WILDLIFE RESEARCH HIGHLIGHTS 2005

TEXAS PARKS & WILDLIFE

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Todd Merendino, Ph.D., Editor


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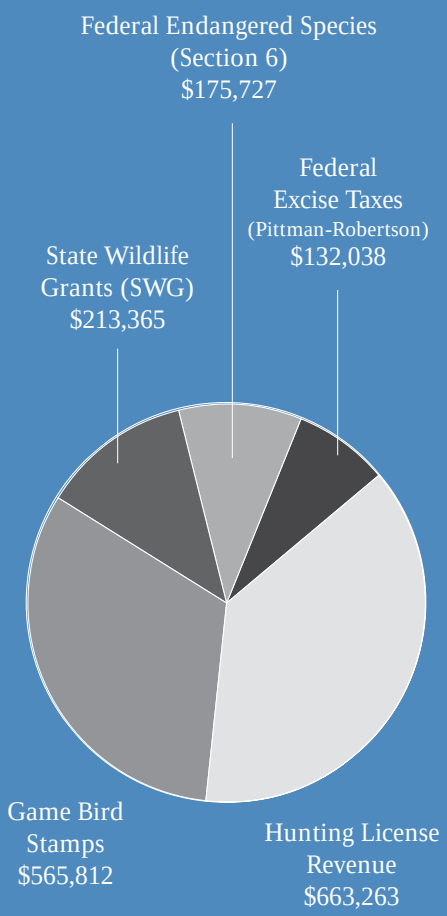
Wildlife Research Highlights 2005

Todd Merendino, Ph.D., Editor

The Wildlife Division of the Texas Parks and Wildlife Department is continuing to develop a more coordinated approach to wildlife research. With ever-expanding responsibilities for wildlife management, the Wildlife Division has recognized the need for additional emphasis on wildlife research. Our primary objectives for conducting research are to seek answers for important management questions, train our staff, expand scientific knowledge, publish results and inform the public.

Each year, the Wildlife Division identifies its top research priorities, and research proposals on these topics are solicited from qualified department and university personnel. A multi-discipline research review committee selects the best proposals, contracts are prepared and projects are conducted. Department personnel take the lead on some of the projects; university personnel lead others. In cases where a university is selected to conduct the research, department biologists are selected to serve as field advisors, graduate committee staff and publication co-authors.

The Wildlife Division budgeted over $1,750,000 for 108 wildlife research projects during Fiscal Year 05. Funding for this research has come from several sources including: (1) Texas hunting license revenue, (2) federal excise taxes, (3) federal endangered species funds (Section 6), (4) Texas waterfowl, white-winged dove and wild turkey stamps and (5) State Wildlife Grants.



Front cover photograph - Texas State Bison Herd by Earl Nottingham
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ACKNOWLEDGMENTS

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Memoriam

Lisa Engeling: Passing of a legendary lady

One of the most beloved figures ever to grace the halls of the Texas Parks and Wildlife Department passed away on Dec. 9, 2004. Mrs. Lisa Engeling died in her sleep one week after her 85th birthday, which she celebrated in a Round Rock convalescent home, surrounded by her friends from the Wildlife Division.

"Miss Lisa", as she was known throughout her career at TPWD, began working for the Department in 1952, after poachers murdered her husband, biologist and game warden Gus Engeling, on a wildlife management area near Palestine in 1951. That WMA was subsequently named for Gus Engeling. Engeling's young widow, who had three small children, went to work at the Austin headquarters as a secretary. In her more than 52 years of service, Miss Lisa's responsibilities included a tremendously wide spectrum of administration, public service and assistance. She played a major role in the areas of the regulatory process, federal aid funding, wildlife management areas, the Public Hunting Program, technical guidance and wildlife restoration. For decades, she administered the Parks and Wildlife Mutual Association, which provides death benefits for employees.

In November 2001, the department honored Miss Lisa with the only 50-year service certificate in existence. She officially "retired" in August 2003, but returned to work part-time in the Wildlife Division one month later. Mrs. Lisa Engeling will be missed throughout TPWD, but especially in the Wildlife Division, where she was greatly loved and is fondly remembered.

(http://iwww.tpwd.state.tx.us/admin/employee/geninfo/mutual_association.phtml)

Birds

Quail

Historic and Contemporary Status of Montezuma Quail in Texas

David A. Holdermann, Texas Parks and Wildlife Department

Montezuma Quail is a Mexican Highland species whose northern range limits extend into the United States in Arizona, New Mexico, and Texas. In Texas, fragmentary (incomplete) historic information suggests that it occurred extensively in the Edwards Plateau and from isolated mountain ranges in the Trans-Pecos regions of Texas. Portions of the known historic range surveyed in the mid-1980s by the Texas Department of Parks and Wildlife (TPWD) detected Montezuma Quail in the Sierra Vieja and the Davis, Del Norte, and Glass mountains of the Trans-Pecos and portions of five counties in the southwestern corner of the Edwards Plateau. Montezuma Quail is classified as a game bird in Texas, but with no open hunting season. Birders actively seek this quail.

This study was initiated to review the historic status and assess the contemporary status of Montezuma Quail in Texas. Historic status will be determined from searches of traditional ornithological literature, agency files and reports, letters and diaries of early settlers and naturalists, and museum specimens. Contemporary status will be determined from published literature, agency records, Texas Ornithological Society and other birding club records, records of expert birders, field surveys, and surveys of private landowners. Field surveys will be facilitated by use of experienced pointing dogs and play-back sound recordings of Montezuma Quail vocalizations.

In 2004, contact was made with 28 Trans-Pecos landowners for the purpose of conducting field surveys for Montezuma quail. A total search effort of 58 hours resulted in the detection of 10 pairs of Montezuma Quail and activity centers of 12 additional pairs. Montezuma Quail were detected in northern, central and southern regions of the Davis Mountains, Del Norte Mountains, Elephant Mountain Wildlife Management Area and Chisos Mountains. They were not detected in the Delaware Mountains or the Sierra Vieja. The 2004-2005 field season will focus on other Trans-Pecos mountain ranges and portions of the Edwards Plateau. Additionally, various sources of historic information will be investigated for evidence of Montezuma Quail occurrence.

Effects of Radio Transmitters on Body Mass, Food Consumption and Energy Expenditure of Northern Bobwhites

Fidel Hernandez, Juan A. Arredondo, Froylan Hernandez, David G. Hewitt, Ralph L. Bingham, Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville; Stephen J. DeMaso, TPWD

Radio telemetry is commonly used in northern bobwhite (*Colinus virginianus*) research. An underlying assumption is that radio marked individuals provide unbiased estimates of population parameters. Our objectives were to evaluate the effects of radio transmitters on body mass and feed consumption of radio marked and banded-only pen-raised bobwhites in a controlled environment and to compare daily energy expenditure (kJ/g/day) between treatments in a simulated field setting. We randomly assigned a treatment (i.e., radio marked or banded-only) to 40 pen-raised bobwhites and placed them in individual cages (51- H 27- H 28-cm) within an environmental chamber. We conducted two separate 21-day experiments to simulate summer (35E C day-time high, 23.9E C night-time low, 15-hr photoperiod) and winter conditions (18.3E C day-time high, 4.4EC night-time low, 10-hr photoperiod) typical for south Texas. For the field experiment, we evaluated energy expenditure via doubly-labeled water for radio marked (n = 5) and banded-only pen-raised bobwhites (n = 5) in a flight pen (50- H 30- H 4-m). We documented no difference in change in body mass or feed consumption between radio marked and banded-only bobwhites during either experiment (P > 0.05). We also found no difference in daily energy expenditure between radio marked (0.839 " 0.056 kJ/g/day) and banded-only pen-raised bobwhites (0.804 " 0.014 kJ/g/day; P = 0.77).

Restoration of Northern Bobwhite Populations in Fragmented Landscapes

Michael W. Janis, N. David Forrester and Royce W. Jurries, TPWD; Fidel Hernandez and Jason Scott, Texas A&M University-Kingsville

Habitat loss and fragmentation have been identified as major factors contributing to the decline of northern bobwhites (*Colinus virginianus*). Although Texas has generally been able to maintain large, contiguous tracts of suitable bobwhite habitat in South Texas and the Rolling Plains, certain regions (e.g., the southern Post Oak Savannah) have become severely fragmented. Additionally, average ranch size in this region is decreasing. However, the interest and willingness of landowners to actively manage for bobwhites is increasing. To restore bobwhite populations in the southern Post Oak Savannah and more effectively guide landowners, we need to determine the minimum area necessary to sustain a bobwhite population. The objective of this study is to determine if viable bobwhite populations can be maintained on habitat patches >400 ha existing within the ecoregion using habitat manipulation and bobwhite relocations. This study will involve four sites (two control sites and two treatment sites [habitat manipulation + relocations]) located in Caldwell and Fayette counties.

In 2004, 220 wild bobwhites were trapped and relocated to two treatment sites. All females (n = 100) were radiocollared in order to monitor movements, nesting attempts, and determine survival rates. Females surviving <14 days (n = 37) were censored from the analysis. Bobwhite survival curves (April through August) were similar between Caldwell (0.31 ± 0.10; n = 33) and Fayette County sites (0.27 ± 0.12; n = 30; x21 = 0.47, P = 0.495). However, Caldwell and Fayette counties survival estimates were lower than for bobwhites being monitored in a nonfragmented landscape in southern Texas (0.70 ± 0.03; n = 182; x21 = 10.98, P = 0.0009 and x21 = 13.36, P = 0.0003, respectively). Ten of the 63 females attempted nesting (n = 10 nests). Movement data currently is being analyzed. Additional releases on the treatment sites are planned for 2005 and, if necessary, 2006.

Funding and support for this project is being provided by contributions from private landowners, the Reynolds Foundation, TPWD, Caesar Kleberg Wildlife Research Institute and The Audubon Society.

Vegetative and Arthropod Responses to Various Discing Regimes

J. Lane Roberson, Fidel Hernandez, Leonard Brennan, Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville; Robert Perez, TPWD

Discing of rangelands has been a recommended management practice to improve bobwhite habitat since the early 20th century. Discing can increase percentage of bare ground, stimulate growth of important food plants, and create plant structural diversity necessary for invertebrates. The objective of this study is to evaluate the vegetative and arthropod responses to various discing regimes.

This project will be conducted in three ecoregions of Texas (Rolling Plains, Rio Grande Plains, and the Gulf Coast Prairies and Marshes). The study areas will be blocked by soil type, with two soil types (sandy and clay) evaluated per study area. Each soil-delineated block will consist of 24 experimental units (10 yards x 100 yards). During each month, three experimental units will be randomly selected for discing. There will be eight treatments, which will be no discing and discing in each month during the period September-March. Plant diversity, percent bare ground, percent canopy cover, visual obstruction, and invertebrate abundance will be collected during the months of March, May and July.

There is virtually no information in Texas on the varied response of vegetation to fall- and winter-month discing, or the long-term effects of discing. Due to the popularity of discing as a management practice for bobwhites, the need exists to evaluate the vegetative and arthropod responses to various discing regimes.

Characteristics of Montezuma Quail Populations and Habitats at Elephant Mountain Wildlife Management Area, Texas

Froylan Hernandez and Louis A. Harveson, Sul Ross State University; Clay E. Brewer, TPWD

Despite its status as a gamebird, little information exists on the ecology of Montezuma quail (*Cyrtonyx montezumae*) in Texas. We initiated a study to elucidate the life history characteristics of Montezuma quail in the Trans-Pecos ecoregion of Texas. Because little information exists on capture techniques for Montezuma quail, we evaluated capture efficiency of funnel traps, trained dogs with hand nets, audio-call back tapes, portable mist nets and night-netting. Based on capture-to-effort ratios, the portable mist nets and trained dogs with hand nets appear to be the most effective capture techniques. Radioed Montezuma quail experienced a high rate of mortality in our study; eight of the nine radioed quail died from avian predation within a week of release. High predation rates may have been attributed to habitat-mediated factors (e.g., low screening cover). Montezuma quail are habitat and foraging specialists that need adequate screening cover and subterranean foods for survival. Montezuma quail foraging sites were typified as having greater slopes, more diggings (an index of quail abundance) and a higher abundance of foods (Allium spp.). Resource managers should evaluate habitat management strategies aimed at enhancing screening cover and manipulating food sources for Montezuma quail.

This project was funded by TPWD, Sul Ross State University, Quail Unlimited, San Antonio Livestock Exposition, United States Department of Agriculture and West Texas Chapter of Safari Club International.

Influence of Buffelgrass on Northern Bobwhite Habitat Use and Selection in South Texas

Joseph P. Sands, Leonard A. Brennan, William P. Kuvlesky, Jr., Fidel Hernandez; Richard M. Kleberg, Jr., Texas A&M University-Kingsville; Donald C. Ruthven, III and James F. Gallagher; TPWD

The purpose of this study is to investigate the role of buffelgrass (*Cenchrus ciliaris*) in habitat use and selection by Northern Bobwhite (*Colinus virginianus*) in South Texas. The specific objectives are to 1) determine the extent to which buffelgrass influences northern bobwhite nest site selection, (2) examine the influence of buffelgrass on northern bobwhite foraging and loafing site use during the brooding period and (3) determine the abundance and diversity of herbaceous vegetation and arthropods on sites with varying degrees of buffelgrass infestation.

Between March and April 2004, 60 northern bobwhites (20 male/40 female) were captured, banded, and fitted with radio collars on the Chaparral Wildlife Management Area in Dimmit and La Salle Counties. Collared birds were relocated $\geq$ two times per week between March 26 and July 30, 2004. Habitat variables including vegetation cover and diversity are being collected for habitat analyses of organism-centered and random nest sites, and brood/covey locations. These data will be compared in univariate and multivariate space (ANOVA and logistic regression) and used to develop models of northern bobwhite habitat relationships.

In late February 2005, an additional 100 quail will be trapped and equipped with radio transmitters and monitored $\geq$ three times per week throughout the nesting, brooding, and covey periods. Collection of habitat characteristics, including abundance and diversity, will continue. We will initiate sampling of ground dwelling and winged arthropods along within one ha study plots with varying degrees of buffelgrass infestations.

The ultimate goal of this research is to provide recommendations regarding the management of buffelgrass on South Texas rangelands to provide suitable nesting and brood-rearing, and non-breeding habitat for northern bobwhites. Research results will shed light on the influence of buffelgrass on vegetation and arthropod communities, as well as northern bobwhite habitat on native, semiarid rangelands in South Texas.

Funding provided by TPWD, Caesar Kleberg WRI and the South Texas Quail Associates Program

Status, Distribution and Diet of Gambel's Quail in Trans-Pecos, Texas

Michael R. Sullins and Mike Hobson, TPWD; Michael T. Gray and Louis A. Harveson, Sul Ross State University

Gambel's quail (*Callipepla gambellii*) are limited in distribution in Texas and therefore have limited economic value as gamebirds. Aside from a few TPWD unpublished documents, virtually no data exists to date on Gambel's quail in Texas. The goal of this study was to obtain baseline information on Gambel's quail to help update its life history and current status in Texas. Our objectives were to: (1) assess the current distribution of Gambel's quail; (2) determine status (relative abundance) of Gambel's quail and (3) determine seasonal food habits of Gambel's quail.

We evaluated historical and recent distribution maps through a variety of techniques including existing TPWD maps and data, landowner surveys, and field reconnaissance. Survey routes, three to five per county and 36 km in length,

were conducted. Birds occurred from the southern tip of Big Bend National Park (BBNP) along the Rio Grande floodplain, north to just below Dell City in Culberson County. Generally birds were distributed along and within 20 miles of the Rio Grande floodplain from BBNP to El Paso, and were restricted to the floodplain and to tributary draws with fairly dense riparian vegetation. Birds also occurred from Van Horn north to Dell City roughly following the Beach and Sierra Diablo Mountains on east and west sides within the drainages that had sufficient riparian vegetation. Highest abundance of Gambel's quail appears to be correlated with density and width of riparian vegetation.

To better understand the habitat requirements and food preferences of Gambel's quail in Texas, 10-30 quail were collected each season (Nov. - Feb., Mar. - Jun, Jul. - Oct.) for two years (2003, 2004) from three study sites representing different habitats and environmental conditions throughout the Trans-Pecos region (n = 410). Preliminary findings indicate heavy use of green leafy material from late winter into early summer, with increasing arthropod material in males and females prior to nesting. Juvenile birds had significantly higher percentage of arthropods in crop contents than adults.

Funding was provided by Texas Parks and Wildlife Department, Sul Ross State University, and the Texas Chapter of Quail Unlimited.

Characteristics of Gambel's Quail Populations in Trans-Pecos, Texas

Michael T. Gray and Louis A. Harveson, Sul Ross State University; Michael R. Sullins, TPWD

The Gambel's quail (*Callipepla gambelii*) are an important game bird in the southwestern United States, however virtually no information exists on Gambel's quail in Texas. We initiated this study to describe (1) population structure, (2) home ranges and habitat utilization, (3) nesting ecology, and (4) identify survival rates and cause-specific mortalities. We established two study areas in the Trans-Pecos Region of West Texas. The first area was six miles west of Sierra Blanca, Texas. The second area is located along the Rio Grande, near the Indian Hot Springs, approximately 20 miles south of the first study area. Both areas historically held high numbers of Gambel's quail. In 2003, we captured 205 birds (19 recaptures) using milo-baited funnel traps. Captured birds were leg-banded, aged, and sexed. We radio marked 77 birds and maintained a sample size of 20-25 radioed individuals/study site. Radio marked birds were located weekly using homing technique to gain information about covey size and composition. Any mortality signals were located immediately to determine cause of death. We documented an 80% mortality rate of radio marked quail during 2003 with avian predation being the primary cause of death. Gambel's quail nests found during radio telemetry were marked, and then monitored from a distance until the nesting attempt was complete. Once the nesting attempt was completed we checked the nest for nesting success/failure, cause of failure, number of eggs and number of eggs successfully hatched. Any renesting attempts were also noted. Habitat conditions around each nest will be described. Collected GPS coordinates of each Gambel's quail were entered into ArcView 3.1 to be plotted on study area DOQQs. High-use habitats were described using 100 meter belt and line-intercept transects for woody vegetation and 100 meter point-step transects for herbaceous vegetation and ground cover. We measured annual and seasonal movements using the collected UTM coordinates and animal movement extension of ArcView. Survival estimates of radio marked individuals were calculated using the Kaplan-Meier staggered entry design.

This project was funded by TPWD, Sul Ross State University and the Texas Chapter of Quail Unlimited.

Gene Flow, Colonization Patterns and Phylogeography of the Black-capped Vireo

C. Craig Farquhar, TPWD; Jose Ignacio Gonzalez, Universidad Autónoma de Nuevo Leon, N.L., Mexico; Robert M. Zink, University of Minnesota; Joseph A Grzybowski, University of Oklahoma

Black-capped vireos (*Vireo atricapillus*) breed in arid, scrub-type vegetational communities typically associated with rocky, limestone-derived soils along slopes and drainages from south-central Oklahoma (34^{o} 50' N) to central Nuevo Leon (26^{o} 30' N), Mexico, giving them the widest latitudinal breeding range of any endangered songbird. Such geographically isolated populations may also be genetically isolated (e.g., 'Distince Population Segments'). Mitochondrial DNA has been used in many studies of birds to assess this problem, and has shown that sometimes populations are not differentiated (e.g., California gnatcatcher, *Polioptila melanura*), and sometimes they are (cactus wren, *Campylorhynchus brunneicapillus*, and verdin, *Auriparus flaviceps*).

It is important to know whether peripheral populations are genetically isolated, because if they are, they merit consideration as distinct units of biodiversity that might require special protection. During fieldwork in 2002, we captured and plucked feathers from samples of individuals from the extreme southern (Nuevo Leon, n=6) and northern (Oklahoma, n=20) range. Feathers will bewere analyzed (Dr. R. M. Zink, University of Minnesota) in early 2003. Preliminary results suggest some differentiation has occurred locally, but more sequence from more genes is needed to draw any useful inferences. If results indicate genetic differentiation between the two samples, then we will proceed to collect more feather samples from populations along a latitudinal transect from Oklahoma to Nuevo Leon, Mexico. A Section 6 project was awarded to Dr. Zink for FY05 to expand feather collecting throughout the range, and to analyze the feathers.

This work will lead to a better understanding of historical rates and geographic patterns of colonization, gene flow among subpopulations, and delineation of metapopulations boundaries which will greatly aid in recovery and management of this endangered songbird.

