Caesar Kleberg Wildlife Research Institute

Current Research 2012–2013

This year's cover features a photograph of a Bullock's oriole taken by Dr. Timothy Fulbright. This oriole is one of over 350 species of birds that can be found in South Texas landscapes.

Editor Alan M. Fedynich, Ph.D.

December 2013

Report of *Current Research*

September 1, 2012 to August 31, 2013

Caesar Kleberg Wildlife Research Institute

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FOREWORD

Wildlife enthusiasts who care about South Texas are hard to match when it comes to the main ingredient of why people care—their passion. Webster's Dictionary calls it "an intense, driving feeling of conviction," "a strong devotion to some activity or concept," "an energetic and unflagging pursuit of a just cause." All of these describe the people who live, visit, or hunt here.

When we need help, our passionate supporters come to our aid. We saw it during the financial crisis of 2008–2009. Dozens signed up to contribute $5,000 per year as a Caesar Kleberg Partner or $1,000 per year as a Sustaining Contributor. A perfect example came from the family of Lauro and Mary Lou Gutierrez of Zapata County. When we sent out our first plea for help, Lauro and Mary Lou sent their contribution in so fast that it was if they read my mind, placed their check in an envelope, and mailed it to me before my letter ever reached them.

And, they continue to give today.

We witnessed it again when we decided to place a quail scientist in San Antonio. Dr. Eric Grahmann's position there is supported 100% from Quail Forever in San Antonio, South Texas and San Antonio Chapters of the Quail Coalition, and several individuals. Eric's goal is to help landowners and foster new quail research in the counties around Bexar County from Goliad to Pawnee to Cotulla to La Pryor to Carrizo Springs.

Last, but certainly not least, we proudly acknowledge 6 new endowments that were established during the last 12 months. Those passionate individuals, in whose honor endowments were named, appear on page 4 of this report.

We hope this Christmas Season brings you all of God's gifts, including peace, hope, love, and, lest we forget, rain.

Sincerely,

Fred C. Bryant

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Every graduate student in our program financially benefitted from this fund.

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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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Hixon Fellowships in Deer, Quail and Range Restoration Research

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Boone and Crockett Fellowship in Ungulate Research

Grady Cage Memorial Fund for Quail Research

In Memory and Honor...

Many people choose to send unsolicited gifts in honor of cherished friends or family.
We have received memorials and gifts to honor...

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TABLE OF CONTENTS

BIOLOGY, ECOLOGY, AND MANAGEMENT

CONTAMINANTS, DISEASES, AND PARASITES

COMPLETED RESEARCH

WHITE-TAILED DEER

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

BOBWHITES AND OTHER QUAIL

HABITAT RESTORATION AND ENHANCEMENT

BIOLOGY, ECOLOGY, AND MANAGEMENT

Our Invasive Grasses Research Program

Attempting to better understand and manage invasive grasses in South Texas has always been a part of the CKWRI research mission. Over the years, a wealth of valuable knowledge has been gained through sound scientific research and the development of applicable management practices to mitigate their impact, yet we have only begun to scratch the surface. There is still much to learn about invasive grasses. The same problems hold true for a rancher in Oregon who is tackling cheatgrass or a rancher in Jim Hogg County, Texas trying to fight off an invasion of tanglehead or Old World bluestem.

Thanks to the commitment of our supporters, CKWRI has a stronger focus than ever before on invasive grasses. Our strategy is founded on a holistic, long-term approach to the problems posed by invasive grasses through a wide-ranging investigation of how these plants interact with and ultimately alter the ecosystems in which they occur. Soil biology, competition with native plants for resources, adaptation to disturbance, climate change, grazing, and wildlife interactions are all part of our evaluation—and all of this must be examined to better understand and manage invasive grasses.

Invasive grass research plays a critical role in helping maintain the diverse ecosystems that makes South Texas so unique. Anyone with a passion for habitat management, range restoration, grazing or simply a love for the beauty of the South Texas outdoors has a vested interest in invasive grass research.

Multiple Management Techniques to Control Tanglehead Monocultures

Scott L. Mitchell, David B. Wester, Joshua L. Grace, Anthony D. Falk, and Keith A. Pawelek

The presence of tanglehead, a warm season perennial bunchgrass, was once considered a sign of range health improvement. In recent years, tanglehead behavior has become very aggressive. Tanglehead has formed complete monocultures on thousands of acres of rangeland in the South Texas Sand Sheet. Our objective is to evaluate management techniques commonly used to control invasive species. These techniques will be used singly and in combination with one another to determine the most effective methods for control of tanglehead.

This study is being conducted on the Eshleman-Vogt, Jones Borregos, and Wagner ranches located in Jim Hogg and Duval counties, Texas. Twenty-eight treatments are being applied to research plots on each ranch. Twenty-seven plots will receive a foundation treatment of either (1) cool season prescribed burn, (2) disking, or (3) summer prescribed burn. After the foundation treatment is applied, 3 pre-emergent herbicides (Arsenal®-Powerline™, Prowl® H2O, and Spike® 80DF) will be individually applied to a treatment plot at 3 rates for each formulation. In addition, each of these treatments will receive glyphosate (generic Round-up®) to produce a top kill of adult tanglehead plants. The final plot will only receive a mechanical disking treatment at repeated intervals to prevent tanglehead plants from reaching seed production.

The primary goal of this study is to evaluate which method is most effective in controlling adult tanglehead plants. In addition, information will also be obtained regarding how best to exhaust the large number of tanglehead seeds that occurs in the soil seed bank.

Cooperative funding provided by the Brown Foundation, Eshleman-Vogt Ranch, Jones Borregos Ranch, Wagner Ranch, and donors to the Caesar Kleberg Wildlife Research Institute's Invasive Grass Research Program.

Soil Modification as a Restoration Tool to Reduce Old World Bluestems

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

Non-native Old World bluestem (OWB) grasses alter native plant and wildlife communities by forming dense monocultures and changing soil chemistry. Modifying chemical and physical properties of the soil may serve as a restoration tool in grasslands affected by OWBs.

In June 2011, we applied 10 soil treatments (pH increase, pH reduction, carbon addition, addition of soil mycorrhizae, soil disturbance alone, and each of the previous combined with seeding of native vegetation) to 50 study plots (5 per treatment). We are comparing soil chemistry and plant and arthropod communities in these treated areas to 5 undisturbed monocultures of OWBs, as well as 5 undisturbed plots dominated by native plants that serve as reference sites.

Based on sampling during summer 2012, we found 2 more plant species, and 13 to 14 more arthropod species on plots dominated by native plants compared to OWB-dominated plots. Although mean arthropod abundance on undisturbed plots dominated by OWB grasses (13.4 arthropods/ft^2) was nearly double that on undisturbed native vegetation plots (7.1 arthropods/ft^2), 1 species of herbivorous arthropod comprised half the overall abundance for plots dominated by OWBs. This suggested that increased dominance of OWBs might affect feeding relationships. Despite differences between reference sites, arthropod abundance was similar among treated plots and undisturbed plots dominated by native vegetation.

We suspect that drought conditions occurring during 2011 and 2012 have affected efficacy of soil treatments. Therefore, we are conducting a greenhouse study to examine the effects of soil treatments on the plant communities in the absence of drought.

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

Efficacy Comparison of Various Herbicide Applications during Times of Drought

Scott L. Mitchell, David B. Wester, and Joshua L. Grace

Some herbicidal treatments (especially pre-emergent chemicals) require incorporation into the topsoil for the mechanism of action to be effective. This is generally accomplished with precipitation or mechanical methods such as disking. Without the guarantee of a precipitation event on rangelands, herbicides can lie exposed to the elements for weeks at a time.

This study is being designed to evaluate the difference in the efficacy of Arsenal®-Powerline™ and Spike® 80DF when (1) applied to the soil surface and (2) incorporated into the topsoil by disking. This study is being conducted on a tanglehead infestation at the Anacahuitas Ranch in Hidalgo County, Texas.

The herbicides will each be applied at 2 rates. Each plot will be mechanically disked before the herbicides are applied to remove mature plants and litter on the soil surface. After application, half of the plots will again be disked to incorporate the herbicide into the top 4 inches of the soil. The herbicide on the remaining plots will remain on the soil surface until a precipitation event moves the chemical into the soil. All plots will be evaluated for a period of several months to determine how much efficacy is lost to exposure when there is no mechanism such as rainfall to move the herbicides into the topsoil. Results from this study will help land managers more effectively use herbicides to control invasive grasses for habitat improvement.

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

Season of Prescribed Burning on Invasive Grasses

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

Exotic Old World bluestems are an increasing threat to native vegetation and wildlife conservation throughout the Texas Plains and Gulf Coast Prairies of Texas. The purpose of this research is to learn how varying the season of prescribed burning affects the relationships between invasive Kleberg bluestem and native vegetation.

This study is being conducted at the TAMUK South Pasture Research Facility in Kleberg County, Texas. We have established permanent plots with grazing exclosures to study the influence of season of burning on fire effects. Some plots are being treated with warm-season summer burns and some plots with cool-season winter burns while other plots will receive no burning treatment. We are sampling vegetation before and after burning for species associations, composition, produc-

© Scott Mitchell

Prescribed fire is being used to prepare this site for multiple herbicidal treatments.

tion, mortality, and recruitment. Soil characteristics and the seed bank will also be studied.

Data collection and burning began this year. By studying the effects of different seasons of prescribed burning, we hope to improve current techniques for managing invasive grasses.

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

Management and Control of Buffelgrass and Kleberg Bluestem

Eric D. Grahmann, Blake A. Martin, Michael W. Hehman, Forrest S. Smith, David B. Wester, and Timothy E. Fulbright

Buffelgrass and Kleberg bluestem are 2 non-native grasses introduced to South Texas for cattle forage production and erosion control in the early 1900s. These grasses have become a serious threat to biodiversity and the integrity of wildlife habitat by spreading into and replacing native plant communities.

Little research has been conducted regarding management of these grasses for wildlife; attempts at their control have been unsuccessful or short-lived. Because of this lack of basic knowledge, we initiated this study.

We are testing the effects of various treatments including fire, grazing, herbicide application, and planting native species on the Hixon Ranch in La Salle County, Texas. Our experiment is replicated twice in grasslands dominated by buffelgrass and twice in grasslands dominated by Kleberg bluestem. We used the Daubenmire frame method to estimate herbaceous canopy cover.

© Scott Mitchell

Multiple management techniques are being evaluated for their effectiveness in controlling invasive plants.

Preliminary results indicate that herbicide treatments using Fusilade had no effect on exotic grass and forb cover when compared to the control plots. Treatments incorporating soil disturbance and planting native species resulted in 64% less cover of exotic grasses and 151% greater cover of forbs 2 years after treatment.

Based on our findings, stands dominated by buffelgrass can be converted into diverse native plant communities in the short term. Additional research is needed to determine treatment longevity.

Cooperative funding provided by the College of Graduate Studies at Texas A&M University-Kingsville, Hixon Ranch, Rotary Club of Corpus Christi (Harvey Weil Sportsman Conservationist Award Trust), Arthur A. Seeligson, Jr. Conservation Fund, South Texas Charity Quail Hunts, Inc., South Texas Chapter of the Quail Coalition, Native Plant Society of Texas, and the Jack R. and Loris J. Welhausen Experimental Station.

Long-term Evaluation of Tanglehead Seed Bank Dynamics

Scott L. Mitchell, David B. Wester, and Alfonso Ortega-Sanchez, Jr.

Tanglehead is a prolific seed-producing bunchgrass that can generate multiple seed crops throughout the year. Initial efforts to control tanglehead have often been successful at eliminating the adult plant. However, many of these efforts have stimulated germination of tanglehead seeds found within the soil seed bank. The successful elimination of a single adult plant can lead to the germination of hundreds of seeds.

Tanglehead seeds go through an initial dormancy period, which allows germination when conditions are favorable for plant growth. A 4-year investigation into the seed bank dynamics of tanglehead is currently under way at the East Wildlife Foundation.

One hundred aluminum packets containing tanglehead seeds collected in 2010 and 100 aluminum packets containing tanglehead seeds collected in 2012 were buried at 2 depths along 5 transects on the East Wildlife Foundation in Jim Hogg County, Texas. Packets will be retrieved every 3 months for 4 years. An initial count of germinated seeds will be performed and a germination trial and tetrazolium stain test will be performed to assess dormancy, germination rates, and seed viability over time.

Our study will provide insight about the dormancy period for newly produced seed, the germination percentage of live seed, and how long seeds remain viable

in the soil. This information can be used to develop multi-year programs to manage tanglehead infestations in South Texas.

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

Long-term Effects of Roller Chopping and Fire on Invasion of Exotic Grasses

Johanna M. Prukop, J. Alfonso Ortega-Santos, Felix Ayala-Alvarez, and Timothy E. Fulbright

The invasion of exotic grasses into South Texas has changed the ecology of native rangelands, which in turn has affected fire patterns leading to decreased biodiversity. This research is being conducted at the Welder Wildlife Foundation Refuge near Sinton, Texas.

The study site consists of 9 plots. During fall 2007, 3 treatments were evaluated: roller chopping, roller chopping plus seeding a native plant mix, and the control (no roller-chopping). Currently, with the addition of prescribed fire in 2011, 5 treatments are being evaluated: roller chopping, roller chopping and prescribed fire, roller chopping plus seeding, roller chopping plus seeding and prescribed fire, and the control (no roller-chopping and no fire manipulation).

Since 2011, data have been collected using a Daubenmire sampling frame for percentage canopy cover of grasses, litter, and forbs. Woody plant cover is being estimated using the line intercept method.

Based on preliminary results, prescribed fire reduced the growth of brushy vegetation. This increased the life of the initial treatment by reducing brush vegetation and allowing grasses to become established.

Cooperative funding provided by the USDA Natural Resources Conservation Service and the Rob and Bessie Welder Wildlife Foundation.

Competition between Tanglehead and Native Species below the Soil Surface

Scott L. Mitchell, David B. Wester, Anthony D. Falk, Keith A. Pawelek, and Forrest S. Smith

Little is known about how certain invasive plants compete for nutrient resources below the soil surface. This is the first in a series of greenhouse studies that will evaluate the root structure and morphology of tanglehead in comparison to and in competition with 3 native species found in South Texas: hairy grama, red lovegrass, and Wright's threeawn.

Tanglehead grass can be so aggressive that it can displace other invasive grasses on affected range sites.

Each grass species will be grown from seed until the plants reach maturity in 11 inch x 24 inch greenhouse pots. Each species will be grown individually and with tanglehead. At maturity, each root system will be measured for root length, density, various morphological and structural features (e.g., number of tips and forks), and total belowground biomass.

The goal of this study is to gain a better understanding of how each plant establishes itself from the point of germination through maturity. In addition, information will be obtained on how each species is affected when having to compete for resources with an invasive grass such as tanglehead.

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

Prescribed Burning Effects on Old World Bluestem Seed Bank

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

Native vegetation is facing increasing threats in South Texas from non-native Old World bluestems. We are investigating the relationship between the seed bank composition and the composition of the existing vegetation in plots invaded by Kleberg bluestem.

© Sandra Rideout-Hanzak

Graduate student Adam Toomey is clipping Old World bluestem plants to estimate fuel moisture and biomass.

As part of a study comparing season of burning on vegetative composition at the TAMUK South Pasture Research Facility in Kleberg County, Texas, we are treating some plots with warm-season summer burns and some plots with cool-season winter burns while other plots are receiving no burning treatment. In conjunction with these sites, we will collect samples from the seed bank. Seeds will be germinated through replicated trials in a greenhouse. Seedlings will be identified to species, and the resulting seed bank composition will be compared to the composition of plant communities at the field site.

Through this study, we will be able to determine the effect of burning treatments on the seed bank and the relationship between seed bank composition and vegetative composition in areas invaded by Kleberg bluestem. Findings will provide the insight needed for creating recommendations to treat existing seed banks as a way to manage native and invasive grasses.

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

Assessing Tanglehead Nutritional Dynamics Throughout the Year

Scott L. Mitchell and David B. Wester

Over the past 20 years, tanglehead has overwhelmed thousands of acres of once diverse native grazing lands in South Texas. One of the tools in a range manager's toolbox to manage invasive grasses is the use of livestock. Previous research and observations from ranchers have confirmed that cattle will graze tanglehead, but only under certain conditions and during a short window when plants are young and tender. From a grazing standpoint, tanglehead matures quickly and cattle will move on to more palatable species.

This study is taking place on the Eshleman-Vogt, Jones Borregos, and Wagner ranches in Duval and Jim Hogg counties, Texas. In pre-determined plots, all of the biomass from each tanglehead plant will be removed at the beginning of each trial period and then samples will be collected every 14 days until the vegetative regrowth reaches maturity. Laboratory analyses of the samples will provide information on crude protein content, crude fiber content, and digestibility. New plots will be initiated every 2 months and collections evaluated to cover a full year.

The goal of this research is to determine the best time for cattle to graze tanglehead. In addition, findings will aid in evaluating how tanglehead performs nutritionally at different times of the year. This information can be used by ranchers to improve grazing strategies for tanglehead.

Cooperative funding provided by the Brown Foundation, Eshleman-Vogt Ranch, Jones Borregos Ranch, Wagner Ranch, and donors to the Caesar Kleberg Wildlife Research Institute's Invasive Grass Research Program.

Effects of Invasive Grasses on Ecosystem Processes along an Invasion Gradient

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

Invasive grasses are an increasing concern in grassland prairie and savannah ecosystems. They threaten biodiversity, ecosystem stability, and quality of wildlife habitat. South Texas has experienced increases of invasive grasses including Old World bluestem, buffelgrass, tanglehead, and Lehmann's lovegrass. Although much research supports the harmful effects of invasive grasses on the aboveground plant community and its structure, the impacts of these grasses on ecosystem processes are less known.

We are assessing the effects of tanglehead and Lehmann's lovegrass on ecosystem processes. This will provide insight into underlying mechanisms that may contribute to the success of these species over native vegetation. The objectives are to determine (1) whether invasive plant species affect composition and

structure of plant communities and whether they affect seasonal dynamics of foliar cover and biomass production of native species, (2) effects of invasive species on seed bank composition and dynamics, and (3) whether presence of invasive residual dry matter alters soil microbial community composition and affects plant species interactions. The project will include both field and greenhouse experiments.

Findings from this study will provide insight about the effects of invasion on ecological processes and wildlife habitat. In addition, findings may be used to further develop management strategies aimed at controlling invasive grasses as well as restoring rangeland and diverse wildlife habitat.

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

Courtesy Texas Parks and Wildlife Department

Long-term Monitoring of Ocelots and Bobcats on the Yturria Ranch

Michael E. Tewes, Arturo Caso, Jennifer M. Korn, Justin P. Wied, and Gordon W. Watts, III

In 1983, researchers from the Caesar Kleberg Wildlife Research Institute discovered an ocelot population on the Yturria Ranch in northeastern Willacy County, Texas. They have been monitoring this endangered cat since that time. This population is part of a larger metapopulation in and around the Yturria Ranch, with another population recently found on the nearby East El Sauz Ranch.

Box-trapping and radio-collaring of ocelots and bobcats occurred during 2012. Five ocelots (3 females and 2 males) were trapped; all were collared except for one that was too young. Three adult male bobcats also were trapped and radio-collared to determine coexistence patterns with ocelots.

On average, bobcats had larger home ranges than ocelots, and bobcats used dense thornshrub on the conservation easements and the surrounding open habitats. However, an adult male ocelot had the largest home range of 0.65 mi^2, and it included the 2 conservation easements. An adult female ocelot used only a single easement; its home range was shared with an adult female ocelot and a young adult male.

This long-term research project will continue to monitor ocelot population dynamics in and around the Yturria Ranch. It is only through this type of consistent, intensive monitoring that we will be able to improve conservation and management decisions for ocelots in South Texas.

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

Potential Vulnerability of the Mountain Lion Population in South Texas

Timothy M. Buquoi, Joseph D. Holbrook, John H. Young, Michael E. Tewes, Jennifer M. Korn, and Randy W. DeYoung

Historical records indicate that the geographic range of mountain lions occurred across Texas. In the last 200 years, populations have been reduced primarily to 2 populations in Texas that show little exchange. These consist of a large, genetically diverse and stable population in the Trans-Pecos of west Texas and a smaller population with less regional connectivity and declining genetic variation in the South Texas Plains. Our purpose was to determine how isolation affected the vulnerability of the mountain lion population in South Texas.

We analyzed data from genetic studies conducted in both regions from 1985 to 2010 and combined it with ecological data collected from 1994 to 1997 in South Texas. The genetic data were taken from 245 individuals, and the ecological data were taken from 19 radio-collared and 19 uncollared individuals in South Texas.

After reviewing genetic data, habitat modeling, population modeling, survival, mortality, dispersal rates, and sex ratios, we believe that the mountain lion population in South Texas may be vulnerable to significant population declines. This population is genetically differentiated from the one in west Texas, and it has fewer opportunities for gene flow because of its isolation and small population size.

Though more research is necessary, the southern mountain lion population may be able to expand its range and become more stable. Researchers may be able to gain a better understanding of the possible vulnerability of mountain lions in South Texas if quantitative data on demographic and genetic patterns are collected over time.

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

Ocelot Population Survey on the East El Sauz Ranch in South Texas

Arturo Caso, Alfonso Ortega-Sanchez, Jr., John P. Leonard, Eric L. Rulison, Daniel J. Kunz, Gordon W. Watts, III, William C. Stasey, Michael E. Tewes, and Lon I. Grassman, Jr.

The ocelot is an endangered cat in Texas. It occupies limited areas of South Texas where adequate dense thornshrub habitat occurs. Previous surveys indicated 2 breeding populations in Texas. However, recent surveys on the East El Sauz Ranch in Willacy County revealed a third breeding population. This project contributes to ocelot population ecology in South Texas.

Ten ocelots (5 males, 5 females) were captured and monitored by radio telemetry. The Locate III and ArcGIS 9 computer programs were used to evaluate

home range size. We obtained a mean ocelot home range size of 1.6 mi^2 for males and 0.8 mi^2 for females. To determine population density, we deployed a grid of 28 camera stations for 24 months. Camera stations were separated by 600 to 1,000 yards. Individual ocelots were identified by their unique coat pattern. Population density was estimated using capture-recapture models with the aid of the software program CAPTURE. To calculate the effective sampling area, we established a buffer for each camera location using the half mean maximum distance moved (HMMDM) of individuals photographed at 2 or more stations.

We obtained 288 ocelot photos, representing 22 individuals (9 males, 11 females, and 2 cubs) from 15,521 trap-nights of photo surveys. Ocelot population density was estimated at 51.5 ocelots per 100 mi^2.

The East El Sauz Ranch ocelot population is a newly found and important population. Studying the East El Sauz population will aid in our understanding of ocelot population dynamics and demographics in South Texas. We plan to continue monitoring this population to detect changes in population structure and dispersal.

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

Immobilizing Jaguarundis using Ketamine-Xylazine and Tiletamine-Zolazepam

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

The jaguarundi is one of the least studied Neotropical cats because of the difficulty in capturing this species in the wild. Subsequently, there is no information on the chemical immobilization of free-ranging jaguarundis. This research examined the use of 2 common sedation drug combinations: ketamine hydrochloride (KH) and xylazine hydrochloride (XH), and tiletamine-zolazepam.

From 1991 to 2007, we studied the jaguarundi population at Los Ebanos Ranch, Tamaulipas, Mexico. Twenty-one jaguarundis were captured using box-traps baited with live chickens and coturnix quail. Jaguarundis were immobilized with an intramuscular injection by pole syringe in the hindquarters. We used a mean dosage of 7.7 mg/lb (17 mg/kg) of KH (Ketaset®) combined with 2.7 mg/lb (6 mg/kg) of XH (Rompun®) for 18 jaguarundis. Three individuals were sedated with a mean dosage of 2.2 mg/lb (5 mg/kg) of tiletamine-zolazepam (Zoletil 50®).

Sedated jaguarundis did not exhibit any physiological problems during or after sedation with both drug combinations. Thus, it appears that the mixtures of KH-XH or tiletamine-zolazepam could be effective immobilization agents for wild jaguarundis.

Chemical immobilization is vital for wildlife research when conducting animal trapping and handling. This research represents a starting point for understanding the effects of various immobilizing drugs on free-ranging jaguarundis. Future research should explore other drugs or drug combinations for safe and effective immobilization for field research protocols.

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

Jaguar and Ocelot Population Estimation using Camera Traps in Mexico

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

The jaguar and ocelot are listed as endangered species within the United States and Mexico. In the United States, ocelots occur primarily in South Texas. However, an individual was recently photographed in southern Arizona. Conversely, the jaguar is thought to be extinct in Texas. The last known individual was trapped in southern Arizona several years ago. Both jaguars and ocelots still occur in Mexico in areas that have suitable habitat.

Ocelots are being monitored using camera traps, which is less invasive than capture and release methods.

We used camera trapping to estimate jaguar and ocelot populations at Rancho Caracol in the Sierra of Tamaulipas, Mexico over a 6-month period. Population density was estimated using capture-recapture models. We photographed 9 jaguars (4 males, 4 females, and 1 of undetermined sex) and 38 ocelots (17 males, 21 females) after 6,335 camera trap-nights, and obtained a population density estimate of 6.3 jaguars per 38 mi^2 and 30.2 ocelots per 38 mi^2.

Future ocelot translocations into Texas would benefit from using similar ecological cohorts from Tamaulipas. The ocelot population in Tamaulipas is likely adequate as a potential source for ocelot translocations into Texas. However, additional monitoring is recommended to determine what effect, if any, removing ocelots has on populations in Tamaulipas.

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

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

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

Bobcats are an important predator in Texas, acting in top-down ecological processes. Changing land use in Texas has increased urbanization and modified habitats through the application of brush management.

Our objectives are to determine how fine-scale movements of bobcats, as measured through fractal analysis, varied in response to brush manipulation, whether the analysis influenced home range size, and to test whether time bobcats spent in brush strips varied by time period. The study site comprised 3 pastures on the Santa Gertrudis Division of the King Ranch in Kleberg County, Texas. We trapped 9 bobcats (3 females, 6 males) from June 2011 to January 2012 and attached 8 Global Positioning Systems (GPS) collars to 2 females and 6 males.

