the habitat on disturbed areas. We completed a 2-year field study in the western Rio Grande Plains that examined biological, physical, and chemical amendments as a way to improve restoration success.

- Erosion control mats reduced soil surface temperature at mid-day on sunny days, but had no effect on soil surface temperature on overcast days and during morning and evening hours of sunny days.
- We documented from 3 to 10 more seedlings per ft^2 in plots covered with erosion control mats than in bare ground plots. Slender grama showed higher early emergence (44%) in early emergence seeding trials. Study plots were dominated by exotic grasses after 2 growing seasons, likely a result of the existing seed bank and seed rain influences.
- Native species with highest biomass included sideoats grama and slender grama. The annual cover crop included in the seeding mix reduced exotic species biomass, but did not negatively impact native species biomass.
- Physical amendment enhanced early seedling emergence, but it did not affect 2-year growing season plant biomass.
- The addition of humic substances did not affect early seedling emergence or plant biomass after 2 growing seasons.

Plots in the foreground show poor restoration from the lack of protective ground cover compared to background plots.

- Findings indicate 2-year plant community composition is affected both by seeded species and species that are seedbank residents.

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

Response of Small Mammals, Birds, and Butterflies to Grassland Restoration

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

Non-native grasses have spread throughout the United States, threatening native grasslands. Non-native grasses also decrease available habitat for native wildlife, leading to less diversity and lower abundance of small mammals, breeding birds, and pollinators. Native grassland restoration may help mitigate the negative effects of non-native grasses.

We initiated a large-scale (300 acre) native grassland restoration project in La Salle County, Texas in January 2014 to restore a buffelgrass-dominated non-native grassland to native grass. We burned dormant grass (January 2014), removed brush (February–March 2014), and conducted repeated disking and herbicide spraying events (starting in April 2014). We monitored small mammals, breeding birds, and butterflies during March–November 2014 and 2015 to determine the change over time on the restoration area, non-native grassland, and native brushland.

- Small mammal, bird, and butterfly populations in 2014 were 175% more abundant on average than those in 2015, most likely because of high rainfall in 2013.
- Diversity and abundance of breeding birds on the restoration area decreased from 19 species in 2014 to 7 species in 2015.
- Hispid cotton rats comprised 93% of small mammal captures on the non-native grassland during both years of the study.
- American snouts comprised more than 50% of butterfly observations on all 3 study areas in 2014, but declined noticeably to less than 40% of observations in 2015.
- Small mammal, bird, and butterfly communities on the native brushland were the most diverse and stable between years.
- Nongame communities are very dynamic over time during the restoration process. However, wildlife managers need not worry about these changing communities if some remnant habitat exists on the area being restored.

Butterflies benefit the native grassland community by serving as pollinators for flowering plants.

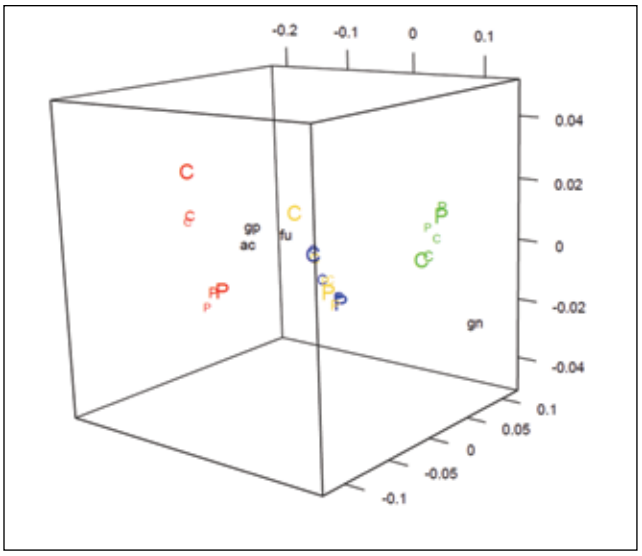
Cooperative funding provided by the Hixon Ranch, George C. "Tim" and Karen Hixon, Texas Parks and Wildlife Department, South Texas Chapter of Quail Coalition, and the Coastal Bend Audubon Society.

Soil Microbial Communities of Stock-Piled Topsoils in the Western Rio Grande Plains

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

The microbial communities in topsoils provide an essential link between living (biotic) and nonliving (abiotic) ecosystem components because of their essential role in nutrient and energy cycling. These microbial communities, however, are vulnerable to disturbance during energy extraction. We completed a 2-year study of soil microbial community dynamics of stock-piled soils at 2 study areas in the western Rio Grande Plains of Texas.

- Microbial community size (whether measured by microbial biomass carbon, microbial biomass nitrogen, or total fatty acids) decreased with increasing sample depth in the undisturbed intact soil, but did not change by depth in the stockpile.
- Furthermore, microbial community size was generally smaller at a 0–4 inch depth in stockpiles compared to intact soil.



A nonmetric multidimensional scaling ordination graph of soil microbial communities on stockpiled topsoils ("P") and adjacent non-disturbed soils ("C"). Soils sampled at deeper depths are represented by smaller letters. Color-coding corresponds to sampling date: red = August 2013; blue = February 2014, Green = July 2014, and gold = February 2015). Microbial communities are represented by Gram negative bacteria ("gn"), Gram positive bacteria ("gp"), actinomycetes ("ac"), and fungi ("fu"). In winter months, soil microbial communities were similar among years; in contrast, microbial communities in summer differed between years. Microbial community composition was dominated by Gram negative bacteria in July 2014.

- Soil microbial communities in winter months were often different from those in summer months.
- At both study sites, mean amount of Gram positive bacteria was highest in August 2013 while mean amount of Gram negative bacteria was lowest. Microbial communities were uniform among depths in stockpiles, but not intact soil.
- Stockpiling affected soil microbial communities. Protection of soil would increase the value of stock-piled soil for use in future restoration efforts.