Census and Monitoring of Black-capped Vireo in Texas

John Maresh and C. Craig Farquhar, TPWD

The fifth and final year of a Section 6 grant has been completed, and a final report is currently being prepared to: (1) determine current population status and distribution of Black-capped Vireos (BCVI) in Texas recovery units 1, 4, 5 and 6 and clarify population status in several counties in recovery units 2 and 3; (2) monitor status and breeding productivity of these populations; (3) determine threats from cowbird (*Molothrus* spp.) parasitism and identify other threats; and, (4) determine differences in habitat structure and composition and habitat use between different recovery units. Eight sites, and 158 territories, were monitored throughout the range of the BCVI. Productivity estimates (# fledged young per territory) ranged widely between zero and 2.73. Insufficient data were collected to estimate parasitism threat in specific localities, but parasitism averaged 45.7% at one site (Chandler Independence Creek Preserve, Terrell Co.). Interestingly, parasitism was determined to be low (18.8%) early in the season and high (60.0%) later. This fits with observations in other passerines and will assist in future management strategies for BCVI. Habitat data collected at several sites adds to the growing body of evidence that BCVI habitat is quite variable across the landscape.

Breeding Habitat, Distribution and Population Status of the Black-capped Vireo in Northern Mexico

C. Craig Farquhar, TPWD; Jose Ignacio Gonzalez, Universidad Autónoma de Nuevo Leon, N.L., Mexico

The federally endangered black-capped vireo (BCVI; *Vireo atricapillus*) ranges from central Oklahoma, through central and near-western Texas, and into northern Mexico. Although well studied in the U.S. portion of its range, the breeding biology, habitat, distribution and conservation threats have been less studied in Mexico. We completed field research in 2004. The main objectives were to conduct surveys, population censuses, habitat characterization, understand conservation threats, and develop management strategies for BCVIs in their suspected historic breeding range in northeastern Mexico (Coahuila, Nuevo Leon, Tamaulipas, San Luis Potosi). In 2002 and 2003, extant populations were surveyed and their habitats characterized on private properties in northwestern Nuevo Leon and northern Coahuila. Road surveys in 2003 in southwestern Tamaulipas revealed presence of a sizeable breeding population. Fledgling BCVI were observed with attendant parents at this site, but upon return in 2004, BCVI were absent perhaps due to prolonged drought and marked over browsing from goats in the area. A final report for the Section 6 project is due November 2004. The project also produced a thesis by undergraduate student Mario Alberto Madriles Guerrero at the Universidad Autónoma de Nuevo Leon.

Winter Ecology of the Black-capped Vireo

Robert Powell and R. Douglas Slack, Texas A&M University; C. Craig Farquhar, TPWD

Black-capped vireos (BCVI; *Vireo atricapillus*) over winter in the Pacific slope states of western Mexico, but our understanding of their habitat use, geographic distribution and conservation threats in this area is poor. In 2001, we obtained a Challenge Cost-Share grant from the U.S. Fish and Wildlife Service to address this problem. The following year a Section 6 grant was obtained to continue the work. In April 2002, sites were surveyed at 36 locations in Durango, Sinaloa, Nayarit, Jalisco, Colima, Michoacan, Guerrero and Oaxaca. These states served as the geographic range for all subsequent work . Sites were also surveyed for the dwarf vireo (DWVI; *Vireo nelsoni*), a little-known Mexican endemic and the BCVI's closest taxonomic relative. Habitat variables were measured at each BCVI and DWVI location, and at random locations along the survey transect at each site. We located 13 BCVI's in 2003, and 49 BCVI's in 2004 in the study area. The geographic center of wintering distribution of the BCVI appears to be further south than what has been described in the literature. Winter habitat selection includes a wider variety of habitat types than what is utilized by BCVI's during the breeding season. BCVI's and DWVI's seem to be segregating habitats by altitude, with BCVI's found at lower altitudes than the DWVI, although there is overlap. This investigation is in its final year. Results from stable isotope analyses of feathers collected at selected wintering localities, as part of the Section 6 grant, should shed light on geographic ties between breeding and wintering sites.

Breeding Abundance and Nest-Site Distribution of the Altamira Oriole at Santa Ana National Wildlife Refuge, Texas

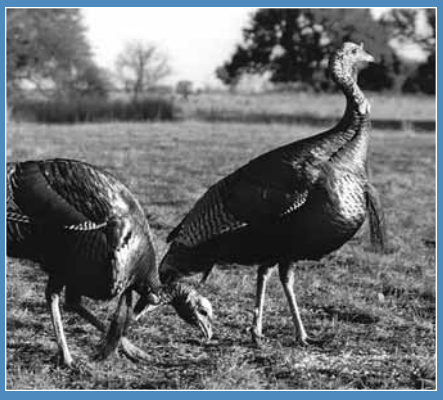
Christopher R. Hathcock, TPWD; Timothy Brush, University of Texas–Pan American

The distribution of the Altamira oriole (*Icterus gularis*) in the United States is restricted to the Lower Rio Grande Valley of southernmost Texas. Our objective was to assess the current breeding status of this species at and near Santa Ana National Wildlife Refuge (SANWR), a principal nesting area in the region. During each breeding season from 1997 to 1999, we attempted to find and monitor all Altamira oriole nests in and within 0.5 km of SANWR to determine annual breeding-pair abundance, annual nest-site distribution, and nest distribution among tree species. We estimated that there were six or seven, eight or nine, and six or seven breeding pairs in 1997, 1998, and 1999, respectively. Of the 26 nests found, 12 (46%) were next to the Rio Grande and 7 (27%) were at the edge of a major wetland within the refuge. Only one of the other seven nests was more than 115 m inside the refuge. Nests were distributed among *Salix nigra* (39%), *Fraxinus berlandieriana* (23%), *Acacia minuata* (19%), *Celtis laevigata* (8%), *Ulmus crassifolia* (8%) and *Chloroleucon ebano* (4%; n = 26). Comparisons of results with historical accounts suggest a decline in annual breeding abundance and nest-site availability at SANWR since the early 1970s.

Wild Turkeys

Habitat Preferences of Rio Grande Wild Turkey Hens in South Texas

Stephen M. Burns, Cody Lawson, Eric Reyes, Megan Dominguez, Sergio Vasquez, William P. Kuvlesky, and David G. Hewitt, Caesar Kleberg Wildlife Research Institute, Texas A&M University - Kingsville; Stephen J. DeMaso, TPWD; Mick Hellickson, King Ranch Inc., Kingsville



Few studies have quantified the habitat preferences of wild turkey hens in South Texas and fewer studies have quantified this phenomenon in the context of how habitat preferences influence wild turkey physiological condition overwinter and ultimately productivity. Therefore, we initiated a three-year research project during fall 2003 to quantify wild turkey habitat preferences during winter and spring on the King Ranch as part of a larger study to determine the impacts of overwinter nutrition on wild turkey hen productivity. A total of 77 hens was captured between December 2003 and February 2004, and 56 hens were fitted with radio transmitters. Hens are monitored on a tri-weekly basis until a mortality event occurs or a radio malfunctions. Habitat sampling is partitioned at 1st (hen location) 2nd (pasture) and 3rd (Ranch Division) orders of resolution.

Numerous habitat variables deemed important to hen life history in South Texas are being sampled at the 1st order of resolution, while specific vegetation communities and important structures such as stock tanks, are sampled at the 2nd order, and at the 3rd order of resolution gross habitat differences between Divisions are compared. Comparing specific physiological and demographic parameters from a sample of hens on each of three King Ranch Divisons will enable us to determine if physiological condition varies on a Divisional basis, and what impact habitat has on the physiological condition of hens, as well as examining the relationship between habitat, hen physiological condition and productivity.

Mortality Rate of Rio Grande Turkeys on the King Ranch

Sarge J. Vasquez, Eric Reyes, Megan K. Domingues, Stephen M. Burns, William P. Kuvlesky, and David G. Hewitt, Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville, Kingsville, Texas; Stephen J. DeMaso, TPWD

The Rio Grande Turkey (*Meleagris Gallapavo Intermedia*) is a native Texas game bird with high economic and aesthetic value. Maintaining populations of wild turkeys capable of meeting management objectives depends on understanding mortality rates. To determine mortality rates of wild turkeys in southern Texas, we placed radio-tags on turkey hens on three divisions of the King Ranch. One area had a relatively stable turkey population, another was increasing and a third had been declining over the last 10 years. We located wild turkeys bi-weekly using triangulation from October 2003 to October 2004. We monitored mortality using motion activated switches in the radio-tags. When a mortality signal was detected, we located the carcass and attempted to determine the cause of death. Preliminary data suggest that mortality was greater during nesting and varied among divisions of the King Ranch. The results of this project will enhance wildlife biologists understanding of wild turkey population dynamics and enable managers to set realistic management goals.

Distribution, Status and Winter Roost-Site Characteristics of Wild Turkey in the Trans-Pecos, Texas

Kory Perlicheck and Louis A. Harveson, Sul Ross State University; Mike Hobson, TPWD

Wild turkeys (*Meleagris gallopavo*) occur intermittently throughout the Trans-Pecos Region and are strongly associated with the limited amount of riparian habitat. Turkey populations in the region are thought to be on the increase; however, empirical data is lacking. We initiated a study to: (1) map the distribution, (2) document microhabitat characteristics of roost sites, (3) map potential roost sites, (4) map riparian corridors and (5) estimate winter population density of wild turkeys throughout the Trans-Pecos. We measured microhabitat characteristics (canopy cover, stand density, visual obstruction readings, understory herbaceous cover, tree height, diameter-at-breast height (dbh), height-to-lowest-live-branch, slope, aspect, and distance to permanent water) from 15 winter roost sites in three habitat types in the Trans-Pecos Region: Ponderosa pine (*Pinus ponderosa*), live oak (*Quercus virginiana*), and sugar hackberry (*Celtis laevigata*). All roost sites were <1 km of permanent water and located in riparian regions. Among the three habitats, large tree diameters were a prerequisite for roost trees in live oak habitat, where live oak roost trees were larger (mean dbh = 57.8 cm) than non-roosting trees (mean dbh = 39.1 cm) and sugar hackberry habitat, where roost trees were larger (mean dbh = 25.8) than non-roosting trees (mean dbh = 21.3). Due to the sparse tree density, we recommend that large trees (>6.3 m) be protected throughout the Trans-Pecos. In addition, exotic species (e.g., *Tamarisk*) should be controlled and native riparian habitats should be preserved.

This project was funded by TPWD and Sul Ross State University.

Impact of Cattle Grazing on Rio Grande Wild Turkey Ecology in the Texas Panhandle

Galon Hall, Warren Ballard, Mark Wallace, Texas Tech University; Jack Jernigan and Chip Ruthven, TPWD

The Rio Grande wild turkey occupies plains grasslands, Texas savanna, and southwestern shrub-steppe across its range from Mexico, through Texas and up to Kansas. In many cases, these same areas are intensively grazed by livestock. Interactions between cattle and Rio Grande turkeys are relatively unknown. The objectives of this study are to determine the impacts of cattle grazing on turkey nesting habitat selection.

Beginning in January 2000, turkeys were trapped at four study sites in the Texas Panhandle and Southwest Kansas. Each turkey was fitted with a radio transmitter in order to obtain triangulated locations throughout the year. Over the four-year study, 291 nests were located and vegetative characteristics were recorded. At each nest site, vegetation measurements including: the horizontal screening cover, vertical cover, percent ground cover of grass, forbs, litter, shrub, bare, and shrub characteristics were recorded. The measured vegetative characteristics at each nest site will be analyzed to determine which characteristics are related to nest selection and success. A preliminary analysis of nest site selection indicates that hens select for riparian areas. This is important because cattle are often concentrated in riparian zones due to the increased vegetative growth and water supply. In 2003, pasture stocking densities were obtained from land managers at the Matador Wildlife Management Area. Nesting turkeys were selected for nest sites in ungrazed areas.

Our next step is to determine stocking rates for nests in riparian zones across other sites and years. Our prediction is that hens will nest less frequently in riparian areas where cattle are present due to a reduced vegetative cover. We will compare habitat characteristics important to nest site selection between grazed and ungrazed areas to estimate impacts of grazing on available nesting habitat. Management implications may include further support for fencing of riparian zones to establish them as a separate pasture for a more controlled grazing regime.

Survival, Movements and Habitat Selection of Male Rio Grande Wild Turkeys in the Texas Panhandle and Southwestern Kansas

Derrick P. Holdstock, Mark C. Wallace, Warren B. Ballard, Texas Tech University; Jack D. Jernigan, TPWD

From January 2000 through August 2002, we studied survival, movements, and habitat selection of 107 juvenile male and 115 adult male radio–marked Rio Grande wild turkeys on four study sites in the Texas Panhandle and southwestern Kansas. We hypothesized that male Rio Grande wild turkey survival differed among study sites, seasons, and age classes, and that survival rates were inversely correlated with movement rates.

Hunting accounted for only 18.5% of all mortalities and was censored in order to investigate natural mortality patterns. Juvenile males had higher annual survival rates than adults (0.597 versus 0.364). Juvenile male survival did not differ among seasons. Adult male turkey survival was higher during summer (0.915) than during spring (0.725), autumn (0.671) and winter (0.851). Males had lower survival rates during seasons when long distance, range–shifting movements were most common. Turkeys that shifted ranges had lower survival rates than turkeys that remained within one area. Also, survival rates increased as time since range shift increased. Managers should

be aware of the presence of natural mortality factors that are evident in lightly-hunted populations and that the necessity for long distance movements to meet resource needs may lead to lower survival rates in male Rio Grande wild turkeys.

Most turkeys roosted in eastern cottonwoods, but black locusts and netleaf hackberries were also used. Mean roost tree diameter at breast height, tree height, and height of lowest branch were 19.6 inches, 44.6 feet, and 11.5 feet, respectively. Displaying habitat had low visual obstruction and low shrub density. Loafing habitat had greater canopy cover and densities of trees and large shrubs. Spring feeding habitat had lower visual obstruction than summer feeding habitat, with spring feeding areas similar to displaying areas and summer feeding areas similar to loafing areas. This suggested that male turkeys feed opportunistically in areas chosen for other purposes. Habitat management for male Rio Grande wild turkeys should focus on protecting remaining riparian roost areas and encouraging cottonwood regeneration. Openings for displaying and brushy areas for loafing should be created or maintained in close proximity to traditional roosts.

Winter Roost Ecology of Rio Grande Wild Turkeys in the Rolling Plains of Texas and Southwest Kansas

John A. Vacca, Mark C. Wallace and Warren B. Ballard, Texas Tech University; Donald C. Ruthven, III, TPWD

The tendency of Rio Grande wild turkeys (RGWT) to congregate at traditional winter areas in the Rolling Plains Region of the Texas Panhandle and southwest Kansas has been documented, but not well studied. Evaluating the dynamics of roost site use during this time period may provide insight useful in the management and conservation of suitable roosting habitat. Furthermore, understanding winter roosting patterns will benefit population estimates conducted during the winter period. The objectives of this study are 1) determining what actually constitutes an adequate winter roost in terms of area, 2) delineating between primary and satellite roosts, 3) examining spatial fidelity to specific roost sites during the winter period over successive years and 4) determining the specific timing of winter roost congregation and subsequent spring break up for this region.

Research will be conducted at three sites in the Texas Panhandle and one site in southwestern Kansas. Radio-equipped turkeys will be located on roost $\geq$ three times per week by visual observations (roost counts) and telemetry from September through spring break up. Roost counts will be used to determine the specific trees being used within a stand, the number of birds occupying each roost, and the identity of radio-equipped birds. Area of roosts will be estimated using ArcView GIS 3.2 to generate minimum convex polygons from the GPS coordinates of specific trees being used as roosts within a stand. Habitat characteristics will be measured at each roost utilizing 20 x 10 m quadrats. Line transects will be conducted within stands containing the roost to estimate suitable roost tree and shrub density. Primary and satellite roosts will be delineated based on the proportion of the population utilizing a roost and the frequency of roosting events over the winter period. Habitat characteristics will be compared between primary and satellite roosts. Spatial fidelity will be examined by plotting roost locations over successive years and evaluated by age and sex class. The specific timing of winter congregation and spring break up will be estimated from trends observed at primary roosts.

Funding was provided by TPWD, Kansas Department of Wildlife and Parks and the National Wild Turkey Federation.

Invertebrate Abundance at Rio Grande Wild Turkey Nest Sites and Brood-use Areas, Edwards Plateau, Texas

Charles J. Randel, Nova J. Silvy, Markus J. Peterson and Fred E. Smeins, Texas A&M University;
Ray Aguirre, Stephen J. DeMaso and T. Wayne Schwertner, TPWD

Rio Grande wild turkey (*Meleagris gallapavo intermedia*) numbers have been declining in the southern region of the Edwards Plateau, Texas since the 1970s. Lack of invertebrates (primary food for turkey poults during first 4-5 weeks of life) has been hypothesized as limiting wild turkey poult survival in declining regions. Wild turkeys were trapped and fitted with mortality-sensitive radio transmitters on four study areas; two within a region of stable (northern Edwards Plateau) populations, and two within a region of declining populations. Monitoring occurred from February 2001 to August 2003. Nest-site locations were determined via homing during the breeding season. Following nesting completions broods were followed for six weeks post-hatch or to brood failure. Brood survival was calculated as >1 poult surviving to two weeks. Invertebrates were collected, via sweep-net and D-vac, at each nest site and at visually confirmed brood location and a paired random site to determine if wild turkey hens selected nest sites and/or brood habitat based on invertebrate abundance. Analyses were preformed to determine if invertebrate abundance differed between regions of stable and declining turkey abundances. Frequency of Orthoptera was 3–5 times greater at nest sites on stable regions than declining regions in all three years. Orthoptera is a noted food source for young galliformes and comprised the majority of dry mass in invertebrate samples, nest sites and brood locations, on both the stable and declining regions. No differences in total invertebrate dry mass were detected between regional brood locations. The greater number of invertebrates found at nest sites in the stable region, possibly gives wild turkey poults from stable regions greater initial chances of survival.

Financial support for this study was provided by TPWD (Turkey Stamp Fund) and Texas A&M University System.

Nest-Site Vegetation Characteristics of Rio Grande Wild Turkey Populations, Edwards Plateau, Texas

Charles J. Randel, Nova J. Silvy, Markus J. Peterson and Fred E. Smeins, Texas A&M University;
Ray Aguirre, Stephen J. DeMaso and T. Wayne Schwertner, TPWD

Since 1970, Rio Grande wild turkey (*Meleagris gallapavo intermedia*) numbers in the southern region of the Edwards Plateau of Texas have been declining. Lack of nesting cover has been hypothesized as limiting wild turkey numbers in declining regions. Wild turkeys were trapped and fitted with mortality-sensitive radio transmitters on four study areas; two within a region of stable (northern Edwards Plateau) populations, and two within a region of declining populations. Monitoring occurred from February 2001 to August 2003. Nest-site locations were determined via homing during the breeding season. Following nesting attempts/completions, nest fate, vegetation height, visual obstruction, litter depth, percent cover, and cover scores of forbs, grass, litter, and bare ground at each nest site and surrounding area were sampled. This was done to determine if wild turkey hens selected nest sites with vegetative characteristics differing from surrounding habitat, and if there were differences in vegetative characteristics at nests site in stable and declining regions. Hens from the four study areas selected similar vegetation characteristics at nest sites. Hens also selected nest sites with greater visual obstruction, greater litter

depth, and greater litter cover than was available at random locations. Trends in these data were similar for hens in both stable and declining regions, suggesting no behavioral differences between populations.

Financial support for this study was provided by TPWD (Turkey Stamp Fund) and Texas A&M University System.

Annual Range Differences in Regions of Stable and Declining Rio Grande Wild Turkey Abundance

Jody N. Schaap, Nova J. Silvy, Markus J. Peterson and Fred E. Smeins, Texas A&M University; Ray Aguirre, Stephen J. DeMaso and T. Wayne Schwertner, TPWD

Since the late 1970s, Texas Parks and Wildlife Department and local ranchers reported that Rio Grande wild turkey (RGWT, *Meleagris gallopavo intermedia*) abundance have declined significantly in the southern region of the Edwards Plateau (EP) while remaining stable in the rest of the EP. To determine the possible cause of the decline in the southern EP, we conducted research on four sites, two each in stable regions (Kerr and Real counties) and declining regions (Bandera and Medina counties). RGWTs were radio-tagged and subsequently located an average of three times per week. Annual ranges were constructed with 95% kernels using ArcView Spatial Analyst software and the Animal Movement Extension. When annual ranges were analyzed, RGWTs in the declining region showed less variation in individual range size ($\bar{x}$ = 1,082.7, SD = 739.3) than in the stable region (range size $\bar{x}$ = 2,397.4, SD = 3,005.3). Annual range sizes on the two original sites show a larger mean distribution (P = 0.025) in the stable region than in the declining region. This discrepancy (birds used larger area on the stable site) is counterintuitive to literature on the movements of RGWT in relation to habitat quality. We hypothesize that "useable space" has been decreasing on declining sites and may be limiting RGWT populations on these sites.

Financial support for this study was provided by TPWD (Turkey Stamp Fund) and Texas A&M University System.