Male and female bobcat home ranges averaged 1.9 mi^2 and 1.1 mi^2, respectively. Fractal analysis did not show movement differences between sexes or seasons. After pooling, an inverse relationship between indirect movements and home range size was detected. As movement paths became more indirect, home range size decreased. This may indicate greater search intensity or abundant resources in the area. Use of brush strips did not differ by time period, but were typically used in greater proportion at night than during daylight periods. Male and female bobcats on this study site used patches differently, with females using smaller patches with more indirect movements.

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CKWRI researchers are studying bobcat movements to understand how bobcats are exploiting their habitat.

Brush management practices that create fragmented landscapes may affect bobcat movement patterns, although larger sample sizes are needed to make further conclusions. Ultimately, understanding how predators react within shifting environments is important for wildlife biologists seeking to manage these lands for productive game management.

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

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

Ocelots and bobcats on the East El Sauz Ranch are part of a larger carnivore community that includes coyotes, raccoons, and other species. Remote camera stations have been established to monitor carnivore abundance, density, and coexistence at specific locations on the ranch.

First, we will identify different habitat use patterns, overlap, and competition between carnivores. Second, permanent camera stations will allow us to observe and monitor the health and survival of each species through time. This information will provide insight on the stability of populations and factors threatening stability.

Finally, through manipulation of camera sampling, we will determine the optimum combination and protocol to establish long-term monitoring with a minimum expense and time commitment for the landowner.

Remote triggered cameras have been set in 2 habitat patches where ocelots have been found. Cameras were placed along animal trails about 15 to 30 inches above the ground. Each survey grid consisted of 15 stations about 0.5 miles apart. Stations were equipped with either 1 or 2 cameras to document target species. Cameras were checked every 3 months.

Our most recent camera trapping session in the north grid logged 1,898 camera-nights. The photo survey yielded 1,748 photographs of animals, including 57 ocelots. Analyses of these photographs are being conducted. Additional camera surveys are planned to further monitor ocelot and bobcat populations on the East El Sauz Ranch.

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

Spatial Patterns and Local Avoidance of the Ocelot and Jaguarundi in Mexico

Arturo Caso and Michael E. Tewes

Ecological patterns of sympatric ocelots and jaguarundis have not been documented. Consequently, little is known about the coexistence of these felines in areas where their ranges overlap. This information is needed to develop better conservation strategies.

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Body measurements are being taken of a sedated ocelot prior to radio-collaring and release back into the wild.

In 1991, we conducted a study on the Los Ebanos Ranch in Tamaulipas, Mexico to assess home range size, habitat use, and activity patterns of ocelots and jaguarundis. We captured 21 jaguarundis (13 males, 8 females) and 29 ocelots (14 males, 15 females), and assessed their movements with radio telemetry. We evaluated ocelot and jaguarundi home range size, core areas of use, and activity patterns. In addition, availability of habitat compared to habitat use was assessed for both species.

Based on our study's findings thus far, mean home range size for male and female ocelots was 9.4 mi² and 5.3 mi², respectively. Mean home range size of male and female jaguarundis was 10 mi² and 7.5 mi², respectively. Home ranges of both species overlapped. However, core areas had a minimum overlap percentage. Ocelots were mainly nocturnal, whereas jaguarundis were active during daylight periods. In addition, ocelots used mature forest (82%) more intensively than other habitat types, whereas jaguarundis used mature forest (48%) less and other habitats more often.

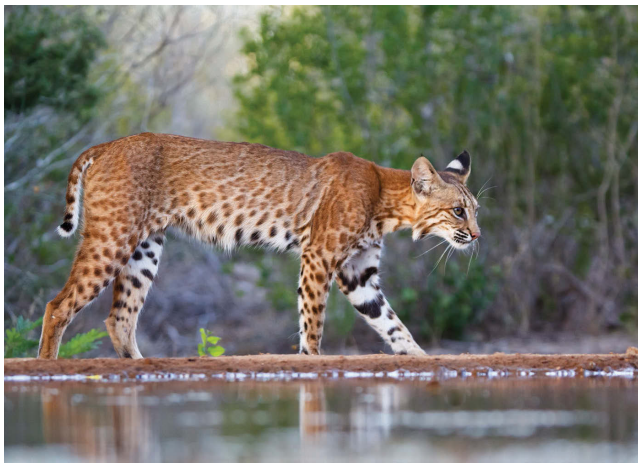
Although home ranges and core areas of both species overlapped, we found that jaguarundis kept a mean distance of at least 1.2 miles from ocelots. This finding suggested spatial avoidance of ocelots by jaguarundis. The reasons for this avoidance pattern, while not clear, may be attributed to the smaller-sized jaguarundi attempting to avoid physical conflicts with the larger ocelot. Further research is needed for clarification of this avoidance pattern.

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

Variety in Coat Patterns of Bobcats and its Potential Adaptive Value

Michael E. Tewes, Jan E. Janečka, John P. Leonard, Eric L. Rulison, Arturo Caso, and Jennifer M. Korn

The cryptic fur patterns that serve as camouflage for bobcats enable this cat to be a more efficient ambush predator. Consequently, bobcats are highly successful predators. They are widely distributed over most of the temperate regions of North America, ranging from northern Mexico, the United States, and southern Canada. This camouflage can have many variations in spots, rosettes, and other markings, as well as different colors of the background fur, including light gray, tan, and reddish brown.



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Variation in fur patterns among bobcats allows this species to occur across a wide range of habitats.

Our goal is to record the types of variation in spotting patterns and identify which ones are common and rare. Also, we will use genetic analysis to identify genes that are responsible for some of the spotting patterns.

We have over 400 bobcat photographs from McMullen and Willacy counties, Texas. These images have been collected using camera surveys from 2010 to 2013. Acquisition of photographs will continue into 2014 to increase our sample size. The results of this study may provide information regarding genes that have a direct impact on the survival of individuals and, ultimately, the adaptive fitness of this feline.

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

Long-term Abundance of Rodents using Ocelot Habitat and Response to Drought

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

Monitoring long-term changes in rodent dynamics in response to drought may aid in planning conservation strategies for the endangered ocelot in Texas. We surveyed prey populations on 2 sites where ocelots occur in Texas: Yturria Ranch in Willacy County and Laguna Atascosa National Wildlife Refuge (LANWR) in Cameron County.

On the Yturria Ranch from July 2009 to March 2013, 5 transects of 60 Sherman live traps were set adjacent to ocelot habitat. On LANWR from June 2010 to May 2012, 4 transects of 50 traps were placed in areas identified as primary release sites for ocelot translocation, and 3 transects of 50 traps were placed at secondary ocelot release sites. Traps were set for 4 consecutive nights. Captured rodents were given a unique numbered metal ear tag.

On the Yturria Ranch and LANWR, we captured 1,513 and 1,001 individuals comprised of 11 and 6 species, respectively. The hispid cotton rat, deer mouse, and Mexican spiny pocket mouse accounted for most of the captured rodents.

Though prolonged drought occurred in 2011, rodent populations on the Yturria Ranch remained stable due to localized rainfall events. Fall trap sessions had highest success. This was attributed to the influx of juveniles produced during the spring and summer breeding periods. Seed-eating species (e.g., Mexican spiny pocket mouse) comprised the majority of captures during drought periods. Trap success was higher on primary release site locations targeted for ocelots.

Detecting declines in prey populations in response to drought may provide an index for population health of ocelots. Additionally, providing baseline prey availability data will aid in future translocation efforts of ocelots in Texas.

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

An Evaluation of Ocelot Reintroduction Strategies

Gordon W. Watts, III and Michael E. Tewes

Currently, there are 3 small, isolated populations of ocelots in the United States. Strategies to maintain these populations include habitat restoration, establishment of road culverts, and translocation. Although translocation may ease some of the major threats to ocelots, the existing small populations would still be prone to catastrophic events such as disease outbreaks, hurricanes, and drought.

To buffer against these events, we will examine the possibility of reintroducing ocelots into their former range in Texas. Once established, the isolated populations could be incorporated into translocation strategies within Texas. Despite the absence of a large, suitable area to re-establish a single self-sustaining population, several smaller populations could function as a meta-

population through periodic translocation. We will evaluate habitat to determine the potential carrying capacity of reintroduction sites. In addition, we will use population viability analysis (PVA) to determine optimal translocation strategies needed to maintain ocelot populations.

Ocelot reintroduction strategies will likely require long-term, multi-collaborative efforts. In addition, it will require significant investments of knowledge, time, and finances. Given the unique niche the ocelot occupies in the ecosystem, it is vital that reintroduction efforts begin soon and continue into the foreseeable future to ensure that this species thrives in South Texas.

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

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

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

The East El Sauz Ranch, located in Willacy County, Texas contains 2 co-occurring felid species—the ocelot and the bobcat. The presence of coyotes and raccoons on the East El Sauz Ranch likely affects these felids since all are competing for small mammal prey. We evaluated the prey population to determine possible pressure and competition related to food resources among these carnivores.

Four trapping grids consisting of 100 Sherman live traps each were established to evaluate rodent populations. Traps were placed about 10 yards apart, thus effectively sampling about 2.5 acres per grid. The ranch has 2 focal habitat patches where ocelots occur more often. Thus, 2 grids were located in each focal area. Furthermore, grid location was evaluated based on vegetation that represented ocelot, bobcat, and coyote habitat. Traps were baited and set shortly before sundown for 4 consecutive nights.

The initial spring 2013 trapping season used 2 grids and yielded 5 rodents on grid 1 and 25 rodents on grid 2. Traps on grid 1 captured only kangaroo rats, whereas those on grid 2 captured white-footed mice and hispid pocket mice.

The low rodent populations may reflect the effects of a multi-year drought that has impacted the study area. Future rodent sampling will illustrate patterns of rodent abundance on the study area and the impacts of dry and wet periods. The analyses of these patterns will be used to monitor the population health of ocelots, bobcats, and other carnivores. Perhaps the information obtained in this study will clarify when competition for food and resources is highest.

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

Activity Patterns of Four Wild Cats in the Sierra Tamaulipas, Mexico

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

The Sierra Tamaulipas in northeast Mexico is an important area for Neotropical wild cat conservation. This area is unique in having 6 felids occurring sympatrically—the jaguar, puma, ocelot, jaguarundi, margay, and bobcat. These species have been studied separately in different study areas. However, there is no information on the interactions among these species where they occur sympatrically. Varying activity patterns may result in avoidance between felids and allow for the coexistence of sympatric species. The objective of this study is to test this prediction.

The activity patterns of jaguar, puma, ocelot, and jaguarundi will be investigated on 2 private ranches (the Caracol and Camotal) in the Sierra Tamaulipas, Mexico using digital remote-sensing cameras. To determine the activity patterns for each species, we will use the time stamp recorded on each photo, and the records will be grouped into 1-hour intervals. We will calculate

Ph.D. student Sasha Carvajal-Villarreal holding an anesthetized radio-collared ocelot prior to release.

the percentage of species photographed during each hour. Statistical analyses will be used to determine if each species exhibits similar activity during the day or night, and if jaguar and puma, or the smaller ocelot and jaguarundi have similar activity patterns.

These data will provide new information on the activity patterns and spacing of poorly studied wild cats in Mexico. Field data collection will continue after safety concerns in Mexico diminish.

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

Genetic Pedigree and Current Population Structure of Ocelots in Texas

Jennifer M. Korn, Michael E. Tewes, Jan E. Janečka, Randy W. DeYoung, Arturo Caso, Linda Laack, Jody Mays, Alfonso Ortega-Sanchez, Jr., and Lon I. Grassman, Jr.

The ocelot is an endangered felid that ranges from southern Texas to Argentina. Populations in Texas have declined because of habitat loss and fragmentation, causing a loss in genetic diversity and decreased gene flow.

Until recently in Texas, ocelots were known to occur as 2 isolated populations, one on the Yturria Ranch in Willacy County and the other on the Laguna Atascosa National Wildlife Refuge in Cameron County. A population discovered on East El Sauz Ranch in Willacy County provided the opportunity to assess genetic diversity and structure of the newly found population, differentiation among the 3 populations, and estimate temporal changes in diversity. We sampled 177 captured and road killed ocelots spanning the period from 1987 to 2013, and used 16 microsatellite loci to construct genotypes.

Genetic analyses revealed that ocelots in Texas have continued to lose genetic diversity. They are experiencing severe genetic drift and the 3 populations are genetically differentiated. The population on Laguna Atascosa Refuge continues to have the lowest diversity and rare to non-existent dispersal between the populations in Willacy County. Within the last 25 years, only one parent-offspring assignment occurred between Willacy County and Laguna Atascosa. The East El Sauz population retains the highest levels of ancestral variation, possibly due to intermittent dispersal from the Yturria population and unknown areas.

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CKWRI graduate students are obtaining vital genetic information on the endangered ocelot.

Future ocelot management options include translocation and the creation of habitat corridors that facilitate movements of individuals among populations, especially given the low dispersal and high incidence of roadkill mortalities. The population on East El Sauz may be an important source of individuals for future conservation strategies.

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

Major Histocompatibility Complex Allele Assessment among Ocelot Populations

John P. Leonard, Michael E. Tewes, Randy W. DeYoung, Jan E. Janečka, and Eric L. Rulison

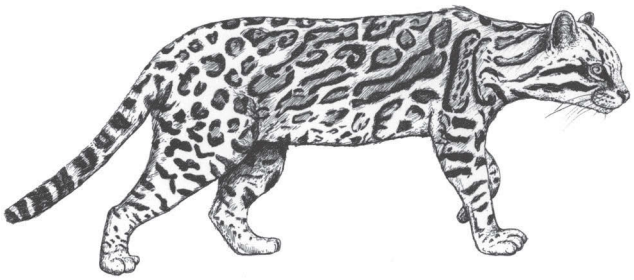
The Major Histocompatibility Complex (MHC) is a gene family thought to play a major role in maintaining the health of wild animal populations. The MHC is broadly divided into 3 regions known as Class I, Class II, and Class III. Of these regions, Class II genes have been among the most diverse genes in vertebrates.

In Texas, the ocelot is confined to isolated breeding populations, occurring primarily in Willacy and Cameron counties. Previous studies have found ocelot microsatellite diversity to be lower in these populations than in nearby Tamaulipas, Mexico. It is unclear how the loss of functional genetic variation reflects the loss of microsatellite diversity.

To examine the level of functionally important MHC diversity, we will sequence the appropriate gene base pair fragment from both historical and current ocelot tissue samples originating from South Texas. Also, we will sequence this gene fragment from tissues of ocelots originating in Tamaulipas, Mexico.

We predict that historical samples will show a higher MHC diversity than current samples, and that samples from Tamaulipas, Mexico will show higher MHC diversity than those from South Texas. Because the maintenance of MHC diversity is an important goal in managing populations that are highly isolated, findings from this study can be used to help guide future translocation efforts.

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



D. Thompson

The Comanche-Faith Project

Charles A. DeYoung, David G. Hewitt, Timothy E. Fulbright, Kim N. Echols, Don A. Draeger, Nathan S. Cook, Dawson W. Lilly, Asa S. Wilson, Whitney J. Priesmeyer, Blaise A. Korzekwa, Lindsey M. Phillips, Lindsay D. Roberts, John H. Clark, Emily H. Belser, Blaise Keller, Jay R. Kolbe, and Victoria Haynes

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

On each ranch, we are using 6 high-fenced enclosures of 200 acres each. The enclosures were constructed in 2003 with research beginning in 2004.

Phase I

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

Phase II

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

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

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

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

Cooperative funding provided by the Comanche Ranch, T. Dan Friedkin, Faith Ranch, and Stedman West Foundation. Additional student support was provided by several named endowments and scholarships and the Hispanic Leaders in Agriculture and the Environment scholarship.

Deer Density and Supplemental Nutrition Effects on White-tailed Deer Populations

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

Supplemental nutrition, deer density, and drought are thought to impact population dynamics of white-tailed deer in South Texas. The objectives of this research are to evaluate several techniques used to estimate deer numbers and to determine survival, productivity, antler development, and population growth rate of white-tailed deer in a semiarid environment with respect to deer density, supplemental feed, and drought. These demographics will then be used in a simulation model of a deer population on a 5,000-acre ranch. This model will provide information concerning the ultimate long-term effects of drought, deer density, and supplemental nutrition on deer herds.

Our goal is to offer landowners specific guidance regarding the optimum deer density, both with and without pelleted feed and in the presence of periodic drought that will produce the greatest number of trophy white-tailed deer. Results of this research will help landowners and land managers make decisions about effective and healthy deer densities for their deer herds given the positive effects of pelleted rations on carrying capacity.

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

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

The use of pelleted feed in deer management has become increasingly widespread since it was first introduced in the early 1980s. Supplemental feed increases deer production, thereby raising deer densities. High deer densities can impact natural food availability, stress existing social hierarchies, and may ultimately influence individual deer habitat selection. The purpose of this study is to examine the effects of deer density and feed on deer habitat choice. In addition, the study will determine what factors influence deer habitat selection throughout the year.

In December 2009, 4 white-tailed deer (2 males and 2 females) in each of 8 enclosures were equipped with Global Positioning Systems (GPS) radio collars on the 2 study ranches. The paired enclosures used were high density (40 deer) and low density (10 deer) with ad libitum pelleted feed available to one of each density pair. The GPS collars collected coordinate locations every 30 minutes and logged activity levels every 15 minutes. They were removed in December 2010. Deer locations will be plotted using ArcGIS software. Habitat types will be determined using ERDAS Imagine and NRCS soil data software. We will then compare habitats used by the GPS-collared deer to the habitats within each enclosure.

The common acceptance of supplemental feeding programs requires wildlife managers to understand how altering natural deer densities may impact deer social interactions and habitat choices. This understanding will foster the development of a stronger management approach.

Impact of Deer Density and Supplemental Feeding on Shrubs

Whitney J. Priesmeyer, Eric D. Grahmann, Timothy E. Fulbright, David G. Hewitt, Charles A. DeYoung, Carlos E. Gonzales, Kim N. Echols, and Don A. Draeger

Supplemental feeding has been used to assist white-tailed deer populations in surpassing carrying capacity while reducing impacts on vegetation communities. However, access to supplemental feed may lead to disproportionate consumption of palatable over unpalatable browse species.

Percent canopy cover of shrubs was estimated each June during 2004–2012 using the line-intercept method on 20 transects within each of 12 enclosures. Change in canopy cover was compared from the beginning of the study in enclosures with and without supplemental feed and among deer densities to determine if feeding results in reduced canopy cover of pal-

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CKWRI researchers are studying how shrubs are impacted by supplemental feeding programs for deer.

atable shrubs. Our results suggest that supplemental feeding and deer density do not affect canopy cover of shrubs in the semiarid environment of South Texas.

Influence of Feed-site Density on Deer Visitation to Supplement in Summer

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

Supplemental feeding is a widespread practice in much of South Texas and provides white-tailed deer with extra nutrients. However, feeding sites can be easily defended by dominant deer, which could affect patterns of feeder use by subordinate deer. Bucks are generally dominant over does and yearlings, and does and yearlings are dominant over fawns.

The objective of this study is to determine if feeder density influences the timing of feed site visitations based on deer social hierarchies. We predict that low feeder densities will cause less dominant deer to feed at less favorable times of the day. We will use 2 pairs of enclosures with 60 deer and 1 feed site and 60 deer and 3 feed sites.

Camera surveys will occur every other week on both ranches from June to August 2013. A majority of the research deer have been previously aged, sexed, and marked with uniquely identifiable ear tags. Individual deer will be counted in the photos and grouped by timing of feed site visitation to identify patterns of feed site use. We will compare deer visitation times between the high and low feeder densities to determine whether additional feeders alleviate hierarchical deer conflicts.

Understanding how deer behavior may change to accommodate feeder use is important to good deer management. This research will offer wildlife managers additional insight into how feed-site density affects deer behavior and will provide specific direction for determination of an appropriate feeder density for a given management program.

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

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

Supplemental feeding of white-tailed deer is a common practice throughout Texas. This management approach, paired with high-fencing, has improved deer

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Many ranches use supplemental feed to maintain their deer populations and help meet desired management goals.

nutrition and increased deer populations. In March 2013, deer with previous experience eating supplemental feed and others with no such experience were relocated into research enclosures. The objective of this study is to assess feed site visitation as influenced by a deer's prior experience with supplemental feed.

Camera surveys will be conducted in each enclosure during 2, 1-week periods each month from May through August 2013. Cameras will be placed at all feed sites with photograph triggers set at 5-minute intervals between pictures. The number of visitations to feed sites by all tagged deer will be tallied.

We predict deer that did not change enclosures and deer with previous exposure to supplemental feed will have a greater number of visitations than those deer that were not previously exposed to supplemental feed. We also predict that these differences will be greater at higher deer densities and will diminish as the summer progresses. Findings of this research will offer ranch managers information on how deer acclimate to supplemental feed sites and increased densities.

White-tailed Deer Behavioral Patterns in Relation to Supplemental Feeding

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

A common deer management practice throughout Texas is supplemental feeding. This practice, paired with high-fencing of properties, creates deer populations that may steadily increase. This study will allow us to determine the effects that provision of supple-

mental feed and increased density have on sexual segregation and activity levels in deer.

In December of 2009, Global Positioning Systems (GPS) collars were placed on adult does and bucks in enclosures with densities of 10 and 40 deer per 200 acres. Each ranch had 2 enclosures at each density and 1 of the enclosures of each density was provided supplemental feed. GPS locations were obtained every 30 minutes and information on vertical/horizontal head movements was collected every 15 minutes for 12 months. To determine the degree of sexual segregation, distance between each buck and each doe in the same enclosure will be calculated for each GPS recorded location. Distance moved between GPS locations and the vertical/horizontal head movements will be averaged among each season and period of day to determine activity patterns.

As ranch managers continue to provide supplemental feed and manage deer at increased densities, the effects of these conditions on white-tailed deer behavioral patterns should not be overlooked. This study will help landowners and ranch managers understand how their deer management programs affect behavioral patterns of white-tailed deer.

White-tailed Deer Fawn Use of Supplemental Feed Sites

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

Fawn survival is critically important for a productive deer population. Supplemental feed provides an alternative source of nutrition during weaning, but fawns may not have full access because they are subordinate to other deer in the feeding hierarchy. This study will allow us to determine the effects of deer and feeder density on fawn visitation rates at supplemental feed sites. In addition, we will obtain information about the intensity of supplemental feed use by individually marked fawns.

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Proper fawn nutrition is an essential component of successful deer management programs in South Texas.

Camera surveys will occur from September 2013 to March 2014. In December 2013, we will capture fawns via helicopter, which will be ear tagged with unique color and number combinations and fitted with Global Positioning Systems (GPS) collars. Intensity of supplemental feed site use by fawns will then be measured from December 2013 to March 2014 by calculating the number of times an individually marked fawn visits a feed site per day. We will use GPS data to determine a fawn's proximity to the supplemental feed sites. We will use camera data to determine whether a fawn was allowed access to the feed.

In order for a supplemental feeding program to achieve its full potential, feed must be accessible to fawns. This study will help wildlife managers determine fawn access to supplemental feed based on deer density and feeder density.

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

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

Supplemental feeding may be used to combat the negative effects of overbrowsing by white-tailed deer. However, it is unclear if increasing feeder density will change the foraging habits of deer. The objectives of this study are to determine (1) the maximum number of supplementally-fed deer that can be supported without damage to the vegetation and (2) how feeder density influences deer foraging on vegetation.

Each June, during 2013–2018, pre-established vegetation transects will be sampled on both study ranches to determine the effects of increasing deer densities on the vegetation. Several palatable species will also be monitored using pairs of plants in which 1 plant from each pair is protected against deer browsing using wire cages. Five pairs of kidneywood, granjeno, blackbrush, hogplum, and desert yaupon, as well as 12 pairs of bushsunflower and desert lantana will be sampled each June and July. In addition, 12 pairs of low menadora and blackfoot daisy will be sampled each March and May.

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CKWRI researchers are evaluating foraging behavior of deer with and without access to supplemental feed.

We predict that as deer densities increase, vegetation production and diversity will decrease, with a browsing line becoming more apparent. However, increasing feeder density may reduce the negative effects of deer browsing.

By measuring the effects of deer browsing on preferred species of vegetation at different deer and supplemental feeder densities, managers can determine the efficiency and effectiveness of providing supplemental feed. This knowledge could be used by wildlife managers to support deer densities that provide more hunting opportunities while avoiding overuse of the habitat.

Influence of Deer Density and Supplemental Feed on Forbs and Sub-shrubs

Whitney J. Priesmeyer, Timothy E. Fulbright, David G. Hewitt, Charles A. DeYoung, Donald J. Folks, David B. Wester, Kim N. Echols, and Don A. Draeger

Increased deer densities and providing supplemental feed may damage the habitat by shifting vegetation composition from more to less palatable plants. We tested the hypothesis that increasing deer density and providing supplemental feed results in reduced cover of preferred forbs and sub-shrubs, shifts the grass-to-forb ratio in favor of grasses, and increases unpalatable forbs and sub-shrubs.

Percent canopy cover of forbs and sub-shrubs was assessed during June from 2004–2012 by estimating species cover in 60 10 x 20 inch frames per enclosure. Standing crop was estimated during spring and summer 2004–2012 using 40 0.8 ft^2 plots per enclosure.

Percent canopy cover of palatable forbs was similar between enclosures with supplemental feed and those with no feed, and was similar among deer densities. Absolute canopy cover of palatable and unpalatable forbs was greater than 5% only during the wet years of 2007, 2010, and 2012. The ratio of standing crop of forbs, and forbs and sub-shrubs combined, to grasses varied among years in spring and summer because of variation in rainfall. The ratio of forbs to grasses was greatest in low deer density enclosures with supplemental feed.

It appears that supplemental feed does not lead to excessive use of palatable forbs and sub-shrubs by deer. However, it does reduce foraging pressure on palatable sub-shrubs at low deer densities.