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

Translocation of Maritime Pocket Gophers as a Management Option

Justin E. Plata, Tara Hansler, Scott E. Henke, Humberto L. Perotto-Baldivieso, Jon Baskin, and Clayton D. Hilton

The Maritime pocket gopher is a rodent that occurs in the upper South Texas coastal region of Nueces and Kleberg counties. Maritime pocket gophers were previously listed as a threatened species and as a species of concern. Maritime pocket gophers could be listed as a separate species because of their unique morphology and genetics.

Gophers can be a nuisance resulting from their ground digging habits in lawns and golf courses. If the legal status of the Maritime pocket gopher changes back to threatened, management options to remedy their damage would become limited. Relocation is a potential option; however, such a management strategy for Maritime pocket gophers is untested.

We trapped 14 Maritime pocket gophers in the Flour Bluff area of Corpus Christi, Texas, and implanted each with a transmitter. Ten gophers were relocated 3 miles from their capture site and 4 gophers were released at their capture site (served as controls). Gophers were tracked 3 times each week during a 6-month period.

- The gophers did not display homing behavior.
- Three, 3, and 4 Maritime pocket gophers exhibited highly directional, somewhat directional, and no directional behavior, respectively.
- Gophers in the control group did not deviate from random movements.
- Mean long distance movements made by gophers was approximately 0.1 mile from their release site.
- Relocated Maritime pocket gophers did not return to their capture site. Therefore, relocation of Maritime pocket gophers can be a viable management option for this potential nuisance species.

Nutrient Reserve Dynamics of Female Northern Pintails

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

The Texas coast is recognized historically as one of the most important wintering areas for waterfowl in North America. However, over the past few decades, urbanization, saltwater intrusion, and a significant decrease in rice acreage have resulted in the deterioration and reduction of important wetland habitats for waterfowl in this region.

The northern pintail winters in large concentrations along the Texas coast. However, its continental population has remained below management objectives since the 1970s and currently is 24% below the long-term average. Our objectives were to determine nutrient reserve and digestive tract dynamics of female northern pintails wintering along the Texas coast.

- Female northern pintails on the central coast of Texas used body protein and somatic fat for energy throughout winter, and by spring were 19% lighter than when they arrived.
- Comparatively, northern pintails wintering on the upper Texas coast maintained nutrient reserves throughout winter and departed in spring with similar reserves.
- We found no influence of molt intensity or number of molting feather tracts on nutrient reserves.
- Mass of the digestive tract declined by 18%, primarily because of gizzard atrophy.
- Analysis of blood metabolites suggested that one-third of the female northern pintails sampled from the central Texas coast were in a negative energy balance, compared to none in the upper Texas coast.
- Our analyses suggest that habitats in the central Texas coast may no longer support wintering waterfowl needs as they did historically.

Cooperative funding provided by the Texas Parks and Wildlife Department.

Translocation of Nuisance American Alligators

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

American alligators once were listed as an endangered species, but with federal protection, alligators have increased to the point of becoming a nuisance. On average, Texas Parks and Wildlife personnel receive about 500 nuisance alligator reports each year. Three options are available to deal with nuisance alligators: (1) kill the offending alligator, (2) translocate it to a different area, or (3) do nothing and see whether the problem was an isolated incident.

For translocation of a nuisance alligator to be successful, the alligator must not cause harm in its new location or return to its site of origin. However, the effectiveness of translocating alligators is untested. Therefore, our objectives were to determine site fidelity, movement patterns, and homing ability of translocated alligators.

Five nuisance alligators were captured and fitted with Global Positioning Systems (GPS) transmitters. The alligators were relocated about 100 miles either north or south of their original capture site and monitored daily to determine their location.

- Alligators did not exhibit site fidelity to their relocation areas.
- Alligators did not return to their capture site.
- Alligators appeared to wander for several months until they established a new area where they became more sedentary in their behavior.
- On average, the newly established home range of translocated alligators was approximately 20 miles from the translocated release site.
- Translocation is a viable management strategy for nuisance alligators. However, a 20-mile radius surrounding the proposed release site must be evaluated to determine if the site is appropriate and safe to release a nuisance alligator.

Cooperative funding provided by the Rob and Bessie Welder Wildlife Foundation, Harry L. Willet Foundation, and the TAMUK Research Award Program.

Bobcat Density and Factors Affecting Their Abundance on East Foundation Ranches

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

Bobcats are generalists that use a variety of habitat types and food items within different ecosystems. These characteristics make bobcats good indicators of lower trophic level community health. We examined bobcat populations using remote cameras and capture-recapture methods at 3 East ranches: Buena Vista Ranch, San Antonio Viejo Ranch, and Santa Rosa Ranch. Our objective was to determine the influence of climate, habitat, and presence of coyotes on bobcat population density.

- We surveyed over 70,000 camera-nights and documented an 8:1 ratio of coyote to bobcat photo events.
- Coyotes were the most abundant carnivore on all 3 ranches, and influenced bobcat behavior.
- Bobcat densities were similar over time at each study site, but varied among the study sites.
- Differences in environmental productivity, habitat, and coyote occupancy rates may partially explain the variation in bobcat density among the sites.

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

Validating a Decision Support Tool for Mottled Duck Habitat Conservation

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

The mottled duck is a non-migratory species associated with coastal marsh habitats, which relies on these areas for all of its life cycle requirements. The loss and degradation of suitable nesting and brood-rearing habitat are believed to be the primary factors associated with the long-term population decline of the mottled duck. Until recently, there has been a lack of science-based knowledge about where, on a spatial scale, to apply conservation and management actions that would result in the greatest biological return on resource investment.

We developed a decision support tool for mottled duck habitat conservation that identifies and prioritizes habitat for conservation using biological parameters. Although the decision support tool can be useful in the management decision-making process, testing

The mottled duck is a year-round resident of Texas that has been affected by the continued loss of habitat.

the performance of the model is critical in guiding future revisions. We conducted several analyses to assess the performance of the mottled duck decision support tool.