Survival of Rio Grande Turkeys on the Edwards Plateau, Texas

Beau J. Willsey, Nova J. Silvy, Markus J. Peterson and X. Ben Wu, Texas A&M University; Ray Aguirre, Stephen J. DeMaso and T. Wayne Schwertner, TPWD

Trends in Rio Grande wild turkey (*Meleagris gallopavo intermedia*) abundance on the Edwards Plateau, Texas have been either stable or in decline since the 1970s. Four study areas, two each within stable and declining regions were delineated to examine annual and seasonal turkey survival. During February 2001 through March 2003, 257 turkeys were captured and instrumented with radio transmitters. Survival probabilities were generated using a Kaplan-Meier product limit estimator; a log-rank test tested for differences among sites. Annual survival was statistically different between regions (stable 0.566 ± 0.081; declining 0.737 ± 0.094; X^2 = 3.68, P = 0.055) in 2002. Seasonal survival differed between regions (stable 0.812 ± 0.103; declining 0.718 ± 0.130; X^2 = 3.88, P = 0.049) in spring 2003. Annual survival results during 2002 were counterintuitive with turkey trend data.

Financial support for this study was provided by TPWD (Turkey Stamp Fund) and Texas A&M University System.

The Use of Portable Infrared Imagers in Wildlife Research

Shawn L. Locke, Roel R. Lopez, and Nova J. Silvy, Texas A&M University; Stephen J. DeMaso, TPWD

Use of infrared imagery is becoming increasingly prevalent in wildlife research. Infrared cameras detect radiating heat from objects and convert it into a visible thermal image, and have been successfully used to locate, identify, and survey animals in previous studies. Historically, use of infrared cameras has been limited due to high costs and technological limitations. However, recent advances in portable infrared imagery appear promising in wildlife research. Here we provide a brief background into infrared technology, and describe the utility and application of infrared imagery in wildlife research. Advancement in statistical procedures (e.g., distance sampling) has improved the utility of infrared surveys and provides a feasible alternative in conjunction with traditional methods. We are currently evaluating the utility and application of infrared imagery in estimating Rio Grande wild turkey (Meleagris gallopavo intermedia) abundance. Infrared imagery is not a "silver bullet" solution to locating and counting animals, however, we believe it has vast capabilities within wildlife research.

Nesting Ecology of Rio Grande Wild Turkey Hens in South Texas

Reyes, Eric Reyes, Megan Dominguez, Stephen M. Burns, Max Echartea, William P. Kuvlesky, Jr., Davie G. Hewitt, Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville; Stephen J. DeMaso, TPWD; Mick Hellickson, King Ranch Inc.

Few studies have quantified the impacts of important habitat landscape variables on the nesting ecology of wild turkey hens in South Texas. In November 2003, we initiated a three-year research project to evaluate how available water and roost sites impact wild turkey hen movements and nesting success on the King Ranch. Fifty-six wild turkey hens were captured between November and February and fitted with radio transmitters. Hens were located at least three times each week until the end of June, 2004. Over 1,000 radio locations have been obtained since December, 2003. Telemetry data has revealed that hen movements began to increase during late February and early March when the breeding season began, and movements peaked when hens began searching for nest sites. Wild turkey mortality was highest during spring when hens were attending nests. Nesting activity, nesting success and hen varied by Ranch Division and were lowest on the Laureles and Norias Divisions and highest on the Encino Division. Over 50% of nest failures were due to predation.

Evaluating Population Estimation Techniques for Rio Grande Wild Turkeys in the Texas Panhandle and Southwest Kansas

Matthew J. Butler, Warren B. Ballard, Mark C. Wallace, Texas Tech University; Stephen J. DeMaso, TPWD

Few studies have addressed methods of estimating abundance, density and trends in wild turkey populations. Without precise population trend estimates, it is impossible to effectively manage wild turkey populations. Thus, our research objectives are to develop and evaluate Rio Grande wild turkey population estimation techniques for their ability to predict changes in population abundance. We plan to evaluate several different population estimation techniques associated with winter roost counts, road surveys and aerial surveys.

Rio Grande wild turkey winter roost concentrations will be identified from historical data, recent radiotelemetry efforts and aerial thermal infrared imaging. A sample of winter roosts will be surveyed from November through March using several techniques. Ground counts will be conducted in the morning and evening with binoculars and at night with night vision devises (NVD). Automated video monitoring systems will be used to record roosting events on VHS tape and aerial counts at night will be conducted with thermal infrared imaging technology.

Two observers, in a pickup truck, will count Rio Grande wild turkeys along road survey routes during the morning hours from September through December. Strip-transect, line-transect, and mark-resight population estimation techniques will be used to estimate the number of radio-tagged individuals at each study area. Evaluations of line-transect and strip-transect population estimation techniques will also be conducted with wild turkey decoys. The decoys will be used to evaluate the effects of vegetation type on wild turkey detectability.

Mid-winter aerial surveys will be conducted from January through March and will also be evaluated using wild turkey decoys. Aerial photography and visual counts will be used to determine wild turkey decoy detectability in different vegetation types. Thermal infrared imaging technology will also be utilized from the air during day light hours in an attempt to detect Rio Grande wild turkeys. Randomly selected radio-tagged individuals within Rio Grande wild turkey flocks will be located and diurnal thermal infrared imaging counts of those flocks will be compared to ground counts.

Each population estimation technique will be evaluated on basis of cost, the ability to standardize population estimation techniques among observers and regions, and ability to detect a 25% to 30% annual population change.

Landscape Scale Habitat Selection in Rio Grande Wild Turkeys

John H. Brunjes, Mark C. Wallace and Warren B. Ballard, Texas Tech University; Michael S. Miller, TPWD

Populations of Rio Grande wild turkeys in the Texas Panhandle are believed to have experienced population declines in recent years due to long-term landscape changes. To assess how landscape change might impact turkeys, we first needed to know the relative importance of different habitats to turkeys. We captured 1,000 turkeys and outfitted 724 of these with backpack radio transmitters at three study sites in the Texas Panhandle and one site in Kansas. We used triangulation with truck mounted antennas to get locations on the birds at least twice weekly. These locations were used to create home ranges for each bird. We compared the complete home range and the core area (or high use area) to habitats that were available on the landscape.

Riparian habitats make up 5.1% of the total habitat at our study sites. They make up a much higher component of turkey home ranges (17.6% for total home range and 42.4% for core use areas). This means turkeys actively select riparian habitats as compared to upland habitats. The most critical component is riparian woodlands (mostly western cottonwoods). Less than 2% (1.4%) of the landscape is made up of riparian woodlands yet 21.4% of the core use area occurs in these woodlands. Random locations at each study site were compared to turkey locations. The average random location was almost 800 yards from riparian trees, while turkey locations averaged 193 yards from riparian woodlands. Upland habitats make up 94% of the landscape at the study sites while 57.6% of the core use areas were upland habitats. Much of the use of upland habitats occurs during the breeding season and females utilize upland habitats more than do males.

The average landscape at the study sites was made up of 21.3% agricultural fields (including dry land and irrigated crops). Within the home ranges of turkeys, 6.7% of the home range was agricultural fields while only 3.8% of the core use was agricultural fields. Houses, oil wells and cattle pens were generally avoided. While 6.2% of the landscape was made up of anthropogenic features, turkey core use areas contained less than 1% anthropogenic features.

Waterfowl - Wetlands

Waterbird Use of Constructed Wetlands at Richland Creek Wildlife Management Area

Angela K. Mangiameli and Warren C. Conway, Stephen F. Austin University; Corey D. Mason and Jeffrey W. Gunnels, TPWD

Continental populations of shorebirds and wading birds have experienced sharp declines due to wetland habitat loss and alteration. In some parts of the country, nearly 90% of natural wetlands have been lost due to agriculture and urbanization. At the Richland Creek Wildlife Management Area (RCWMA), a series of water treatment wetlands are being developed and evaluated in a cooperative effort between the Texas Parks and Wildlife Department and the Tarrant Regional Water District, to examine their utility as wetland wildlife habitat while simultaneously providing quality drinking water.

The objectives of this study are to examine wading bird and shorebird behavior, occupancy, and use of the constructed wetlands from April - September 2004 and 2005. We are (1) quantifying chronology of occurrence of shorebirds and wading birds, (2) developing time activity budgets and examining habitat use of the most abundant shorebird and wading bird species and (3) correlating use and abundance of shorebirds and wading birds with invertebrate and fish availability.

Preliminary results have been generated from data collected during 2004. To date, approximately 750 birds have been observed. Great egrets (*Ardea alba*), cattle egrets (*Bubulcus ibis*) and snowy egrets (*A. thula*) were the most abundant wading birds and greater (*Tringa melanleuca*) and lesser yellowlegs (*T. flavipes*) were the most abundant shorebirds observed. Few shorebird species were observed because of high water levels in the treatment wetlands from late season flooding of the Trinity River. During June, 200-250 wood storks (*Mycteria americana*) were consistently observed in the treatment wetlands. Approximately 1,400 three-minute focal samples have been collected on great, cattle, and snowy egrets and wood storks, these four species generally use constructed wetlands at RCWMA as loafing/resting sites. Finally, most wading birds observed have occurred in wet habitats with both aquatic submergent and emergent vegetation. Results will contribute to the understanding of use and habitat suitability of constructed wetlands for wetland birds other than waterfowl. Data collection will continue through 2005.

Evaluating Moist Soil Management on Constructed Wetlands at Richland Creek WMA

Daniel P. Collins and Warren C. Conway, Stephen F. Austin University; Corey Mason and Jeffrey Gunnels, TPWD

Texas Parks and Wildlife Department and the Tarrant Regional Water District partnered to construct a series of water treatment wetlands at Richland Creek Wildlife Management Area (RCWMA). The first four managed wetland cells were constructed and operational by January 2003. As these wetlands are constructed and mature, a unique opportunity exists to examine how plants, invertebrates and nonbreeding waterfowl respond to moist soil management in differing aged constructed wetlands.

Non-breeding waterfowl use, occupancy, diversity and abundance on constructed wetlands will be quantified. At waterfowl hunter check stations hunter-killed carcasses are being collected to examine general body condition and diet composition. Aquatic and benthic invertebrate abundance, richness, diversity, and biomass are being collected twice monthly to examine invertebrate response(s) (i.e., numeric and biomass) to moist soil management techniques, water quality (i.e., water depth, temperature, pH, dissolved oxygen and salinity), and wetland age, as the constructed wetlands mature. Finally, we have established permanent plots and transects to monitor vegetative community development and seed biomass production to examine structural habitat development and food productivity for nonbreeding waterfowl.

Data collection began in November, 2003 and will continue through August, 2006. During the first hunting season, over 110 carcasses were collected. Mallards (*Anas platyrhynchos*), gadwall (*Anas strepera*), and green-winged teal (*Anas crecca*) were the most abundant waterfowl collected and occupying constructed wetlands. To date, 1,800 invertebrate samples have been collected. Larval and adult forms of individuals representing eight common orders (i.e., Odonata, Hemiptera, Trichoptera, Coleoptera, Diptera, Amphipoda and Decapoda) have been identified. Currently, data collection of vegetative community structure and biomass production is occurring in each constructed wetland.

Winter Ecology of Diving Ducks in East Texas

Shaun L. Crook and Warren C. Conway, Arthur Temple College of Forestry, Stephen F. Austin State University; Kevin J. Kraai, TPWD

Diving ducks, particularly canvasback (*Aythya valisineria*) and lesser scaup (*A. affinis*), have been experiencing long-term population declines in North America,. Neither species has attained population goals set by the North American Waterfowl Management Plan. Past studies indicate that habitat quality and body condition during winter will impact future reproductive success. Although Texas winters a majority of the Central Flyway's diving ducks, few data exist on canvasback, lesser scaup, and ring-necked duck (*A. collaris*) body condition and behavior during winter. Our objectives were to: estimate body condition through fat and protein reserves, develop species specific body condition indices, quantify diurnal time-activity budgets, and generate chronologies of occurrence of canvasback, lesser scaup, and ring-necked ducks wintering on Sam Rayburn, Toledo Bend, and B.A. Steinhagen Reservoirs in East Texas.

Almost 20,000 individuals of these three species were observed between November 1, 2003 and March 31, 2004. Almost 30% of all birds were observed in November, 40% in December, 16% in January, 13% in February and 1-2% in March. During this initial field season, 107 birds were collected. Morphology (i.e., wing cord, body mass, body, culmen and tarsus lengths), organ mass, fat mass and intestine length were measured for each bird. Ether extraction will be used to estimate total body fat content. Total protein content levels are being estimated by ashing fat-free tissue samples. All morphology and organ measures, as well as fat and protein content measures will be used to estimate overall body condition and develop species specific condition indices. A total of 675 focal individual behavior samples was collected, totaling over 1,700 minutes of recorded behavior. Preliminary analyses indicate that all three species spent > 50% of their time feeding and moving, while spending the remainder of their time loafing, sleeping and in comfort movements. Data collection for the second year of this project will begin in October, 2004 and continue through March, 2005.

Doves

Development and Evaluation of Mourning Dove Population Models and Monitoring Programs for Improved Harvest Management of Mourning Doves

David Otis, Iowa Cooperative Fish and Wildlife Research Unit;
Jay A. Roberson, TPWD

An informed harvest management process for mourning doves (*Zenaida macroura*) in the U.S. will require development of one or more population models that synthesize existing knowledge of basic life history parameters and how these parameters may be affected by factors such as harvest rate, weather, and habitat conditions. This modeling and monitoring effort is an integral component of the recently adopted Mourning Dove National Strategic Harvest Management Plan.

Re-analysis of 1965-1975 banding studies in the EMU, CMU and WMU have resulted in a set of survival models for each management unit. Models are distinguished by the functional form of the relationship between annual survival and harvest rate, and range from completely additive to totally compensatory.

A predicted range of per capita reproductive rates has been derived for each of several large geographical sub-regions based on a review of the scientific literature. These estimates are based on a simple model that is a function of breeding season length, nest success and length of the nesting cycle.

Initial population models were developed by integrating survival and reproductive models, and comparison of predicted population growth rates to Call Count Survey trends suggest positive bias in model parameters. Contemporary and statistically reliable estimates of survival and recruitment will be necessary to improve model utility for harvest management.

To that end, a three-year national pilot banding program was initiated in 2003 to produce data for estimation of survival and harvest rates and geographical distribution of harvest. During the summers of 2003 and 2004, state and federal cooperators in 27 states have banded and released approximately 60,000 doves. This cooperative effort between state wildlife agencies, the U.S. Fish and Wildlife Service and the U.S.Geological Survey Bird Banding Laboratory will result in much needed information for improvement of dove harvest management. The study will also serve as the basis for a planned operational nationwide banding program designed to produce annual comprehensive estimates of harvest and survival rates.

Competition, Nesting Density and Predation of Newly Sympatric Populations of White-winged, Eurasian Collared and Mourning Doves in Texas

Nova Silvy, Roel Lopez and Anna Munoz, Texas A&M University; Jay A. Roberson, TPWD

Texas A&M University (TAMU) supports a substantial breeding population of mourning doves (*Zenaida macroura*) with one of the highest nest densities in Texas. White-winged doves were documented nesting on TAMU Campus in 2002 and Eurasian collared doves are known breeding in the area. The interspecific interactions and relationship of each of these species relative to partitioning and use of available habitat may be incrementally determined as each begins nesting in the area.

There has been a long history of mourning dove research on the TAMU Campus, with initial population studies conducted in the 1950s, and the most recent studies occurring in the 1980s. The TAMU Campus and surrounding areas have experienced substantial changes associated with urbanization and expansion over the last 50 years, altering habitat on and around campus. We examined dove nesting and production in this urban setting to evaluate how microhabitat and landscape features affect nest-site selection and nest success. Specifically, we (1) examined trends in mourning dove nesting density and nest success and (2) identified important microhabitat and landscape features associated with nest-site selection and nesting success.

A total of 778 mourning dove nests were located and monitored on campus. An equal number of random nests were randomly generated in ArcView and assigned to non-nest trees to evaluate habitat variables associated with nest-site selection. Binary logistic regression was used to evaluate the significance of microhabitat and landscape variables to nest-site selection and nest success.

Comparisons with data collected in 1950, 1978 and 1979 showed relatively similar nesting densities, but a significant decrease in nest success over time. A comparison of microhabitat features between actual nest trees and random locations (non-nest trees) indicated increasing values of tree diameter at breast height and tree species were important predictors of mourning dove nest-site selection. Landscape features found important in dove nest-site selection were proximity to open fields, roads and buildings. Proximity to roads and buildings also were significant predictors of nest success. Combining significant microhabitat and landscape variables for nest-site selection increased the predictability of the model indicating a possible hierarchical nest-site selection strategy.

Hematological Responses in Captive White-winged Doves (*Zenaida Asiatica*) Induced by Various Radio Transmitter Attachments

Michael F. Small, John T. Baccus, Jeffrey N. Mink, Texas State University; Jay A. Roberson, TPWD

We monitored white blood cell (WBC) counts, heterophil-lymphocyte ratios and leukocyte differentials for captive white-winged doves (*Zenaida asiatica*) in Texas with different radiotransmitter attachment packages. Doves were segregated by gender and age with males, females, and hatching year (HY) individuals housed in 30 large outdoor pens in groups of seven. Treatments consisted of controls, glue-on transmitters, body loop harnesses, surgically implanted intracoelomic transmitters, surgically implanted subcutaneous transmitters, intracoelomic surgery without implants and subcutaneous surgery without implants.

We made blood smear for each individual six times; one pretreatment and five post-treatment. We used multivariate analysis of variance with pen as a blocking variable and gender nested to reveal no significant difference between any of the transmitter attachment techniques and the control among variables. Repeated measures analysis of variance revealed significant differences across sampling periods. However, there were no significant differences in treatments within sampling period. Based on retention rates, feasibility and application parsimony we determined surgically implanted subcutaneous radio transmitters to be the preferred method of radio-transmitter attachment.

Genetic and Isotopic Characterization of Eastern and Western White-winged Dove Populations in Texas

Scott Carleton, Carlos Martinez del Rio, University of Wyoming; Jay A. Roberson, TPWD

Each year billions of animals, representing hundreds of species, fly across the earth to populate regions that are habitable only seasonally. Migratory creatures do not recognize our political constructs and reveal with special clarity biological links that bind distant geographical areas. Events that affect populations of migrant birds in one place can have consequences thousands of kilometers away. Most studies of migratory species focus on their breeding biology. For many migrants, however, as much as 80% of their lives are spent in wintering areas or in transit to or from breeding areas.

Although patterns of anthropogenic change and population flux are mostly understood for white-winged doves in Texas and Arizona, it is unclear how changes on the wintering grounds are affecting these same populations. Before we can begin to understand events affecting white-winged doves on wintering grounds, a clearer understanding of where Eastern and Western populations spend winter months must be determined. Doves banded in Texas and Arizona have provided only a small fraction of returns in Central America.

Recently developed molecular techniques, microsatellite DNA and stable isotopes, have the potential for helping us resolve this dilemma. Microsatellite DNA is a powerful genetic tool used for differentiating populations of closely related species and has proven very useful when other genetic techniques fail to reveal differentiation. The stable isotopes of carbon and hydrogen show distinct continental gradients across North America. These unique signatures, based on precipitation and temperature, are incorporated into growing feathers of molting birds where they are preserved until the birds molt again. In this way, each bird carries a signature of its place of origin and becomes a “banded bird.” Collecting birds across broad geographic regions, like Texas, enable us to create a map of isotopic signatures and genetic differentiation that can be used to trace birds collected in Central America back to their breeding origin in North America. By collecting post-breeding white-winged doves in North America and wintering doves across southern Mexico we hope to determine the wintering areas of Eastern and Western populations of this species using a compliment of genetic and isotopic techniques.

Assessing Mourning Dove Count Trends Along Call-Count Transects in Texas

Brian L. Pierce, Fred Smeins, Nova Silvy, Marcus Peterson, Texas A&M University; Jay A. Roberson, TPWD

Significant declines in the Mourning Dove Call-Count Index were reported for the Central Management Unit (CMU) for the 10 year (1992-2001) and 36 year (1966-2001) periods, using the route-regression method (RRM) employed by USFWS for analysis. Texas, which comprises the largest proportional land area and the largest number of call-count survey routes (CCS; 133) within the CMU, showed a significant decline in the 10 year (1992-2001) statewide population index. These trends have become non-significant declines in the most recent Annual Breeding Population Report (2004). Furthermore, contradictory trends are evident between the raw CCS data and the RRM over these same time periods, casting additional doubt on the utility of index methods that have been criticized heavily in recent wildlife publications. While it is anticipated that USFWS will consider some form of harvest restrictions if the statewide downward RRM trend continues, changes in harvest regulations will not identify nor alter the underlying factors affecting long term dove population trends.

Our objectives for this study were to: 1) identify those micro and macro habitat variables correlated with count trends, 2) determine if micro and macro habitat variables differed among ecoregions with declining and stable or increasing trends, 3) identify potential causes for differences in RRM and raw data trends, and 4) establish a spatially explicit database that can be used for future data input and the development of predictive models at differing spatial scales.