The Effects of White-tailed Deer Density on the Disappearance of Prickly Pear Mast

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

Prickly pear is the most prevalent cactus in South Texas. Because of the dry summer conditions typical in this semiarid climate, this cactus acts as both an alternate water source and an important source of digestible energy for white-tailed deer and other wildlife. The objective of this study is to assess the amount of prickly pear consumed by supplementally-fed deer at different deer and feeder densities.

Five prickly pear plants will be chosen in each of the 12 enclosures from June to August 2013. A fruit and flower count will be conducted at weekly intervals to determine the disappearance rate of prickly pear within the enclosures. The specimens will be chosen near the start of existing transects established during Phase I of the study. The total number of ripe fruits, green fruits, and flowers of prickly pear will be compared across enclosures that vary in deer density and number of feed sites.

Deer in enclosures that have a higher deer density are predicted to consume more prickly pear fruits and flowers than those in low deer density enclosures. This study will provide a better understanding of deer use of prickly pear during summer and may help landowners better understand the need to conserve cacti as part of their deer management program.

**** End of In-Progress Research for Comanche-Faith Project ****

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

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

Deer Management Permits (DMPs) are issued by the Texas Parks and Wildlife Department for the purpose of controlling breeding in white-tailed deer. The study is being conducted on the Faith Ranch in Dimmit County, Texas and is evaluating how DMP permits can affect antler size in a population.

Two, 1,100-acre treatment and control pastures surrounded by high fence were established in 2007. Both pastures are under identical supplemental feeding programs. Resident deer were removed from the treatment pasture prior to this study, and the treatment pasture has been replenished with DMP sired offspring. The control pasture has resident deer that were enclosed when the high fence was constructed. DMP pens are stocked with native deer from the property. Fawns are marked in DMP pens and the control area each year with ear tags specific to year-of-birth. Each fall, marked bucks that are DMP offspring and marked bucks in the control area are captured via helicopter. Antler size is compared within age classes.

In 2012, there was no difference in Boone and Crockett (B&C) score between treatment yearlings (1.5 years) and control yearlings. Also in 2012, treatment bucks compared to controls averaged as follows: 2.5-year-olds +3 B&C inches, 3.5-year-olds +8 B&C inches, 4.5-year-olds +27 B&C inches, and 5.5-year-olds +5 B&C inches. The study will continue for several more years.

Cooperative funding provided by the Faith Ranch.

Activity Patterns of White-tailed Deer on Low-Energy Diets

Breanne N. Carr, David G. Hewitt, Randy W. DeYoung, Ryan L. Reitz, and Donnie Frels

Dietary energy is important to animal growth and maintenance. However, energy is often limiting in forage of white-tailed deer in Texas. If energy is limiting, deer might compensate by reducing their activity. We will determine if deer maintained on a low-energy diet will compensate by reducing their activity and spending more time bedded and less time walking, running, or interacting with other deer. This research is part of a long-term study on the effects of low-energy diets conducted at the Donnie Harmel White-tailed Deer Research Facility located on the Kerr Wildlife Management Area, west of Kerrville, Texas.

Forty-four yearling deer (less than 6 months old) were maintained on a low-energy diet and 43 yearlings were maintained on a standard diet starting in October 2012. Males and females were maintained in separate pens for each treatment. We quantified behavior during four-day periods in January and March. Deer were observed every 10 minutes during daylight hours, and the proportion of deer in each of the following activity categories was recorded: bedded, standing, walking, running, feeding, and interacting socially.

Changes in activity patterns of white-tailed deer will be correlated with changes in growth rates, body size, body condition, and reproduction to better understand the effects of chronic exposure to diets low in energy. The results will have implications for deer management in semiarid regions of Texas, where high-energy foods are limited during droughts.

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

A High-tech Approach to White-tailed Deer Food Habits

Landen R. Gulick, David G. Hewitt, Michael J. Lavelle, and Kurt C. VerCauteren

The South Texas Brush Country has a wide diversity of forage species for white-tailed deer. Despite the importance of foraging and nutrition to white-tailed deer population dynamics and management,

Collars with motion-activated video cameras enable scientists to study many aspects of deer ecology.

most techniques used to measure diet composition of deer are biased. Digital video technology has progressed sufficiently to enable mounting a camera on a deer collar. Videos taken while animals forage can provide unbiased insight into deer diet composition. The objective of this study is to assess the use of video from cameras mounted on deer collars as a method to determine white-tailed deer diets in South Texas.

Our study site is located in Zapata County, Texas along the Rio Grande River. Twenty-six male white-tailed deer were captured using a net gun fired from a helicopter. Each deer was fitted with a motion-sensing video camera mounted on a collar. When triggered, the camera records a 30-second video at 5-minute intervals throughout the day. We are examining 1,200 video clips of foraging collared deer and are identifying the plant species on which the deer foraged.

This study will provide a better understanding of white-tailed deer food habits in South Texas rangeland habitats. Deer research and management efforts will benefit from the information provided by our study.

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

Foraging Ecology of Unmanaged Deer in Southern Texas

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

White-tailed deer management programs have been adopted by many landowners throughout southern Texas, making deer populations not under active management uncommon. Unmanaged white-tailed deer populations provide an increasingly rare opportunity to obtain baseline data on diets, body weight, body condition, and population parameters. Such information, when compared to managed populations, will provide insight regarding the effects of current deer management practices.

This research is focused on the foraging ecology of unmanaged deer populations. We will use non-radioactive forms of isotopes known as stable isotopes found in deer tissues and vegetation. This technique will be used to determine the proportion of C3 (shrubs and forbs) versus C4 plants (warm season grasses) and cacti consumed by individual deer. To provide such data along soil and precipitation gradients across

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Researchers are studying an unmanaged deer population in South Texas to obtain information on basic ecology.

southern Texas, we will capture about 750 white-tailed deer each autumn from 2011–2015 on 4 East Wildlife Foundation properties on which deer are not managed. We will then use the stable isotope ratios of deer tissue and vegetation to determine the proportion of C3 versus C4 plants and cacti in an individual deer's diet as it relates to deer age and sex, precipitation, and vegetation community.

This study will provide valuable insight into the foraging habits of unmanaged white-tailed deer. This information will allow researchers to better understand the interactions between white-tailed deer and their environment on rangelands in South Texas.

Cooperative funding provided by the East Wildlife Foundation.

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

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

Genetic improvement in antler size is common with selective breeding in confined white-tailed deer. However, data are limited regarding the effects of culling on ranch-sized white-tailed deer populations. A 10-year buck culling study is being conducted on large acreages to provide a better understanding about what can be expected from various buck-culling practices.

Bucks are captured annually by helicopter and net gun on 3 areas of the Comanche Ranch in Maverick

County, Texas. The randomly captured deer are aged and measured for Boone and Crockett (B&C) score. Bucks meeting the culling criteria are sacrificed, and the meat donated to worthy users. Bucks not meeting culling criteria are released after a microchip is implanted. On one area, we cull yearlings less than 6 points, 2-year-olds less than 8 points, 3 and 4-year-olds less than 9 points, and 5-year-olds and older with a gross B&C score less than 145. On another area, all the yearlings and 2-year-olds are released and the older deer culled by the same criteria as above. Finally, a third area serves as a control and all bucks captured are released.

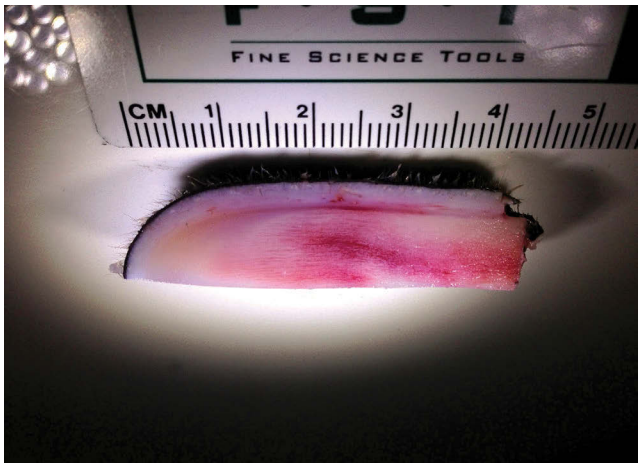
After 7 years of study, 3,155 individual bucks have been caught, of which 1,870 have been culled and 1,285 released. In addition, 1,324 bucks have been recaptured. The study will continue for 3 more years.

Cooperative funding provided by the Friedkin Conservation Fund.

Antler Growth as a Potential Therapeutic Model for Human Bone Injury and Disease

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

Antlers are cranial appendages unique to the family Cervidae (commonly known as deer). Males of all species in this family grow antlers, while only female caribou and reindeer grow antlers under normal conditions. Unlike horns, antlers are unique in that the tissues are cast and re-grown each year.



Tissue from growing antlers is studied to better understand bone growth, which has implications for human medicine.

The casting and regeneration process is triggered by hormonal fluctuations that are regulated by changes in day length. Antlers are the most rapidly growing non-cancerous tissue and the only appendage that mammals can re-grow. Therefore, antler regeneration could be used to develop a therapeutic model for the repair of bone injuries or disease. Unfortunately, antler growth is poorly understood at the molecular level. Knowledge of the cellular and genetic mechanisms that underlie antler growth is needed to provide clues about the potential for human limb repair.

We will characterize gene expression by sequencing the RNA in growing antlers and other relevant tissues. The RNA profiles will be compared to the genome sequence to identify candidate genes involved in antler regeneration. Once the initial analyses are complete, we will investigate the genes that cause differences in antler growth and regeneration by comparing sequence diversity in animals on either end of the antler-growth distribution.

The results from this study will lay the groundwork for the eventual development of tissue engineering strategies applicable to human health care. In addition, we will gain the ability to understand the white-tailed deer's long history of evolution and adaptation to its wide distribution in the New World.

Cooperative funding provided by the Baylor College of Medicine.

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

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

The increase of urban sprawl leads to more human-wildlife conflicts. To formulate effective management recommendations, reliable estimates of wildlife population sizes and home ranges are needed. The City of Fair Oaks Ranch, Texas is 27 miles north of San Antonio and has a white-tailed deer population judged overabundant. We are conducting a 2-year study to estimate deer population size and movement throughout the city and adjacent landholdings. After fieldwork, we will model different management practices designed to reduce the population, with particular focus on contraceptives.

We captured 458 white-tailed deer (178 males, 280 females) during January–April 2012 and January–March 2013 using drop-nets baited with corn through-

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Unrestrained urban deer populations are a major concern for both residents and wildlife managers.

out the city. Each deer was sexed, aged, and marked with individually numbered plastic livestock ear tags. VHF radio transmitters were placed on 38 of the deer in 2012 and 30 in 2013. Deer with transmitters are located weekly using a receiver and portable antenna. Surveys are conducted monthly from a vehicle along city streets to produce a scientifically-sound estimate of population size. Fixed kernel home ranges were calculated in the ArcGIS 10.0 computer program for deer that received transmitters in 2012.

The average 95% fixed kernel (± standard error) for females was 41.9 ± 9.7 acres with a 50% core area of 9.0 ± 1.4 acres. The average 95% fixed kernel for males was 65.7 ± 14.7 acres with a 50% core area of 12.9 ± 2.5 acres. Population estimates were determined using a mark-resight method in the computer program MARK. Based on more than 8 sampling periods, population estimates (± standard error) ranged from 1,152 ± 38 to 1,942 ± 60 white-tailed deer. The final field season will be completed in December 2013.

Cooperative funding provided by City of Fair Oaks Ranch.

The Effects of Culling on the Distribution of Breeding in White-tailed Deer

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

Culling is the selective removal of individuals. It is a widely practiced management technique. Previous research on captive deer has demonstrated that the genetic potential for antler development can be altered by selective breeding. Therefore, it may be possible to affect the genetic potential for antler development in wild deer by culling deer with poor antlers.

For a culling program to succeed in wild deer, one must assume that bucks with desirable antler traits will breed. Breeding success in wild deer is spread among many individual bucks, but is clearly affected by competition from other bucks. One unavoidable result of culling is that the process removes many bucks, which probably will affect competition for mates. Even the most efficient culling program cannot remove all undesirable bucks each year. Consequently, the proportion of fawns sired by bucks with undesirable antlers may not change if competition is low. In addition, the effects of generation time and offspring production mean that there is an optimal male age structure for population response to selection.

We will analyze tissue samples collected during a 10-year study of culling efficacy on the Comanche Ranch in Maverick County, Texas. We will use genetic markers to estimate breeding success of bucks, quantify breeding by age and antler characters, and compare the distribution of breeding among 2 culling treatments and a control. Finally, we will estimate selection intensity using the "lifetime" breeding success of bucks in the treatments.

The information obtained in this study will help us understand how culling affects the distribution of breeding. This is an important but little-known part of the culling process.

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

Population Parameters of Unmanaged White-tailed Deer in Southern Texas

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

Intensive white-tailed deer management is pervasive, especially in Texas. Populations not subjected to harvest or other management provide a baseline for diets, body weight, body condition, and population parameters. Such information is needed to understand the magnitude of change resulting from modern deer management. To provide such data along precipitation and soil gradients across southern Texas, we will

capture about 750 white-tailed deer each autumn from 2011–2015 on 4 East Wildlife Foundation properties where deer are not managed. We will record gender, body mass, body condition, age, antler size, and lactation status of each deer captured.

We captured 736 deer in 2011 and 761 deer in 2012. Preliminary results of the body mass of middle age and mature deer showed a moderate east-west gradation (coastal populations to 100 miles inland). This trend may be confounded among ranches because of variation in soils and precipitation. Weights of young deer did not show these same trends, suggesting that early growth rates are similar. However, deer on the western-most study site continue to grow, whereas deer on the coast cease growth at an earlier age. Gross Boone and Crockett antler scores of males showed a similar trend to body mass, suggesting that they may be correlated to body size.

Greater insight into the effects of environmental conditions will be gained as more data are obtained in subsequent years. This study will help our understanding of how environmental variables, such as rainfall, affect unmanaged white-tailed deer populations in South Texas.

Cooperative funding provided by the East Wildlife Foundation.

Timing of Northern Bobwhite Breeding in a Semiarid Environment

Ian C. Trewella, Fidel Hernández, Bart M. Ballard, and David G. Hewitt

Northern bobwhite abundance is known to be highly correlated with the amount of rainfall in semiarid lands. The close relationship with rainfall results in dramatic population fluctuations, which is often called the "boom-and-bust" cycle. In relatively unpredictable environments such as the Rio Grande Plains of southern Texas, northern bobwhites may rely more on local stimuli such as rainfall and landscape appearance to adjust their breeding schedule instead of relying solely on photoperiod.

The objectives of this study are to (1) experimentally test the breeding response (laying date, nesting season length, and egg-laying rate) of bobwhites to rainfall and landscape appearance in a captive setting and (2) quantify the reproductive response (percentage of hens nesting, laying date, nesting rate, and nesting season length) of bobwhites to rainfall and temperature using data from a long-term field study.

Preliminary results suggest that northern bobwhite hens positively responded to rainfall in both captive and field settings. Early spring rainfall resulted in hens initiating nests earlier in the breeding season while increased late summer rainfall prolonged the nesting season. Late summer rainfall also increased the number of nests per hen. Temperature negatively affected nesting rate. Vegetation color appeared to have no influence on the timing of egg laying.

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

Northern Bobwhite Population Structure and Diversity in Texas and the Great Plains

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

Northern bobwhite populations have experienced severe declines in size and geographic distribution. The decline has been attributed to changes in land use and habitat suitability that interrupt connectivity among populations. Therefore, the effects of habitat fragmentation might be manifested in genetic structure. Our goal is to assess the effects landscape features on the population structure and diversity of the northern bobwhite in Texas and the Great Plains.

We extracted DNA from hunter-harvested northern bobwhites from 28 sites in Texas, Oklahoma, Kansas, and Missouri from 2004–2011 and amplified 7 DNA microsatellite loci. We determined allelic diversity, structure (FST), and distance (DST) among sites. We compared pairwise FST and DST values to geographic distances among sites as well as soil types, land cover features (National Bobwhite Conservation Initiative), and temperature using models of resistance to movement. We also tested for associations among variables.

We observed low levels of genetic population differentiation (FST < 0.01). Most variation was within individuals versus sites or regions. There was a weak correlation of FST to soil type and temperature models in South Texas. This weak association with landscape features may reflect a greater dispersal capability than previously assumed, or that populations are extirpated through demographic fluctuations before loss of diversity is detected.

We will add additional genetic markers and fine-tune our resistance maps. This will help us to better determine the effect that habitat continuity and fragmentation have on northern bobwhite populations, and how we can manage for the species.

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

Ecological Niche Modeling of the New World Quails in Western North America

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

The geographic distribution and range limits of terrestrial and semi-terrestrial species are heavily influenced by temperature and precipitation. Human-induced climate change will alter temperature and precipitation regimes. This will have direct, possibly negative, effects on geographic distributions of gamebirds. Maximum likelihood ecological niche models (ENMs) can be used to predict how these species have responded to past changes in climate. In addition, ENMs will help predict how quail respond to an increasingly warm climate.

We are currently constructing ENMs for the mountain, scaled, Gambel's, California, and Montezuma

quails. We will use 19 temperature and precipitation variables and occurrence data to construct initial ENMs that represent the potential geographic distribution of each species under current conditions. The initial model of each species will be used to predict the past distribution under the conditions of the colder Last Glacial Maximum (21,000 years ago) and the Last Interglacial (120,000–140,000 years ago), which was slightly warmer than today.

Preliminary models constructed for the California and mountain quails suggest that their potential distribution has not changed much since the Last Interglacial. In contrast, ENMs constructed for the Gambel's and scaled quails indicate that the geographic distributions of these southwestern species expanded northward during warmer periods (Last Interglacial Maximum and today), but contracted southward during the Last Glacial Maximum. The distribution of the Montezuma quail appears to have remained relatively stable since the Last Glacial Maximum, but largely disappeared from the United States during the Last Interglacial.

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

Scaled Quail Habitat Use and Resource Selection

Holley N. Kline, Richard H. Sinclair, II, Blake A. Martin, Timothy E. Fulbright, Fidel Hernández, Eric D. Grahmann, Michael W. Hehman, and Leonard A. Brennan

Scaled quail populations have been declining since the 1960s throughout their range, but the trend is particularly apparent in South Texas. While the cause of the scaled quail decline has not been determined, habitat loss and habitat fragmentation may be the driving factors. The objective of this study is to test the hypotheses that scaled quail (1) prefer landscapes with low levels of exotic grasses and (2) select less fragmented landscapes.

Scaled quail will be radio-collared and located during April to August 2013 and 2014 on 3 ranches in LaSalle County, Texas. Vegetation composition and air and soil temperatures will be determined at bird relocations, nest sites, and random sites. Each bird location will be imported into a Geographic Information Systems (GIS) database and used to establish estimates of home range and core area sizes. Vegetation variables and temperatures will be compared between used and random sites to determine habitat selection at the individual, core area, and home range scales.

Currently, 55 scaled quail have been radio-collared and relocated. Average woody canopy cover and average prickly pear canopy cover at used sites was 12% and 2% greater than at random sites. Woody plant height averaged 1.6 feet taller at used sites than random sites. Additionally, average soil temperatures at used sites were 9°F lower and temperatures experienced by the birds have been 4°F lower than at random sites. Our results are too preliminary to draw conclusions, but we hope to identify habitat variables important for creating and maintaining usable areas for scaled quail.

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

Simulating Relative Abundance in Response to Drought and Land Management

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

There are management options to reduce population declines of bobwhites during periods of drought. These include reducing harvest and grazing intensity and performing habitat management (i.e., brush management, prescribed fire). Management actions are often applied simultaneously. However, it is not clear if simultaneous treatments have a greater capacity to influence long-term mean abundance (hereafter, abundance) than individual treatments. Our objectives are to (1) identify which treatments have the great-

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Northern bobwhites are exposed to a wide range of harsh environmental conditions in South Texas.

est capacity to influence abundance during simulated periods of drought and (2) assess the benefit of simultaneous management treatments.

We developed a systems model that predicted northern bobwhite abundance, which used previously modeled relationships. We simulated abundance in response to a drought by (1) artificially reducing harvest and grazing intensity, (2) creating 2-year and 5-year cycles of management frequency, and (3) a combination of harvest and grazing reductions with the management cycles.

Our results suggested that reductions of harvest and grazing yielded the largest estimates of abundance. Applying these treatments simultaneously resulted in increased estimates of abundance. Frequent applications of habitat management resulted in smaller estimates of abundance than did less frequent applications.

These preliminary findings suggested that individual applications of grazing and harvest have the greatest capacity to influence bobwhite abundance during drought. This was followed by simultaneous applications (but the 2 were not statistically different).

Cooperative funding provided by the South Texas Chapter of the Quail Coalition and King Ranch, Inc.

Occupancy, Survival, and Nesting Ecology of Scaled Quail in the South Texas Plains

Richard H. Sinclair, II, Fidel Hernández, Timothy E. Fulbright, Eric D. Grahmann, and Leonard A. Brennan

Scaled quail populations are declining across their range, particularly in the South Texas Plains. Although the actual cause of the decline is unknown, habitat loss resulting from extensive root plowing and the increase in non-native grasses over the past 30 years may be driving the decline. A diverse woody plant community with sparse herbaceous cover characterizes scaled quail habitat. We hypothesize that root plowing has decreased brush diversity, while the concurrent propagation of non-native grasses and reduction of livestock stocking rates have increased herbaceous cover.

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Very little is known about the scaled quail population occurring in the South Texas Plains region.

To evaluate our hypothesis, we will estimate occupancy and detection probability of scaled quail on 3 study sites in La Salle County, Texas. Each site represents a low, medium, or high relative abundance of scaled quail. Each site will contain 20 survey points. We will measure macrohabitat and microhabitat characteristics at each survey point to assess the influence of these variables on occupancy and probability of detection. We also will determine spring-summer survival and reproductive success of scaled quail via radio telemetry (n = 60 quail) during April–August 2013 and 2014.

This study will provide important data on the life history and ecology of the scaled quail population in the South Texas Plains. Our goal is to use this information to develop effective management strategies for areas currently experiencing a population decline.

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

Bobwhite Habitat Restoration in South Texas: Habitat Use

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

Monotypic stands of exotic grasses are poor habitat for northern bobwhites. To date, no large-scale studies have been conducted to determine if restoring native vegetation in areas dominated by exotic grasses increases bobwhite use and densities.

We initiated this study to determine if restoring native herbaceous and woody plants on a 300-acre area will increase use of the area by bobwhites and result in greater abundance. We will determine whether bobwhites prefer to forage and nest in areas with restored vegetation compared to an experimental control area.

The thermal environment is an important factor limiting usable space for bobwhites. We will document the thermal environment of the restoration area

and control area to determine its influence on bobwhite habitat selection before and after restoration. In addition, we will determine nest success and relative abundance to see if abundance increases following restoration and is similar to areas with native vegetation.

Bobwhites will be trapped and radio-marked from April to August in 2013 and 2014. We will place radio transmitters on 20 bobwhites in the 300-acre area to be restored with native vegetation and on 20 bobwhites in an area dominated by exotic grass of similar size (experimental control). Determining the suitability of restored habitats for northern bobwhites will aid landowners in making decisions regarding whether or not to restore native vegetation in areas that have been invaded by exotic grasses.

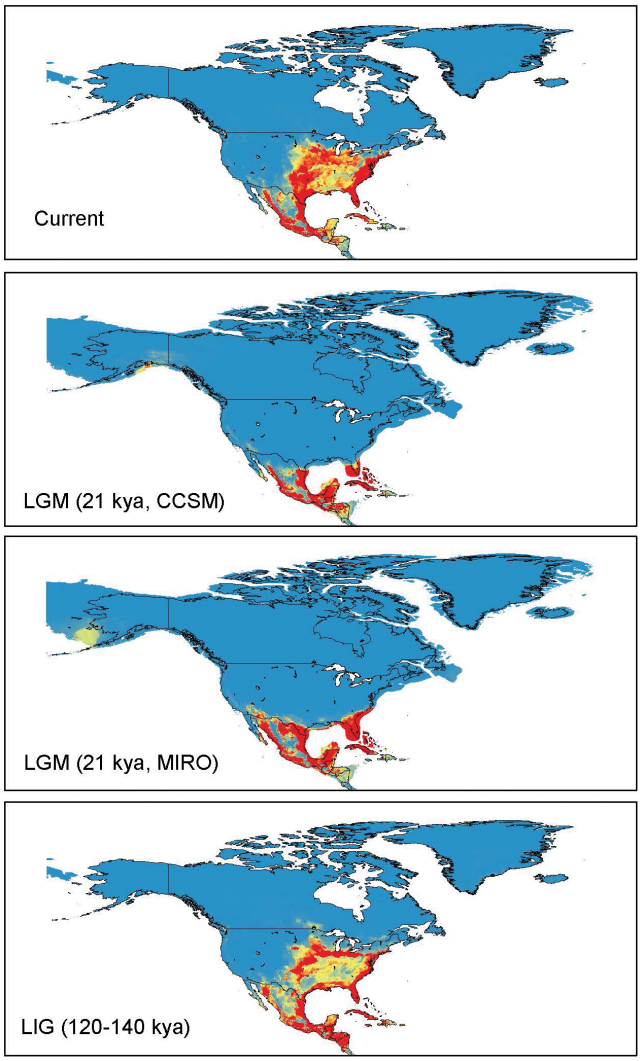
Cooperative funding provided by Tim Hixon and family and the ExxonMobil Summer Internship Program.

Ecological Niche Modeling of the Northern, Black-throated, and Crested Bobwhites

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

The population dynamics and range limits of the northern bobwhite are heavily influenced by climatic variables. These variables include precipitation, maximum summer temperatures, and minimum winter temperatures. Less is known about the northern bobwhite's Neotropical relatives—the black-throated and crested bobwhites. It is likely that the geographic distribution and population dynamics of these 2 species are also heavily influenced by climate. Concern exists that an increasingly warm climate may lead to the disappearance of the northern bobwhite from the southern parts of its range because of changes in summer temperature and precipitation regimes.