- Based on a survey where we visited 420 random points of varying conservation priority, our decision support tool identified currently unsuitable habitat with 91% accuracy, currently suitable nesting habitat with 79% accuracy, and currently suitable brood-rearing habitat with 89% accuracy.
- Based on an analysis using 6 years of breeding mottled duck surveys, breeding mottled ducks selected habitat matrices with higher mean priority ranks, as defined by the model, for nesting and brood-rearing habitat. They avoided habitat matrices with low mean priority ranks.
- Edge evenness and edge density of brood-rearing habitat were consistently significant at predicting breeding mottled duck density in both coastal and non-coastal areas.
- Overall, the decision support tool performed very well and should provide high accuracy in identifying mottled duck high-priority nesting and brood-rearing habitat for the conservation and management of this species.

Black-tailed Jackrabbit Response to Coyote Removal

Kyle Brewster, Scott E. Henke, John Tomecek, J. Alfonso Ortega-Santos, Stephanie Shwiff, and Ben Turner

A negative feedback involving black-tailed jackrabbits and cattle occurs on grasslands, especially during drought years. If stocking rates of livestock are not reduced sufficiently to compensate for reduced forage production during periods of drought, overgrazed habitat can occur. Black-tailed jackrabbit abundance increases when livestock overgraze the habitat. A major predator of jackrabbits is the coyote.

Unfortunately, ranchers typically do not consider the linkages between ecosystem components. Thus, our objective was to determine the niche of black-tailed jackrabbits within grasslands, and especially to investigate the response of black-tailed jackrabbits to coyote control efforts. Black-tailed jackrabbits were monitored via radio telemetry for a year on 4 ranches in Texas prior to coyote removal efforts; after which, 2 ranches received continuous coyote removal, and monitoring efforts continued for 18 months.

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Coyotes can help control jackrabbit populations, thereby making more grass forage available to cattle.

- Jackrabbit populations increased nearly 3-fold on ranches with coyote removal, while populations remained stable on the other ranches.
- The home range of black-tailed jackrabbits nearly doubled from 29 acres to 52 acres on ranches that received coyote removal; whereas, jackrabbit home range was unaffected on the other ranches.
- Greater overlap of home ranges occurred on ranches that received coyote removal.
- The diet of jackrabbits appeared to be unaffected by the removal of coyotes; most jackrabbit diets consisted of grasses.
- Coyote removal exacerbates the negative feedback between jackrabbits and cattle. Coyote removal resulted in more jackrabbits grazing the habitat, which increased the stocking rate and caused more overgrazing. Therefore, coyote removal may not be appropriate on grassland habitats during periods of drought or if overgrazing is a possibility.

A Comparison of Rodent Trap Preferences in South Texas

Heather J. Hannusch and April A. Torres Conkey

Animal trapping is a fundamental part of various wildlife studies, and folklore exists among biologists on factors that influence trap success. One common belief is that rodent trapping success is improved with previously used traps (where rodent scent may remain). Our objective was to determine if rodents have a preference for used or new traps.

Eighty Sherman live-traps were set along 2 transect lines for 4 nights in a brushy area on the west side of the Texas A&M University-Kingsville campus in October 2015. New and used traps were alternately placed at stations 16.4 feet apart along both trap lines. The traps were baited with oats each evening and checked in early morning. Captured rodents were removed from the trap, identified to species, marked on their fur to identify recaptures, and released at the capture site.

- We captured 152 rodents: 79 in new traps and 73 in used traps. Averages of 20 rodents per new traps and 19 rodents per used traps were caught per night.
- A population estimate from the data approximates 1,614 rodents may live in the area.
- Hispid cotton rats were the primary species captured, so our results are best applied only to this particular species.
- Statistical analysis indicated hispid cotton rats exhibited no preference between traps. Therefore, when trapping hispid cotton rats, researchers can use new and used traps interchangeably without concern that scent will influence trap success.

Do Small Mammals Cause Spot Fires during Prescribed Burns?

Justin E. Plata, Scott E. Henke, and Sandra Rideout-Hanzak

A universally held idea among land managers is that small mammals can create spot fires. This is thought to occur when an animal becomes trapped in a prescribed burn, catches its fur on fire, runs into an adjacent field, and starts a spot fire. Although this scenario is held as a principle, only anecdotal stories exist. Our objective was to determine if such a scenario is plausible.

© Sandra Rideout-Hanzak

Researchers tested whether spot fires outside the prescribed burn are caused by small mammals that are caught on fire.

We developed 10 pairs of 10 x 10-foot dried grass plots separated by 8 feet of tilled soil. Each plot contained over 6,000 pounds per acre of plant biomass. Cottontail and cotton rat carcasses were used to simulate live animals. Conditions for burning were within parameters to conduct prescribed fires. Plots containing the carcasses were ignited and the carcasses were pulled through the fire and onto a mound of dried grass to see if they could start a spot fire.

- No animal carcass created a spot fire. Three carcasses did flame, but for less than 1 second.
- Six carcasses smoldered within the dried grass, but did not ignite a fire.
- Guard hairs of each carcass were charred by fire, but the underneath fur and skin were not burnt.
- No differences were observed between cottontail and cotton rat carcasses regarding the probability of carcasses igniting spot fires.
- Although guard hairs flashed for a brief second, the time that hairs flamed was insufficient for an animal to exit the prescribed burn area, go to another area, and start a fire. Therefore, it appears unlikely that a small mammal can start a spot fire.

Coyote Food Habits Concerning Livestock: How Much is Actually Scavenged?

Kyle Brewster, Scott E. Henke, John Tomecek, J. Alfonso Ortega-Santos, Stephanie Shwiff, and Ben Turner

Coyotes are generalists and opportunistic as predators. Diet items include vegetation, insects, reptiles, amphibians, birds, and mammals. Prey could be as small as termites to as large as cattle. Coyote diets vary seasonally, but livestock typically occurs in stomachs or scats collected from coyotes regardless of season. However, it is unknown what proportion of the livestock found in coyote diets is scavenged and how many livestock are actually killed by coyotes. Our objective was to quantify the percentage of livestock within the coyote diet that was scavenged.