We demonstrate the utility of recent multivariate multiple response permutation methods for analysis of spatially autocorrelated ecological data with skewed distributions. Variables defining physiognomic class, climate, ground cover, and canopy cover were significantly correlated ($P \leq 0.05$) with CCS results. Univariate and multivariate correlograms indicate these variables are spatially autocorrelated over large areas (130 km to 330 km), and differ in distribution across the state. Likewise, CCS results differ between ecological regions within the state. In addition, our data suggest that CCS results may be biased toward rural areas, and question whether high calling rates necessarily indicate high dove densities. These uncertainties within the CCS undoubtedly decrease correlations and hinder analysis by adding variability to the independent variable. We demonstrate that these factors may be minimized in future studies by utilizing methods that estimate the probability of detection along each route.

Evaluation of Environmental Contaminants in White-winged Doves Sampled from the Lower Rio Grande Valley of Texas

Timothy B. Fredricks, Alan M. Fedynich, Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville; Steve Benn, TPWD

The population of white-winged doves in the LRGV has declined over the past 50-70 years, while expanding its range and numbers outside the LRGV in Texas. The cumulative effects of sublethal and chronic exposures to environmental contaminants result in subtle influences on fertility, sub-cellular genetic damage, and alteration of nesting behavior. Our study was designed to determine if white-winged doves (*Zenaida asiatica asiatica*) breeding in areas where environmentally persistent contaminants occur in the Lower Rio Grande Valley (LRGV) are acquiring contaminants.

Juvenile white-winged doves were trapped in Kingsville, Texas during summer 2002 and housed at the TAMUK research aviary to be used as control birds. During the 2003 breeding season, 70 adult white-winged doves were collected from pre-selected urban/industrial and agricultural habitats. Wild caught and captive control doves were analyzed individually for 20 chlorinated pesticides, polychlorinated biphenyl congeners (PCBs), toxaphene compounds, and 10 major and trace elements at The Institute of Environmental and Human Health at Texas Tech University.

Cadmium, copper, mercury, nickel, selenium, silver, zinc, DDE, DDT, dieldrin, chlordane and g-BHC were detected, but were all found at levels not known to cause survival or reproductive problems in doves. Arsenic, chromium, lead, remaining chlorinated pesticides, PCBs and toxaphene were not detected. Overall low exposure to and acquisition of bioaccumulative contaminants may be due to white-winged doves' short lifespan and/or low position in the food chain combined with decreased amounts of these contaminants available in the environment.

The current suppressed population status of white-winged doves in the LRGV of Texas does not appear to be associated with the contaminants analyzed for in this study. Several bioaccumulative compounds and metals were observed in this study, thus it is recommended that contaminant analysis be included in management for mammalian and avian top-level predators, in addition to scavengers that forage on white-winged doves. Additionally, it will be important to periodically monitor water sources as a preventative measure to detect possible contamination sources for white-winged doves and wildlife in the LRGV of Texas.

This project was funded by sportsmen purchases of the TPWD White-winged Dove Stamp and Caesar Kleberg Wildlife Research Institute.

Historic and Current Forage Area Locations and Food Abundance in Relation to Nesting Sites for White-winged Doves in the Lower Rio Grande Valley of Texas

Karen A. Bautch, David G. Hewitt, Caesar Kleberg Wildlife Research Institute, Texas A&M - Kingsville; Susan Cooper, Texas Agricultural Experiment Station - Uvalde; Steve Benn, TPWD

Declining white-winged dove (*Zenaida asiatica asiatica*) populations in the Lower Rio Grande Valley since the 1920s have been largely attributed to loss of breeding habitat. Although land acquisition and re-vegetation have increased habitat, a decline of this economically important game bird still exists. To determine if food resources influence nesting, food biomass from agricultural crops, fallow land, rangeland and brush tracts were assessed adjacent to nesting locations during May through August, 2002 and 2003. Results indicated an abundance of grain sorghum, yet nest density was not related to the presence or acreage of agricultural crops consumed by doves. Assuming natural foods were necessary for successful reproduction, modeling showed the biomass of natural foods was insufficient to support colonial densities of nesting doves. Aerial photography and agricultural censuses were used to infer the impact of changes in agriculture on potential food resources of nesting in 1961, 1983 and 2002. Changes in total cropland and agricultural crops consumed by doves were not related to changes in nest density. Relationships between nest density and increased herbicide use and decreased fallow lands followed predicted trends, thus suggesting that agriculture impacted the amount of natural foods and may limit nesting.

A Comparison of Effects of Radio Transmitter Attachment Techniques on Captive White-winged Doves

Michael F. Small, John T. Baccus, Floyd W. Weckerly, Texas State University; Randy Rosales, Sul Ross State University; David N. Phalen, Texas A&M University; Jay A. Roberson, TPWD

We experimentally evaluated alternative techniques of attaching radiotransmitters to captive white-winged doves (*Zenaida asiatica*) in Kingsville, Texas during 1998. Our evaluation consisted of monitoring physiological, pathological, and behavioral parameters in doves subjected to six radiotransmitter attachments (backpack harnesses, adhesive, subcutaneous implants, intracoelomic implants, subcutaneous surgeries without implantation, intracoelomic surgeries without implantation). We analyzed physiological parameters across two pre-treatment and four post-treatment periods using a model selection approach of mixed-effect models. Birds did not differ in physiological variables among treatment groups and a control. Time activity budgets analyzed using non-parametric Friedman's tests did not differ in any activity category among treatment groups and a control. Subcutaneous implants were the most effective method of attachment based on retention rates, lack of mechanical difficulties associated with external attachment techniques and minimum levels of pathology reported following necropsies.

Is Grain Sorghum Sufficient for Reproduction of White-winged Doves?

Kenneth Pruitt, David G. Hewitt, Caesar Kleberg Wildlife Research Institute, Texas A&M - Kingsville; Susan Cooper, Texas Agricultural Experiment Station - Uvalde; Steve Benn, TPWD

Sorghum comprises over 95% of the seed and fruit biomass available to breeding white-winged doves (*Zenaida asiatica asiatica*) in the Lower Rio Grande Valley. Populations of doves in this area have been declining, thus, we conducted a project to determine if sorghum is sufficient for doves to successfully reproduce. During autumn 2003 and spring 2004, 105 white-winged doves were placed in captivity to determine the effect of diet composition on reproduction. In early April 2004, subjects were sexed, paired into individual cages. Each of 52 pairs was randomly assigned to one of two treatments. One group was fed sorghum ad libitum, while the other group was offered sorghum, croton (*Croton sp.*), and native sunflower (*Helianthus spp.*) seeds. Reproductive parameters were measured throughout the summer. The amount of feed consumed over a two-day period was measured for each pair on a weekly basis. The mass of all young was measured at 10, 14, 21 and 56 days post-hatch. Statistical analyses are being conducted, but initial results indicate that birds consuming sorghum, croton, and common sunflower seeds produced 78% more young and those young were 35% heavier at fledging than chicks produced by birds eating sorghum only.

Another group of white-winged doves will be held in captivity during fall 2004 to estimate the metabolizability of many foods. These trials will not only give insight into conversion of food to biomass, but will allow development of a laboratory analysis to estimate metabolizability of other dove foods. During these trials, 15 individuals will be fed exclusive diets composed of one food source for five consecutive days, during which all food eaten and all feces excreted will be measured. The foods being used include sorghum, croton, native sunflower, domestic sunflower, brown top panicum, Texas millet, cowpeas and anacua berries.

Developing a Survey Method For Breeding Populations of White-winged Doves in Texas

Jeff B. Breeden, Fidel Hernandez, Nova J. Silvy and Ralph Bingham, Caesar Kleberg Wildlife Research InstituteTexas A&M University-Kingsville, Jay A. Roberson and Gary L. Waggerman, TPWD

White-winged doves (*Zenaida asiatica*) have been expanding from their historical range in the Lower Rio Grande Valley (LRGV) of Texas, northward primarily into urban areas. This change in geographic distribution has created the need to monitor white-winged dove populations in urban environments. A call-count survey method has been used by Texas Parks and Wildlife Department (TPWD) to monitor populations since 1949. However, neither the accuracy of this method nor its applicability to urban settings has been verified. The objectives of this study are to: (1) evaluate the accuracy of the current call-count survey in urban environments; (2) evaluate the feasibility of using Distance Sampling as an alternative survey method; and (3) design a reliable and efficient method for TPWD that may be used statewide.

This study will be conducted during May through August, 2003 and 2004 in small towns (Kingsville and Beeville) and large cities (San Antonio and Austin). We will assess the reliability and accuracy of the current call-count method by comparing its estimates of dove density to population and nest density estimates obtained in an area surrounding survey points. To accomplish this objective, we will develop a uniform grid of survey points in each city in which to conduct a call count. We then will systematically select a subset of 15 points that uniformly encompass the city and obtain nest density and population estimates at each. We will correlate the number of calling birds, determined by ear and an electronic counter at each survey point to the number of nests/acre and birds/acre. We will evaluate Distance Sampling by estimating visual and auditory dove calls into five distance categories 0-20 m, >20-50 m, >50-100 m, >100-200 m and >200 m. We will compare population estimates from the three survey methods (i.e., auditory, electronic counter and distance). This study will provide TPWD with the information necessary to implement a statewide survey method in Texas.

Land-Use Change Effects on White-winged Doves in the Lower Rio Grande Valley, 1961-2002

Andrea Felton and William P. Kuvlesky, Jr. Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville; Mike Frisbie and Jay A. Roberson, TPWD; Gary L. Waggerman, TPWD

Throughout the 20th century, >95% of the original nesting habitat of white-winged doves (WWD) in the Lower Rio Grande Valley (LRGV) has been cleared for agriculture and urban development. We hypothesized that WWD density is related to the spatial, temporal and numeric distribution of landscape components in the LRGV. We created a Geographic Information System (GIS) database to determine whether land-use changes have effected WWD populations in the LRGV over the past 40 years. Methodology included acquiring, digitizing and orthorectifying aerial photographs for the years 1961, 1983 and 2002 to delineate spatial and temporal land cover across the LRGV. Twenty historical WWD nesting brush tracts were selected and all land-use components within a 3-km buffer of each site were delineated and classified using ArcGIS software. The seven land-use classifications included agriculture, brush, citrus, fallow fields, pastures, urban development and water. Geospatial attributes generated by the GIS program for each site included patch, area, proportion, and distance statistics. We then used simple linear regression in SAS to examine if these land-use attributes were functions of WWD density. Results

indicate very few statistically significant relationships between WWD density and land-use change, and those results that were significant may be coincidental. Our findings suggest that WWD density in the LRGV over the last 40 years is neither directly nor inversely related to land-use changes across the area. Therefore, possible unknown variables in WWD physiology or morphology may be contributing to its population dynamics in South Texas.

Breeding Ecology of a Recently Colonized Urban White-winged Dove Population

Cynthia L. Schaefer, John T. Baccus, Michael F. Small, Texas State University; Jay A. Roberson, TPWD

We monitored breeding biology of white-winged doves (*Zenaida asiatica*) in a recently colonized urban area (Waco, Texas) using field-implanted subcutaneous radio transmitters. We implanted adult white-winged doves in June 2002 (n = 39; 16 males, 23 females) and in February - March 2003 (n = 40; 17 males, 17 females, 6 unknown). We tracked radio tagged doves every third day for the duration of transmitter function (90 – 120 days). When tracked to a nest, we recorded habitat characteristics and nest status as determined with binoculars or an extendable mirror and pole device. Nest success was calculated using the Mayfield method. We located 26 doves to 36 nests in nine tree species. Maximum number of nesting attempts was 4 for a single individual. Mean nest height as a proportion of tree height by tree species ranged from 0.31 to 0.75. Overall nest success for both years combined was 0.52. Nesting success of first and second nest attempts was 0.62 and 0.24, respectively. We showed that urban white-winged doves have an extended breeding season with nesting attempts both before and after the traditional breeding period by doves in native brush habitats of the Lower Rio Grande Valley of Texas. Our research confirmed that field implanted subcutaneous radio transmitters are a viable technique for monitoring nesting activities of white-winged doves. In addition, we identified problems associated with using radio transmitters in urban habitats and recommendations for improving the methodology.

Factors Influencing Establishment and Stability of White-winged Dove Nesting Colonies in Northeastern Mexico and Southern Texas.

Yara Sánchez J., Fidel Hernandez, David G. Hewitt, Eric J. Redeker, Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville; Jay A. Roberson, TPWD

Land use changes have resulted in much habitat loss for white-winged doves in northeastern Mexico and southern Texas. This habitat loss has occurred within white-winged dove historic nesting colonies, most of which are located in the state of Tamaulipas, and are at risk of disappearing. Because of the importance of Tamaulipas and southern Texas for nesting white-winged doves and because of ongoing habitat changes, the Texas Parks and Wildlife Department and the Government of Tamaulipas have sought to document and geographically record the location of all nesting colonies in Tamaulipas and southern Texas.

The objective of our study is to understand how landscape changes have affected nesting colonies of white-winged doves. During the summer of 2004, boundaries of all current and most of the historic colonies in Tamaulipas and southern Texas were located and recorded with a GPS unit. General landscape components of the colonies, such as dominant brush species, estimated age of brush area, and evidence of human activity, were recorded. We will obtain aerial photography or satellite imagery of each area and quantify changes in landscape composition over three time periods: 1970s, 1980s and present. We will evaluate landscape heterogeneity or similarity (i.e. patch size, patch shape, heterogeneity, diversity of land use/ land cover) of existing or extinct colonies for each time period.

During the summer of 2005, we will use two methods to estimate population status: auditory counts and nest density. To estimate nest density, we will randomly place a minimum of three 100-m transects in a subset of the colonies during peak nesting (June - July). We will use Distance sampling to estimate nest density for each colony. Our study will provide information on the habitat changes that might influence dove populations. By examining these data, we will identify management techniques that can be used to create or maintain white-winged dove habitat and therefore possibly increase its productivity in the future.

Cooperative funding provided by TPWD.

Evaluation of Field Implanted Subcutaneous Radio Transmitters in Breeding White-winged Doves

Michael F. Small and John T. Baccus, Texas State University; Gary L. Waggerman, TPWD

We surgically implanted 40 adult white-winged doves (Zenaida asiatica) with subcutaneous radio transmitters in the field at the capture site and immediately released them following recovery from anesthesia. We monitored radio-marked doves for up to 110 d. Our primary objective was to evaluate the use of subcutaneous transmitters as a tool for measuring nesting parameters and productivity of white-winged doves. White-winged doves preferred live oak (*Quercus virginiana*) trees as nesting sites and nested at a height between 60 and 70% of overall tree height. 26 individuals made at least one nesting attempt, 10 made two attempts, and three made three attempts with nesting success rates of 0.95, 0.13, and 0.002, respectively. We estimated home range size for 37 individuals. Home range size was highly variable for males and females (s^2 = 2,676.24 and s^2 = 343.06, respectively), however, between gender home range size was not significantly different (n = 37, t = 1.19, df = 35, P = 0.24). Results of this study indicate that this technique is a promising method for collecting natural history data for white-winged doves, however, further research is needed to document its full potential.

Trapping and Recapture Rates for Urban White-winged Doves in Waco, Texas

C.L. Schaefer, John. T. Baccus and M. F. Small, Texas State University; Roy Welch, TPWD

We banded white-winged doves in a recently established urban population in Waco, Texas to determine recapture rates for efficiency of utilizing urban trapping to estimate winter resident and summer migrant breeding population size and survival rate change over time. We banded a total of 1,517 (88.9% after hatching year and 11.1% hatching year) January 16 through June 17, 2002 and January 20 through July 11, 2003 during 11,235 trap/hours at 36 locations. Mean overall trap rate was 0.14 doves/trap/hour and overall recapture rate was 0.005 doves/trap/hour. We recaptured 52 individuals one time (no individual was recaptured > two times), for a 3.4% recapture rate. A strong positive correlation between captures and

recapture rates by season was present ($r = 0.95$, $P < 0.001$). Capture and recapture rates were lowest in the winter with a subsequent, steady increase as migrants arrived in mid-March. Recapture rates were much lower than anticipated but no similar studies exist for comparison. Differential vulnerability or susceptibility to capture between the first and subsequent captures may violate critical assumptions necessary to use capture-recapture techniques to estimate population size. A minimum annual of 5,000 trap hours with a recapture rate of 5% would be necessary to obtain the sample sizes necessary to estimate population size within 25% for urban areas like Waco. This may be possible because five trap sites accounting for 55.7% of the doves captured had a mean trap rate nearly twice (0.25) the overall rate (0.14, $P < 0.01$). Sample sizes were too small to determine recapture rates by trap site but could very well be double the overall capture rate (3.4%), as well. It may be feasible to conduct exploratory trapping the first year among a simple random sample of trap sites across an urban area of inference, identify strata based on capture/recapture rates. Then, in subsequent years, volunteers could be used within the strata to provide sufficient recaptures to efficiently model population size. However, previously captured individuals generally appear to avoid recapture. Therefore, the degree and uniformity of this source of bias and solutions to recapture avoidance needs to be explored.

An Electronic Coo-Counter to Estimate Populations of White-winged Doves

Mario Sepulveda, Fidel Hernandez, David G. Hewit, William P. Kuvlesky, Jr., Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville; Gary L. Waggerman, TPWD.

Coo-counts have been used to monitor white-winged dove populations in the Lower Rio Grande Valley (LRGV) of Texas since 1951. This procedure involves determining the number calling at predetermined stops, and then relating this number to a particular breeding pair density. Although this technique had been used for many years, its accuracy remains unknown, particularly in areas that have high densities of breeding white-winged doves. The objectives of this study are to (1) evaluate the coo-count survey in terms of time of year, time of day, and duration, (2) determine the influence of weather on calling intensity, (3) assess the validity of Uzzell and Kiel's (1950) conversion table, and (4) evaluate the use of an electronic coo-counter.

The study occurred during 2002 through 2003 and involved 15 coo-count points at sites representing varying dove densities, which were selected from the current TPWD coo-count points in the LRGV. We conducted counts using an auditory and electronic coo-counter at each point every four days. We counted doves heard over 2-minute intervals every 20 minutes from 0600-1100 and over five consecutive two-minute intervals. We recorded weather variables (temperature, humidity, wind speed, and cloud cover) during all counts. We also measured nest density and population density within a 400-meter radius around each point.

We found that in 2002, peak calling for white-winged doves occurred between June 6 - 9, but in 2003, peak calling occurred between May 15 - June 5. Calling within a day was too variable to document a peak for both years; however, at least 75% of the doves heard calling were detected in the four-six minute interval for both years. In 2002 and 2003, weather accounted for a low proportion (< 5%) of the variability observed in calling intensity. In 2002, a relationship did not exist between coo-counts and population and nest density; however, in 2003, a strong relationship did not exist between those same variables. In 2002 and 2003, a strong relationship did exist between the electronic coo-counter tally and population and nest density and coo-counts. Although the electronic coo counter performed well under field testing, some modifications are still necessary to improve the data obtained from such device.

This project was cooperatively funded by TPWD.

Other Birds

Effects of Shinnery Oak Control on Lesser Prairie Chickens in the Western High Plains of Texas

Eddie K. Lyons, Nova J. Silvy and Roel R. Lopez, Texas A&M University; Stephen J. DeMaso, Duane Lucia and Heather A. Whitlaw, TPWD

The historic range of the lesser prairie chickens (*Tympanuchus pallidicinctus*) has decreased significantly in the past century due to numerous human-induced changes to the landscape. Cultivation of native rangeland, control of sand sagebrush (*Artemesia filifolia*) and shinnery oak (*Quercus havardii*), and fragmentation of existing suitable habitat are hypothesized to be the primary factors responsible for shrinkage of the species range. We initiated a study in 2003 to evaluate the effects of herbicide treatment of shinnery oak on habitat use and survival of lesser prairie chickens in northern Yoakum County, Texas. Lesser prairie chickens were trapped during spring and fall on breeding grounds (leks) using non-explosive drop nets. Radio-marked lesser prairie chickens were monitored daily (5-7 days/week) during one of four random-tracking periods using a 5-element yagi antenna mounted through a truck roof to monitor survival (adult and chick), movements, and habitat use. Through April 20, 2004, 39 lesser prairie chickens have been trapped (22 females, 17 males). Preliminary results for summer 2003 indicated nest (<43%) and brood success (28%) were low. Herbicide treatment for shinnery oak on two of the four study pastures was completed during March and April 2004. Comparisons of vegetation characteristics on treated versus non-treated sites will be conducted quarterly.

Financial support for this study was provided by TPWD and Texas A&M University System.

Resource Partitioning and Overlap of a Raptor Assemblage Associated With Prairie Dog Colonies: a Preliminary Report

Matthew D. Giovanni, Texas Tech University; Clint W. Boal, Texas Cooperative Fish and Wildlife Research Unit; Heather A. Whitlaw, TPWD

Ferruginous (*Buteo regalis*) and Swainson's (*Buteo swainsoni*) hawks are sympatric birds of prey that inhabit grasslands, shrubsteppes, deserts and agricultural regions. Both species are experiencing population declines due to habitat conversion and degradation, and anthropogenic impacts (e.g., pesticide poisoning, shooting). We are studying the breeding season diet of the ferruginous and Swainson's hawk in the North Texas Panhandle, northeast New Mexico and southwest Oklahoma.