Ecological niche models (ENMs) are maximum likelihood models that are used to predict how a species has responded to past climates or will respond to future climates. We are currently constructing ENMs for the 3 bobwhite species based on the collection localities reported for museum specimens and 19 temperature and precipitation variables. For each species, we will develop an initial ENM that represents the potential geographic distribution under current conditions. The initial model of each species will be used to predict the past distribution under the conditions of the Last Glacial Maximum (21,000 years ago) and the Last Interglacial (120,000–140,000 years ago).



Ecological niche models for the northern bobwhite showing its potential geographic distribution under current conditions, the Last Glacial Maximum (LGM, 2 different models: CCSM and MIRO), and the Last Interglacial (LIG). Note: warmer colors on graphs indicate more favorable range; kya = thousands of years ago.

Preliminary models constructed for the northern bobwhite suggest that this species was largely absent from the United States during the Last Glacial Maximum. However, the northern bobwhite was more abundant in the now-arid southwestern deserts. In contrast, the distribution of the northern bobwhite during the Last Interglacial was highly similar to its historical distribution.

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

Demonstration of Pipeline Reseeding using Native Plants in the Eagle Ford Shale

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

As oil and gas production increase in the Eagle Ford Shale, there has been a rapid increase in the number of pipelines to move the products. Since many ranchers affected by Eagle Ford Shale development consider wildlife management a top priority on their property, there is a desire to reseed disturbed areas, such as pipeline right-of-ways, with native plants. However, because of past reseeding failures using maladapted native seeds, many are hesitant to use native plants.

In February 2011, *South Texas Natives*, in cooperation with the Dobie Ranch, USDA Natural Resources Conservation Service, and Texas AgriLife Extension Service planted a locally adapted native seed mix of 21 species on 3 different ecological sites along a new Eagle Ford pipeline right-of-way in Live Oak County, Texas. Three planting methods used included a no-till native seed drill, a broadcast seeder, and a hydroseeder to determine what effect the various planting methods have on plant establishment.

Plantings have been sampled twice annually for basal coverage and plant density. Results clearly indicate successful revegetation on all sites regardless of planting technique. In field days subsequently hosted at these sites, we have shared the results of this project with more than 100 landowners, oil and gas industry professionals, and natural resources managers.

Cooperative funding provided by donors to South Texas Natives, Dobie Ranch, Native Habitat Restoration, Douglass W. King Seed Company, Pogue Agri Partners, USDA Natural Resources Conservation Service, and Texas AgriLife Extension Service.

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

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

The Texas Department of Transportation (TxDOT) is one of the largest land managers in Texas. It is responsible for the management of more than a million acres. TxDOT is also one of the largest and most influential native seed consumers in the state. To meet provisions of the Federal Clean Water Act, TxDOT must revegetate any area greater than an acre disturbed during their activities to at least 60% of the adjacent vegetation cover. Federal directives dictate that whenever possible native plants are used in revegetation activities supported by federal funds. Historically, TxDOT has used seeds of many native plants. However, lack of adequate performance by native plants and limited availability of native plant seeds for many regions in Texas have resulted in the use of exotic grasses in TxDOT projects to meet Clean Water Act requirements.

As a result of increased public awareness of the value of native plants, and to meet existing guidelines, TxDOT prefers to use native seeds whenever possible. The TxDOT Native Plant Integration Program overseen by the Texas Native Seeds Project is the embodiment of that commitment.

The project, now in its third of 8 years of committed support, is working to provide solutions to problems that limit the use of native seed by TxDOT. Primary directives for the program include providing science-based information on the performance of available native seed sources, developing new native seed products to meet agency needs, and providing recommendations for TxDOT standard specifications for roadside seeding.

Cooperative funding provided by the Texas Department of Transportation.

Conservation of Endangered Slender Rushpea

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

Slender rushpea is a small herbaceous plant native to Kleberg and Nueces counties, Texas. It is endangered largely because of lack of habitat and the invasion of non-native species, particularly Kleberg bluestem, into former short-grass prairie remnants.

We are studying slender rushpea at the St. James Cemetery in Bishop, Texas. Our objectives are to determine the best way to conserve the species, primarily by reducing the effects of invasive grasses.

We have marked individual plants and recorded the number of main stems, length of the longest stem, number of leaves on the longest stem, and the number

of flowers and seedpods. We have removed the plant neighbors of these plants to reduce competition. Neighboring vegetation of 33 plants was trimmed to reduce aboveground competition. Neighboring vegetation of 34 plants was treated with herbicide to remove aboveground and belowground competition. As an experimental control, neighbors of 33 plants received no treatment. Additionally, we will burn small plots around 33 plants to assess the effects of fire.

Results from this study will help our understanding of how to manage remaining populations of slender rushpea to avoid extinction of the species. Our findings may also help determine how to manage remaining short-grass prairie remnants facing possible invasion by non-native grasses.

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

Vegetation and Arthropod Responses to Brush Reduction by Grubbing

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

Grubbing is a more selective brush management practice than root plowing and chaining. It allows the targeting of mesquite and huisache while leaving mixed brush species intact. In addition, grubbing can be used to clear brush and open lanes for hunting.

We initiated this study on the Santa Gertrudis Division of the King Ranch to determine the short-term effects of grubbing on vegetation and arthropod communities that are important to bobwhites. We anticipated an increase in forbs and arthropods following soil disturbance. Vegetation was sampled before treatments were applied in summer 2012 and after treatment in fall 2012, spring 2013, and summer 2013. Canopy coverage of grasses, forbs, bare ground, and litter are visually estimated using the quadrat technique. Arthropods are sampled monthly using sweep netting and a D-Vac insect collector.

Although an effect on total insects found or insect Order richness was not detected in the first 3 months following treatment, both positive and negative responses of individual Orders were observed. Orthoptera (includes grasshoppers, crickets, and locusts) numbers on the treated sites showed a significant drop 1 month post-treatment, but a significant increase 3 months post-treatment. A negative response was detected for croton, a common bobwhite forb food, 3 months post-treatment, but an effect on total forbs preferred by bobwhites was not detected. Also, there appeared to be no change in invasive grasses 3 months post-treatment. We will continue monitoring vegetation and arthropod responses until July 2013.

Cooperative funding provided by King Ranch, Inc.

Seeding Specification Recommendations for the Texas Department of Transportation

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

Texas Department of Transportation (TxDOT) seeding specifications provide contractors with a detailed list of seeds to use on highway right-of-ways. These specifications are also voluntarily followed by many other agencies and private entities. As a result, TxDOT seeding specifications strongly influence commercial seed production.

Since 2010, we have been evaluating the suitability of commercially produced native seed varieties available in Texas for highway right-of-way seeding. We have also worked for the last 2 years to conduct market analysis to quantify the commercial production capacity of various native seed varieties.

In May 2013, at TxDOT's request, we recommended and submitted seeding specification revisions for south, central, and west Texas for consideration in the agency's 2014 specification rewrite process. Based

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TxDOT is working with CKWRI researchers to develop native seeding specifications for right-of-ways across Texas.

on our results indicating satisfactory performance of available native seed sources to meet Federal Clean Water Act requirements, we recommended removal of all exotic grasses from the TxDOT seeding specifications for rural areas in 15 TxDOT districts. We also recommended the addition of a provision to TxDOT's specifications requiring the use of Texas Department of Agriculture Certified Native Seed in all projects as a quality control measure.

Should TxDOT adopt these recommendations, it would have a major impact on the use of native plants across a large portion of the state. This impact not only applies to the activities of TxDOT, but to the activities of the numerous state agencies and private consumers that use these specifications to guide their restoration, reclamation, and revegetation activities.

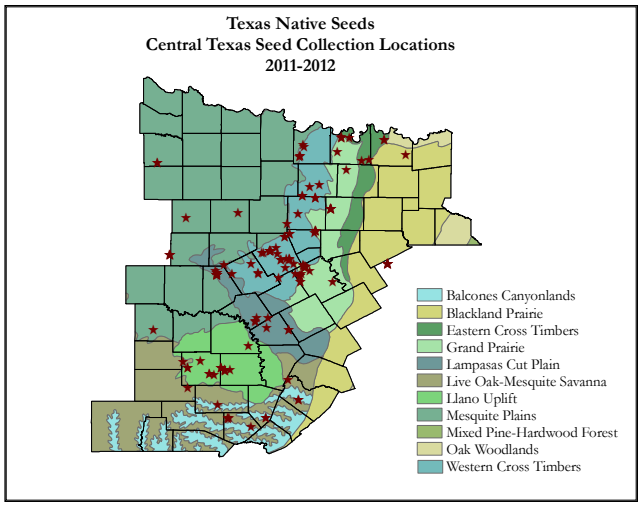
Cooperative funding provided by the Texas Department of Transportation.

Native Plant Seed Collections in Central Texas

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

The first step in the development of commercial native seed sources is the collection of seeds from native populations. Texas Native Seeds' (TNS) central Texas project is working to obtain seed collections of a variety of native plants across a 67-county area encompassing several ecoregions. These collections will be used to develop new commercial seed sources of native plants for restoration and reclamation needs in the region.

Seed production and quality of wild-harvested native seeds are directly related to weather conditions. The 2011 drought severely limited wild seed production of most native plants. We obtained just 130 seed collections for the year. In 2012, a mild winter and more widespread rainfall provided much improved seed collection conditions, and we obtained 328 new seed collections. In 2013, a harsher winter delayed seed production of many plant species. However, widespread rains in late spring and overall improvement in drought severity have allowed significant seed collection progress in central Texas. By the end of June, we obtained 14 new collections. Presently, 472 new native seed collections have been made across the central Texas region.



A map showing the Texas Native Seeds Project seed collection locations in central Texas. Collections will be used to develop new native seed sources for the region.

Over the past 2 years, we have made 25 presentations about the TNS collection efforts to various landowner associations. This also provided needed contacts for access to private ranches for seed collections. Landowners have been overwhelmingly supportive of the project. They have been tremendous cooperators in allowing us access to their ranches to make seed collections.

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

Long-term Monitoring of Native Range Seedings in South Texas

Anthony D. Falk, Keith A. Pawelek, Robert Obregon, Forrest S. Smith, and Fred C. Bryant

To demonstrate the use of locally adapted native seed sources and test long-term performance and persistence of native range seedings, *South Texas Natives* (STN) installed 18 demonstration plantings across South Texas from 2008–2012. Many of these sites have been through chaotic South Texas climatic conditions including multiple drought and wet years, along with being burned, grazed, driven through, disked, and otherwise disturbed.

Data collected from these plantings reveal a number of commonalities of successful range seedings using native plants in South Texas. First, thorough site preparation, such that competition from existing

weeds and exotic grasses is decreased or eliminated, greatly increases success. Second, early success is a great predictor of long-term success and longevity of reseeded stands. All plantings that had higher coverage of seeded species compared to non-native species at the first sampling period (30 days after planting) still had higher cover of seeded species than non-native species up to 5 years after planting. A third commonality of success is species selection. Careful soil series matching of the site to seeded species, based on USDA Natural Resources Conservation Service Ecological Site Description information, strongly correlates with short-term success and long-term persistence.

Results from this project are being used to provide better seed mix and range seeding recommendations for landowners in South Texas. We plan to monitor the study sites indefinitely to document long-term performance of locally adapted native plants in rangelands, and determine responses of reseeded native vegetation to environmental factors in the region.

Cooperative funding provided by the donors to the South Texas Natives Demonstration Project.

Commercial Seed Production of Native Seed Releases

Keith A. Pawelek, Forrest S. Smith, Dean N. Williams, Brian C. Wille, Keith J. Walters, and William R. Ocumpaugh

Commercial seed production and sales of native seed releases made by *South Texas Natives*, the USDA Natural Resources Conservation Service E. "Kika" de la Garza Plant Materials Center, and Texas AgriLife Research Station-Beeville again set records. Commercial seed growers produced over 39,000 pounds of South Texas native seeds in 2012. Despite increased production, demand for some species continued to exceed supply.

Commercial seed production field of sideoats grama managed by Douglass King Seed Company.

Seed production is expected to top 2012 figures in 2013 partly because of a mild spring, increases in production acreage, and the fact that 15 species are now in commercial production. The 2 newest species released by *South Texas Natives*, Balli Germplasm prostrate bundleflower and Venado Germplasm awnless bushsunflower, were established by Douglass King Seed Company in the spring of 2013.

Commercial growers are ramping up production of many early releases to meet the strong demand for these plant materials. This demand is a result of Eagle Ford Shale land reclamation activities, inclusion of many plant varieties in TxDOT specifications, and the growing use of native plants in the USDA's Environmental Quality Incentives Program (EQIP) and Conservation Reserve Program (CRP). A number of private habitat restoration projects over 100 acres in size were also strong drivers of production increases by commercial growers.

By the end of 2013, commercial production of South Texas native seed should exceed 400 acres. This should yield enough seed for over 50,000 acres of on-the-ground restoration plantings. Consumers are encouraged to provide advanced notice to commercial seed dealers well before desired planting dates, particularly for 100 acre or larger projects.

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

Quail Habitat Restoration in South Texas: Wildlife Use

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

Non-native grasses such as buffelgrass and Kleberg bluestem were planted as early as the 1930s on South Texas rangelands to provide erosion control and forage for cattle. However, these grasses have resulted in simplified plant communities. Such species-poor communities represent degraded habitat for a variety of wildlife species. Our goal is to restore a native plant community on 300 acres dominated by a monotypic stand of exotic grass.

We will conduct preliminary sampling of wildlife use on this area and an unrestored pasture starting the summer of 2013 using 10 trail cameras. The cameras will randomly be placed throughout the study sites and used during 2-week intervals. The photos will allow us to monitor habitat use by wildlife during and after the restoration process to determine if restoration results in increased wildlife use.

This study will provide insight regarding the effects that restoring native plant communities have on wildlife. Findings will aid landowners in making decisions about the feasibility of restoration on South Texas rangelands.

Cooperative funding provided by the ExxonMobil Summer Internship Program and Tim Hixon and family.

Advanced Evaluation and Seed Increase of Sand Dropseed

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

Sand dropseed is a native grass used in many restoration plantings in the United States. Desirable features of this species include its rapid establishment, low seed cost, and wide ecological adaptation. However, in South Texas, sand dropseed from available sources generally has poor persistence and performance. *South Texas Natives* has been working to collect, evaluate, and release regionally adapted sand dropseed that could be used successfully in the South Texas region.

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Seed of native populations of sand dropseed is being increased for distribution to commercial growers.

From 2001–2010, we collected seeds from 30 native populations of sand dropseed within South Texas. During 2010–2012, we conducted selection research on these collections at evaluation plantings near Kingsville, in the Lower Rio Grande Valley, and near Laredo. By spring of 2012, we had selected 5 collections that had superior restoration and seed production potential and began seed increases. In spring 2013, 4 of the 5 collections were selected for inclusion in a South Texas-specific seed blend of sand dropseed to be released to commercial seed growers in 2014.

The fifth collection exhibited unique growth characteristics (primarily height and flowering phenology) that would prevent it from being grown with the other 4 collections. However, this ecotype of sand dropseed originates from the South Texas Sand Sheet and would be in high demand if it were available for that specific area. Pending successful commercial seed production, we plan to make releases of a Sand Sheet selection and a more broadly adapted South Texas sand dropseed blend in 2014.

Cooperative funding provided by Rio Farms, Inc., USDA Natural Resources Conservation Service, Texas AgriLife Research, ConocoPhillips, Joan and Herb Kelleher Charitable Foundation, and numerous donors to South Texas Natives.

Evaluation and Development of a White Tridens Seed Release for Texas

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

White tridens is a common native, warm-season perennial grass found across Texas on clayey soils and in low areas. This grass is often a dominant plant in seasonal depressions, on slightly saline sites, and in barrow ditches of highways. Because it is an early successional species that quickly establishes after disturbance and produces large amounts of seed, white tridens has the potential to be a beneficial addition to restoration planting mixtures on many areas. Currently, white tridens seed is not available in large quantities for use in restoration projects.

Texas Native Seeds is in the second year of research on white tridens at 5 evaluation sites in south, central, and west Texas. Thirty-one wild collected accessions of white tridens were planted in spring 2012 at each site. We are collecting data on plant characteristics including biomass, seed production, leaf density, sur-

vival, and seed quality. We hope to identify white tridens populations with broad regional adaptation, increase them, and make them available to commercial seed growers for large-scale seed production and eventual use in restoration activities by consumers.

Data on plant growth characteristics are being collected for a second year. Seeds were collected from each accession at each evaluation site in 2012 and 2013 for germination tests. Germination of seeds and plant growth and production data will be analyzed to select the populations with the best natural adaptations for commercial seed production and restoration. We hope to make a white tridens seed release in 2014.

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

Evaluation of Little Barley for Use in Cool-Season Reclamation Plantings

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

Little barley is a cool season annual grass that grows up to 14 inches tall. It is found throughout Texas and most of the United States. Its ability to cover and spread quickly in degraded areas in various soil types is of great interest for restoration and reclamation purposes, especially for soil stabilization projects along roadsides in winter months. Unlike other winter-cover crop grasses, little barley is complimentary with native wildflowers. We are evaluating the potential of little barley for use in highway restoration projects and to meet other cool-season reclamation needs in the state.

Seed of little barley was collected across Texas during 2011 and 2012. In early 2013, 33 collections were propagated in a greenhouse. These plants were then transplanted at 5 irrigated research sites across south, central, and west Texas in spring of 2013.

Data were collected at each site on a monthly basis and included plant vigor, biomass production, height, and seed production. The seeds from these transplants will be collected and tested for quality. Data from the 5 evaluation sites will be compiled and analyzed to identify accessions with the best characteristics for restoration purposes and commercial production.

Little barley is a cool-season annual grass that is being evaluated for use in reclamation projects within Texas.

A mix of several accessions may be made to suit various needs and soil types. We are also investigating seed yield potential and agronomic production techniques. This study could lead to one of the first native cool-season grasses for use in reclamation and restoration plantings in Texas.

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

Release of Venado Germplasm Awnless Bushsunflower

Forrest S. Smith, Keith A. Pawelek, Anthony D. Falk, John Lloyd-Reilley, Shelly D. Maher, William R. Ocumpaugh, Andrew W. Scott, Jr., and David T. Forbes

Awnless bushsunflower is a valuable native forb on South Texas rangelands. It provides preferred browse for white-tailed deer and cattle, produces seeds consumed by bobwhite quail, and supports a variety of insects. A commercial source of regionally adapted seed of this plant has been desired by land managers for use in habitat restoration efforts.

South Texas Natives (STN) began work to develop a seed release of awnless bushsunflower in 2002. From 2002–2004, we obtained 35 seed collections from across South Texas, which were propagated and planted at Rio Farms near Monte Alto, USDA Natural Resources Conservation Service E. "Kika" de la Garza Plant Materials Center in Kingsville, and Texas AgriLife Research and Extension Center in Uvalde for

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Venado Germplasm awnless bushsunflower was released by *South Texas Natives* and their collaborators in 2013.

evaluation and selection from 2002 to 2006. Based on performance data from these sites, we selected 7 populations for increase and possible release. Following advanced evaluations and increase at Rio Farms, we refined our selections to 4 populations for release, based on seed production and plant productivity.

Components that will comprise Venado Germplasm originated from Medina, Webb, La Salle, and Bee counties, Texas. They were collected from loam, fine sandy loam, clay loam, and sandy clay loam soils. Seed produced from 2010–2012 in a half-acre breeder field at the STN Farm in Kingsville was distributed to Douglass King Seed Company in early 2013. Commercial seed production of Venado Germplasm was initiated in May 2013, and seed could be available for purchase by fall 2013.

Cooperative funding provided by numerous donors to South Texas Natives.

Native Seeding Trial on a Wilson County Pipeline Right-of-Way

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

Pipeline right-of-way reseeding in the Eagle Ford Shale (EFS) is a major concern for landowners. In 2013, *South Texas Natives* implemented a pipeline reseeding experiment at the Buen Vecino Ranch in Wilson County, Texas to learn about the best planting methods for native seeds on pipeline right-of-ways in the eastern reaches of the EFS.

The installation of the pipeline in the right-of-way to be seeded was completed in February of 2013. Upon inspection of the pipeline right-of-way, it was determined that the area should be sprayed with herbicide to kill the existing weedy vegetation that had established after pipeline construction. The site was sprayed with glyphosate herbicide on April 16th and planted the following day.

We designed this experiment to compare 2 seeding methods: (1) Truax Flex II drill and (2) Truax Trillion drop seeder. We also chose to examine 2 types of seed mixes. The first seed mix is a native grass-only mix that has been successfully used in other parts of South Texas. The second mix was designed with an emphasis on wildlife. This mix contains 50% native grasses and 50% native forbs that are known to be preferred food plants for gamebirds. Each seed mix and planting method is being evaluated on sandy loam and clay loam sites.

Plantings will be sampled biannually. Findings from this study will be used to guide landowners on the best techniques for pipeline right-of-way reseeding in this area of South Texas.

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

Evaluating Texas Wintergrass for Roadside Seeding and Commercial Seed Production

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

Texas wintergrass is a common native, cool season perennial. It is abundant on heavy soils throughout the southern and central portions of Texas. The grass provides erosion control and vegetation cover from fall to spring when most grasses are dormant.

We are evaluating this species for use in winter seed mixes used by the Texas Department of Transportation (TxDOT) for erosion control. Current cool-season seeding options for TxDOT consist primarily of small grains, which can limit wildflower displays and negatively suppress later warm-season grass establishment and performance, both of which are high-priority concerns of TxDOT.

We made 70 collections of Texas wintergrass across Texas during 2011 and 2012. Each collection was planted in a greenhouse for evaluation in fall 2012.

Accessions with adequate germination were transplanted for field evaluation at 5 locations. Plants at each site will be evaluated monthly from 2013–2015, and seed will annually be collected to assess quality and production potential. Data will be analyzed to determine the adaptability of each population across the geographic range of the species, and determine if large-scale commercial seed production is feasible.

Early observations confirm previous research on Texas wintergrass. Limitations to economical production of the seed and efforts at restoration include high seed dormancy, slow emergence, seed head lodging when grown under irrigation, and difficulty in planting, harvest, and cleaning. Use of Texas wintergrass in revegetation projects may be limited without the development of new production and planting methods.

Cooperative funding provided by the Texas Department of Transportation.

Advanced Evaluation and Seed Increase of Red Lovegrass

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

Red lovegrass is an early successional stage bunchgrass. It was selected for increase and advanced evaluation by *South Texas Natives* (STN) in 2012. We chose to explore a commercial seed release of the plant primarily because of its rapid germination and establishment ability, with hopes that it will perform well in highly disturbed sites on sandy soils. From our initial evaluation plots, we chose 4 selections for increase, evaluation in an agronomic production setting, and to make final selections for a possible commercial seed release.

In advanced evaluation experiments conducted at Rio Farms, we determined that one of the 4 collections would have to be grown separately from the others because of plant height, seed production, and phenology differences. The ecotype represented by this collection is also thought to have a restricted distribution, which may limit its utility in the commercial seed market. With those issues in mind, we decided to take that collection to a commercial grower and let them decide if it would be economical to produce.

The 3 remaining collections will continue to be increased at Rio Farms to provide growers with enough seed to establish commercial seed production fields in 2014. This blend of collections will form a germplasm release that should work well throughout South Texas. Pending 2013 seed yields, we hope to have enough seed to distribute to commercial growers to start full-scale commercial production of our red lovegrass selection in 2014.

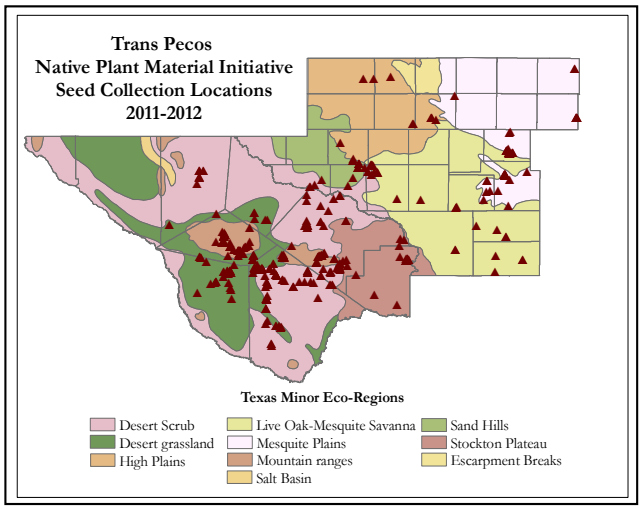
Cooperative funding provided by Rio Farms, Inc., USDA Natural Resources Conservation Service, ConocoPhillips, Texas AgriLife Research, Joan and Herb Kelleher Charitable Foundation, and numerous donors to South Texas Natives.

Texas Native Seeds – West Texas Native Plant Seed Collection

Colin S. Shackelford, Bonnie J. Warnock, and Forrest S. Smith

Native seed collections continue across the 37-county west Texas region covered by Texas Native Seeds. Project personnel accessed 48 properties for collections during 2011–2012, resulting in 537 new native seed collections for use in our seed source development research. These collections are the product of extensive collaborations with private landowners and natural resource agencies who have allowed us access to their properties.

Collection data are continually compiled, then overlain on maps of cumulative rainfall totals across the project region. This information is then used to prioritize future seed collection efforts. Our seed collection efforts will continue until suitable numbers (approximately 30) of collections are made of the 45 species that are likely candidates for use in restoration



A map showing the Texas Native Seeds Project seed collection locations in west Texas. Collections will be used to develop new native seed sources for the region.

projects. This will allow us to conduct rigorous evaluation studies of each plant. Our goal is to obtain at least one collection of each species from each county in the Trans Pecos in which it occurs.

A number of new landowner partnerships and above average spring to early summer precipitation across much of west Texas bodes well for a productive 2013–2014 seed collection season. Our seed collection efforts will result in the eventual release, and subsequent commercial availability, of ecotypic native seed sources for use in restoration efforts in the Trans-Pecos region of Texas.

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

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Purple threeawn is being evaluated by the Texas Native Seeds Project for use in reclamation plantings in Texas.

Evaluating Purple Threeawn for Restoration Use and Commercial Seed Production

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

Purple threeawn is a native, warm season perennial grass found throughout Texas. It is often one of the first perennial plants to establish in highly disturbed sites. This grass is frequently found on rocky, shallow dry sites including embankments of highway right-of-ways. These natural adaptations to harsh conditions and the ability to produce abundant seed make purple threeawn a great candidate for use in restoration and reclamation plantings across Texas.