We baited a 16-mi^2 site with quartered cattle carcasses evenly distributed every mile. Differently colored glitter (used as identification markers) was spread on each carcass daily for a week. Helicopter and

© Larry Ditto

There are concerns that coyotes will kill calfs, but evidence suggests they opportunistically feed on cattle carcasses.

ground hunting of coyotes was conducted on 2 cattle ranches located 60 miles apart. One ranch had baited carcasses with glitter; the other received no carcasses. Twenty-five coyotes were collected from a 36-mi^2 area from each ranch and stomach contents analyzed.

- Stomachs from 20 of 25 (80%) coyotes collected on the baited area contained cattle with glitter.
- Within the baited site, 7, 5, and 7 coyote stomachs contained 1, 2, and 3 glitter colors, respectively. One coyote stomach (4%) contained cattle without a trace of glitter.
- From the non-baited site, 2 of 25 coyote stomachs (8%) contained cattle, but it was unknown if this represented scavenged or killed cattle. A carcass of a cow was found on the non-baited site.
- Our findings (based on the results from the non-baited site) is consistent with typical coyote food habit studies in which less than 10% of coyote stomachs contain cattle. In our study, most of the cattle in the coyote stomachs was scavenged, often by multiple coyotes.

Effects of Microhabitat Structure and Lure Encounter Rates on Bobcats

Gordon W. Watts, III, Tyler A. Campbell, and Michael E. Tewes

Researchers often use sampling stations such as camera trap sets at micro-sites with attractants to increase encounter rates of the wild cats. Bobcats can be particularly difficult to survey because of their secretive habits. Our objectives were to examine the influence of microhabitat structure and lures on bobcat encounter rates using camera traps.

We arranged camera stations in a grid of 26 to 29 cameras per site spaced 650 to 1,950 yards apart. We placed 1 of 2 call lures (lures effective at long-range) and 1 of 4 local lures (lures used for attracting nearby animals) at each camera station so that all combinations of call lures and local lures were used. Seven microhabitat variables were measured: opening width, canopy cover at 2 heights (0–3 feet and greater than 3 feet), vertical vegetation structure (screening cover) at 3 heights (0–1.5 feet, between 1.5 and 3 feet, and between 3 and 6 feet), and canopy height. The detection of bobcats was noted at each camera station.

- Three habitat variables were important: screening cover 1.5–3 feet, canopy cover greater than 3 feet high, and opening width.
- Although more photographs of bobcats were observed after the lure was applied, the mean rate of photographs per camera station was similar.
- Individuals remained in front of cameras with lures for longer periods, which aided in the identification of individuals.
- Lure and study site were not important variables.
- This study was effective in identifying microhabitat variables that may be important to bobcats.

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

Are Mint-Scented Trash Bags a 'Waste' in Controlling Raccoons?

Justin E. Plata and Scott E. Henke

Raccoons are often considered a nuisance species that vandalize dumpsters, trash cans, and tear into trash bags. Commercially-manufactured trash bags with a mint-scented odor have been developed to repel raccoons. We tested the advertiser's claim that mint-scented trash bags will repel raccoons.

We placed an equal quantity of food items (i.e., sardines and cans, 10 ounces of cooking oil, and whole kernel corn) into 8 mint-scented and 8 non-scented white trash bags and hung the bags approximately 1 foot above the ground. A Reconyx HC500 remote camera was placed 20 feet from the trash bags to

monitor raccoon activity and behavior. The number of raccoons per visit, raccoon interaction time with trash bags, and the time ratio of when bags were torn open to total interaction time were compared between mint-scented and non-scented trash bags.

- No differences were observed in the number of raccoons that visited trash bags for mint-scented and non-scented bags (3.9 and 3.8 raccoons per visit, respectively) or in the amount of time spent interacting with trash bags for mint-scented and non-scented bags (62 and 81 minutes, respectively).
- Mint-scented trash bags were torn open by raccoons more so than non-scented trash bags.
- Raccoons tore into mint-scented trash bags twice as quickly as non-scented trash bags (35 and 69 minutes, respectively).
- Mint-scented trash bags did not repel raccoons as advertised. It would be prudent to invest in trash cans with locking lids rather than scented trash bags to keep raccoons from scattering trash.

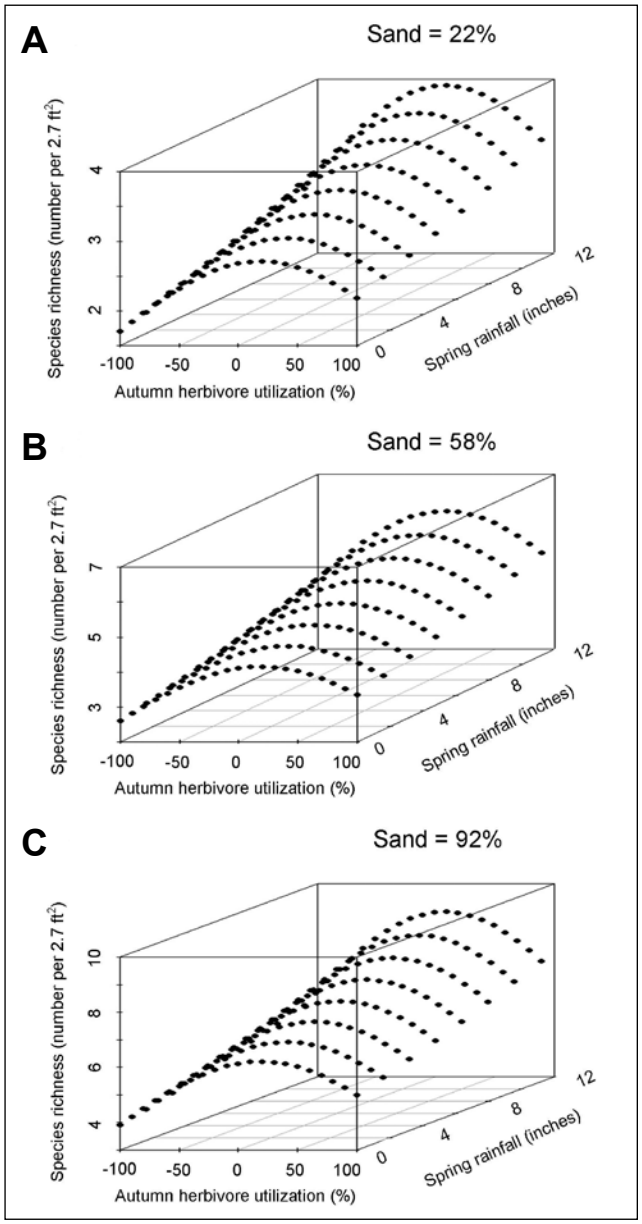
Large Herbivore Impacts on Plant Species Richness in a Semiarid Environment