We used video-monitoring systems at hawk nests to facilitate prey delivery observations. We collected 1,449 hours of video footage from six ferruginous hawk nests and identified 274 prey items of the 413 delivered (66%). Black-tailed prairie dogs (*Cynomys ludovicianus*) represented the majority of delivered biomass at 46%. Other primary prey items ($\geq$ 5% biomass) include black-tailed jackrabbits (*Lepus californicus*), pocket gophers (*Geomys* spp.), and cottontails (*Sylvilagus floridanus*). We have also collected 1,302 hours of nest footage from six Swainson's hawk nests and identified 372 prey items of 503 delivered (74%). Cottontail rabbits represented the majority (29%) of the Swainson's hawk diet biomass. Other primary prey items included black-tailed jackrabbits, bull snakes (*Pituophis melanoleucus sayi*), pocket gophers, black-tailed prairie dogs and Southern Plains woodrats (*Neotoma micropus*).

Ferruginous hawks had higher mean biomass per delivery than Swainson's hawks (540g vs. 132g), but had a lower daily delivery rate (4.0 vs. 5.4). Swainson's hawks used a greater variety of species (27 vs. 21) and more of these species were primary contributors to the overall diet biomass (6 vs. 4). The Shannon-Wiener Index for Prey Diversity (on a scale of 0-1 with 1 being maximum diversity) indicated that both hawk species have a diverse diet base (ferruginous hawk: 0.73, Swainson's hawk: 0.81). Morisita's index estimated a 33% diet overlap between ferruginous and Swainson's hawks, which is relatively low for large sympatric predators and is indicative of inter-specific prey partitioning.

Ferruginous hawks produced an estimated 71 nestlings and had an overall nest success rate of 82%. Swainson's hawks produced an estimated 83 nestlings and had an overall nest success rate of 46%. These diet and nest data will contribute to the understanding and conservation of the short-grass prairie and agricultural communities of the South Plains Region.

This study was funded by TPWD and USDA-Forest Service.

Bald Eagles Nesting and Wintering Surveys

Brent Ortego, Chris Gregor and Annice Storey, TPWD

Nesting bald eagles (*Haliaeetus leucocephalus*) have been monitored in Texas since the 1960s. Initially there were only three known active nesting territories. From 1975-2004 the number of known active nests increased from 7 to 143, respectively. This increase was due to changes in pesticide regulations and laws protecting the eagles which provided for a population increase, and an associated increased agency effort to locate nests along with public awareness to report nests.

The nesting population of bald eagles is estimated using aerial and ground surveys of known and newly reported nests. Surveys are conducted annually January-April. Nest data collected includes location, status, productivity, general site description and estimated hatching date. These data are used extensively in the preparation of environmental impact assessments for development projects in areas of known nesting activity.

Annual surveys of non-nesting bald eagles are conducted on 18 standardized locations during mid-January. Survey sites include the Attwater's Prairie Chicken National Wildlife Refuge, the Garwood/Eagle Lake Rice Prairies and 16 reservoirs throughout North, Central and East Texas.

In the 2004 mid-winter survey, 221 bald eagles were reported. During January, 2004, the greatest numbers were found on Lake Texoma, Lake Palestine and Lake Fork with 46, 40 and 37 bald eagles, respectively.

These are ongoing annual surveys funded by TPWD and Federal Aid in Wildlife Restoration Grant W-125-R-15.

Colonial Waterbird Survey and Management

Brent Ortego, Marc Ealy, Greg Creacy and Larry LeBeau; TPWD

The Colonial Waterbird Survey is an ongoing cooperative effort between Texas Parks and Wildlife Department (TPWD), the U.S. Fish and Wildlife Service (USFWS), Texas General Land Office, Texas Colonial Waterbird Society and other interested organizations and volunteers. TPWD has participated in the annual statewide colonial waterbird survey since 1968.

Data obtained from sites over public lands were pooled into a common database that is managed by the USFWS and is frequently used by participants, consultants, and developers to avoid damaging colonial waterbird nesting sites. Private land colony site data were summarized by geographic area.

In 2004, a very wet year, a total of 27 active colonies and 83,000 nesting pairs were found in the traditional survey areas along the lower reaches of rivers and coastal marshes between the Trinity River in the east and the Guadalupe River in the west. A survey of the same site during a dry spring in 2002 only located 62,000 nesting pairs. Populations of Anhinga (*Anhinga anhinga*), Snowy Egret (*Egretta thula*), Little Blue Heron (*Egretta caerulea*), Cattle Egret (*Bubulcus ibis*), Roseate Spoonbill (*Platalea ajaja*), Royal Tern (*Sterna maxima*) and Black Skimmer (*Rynchops niger*) appeared to be higher than normal, and only Great Blue Heron appeared to be lower across this stretch of the Coast.

Aerial surveys of 147 inland colonial waterbird sites in 2004 estimated 145,000 nesting pairs which were 15,000 more than the previous survey of the area. Numbers of nesting Great Blue Heron (*Ardea herodias*) declined, and Anhinga, Great Egret (*Ardea alba*), Snowy Egret and White Ibis (*Eudocimus albus*) increased during the interim.

TPWD colonial waterbird survey activities have been funded by the Federal Aid in Wildlife Restoration Grant W-125-R.

Burrowing Owl Nest Site Selection and Productivity in Prairie Dog Colonies

Andrew P. Teaschner and Mark C. Wallace, Texas Tech University and James D. Ray, BWXT-Pantex

On the Southern High Plains in the Texas Panhandle, burrowing owls live almost exclusively in prairie dog colonies. Prairie dogs change the vegetative structure and provide burrows that are vital to burrowing owl survival. Our objectives are to: estimate relative burrowing owl abundances across the Southern High Plains; determine seasonal proportions of resident versus migratory burrowing owls nesting in this area; and determine nest site selection, fidelity and nesting productivity for burrowing owls in the Southern High Plains. We want to determine whether burrowing owl nesting is related to prairie dog colony size, prairie dog density, small mammal abundance or diversity, distance to playas or vegetation structure and abundance.

In January and February of 2003, we captured and banded nine burrowing owls. We surveyed and mapped burrowing owls nesting in Lubbock, Hale, and Carson and Randall counties during summer 2003. In May, June and July we attempted to capture all breeding pairs at three sites in Lubbock County and three sites in Carson County, Texas. An additional 79 burrowing owls were captured and banded during this period. All captured adults were also fitted with an individually coded red colored leg band designed to be individually identifiable through a spotting scope. We monitored burrowing owl productivity, counting young observed during three consecutive surveys, at nine prairie dog colony sites in the Lubbock area and 11 prairie dog colony sites in the Amarillo area. At the six intensive monitoring sites, we measured prairie dog colony size, estimated prairie dog numbers, and measured vegetative composition and structure (visual obstruction). We also mapped distances to nearby playas with water that could support amphibian populations and trapped (300 Sherman live trap-nights per site) small mammals to estimate relative abundances of potential burrowing owl foods. We will continue to collect data during the upcoming 2004 spring-summer burrowing owl breeding season.

Mammals

Bighorn Sheep

Habitat Use and Movements of Desert Bighorn Sheep in West Texas

Shawn L. Locke and Louis A. Harveson, Sul Ross State University;
Clay E. Brewer, TPWD

Restoring desert bighorn sheep (*Ovis canadensis*) to historic levels is a priority for resource managers, however, little information is available on their life history in Texas. We initiated a study to document annual range size, movements and habitat use of desert bighorn sheep at Elephant Mountain Wildlife Management Area in Brewster County, Texas. Between February 2001 and March 2002, we collected 790 (663 F, 127 M) radio locations for seven ewes and two rams, respectively. Ram annual home range size (0 = 1,471 ha, *SE* = 10, *n* = 2) was larger than ewe annual home range size (0 = 1,071 ha, *SE* = 4, *n* = 7). Ram daily movements were also larger (0 = 1,080 m, *SE* = 124, *n* = 26) than ewe daily movements (0 = 811 m, *SE* = 49, *n* = 182). We evaluated habitat use at multiple spatial scales using habitat selection ratios. Desert bighorn sheep preferred steep slope classes with high elevation in predominately southern aspects. Areas in proximity (1 km) to permanent water sources and escape terrain were also preferred. Understanding desert bighorn sheep habitat use and movements is critical in managing bighorn habitat and may assist in predicting future translocation sites.

This project was funded by Sul Ross State University, Texas Bighorn Society, West Texas Chapter of Safari Club International, Houston Safari Club and TPWD.

Bison

Development of a Genetic Breeding Program for the Texas State Bison Herd.

James Derr and Natalie Halbert - Texas A&M University; Danny A. Swepston, TPWD

Charles Goodnight began establishing his bison herd in the Texas Panhandle in 1878. The herd eventually grew to approximately 250 head. After Goodnight's death in 1929 the herd's size gradually declined as the ranch changed ownership several times. The remnants of the herd escaped to the adjacent JA Ranch in the mid-1930s and remained there until 1996 when the owners of the ranch donated them to TPWD. Goodnight's herd is considered one of the five foundation herds that prevented extinction of the plains bison in North America. They were officially designated as the Texas State Bison Herd (TSBH).

Texas A&M University researchers in 1999 found six of the 38 Goodnight bison captured in the winter of 1997-98 had traces of cattle DNA. The herd's genetic diversity is low and their DNA is unique when compared to other public herds. This study will use detailed analyses of molecular genetic markers to develop a breeding and conservation plan that will support and strengthen the overall management of the herd.

Two management options were proposed by the A&M researchers. If the TSBH is maintained with the current individuals, an intensive breeding program to improve genetic diversity should be implemented based on the degree of relatedness of the individuals. The alternative is to introduce genetic diversity into the TSBH from another bison herd that could meet certain health, fertility and historical criteria.

The second alternative was selected because of the expense, labor and uncertainty of the first choice to achieve significant genetic diversity. In January, 2003, three juvenile bison bulls were donated to the TSBH project from the Castle Rock Herd on the Vermejo Ranch in New Mexico by Turner Enterprises. These bulls meet all the requirements established by the Texas A&M researchers for breeding with the Goodnight Bison. They will be used in a long term breeding experiment to determine if the TSBH's genetic diversity can be increased without drastically changing their unique DNA.

Funding provided by TPWD.

The Charles Goodnight Bison Herd – Its History and Current Management

Danny A. Swepston, TPWD

The decline of American bison (*Bos Bison*) in Texas followed a pattern similar to bison populations throughout their range in North America. Bison originally were distributed over the majority of Texas, but the largest herds were found from the western Edwards Plateau northward into the Rolling and High Plains. The only statewide effort to save bison from extinction was a bill introduced into the Texas Legislature in 1875 protecting them from commercial hunting. This bill was defeated and the population continued to decline.

Beginning in 1878, Charles Goodnight initiated efforts to establish one of the five foundation herds that prevented extinction of the Plains Bison. One of the amazing things about the history of the Goodnight bison herd is that it survived all the changes in ownership and efforts to dispose of them. Goodnight tried to convince both the Texas and U.S. Government to acquire his ranch and preserve the bison herd in the following years, but was unsuccessful. Eventually, he contracted with H.A. Fleming & Company of Dallas, Texas in 1910 to create the Goodnight American Buffalo Ranch Company that would take over operation of the ranch which consisted of 5,528 acres. The ranch was incorporated for $300, 000, an advertising brochure prepared and efforts were made to attract investors at $10.00 per share (H.A. Fleming and Company, 1910). The venture was unsuccessful. Some consideration was given to creation of a "buffalo park" which would be open to the public, but that idea never developed.

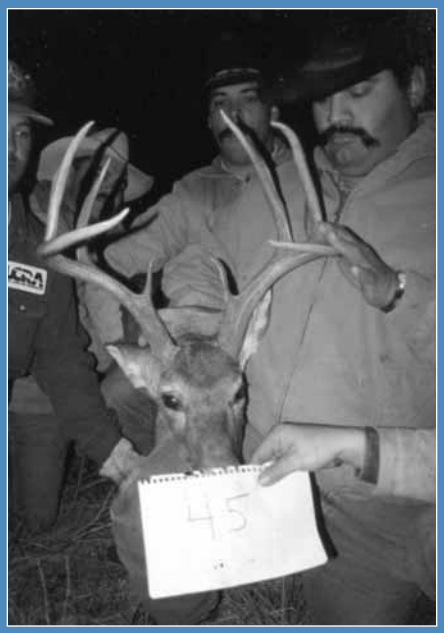
Little information is available concerning the bison in the years following their return to the JA Ranch. It is unknown how many bison escaped from Goodnight's ranch, but estimates of the herd's size between 1974 and 1988 varied from forty to sixty-seven head. Test results from six of the animals confirmed their DNA was unique among American bison herds. Based on these results, the Texas Parks and Wildlife Department accepted donation of the herd by the owners of the JA Ranch in 1996.

Caprock Canyons State Park near Quitaque, Texas was selected in early 1997 as the relocation site for the bison. Preparations for capture of the herd were initiated along with construction of temporary holding facilities on the JA Ranch. These facilities were needed so each bison could be ear tagged, vaccinated, have blood samples taken and tested for brucellosis and tuberculosis. Construction of the permanent breeding facility on 330 acres at Caprock Canyons State Park began in August, 1997 and was completed in November, 1999.

Deer

Comparative Mating Success of Male White-tailed Deer in Relation to Age and Perceived Quality

Donnie Frels, TPWD; Dr. James Ott, Texas State University



Current interest in "genetic improvement" of free-ranging white-tailed deer (*Odocoileus virginianus*) through selective harvest of "low quality" bucks and/or the introduction of "superior quality" bucks is at an all time high in Texas. This management strategy cannot be adequately addressed without detailed information on the breeding success of males in relation to body size, antler characteristics and age. Much of the controversy surrounding the management and harvest strategy of yearling bucks (spike bucks in particular) is fueled by the lack of information on the breeding success of males of this age class.

The goal of this research project is to provide baseline information to better understand the probable effects of selective harvest and management techniques and better design breeding trials. This project will: 1) estimate mating success of yearling white-tailed bucks in competition with mature bucks and 2) determine whether variation in relative antler quality and body weight within each age class affects mating success.

Mating success will be assessed by performing paternity analyses on all offspring sired within two replicate captive herds on the Mason Mountain Wildlife Management Area in Mason County, Texas. Resident deer were removed in the fall 1999 from two 500 acre high fenced enclosures. The pastures were then stocked with selected white-tailed deer culled from 320 native deer trapped throughout the Edwards Plateau during winter 1999. The experimental herds were established in January and February of 2000 at a sex ratio (1 buck : 2.5 does) and density (1 deer/7 acres) representative of the Hill Country. The following classes of WTD were introduced into the enclosures and allowed to acclimate until the 2001 breeding season: does $\geq$ 1.5 years old, bucks $\geq$ 3.5 years old of high and low antler quality, and 0.5 year old buck fawns. DNA samples were collected prior to release of all deer. Following the 2001 breeding season, deer were collected and adults and fetuses were typed at $\geq$ 13 microsatellite loci. The computer program "Cervus" followed by hand-matching was used to assign paternity.

Reproductive success differed significantly between mature and yearling males. Mature bucks tend to mate disproportionately when compared to their yearling counterparts. Antler quality among mature males did not influence reproductive success to the same extent. Mature bucks of high antler quality were disproportionately successful in one study area but mature bucks of low antler quality proved to be significant breeders in the other. Additionally, multiple paternity of 16% to 28% was observed. These results provide the first estimates of single-season male reproductive success and multiple paternity in field populations of white-tailed deer.

Funding for this project is provided by the TPWD.

Fawn Mortality of Sympatric Desert Mule and White-tailed Deer in Crocket County, Texas

Shawn Haskell, David Butler, Warren Ballard and Mark Wallace, Texas Tech University; Mary H. Humphrey and Clay E. Brewer, TPWD

Crockett County, Texas lies on the western edge of the Edward's Plateau bordering the Trans-Pecos Region, and has populations of both desert mule deer and white-tailed deer. The local mule deer population has been stable for a number of years, while the white-tailed deer population has increased. Previous studies have shown high survival rates for adults of both species; thus, there is a need for data concerning rates of productivity and fawn survival. We plan to collect data on the following: condition of adult females prior to parturition, pregnancy rates of mature deer, condition of fawns immediately following parturition, patterns and causes of neonate mortality, and habitat characteristics of fawn bed sites.

In the springs of 2004–2006, does of both species will be captured on five contiguous ranches (~80,000 acres). Once captured, body measurements will be taken to assess body condition of the doe, ultrasound will be used to confirm pregnancy and assess fetal condition, and the doe will be fitted with a radio-collar and a vaginal implant transmitter (VIT) to alert researchers when and where births occur. Once a birth occurs, researchers will use the VIT to locate the birth site and capture and fit the fawn with an expandable radio-collar, which will allow researchers to track the fawn and determine survival, bed sites used and cause-specific mortality.

Effects of Maternal Nutritional Stress on Yearling Antler Production

Eugene R. Fuchs, Bill Armstrong and Donnie Frels, TPWD

Research on the Kerr Wildlife Management Area has illustrated the relationship between genetics and nutrition in antler development of white-tailed deer. These studies have also shown a compelling correlation between yearling antler development and antler development at maturity. It is speculated that many spike-antlered yearlings are simply the result of poor nutritional conditions experienced by the dam during pregnancy. The goal of this project will be to investigate the effects of nutritional stress (applied during the third trimester of pregnancy) on antler production of yearling male white-tailed deer.

Seven, single-sire breeding herds will be established and maintained throughout the duration of the study. Each pen will be comprised of a single male and 10-12 females. Composition of each breeding herd will remain the same each year and all herds will be maintained in 2/3-acre pens on the Kerr WMA. Semen will be collected from all sires to ensure continuation of the breeding program should sire mortality occur.

The control group of females will be fed an unlimited, 16% protein diet year round. The treatment group will be fed an identical diet during the first year but in year two, will be subjected to a limited, 8% protein diet during the third trimester of pregnancy until weaning. Diet for this group will be alternated annually between the two feed rations. All male offspring will be fed an unlimited, 16% protein diet while producing yearling antlers. At birth, all fawns will be weighed and marked for individual identification and pedigree records will be established.

Data from all male progeny will be collected each October through 2006 and will include body weight, antler weight, spread, main beam basal circumference and length, number of points and gross Boone and Crockett score. Antler characteristics will be evaluated among full siblings and between cohorts of the treatment and control groups. Additional comparative information such as survival rates, birth weights, weaning weights and sex ratios will be analyzed. These data will also be used to investigate the variability of antler traits among full siblings.

Preliminary results (n = 47) for the 2003 cohort (first year of stress) indicates a notable difference in average weaning weights of the two groups (control - 48 lbs, treatment - 40 lbs.) but little variation in average live body weight at 1.5 years of age (control - 128 lbs., treatment - 124 lbs.).

Use of the Stem Count Method to Estimate Browse Utilization of Varying Deer Densities

Timothy E. Fulbright, Jimmy Rutledge, Charles DeYoung, David Hewitt, Ty Bartoskewitz, Daniel Kunz, Alan Cain and Evan McCoy, TPWD

The Stem Count Index (SCI) Method is a browse utilization technique used by the Texas Parks and Wildlife Department to determine if herbivore densities are within the carrying capacity of the habitat. In the method, browses are classed according to palatability with Class 1 plants the most palatable and Class 3 plants the least palatable. The percentage of browsed twig tips is determined on a minimum of 100 twigs/plant species. Our objective is to determine intensity of use of browses by the Stem Count Method in 200-acre enclosures with low, medium and high densities of deer.

Research is being conducted on the Faith and Comanche Ranches near Carrizo Springs, Texas. Use of first choice, second choice and third browse species was estimated in six enclosures at each ranch surveyed in February and August 2004. Deer densities were adjusted in March 2004 with pairs of enclosures containing 10, 25 or 40 deer. Forage in one of each pair of enclosures is supplemented with protein pellets. Additional browse surveys will be conducted during August and February for the next five years. Results of the study will indicate if level of estimated browse utilization is related to deer density.

Cooperative funding provided by Comanche Ranch, T. Dan Friedkin, Faith Ranch, and the Neva and Wesley West Foundation.

Antler Development in the Progeny of Nutritionally Stressed Yearling Spike Sires

Eugene R. Fuchs and Donnie Frels, TPWD, Kerr Wildlife Management Area

For many years biologists, land managers and sportsmen have discussed the effectiveness of spike buck management in white-tailed deer (*Odocoileus virginianus*) herds. Although data exists which supports the removal of spike antlered bucks, many landowners choose to allow these deer several years of growth hoping that a few of these animals develop trophy antlers. Kerr Wildlife Management Area (KWMA) research has shown that although a few (<5%) spike antlered yearlings do eventually produce respectable antlers, the majority of their resultant male offspring will exhibit less than desirable antlers due to the heretibility of heterozygous antler traits.