Texas Native Seeds is evaluating purple threeawn at 5 locations in south, central, and west Texas for restoration use and commercial seed production. Thirty-four wild collected populations of purple threeawn from Texas were planted for evaluation in spring 2012. Data on plant vigor, biomass production, seed production, and long-term survival are being collected. We hope to identify populations that can be profitably grown for large-scale seed production, which have the traits needed to increase restoration success.

Data from the first year of field evaluations have allowed us to identify the best performing accessions in each evaluation region based on vegetative characteristics. We are currently conducting seed quality tests on each accession using seed collected from each location. We are considering 2 commercial releases of this plant: (1) a low-growing ecotype that would be ideal for highway right-of-way reclamation and (2) a tall ecotype that would be useful for bunchgrass restoration efforts on degraded rangelands aimed at benefitting wildlife such as bobwhites.

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

Release of Balli Germplasm Prostrate Bundleflower

Anthony D. Falk, Forrest S. Smith, Keith A. Pawelek, William R. Ocumpaugh, John Lloyd-Reilley, and Shelly D. Maher

Prostrate bundleflower is a low growing, warm-season legume found throughout South Texas. This species produces seed eaten by gamebirds and forage consumed by deer and cattle. Historically, 'Sabine' Illinois bundleflower and 'BeeWild' bundleflower have been used in restoration plantings in South Texas. Many of these plantings have either not been successful (with 'Sabine'), or resulted in difficult to manage monocultures on some soils (with 'BeeWild'). Furthermore, neither 'Sabine' nor 'BeeWild' bundleflower naturally occurs in South Texas. Because of these factors, *South Texas Natives*, the USDA Natural Resources Conservation Service E. "Kika" de la Garza Plant Materials Center, and Texas AgriLife Research-

Beeville have worked on the development and release of Balli Germplasm prostrate bundleflower.

Balli Germplasm was selected from evaluations of native bundleflower collections at Kingsville, Beeville, and Laredo. The released selection had greater long-term (more than 3 years) survival than 'Sabine' Illinois bundleflower or 'Hondo' velvet bundleflower. Balli Germplasm prostrate bundleflower is more conducive to use in multi-species native seed mixes than the more robust Mexico-origin cultivars like 'Beewild' bundleflower that are often used in food plot plantings in South Texas. Our evaluations have shown excellent performance of Balli Germplasm throughout the Rio Grande Plain, Gulf Coast Prairies and Marshes, and Sand Sheet regions.

We distributed seed of Balli Germplasm prostrate bundleflower to Douglass King Seed Company for production in spring 2013. Seed should be available for purchase by spring 2014.

Cooperative funding provided by the USDA Natural Resources Conservation Service and numerous donors to South Texas Natives.

Characteristics of Stockpiled Topsoils in the Western Rio Grande Plains

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

Energy development in South Texas has increased dramatically in recent years. Restoration efforts to mitigate the impacts of extracting mineral resources should be started before construction begins. Often, the removed topsoil is segregated and stockpiled.

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We are studying the microbiology and seed bank dynamics of stockpiled topsoil associated with energy development.

Although stockpiling topsoil is a common practice, there is little information available on the effects it has on soil microbial processes and seed bank dynamics, which could affect responses when the topsoil is later reused. A topsoil's seed bank includes seeds of the existing plant community as well as seeds from historical plant communities. Thus, depending on local site history, seed banks may include both native and invasive species. The topsoil is also the reservoir for a rich microbial community that is essential for ecosystem processes.

We began a study that includes an assessment of seed bank dynamics and an analysis of soil microbial responses in soil stockpiles. Stockpiles are sampled at different depths as they age; the seed banks are then examined under greenhouse conditions. We expect that residence time and stockpile depth will have major effects on seed bank composition and viability.

The second part of our study will examine soil microbial communities and soil chemical properties of the stockpiles. We will characterize how stockpiling topsoil affects soil microbial composition, soil microbial biomass, and carbon and nitrogen dynamics.

Being able to effectively manage disturbed soil has far-reaching consequences for ecological restoration. This study will focus on providing additional insight into management of stockpiled topsoils and will contribute practical information needed to enhance the chances for successfully restoring disturbed sites in South Texas landscapes.

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

Seed Increase of Current and Upcoming Releases

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

The 9-year partnership between *South Texas Natives* (STN) and Rio Farms continues to be quite successful despite continued drought and limited irrigation water availability in 2013. A cool spring and timely rainfall in May and June helped to boost seed production. After several years of low yields, Webb Germplasm whiplash pappusgrass exemplified a notable increase in seed yields at Rio Farms during 2013.

Fields of Chaparral Germplasm hairy grama and Dilley Germplasm slender grama were removed at Rio Farms because they are being produced commercially. This allowed the establishment of larger fields of red lovegrass and sand dropseed to facilitate release of these during 2014.

Cooperative efforts with the USDA Natural Resources Conservation Service E. "Kika" de la Garza Plant Materials Center (PMC) have assured good seed production of several native forb and legume species, which have recently been distributed to commercial growers. These include Zapata Germplasm Rio Grande clammyweed, Balli Germplasm prostrate bundleflower, Goliad Germplasm orange zexmenia, and Venado Germplasm awnless bushsunflower. Seed production efforts will continue at Rio Farms, STN Farm, and the PMC, as needed, to provide seed for large-scale commercial seed production.

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

Restoration of Plugged and Abandoned Oil and Gas Well Pad Sites on the King Ranch

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

Reestablishment of native plants on oil and gas pads can be difficult. This is often a result of soil compaction, altered soil properties, and inability to defer livestock grazing during restoration. To evaluate restoration potential of old pad sites and determine the best native seed varieties to use, *South Texas Natives*, King Ranch, and ExxonMobil are restoring and monitoring vegetation at 4 pad sites on the Santa Gertrudis Division of the King Ranch.

Restoration of native plants on abandoned oil and gas pad sites is desired by many ranch managers and owners.

After wells on each well pad were plugged, the caliche was removed, the soil profile was ripped, and each site was disked during summer 2011. We then tested the soil properties of each pad site and adjacent areas and found no differences in soil properties. Each site was left fallow until September 2011 and then sprayed with glyphosate and 2, 4-D herbicides to control weeds and brush. Finally, we planted a mix of 20 locally adapted native grasses and forbs with a no-till seed drill.

Despite drought conditions throughout the study, we measured the establishment of an average of 2 seeded native plants per ft^2, and 19 of 20 seeded species by summer 2013. This density and diversity of plant species easily exceeded restoration benchmarks commonly used to evaluate success of seeding projects. A few late successional, preferred forage plants have only established in grazing exclosures. This finding indicates seed mix selection for such sites should consider livestock access during restoration.

Preliminary results indicate that restoration of native plants at historical oil and gas pad sites in eastern South Texas is possible. And, there is a high likelihood of success using these techniques.

Cooperative funding provided by ExxonMobil and numerous donors to South Texas Natives.

Texas Native Seeds Central Texas Seed Source Development Projects

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

The central Texas project of Texas Native Seeds has made significant progress in developing additional native seed sources since beginning work in the region in 2010. Evaluations are ongoing and expanding at the Texas A&M AgriLife Research centers in Stephenville and Uvalde, Texas and the USDA Natural Resources Conservation Service Plant Materials Center in Knox City, Texas. These efforts will lead to the commercial release of regionally adapted seeds to meet the growing demand for restoration.

Evaluations of 7 native grasses have been initiated in central Texas. In 2012, we planted collections of white tridens and purple threeawn for evaluation. In 2013, we established plots of collections of Texas wintergrass, little barley, little bluestem, tall dropseed, and silver bluestem. Growth characteristics will be evaluated for the next 3 years. Seed will be collected when ripe for yield and quality testing.

Data collected in this study will help determine future release and commercialization potential of each species. This will aid us in selecting the most appropriate materials for increase, release, and use across central Texas.

Our focus on these native plant species is reflective of the deficiencies in current commercial availability of adapted native seed for the central Texas region. At present, no regionally adapted seed is available for most of these species for use in central Texas. These native plants are desired by the Texas Department of Transportation for use on roadsides, and they will also be useful for rangeland and wildlife habitat restoration needs in central Texas.

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

Habitat Restoration in South Texas: Vegetation Dynamics

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

Exotic, invasive grasses such as Kleberg bluestem and buffelgrass reduce habitat quality for wildlife and reduce plant species diversity. Previous research conducted on the Hixon Ranch (La Salle County, Texas) using small plots indicated that native plant communities could be restored in areas dominated by buffelgrass. The successful technique involves a combination of repeated deep disking and planting native grasses and forbs. We will use this knowledge to begin restoration of a 300-acre area on the Hixon Ranch using this technique.

We will conduct pre-restoration vegetation sampling during summer and autumn 2013 to determine vegetation composition and soil texture on the restoration area and a control area of similar size. We will monitor the changes in vegetation during and following restoration. In addition, we will conduct experiments to determine the effects of restoration treatments on the soil seed bank and to test the effectiveness of various herbicides on exotic grasses.

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A restored native plant community on the Hixon Ranch in an area that was previously dominated by buffelgrass.

This study will be used to determine the effects of restoring native vegetation on re-invasion by exotic grasses and on plant species diversity. Findings will aid landowners in making decisions about the feasibility of restoring native vegetation in areas invaded by exotic grasses.

Cooperative funding provided by Tim Hixon and family and the ExxonMobil Summer Internship Program.

Release of Carrizo Germplasm Little Bluestem

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

Historically, little bluestem was a dominant native grass on many sites in South Texas. Even today on some sites that are well managed, it can comprise 50% or more of the vegetation cover. Research indicates little bluestem provides ideal nesting habitat for bobwhites, excellent cover for wildlife, and is a seasonally important forage for cattle. Because of these values, little bluestem seed for use in restoration projects in South Texas has long been desired by land managers. However, none of the commercial sources of little bluestem seed have shown satisfactory adaptation and performance in our region.

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A South Texas selection of little bluestem called Carrizo Germplasm will be released by *South Texas Natives* in 2014.

South Texas Natives began an extensive collaborative effort to develop a South Texas-adapted commercial seed source of little bluestem in 2001. From 2001–2006, we collected and evaluated 70 native South Texas populations.

Based on plant characteristics and seed production potential of little bluestem, we selected 2 ecotypes for release to the commercial seed industry. One or both of these selections should be well adapted to sites where little bluestem is naturally found in South Texas rangelands—primarily areas with sand, loamy sand, or sandy loam soil textures.

The selections comprising Carrizo Germplasm originate from Bexar and Zavala counties, Texas. Douglass King Seed Company and Pogue Agri Partners have initiated commercial seed production of Carrizo Germplasm. The commercial seed could be available to consumers by spring 2014.

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

Evaluation of Available Native Seed Sources for Use by TxDOT

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

The Texas Department of Transportation (TxDOT) is required by the Federal Water Pollution Control Act (referred to as the Clean Water Act) to revegetate any area of soil disturbance greater than an acre under their jurisdiction. In addition, TxDOT is required by federal mandates to use native plants whenever possible. To help TxDOT select the most appropriate native seeds to use to meet the Clean Water Act revegetation standards, we are investigating adaptation and performance of previously released, commercially available native seed sources in south, central, and west Texas.

This project includes 2 extensive plot studies of 65 native and exotic seed varieties replicated at 6 locations across the state. Experiment 1 uses greenhouse-grown transplants of these varieties. We are measuring relevant mature plant characteristics, including maximum height, biomass production, ground cover ability, and long-term survival. Experiment 2 is evaluating seedling emergence and stand development characteristics of each variety in dryland conditions, and with similar management regimes as those used by TxDOT. By including both exotic and native species in the experiment, we are able to compare the performance of available native plants to the exotic grasses that have historically been used to successfully meet Clean Water Act provisions by TxDOT.

Information from these experiments is already being used by TxDOT to select appropriate native seed sources for use across Texas. Data will also be of use to agencies and private landowners interested in native plant restoration in each region. Data will continue to be collected from both experiments to monitor long-term performance of each seed source.

Cooperative funding provided by the Texas Department of Transportation.

CKWRI's Texas Native Seeds – West Texas Evaluations

Colin S. Shackelford, Bonnie J. Warnock, and Forrest S. Smith

Construction is being completed at a 25-acre evaluation and seed increase facility south of Alpine for the west Texas program of Texas Native Seeds. Construction is scheduled to be completed midsummer 2013. Greenhouse production is underway for 4 new evaluation plantings planned for the site in mid-July in time to capture the summer monsoon season of the Trans Pecos.

Two native, early successional plants, Hall's panicum and burrograss, and 2 native, later successional plants, sideoats grama and silver bluestem, will be evaluated. These evaluations originate from plant

materials collected from across the 37-county west Texas project area.

Plant material from these evaluations will become the first commercially available seed sources developed specifically for restoration and reclamation projects in the west Texas region. Landowners, federal and state agencies, and other land use interests will soon have price competitive, regionally adapted plant material with proven performance. These new evaluations are the first of 15 or more commercial native seed releases we hope to make for west Texas over the next decade.

A new collaborative research project between Texas Native Seeds and Texas AgriLife Extension Service will begin this summer. The project will focus on plant material performance on reclaimed pipeline right-of-ways in west Texas. Lessons learned from planting technique and plant performance can be used by landowners and right-of-way managers in the booming energy sector across west Texas.

Cooperative funding provided by the Texas Department of Transportation, Will Harte, Dixon Water Foundation, Faye L. and William L. Cowden Foundation, Rotary Club of Corpus Christi (Harvey Weil Sportsman Conservationist Award Trust), Pecos River Water Control and Irrigation District #3, CF Properties, and the Sierra la Rana Development.

Cindi Brunner

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

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

The Laguna Madre along the lower Texas coast supports nearly 80% of the World's redheads during winter. This extremely restricted winter range may predispose the redhead population to unfavorable consequences should habitats change or degrade. Redheads forage in the Laguna Madre and access coastal ponds on the mainland to drink. Several large wind farms have been constructed along the Laguna Madre and several more are proposed.

The effects of wind farms on redheads and other birds in this region are unknown. Our objectives are to (1) conduct a development favorability analysis for the Laguna Madre that ranks areas for development based on its potential impacts to wintering redheads and (2) investigate the influence of wind turbines on redheads by documenting changes in coastal pond use pre and post construction of wind farms.

We monitored the use of coastal ponds by redheads in 2000–2003, a period before construction of any wind farms in the area. We are currently monitoring coastal pond use by redheads following the construction of several wind farms next to the Laguna Madre. Additionally, we plan to monitor flight paths and behavioral responses of radio-marked redheads around existing wind farms as the ducks travel between foraging areas in the Laguna Madre and freshwater drinking sites on the mainland.

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

Effect of Population Density on American Alligator Growth Rates

Cord B. Eversole, Jacob L. Ogdee, Scott E. Henke, Bart M. Ballard, and Randy Powell

The American alligator was a once-endangered species, but has made an astonishing comeback since its delisting in the 1980s. The restoration of the American alligator throughout the southern United States has been attributed to strict harvest regulations, intensive management strategies, and wetland conservation. Populations have since increased to the point that the American alligator requires intense management to preserve population health.

Our objective is to understand how population density affects alligator growth rates. Alligators will be captured, tagged, and measured for total body length, snout to vent length, tail girth, eye to nare length, total head length, and live weight. The following year, individuals will be re-measured to determine the growth rate in a year's time. The growth of individuals will be compared to varying levels of population density. This will allow us to determine how population density is related to individual growth rate.

The data collected from this study will help us understand how population density and growth dynamics vary among populations. It will also help determine if management strategies need to be adjusted to maintain healthy American alligator populations.

Cooperative funding provided by Brazos Bend State Park Volunteer Organization and the East Texas Herpetological Society.

Reproduction Assessment of American Oystercatchers Along the Texas Coast

Lianne M. Koczur, Alexandra E. Munters, Susan A. Heath, Bart M. Ballard, M. Clay Green, Fidel Hernández, and David B. Wester

The American oystercatcher is a charismatic shorebird that relies on coastal wetlands throughout its annual cycle. Like many species of shorebirds, American oystercatchers are greatly affected by human development of coastal areas. In 2001, the American oystercatcher was listed as a Species of High Concern in the U.S. Shorebird Conservation Plan because of their small population size, low productivity, and considerable loss of habitat.

The objectives of this study are to determine the reproductive success of American oystercatchers in Texas and to identify the causes associated with nest failure and chick mortality. Our study is being conducted along the Texas coast from Corpus Christi to Galveston. In 2011, 2012, and 2013, we monitored nests and chicks once weekly until nest and brood fate were determined. For the 2011–2012 period, we monitored 229 pairs that maintained 329 nests (inclusive of renests).

Preliminary results show that of the 329 nests, 195 nests failed before hatching, 122 nests successfully hatched 179 chicks, and 90 of those chicks survived to

fledging age. Known causes of nest failure and chick mortality were depredation by birds and mammals, and over-wash from tides. In future analyses, we will examine several environmental factors to help explain variation in nest and chick survival. These include size of the nesting island, distance of the nest from the mainland, and the amount of available foraging habitat around the nest site.

This study provides the first estimates of nest and chick survival for the American oystercatcher in Texas. Information from this study will provide baseline data needed to enhance conservation strategies for the American oystercatcher along the Texas coast.

Cooperative funding provided by the Gulf Coast Bird Observatory and the Coastal Bend Audubon Society Bird Conservation Research Award.

Training Dogs to Locate Endangered Houston Toads

Sandra Rideout-Hanzak, Rebecca V. Ross, Paul S. Crump, and Scott E. Henke

The Houston toad was the first amphibian listed as an Endangered Species in 1970. Although it occurs within 9 counties of southern Texas little is known about habitat characteristics for the Houston toad outside the breeding season. The toads burrow into the soil to spend their dormant periods underneath the litter and duff layers making them hard to find. This also makes it difficult to know how to manage the pineywoods surrounding their breeding ponds.

We are training a dog to alert at the scent of a Houston toad. Terra was a shelter dog scheduled for euthanasia when she was rescued for use as a conservation dog. She is trained through short daily sessions using positive reinforcement with balls—her favorite toys. Terra's high toy drive will enable her to work long hours in the field finding toads.

The ability to use dogs to detect dormant toads will allow researchers to characterize habitat requirements for periods that toads spend outside the breeding ponds, and to create more suitable year-round habitat. It could also allow more accurate estimations of population sizes of Houston toads in known locations, and detection of Houston toads in areas where they are not known to be currently present.

Cooperative funding provided by the Arthur A. Seeligson, Jr. Conservation Fund.

Growth Rates of American Alligators at Three Sites in Texas

Cord B. Eversole, Jacob L. Ogdee, Scott E. Henke, Bart M. Ballard, and Randy Powell

The American alligator is an endemic species that inhabits rivers, swamps, marshes, lakes, bayous, and ephemeral bodies of water along the Gulf Coast of the United States. It was hunted to near extinction in the early part of the 20th century. However, the American alligator has made an incredible comeback because of harvest regulations, intensive management strategies, and wetland conservation.

American alligators, unlike many other wildlife species, experience sexual maturity at a minimum size instead of a particular age. This life history characteristic is a key factor in the proper management of the species. Research has shown that growth rates of alligators may vary among habitats and regions. By understanding how growth rates differ throughout the American alligator's range, managers can employ more precise management practices to better protect local populations.

In this study, growth of American alligators will be assessed at 3 sites in Texas. Individuals will be captured and tagged. Body condition and growth will be assessed by measuring total body length, snout to vent length, tail girth, eye to nare length, total head length, and live weight. The following year, individuals will be recaptured and measured to determine the change in growth.

Wildlife managers currently base management decisions on growth data from other parts of this species' range. Our research will aid managers in

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Our research will provide information to wildlife managers tasked with maintaining healthy alligator populations.

developing more site-specific management plans for the American alligator.

Cooperative funding provided by Brazos Bend State Park Volunteer Organization and East Texas Herpetological Society.

Dietary Needs of Female Northern Pintails during Winter

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

The Texas coast is an important wintering area for waterfowl and particularly northern pintails where it winters about 78% of all pintails in the Central Flyway. Much of the native wetland habitats along the Texas coast have been lost or degraded. Consequently, the remaining habitats must support a greater proportion of the dietary needs of wintering waterfowl. Wetland habitat management can be improved by understanding the dietary and energy needs of waterfowl.

Our goal is to estimate nutrient composition and energy provided by diets of female northern pintails from inland freshwater wetlands and coastal marsh, and from managed and nonmanaged wetlands throughout the Texas Coastal Plain. We will remove food items from the upper digestive tract of female northern pintails collected while foraging. All food items will be sorted, identified, and dried in an oven to determine dry weight (mass). We will determine the proportional contribution to the diet, nutrient composition, and energy contribution of each food item. This will allow us to understand how diets differ between habitats and how they change across the winter period.

The nutritional needs of wintering female northern pintails are being assessed by CKWRI researchers.

Information from this study will help us understand how our wetland management practices contribute to the nutritional needs of female northern pintails. In addition, it will be used to support future body condition analyses of female northern pintails.

Cooperative funding provided by the Texas Parks and Wildlife Department.

Effect of Time of Night and Environmental Parameters on Nighttime Alligator Activity

Cord B. Eversole, Jacob L. Ogdee, Scott E. Henke, Bart M. Ballard, and Randy Powell

Nighttime surveys are useful in understanding American alligator populations. The surveys are simple to conduct, and they provide information on the size and composition of alligator populations. Reptiles have a unique relationship with their environment. However, the role that the environment plays in the nighttime activity of alligators is not well understood. It is also unknown what effect time of night has on activity and how that would influence survey population estimates.

Nighttime population surveys for American alligators will be conducted during varying weather conditions. Environmental and weather parameters will be recorded such as wind speed, wind direction, barometric pressure, water temperature, air temperature, moon phase, moon rise, moon set, percentage of moon illumination, and time since the last rain event. The counts will be conducted for 4 consecutive nights to collect information on alligator activity across a range of changing conditions. Each night the order of wetlands to be surveyed will be changed resulting in a different start time each night. The number of individuals observed on the surveys will be used to indicate the activity level of the alligators.

Findings from this study will provide insight about what types of weather and time of night are best in obtaining an accurate estimate of alligator populations. By restricting surveys to times and weather patterns best for high alligator activity, better population estimates can be made. This will allow biologists to make management decisions that are conducive to healthy alligator populations.

Cooperative funding provided by Brazos Bend State Park Volunteer Organization and the East Texas Herpetological Society.

Prioritizing Habitat Conservation for Mottled Ducks

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

The mottled duck is a year-round resident of the western Gulf Coast. Because of its limited range, mottled ducks are particularly sensitive to habitat loss. Its steady population decline has earned it "Red" status on the Audubon WatchList. Nesting and brood-rearing habitat loss and degradation are the most important threats to the western Gulf Coast population. Our goal is to develop a biological model to aid managers in decision-making that allows them to prioritize areas of mottled duck nesting and brood-rearing habitat throughout the western Gulf Coast that would be most beneficial for conservation or management.

We are currently evaluating habitat patch and landscape characteristics known to be important contributors to nest success and brood survival. These characteristics include size of nesting habitat patch, land cover type, distance to suitable brood-rearing habitat, etc. We expect to produce an interactive spatial dataset that identifies (1) suitable nesting and brood-rearing habitats within the mottled duck's range in the western Gulf Coast, (2) areas of potential nesting habitat that could become suitable with limited enhancement, and (3) areas of potential brood-rearing habitat that could become suitable with limited enhancement.

Preliminary results from the Chenier Plain region of Texas and Louisiana indicate that our model will be an effective tool to focus limited conservation resources to areas that will have the greatest positive impact on the mottled duck population.

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

Conducting a Carnivore Survey on Three East Foundation Ranches

Arturo Caso, Alfonso Ortega-Sanchez, Jr., Sasha Carvajal-Villarreal, Gordon W. Watts, III, Lon I. Grassman, Jr., William C. Stasey, Jennifer M. Korn, Justin P. Wied, and Michael E. Tewes

Mammalian carnivores have relatively large area requirements with stationary home ranges. Their upper level trophic position allows them to function as indicators of community health and umbrella species for the habitats they occupy.

One of the mammalian species found in the South Texas carnivore community is the striped skunk.

The distribution and abundance of carnivore species may be related to habitat type and resource availability (e.g., food and water). This abundance and resource use information can assist in establishing conservation or control strategies for mammalian carnivores.

In July 2011, we began a camera survey of the mammalian carnivore communities on 3 East Wildlife Foundation ranches: San Antonio Viejo, Santa Rosa, and Buena Vista. The objectives are to examine carnivore abundance, distribution, and spatial overlap.

Our results have included common species such as raccoons, striped skunks, coyotes, gray foxes, and bobcats. However, we have documented rare species including the hog-nosed skunk and badger. We have performed approximately 53,000 camera-nights of sampling. From this, we obtained 3,145 coyote photos, 348 bobcat photos, 13 hog-nosed skunk photos, and 18 badger photos (likely includes multiple photos of the same individuals). Relative abundance indices suggest that the coyote is the most abundant followed by raccoon and bobcat. The bobcat was the only feline species photographed on these ranches.

It is important to survey areas in Texas to determine the status and distribution of mammalian carnivore species. We will monitor the East Foundation ranches with cameras to add to a long-term data set. This information will aid in identifying ecological patterns that vary over time and under different conditions.

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

Findings of the South Texas Wintering Birds Program

Thomas M. Langschied and Fred C. Bryant

What happens to bird diversity and abundance during an intense drought? As you might expect, both diversity and overall numbers decrease. Interestingly, the number of checklists (sightings) submitted to the South Texas Wintering Birds (STWB) website also decreased. This is possibly related to a decrease in bird-watching interest given the lack of birds encountered.

Overall, 237 species were submitted to the STWB website during the 2012–2013 winter season (November–March), the lowest bird species total since the 2005–2006 winter season. Although there was a low species total, several rare or unusual species were reported. These include the zone-tailed hawk, Cassin's kingbird, red-breasted nuthatch, and rusty blackbird. The Cassin's kingbird and red-breasted nuthatch represent new species reported to the STWB program. The Cassin's kingbird normally winters in central and western Mexico and further south. The red-breasted nuthatch is a widespread winterer throughout much of the United States, but is a very rare winter visitor to the South Texas region.