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

The relationship between intensity of herbivory and plant species richness widely varies in the literature, resulting in a lack of consistent theory. Our objective was to determine the relationship between intensity of herbaceous vegetation use by cattle, deer, and nilgai and plant species richness, as well as other variables that may influence species richness (rainfall, temperature, soil texture, and site productivity).

Every autumn and spring during 2012–2015, plants were identified to species at 300 paired non-grazed and grazed sampling areas. These areas were randomly allocated and were representative of open grasslands on 4 East Foundation ranches spanning 83 miles from the Gulf Coast to western South Texas.

- During the study period, we identified 144 forb species, 60 grass species, 2 woody seedlings, and 2 succulent propagules.
- Large herbivores were the most important driver of plant species richness, but site productivity and environmental factors were also important in determining species richness.
- Our models predict that herbivores have a neutral effect on plant species richness when herbivore use of vegetation during autumn is conservative (20%) and site productivity is at least 3,569 pounds of vegetation per acre.
- When site productivity is less than 3,569 pounds per acre, as it was for 92% of the sampling locations, large herbivores decrease species richness.



Potential plant species richness per 2.7 ft² (e.g., non-grazed area where large herbivores were excluded for 5–6 months) during spring as it related to herbivore (use of autumn herbaceous vegetation), seasonal rainfall, and minimum percentage of sand in soil (A), median percentage (B), and maximum percentage (C) on 4 East Foundation ranches in South Texas from 2013–2015 (n = 856). Potential species richness peaked when herbivore use was 20%, and increased with both increasing rainfall and percentage of sand in the soil.

- Potential species richness during spring peaked when herbivore use of herbaceous vegetation was 20% during autumn.
- Conservative management practices are required in semiarid environments to ensure grazing by large herbivores, both domestic and wild, does not decrease species richness.

Cooperative funding provided by the East Foundation.

The Impacts of Habitat Fragmentation on Northern Bobwhites

Katherine S. Miller, Leonard A. Brennan, Fidel Hernández, Eric A. Grahmann, Humberto L. Perotto-Baldivieso, Jose M. Mata, Heather J. Hannusch, and Jaclyn Robles

Northern bobwhite populations have declined over the last 30 years because of habitat fragmentation. Factors of habitat fragmentation include large-scale clean farming, fire suppression in forest areas, and increasing urbanization. Biologists have called for quail management at a larger scale than the individual property level. However, we lack analyses regarding habitat changes and their impact on northern bobwhite population trends at multiple spatial scales.

Our goal was to assess bobwhite declines and changes in land use in Texas, Oklahoma, and Louisiana in the last 40 years at multiple scales. We determined long-term (1969–2012) bobwhite population declines using Breeding Bird Survey data. We then conducted large-scale analyses over Texas, Oklahoma, and Louisiana, metapopulation-level analyses at 1,977–23,722 acres, and at the home range level.

© Rachel Smith

The negative response of bobwhites to habitat fragmentation is a major concern for biologists and wildlife managers.

- Large-scale analyses indicated that the northern bobwhite population decline is related to human population growth and increased road density. At the metapopulation level, declining populations are related to higher road density, larger patches of pasture and range, smaller patches of woodland, higher woodland edge density, and more cropland.
- From 1986 to 2013, northern bobwhite populations in Jim Hogg County have experienced declines related to changes in pasture and rangeland and to brush cover, resulting in more fragmentation.
- Future studies should look at the same class-level landscape metrics at the home range scale and determine the effect that urban growth will have on northern bobwhite habitat.

Cooperative funding provided by the Gulf Coast Prairie Landscape Conservation Cooperative, South Texas Chapter of Quail Coalition, Quail Associates Program, and the Robert M. Kleberg, Jr. Center for Quail Research.

Moth Balls as a Wildlife Repellent—Fact or Myth?

Justin E. Plata and Scott E. Henke

Numerous options are mentioned on the Internet as ways to control wildlife damage inside and outside of homes. Moth balls are consistently mentioned as a control method and are considered an age-old remedy to repel a variety of wildlife species. Moth balls contain naphthalene as the active ingredient, which is considered an irritant of respiratory tracts. We tested the efficacy of moth balls as a repellent of wildlife, and specifically of rodents.

We sealed 5 moth balls into 1 inch x 1 inch wire screen baskets and placed 1 basket each into 40 Sherman live traps. We set a line of 80 randomly-assigned traps within grassland-mesquite habitat along fence lines for 2 weeks. Traps either contained moth balls or were cleaned with detergent. Trap assignment remained constant throughout the experiment, but random order of traps and location changed each night. In addition, Reconyx cameras were used to record wildlife species that approached the traps.

- Moth balls did not repel cotton rats or house mice.
- Numerically fewer cotton rats and house mice entered traps that contained moth balls (4.7 and 0.8, respectively) than clean traps (7.5 and 2.1, respectively); however, repellency was never achieved.

- Moth balls appeared to attract white-tailed deer (n = 10), cottontails (n = 6), armadillos (n = 5), skunks (n = 5), coyotes (n = 8), and gray foxes (n = 4) to specific areas; whereas, these species were not observed on camera in areas without moth balls.
- Therefore, the belief that moth balls can be used as area repellents to keep wildlife away is not supported and appears to be a myth.