Antler development at 1.5 years of age

	6+ pts	Avg. Antler Wt (grams)	GBC Score
G/E Study n=28	100%	336	72 1/8
Phase I n=16	69%	272	55 5/8
Phase II	32%	184	44 6/8

At the KWMA intensive selection procedures associated with previous research efforts resulted in the development of a female deer herd that has produced all fork-antlered yearling bucks (three or more points) for three consecutive years when fed a limited diet of 8% protein. We hypothesize that when mated to the same females, antler development in the male offspring of yearling spike-antlered sires will be inferior to antler development of male offspring from yearling sires that produced six or more antler points. Phase I (year 1) involved the mating of three, nutritionally stressed yearling spike sires with a gross Boone and Crockett score (GBC) >130 at maturity (4.5 years of age or older). The three sires were placed in individual breeding pens with 9-12 pedigreed females referenced above. Phase II (year 2) utilized these same females bred to three sires that were also nutritionally stressed spike-antlered yearlings with GBC scores >130 at maturity. However, these bucks represent the largest male offspring resulting from the mating of a large-antlered male (205 GBC) and females from "spike line" sires. The male progeny from these two breeding trials will be compared to the offspring produced from the final year of the Genetic and Environmental Interaction study. Antler development will be compared among the three cohorts until 4.5 years of age.

Collection of yearling antler data was completed for the Phase II cohort in October 2002 (Tables 1). Collection of the third set of antler data was completed for the Phase II cohort in October, 2004. The average gross Boone and Crockett scores for these three cohorts at 3.5 years of age is 142 2/8, 131 1/8 and 114 6/8 inches, respectively. Final analysis will be made when antler data from the Phase II cohort is collected in October 2005.

This study is being funded by the TPWD.

Ecological Relationships Between Male Desert Mule Deer and White-tailed Deer in West-Central Texas

Kristina J. Brunjes, Warren B. Ballard, Mark C. Wallace, Paul Krausman, Texas Tech University; Mary H. Humphrey and Fielding Harwell, TPWD

In West Texas, the distributions of desert mule deer and white-tailed deer overlap along the western edge of the Edwards Plateau, in the Trans-Pecos Region and in the Panhandle Region. Texas Parks and Wildlife Department and private landowners need information on how these two species interact with their environment in order to manage both species effectively in areas of overlap. Our objective was to estimate home range and core area sizes and overlap and survival of sympatric male desert mule deer and white-tailed deer in West-Central Texas.

We captured 18 males of each species, fitted them with radio-collars, and monitored them for mortality from 2000 through 2003. We calculated 95% kernel home ranges for seven males of each species in 2001 and 2002. Home range sizes of mule deer (3.4 mi km^2) and white-tailed deer (2.9 mi km^2) were similar. Home range overlap was less common between individual mule deer and white-tailed deer compared to overlap between individuals of the same species. Mule deer home ranges overlapped those of white-tailed deer in 10 instances and on average about 9% of the locations of those animals occurred in the area of overlap. Overlap between individual mule deer occurred in 17 instances and averaged 29%; overlap between white-tailed deer occurred in 15 instances and averaged 44%. Average core area size of mule deer was 1.0 km^2 and was nearly the same size as that of white-tailed deer, 1.1 km^2. No locations occurred within an area of overlapping core areas between individuals of different species.

Mean annual survival was 0.76 (*SE* = 0.04) for mule deer and 0.80 (*SE* = 0.06) for white-tailed deer. One mule deer died entangled in a fence, two mule deer and two white-tailed deer were legally harvested, one white-tailed deer was poached, two mule deer and one white-tailed deer apparently starved or died of disease, and one of each species died of undetermined causes. Given there is home range overlap and similar survival between the species in this area, traditional management efforts targeting only one species may be unfeasible. However, increased harvest of white-tailed deer in conjunction with habitat improvement efforts should benefit mule deer populations.

Predators

Landscape Analysis of Black Bear Habitats in the Trans-Pecos Region of Texas

Mindy Rice, Warren B. Ballard and Ernest Fish, Texas Tech University; David Holdermann, TPWD

Black bears were reportedly common and widespread across Texas in the 1800s, but they were virtually extirpated from the state by the 1940s as a result of over hunting, predator control and loss of habitat. In the early 1990s, a small black bear population in Coahuila, Mexico, served as a source for recolonization of the Chisos Mountains and Sierra del Carmen (Big Bend) in the Trans-Pecos Region in Texas. Black bears are now sighted annually in other parts of the Trans-Pecos suggesting that recolonization is ongoing.

Our study was initiated in fall 2003 to identify potential black bear habitat on a landscape scale and to determine the carrying capacity of black bears in the Trans-Pecos. We will accomplish this by: (1) populating a standard database with all past TPWD black bear sighting and mortality records; (2) developing an integrated, spatial GIS database with layers for surface water, vegetation, transportation corridors, human population centers and black bear sighting locations; and (3) modeling known black bear habitats, potentially suitable habitats and linkages between habitats to predict black bear metapopulation function. Results of this study will serve as an objective platform for future black bear planning, management and conservation.

Additionally, we are surveying private landowner attitudes towards black bears in the Trans-Pecos, since most potential habitats occur on private land. In September, 2004, we mailed 1,100 questionnaires to landowners with areas large enough to support black bears. To date, there have been 246 responses (22% response rate). Preliminary results suggest landowner attitude toward black bear re-colonization is nearly split with 43% against, 41% in favor and 16% with no opinion. Complete analysis of survey results is expected by spring 2005.

Coyote Predation of the Rio Grande Wild Turkey

Rachael L. Houchin, Warren B. Ballard, Mark C. Wallace, Texas Tech University; Jeff P. Bonner, TPWD

The Rio Grande wild turkey has been studied for the past four years at three separate study sites in the Texas Panhandle, and one site located in southwestern Kansas. Population modeling suggests that the turkey populations at the Salt Fork (SF) site and Gene Howe Wildlife Management Area (GHWMA) are stable or increasing, whereas, the populations at the Matador Wildlife Management Area (MWMA) and the Kansas (KS) site are declining. Differences in rates of predation may be responsible for population differences among study sites. Examination of mortality sites of radio-transmittered turkeys on these study sites attributed 43% (MWMA, n = 147); 24% (GHWMA, n = 122); 12% (SF, n = 132); and 24% (Kansas, n = 70) of the mortalities to coyotes.

Effects of predator control upon game bird populations differ depending on the kind and intensity of predation, the degree of predator control and the prey species. Most studies on the effects of predator densities upon game birds have focused on nest success. We are investigating the effects of coyote densities on Rio Grande wild turkey survival. Scent stations and scat surveys will be used to estimate relative abundance of coyotes at each of the four study sites. Coyote scats will also be collected along transects for analysis of coyote diet composition. These data will be correlated with cause specific mortality data from each study site and the effects of relative predator abundance will be tested between years and seasons within and between sites.

Scent station and scat survey results for our first year of data do not appear to be correlated. Scat surveys indicate highest coyote abundances at the Kansas study site, while scent stations indicate highest at the Salt Fork site. Both methods suggest that the MWMA site has the lowest coyote abundance. We will continue to collect scent station and scat transects data during the winter, spring and summer seasons of 2004.

Trends in Mammalian Predators of Rio Grande Turkeys on the Edwards Plateau, Texas

Beau J. Willsey, Nova J. Silvy, Markus J. Peterson and X. Ben Wu, Texas A&M University; Ray Aguirre, Stephen J. DeMaso and T. Wayne Schwertner, TPWD

Rio Grande wild turkey (*Meleagris gallopavo intermedia*) abundance on the southern Edwards Plateau, Texas has declined since the 1970s. Scent-station transects were established on non-paved ranch roads within four study areas, two each within stable and declining regions to examine mammalian predator abundance and potential effects of lunar phase on scent-station visitation. Scent-station indices revealed higher (X^2 = 19.653, $P < 0.001$) numbers of opossum (*Didelphis virginiana*) and skunk (eastern spotted [*Spilogale putorius*], striped [*Mephitis mephitis*] or western spotted [*S. gracilis*]) (SAA, $\bar{x}$ = 0.0148; SAB, $\bar{x}$ = 0.0151; DAA, $\bar{x}$ = 0.0042; DAB, $\bar{x}$ = 0.0065) on stable areas. Higher numbers of coyotes (*Canis latrans*) on declining areas (SAA, $\bar{x}$ = 0.0067; SAB, $\bar{x}$ = 0.0022; DAA $\bar{x}$ = 0.0234; DAB $\bar{x}$ = 0.0434) suggested a possible causative factor of the decline, but abundance indices were not verified by empirical data. Lunar phase was not a significant (Z = -0.225, P = 0.822) covariate in scent-station visits by raccoons, opossums (new, $\bar{x}$ = 0.0111; full, $\bar{x}$ = 0.0324), or unidentified tracks (new, $\bar{x}$ = 0.0649; full, $\bar{x}$ = 0.0375). Nightly precipitation and wind speed probably influence mammalian use of scent stations more so than lunar illumination.

Financial support for this study was provided by TPWD (Turkey Stamp Fund) and Texas A&M University System.

Population and Habitat Visability Analysis of Ocelots in Southern Texas

Aaron M. Haines and Michael E. Tewes, Caesar Kleberg Wildlife Research Institute, Texas A&M University - Kingsville; John Young, TPWD

The ocelot is one of the most endangered cat species in the United States, with distribution limited to two small populations in southern Texas. In this study, ocelot population and habitat viability will be further examined to provide guidelines for ocelot conservation. Population and habitat viability analysis (PHVA) integrates information from ecological studies to predict the persistence of population survival. PHVAs are useful in identifying factors critical for the conservation of a species or population, and have been previously used for predicting the effects of various management strategies on endangered populations. Over the last 20 years, data gathered on ocelots will be used to estimate parameters such as mortality, sex ratios, fecundity, dispersal, distribution and habitat use.

These parameters will be used to construct a PHVA model of ocelot populations in southern Texas and northern Mexico. Supplemental molecular data will provide additional information on dispersal, variation and effective population size. Specific goals of this project are to (1) analyze spatial patterns, density and habitat use of ocelots in southern Texas; (2) assess population persistence of ocelots in South Texas and (3) develop a predictive model for the effects of selected recovery strategies (e.g., habitat restoration) and conservation problems (e.g., vehicle-induced mortality).

This proposed model will be used as a tool by the U.S. Fish and Wildlife Service and TPWD for the management and recovery of the ocelot.

Population Size and Population Structure of Mountain Lions in Texas

Jan Janecka and Michael Tewes, Caesar Kleberg Wildlife Research Institute,
Texas A&M University-Kingsville; John Young, TPWD

The Texas Parks and Wildlife Department (TPWD) identified population size, structure and distribution of mountain lions in Texas as a research priority to provide sound management decisions. Due to the low density and secretive habits of mountain lions, population parameters are difficult to estimate. This study utilizes genetic data obtained from mountain lions sampled throughout the state to estimate important population parameters such as population size, population structure and gene flow. Tissue samples from 52 mountain lions have been collected from TPWD, Texas Wildlife Damage Management Services and private individuals in eight counties. We have collected 102 museum specimens that represent historic populations in 12 Texas counties and several areas in Mexico. Currently we are extracting DNA and have begun the optimization of 20 microsatellites and a portion of the control region that will be used in the genetic analyses. Mountain lion samples are currently being screened at these loci. Additional samples from extant historic populations will be obtained through the following year to increase sample size. These data will provide estimates of genetic diversity, effective population size recent fluctuations in population size, and gene flow between geographic areas.

Ecology of Three Species of Skunks in West Texas with Emphasis on Developing Management Recommendations for the Hog-nosed Skunk

Robert C. Dowler, Jeffrey B. Doty, Sean A. Neiswenter and Joshua B. Coffey, Department of Biology,
Angelo State University; John Young, TPWD

Three species of skunks occur in West-Central Texas: the striped skunk (*Mephitis mephitis*), the western spotted skunk (*Spilogale gracilis)* and the hog-nosed skunk (*Conepatus leuconotus)*. Although striped skunks are relatively well studied, few studies have focused on western spotted skunks or hog-nosed skunks. The ecology of these three species where they co-occur is still poorly understood. The objectives of this study were to compare home ranges, seasonal activity patterns, and den site locations for striped skunk, hog-nosed skunk and western spotted skunk and to determine the degree of overlap for habitat preferences.

The study is being conducted at a mesquite brushland area of San Angelo State Park and the Angelo State University Management Instruction and Research Center in Tom Green County. Additional sites were in Kimble County at the South Llano River State Park, the Walter Buck Wildlife Management Area and Texas Tech Center at Junction.

Skunks were caught using Tomahawk live traps or by hand. To date, 22 western spotted skunks, 38 striped skunks, and one hog-nosed skunk have been radio-collared from October, 2001 - August, 2004. Habitat analysis at den sites (n = 100) showed that western spotted skunks favored den sites with dense mesquite, prickly pear cactus and shrubs, whereas striped skunks denned in these areas as well as open grassland. Studies of home range for these two species showed the same pattern with spotted skunks having most activity in brushy areas. Striped skunks are less specialized in both habitat preferences for foraging and denning. Individual of both species used multiple den sites and had more den sites above ground than below ground. Activity occurs throughout the night for both species for which data are available, though peaks in activity differ between them.

A comparison of the endoparasites for the three species was conducted using primarily road-killed animals. Results of necropsy of 28 hog-nosed skunks, 23 striped skunks, and nine western spotted skunks revealed nine helminth species, most shared between striped and hog-nosed skunks. Striped skunks had greater abundance of endoparasites than either of the other skunk species.

Other Mammals

Remote Sensing the Current Status of Black-tailed Prairie Dog Populations in Texas

Jason R. Singhurst and Greg Kerouac, TPWD

Determination of the status and distribution of black-tailed prairie dogs is the primary goal of the Texas Black-tailed Prairie Dog Conservation and Management Plan. The range of prairie dogs in Texas was last estimated in the 1960s. Because the area is extremely large (86 million acres) and primarily privately owned, we chose to use remote-sensing (RS) techniques to survey the current range of this animal in Texas.

We surveyed prairie dog disturbance by utilizing digital orthophoto quadrangles (DOQ's). DOQ's have very high resolution (1m) and reveal disturbances such as mounds and vegetation removal. We delineated the area of interest based upon the Geographic Information System (GIS) historic range layer that we developed. We searched over 1,400 individual DOQ's using ERDAS Imagine software and used both black and white and color images from 1995-1996.

We generated nearly 6,000 polygon features formatted for GIS software. In addition, data was collected by means of Global Position Systems (GPS) units at over 1,000 locations. These two sets of data were sorted and combined in different ways in order to answer specific questions. The datasets were used to estimate the total number of acres of prairie dog colonies in both 1996 and 2004, the change in population from 1996 to 2004, the current hypothetical range for the BTPD, the locations and sizes of complexes of prairie dog colonies greater than 5,000 acres, and the percentage of prairie dogs living in complexes greater than 1,000 acres. The results of the inventory yield a best estimate of 115,000 acres of prairie dog colonies in Texas in 2004.

Rapid Recovery of Rodent Populations Following Drought

Robert D. Bradley, John D. Hanson, B. Dnate' Baxter, Michelle L. Haynie and Francisca M. Mendez-Harclerode, Texas Tech University; Charles F. Fulhorst, University of Texas Medical Branch at Galveston; Donald C. Ruthven, III, TPWD

Rodents are an important food source for a wide variety of predators including coyotes (*Canis latrans*) and bobcats (*Felis rufus*). Coyotes and bobcats can also be major predators of white-tailed deer (*Odocoileus virginianus*) fawns. Healthy rodent populations may serve as buffer prey items to alleviate fawn predation. Drought can greatly reduce the availability of rodent populations; thus, affecting predator-prey relationships. Although reductions of rodent populations in response to drought are well documented, little data is available on how quickly rodent populations can recover following drought.

A long-term research project on small mammal populations on the Chaparral Wildlife Management Area in South Texas allowed for data to be collected during a drought period (2001-02, precipitation 56% of normal) and a recovery period of above normal precipitation (2002-2003, precipitation 168% of normal). Small mammals were captured seasonally by Sherman traps and permanently marked before being released during the 2001-2003 study period. Species abundance was compared between drought and post-drought periods using a one-way analysis of variance.

Southern Plains woodrat (*Neotoma micropus*, n = 531), white-footed mouse (*Peromyscus leucopus*, n = 1037), northern grasshopper mouse (*Onychomys leucogaster*, n = 76), fulvous harvest mouse (*Reithrodontomys fulvescens*, n = 108), and cotton rat (*Sigmodon hispidus*, n = 670) were captured in significant numbers for analyses. Southern Plains woodrat and cotton rat had significant declines shortly following the onset of drought, whereas declines in northern grasshopper mouse and fulvous harvest mouse numbers did not become evident until three-four months following drought onset. Likewise Southern Plains woodrat were the first to recover to pre-drought numbers shortly following the breaking of the drought, with the other four species recovering within three months post-drought. Within three months post-drought total rodent numbers were 160% greater than pre-drought numbers and had increased 500% compared to the last drought sampling period. This data suggests that although prolonged drought can adversely affect rodent populations, numbers can recover quickly following the return of normal to above-normal precipitation.

Genetic Diversity within the Southern Plains Woodrat in Southern Texas

Francisca M. Mendez-Harclerode, John D. Hanson and Robert D. Bradley, Texas Tech University; Charles F. Fulhorst and Mary L. Milazzo, University of Texas Medical Branch at Galveston; Donald C. Ruthven, III, TPWD

Woodrats (*Neotoma* sp.) are a principal host of the Whitewater Arroyo virus (WWAV) and other arenaviruses. The dominant feature of the arenaviruses is their ability to establish chronic infections in their respective principal rodent hosts. There is extensive genetic diversity among strains of WWAV isolated from Southern Plains woodrats (*Neotoma micropus*) on the Chaparral Wildlife Management Area (CWMA) in southern Texas. Knowledge of the genetic diversity within the woodrat population is required to elucidate the source(s) of genetic diversity within WWAV on CWMA. We tested the hypothesis that the population of woodrats on CWMA is genetically homogeneous.

Genetic diversity within the population of woodrats on CWMA was examined using DNA sequences (967 bp) obtained from the control or d-loop region of the mitochondrial genome. One hundred fourteen individuals from 10 collection sites were assigned to 42 haplotypes. Haplotype diversity values were moderate to high (0.974 overall and ranged from 0.524 to 0.964 across collecting sites), whereas nucleotide diversity values were low (0.008 overall and ranged from 0.001 to 0.010 across sites), indicating that this population possesses a high number of closely related haplotypes. Seventy-nine percent of the genetic variability was partitioned within groups that corresponded to the collecting sites. In addition, 13 samples from Texas, New Mexico and Mexico were included as references for evaluating the evolutionary history of haplotypes. Nested clade analysis revealed that restricted gene flow with isolation by distance in conjunction with contiguous range expansion was responsible for the observed pattern of genetic diversity. A test of neutrality supported the diagnosis of restricted gene flow, but failed to support contiguous range expansion due solely to population growth. Examination of the spatial distribution of the haplotypes indicated that most haplotypes were restricted to a single collecting site; however, a small number of haplotypes were found at two or more sites. A phylogenetic analysis indicated that some haplotypes (28.6%) were restricted to the study area whereas the remaining haplotypes occupied a broader geographic region. The extensive genetic diversity in woodrats on CWMA supports the hypothesis that at least some of the genetic variation observed in WWAV on CWMA may be a result of genetic interactions of two or more populations of Southern Plains woodrats.

Natural History of the Southern Plains Woodrat in South Texas

John R. Suchecki and Robert D. Bradley, Texas Tech University; Charles F. Fulhorst, University of Texas Medical Branch at Galveston; Donald C. Ruthven, III, TPWD

The Southern Plains woodrat (*Neotoma micropus*) is common throughout southern Texas and their middens are important refugia for a wide variety of wildlife including species of concern such as the Texas Indigo snake (*Drymarchon corais*). Little is known of the natural history of the Southern Plains woodrat in the xeric regions of the western South Texas Plains. A long-term research project investigating the biology of the Whitewater Arroyo virus in woodrat populations on the Chaparral Wildlife Management Area (CWMA) in South Texas allowed for the collection of data on woodrat demography and ecology.

One hundred forty-eight woodrat middens were excavated from eight study sites on the Chaparral Wildlife Management Area in southern Texas. Several parameters were examined within and between study sites, including sex and age of individuals, demographics of occupancy and distance between middens. One hundred seventy-seven individuals were captured, with significantly more adult woodrats represented than any other age category. Ninety males and 87 females were captured indicating an equal sex ratio. Analyses revealed that no difference existed in distances between male middens or in distances between female middens. Together, the data suggest no apparent patterns of social structure in woodrats at this study site.

As study sites were selected based on high midden density, the midden density on our study sites of 92 middens per hectare (2.47 acres) is considerably higher than that previously reported in the literature and most likely over estimates the midden density on the entire CWMA. The lack of social structure observed on our study sites, which is uncharacteristic of woodrats, appears to allow woodrats to fully occupy exceptional habitat.