Started in 2005, the STWB program is a cooperative project between the CKWRI and Cornell Laboratory of Ornithology. Bird sightings submitted to the STWB program website are private at the property level, but the information becomes available to researchers at a county or regional level allowing a better understanding of bird distribution in South Texas. We urge you to become a citizen scientist and submit your bird sightings to the STWB website at www.stwb.org.

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The red-breasted nuthatch is one of the more rare sightings reported to the South Texas Wintering Birds program.

If you are not familiar with birds, consider obtaining the CKWRI publication entitled A Guide to Bird-watching and South Texas Wintering Birds. It is available in hard copy (please contact the CKWRI office) and PDF download from the CKWRI website at http://www.ckwri.tamuk.edu/fileadmin/user_upload/docs/SpecialPublications/CKWRI_BirdGuide-092011.pdf.

Cooperative funding provided by the Cornell Laboratory of Ornithology, Fondren Foundation, King Ranch Family Trust, Trull Foundation, George and Mary Josephine Hamman Foundation, Elizabeth Huth Coates Charitable Foundation, and the East Wildlife Foundation.

Assessing Habitat Characteristics of Nesting American Alligators

Cord B. Eversole, Jacob L. Ogdee, Scott E. Henke, Bart M. Ballard, and Randy Powell

Despite numerous studies conducted on the American alligator, there remains much needed information about the ecology and population dynamics of the species. For example, the relationship that nesting female alligators have with the environment remains a mystery. Our objectives are to determine habitat requirements for nesting American alligators and quantify the environmental features associated with successful nests.

Nests will be located, opened, and checked for eggs. If eggs are present, information on number of eggs and timing of egg deposition will be collected. Habitat assessments such as distance from the water, slope of the bank, percentage of canopy cover, surrounding vegetation, nesting material, wetland classification, and water quality (e.g., salinity, conductivity, total dissolved solids, pH, dissolved oxygen, turbidity, water temperature, water depth) will be recorded. Nests will be monitored to determine success or failure. Nests will be considered successful if at least 1 egg hatches.

This study will provide insight into the nesting ecology of alligators and what habitat features are required to produce a successful nest. Findings will aid managers in understanding the environmental factors influencing reproduction and can be used to help manage alligator populations.

Cooperative funding provided by the East Texas Herpetological Society and the Brazos Bend State Park Volunteer Organization.

Wetland Habitat Selection by Mottled Duck Broods in Texas

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

Considerable loss of wetlands due to human activities has occurred throughout the mottled duck's range in Texas. Paralleling this loss of habitat has been a decline in the mottled duck population over the past 3 decades. One of the main components to increasing recruitment into the mottled duck population is managing and preserving high-quality brood-rearing habitats. However, little research has been conducted on wetland habitat selection of mottled duck broods. Our objective is to gain a better understanding of how mottled duck broods use the landscape. This will be accomplished by determining the distance between nest sites and initial brood habitat, assessing brood-habitat selection, and investigating the number of wetlands used during the brood-rearing period.

We analyzed habitat selection for 16 radio-marked mottled duck broods along the Texas coast. We also assessed habitat use from 96 mottled duck brood observations from 6 replicate surveys of 330 randomly selected wetlands along the Texas coast during 2 consecutive breeding seasons. Preliminary results indicate that mottled duck broods selected freshwater and tidally influenced wetlands that had more than 30% emergent vegetation cover and more than 30% submerged aquatic vegetation.

Findings from this study will increase our understanding of the habitat and landscape requirements of mottled duck broods. This information can be used to strengthen our ability to make sound habitat management decisions for mottled ducks occurring along the Texas coast.

Cooperative funding provided by the Texas Parks and Wildlife Department.

Determining the Suitability of the Jamaican Boa for Translocation

Brent C. Newman, Scott E. Henke, and Susan Koenig

The Jamaican boa is endemic to Jamaica and is the island's largest native terrestrial predator. Once considered common throughout the island, Jamaican boas were declared Vulnerable by the International Union for Conservation of Nature in 1986. This species is listed under Appendix I of Convention on International Trade in Endangered Species of Wild Fauna and Flora. The U.S. Fish and Wildlife Service also declared the species an endangered foreign species in 1970.

The Jamaican boa has experienced dramatic population declines resulting from human development in Jamaica.

Boa populations in Jamaica continue to decline, which is caused by the reduction of native habitat from human development and open pit bauxite mining. Consequently, the National Environment and Planning Agency of Jamaica recognized the Jamaican boa as a conservation target in 2009.

Environmental impact assessments created by governmental organizations repeatedly cite translocation of Jamaican boas to mitigate against habitat loss. However, no research has been conducted to determine if this form of mitigation activity is a viable option. From August 2011 to May of 2012, 12 Jamaican boas were radio-tagged and translocated in connection with the Windsor Research Centre located in Cockpit Country, Jamaica to monitor the effects of translocating this species.

This research will provide insight into the habitat needs as well as the ecology of this threatened species. In addition, it will also offer justification to help protect Cockpit Country. This area is Jamaica's largest remaining contiguous rainforest. However, open pit bauxite mining continues to threaten the plants and animals in the region.

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

Brood Parasitism and Multiple Mating in Lesser Prairie-Chickens

Katherine S. Miller, Kelly S. Corman, Randy W. DeYoung, Leonard A. Brennan, Stephen J. DeMaso, Warren B. Ballard, Mark C. Wallace, Clint W. Boal, Heather A. Whitlaw, and Robert M. Perez

Prairie grouse are known to mate on leks (communal display and breeding grounds), where one or a few males mate with females that visit the lek. Molecular markers have revealed unexpected patterns of mating in many species of wildlife. In some avian species, molecular markers confirmed that females mate with more than one male. Furthermore, hens may attempt to deposit eggs in the nests of nearby females in an attempt to increase the chances that some offspring will survive. This behavior is called brood parasitism.

The lesser prairie-chicken has experienced severe declines in range and population size, prompting concerns about genetic diversity. The occurrence of multiple mating and brood parasitism has implications for the maintenance of genetic diversity. We used genetic markers to investigate the occurrence of cryptic mating patterns in lesser prairie-chickens.

We extracted DNA from 544 lesser prairie-chicken adults and 170 eggshells from 25 nests in Texas and eastern New Mexico. Using 5 microsatellite DNA loci, we compared egg genotypes to the genotype of the hen attributed to the nest. Lesser prairie-chicken nests with 1 or more eggs that mismatched the hen at 2 or more loci were considered to be parasitized. We used a maximum-likelihood method to assign eggs, males, and females into family groups based on genetic relationships.

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CKWRI researchers are studying the lesser prairie-chicken to provide insight that will aid in their long-term recovery.

Nest parasitism occurred in 9 of 25 (36%) nests, and we inferred multiple mating relationships in 2 nests. Ongoing analyses will focus on paternity and investigate the geographic distance from leks where hens mated to the nest site location.

Cooperative funding provided by the Texas Parks and Wildlife Department.

Duration of Marking Tags on American Alligators

Cord B. Eversole, Jacob L. Ogdee, Scott E. Henke, Bart M. Ballard, and Randy Powell

The American alligator is known to inhabit areas that consist of rough terrain. These habitat features make tagging individuals for mark recapture studies difficult. The longevity of tags in alligators has often been a challenge for researchers to overcome in the pursuit of knowledge of the species.

In this study, individuals will be tagged using 4 tagging techniques. Each captured individual will be marked by a uniquely numbered tail tag, a Kemco ear tag that will be placed on the back left foot, an individual Passive Integrated Transponder (PIT) tag that will be placed internally at the base of the tail, and a uniquely numbered and colored T-Bar Anchor fish tag that will be placed at the base of the head. The duration and effectiveness of each tagging technique will be determined after 1 year by the presence or absence of each tag type on each individual upon recapture.

This study will aid in determining the effectiveness of a novel tagging technique (fish tags) and quantify the effectiveness of customary techniques. The data collected will better guide mark-recapture studies that are conducted on American alligators.

Cooperative funding provided by the East Texas Herpetological Society and Brazos Bend State Park Volunteer Organization.

Assessing the Nocturnal Roosting Habitats of the Reddish Egret

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

The reddish egret is North America's rarest and least studied heron. It is currently a species of concern according to the U.S. Fish and Wildlife Service and is

listed as threatened in Texas. The U.S. population is estimated at approximately 2,000 breeding pairs with about 900 to 950 pairs occurring in Texas. There is a paucity of information about habitat requirements of the reddish egret; most studies have focused on breeding and foraging. Therefore, management efforts for this species may be lacking important information on the range of habitats needed throughout the annual cycle. Roost sites are used for resting and sleeping. Safe roost sites are an important component for survival during nocturnal hours.

Our objectives are to examine roosting behavior and determine factors that affect roost site selection by reddish egrets. We attached satellite transmitters to 22 adults that were breeding in the Laguna Madre of Texas and use wintering areas along the Gulf and Pacific coasts of Mexico. Using locations obtained from the transmitters at midnight and 1:00 a.m., we will be able to identify important roost sites and examine the parameters that may affect roost site selection by reddish egrets. This information has been identified as a critical data need by the Reddish Egret Recovery Team and will contribute to the conservation of habitats that are vital to the reddish egret.

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

Grazing and Dietary Overlap: Cattle, Deer, and Nilgai Interactions

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

Few studies have been completed regarding cattle grazing impacts on dietary overlap among cattle and wild ungulates. The objective of this project is to (1) complete a literature review on cattle grazing and deer, (2) assess impacts of cattle grazing on forbs preferred by deer, (3) determine seasonal dietary overlap between cattle, deer, and nilgai, and (4) establish stable isotope turn-over rates in deer and cattle.

An extensive literature review will be completed to synthesize cattle grazing impacts on deer behavior and dietary overlap. For objective 2, we installed 50 enclosures with outside paired grazed plots at each of 6 study sites (6,000 acres each) on the East Wildlife Foundation ranches. Information from monitoring these plots will be used to assess the relationship between cattle grazing intensity and abundance

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Nilgai, white-tailed deer, and cattle occur together in South Texas and they may compete for forage during droughts.

of forbs preferred by deer. Every autumn and spring, vegetation will be identified to species. Every autumn, vegetation biomass will be estimated in the following categories: (1) grasses, (2) forbs preferred by deer, and (3) forbs not preferred by deer.

Twenty cattle, deer, and nilgai (where present) fecal samples per study site will be collected during spring, autumn, and winter for stable isotope analysis. This information will be used to establish dietary overlap among cattle, deer, and nilgai. Stable isotope turnover rate of cattle and deer feces and blood will be determined in controlled experiments at TAMUK.

Our project will bring together relevant literature to reveal possible trends and determine if cattle grazing promotes or hinders growth of forbs eaten by deer. In addition, the information will be used to assess competition, based upon dietary overlap and provide insight into the use of stable isotopes in wildlife ecology.

Cooperative funding provided by the East Wildlife Foundation and Texas A&M University-Kingsville Title V Promoting Post-Baccalaureate Opportunities for Hispanic Americans Program.

Predicting Effects of Sea Level Rise on Wintering Redheads

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

During winter, the Laguna Madre along the lower Texas coast is home to nearly 80% of the World's redheads. On the wintering grounds, redheads feed

© Bart Ballard

Researchers are modelling the possible effects of rising ocean levels on wintering redhead distribution patterns.

almost exclusively on shoalgrass that grows in the Laguna Madre. Because the water in the Laguna Madre is salty, redheads fly to coastal freshwater ponds each day to dilute the high salt load they ingest while foraging. Many of these ponds used by redheads are located close to the coast with elevations near sea level. Thus, the threat of rising sea levels could have a drastic effect on the future distribution and availability of drinking sites for redheads.

We plan to model changes in sea level with different proposed scenarios to predict changes in the distribution and availability of coastal ponds adjacent to the Laguna Madre. Conservation strategies can then be devised to ensure adequate freshwater drinking sites are available with appropriate spatial distribution to sustain future redhead populations during winter.

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

Effect of Water Quality and Quantity on American Alligator Density

Cord B. Eversole, Jacob L. Ogdee, Scott E. Henke, Bart M. Ballard, and Randy Powell

The American alligator is known to tolerate, and to some extent thrive, in habitat considered less than optimal for other wildlife species. This ability has aided in the proliferation of the species. However, it is unknown what the range of tolerance is for alligators regarding water quality and quantity and how these parameters influence population density. Therefore, we will investigate water quality and quantity features that constitute optimum habitat and determine the relationship of these variables to population density.

In this study, quality of each body of water will be assessed in concurrence with monthly nighttime population surveys for American alligators. Area of inundation will be determined by mapping the boundary of each body of water with a hand-held Global Positioning Systems (GPS) unit. Percentage of open water will be determined through visual estimation and with water depth information. Water chemistry data such as temperature, dissolved oxygen, salinity, conductivity, and pH will be collected at 3 random points within each wetland.

The information collected in this study will aid in the determination of what constitutes optimum American alligator habitat. This will allow the development of more sound management plans in which better management decisions can be made to conserve the species and the habitat that it occupies.

Cooperative funding provided by Brazos Bend State Park Volunteer Organization and the East Texas Herpetological Society.

Management Implications for Unbalanced Sex Ratios of Wintering Northern Pintails

Nathaniel R. Huck and Bart M. Ballard

Sex ratios in birds can be skewed towards one sex or another for a variety of reasons. For instance, the population sex ratio can be influenced by differential hatching rates or survival between the sexes. Sex ratios can also be biased geographically because of differential migration where one sex migrates to different regions than the other, competitive exclusion in which the dominant sex occupies higher quality habitats, or because of differential requirements between the sexes during the annual cycle forcing the sexes to use different habitats.

Northern pintails tend to experience male-biased sex ratios. Consequently, studies assessing data from flocks may not provide sufficient information on the specific habitat needs of female pintails.

Our goal is to investigate differences in sex ratios of northern pintails wintering in different habitat types along the Texas coast. We currently have evaluated sex ratios of about 1,000 flocks across 4 years as part of other studies. We hope to gain a better understanding

of possible differential habitat use between the sexes, particularly as females are most important in population dynamics.

With this information, biologists will be able to fine-tune management to those conditions that are optimal for female pintails. Management, based on our findings, will likely have immediate positive impacts on the northern pintail population.

Brown Tree Snake Invasion Risk Assessment for the Caribbean

Brent C. Newman, Scott E. Henke, and David Britton

The brown tree snake is a mildly venomous, rear-fanged constrictor that is native to Australasia. These snakes were unintentionally introduced to the island of Guam sometime after World War II, possibly on a cargo shipment from Australia. Because of population explosions of the brown tree snake around 1960 on Guam, it is considered an exotic invasive causing significant economic, biological, and human health problems on the island. In addition, brown tree snakes have been found on planes, ships, and cargo leaving Guam. They have been found in Hawaii, Texas, Oklahoma, and Alaska, highlighting their invasive potential.

Recent risk assessment models for brown tree snakes indicate that the southeastern United States has a high potential risk for establishment if the snake is accidently introduced. It is assumed that the Caribbean also would be at risk of potential establishment by brown tree snakes, but such an assessment has not been conducted. Therefore, our objective is to determine the potential risk of invasion and establishment by brown tree snakes if accidently introduced into the Caribbean.

We propose to develop a risk assessment model identifying and quantifying shipments originating from Guam, climatic suitability for brown tree snakes between the Caribbean and its native and introduced range, and potential prey abundance on islands of the Caribbean. Data from this study will further our knowledge of the potential breadth for negative ecological and economic impacts caused by this highly invasive reptile.

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

Habitat Characteristics Associated with Chagas Disease and its Prevention

Scott E. Henke, Greta L. Schuster, Blake Bextine, and Alan M. Fedynich

Chagas disease is caused by the protozoan parasite *Trypanosoma cruzi*. The parasite is transmitted when triatomine bugs, commonly called kissing bugs, obtain a blood meal from a mammal. This parasite causes heart, intestinal, and breathing problems in domestic dogs, wild mammals, and humans. Eleven species of kissing bugs are known carriers of the protozoan with more than 150 mammalian species reported as potential hosts. However, domestic dogs appear to be a preferred host of kissing bugs.

Infection rates of *T. cruzi* in kissing bugs worldwide are unknown, but are reported to range from 17 to 48% in Texas. In addition, infections range from 3 to 10% in domestic dogs from Texas. Little is known about prevalence of infection in wild animals.

Death of domestic dogs from Chagas disease is reported each year in southern Texas. Actual mortality of dogs is likely underestimated resulting from the lack of veterinary care in lower socioeconomic regions. Evidence suggests that humans who are associated with seropositive animals have an increased risk of becoming infected.

In this study, we propose to investigate the floral and faunal associations among kissing bugs, *T. cruzi*-positive animals, and human infections. This information will be needed to develop Integrated Pest Management strategies to break the transmission cycle and help prevent the disease. We plan to use southern Texas as a model for developing countries. Our research is aimed at improving the health of lower socioeconomic classes that are afflicted with this often-ignored zoonotic disease.

Survey for Bobwhite and Scaled Quail Parasites in South Texas

Andrew C. Olsen, Alan M. Fedynich, and Fred C. Bryant

Quail conservation efforts in Texas have primarily focused on habitat restoration, preservation, and creation. However, with the continual long-term decline in quail populations, there is renewed interest in parasitic diseases of quail and their potential impacts.

Several species of helminths are known to cause disease in quail, and it is essential to determine if these species occur in South Texas. Unfortunately, the last bobwhite parasite study conducted in South Texas occurred over 30 years ago. In addition, no parasite-related information is available on scaled quail within the region. Our objectives are to determine helminth parasite species of northern bobwhites and scaled quail occurring in South Texas and to analyze the parasite prevalence and abundance in relation to collection year, host sex, and host age.

Ninety-two bobwhites and 12 scaled quail were donated during the 2012–2013 hunting season, spanning 11 counties. These quail are being necropsied at the Buddy Temple Pathology and Diagnostic Laboratory at Texas A&M University-Kingsville. All quail have been examined for eyeworms (*Oxyspirura petrowi*); complete necropsies of the carcasses for other helminths are currently being conducted.

From the results thus far, 6 bobwhites were infected with 1 to 3 eyeworms, whereas only 1 scaled quail was infected with 3 eyeworms. Additional quail will be obtained during the 2013–2014 hunting season. The findings from this study will give us a better picture of parasite infections occurring in quail within South Texas and provide insight into the possible negative effects of parasitic infections.

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

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

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

White-tailed deer are intermediate hosts for the cattle fever tick (CFT). This tick carries a protozoan that causes cattle fever, which is an important livestock disease.

After a successful eradication program in the early 20th century, CFTs were extirpated from the United States except along the Rio Grande from Del Rio to Brownsville, Texas. This region is referred to as the Tick Eradication Quarantine Area (TEQA). High deer densities in the TEQA in Zapata County have complicated tick eradication efforts. The objective of this study is to influence deer management in the TEQA by assisting landowners in meeting their deer manage-

ment goals, in part, by providing management guidance about deer density and herd composition.

We held landowner conferences in Zapata County during July and September of 2012, which featured biologists from the CKWRI and the Quality Deer Management Association. The presenters encouraged landowners to manage for an appropriate deer density with a 2:1 doe-to-buck ratio through doe harvest and allowing quality young bucks to mature.

We flew helicopter surveys in February, November, and December of 2012 on private properties in the TEQA and on government-owned land next to Falcon Reservoir. Surveys on 2 areas of government-owned land were flown in February and December, which revealed average densities of 8 acres per deer and 5 acres per deer, respectively, and sex ratios of 9 does per buck and 5 does per buck, respectively. We are currently working with the governmental organization in charge of the land on a youth doe hunt and the issuance of doe tags to cattle ranchers who lease the land for grazing.

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

Brevetoxin Exposure to Terrestrial Wildlife Along the Southern Gulf Coast of Texas

Brian Barrera and Scott E. Henke

The dinoflagellate *Karenia brevis* creates "red tides" in the Gulf of Mexico, which produces a powerful neurotoxin known as brevetoxins. Brevetoxins accumulate in water and become incorporated in seagrass, phytoplankton, and zooplankton. Brevetoxins then bioaccumulate and transfer to upper trophic levels. In animals, brevetoxins bind to sodium channels in nerve cells and disrupt normal neurological processes.

Brevetoxins have been the cause of death for marine mammals such as manatees and bottlenose dolphins, fish, sea turtles, birds, and even humans. As dead animals wash ashore, terrestrial animals potentially become exposed, thereby increasing the risk to more species. Human exposure can occur by inhalation of marine spray during red tide events. Wildlife and pet mortalities and human illness can affect visitation rates to beaches. This, in turn, can affect local communities and economies.

Our objectives include the following: (1) identify and quantify fish and marine mammal mortality on Gulf Coast beaches of Texas, (2) evaluate potential exposure of brevetoxins to terrestrial mammalian species by assessing brevetoxins in marine water and in dead fish and marine mammals that have washed ashore, (3) determine terrestrial mammalian species use of Gulf Coast beaches, and (4) assess prevalence of brevetoxins in terrestrial mammalian species. This study will further our knowledge of the potential exposure of brevetoxins to coastal wildlife.

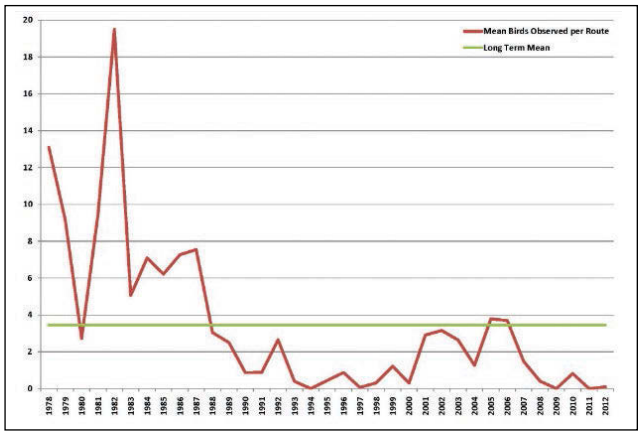
Cooperative funding provided by the TAMUK University Undergraduate Research Award.

Parasitological Survey of Scaled Quail Collected from Western Texas

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

The scaled quail is an important game species with both economic and cultural significance across the western half of Texas. However, the population has been in decline since the 1960s especially throughout the Rolling Plains. Little research has been conducted on the parasites of scaled quail or their potential role in negatively affecting this gamebird. The possible role of parasites and diseases in the scaled quail population decline needs to be examined in more depth.

The objectives of this study are to (1) determine prevalence, intensity, and abundance of helminth parasites in scaled quail from the Rolling Plains and west Texas; (2) determine if helminth infections vary by host age, host sex, and body weight; (3) document pathological responses to tissues caused by infections, focusing on eyeworms and cecal worms; and



Texas Parks and Wildlife Department scaled quail survey data from 1978 to 2012 for the Rolling Plains region showing the dramatic decline in call counts in the region (http://www.tpwd.state.tx.us/huntwild/hunt/planning/quail_forecast/forecast/rolling_plains/).

(4) create an updated database of helminths found in scaled quail. If time and sample size permit, we will examine the relationships between helminth infections and scaled quail diet, and compare helminth infections found in this study to those in scaled quail from an ongoing study in South Texas using hunter-shot birds.

Scaled quail have been collected in the Rolling Plains and west Texas during August and October 2012 and 2013 under the umbrella project Operation Idiopathic Decline. In addition, we will attempt to acquire hunter-shot scaled quail during the upcoming hunting season.

This study will provide new information about helminth parasite infections in scaled quail from Texas. Such information forms the basis for a better understanding of the possible relationship between parasites and their negative effects on scaled quail individuals and populations.

Cooperative funding provided by the Rolling Plains Quail Research Foundation.

Insulation Properties of Raccoon Feces Aid the Viability of *Baylisascaris procyonis* Eggs

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

Baylisascaris procyonis is a large roundworm that lives in the small intestine of raccoons. The prevalence of this nematode in raccoon populations can range from 0 to 60%. Infected raccoons shed eggs of *B. procyonis* in their feces. The larva, when ingested by a susceptible host, can cause numerous physiological disorders and death within their hosts. Humans, especially children, have become infected through contact with raccoon latrines.

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Raccoons are the natural host for the roundworm that can cause blindness and neurological damage in humans.

The lethal temperature for *B. procyonis* eggs is considered to be 150°F. Recently, we demonstrated that certain latrine locations exceed 150°F, which can kill the eggs. However, the insulation properties of feces were not considered in the previous study. Therefore, our objective is to determine the exterior and interior temperatures of raccoon feces to evaluate the potential insulation properties of feces, which may aid the viability of this zoonotic parasite. This study will further our knowledge about the potential longevity of *B. procyonis* eggs within the environment.

Cooperative funding provided by the Harry L. Willet Foundation.

Survey and Assessment of Parasites in Bobwhites from the Rolling Plains

Andrea Bruno, Alan M. Fedynich, and Dale Rollins

The northern bobwhite is experiencing long-term declines throughout its range in North America, likely in response to shrinking habitat and fragmentation. However, there is a realization that populations are declining even where good habitat conditions occur, thereby raising concerns that other factors may be involved as well.

Parasites and the diseases caused by them are often overlooked or disregarded as inconsequential. To learn more about this topic, a 3-year parasite survey focusing on northern bobwhites is being conducted in the Rolling Plains Ecoregion of Texas and western Oklahoma. The objectives are to examine bobwhites for *Trichomonas gallinae* (a protozoan parasite) and helminth parasites and identify pathological responses attributable to parasitic infections.

Bobwhites were collected in August and October 2011 and 2012. Samples were taken from 485 live bobwhites for *T. gallinae* testing and 97 bobwhites were collected for helminth parasite examination. Samples of eye and cecal tissues were taken to assess pathological responses.

All 194 bobwhites tested negative for *T. gallinae* from the 2011 sample. The remaining 291 samples will be analyzed for *T. gallinae* in July 2013. Eleven species of helminths were found. The most commonly occurring (prevalent) species were the intestinal worm (*Aulonocephalus pennula*), eye worm (*Oxyspirura petrowi*), and proventricular worm (*Tetrameres patter-*

Descriptive statistics of helminth parasites from 97 northern bobwhites collected during August and October of 2011 and 2012 in the Rolling Plains Ecoregion of Texas and western Oklahoma.