Activity Patterns of Selected Felids in the Sierra Tamaulipas, Mexico

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

Activity patterns likely influence the movements and behavior of sympatric wild felids. We studied activity patterns of jaguars, cougars, ocelots, and jaguarundis in northern Mexico to determine the extent that activity patterns contribute to the spatial avoidance in these species.

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

- The Chaco-Jaccard Index indicated the greatest pair-wise similarity was between ocelot-cougar, ocelot-jaguar, and jaguar-cougar.
- Jaguars and ocelots were principally nocturnal, cougars showed irregular activity, and the only diurnal wild felid was the jaguarundi.
- Jaguars were most active around 2100 hours, whereas cougars exhibited several activity peaks with the greatest activity around 1800 hours.
- Ocelots showed 4 activity peaks: 0100 hours, 0300 hours, 2000 hours, and 2300 hours; jaguarundis had a peak activity at 0800 hours.
- Long-term camera trapping studies are effective for determining activity patterns of secretive felids.

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

Do Commercial Baits Really Attract Wildlife?

Michael Moczygemba, David Campbell, Justin E. Plata, and Scott E. Henke

Many commercially available supplemental feeds and additives are sold that claim to attract wildlife. Attractants are designed as a stand-alone bait or as an additive to feed. The concept behind attractants is that the additive uses the odor and flavor of known and preferred food sources, which then will entice the target species to a designated area. Our objective was to determine the efficacy of 2 commercial additives in attracting common game species.

We used 4 feeders that dispensed whole kernel corn 4 times per day. Remote infrared cameras were placed near each feeder to record species use of feeders, animal behavior, and day and time of use.

- White-tailed deer use of feeders was unaffected by either attractant.
- The average number of deer per visit, number of visits per day, and time spent at a feeder per visit was 2.1 deer, 3.4 visits, and 19.8 minutes.
- Deer use of feeders was unaffected by time during the study.
- Although feral hogs are common in the area and observed frequently on the property, feral hogs were not photographed using the feeders.
- Raccoons were the most frequent and numerous visitor to feeders. However, their behavior also was unaffected by the addition of attractants.
- The selected attractants did not help or hurt the enticement of wildlife to feeders. Consumers should consider the evidence to determine if attractants are worth the expense.

Neospora caninum in Domestic Animals and Exotic Ungulates in Northern Mexico

Jose Remigo de la Torre-Garcia, J. Alfonso Ortega-Santos, Antonio Cantu, Clayton D. Hilton, and Scott E. Henke

Neosporosis is a disease caused by the parasite *Neospora caninum*. Infections can lead to abortion and neonatal mortality in domestic and wild animals. The life cycle of *N. caninum* has been worked out for some host species, but is unclear for others. Concern exists that the introduction of exotic cervids whose role in the life cycle of the pathogen has not been determined might represent a risk to the health of native animals and livestock. Finding *N. caninum* antibodies in introduced axis and fallow deer would suggest that those species act as a carrier for the parasite.

Blood samples were collected from 18 axis deer, 19 fallow deer, 34 cows, 17 horses, and 6 dogs on a ranch in Soto La Marina, Tamaulipas, Mexico. The blood samples were tested to determine the presence of *N. caninum* antibodies.

- Antibodies to *N. caninum* were found in 2 (11%), 2 (10%), 33 (97%), 0%, and 0% axis deer, fallow deer, cattle, horses, and dogs, respectively.
- The information from this study provides a better understanding of the role that axis and fallow deer might play in the transmission of *N. caninum*.

Cooperative funding provided by Consejo Nacional de Ciencia y Tecnología, USDA Animal and Plant Health Inspection Service, and Rancho Miramar.

Feasibility of Ranchers in Testing Their Wildlife Feed for Aflatoxin

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

Aflatoxin, a harmful fungal metabolite produced by strains of *Aspergillus flavus* and *Aspergillus parasiticus* growing on grain, can negatively affect the health of wildlife. Any cereal grain is susceptible to the production of aflatoxin. Consequently, wildlife resource and ranching personnel are concerned about aflatoxin. Unfortunately, equipment to quantify aflatoxin concentrations in supplemental feed is expensive and tests involve multiple chemistry procedures that could be considered complicated by some users.

We compared commercially available aflatoxin tests for cost and ease of use. We used 150 freshmen and sophomore college students as non-technical personnel. Students were provided the equipment, supplies, instructions on how to perform the aflatoxin test, and given a corn sample with a known amount of aflatoxin to test.

- All quantitative tests required specialized equipment, with costs ranging from $2,400 to $6,008.
- The cost of quantifying aflatoxin concentrations in grain samples ranged from $10 to $30 per test.
- Differences occurred among the products concerning the ease of use, but accuracy and precision were similar among the commercially available tests.
- Individual performance to accurately quantify aflatoxin in samples improved with video instruction.
- Much variability in aflatoxin concentrations occurred between the methods, which required anywhere from 0.2 to 1.8 ounces (5 to 50 grams) of grain. However, precision increased among the methods when 5 samples were averaged for each method, but the cost also increased 5-fold.
- Training is required for a non-technical person to become proficient with the methodology to obtain precise and accurate results. Therefore, a simple, relatively inexpensive test to quantify aflatoxin is not available for use at this time.

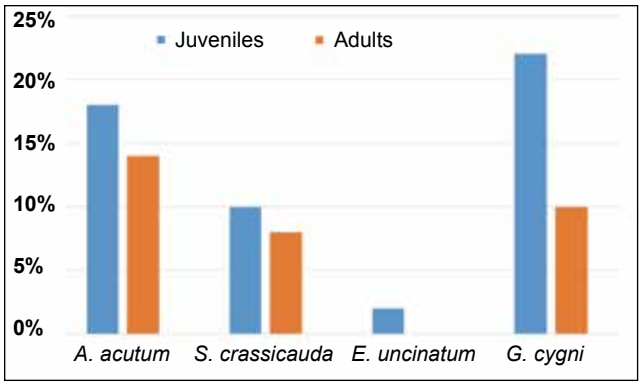
Cooperative funding provided by the Rachael and Ben Vaughan Foundation and Texas AgriLife Extension Service.