Serologic Survey of Selected Diseases and Movements of Feral Swine in Texas

A. Christy Wyckoff, Scott E. Henke and David G. Hewitt, Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville; Kurt C. VerCauteren, USDA-Wildlife Services, National Wildlife Research Center; John G. Himes, TPWD

Feral swine populations occur throughout east, central and southern Texas, and their populations appear to be increasing. Despite their abundance and wide distribution, little is known about their range and interaction with domestic animals. In the last decade the national pork production industry has enforced an eradication program for economically detrimental swine diseases such as pseudorabies and brucellosis. It is hypothesized that feral hogs can be reservoirs that could re-introduce diseases to disease-free domestic swine herds.

The objectives of this project are to determine the prevalence of selected swine diseases that exist within feral hog populations in Texas, as well as the range and movement of feral populations. Of particular interest is the proximity and interaction of collared feral hogs with neighboring domestic swine in respect to potential for disease transmission.

Trapping will be done in East, Central and South Texas, including the Gus Engeling and Big Lake Bottom Wildlife Management Areas in Anderson County. Trapped individuals will be chemically immobilized in traps. Every pig trapped will be ear tagged and blood will be obtained for serology testing for pseudorabies, brucellosis and classic swine fever. Body measurements will be taken, including weight, body length, neck size, shoulder height and rib circumference. Selected adults will be fitted with a GPS collar, and the animals will be released at their capture site. At present date seven animals have been collared, consisting of three adult females and four adult males.

The GPS collars will collect data for approximately 1.5 years. The data collected will be used to assess the average range and movement of male and female feral hogs. The disease and range results together will help identify high risk feral populations, as well as aid in the understanding of herd size and habitat use of infected populations. The size of feral hog range and seasonal use of general habitats such as forest, field and developed areas also will be quantified for use in future management of feral hog populations.

This project is funded by the Animal and Plant Health Inspection Service, National Wildlife Research Center, U.S. Department of Agriculture and Veterinary Services.

Developing a Protocol for Using Motion Triggered Cameras to Estimate Habitat Use of Collared Peccaries

Meredith P. Longoria and Floyd W. Weckerly, Texas State University; James F. Gallagher, TPWD

The goal of this project was to develop a protocol that allows for collection of reliable data for examining and testing hypotheses of habitat use of group-living collared peccaries at the landscape scale. The objectives of this project were to address three issues that affect data reliability: (1) the number of cameras needed per station, (2) the length of time camera stations should remain in operation and (3) the minimum distance necessary between camera stations.

Research was conducted on the Chaparral Wildlife Management Area (CWMA) in Dimmit and La Salle counties, located in the South Texas Plains ecological region. Four camera stations were established in sites frequented by peccary. Four DeerCam DC-100® scouting cameras were secured approximately 25-30 cm from ground level and positioned at each station so that pairs of cameras were approximately 20 m apart facing each other, perpendicular to the other pair of cameras. Camera stations were active for 28 days (August 2-30, 2003), and were examined every four days to ensure activity, collect and replace film.

Out of 966 total photos taken on 58 rolls of film, the proportion of photos that were of peccaries was 0.31, deer was 0.26, other mammals (including bobcats, coyotes, badgers, cottontails, armadillo, opossums, etc.) was 0.12, birds was 0.11, nothing detectable was 0.15, and of people or vehicles was 0.05.

There were no differences in the mean number of photos of peccaries, or the mean number of peccaries counted in photos taken by more than one camera per station. However, on average peccaries triggered two of four cameras simultaneously ($\leq$10 min. apart) upon entering a station. Based on the combination of these results, we recommend having at least one pair of opposite-facing cameras at each station. Camera stations should be a minimum of 1.76 km apart in order to maintain independence, since that was the maximum diameter of peccary home range estimates calculated from telemetry data gathered by Timothy Gabor et al. at CWMA in 1994 and 1995.

Camera stations had the highest rate of visitation by peccaries during the first four - eight days of operation. Operating camera stations for a period of 4-8 days should provide adequate time for peccaries to travel at least twice the distance of their home range, and therefore sufficient amount of time for habitat use of peccaries to be detected.

Restoring Javelina to Historic Native Range in the Edwards Plateau Ecological Area of Central Texas

Mark Mitchell and Kelsey Behrens, TPWD; Brad Porter and Roel Lopez, Texas A&M University

Javelina, or Collared Peccary (*Pecari tajacu*), historically occupied a range in Texas that extended from the southern border north to the Red River in Clay and Montague counties and eastward from Fort Worth to Brazoria County on the Gulf Coast. During the early part of the 20th century their range diminished due to habit changes and intentionally extirpation.

Many landowners have expressed an interest in transplanting javelina for the purpose of adding additional native species to increase hunting revenue. Some landowners desire to reestablish the species to its historic range. Our objectives were to investigate the feasibility of re-establishing a viable javelina population, evaluate impact on native vegetation, document javelina habitat requirements in the central mineral region of Texas.

In spring 2003, the TPWD captured 38 javelina from McMullen and Dimmit counties using walk-in box traps and then transported to the Mason Mountain Wildlife Management Area (MMWMA) in Mason County. We attempted to hold the

animals from a few hours to several days in an attempt to acclimate the herd to the area and hopefully diminish the "homing instincts" associated with many species upon translocation. Javelina were released into a 418 hectare study pasture enclosed by an 8-foot net wire fence. Twenty-seven of the individuals were fitted with radio transmitters attached to one ear along with a colored ear tag for identification. Movements and locations were documented for the life of the batteries, approximately six months.

Currently 18-20 individuals remain on the MMWMA and have established home ranges totally within the confines of the area. Two to four individuals are believed to have established their home range only partially within the WMA. One individual, a pregnant female, was found captured in a snare approximately seven miles from the release site on a private ranch. She was also observed by the landowner to have two young that were born after relocation.

Of the estimated 20-24 javelina currently on the area, five (two male, three female) were known to have operating transmitters in June of 2004 and their locations determined. We have documented six young that have been born on the area. In addition to telemetry data all sightings are routinely recorded.

This project was funded by revenue generated through the public hunting program on Mason Mountain WMA.

Playa Lakes as Habitat Reserves for Black-tailed Prairie Dogs

Alison Pruett, Texas Tech University; Clint W. Boal, Texas Cooperative Fish and Wildlife Research Unit; Mark C. Wallace, Texas Tech University; Heather Whitlaw, TPWD; Jim Ray, BWXT-Pantex

Although playa lakes comprise only about 2% of the total landscape of the Texas Panhandle, they are critical to the survival of many wildlife species and provide habitat for a diversity of vertebrates, invertebrates and plants. Anecdotal to recent vegetation surveys at playas lakes, it was estimated that black-tailed prairie dogs (*Cynomys ludovicianus*) might be present at as many as 10% of the playas. However, no research had been conducted to confirm this estimate or to specifically analyze the relationship between playas and prairie dogs.

We assessed the distribution of prairie dogs across 12 counties in the Texas Panhandle (Armstrong, Briscoe, Carson, Castro, Crosby, Floyd, Hale, Hockley, Lamb, Lubbock, Randall and Swisher) and located 423 active prairie dog colonies (n = 407 surveyed). The average colony size was 53.5 acres with a density of 5.5 prairie dogs per acre. Of the colonies we located, 88% were on top of the Caprock. When compared to 1,000 randomly generated points, prairie dog colonies were closer than expected to playa lakes. The average distance from colony edge to the center of nearest playa on the Caprock was 277 m, with a median distance of 59 m. However, there was no apparent relationship between the population size of a colony and distance from the nearest playa. Our results support the suggestion that playa lakes may provide important habitat for black-tailed prairie dogs.

We also examined abundance of small mammal species at playas with and without prairie dog colonies. We conducted small mammal trapping at 28 colonies located on playa slopes and 28 paired "non-colony" sites located along a playa slope within two miles of the colony. We captured 11 different small mammal species during 21,600 trap nights. Only four species and one genus were captured with enough frequency to allow for individual analysis. The western and plains harvest mice (*Reithrodontomys megalotis* and *R. montanus*, respectively) were analyzed at the genus level because it was difficult to differentiate the two species in the field. Reithrodontomys spp ($P=0.0005$) and hispid pocket mouse (*Chaetodipus hispidus*) ($P=0.0003$) were found more often at non-colony sites than on prairie dog colonies ($P = 0.0005$). The abundance of Deer mice (*Peromyscus maniculatus*), a generalist species, was not significantly different between colony and non-colony areas ($P = 0.1405$). The northern grasshopper mouse (*Onychomys leucogaster*) was found almost exclusively on prairie dog colonies ($P < 0.0000$).

This study was funded by TPWD, USGS Texas Cooperative Fish and Wildlife Research Unit, Texas Tech University and BWXT-Pantex.

Plants

Remote Sensing Pitcher Plant Bogs and Conservation Along the Longleaf Pine Ridge on Temple-Inland Lands

Jason R. Singhurst, TPWD; Edwin L. Bridges
and John Schadler, Sebring

Temple-Inland Timber Cooperation (TI) lands contain the largest concentration of carnivorous plant bogs in Texas. These insectivorous plants share a common mechanism of trapping prey. The yellow pitcher plant (*Sarracenia alata*) has passive pitfall traps. Prey is attracted to the lip of the pitcher by nectar, and waxy secretions or downward pointing hairs encourage the insect to slide into the digestive enzymes at the bottom of the pitcher. This passive system is distinct from the active traps of plants such as bladderworts (*Utricularia* spp.), which also occur in these bogs. Other insectivorous plants found in these bogs include sundews (*Drosera* spp.) and small butterwort (*Pinguicula pumila*), both of which have sticky secretions and moving leaves, a combination of active and passive traps.

Pitcher plant bogs are located on TI lands along the Longleaf Pine Ridge (LLPR) in southeast Texas. The 'Ridge' is defined by exposed Catahoula Barren (CB) sandstone formation extending from the lower Angelina National Forest east to the Lower Sabine National Forest. Along the LLPR, yellow pitcher plants bogs are found restricted to seep contacts with the CB. Considered isolated wetlands, bogs have numerous plant species of concern and other plant specialist species that are restricted to these areas. Bogs once commonly dotted this landscape but are now scarce in this region due to a variety of land uses.

TI has joined TPWD in a Memorandum of Understanding, to map bogs, inventory associated flora and develop a conservation plan to conserve bogs while integrating commercial forest practices. Digital orthophoto quadrangles (DOQ's) ranging from 1995-1996 with a high resolution (1m) were interpreted with ERDAS Imagine software to reveal natural bog openings. We identified and ranked over 120 potential bog features based upon highest probability of intact natural and semi-natural function (first, second and third order). We ground-truthed the first and second order bogs and omitted third order and anomalies. During the fall of 2002 and 2003, we conducted a floristic assessment of 45 bogs and identified and mapped 67 plant species of concern occurrences. Surveys will continue through fall of 2004 and 2005.

Floral Inventory of Amistad National Recreation Area

Jackie M. Poole, TPWD

The National Park Service has initiated a nation-wide inventory and monitoring program. The four national parks in West Texas are within the Chihuahuan Desert network. Of these four parks, only Amistad National Recreation Area lacks an adequate floral inventory. The goal of this project is to develop an annotated, voucher plant list for Amistad NRA, complete with locations, frequency and habitat.

Although most of Amistad NRA is under water, the National Park Service owns property to the flood pool level, 1,144 feet. Many areas have never been flooded, or have become exposed due to continuing low water levels. Also Amistad NRA does own several thousand acres of upland areas, used primarily for recreational purposes. The logistics of surveying such a riparian corridor are challenging, and the Park Service has offered a boat and driver to access many of the sites.

A baseline plant list was developed from nearby state parks and Nature Conservancy preserves. Although Amistad NRA stretches from Del Rio to past Langtry along the Rio Grande and north up the Devil's and Pecos Rivers, most of the habitat is characteristic of Tamaulipan thornscrub.

During the two year survey, 61 sites were visited, and 707 species were documented for the park, including 40 not previously reported for the area. An additional 137 species were found in the vicinity of the park, and may eventually be located within the boundary. A total of 116 species considered as possibly occurring at the beginning of the project were found to not even occur within Val Verde County. No listed endangered species were found, and only two rare species, Correll's bedstraw and Rydberg scurfpea, were discovered. Non-native species represented only 7% of the flora, and top 10 most common plants were all native perennials. Seventy-seven finely delineated plant communities were also described during this study.

Funding for this project is provided in part by the National Park Service.

Guide to the Rare Plants of Texas, including Listed, Candidate and Species of Concern

Jackie M. Poole, Dana Price and Jason Singhurst, TPWD; William R. Carr, The Nature Conservancy of Texas

In response to the need for an updated guide to the rare, threatened and endangered plants of Texas, a project was undertaken to produce a new field guide. The last such effort was produced in 1987 (Poole and Riskind 1987). Several plants have been listed (or delisted) since that time as well as many changes in both the candidate and species of concern lists. Most of these species are too rare to be found in any of the common field guides, and only a handful of botanists know what these species and their habitats look like. Without more information on these species readily available, their protection and recovery is tenuous. Misidentifications are common as these rare species lack published photographs or easily acquired illustrations.

The objective of this project was to produce a reference book with photographs, line drawings, county-level maps and text on the distribution, habitat, physical description, phenology, federal and state legal status, similar species, selected references and other comments. The introductory chapters of the book will include information on

threats, recovery strategies, the history of plant conservation in Texas, an ecological overview of the state and how to report new information.

To date, all species treatments and introductory chapters have been completed. The maps depicting the distribution of each species by county have been finished. Photographs have been obtained for almost all recently located species. Original illustrations have been produced for those species that are difficult to identify or for those that have not been photographed or illustrated previously. Species treatments and introductory chapters have been reviewed, and the draft manuscript will be presented to the publisher on March 1, 2005.

Funding for this research was provided in part by Section 6 Grant E-1-12 from the U.S. Fish and Wildlife Service Endangered Species Program.

Tobusch Fishhook Cactus Annual Monitoring and Assessment of Mortality

Jackie M. Poole, TPWD

The purpose of this study is to determine the long-term demographics of Tobusch fishhook cactus (*Sclerocactus brevihamatus var. tobuschii*) at several sites within the range, and to evaluate mortality, particularly the effect of the cactus weevil (*Gerstaeckeria* sp. nov.) on the Tobusch fishhook cactus. Tobusch fishhook cactus is a listed endangered species that occurs in seven counties in the southwestern portion of the Edwards Plateau.

Eighty-eight plots tracking approximately 2,000 individuals have been established at 12 sites scattered across the range of Tobusch fishhook cactus. Although most plots were established in 1996, several of these plots were established as early as 1991 and nine new plots were set up in 2003-2004. Populations are being monitored at six state parks and wildlife management areas, two highway rights-of-way and one private property. Most sites remained more or less stable, with mortalities balanced by recruitment. A significant new population of several hundred plants was discovered at Garner State Park on newly acquired property. A high level of mortality continued at Kickapoo Caverns State Park due to weevils and feral hogs. The population at Devil's Sinkhole State Natural Area remains low, still not recovering from a weevil infestation that cut the population from 1,100 to 25 individuals in five years.

Funding for this research was provided in part by Section 6 Grant E-1-12 from the U.S. Fish and Wildlife Service Endangered Species Program.

The Research and Recovery of Star Cactus (*Astrophytum asterias*)

Gena Janssen, Janssen Biological; Dr. Paula Williamson and Anna Strong, Texas State University; Jackie M. Poole, TPWD

Star cactus is one of the most rare and imperiled endangered cacti within Texas. Historically the species was known from Cameron, Hidalgo and Starr counties as well as northern Mexico, but now only two populations exist in Starr County, and six very small populations in adjacent Mexico. Habitat destruction and collection by cactus enthusiasts are the primary threats. The purpose of this study is to search for new populations, monitor existing populations to learn about life history, document habitat characteristics and determine reproductive biology strategies.

To date, star cactus has been discovered at five additional sites, and the population total now stands at close to 4,000 plants. Three monitoring plots have been established, and data on various life history aspects have been recorded monthly on approximately 117 individuals. So far recruitment has been noted, and no mortality has been recorded within the transects. Also no poaching has been noticed. Size class distribution is fairly even, although there are fewer individuals in the largest size class. Flowering occurs primarily from mid-March to early May, although occasional flowers were observed June through September. Flowering is directly correlated to plant size, with the smallest flowering individual being 3.5 cm in diameter. Slightly less than half of the flowers developed into fruits. Star cactus is an obligate outcrosser. Floral visitors included beetles, halictid and andrenid bees.

Future studies will include identification of suitable sites for reintroduction and continuation of the surveys, monitoring, habitat characterization and reproductive biology studies.

Funding for this project is provided in part by Section 6 grant E-46 from the U.S. Fish and Wildlife Service Endangered Species Program.

Texas Wild Rice (*Zizania texana*) Monitoring and Management

Jackie M. Poole and Sandy Birnbaum, TPWD

Texas wild rice grows only in the uppermost two miles of the San Marcos River, a uniquely clear and thermally constant river. This listed endangered perennial grass is primarily a submerged aquatic, but will occasionally flower and produce seed above water. Threatened by many factors, Texas wild rice also suffers from reduced genetic resources and loss of individuals to random events.

Historically, Texas wild rice was known from the upper San Marcos River, its irrigation canals, and Spring Lake (an impoundment at the spring headwaters). When the first distribution map was drawn in 1976, Texas wild rice was only found in the river itself, with surface coverage of 1132.5 m^2. During mid-1980s coverage dropped to a low of 412 m^2. In 1989, Texas Parks and Wildlife Department staff began annual monitoring and mapping of the distribution of the entire population. Individual stands (tangled masses of individual stems) are identified either by GPS or through a system of distance and bearing from witness points. The length, width, and percent vegetative cover of each stand are calculated, and the total of all stands added together by river segment and entire population. Coverage has been slowly increasing from 1989, with a high in 2003 of 2776 m^2. However coverage is becoming confined to the upper part of the river as the dramatic flood of fall 1998 destroyed most of the stands below I-35. Concentrating the population in an even smaller area makes the species more prone to extinction through chance events.

In addition to the annual monitoring and mapping, in 2003 Wildlife, Coastal and Inland Fisheries Division biologists began a monthly removal of floating vegetation mats that covered wild rice, blocking sunlight. The primarily non-native vegetation is removed and composted at the A.E. Wood State Fish Hatchery in San Marcos.

This project is funded by TPWD.

Texas Snowbell (*Strap platanifolius* ssp. texanus) Demography

Jackie M. Poole and Sandy Birnbaum, TPWD

Texas snowbells are long-lived, large shrubs that grow in gravelly intermittent streambeds and cracks, crevices and solution pockets in limestone boulders, ledges, and cliffs along the drainages of the Devils and upper Nueces rivers in Val Verde, Real and Edwards counties. At present there are 20 known natural populations, consisting of one to several hundred individuals. The entire population is less than 1,000 individuals. Attempts are underway to augment natural populations or introduce new populations in suitable habitat.

The primary threat to Texas snowbells is from browsing animals. Remnant populations along the Nueces River are relegated to inaccessible cliff faces, beyond the browsing reach. Some exclosure studies have shown that plants cannot establish in areas easily available to browsers. However the populations along the Devils River grow within easy access of browsing animals, yet do not seem to suffer the damage of the Nueces River populations. Camera trapping has shown aoudads within the Nueces River populations while only foxes and raccoons were seen at Devils River.

Two of the largest populations of Texas snowbells have been monitored for more than 10 years to determine and compare population demographics between browsed and unbrowsed populations. Individual plants are tagged, mapped and various measurements of vigor (height, stem diameter, number of stems, reproductive output, overall condition, disease and herbivory) are recorded.

Populations between the two sites are similar in age class composition and size, although some of the accessible Nueces River plants remain small in stature due to constant browsing. Both populations produce thousands of flowers and hundreds of seeds (reproductive output is about 50-60%). However recruitment at the Nueces River site is practically nil outside of the exclosures. Within the exclosures, recruitment rates are similar to those at Devil's River. Recruitment is extremely variable depending on timing and amount of annual precipitation. Also true recruitment (seedling establishment to reproductive adult) has not yet been observed, even in the 14-year-old exclosure plants.

This project is funded by the TPWD.

Status, Distribution and Conservation of Three Species of Rare Plants of the Lower Rio Grande in Mexico

Alberto Contreras Arquieta, Pronatura Noreste, A.C.; Jeff Weigel, The Nature Conservancy Northeast Mexico Program; Dana Price, TPWD

Pronatura Noreste biologists, in collaboration with the Nature Conservancy (TNC)'s Northeast Mexico Program, are examining the status and distribution of three U.S.-listed endangered plant species in Mexico. This project was initiated in 2002 with funding from the U.S. Fish and Wildlife (USFWS) Section 6 program, obtained through the Texas Parks and Wildlife Department (TPWD). The target species are *Ayenia limitaris* (Texas ayenia, family Sterculiaceae), *Lesquerella thamnophila* (Zapata bladderpod, family Brassicaceae) and *Manihot walkerae* (Walker's manioc, family Euphorbiaceae). Each of these species has been reported from Mexico, but their current status and distribution are unknown.