	Prevalence	Intensity of Infection		Abundance	
Helminth	n (%)	mean ± SE	Range	Mean ± SE	Total
Aulonocephalus pennula (S, L, C)*	73 (75)	126.1 ± 14.5	1–579	95.0 ± 12.2	9,207
Oxyspirura petrowi (E)	33 (34)	10.1 ± 2.5	1–62	3.4 ± 1.0	334
Tetrameres pattersoni (P)	17 (18)	2.8 ± 0.4	1–7	0.5 ± 0.1	47
Acanthocepha (N, C)	10 (10)	4.0 ± 1.4	1–14	0.4 ± 0.2	39
Physaloptera sp. (BM)	9 (9)	3.4 ± 1.2	1–12	0.3 ± 0.1	30
Gongylonema phasianella (CR)	1 (1)	3.0 ± 1.0	1–3	<0.1 ± <0.1	3
Cheliospirura spinosa (G)	2 (2)	1.5 ± 0.5	1–2	<0.1 ± <0.1	3
Dispharynx nasuta (P)	2 (2)	1.0 ± 0.0	1	<0.1 ± <0.1	2
Cestoda (S)	2 (2)	1.0 ± 0.0	1	<0.1 ± <0.1	2
Mediorhynchus sp. (S)	1 (1)	1.0 ± 0.0	1	<0.1 ± <0.1	1
Eucoleus contortus (CR)	1 (1)	1.0 ± <0.1	1	<0.1 ± <0.1	1

* Tissues where parasites occurred: BM = breast muscle; C = ceca; CR = crop; G = gizzard; E = eye, nictitating membrane, ducts, and ocular sinus; L = large intestine; N = neck muscle; P = proventriculus; S = small intestine

soni). Prevalence of these helminths increased with host age, decreased between 2011 and 2012, but were similar between host sexes. Preliminary pathology results indicated that bobwhites infected with eyeworms had corneal scarring of the eye.

The third year of collections will occur in August and October 2013. Findings from this study will shed light on a topic that has not been adequately addressed for the last 60 years in Texas.

Cooperative funding provided by the Rolling Plains Quail Research Foundation.

Prevalence of Mange in Carnivores and Potential Risk to Ocelots

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

Mange has been documented in various mammals including rodents, rabbits, ungulates, and carnivores. It has been reported that an ocelot died from mange in South Texas. The high density of ocelots in small, isolated habitats may make this felid more vulnerable to disease transmission. Given the low population size and decreasing genetic diversity of ocelots in South Texas, a disease outbreak causing only a few deaths could be harmful to the population.

In 2011, we began a remote sensing camera survey for ocelots and other carnivores at the East El Sauz Ranch in Willacy County, Texas. We established a camera grid consisting of 15 paired camera stations separated by a distance of 2,000 to 3,300 feet (600 to 1,000 meters). Our survey consisted of 4,515 camera-nights.

We documented mange in 28% of the coyotes. Mange was also detected in a male and a female bobcat, but not in ocelots despite their high density and spatial overlap with these other species. In addition, we conducted camera surveys at 3 other ranches managed by the East Wildlife Foundation (San Antonio Viejo, Buena Vista, and Santa Rosa) and mange also was detected in coyotes.

We are currently evaluating the influence of several factors on mange prevalence at these ranches. Future research will focus on rapid assessment of mange prevalence and efforts for control.

Cooperative funding provided by the East Wildlife Foundation, Wild Cat Conservation, Inc., and Texas Parks and Wildlife Department.

The Comanche-Faith Project

Charles A. DeYoung, David G. Hewitt, Timothy E. Fulbright, Kim N. Echols, Don A. Draeger, Dawson W. Lilly, Asa S. Wilson, Whitney J. Priesmeyer, and Blaise A. Korzekwa

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

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

Cooperative funding provided by the Comanche Ranch, T. Dan Friedkin, Faith Ranch, and Stedman West Foundation. Additional student support provided by several named endowments and scholarships and the Hispanic Leaders in Agriculture and the Environment scholarship.

Deer Density and Supplemental Feed Effects on White-tailed Deer Space Use

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

The addition of supplemental feed can help lessen competition for limited resources. However, it can create more interactions among individuals as deer densities increase. This could alter social structure and change behavior. The resulting deer distributions may affect individual fitness, survival, or reproduction. We hypothesized that deer in enclosures where supplemental feed was available would have larger home ranges than those in enclosures without supplemental feed and home range size would decline as densities increased.

We equipped 37 deer with Global Positioning Systems (GPS) collars from December 2009 to December 2010 and monitored them. The deer occupied high and low density enclosures, both with and without ad libitum supplemental feed. We selected 5 biologically relevant seasons (rut, winter-spring, late gestation, summer lactation, autumn) to analyze deer spatial distributions.

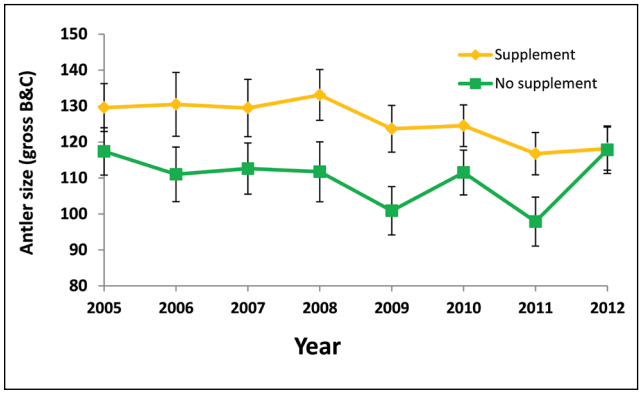
- Home ranges were larger for deer in low-density enclosures than for deer in high-density enclosures despite access to feed during late gestation, summer lactation, and autumn.
- During the rut, males occupied larger areas than females irrespective of supplemental feed availability. However, males in enclosures with supplemental feed used larger areas than males in enclosures without supplemental feed.
- Supplemental feed availability reduced doe home range size.
- Increasing density limits the area each deer has available to meet its needs.
- Herd density and availability of feed influence deer social interactions and landscape use.
- Understanding social responses to increasing density can help land managers make decisions about managing deer density and supplemental feed.

Patterns of Antler Growth in Male White-tailed Deer

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

Supplemental feed is often used to increase nutrient availability for white-tailed deer in Texas with a common goal being to improve antler growth. However, supplemental feed may also allow deer density to increase, which, in turn, may influence the effect of supplemental feed on antler size.

The objective of our study was to evaluate the effects of supplemental feed and deer density on antler growth



Mean annual (± standard error) gross Boone and Crockett (B&C) antler score (inches) of supplemented and unsupplemented mature male white-tailed deer for 2005–2012 on the Comanche and Faith ranches, Dimmit County, Texas.

in male white-tailed deer in southern Texas. We evaluated yearling male antler development and antler score of mature males from autumn 2005 to autumn 2012. We used the total number of antler points for yearlings and the antler score of mature males taken at the time bucks were captured or estimated by an antler scoring computer software program called Buckscore™.

- Population density did not affect the number of yearling antler points or antler score of mature males; supplemental feeding increased antler size.
- The proportion of spike yearlings was greater in unsupplemented enclosures than in supplemented enclosures (92% versus 44%).
- Antler score of adult males was 16% greater in the supplemented enclosures than found in unsupplemented enclosures.
- In the dynamic, semiarid environment of South Texas, environmental conditions and nutrition affect white-tailed deer antler growth. Deer density within the range of 5 to 20 acres per deer did not have a large effect on antler size.

Patterns of Supplemental Feed Use by White-tailed Deer

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

Many white-tailed deer management programs in Texas provide supplemental feed. Various factors might affect the use of supplemental feed. Feed consumption rates may be influenced by season and weather patterns and may vary among individual deer.

Our objectives were to evaluate use of supplemental feed by white-tailed deer in southern Texas, determine factors that influence feed consumption, and evaluate their relative effects. Daily per capita feed consumption was monitored from January 2007 to December 2012 within 6 supplemented enclosures.

- Deer density alone did not appear to affect per capita feed consumption. Season appeared to influence the effect of deer density and year on per capita feed consumption.
- Per capita consumption of supplemental feed tended to be greater at low deer densities than at medium and high densities during winter, spring, and autumn. However, per capita consumption was similar among all deer densities during summer.
- Feed consumption was inversely related to moisture conditions.
- High temperatures and often abundant mesquite bean and cactus fruit crops appeared to reduce per capita feed consumption among all deer densities during summer.
- In semiarid South Texas, seasonal conditions and moisture appear to influence the effects of density on per capita feed consumption.

Factors Affecting White-tailed Deer Fawn Survival and Bed-Site Characteristics

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

Little is known about the effects of deer density and supplemental feed on white-tailed deer fawn sur-

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Bed-site selection plays a critical role in a fawn's ability to survive during a vulnerable period in a deer's life.

vival and bed-site characteristics within South Texas environments.

In April 2011 and 2012, vaginal implant transmitters (VITs) were placed into 50 and 70 pregnant does, respectively. For each ranch in 2011, 10 VITs were implanted in does within the high-density deer enclosures with supplement, 10 in high-density enclosures without supplement, and 5 in low-density enclosures with no supplement. For 2012, 15, 15, and 5 does were fitted with VITs in the same enclosures studied in 2011, respectively.

Does were monitored 3 times daily beginning on June 15th. Captured newborn fawns were measured and fitted with radio collars and monitored through 35 weeks of age. Vegetation and temperature were sampled at birth sites and at bed sites when fawns were 7 and 14 days of age. Each birth/fawn site was paired with a random site in the enclosure, which was sampled using the same methods.

- Survival increased with longer birth body length, higher rainfall, and presence of supplemental feed. Fawn sites were 4°F cooler than random sites.
- Hiding cover was 20% higher for fawn sites than random sites.
- Fawns 7 and 14 days old selected for higher shrub cover than does selected at birth sites.
- Fawns in low-density enclosures selected higher shrub cover than fawns in high-density enclosures.
- Fawns chose sites nearer to a shrub for east and west (sun) directions versus random sites.
- This study can help white-tailed deer managers better understand fawn survival and bed-site characteristics enabling them to produce high quality habitat for fawns to be concealed from predators and harsh temperatures.

Response of Preferred Browse to Increasing Deer Density and Supplemental Feed

Whitney J. Priesmeyer, Timothy E. Fulbright, Eric D. Grahmann, Blaise A. Korzekwa, David G. Hewitt, Charles A. DeYoung, David B. Wester, Kim N. Echols, and Don A. Draeger

The effects of white-tailed deer density on vegetation may be altered as the result of providing nutritious artificial feed. We tested the hypothesis that increasing deer density and providing supplemental feed in southern Texas will reduce the growth of plants exposed to deer browsing relative to plants protected from deer browsing.

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We have learned about the interrelationships between supplemental feed and vegetation use by white-tailed deer.

The height, width, and internode length of non-lignified growth, and thorn length were determined for Texas kidneywood and granjeno plants. These plants are preferred by white-tailed deer. Nutritional analysis was conducted on both species to determine if neutral detergent fiber (NDF), acid detergent fiber (ADF), and digestible protein (DP) content were affected by changing deer density and supplemental feed. Plants were protected from browsing with fenced exclosures (cages) in 2005 and a corresponding unprotected plant was selected for each caged plant in each enclosure. Data were collected from June 2007–2012.

- Supplemental feeding did not lead to increased use of either plant species by deer.
- Neither height nor width of granjeno plants was affected by supplemental feeding or increasing deer density.
- Granjeno plants exhibited compensatory growth in response to browsing, which may explain why canopies of granjeno were not affected by changing deer density.
- Precipitation helps compensate for browsing pressure, allowing granjeno plants to recover.
- The fiber content of unprotected granjeno was higher than protected plants in enclosures that had supplemental feed, which is evidence of compensatory growth.
- The height and width of unprotected kidneywood declined through time at high and medium levels of deer density. This suggests that browsed kidneywood plants are not capable of recovery despite increased levels of rainfall in 2007 and 2010.

Effects of Nutrition and Density on Fawn Recruitment in Semiarid Rangelands

Aaron M. Foley, Randy W. DeYoung, David G. Hewitt, Timothy E. Fulbright, Charles A. DeYoung, and Don A. Draeger

The importance of nutrition, maternal age, and population density on recruitment has not been quantified in populations of white-tailed deer occurring in variable environments. We studied recruitment in the 200-acre enclosures, which were populated with wild deer during 2004–2009.

We genotyped 841 individual white-tailed deer sampled in the 12 enclosures at 14 microsatellite DNA loci. Samples included 488 fetuses, fawns, and yearlings. From these, we were able to assign maternity for 384 (79%) offspring.

- Fetal counts showed that 88 to 100% of does aged more than 1 year old conceived, while 31% and 13% of doe fawns conceived in nutritionally enhanced and control enclosures, respectively.
- Does 3 years old or more recruited most (over 75%) offspring, regardless of treatment. Mature does in nutritionally enhanced enclosures recruited more fawns per year (49% versus 23% of individuals raised a fawn), more litters of twins (31% versus 9% of individuals), and had higher fetal counts (1.85 versus 1.50).
- The effects of density on recruitment were relatively subtle and might have been masked by annual variation in precipitation.
- Nutrition is clearly limiting in the semiarid environment of South Texas where variable rainfall determines quality and quantity of forage.

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CKWRI researchers are learning how fawn recruitment influences genetics and population composition.

- Maternal experience or social factors that affect access to enhanced nutrition or fawning areas may be important for physically immature does.
- Findings have implications for harvest management and provide a better understanding of the dynamics of deer populations in variable environments.

End of Completed Research for Comanche-Faith Project

Aging White-tailed Deer On-The-Hoof: How Reliable is the Method?

Josh Hartwick, Brodie Carroll, and Scott E. Henke

Aging white-tailed deer on-the-hoof has become a common practice on many Texas ranches. Landowners expect their wildlife biologists to be trained in this technique and become proficient in aging live deer.

We hypothesized that the technique is very subjective and even experienced wildlife biologists will have difficulty in aging unknown white-tailed deer on-the-hoof. Therefore, our objective was to determine the accuracy of this method by asking 25 wildlife biologists to review 20 full-body photographs of known-age, adult male white-tailed deer and estimate their age to the nearest year.

We assigned 5 points to correct assignments of year class, 3 points for ± 1 year away, and 1 point for ± 2 years from the correct age. Total scores were recorded for each person. We also asked biologists their years of experience and to self-rate their ability to estimate deer age on-the-hoof.

- Estimating age of deer did improve with experience level, but even experienced biologists averaged less than 50% on our survey.
- Overall, average score of all participants was 36.4 ± 2.1 (mean ± standard error) with a range of scores of 18–54 for estimating year class of deer.
- Average scores of the participants improved to 70.8 ± 3.0 with a range of 40–95 for estimating age class of deer from the photographs.
- Participants claimed their capabilities were greater than in actuality.
- The placement of deer in age classes is more realistic than the placement of deer into year classes.

Cooperative funding provided by the TAMUK University Undergraduate Research Award.

Evaluating Aeration and Burning for Quail Habitat Management in South Texas

Kristan E. Jenschke, Leonard A. Brennan, Fidel Hernández, and Timothy E. Fulbright

During the breeding season, appropriate habitat for brooding and foraging is crucial for northern bobwhites. Adequate overhead screening cover along with available bare ground for easier mobility is an essential component of these foraging areas. In addition, these areas need to provide a rich and diverse source of insects for growing chicks and breeding hens. Prescribed fire, cattle grazing, disking, and aeration are common management disturbances used to create or maintain bobwhite brooding and foraging areas.

The recent development of a new type of aerator that creates soil disturbance without crushing bunchgrasses (called the "quailerator") provides a unique opportunity to test how this technique works in comparison with other management disturbance methods. Our objectives were to evaluate the effectiveness of the quailerator in comparison with prescribed fire and disking for maintaining bobwhite brooding and foraging areas in South Texas rangeland vegetation.

- Following the quailerator disturbance, vegetation composition was a mix of bunchgrasses and forbs.
- In contrast, the vegetation structure following prescribed fire contained mainly grasses; following disking, the structure consisted of mainly forbs.
- The best brood habitat structure was provided by treatments that included prescribed burning.
- The best nesting habitat structure was provided by the quailerator only treatments.

Cooperative funding provided by Laborcitas Creek Ranch, the Lawrence Family Foundation, the Richard M. Kleberg, Jr. Center for Quail Research, and the South Texas Chapter of the Quail Coalition.

Phylogeography of the Scaled Quail in the American Southwest

Damon L. Williford, Randy W. DeYoung, Rodney L. Honeycutt, Leonard A. Brennan, and Fidel Hernández

Although the scaled quail is a popular upland gamebird of the southwestern United States, little is known about its population structure or levels of genetic diversity. We used sequences of the mitochondrial control region obtained from contemporary specimens and museum study skins to study the genetic diversity, phylogeographic structure, and demographic history of the scaled quail.

- Overall, the scaled quail exhibited low haplotype and nucleotide diversity. Locally, the highest levels of haplotype diversity were found in 3 Texas counties: Dimmit, La Salle, and Hudspeth.
- The scaled quail exhibits no phylogeographic structure among its 16 haplotypes. In addition, the patterns of genetic variation were not congruent with the potential geographic barriers or the current subspecies taxonomy.
- The low levels of genetic diversity and evidence of demographic expansion suggest that the scaled quail has undergone population and range expansion from a Pleistocene refugium.
- The geographic distribution of haplotypes did indicate slight genetic differentiation between the chestnut-bellied scaled quail subspecies (*Callipepla squamata castanogastris*) and the 3 western subspecies (*C. s. pallida*, *C. s. squamata*, and *C. s. hargravei*).

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

A Primer of Landscape Ecology in Quail Science

Chad J. Parent, Fidel Hernández, Leonard A. Brennan, Fred C. Bryant, David B. Wester, and Matthew J. Schnupp

The current spatial level of investigation and management is inconsistent with the scale at which habitat loss occurs for quails. Broad-scale loss of habitat is an important factor influencing range-wide population trends. Therefore, incorporating principles of landscape ecology into quail research would improve our understanding regarding the scale of habitat loss. However, there are few good applications of landscape ecology in quail science.

We propose that there is a disconnect surrounding the concepts of landscape ecology that precludes proper use. We reviewed the concepts of landscape ecology and identified potential ways researchers could incorporate landscape ecology into quail ecol-

ogy and management. Presented below are our conclusions from this study.

- The models used to make decisions about contemporary quail management issues do not formally address landscape ecology.
- Landscape ecology (1) requires an investigation of spatial pattern on ecological processes and (2) must occur on sufficiently large spatial areas.
- The confusion surrounding landscape ecology may be tied to the concept of scale—a species-specific concept. This confusion may create potentially false conclusions.
- Multi-scale modeling and spatially explicit modeling are 2 ways to incorporate landscape ecology into quail ecology and management.
- Multi-scale modeling permits extrapolation across scales and improves the ability to detect the occurrence of significant relationships.
- Spatially explicit models are easily constructed in a Geographic Information Systems (GIS) framework and could provide the basic information needed to establish management goals at the landscape scale for quail.

Cooperative funding provided by the South Texas Chapter of the Quail Coalition and King Ranch, Inc.

Contemporary Genetic Structure of the Bobwhite West of the Mississippi River

Damon L. Williford, Randy W. DeYoung, Rodney L. Honeycutt, Leonard A. Brennan, Fidel Hernández, Erin M. Wehland, Joseph P. Sands, Stephen J. DeMaso, Katherine S. Miller, and Robert M. Perez

The northern bobwhite is one of the most intensively studied birds in the United States. This is the result of its popularity as a gamebird and its economic importance to state governments and landowners. However, there have been few genetic studies of this species. Little is known about its population structure, intraspecific phylogeny, and biogeographic history. The clarification of taxonomic and phylogenetic relationships among the subspecies of the northern bobwhite has been deemed a conservation priority. This is because subspecies are often used as proxies for population structure, patterns of genetic diversity, and evolutionary potential.

We used mitochondrial DNA to study population structure and genetic diversity of the northern bobwhite west of the Mississippi River. Samples were obtained from wings and feathers of hunter harvested bobwhites and blood from trapped bobwhites. The samples came from populations in Sonora, Texas, Kansas, Oklahoma, and Missouri.

- The northern bobwhite displayed a lack of phylogeographic structure in the western portion of its U.S. range. This may be the result of population expansion after the last Pleistocene glaciation.
- Despite the lack of phylogeographic structure, there was evidence of isolation by distance. A latitudinal gradient regarding the geographic distribution of haplotypes was also apparent.
- Significant genetic differentiation was detected among plains (*Colinus virginianus taylori*), eastern (*C. v. virginianus*), Texas (*C. v. texanus*), and the masked (*C. v. ridgwayi*) bobwhite subspecies.

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

Burning and Grazing Grass Monocultures to Manage Bobwhite Habitat

Eric D. Grahmann, Timothy E. Fulbright, David B. Wester, Michael W. Hehman, Blake A. Martin, Fidel Hernández, and J. Alfonso Ortega-Santos

Buffelgrass has been introduced on southwestern rangelands for cattle production. Unfortunately, this species has contributed to the degradation of northern bobwhite habitat. Bobwhites use buffelgrass adjacent

Bobwhite hens may use buffelgrass for nesting, but move to native plant communities for brooding habitat.

to woody plant communities, but avoid it otherwise. We initiated this study to evaluate if patch burning and grazing would (1) increase forbs and sub-shrubs while decreasing exotic grass canopy cover, (2) lead to increased use of exotic grass-dominated landscapes by bobwhites, and (3) increase bobwhite density.

Our research was conducted in La Salle County, Texas (2009–2011). We designated 2, 500-acre pastures dominated with buffelgrass to receive a patch burn-graze treatment and another 2 pastures to receive a graze only treatment. We burned patches in January 2010 and 2011 and followed with grazing when emerging grass reached 6 inches. Vegetation was sampled each October. Bobwhites were captured, fitted with radio transmitters, and located 2 to 3 times per week April–September. Northern bobwhite density was estimated using fall covey call counts.

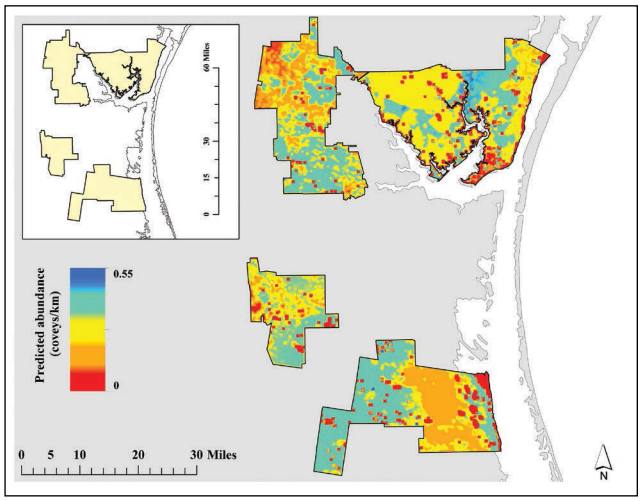
- Exotic grass cover decreased and forb and sub-shrub cover increased more in grazed only pastures, compared to pastures burned and grazed.
- Bobwhites used stands of exotic grass similarly in grazed only pastures, compared to pastures that were patch burned and grazed.
- Bobwhite densities increased slightly in patch burned and grazed pastures.
- Heterogeneity and plant species richness increased in pastures patch burned and grazed.
- Under the conditions of our study, grazing alone provided adequate control of monotypic stands of exotic grass for bobwhites, compared to patch burning and grazing. Usable space might have been dictated more by the availability of woody plants and their associated herbaceous understories than our treatments.

Cooperative funding provided by the Hixon Ranch, Rotary Club of Corpus Christi (Harvey Weil Sportsman Conservationist Award Trust), ExxonMobil, and the Arthur A. Seeligson, Jr. Conservation Fund.

Spatial Abundance Model for Bobwhites in Response to Rainfall and Landscape

Chad J. Parent, Fidel Hernández, Leonard A. Brennan, Fred C. Bryant, David B. Wester, and Matthew J. Schnupp

Broad-scale losses and deterioration of habitat have drawn much support as ultimate causes for the population declines of bobwhites. Management needs to be applied at a large scale if conservation is to be effective throughout the bobwhite's range. The ability to quantify landscape factors that influence bobwhite population dynamics at large scales may have implications for landscape-scale management.



Predicted abundance of northern bobwhites on the King Ranch related to rainfall, composition of grassland cover, and fragmentation of bare ground.

We quantified rainfall and the composition and fragmentation of important quail habitats on 4 landscapes on the King Ranch. We used these factors to develop a spatial model that predicts bobwhite abundance across space given the distribution of rainfall and spatial patterns of land cover on the landscape.

- Abundance of bobwhites was mediated primarily by autumn rainfall, but also by the configuration and fragmentation of grassland and bare ground habitat types.
- Our model suggested that managers could increase abundance by providing bobwhites more grassland on their landscapes (current grassland cover is typically around 65%) and by providing many small, fragmented patches of bare ground.
- Increasing grassland may be cost prohibitive since this is typically accomplished through brush removal. Increasing bare ground can be more easily accomplished via grazing or prescribed fire.
- Our spatial model demonstrates that management does not need to be applied broadly to a pasture. Rather, small sections of the pasture where predicted estimates of bobwhite abundance are low can be treated.

Cooperative funding provided by the South Texas Chapter of the Quail Coalition and King Ranch, Inc.

Phylogeny of the New World Quails from Mitochondrial ND2 Sequences

Damon L. Williford, Randy W. DeYoung, Rodney L. Honeycutt, Leonard A. Brennan, and Fidel Hernández

The New World quails is a family of galliform birds comprised of 9 extant genera. This group includes bobwhites (*Colinus* spp.), scaled quail and allies (*Callipepla* spp.), mountain quail (*Oreortyx pictus*), harlequin quails (*Cyrtonyx* spp.), tree quails (*Dendrortyx* spp.), singing quail (*Dactylortyx thoracicus*), tawny-faced quail (*Rhynchortyx cinctus*), banded quail (*Philortyx* spp.), and wood-quails (*Odontophorus* spp.). Previous studies of the evolutionary relationships among these genera of New World quails have been limited to those that occur in North America.