Gizzard Helminths in Female Northern Pintails Wintering Along the Texas Coast

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

Helminth parasites in the genera *Amidostomum* and *Epomidiostomum* are known to feed on blood and can cause tissue damage to the gizzard lining and lead to gizzard dysfunction. Such negative impacts have been noted in geese. In addition, 2 other genera of gizzard worms have been identified in waterfowl—*Streptocara* and *Gastrotaenia*. The impact, if any, that parasites infecting the gizzard have on northern pintails is not well understood.

Our objectives were to identify the species of helminths occurring underneath the gizzard lining in female northern pintails, determine their frequency



Occurrence of gizzard helminths by host age in northern pintails collected along the Texas coast from mid-October 2014 to mid-March 2015.

of occurrence and intensity of infection, and evaluate the influence of host age. One hundred female pintails (51 adults and 49 juveniles) were collected along the Texas coast from mid-October 2014 through mid-March 2015 as part of a larger study on pintail body condition. Gizzards were examined, and parasites identified to species and counted.

- We found 3 species of nematodes (*Amidostomum acutum*, *Streptocara crassicauda*, *Epomidiostomum uncinatum*) and a cestode (*Gastrotaenia cygni*).
- *Amidostomum acutum* had the highest prevalence (17%), followed by *G. cygni* (16%), *S. crassicauda* (9%), and *E. uncinatum* (1%); intensity of infection was about 1 worm for each species.
- Of the 51 adult pintails examined, 16% were infected with nematodes and 10% had the cestode.
- Of the juveniles examined, 16% had nematodes and 18% had *G. cygni*.
- Overall, a host age effect was not observed in helminth prevalence or intensity of infection.
- Further research is needed to evaluate how helminth populations and communities vary across the northern pintail's life cycle and whether these parasites have a negative effect on pintails.

Aspergillus flavus Control: Do We Need to Worry about Spores?

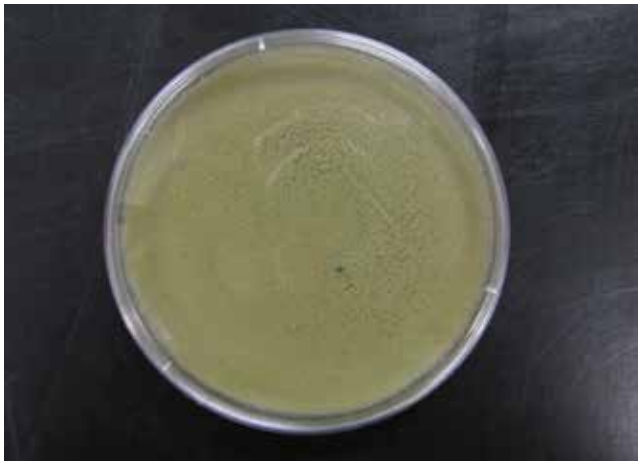
Jacobo Solis, Alan M. Fedynich, Scott E. Henke, Greta L. Schuster, and James C. Cathey

Aflatoxin is a toxic metabolite of *Aspergillus flavus* and *Aspergillus parasiticus*. These fungi grow on various cereal grains that often are used for supplemental wildlife feed. Consequently, this toxin represents a significant morbidity and mortality factor to wildlife feeding on contaminated grain.

A 10% Clorox® bleach solution is often recommended in the popular literature for disinfecting bird feeders. Although this concentration may kill the fungal colonies, it is unclear whether spores (i.e., propagules of fungi) remain viable, thereby allowing rapid repopulation. Our objective was to determine the concentration of Clorox® bleach solution needed to effectively kill spores of *A. flavus*.

Fungal colonies of *A. flavus* growing on potato agar in Petrie dishes were exposed to water control, 10%, 12%, and 14% bleach solution made from a Clorox® bottle containing 8.25% active ingredient of sodium hypochlorite. Spores from each treated dish were placed into Petrie dishes containing growth agar and incubated at room temperature for 5 days to see if spores survived by forming new colonies.

- All fungal colonies exposed to each bleach solution were killed, while the control group (water only) colonies remained alive.
- Some of the spores survived the 10% and 12% bleach treatments, which produced fungal colonies. However, none of the spores from the 14% bleach solution treatment survived.
- We conclude that *A. flavus* colonies can be killed by a 10% Clorox® bleach solution, but it is not sufficient to reliably kill all spores, which would lead to fungal repopulation.
- Our recommendation is to use a 14% bleach solution (made from bleach containing 8.25% active ingredient of sodium hypochlorite) applied to feeders for at least 30 minutes.



***Aspergillus* can be killed with a 10% Clorox® bleach solution, but viable spores remain to re-establish colonies.**

- When using metal feeders for wildlife supplementation, it is necessary to flush the feeder with water immediately after the bleach contact time has lapsed to remove the corrosive effects of chlorine on metal.

Cooperative funding provided by the Texas A&M AgriLife Extension Service, Rachael and Ben Vaughan Foundation, and USDA-AFRI Minimizing Diseases due to Fungal Pathosystems Program (Program Area Code A5122).

Remote Cameras to Monitor Prevalence of Sarcoptic Mange in Wild Mammals

Kyle Brewster, Scott E. Henke, M. Eric Mehlenbacher, Alfonso Ortega-Sanchez, Jr., and Clayton D. Hilton

Sarcoptic mange, which is caused by the mite *Sarcoptes scabiei*, is a common, highly contagious skin disease that can infect more than 100 species of mammals, including humans. Severe mange has resulted in about 80% mortality and reduced ovulation and pregnancy rates in surviving adult females. Such a disease can devastate local wildlife populations and is especially concerning when endangered mammals, such as ocelots, are at risk. Our objectives were to (1) document the current prevalence of mange in wild mammals of southern Texas and (2) determine the efficacy of using trail cameras on ranches to estimate the prevalence of mange.