We investigated the phylogenetic relationships among the New World quails using sequence data from the mitochondrial NADH dehydrogenase subunit 2 (ND2) gene. Tissue samples were obtained from hunter-harvested and museum specimens.

- The monophyly of all genera (except for *Colinus*) was strongly supported by phylogenetic analyses.
- *Colinus* was comprised of 2 distinct lineages. One was made up of the northern (*Colinus virginianus*) and black-throated (*Colinus nigrogularis*) bobwhites. The other was the Neotropical crested bobwhite (*Colinus cristatus*).
- The tawny-faced quail, which occurs in Central and northern South America, was basal to other New World quail.
- The remaining genera formed 2 distinct clades. The first clade was composed of *Dendrortyx*, *Oreortyx*, *Callipepla*, *Philortyx*, and the 2 *Colinus* lineages. The second clade was composed of *Odontophorus*, *Cyrtonyx*, and *Dactylortyx*.
- Results suggest that the most likely common recent ancestor of the New World quails was a forest-dwelling species similar to *Rhynchortyx*.
- It appears the divergence of the New World quail genera was driven by climatic and environmental changes occurring during the Miocene (23–5 million years ago).

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Very little is known about the relatedness of the mountain quail to other quail species.

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

Phylogeography of the Gambel's Quail-California Quail Complex

Damon L. Williford, Randy W. DeYoung, Rodney L. Honeycutt, Leonard A. Brennan, Fidel Hernández, James Heffelfinger, and Louis A. Harveson

The Gambel's quail is a common resident of brushland and thornscrub habitats of southwestern North America. Its sister species, the California quail, occupies shrubby habitats and open woodlands of Washington (where introduced), Oregon, California, and the Baja California Peninsula.

Both species are important gamebirds of western North America. They have been the subjects of many ecological studies. However, little is known about their population structure. We conducted a phylogeographic study of the Gambel's-California quail complex using mitochondrial DNA extracted from contemporary samples and museum specimens.

- Thirty-four of the 36 haplotypes found in the Gambel's quail clustered into 2 distinct haplogroups that overlapped geographically. Two additional highly divergent haplotypes, not part of either haplogroup, were also observed.
- Little phylogeographic structure was observed among the 16 haplotypes found in the California quail. This finding was similar to a previous study based on allozymes.
- The Gambel's quail and the California quail exhibited high haplotype diversity, but low nucleotide diversity. Both species showed evidence of past demographic expansion.
- The patterns of genetic variation observed in the Gambel's quail and the California quail were not

consistent with current subspecies taxonomy of either species.

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

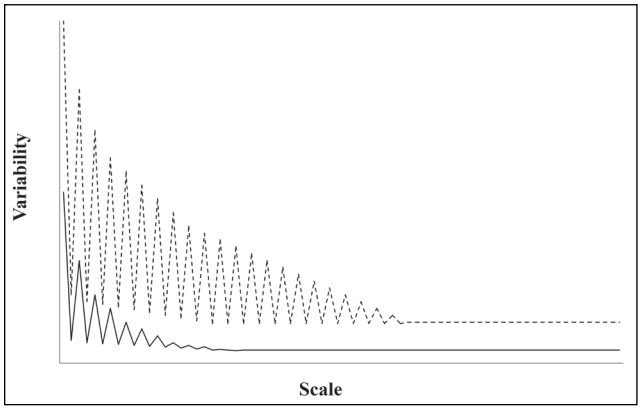
Multi-scale Models of Bobwhite Abundance in Relation to Rainfall and Management

Chad J. Parent, Fidel Hernández, Leonard A. Brennan, Fred C. Bryant, David B. Wester, and Matthew J. Schnupp

The factors that drive populations of northern bobwhites occur at more than one scale. Quail researchers traditionally have modeled the population dynamics of bobwhites at small scales. This ignores the possibility that factors driving population dynamics at large scales may differ in direction and magnitude.

Given recent conservation initiatives that call for a reversal of the scale at which bobwhites are managed, understanding population dynamics at large scales is necessary. We modeled relationships between abundance and abiotic (i.e., rainfall) and biotic (i.e., harvest, grazing, supplemental feeding, habitat management) factors on the King Ranch at 2 scales: a pasture scale (resolution = 5,900 acres) and a landscape scale (resolution = 206,000 acres).

- Data collected at landscape scales generally produced more reliable abundance models.



Conceptual relationships for variability in rainfall (hashed line) and variability in northern bobwhite abundance (solid line) are shown in the above figure. Rainfall is expected to be more variable across the spatial scale than abundance. Accordingly, models that attempt to fit a linear relationship to abundance using rainfall data will not explain maximal amounts of variation until the scale-point at which variation in both rainfall and abundance is stable (i.e., averaged out).

- Harvest of juvenile bobwhites had greater influence on long-term abundance at pasture scales, while harvest of adults had greater influence at landscape scales. Grazing and prescribed fire did not influence abundance.
- Brush management applications positively influenced abundance of bobwhites.
- Our results showed peak levels of abundance between 2 and 4 years after initial treatments.
- We identified 2 distinct periods in which rainfall influenced abundance of bobwhites. These were an autumn period (October, November) and a summer period (June).
- At small scales, rainfall varies markedly across space and time; this variation averages out at large scales. We speculated that it may be difficult to create reliable models using data that quantifies rainfall at scales smaller than the point at which the variation averages out.

Cooperative funding provided by the South Texas Chapter of the Quail Coalition and King Ranch, Inc.

Phylogeography of the Bobwhite Quails (*Colinus* spp.)

Damon L. Williford, Randy W. DeYoung, Rodney L. Honeycutt, Leonard A. Brennan, and Fidel Hernández

The bobwhites consist of 3 species of New World quails. They include the northern bobwhite, which occurs from the eastern United States to Guatemala; the black-throated bobwhite, which is found in scattered localities in the Yucatán Peninsula, Nicaragua, and Honduras; and the crested bobwhite whose range stretches from the Pacific coast of Central America to northern Brazil.

About 56 subspecies are recognized among these 3 species and are separated largely on the basis of geographic distribution and male plumage coloration. We used mitochondrial DNA sequences from museum specimens to study the phylogenetic relationships of bobwhites and examine the phylogeography of each of the 3 species.

- Bobwhites are subdivided into 2 divergent lineages. One lineage is represented by the northern bobwhite and the black-throated bobwhite and the other lineage by the crested bobwhite.
- Based on our findings, patterns of genetic variation among the northern bobwhite and black-throated

Ventral and lateral views of the northern bobwhite from Ohio (1), northern bobwhite from Jalisco, Mexico (2), northern bobwhite from Arizona (3), northern bobwhite from Chiapas, Mexico (4), black-throated bobwhite from Yucatán, Mexico (5), crested bobwhite from Colombia (6), crested bobwhite from Guatemala (7), crested bobwhite from Curaçao (8).

bobwhite are consistent with the recognition that each are a distinct species.

- The northern bobwhite lacks significant phylogeographic structure. Patterns of genetic variation were not consistent with current subspecies taxonomy. They also showed evidence of past demographic expansion.
- Populations of the black-throated bobwhite occurring in the Yucatán Peninsula were distinct from those in Nicaragua.
- The crested bobwhite was composed of 4 genetically distinct and geographically distinct groups. These included (1) a Central American clade in Guatemala, Honduras, El Salvador, and Costa Rica; (2) a western clade in Panama, northwestern Venezuela, and Colombia; (3) an eastern clade concentrated in Venezuela; and (4) a southern clade restricted to northern Brazil. These 4 clades may represent distinct species.
- Many of the South American subspecies of the crested bobwhite were genetically distinct.

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

Pipeline Restoration Techniques for Saline Clay Soils in the Eagle Ford Shale

Anthony D. Falk, Keith A. Pawelek, Forrest S. Smith, Michael W. Hehman, and Wallace Nichols

Revegetating new pipeline right-of-ways using native plants can be difficult in saline soils in the Eagle Ford Shale. Many efforts have failed. We conducted research from 2011–2013 at the Hixon Ranch in La Salle County, Texas on new pipeline right-of-ways occurring in saline clay soils (Cochina clay).

Our objectives were to determine if planting method influenced native seed establishment and which of 20 commercially available native seed varieties were best for revegetation of saline clay sites in the Eagle Ford region. We also tested 2 seeding techniques: (1) drill seeding using a Truax Flex II native seed drill and (2) hydroseeding using a Finn hydroseeder with wood-fiber mulch at 3,000 pounds per acre.

- One year after planting, hydroseeding resulted in over 1 seeded native plant per ft^2 while drill seeding had just 0.47 plants per ft^2.
- Seed varieties that performed best on the saline clay soil were Dilley Germplasm slender grama, Webb Germplasm whiplash pappusgrass, Kinney Germplasm false Rhodesgrass, Oso Germplasm Halls panicum, and Catarina Blend bristlegrass.
- On a Cochina clay soil planting site in La Salle County monitored from 2011–2013, hydroseeding resulted in better establishment of reseeded native grasses than drill seeding.

Cooperative funding provided by donors to South Texas Natives, Hixon Ranch, Native Habitat Restoration, and Douglass W. King Seed Company.

Seedling Competition between Tanglehead and Slender Grama

Jeremy W. Edwardson, Sandra Rideout-Hanzak, David B. Wester, and Greta L. Schuster

Tanglehead is a native perennial grass that has become invasive throughout the South Texas Sand Sheet. Areas within this region often become infested with tanglehead within a few years of invasion.

In a greenhouse setting, we studied growth rates and competition between tanglehead and slender grama at various seedling stages. We focused on seedling establishment with and without litter cover. In addition, we examined how water availability influences competition between tanglehead and slender grama. We analyzed root scans with WinRHIZO® software.

- We found increased establishment rates of tanglehead seedlings from 3.5% with litter to 12.5% without litter.
- Tanglehead seedlings established without litter grew more leaves, longer leaves, more roots, and longer roots over 105 days than those established in pots with litter.
- Most tanglehead root measurements, except the root diameter, were higher when plants were watered at the high level than at medium or low-level waterings.
- Tanglehead root diameter decreased with increasing available moisture, possibly because the number of small, lateral roots and root hairs increased. However, root diameter of slender grama did not decrease with increasing water although it also showed an increase in small roots.
- Our results provide insight regarding the effects of various management techniques that leave the soil without litter, such as prescribed burning, and the timing of management treatments in relationship to available water.

Comparative Evaluation of Four Pipeline Right-of-Way Seeding Techniques

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

Various seeding methods are used to revegetate areas disturbed by oil and gas pipeline development in the Eagle Ford Shale oil and gas play. We conducted a comparative evaluation of 4 common seeding methods from 2012–2013 to provide guidance on planting method selection to landowners and industry.

We planted a native seed mix and oat cover crop by 4 methods: (1) drilling using a Truax Flex II drill, (2) broadcasting and culti-packing, (3) hydroseeding using wood fiber mulch at 2,000 pounds per acre, and (4) hydroseeding using Flexterra mulch at 5,000 pounds per acre. Seedbed preparation included discing, cultivation, and culti-packing. The planting site was irrigated immediately after planting and received below average rainfall thereafter.

- We found no effect of planting method on plant density or cover.
- Each of the 4 planting methods resulted in greater than the 0.5 seeded native plants per ft^2 threshold for success ratings, averaging 3.25 plants per ft^2 across the treatments.
- The best performing native seed varieties (in order of relative performance) were Kinney Germplasm false Rhodesgrass, Van Horn green sprangletop, Maverick Germplasm pink pappusgrass, Webb Germplasm whiplash pappusgrass, and Dilley Germplasm slender grama.
- From a stand establishment standpoint, all methods studied proved adequate. However, costs associated with each method varied greatly, averaging $45 per acre for drilling, $25 per acre for broadcasting, $500 per acre for hydroseeding with wood fiber mulch, and up to $5,000 per acre for hydroseeding using Flexterra mulch.

Cooperative funding provided by donors to South Texas Natives.

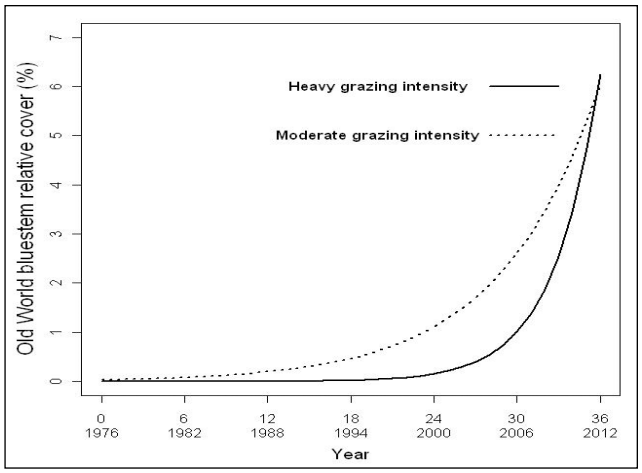
Patterns of Old World Bluestem Invasion during 37 Years in Southern Texas

Steven J. Goertz, Timothy E. Fulbright, David B. Wester, Terry L. Blankenship, J. Alfonso Ortega-Santos, and Eric J. Redeker

The invasion of Old World bluestems reduces habitat quality for wildlife and biodiversity. Our primary objective was to determine spatial and temporal patterns of Old World bluestem invasion in relation to soils, time, brush canopy cover, grazing, closeness to roads and pipelines, and species richness.

Plant survey transects, established in 1976, were distributed throughout the Welder Wildlife Refuge in northern San Patricio County, Texas. Canopy cover of woody and herbaceous vegetation was estimated during each summer from 1976–2012.

- Sites on the study area with clay textured soils and less than 70% absolute woody canopy cover were more prone to exotic plant invasion than those with sandier soils and greater than 70% absolute woody canopy cover.
- Canopy cover of Old World bluestems increased from 0% in 1976 to an average of 9% in 2012.
- Heavy cattle grazing reduced relative cover of Old World bluestems. However, once grazing intensity was changed to moderate, relative cover increased rapidly and might have potentially exceeded cover on areas that were only moderately grazed.
- Relative cover of Old World bluestems declined with increasing woody plant canopy cover. However, there was a positive relationship between Old World bluestem cover and woody plant canopy cover when woody plant canopy cover was less than 70%.
- Relative cover of Old Word bluestems was between 10 and 15% near roads and pipelines and declined to near 0% more than 200 yards away.
- Management to prevent invasion of Old World bluestems should focus on areas that are the most susceptible to invasion. Our results indicate these are open areas near roads and pipelines dominated by grasses and forbs with clay-textured soils.



Predicted relative cover of Old World bluestems over time for 2 grazing intensities in San Patricio County, Texas. Note: X = year – 1976 (i.e., when year = 1976, X = 0 and when year = 1977, X = 1, etc.).

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

The Effect of Drought on Clutch Size and Hatchling Production of Alligators

Cord B. Eversole, Scott E. Henke, Randy Powell, and Larry W. Janik

The American alligator has made a remarkable recovery throughout its range during the last half century. This recovery is attributed to sound management practices that are based on sound research. However, little research has focused on nest characteristics, nest success, and production of hatchling alligators. We quantified hatching success of American alligator nests in Texas during 2007–2012 and is based on 33,541 eggs from 902 nests.

- On average, each nest contained 37 eggs, of which 32 eggs were viable (86% of egg total) and 5 were infertile (14% of egg total).
- Of the 32 viable eggs per average nest, 23 hatched (71% of viable eggs; 61% of total eggs) and 9 did not hatch (29% of viable eggs; 25% of eggs).
- On average, 15 eggs did not hatch from an average nest of 37 eggs.
- Wild alligator nests had an average hatchling potential production rate of 61% per nest.
- There were fewer hatchlings (18.1; 49% of total eggs, 58% of viable eggs) and more fertile non-hatching eggs (13; 35% of total eggs, 40% of viable eggs) in 2011 than in all other years.
- Findings suggest that hatching success fluctuates due to drought conditions.

Cooperative funding provided by Janik Alligator Farms, the East Texas Herpetological Society, and the Brazos Bend State Park Volunteer Organization.

Size of the Ocelot Tamaulipan Population Needed to Sustain Translocations

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

The Ocelot Recovery Plan and CKWRI research have identified translocation and habitat restoration as 2 management actions with the potential to reduce the probability of ocelot extirpation in the United States. Ocelots in Tamaulipas, Mexico are ecologically and genetically similar to ocelots in Texas. Consequently, they are good candidates for translocation activities.

We used population viability analysis (PVA) models to identify the duration and intensity of translocation of ocelots from Mexico needed to prevent extirpation in the United States. PVA indicated the following.

- Ocelots occupy 50% of 1,756 mi^2 of thornshrub habitat in Tamaulipas.
- There is a conservative estimate of 269 ocelots in the Sierra Tamaulipas.
- Translocating 16 ocelots every 3 years resulted in zero chance of extirpation of the source population.
- Removing source ocelots from Tamaulipas for translocation to Texas would likely not negatively impact the source population.

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

Prevalence of Cannibalism in American Alligators

J. Allen Farge, Brent C. Newman, Cord B. Eversole, and Scott E. Henke

American alligators are considered opportunistic predators with cannibalistic tendencies. Past research suggests that as much as 65% of alligator mortality is attributable to cannibalism. We hypothesize that if alligators were cannibalistic, they would depredate young individuals.

We analyzed stomach contents from 62 wild American alligators collected during the 2012 harvest season (e.g., September) from rivers, lakes, and ponds in southeastern Texas. Alligators were separated by sex and size (up to 6.5 ft and greater than 6.5 ft). Food habits are reported as aggregate percentage volume.

- Twenty items were identified as part of the alligator's diet.
- Smaller-sized males ate more reptiles such as red-eared slider turtles and diamondback water snakes, whereas smaller-sized females ate more fish such as alligator gar.
- Larger-sized females ate more birds such as reddish egrets and teal, whereas larger-sized males ate more mammals such as raccoons and feral hogs.
- We found only a single instance (1.6%) of an American alligator from southeastern Texas to be potentially cannibalistic.

- Perhaps alligator density within our study area was not sufficient to elicit cannibalistic behavior.

Cooperative funding provided by the East Texas Herpetological Society, Brazos Bend State Park Volunteer Organization, the Armand Bayou Nature Center, and Larry W. Janik.

Assessment of Sarcoptic Mange in Selected Wild Mammals in Southern Texas

M. Eric Mehlenbacher, Scott E. Henke, Alfonso Ortega-Sanchez, Jr., and Tyler A. Campbell

Sarcoptic mange is caused by the mite *Sarcoptes scabiei*. It is a highly contagious skin disease found in over 100 species of mammals, including humans. Its prevalence in North America has ranged from 11% to over 80% during epizootic peaks. Severe mange has resulted in about 80% mortality and reduced ovulation and pregnancy rates in surviving females.

Our objective was to document the prevalence of mange in wild mammals of southern Texas. Blood and skin samples were taken from captured mammals. Photographs of the mammals were taken to document the extent of hair loss, oily skin and fur, and lesions.

- Samples were collected from 17 feral hogs, 34 white-tailed deer, 9 coyotes, 2 nilgai, 3 raccoons, 5 javelinas, 2 bobcats, 1 black-tailed jackrabbit, and individuals representing 3 rodent species.
- Overall, 36% were positive for mange.
- *Sarcoptes scabiei* was found in 76% of feral hogs, 33% of white-tailed deer, and 56% of coyotes. Mites were not found on the other species.
- Mange was mild to moderate in feral hogs and deer, but severe in coyotes.
- Coyotes appeared to be more susceptible to the effects of mange than the other mammalian species.

Cooperative funding provided by the East Wildlife Foundation.

Nuisance American Alligators: An Investigation into Texas Trends

Cord B. Eversole, Amos Cooper, Monique Slaughter, and Scott E. Henke

The rebound of American alligator populations throughout this species' range has caused an influx of human-alligator conflicts. We quantified 5,838 nuisance alligator reports made from 2000 to 2011 in Texas to provide more site-specific information for conflict management, and to determine where management should be focused to minimize this conflict.

- Counties of concern based on percentage of total reports were Jefferson (16%), Fort Bend (14%), Matagorda (11%), Brazoria (10%), Harris (7%), Jackson (5%), Orange (5%), Chambers (5%), Calhoun (5%), and Liberty (3%).
- Of the nuisance alligators reported, 45% were by males, 18% were by females, and 38% were not identified by sex.
- The largest size cohort consisted of alligators that were 5 ft in length (18%) with May (21%) being the highest reporting month.
- The most common nuisance situation occurred in residential areas (24%).
- The most common resolution was lethal removal by state contracted nuisance alligator hunters (50%).
- As both human and alligator populations expand, these conflicts will become more prevalent.

Cooperative funding provided by the East Texas Herpetological Society, Brazos Bend State Park Volunteer Organization, and Texas Parks and Wildlife Department.

Everything is Bigger in Texas, or so Texas Hunters Think

M. Eric Mehlenbacher and Scott E. Henke

Feral hogs are a popular game species in Texas. Although weights of adult Russian boars can reach 660

Texas hunters often overestimate the size of feral hogs by over double the actual weight.

lbs, the average weight of an adult feral hog in Texas is 118 lbs. Yet, Texas hunters often claim weights of harvested hogs to be over 300 lbs. This is based on estimated weights instead of actual weights.

To test our hypothesis that hunters overestimate the size of feral hogs, we captured 3 feral hogs (1 young, 1 sub-adult, and 1 adult) and asked 104 Texas hunters to estimate the weight of each hog. The actual weight of each hog was recorded by a spring scale the same day.

- The actual weight was 12 lbs, 68 lbs, and 121 lbs for the young, sub-adult, and adult hog, respectively.
- Texas hunters overestimated the weight of each size class of hog by approximately 2-fold.
- The mean and mode of estimated weight was 27 lbs and 23 lbs for the young feral hog, 114 lbs and 76 lbs for the sub-adult feral hog, and 231 lbs and 250 lbs for the adult feral hog.
- Most feral hogs in Texas are less than 175 lbs.
- The reports of "Hogzillas" in Texas are likely as mythical as Bigfoot and the Lochness Monster.

Cooperative funding provided by the TAMUK University Undergraduate Research Award.

Influence of Weather on Avian Migration Dynamics Along the Lower Texas Coast

Suzanne Contreras, Bart M. Ballard, David B. Wester, William P. Kuvlesky, Jr., Leonard A. Brennan, Michael L. Morrison, and Kathy Boydston

The Texas coast is a migration corridor that funnels millions of birds between the breeding and wintering grounds every spring and fall. The timing and amount of fall and spring migration is often predicted by weather conditions.

© Greg W. Lasley

The indigo bunting is one of the many species of birds that migrates through the South Texas coastal region.

In this study, we investigated the effect of 5 weather variables that influence migratory bird behavior: wind direction, wind speed, temperature, barometric pressure, and the presence of fog. We combined our data on nocturnal bird passage and upper air weather data from the nearest National Weather Service station to each coastal study site to examine the relationship between nocturnal migration and weather among different altitudes.

- Wind direction (tailwinds) was the strongest predictor of bird passage in fall.
- Highest bird passage occurred when wind speeds ranged from 4.5 to 22.4 miles per hour; passage rates decreased when winds became stronger.
- Migrating birds chose altitudes with temperatures ranging from 60° to 70°F and barometric pressure ranging from 737 to 750 mm Hg.
- This is the first study that evaluates the influence of weather on bird passage rates at specific altitudes. It provides valuable insight for understanding how birds use the airspace during migration.

Cooperative funding provided by the Robert J. Kleberg, Jr. and Helen C. Kleberg Foundation and Texas Parks and Wildlife Department.

Translocation Strategies to Augment Texas Ocelot Populations using PVAs

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

Ocelot populations in the United States are vulnerable to extirpation. Currently, there are only 3 known breeding ocelot populations in the United States. All of these populations occur in extreme southern Texas. One is located in and around the Laguna Atascosa National Wildlife Refuge and the other 2 occur on private ranches in Willacy County. The Ocelot Recovery Plan and research conducted by the CKWRI have identified translocation and habitat restoration as 2 methods that can reduce the probability of ocelot extirpation in Texas.

Habitat restoration will likely take many years before achieving appreciable results. However, ocelot translocations can produce immediate results in improved genetic fitness and increasing the number

of individuals. We used population viability analysis (PVA) models to identify the duration and intensity of translocation of ocelots from Mexico required to prevent extirpation in the United States.

- Four ocelots every 3 years were the most efficient for effective translocation from Mexico to the populations in the United States.
- All translocated individuals are assumed to become part of the breeding population.
- Twenty-four individuals would need to be translocated over 20 years.
- Habitat restoration and a reduction in road mortality must accompany translocation to avoid extirpation.

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

Human Attitudes Toward the American Alligator

Jacob L. Ogdee, Cord B. Eversole, and Scott E. Henke

The general public's knowledge of the American alligator is surrounded by sensationalized facts and myths. This is fueled by Hollywood's portrayal of alligators in movies such as Lake Placid and the popular television show Swamp People. We surveyed 98 park visitors of Brazos Bend State Park, a Texas park that highlights alligators, to assess their attitudes toward and knowledge of alligators.

- Responses of park visitors did not differ by ethnic background or age.
- Responses were moderately variable between sexes, and responses were slightly variable between participants having more than an undergraduate degree. Visitors with more education (more than an undergraduate degree) were willing to support lethal control of alligators.
- Respondents stated that they feared reptiles more than mammals, and predators more than the non-predatory animals.
- Females stated they had a greater fear, or were more willing to admit to a greater fear, of reptiles, including alligators.
- The majority of park visitors would support a non-lethal alligator removal program if alligators became a nuisance. However, they were unwilling to have alligators relocated near their homes.

Graduate student Cord Eversole studied the ecology of alligators in coastal areas of Texas.

- Park visitors had a very cursory understanding of alligators, and they would benefit from the development of an alligator education program.

Cooperative funding provided by the East Texas Herpetological Society and Brazos Bend State Park Volunteer Organization.

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Mr. M. Eric Mehlenbacher
Mr. John Orsak

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