We collected blood and skin samples and photographs from 166 mammals representing 12 species from southern Texas during 2012. Two photographs of the animals were reviewed by a veterinarian experienced with cases of mange to see how difficult it would be to identify mange based solely on photographs of wild animals.

- Feral hogs, white-tailed deer, coyotes, nilgai, and raccoons displayed hair loss, excessive discharge of the sebaceous glands, and crusted lesions consistent with mange.
- Only feral hogs, coyotes, and white-tailed deer had mites present within skin samples.
- Antibody titers ranged from 'not appreciable' to 1:1,024 in sera from all animals, with titers from mite-positive animals higher than from animals that were negative for mites.
- The veterinarian correctly identified animals in 18 photographs as positive and 97 photographs as negative for mange, with 19, 9, and 23 photographs

Review of photographs by a veterinarian experienced with cases of mange to determine if photographs are a sufficient method of diagnosis for selected mammalian wildlife species collected in southern Texas during 2012–2013.

						Inconclusive[1]	
Species	N	Positive	Negative	False Positive	False Negative	Positive	Negative
Rodent[2]	40	0	40	0	0	0	0
Lagomorph[3]	10	0	10	0	0	0	0
W-T deer	28	4	15	2	4	1	2
Feral hog	25	6	2	5	3	5	4
Javelina	10	0	8	0	0	0	2
Nilgai	5	0	3	1	0	0	1
Coyote	25	8	5	6	2	4	0
Raccoon	20	0	11	5	0	0	4
Bobcat	3	0	3	0	0	0	0
Overall	166	18	97	19	9	10	13

[1] Two photographs were provided of each animal to determine the precision of the method. Inconclusive positive = animal in 1 photograph was deemed a mange case, but in the other photograph it was deemed negative when in actuality the animal was positive for mites. Inconclusive negative = animal in 1 photograph was deemed a mange case, but in the other photograph it was deemed negative when in actuality the animal was negative for mites.

[2] Rodent: hispid pocket mouse (N = 10), silky pocket mouse (N = 10), and hispid cotton rat (N = 20).

[3] Lagomorph: cottontail (N = 5) and black-tailed jackrabbit (N = 5).

being false positive, false negative, and inconclusive, respectively.
- Moderate to severe cases of mange were readily identifiable via photographs; however, mild cases often were missed using photographs. Therefore, the true prevalence of mange in an area can not be reliably determined using trail cameras.

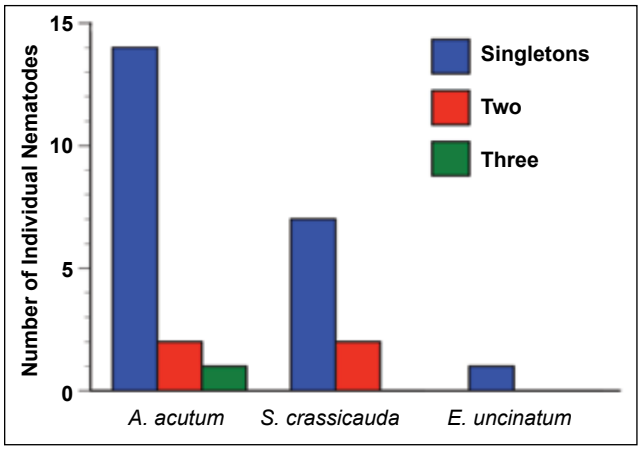
Cooperative funding provided by the East Foundation.

Sex Ratios of Gizzard Nematodes in Pintails Wintering Along the Texas Coast

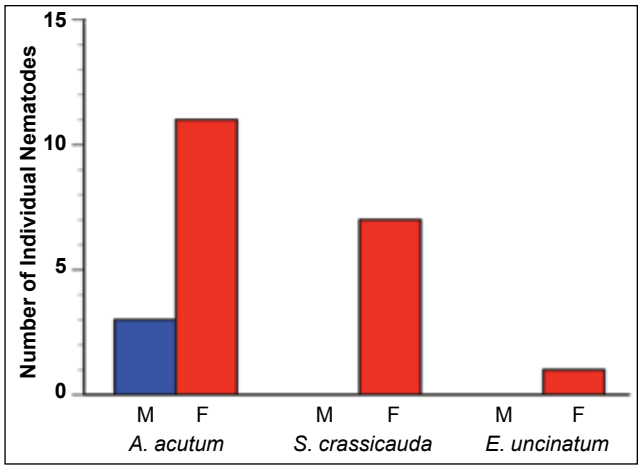
Derek C. Ballard, Matthew J. Garrick, Bart M. Ballard, and Alan M. Fedynich

Hypotheses regarding nematode reproduction strategies predict that sex ratios should be female biased at low prevalence and mean intensity and approach 1:1 as prevalence and mean intensity increase. The consequences of a highly skewed sex ratio have important implications regarding the species ability to reproduce and infect its host. We determined sex ratios of gizzard nematodes that rarely occurred (less than 25% prevalence) in 100 pintails collected along the Texas coast from mid-October 2014 to mid-March 2015.

- We found 18 of 21 *A. acutum* individuals were females (male:female sex ratio 0.2:1) and all 11 *S. crassicauda* individuals were females, suggesting female bias.
- Even more pronounced was the occurrence (or lack thereof) of males and females within individual hosts, where reproduction actually occurs. In each case, singleton females accounted for most of the worms within infected host individuals.
- We conclude that the low numbers of female individuals of each of these nematode species reduce reproductive output, compared to those species that have high levels of infection. These features would likely perpetuate the infrequent occurrence of these parasite species and affect their persistence within the host population.



The distribution of individual nematodes within infrapopulations for each of the 3 gizzard nematode species found in 100 northern pintails collected along the Texas coast from mid-October 2014 to mid-March 2015.



The distribution of singleton infrapopulations by sex (M = male, F = female) for each of the 3 gizzard nematode species found in 100 northern pintails collected along the Texas coast from mid-October 2014 to mid-March 2015.

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