Field work on this three-year project began in spring 2003. Pronatura Noreste (PNE) biologist Alberto Contreras has visited over 200 field sites and collected over 300 plant specimens, many of them representing rare plants that are conservation targets for TNC's Tamaulipan Thornscrub Ecoregional Plan. Several joint field visits have been conducted on both sides of the border with PNE, TNC, TPWD, USFWS personnel and botanical colleagues. To date, only one of the target species (*Manihot walkerae*) has been found in Mexico at a previously known site. However, PNE discovered a new site for endangered star cactus (*Astrophytum asterias*) as well as new sites for several other rare plant species. This project will result in better understanding of the distribution and status of several species of interest in the U.S.-Mexico border region, and complements other projects being undertaken by TPWD and TNC on both sides of the border.

This project (WER89) is federally funded by Grant E-34.

Bracted Twistflower: Surveys, Monitoring and Reintroduction

Dana Price, Jeffrey Hershey, Lee Ann Linam and Wendy Connally, TPWD; Mary Ruth Holder, volunteer; Nancy Wooley, Friends of Bright Leaf; Pat McNeil, McNeil Growers; Flo Oxley, Lady Bird Johnson Wildflower Center; Charmaine Delmatier, U.S. Fish and Wildlife Service

Bracted twistflower (*Streptanthus bracteatus*) is a rare and beautiful annual mustard that is endemic to the Texas Hill Country. Although not yet listed as threatened or endangered, its rarity, proximity to urban development, and palatability to herbivores (particularly, white-tailed deer) make it highly imperiled. Populations fluctuate dramatically from year to year, making it difficult to track population trends or to understand the species' habitat and management needs.

Texas Parks and Wildlife Department staff began monitoring bracted twistflower populations at 10 sites in Travis, Bexar and Medina counties in the mid 1990s. Staff and volunteers realized that the bracted twistflower was in trouble in Travis County due to development and browsing activities. At the urging of volunteers, a larger group called "Friends of Streptanthus" began meeting in 2001.

"Friends of Streptanthus" is comprised of volunteers, TPWD staff, and representatives from the City of Austin, Travis County, the LCRA, the Lady Bird Johnson Wildflower Center, the U.S. Fish and Wildlife Service, and The

Nature Conservancy. In addition to continuing to monitor all previously known and accessible sites, the group has trained new volunteers, conducted searches for new populations on public land, and made contact with landowners. Seed has been collected and banked to safeguard against loss of populations and to use in future reintroduction projects. At least one population on private land has been fenced to prevent browsing by deer.

The group is currently working on a conservation and reintroduction plan for bracted twistflower. To offset the loss of Austin-area populations to development, we plan to reintroduce bracted twistflower to suitable sites on public land and on the properties of interested private landowners. Bracted twistflower's habitat requirements are not completely known, so we are mapping the known sites onto detailed geologic maps using GIS to detect patterns in the species' distribution. We are currently seeking funding for soil testing and germination studies to aid in identification of sites and methods for reintroduction.

This project is supported by TPWD and the collaborating agencies and individuals named above.

Zapata Bladderpod Surveys and Monitoring

Dana Price, TPWD; Chris Best, Lower Rio Grande Valley National Wildlife Refuge

Zapata bladderpod (*Lesquerella thamnophila*), a wildflower in the mustard family, is found only in Starr and Zapata counties in the Lower Rio Grande Valley. It was listed as Endangered in 1999. Like other species in its genus, Zapata bladderpod is named for its small, round fruits that are inflated like tiny bladders. Zapata bladderpod is a short-lived perennial whose populations fluctuate greatly in response to rainfall, making it difficult to determine population trends and management needs for the species.

TPWD personnel began making observations of Zapata bladderpod in the early 1990s at the six sites to which we had access. Detailed monitoring was initiated at the Cuellar tract of the Lower Rio Grande Valley National Wildlife Refuge (LRGV NWR) in 2002. The previous year, TPWD and LRGV NWR staff had observed a dramatic increase in the bladderpod population in part of this tract where brush was cut with a Woodgator. We established permanent monitoring plots in the area so we could document changes over time following this management practice. We have added a site to the monitoring program each year. Observations at these sites have led to searches in similar areas and two new populations have been discovered. Attempts to relocate a historical site in Mexico have been unsuccessful to date (see "Status, distribution and conservation of three species of rare plants of the Lower Rio Grande in Mexico").

Goals for this project are to track population fluctuations at four sites, to characterize the vegetation at each of these sites, and to create GIS maps of Zapata bladderpod distribution. If additional funding and time becomes available we will study the soils and geology of known sites, all of which appear to be underlain by a particular sandstone formation. Another research need is to study the effects of management practices on Zapata bladderpod.

This project is supported by TPWD and LRGV NWR.

The Lower Rio Grande Valley Plant Candidate Conservation Project

Dana Price, TPWD; Gena Janssen, Janssen Biological; Lisa Williams, The Nature Conservancy of Texas

The Lower Rio Grande Valley of Texas and adjacent Mexico is an area of high biodiversity confronted by rapid human population growth and development. The five-county area along the Lower Rio Grande River between Brownsville and Laredo, Texas, contains 12 unlisted, imperiled plant species that are primarily restricted in range to the lower Valley and adjacent Mexico. In addition to these potential candidates for listing as threatened or endangered, six federally-listed endangered plant species are restricted to the Lower Rio Grande Valley. Rapid development in the Lower Rio Grande Valley makes conservation of rare plant species and communities an urgent priority. The increasing pressures of urbanization and associated introduction of exotic species pose short- and long-term threats to rare species and their habitats as land-use practices change.

In 2002, TPWD received a Section 6 grant to conduct private-lands outreach with the goal of conserving the LRGV's rare plant species that are potential candidates for listing as threatened or endangered. The Nature Conservancy and Janssen Biological were contracted to conduct landowner outreach and surveys, and when possible, to obtain conservation agreements from landowners.

Initial workshops for botanists on both sides of the border, resulted in the sharing of information and collaboration between Texas and Mexican botanists. TNC and Janssen worked with private landowners to conduct surveys for rare plants. Numerous new populations of rare plants, including listed endangered species, have been discovered. Thirty landowners are currently considering the possibility of entering into a CCA with the Texas Parks and Wildlife Department. If all agreements are signed, they will protect nine rare species and five listed species.

Cooperation with landowners will result in improved continuity of appropriately managed sites along the corridor adjacent to the Lower Rio Grande River. By working with private landowners we are finding a great deal of local interest and involvement in the conservation of native flora and fauna.

This project (WER80) is funded by federal grant E-28.

Reptiles

Alligators

Composition of Prey Consumed by American Alligators Along the Upper and Central Coasts of Texas

K.J. Lodrigue, Jr., Marc Ealy, Amos Cooper and Monique Slaughter, TPWD; Tim Scott, Texas A&M University

American alligators are known to play extremely important roles in the coastal ecosystems; however, higher than desired population densities may result in a reduction of game and non-game prey. Very little is known about waterfowl and amphibian predation by American alligators. Because American alligators are known to vary their diet according to age, size, and habitat, it is important to consider size class and collection site in any food study. Further research is required on Texas coastal populations on American alligators before American alligator harvest levels can be established in a management plan that conserves all of the available natural resources at a sustainable level.

Study objectives were to determine: (1) the prey base by American alligator size class; (2) the occurrence of mottled ducks and pig frogs in the stomach contents of American alligators and (3) if the prey types consumed by various size classes were correlated with habitat type or other environmental factors.

Stomach contents of live juvenile (£1.4 m), subadult (1.4-1.8 m), and adult (1.8-2.3 m) American alligators are lavaged soon after capture by forcing water into the stomach and applying abdominal compression to stimulate regurgitation. The mouth is held open during this process by inserting and securing PVC tubes of appropriate size. To evaluate the accuracy of our techniques, American alligators that are to be lethally removed by a nuisance control hunter will be lavaged before euthanasia. After euthanasia, the stomach will be removed to determine what, if any, contents were left in the stomach. Additionally, stomach contents from a maximum 105 harvested American alligators from the J. D. Murphree, Mad Island and Guadalupe Delta Wildlife Management Areas will be collected annually.

Stomach contents will be stored until identified, counted and weighed. Final analysis of stomach contents will be based on frequency of occurrence. All captured individuals are permanently marked for identification in case of recapture. Individuals will not be sampled more than once per month.

This project is funded by TPWD and Texas A&M University.

Inland Alligator Habitat Parameters and Growth Rates

Keith Webb and Dr. Warren Conway, Stephen F. Austin State University; Gary Calkins, Joel Casto and Robert Baker, TPWD

Information is lacking regarding the natural history and habitat requirements of inland populations of the American alligator (*Alligator mississippiensis*) throughout their range in North America. States with inland populations have resorted to management using coastal population information and extrapolations. Florida, Louisiana and Texas all hunt inland populations using a variety of methods to determine harvest quotas, with inadequate supporting research. If populations are to be managed and surplus alligators harvested from these populations, harvest quotas based on information derived from inland populations is essential.

Fieldwork for this project commenced in 2003. The purpose of this research is to: establish a reliable density estimator for inland populations, determine inland habitat suitability indices, determine growth rate parameters, establish pod dispersal distances and variables, determine dispersal patterns of relocated nuisance alligators, determine home range parameters of radio-implanted females and establish an improved inland alligator harvest quota formula.

During 2003, fifteen night counts were conducted resulting in the observation of 299 alligators. Each alligator observed was estimated for total length using eye/nare length. Buoys were released at each observation point to facilitate habitat measurements the following day. Alligator locations netted 258 habitat measurements. An additional 505 random locations and 409 macro-habitat locations were evaluated. Additionally, perpendicular distances from the observers were recorded approximately every two minutes during the night count to determine acreage observed.

A total of 130 alligators was captured utilizing hand grab (51), walk in traps (37), snake tongs (25), pole snares (15) and dowel rods (2). Several measurements were taken and each animal was identified by unique tail scute removal. Animals were then released at the capture location to facilitate growth rate measurements and population estimators through recapture.

One nuisance alligator was fitted with a radio transmitter to evaluate movement of relocated nuisance animals. The animal was tracked for approximately a month before contact was lost. Fieldwork will continue through the summer of 2004 with a final report due in 2005.

Funding for this project is through TPWD, State Wildlife Grants and Stephen F. Austin State University.

Distribution and Growth of American Alligators in a Texas Coastal Marsh

Todd Merendino, G. Matt Nelson, Kevin. H. Kriegel and Marc J. Ealy, TPWD

We examined growth rates and movements of American alligators (*Alligator mississippiensis*) in a Texas coastal marsh. Study objectives were to: 1) determine growth rates for American alligators, 2) assess movements and habitat use along a salinity gradient and 3) provide habitat management recommendations.

From 1994 to 2004, we have captured and marked 1,080 alligators, ranging in size from 0.4-3.4 m (1.25-11.0 ft). Two-hundred and forty alligators have been recaptured. Overall growth rate of all recaptures was 13.3 cm/yr (5.2 inches/year). Using data from 58 alligators re-captured >3 growing seasons from initial capture, growth was about 15.4 cm/year (6 inches/year).

Most alligators were captured at the fresher sites along the salinity gradient; in fact, most were captured within one or two lakes on the study area. Most were recaptured in close proximity to the initial capture site. During times of heavy rainfall or run-off, alligators are seen throughout most of the study area. Of note, one alligator recaptured in 1999 was recaptured within about 50 yards of the initial 1994 capture site!

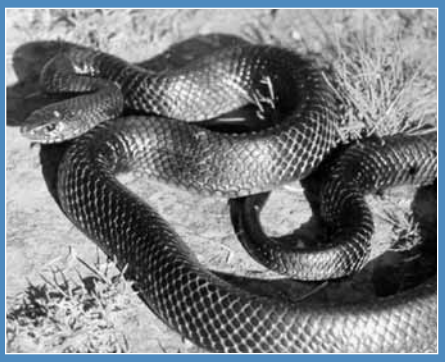
The importance of this information is that alligators may be somewhat habitat limited to fresher sites along the Texas Coast. As degradation of coastal marshes continues, most notably due to saltwater intrusion, alligators may be forced into more inland habitats such as creeks and ditches and become further concentrated into shrinking habitats. These high concentrations of alligators may then in turn begin to affect population levels of other organisms such as furbearers, breeding ducks, etc.

We propose to continue this study through summer 2006.

Snakes

Influences of Land Use Practices on the Texas Indigo Snake

Todd Y. Montandon and Richard T. Kazmaier, West Texas A&M University; Donald C. Ruthven, III, TPWD; David G. Hewitt, Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville



The western Rio Grande Plains is a biologically diverse ecoregion within Texas that has been subjected to extensive manipulation via grazing, burning and brush manipulation. Knowledge of the impacts of land use practices on populations of rare or protected taxa is essential for their management. Texas indigo snakes (*Drymarchon corais erebennus*) are listed as state threatened. Although never critically evaluated, anecdotal observations suggest indigo snakes require ready access to free water or moist conditions.

We seek to expand our knowledge of Texas indigo snake ecology by conducting a radiotelemetry study at the Chaparral Wildlife Management Area (CWMA). Our specific objectives are to (1) measure home range, activity, and movement patterns of indigo snakes; (2) address the relationship between indigo snakes and free water in the semiarid western Rio Grande Plains and (3) assess habitat selection by Texas indigo snakes in the mosaic of grazed, burned and brush manipulated treatments found on CWMA.

We have collected sufficient data for home range and movement analyses from 14 individuals (>3,500 radiolocations). Indigo snakes were highly mobile, and movements >1 km (0.62 mi) within 24 hours were not uncommon. Adult male home ranges averaged 212 ha (524 ac), but exceeded 300 ha (741 ac) in several individuals. Adult female home ranges averaged 88 ha (217 ac). One juvenile female produced a home range of >500 ha (1,235 ac) in less than a year, possibly resulting from dispersal movements. Indigo snakes were active in all months, but activity seemed to increase in cooler and more humid periods. Radiotransmittered snakes did not demonstrate a preference for areas with permanent water. Examination of habitat selection revealed a preference for habitats dominated by a continuum of parkland to woodland thornscrub. Likewise, indigo snakes exhibited a strong avoidance of areas were brush removal via aeration had occurred. In general, it appears that maintenance of large blocks of thornscrub is important for the persistence of this species in the western Rio Grande Plains.

This project is continuing and will increase our understanding of Texas indigo snake ecology and provide knowledge to help land managers understand the influence of land-use practices.

Funding for this research was provided by TPWD (Region IV, South Texas Research Fund, State Wildlife Grant, Conservation Action Grant) and Mr. Jack Cato.

Ecology of Canebrake Rattlesnake at Richland Creek Wildlife Management Area

John G. Himes and Hayden Haucke, TPWD

The timber, or canebrake rattlesnake (*Crotalus horridus*), is a state-threatened species in Texas, where it is vulnerable to habitat loss, as well as to direct human persecution (i.e., illegal killing). In Texas, this snake is associated primarily with riparian bottomland forests in the eastern half of the state. However, snakes may move over large areas and utilize multiple habitat types over the course of the year. The ecological requirements of this species have not been well established in Texas. Thus, the primary objectives of this study are to determine activity patterns (and the associated utilization of home ranges) and habitat usage (and the associated human land uses and management of the different habitats utilized by the snakes), and to assess reproductive phenology (as opportunity permits).

This study will be conducted on a population of timber rattlesnakes inhabiting a bottomland forest along the Trinity River (Richland Creek Wildlife Management Area [RCWMA], Freestone County). Beginning in 2005, snakes will be captured, implanted with a subcutaneous radiotransmitter, and released at their capture site. Movements and locations will be regularly monitored (a minimum of once per week) by telemetry for at least one activity season. The location (UTMs), activity, macrohabitat and microhabitat variables, and weather conditions will be recorded.

By determining activity patterns and establishing home range characteristics (i.e., size, shape, habitats included, etc.) of timber rattlesnakes, the minimum spatial requirements will be better established. The RCWMA has been subjected to various land use practices (i.e., logging, fire, wetlands restoration, etc.) in the past and present, and thus the snakes have available several types of macro- and microhabitats. By determining the macro- and microhabitats utilized by snakes on a seasonal basis, private landowners and land use managers in East Texas will be able to better determine the types of land use practices that are most compatible with the snakes' habitat requirements.

This project will be a cooperative effort between TPWD, United States Forest Service and University of Texas in Tyler.

Determination of the Status of the Louisiana Pine Snake (*Pituophis ruthveni*)

D. Craig Rudolph, Richard N. Conner and Richard R. Schaefer, USDA Forest Service, Southern Research Station; Ricky W. Maxey, TPWD

The Louisiana pine snake (*Pituophis ruthveni*) is one of the rarest terrestrial vertebrates in the U.S., and is state-listed as threatened in Texas, but has received no similar protection in Louisiana. During this, and previous trapping efforts prior to 1999, it has been documented on southern portions of the Angelina and Sabine National Forests, and on private lands in northern Newton County.

This species' distribution is confined to well-drained, sandy soils generally in association with longleaf pine (*Pinus palustris*) throughout its limited range in eastern Texas and western Louisiana. Remnant populations occur in habitats that still experience a fire regime characterized by frequent low-intensity fires. Fire maintains an open midstory and abundant herbaceous vegetation in the understory, that supports Baird's pocket gopher (*Geomys breviceps*) populations, the primary prey species of Louisiana pine snakes.

In 2004, approximately 9,320 trap days were concentrated on areas of suitable habitat in Angelina, Newton, Sabine and Tyler Counties that are not currently known to be occupied by Louisiana pine snakes. No Louisiana pine snakes were captured.

To date the Louisiana pine snake is a rare species, and is currently confined to a total of six general areas of Louisiana and Texas. These areas contain from a few hundred to several thousand hectares of potential habitat, but represent only a small portion of the original range of the species. Continued survival of this species will, to a large extent, be dependent on the management of the currently known populations. Intensive management of the currently occupied habitat, especially using prescribed fire, will be required to insure the continued viability of these populations.

Food Habits of the Texas Indigo Snake

Richard T. Kazmaier and Todd Y. Montandon, West Texas A&M University; David G. Hewitt, Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville; Donald C. Ruthven, III, TPWD

The Texas indigo snake (*Drymarchon corais erebennus*) is a large, diurnal snake whose geographic range in the United States is limited to the South Texas and Lower Coastal Plains ecosystems in Texas. Indigo snakes are well known for their consumption of rattlesnakes and other snakes. Predation by indigo snakes could influence populations of other wildlife. Our objectives are to describe the diet of Texas indigo snakes and compare diet composition between snakes in the eastern and western portions of the South Texas Plains.

We collected fecal samples and regurgitated foods from indigo snakes caught during other research activities. Contents were identified to the lowest taxonomic order possible by examine samples under a microscope and comparing morphology of diet fragments (especially hair and scales) to voucher specimens. Currently, 24 samples from Kingsville and 19 samples from Chaparral WMA have been analyzed. Prominent species included western diamondback rattlesnake (*Crotalus atrox*), Texas horned lizard (*Phrynosoma cornutum*), Texas spiny lizard (*Sceloporus olivaceus*), coachwhip (*Masticophis flagellum*), cottontail (*Sylvilagus* spp.), Southern Plains woodrat (*Neotoma micropus*), hispid cotton rat (*Sigmodon hispidus*) and large wolf spiders (*Lycosidae*). When grouped into major taxonomic categories (mammals, reptiles, invertebrates, etc.), the proportion of snakes consuming these items did not differ between regions. Texas horned lizards were found in nearly 60% of samples from both regions, but western diamondback rattlesnakes were much more common in the diet at Chaparral WMA (>50% of samples) than Kingsville (<20% of samples). Approximately 55% of samples from both regions contained cottontail and 30% of samples from both regions contained Southern Plains woodrat. Invertebrates were quite common in samples (72% overall), but in some cases it was difficult to determine whether these items represented primary consumption or incidental consumption. However, we speculate that some of the invertebrate remains represent primary consumption. Adult collared peccary (*Tayassu tajacu*) hair in one sample suggests that indigo snakes may engage in scavenging.

This project should increase our understanding of Texas indigo snake ecology and help define its interactions with other species on southern Texas rangelands. This study will also provide data and ideas to stimulate additional research projects.

Ecology of the Western Diamondback Rattlesnake in a Managed Thornscrub Community

Richard T. Kazmaier, West Texas A&M University; Donald C. Ruthven, III, TPWD

Western diamondback rattlesnakes (*Crotalus atrox*) are commonly targeted by numerous rattlesnake roundups within the state, yet little information is available on the ecology of this species within Texas. This is particularly true for populations in the Rio Grande Plains of southern Texas. Although roundups annually remove significant numbers from various populations, our lack of information on the ecology of this species makes it difficult for researchers and managers to predict the possible impacts of these removals on wild populations.

Our objective was to establish a long-term monitoring and radiotelemetry project at a site unimpacted by rattlesnake roundup activity in order to establish a baseline dataset for comparisons with impacted sites in the future. Our work is being conducted on Chaparral Wildlife Management Area (WMA) in Dimmit and LaSalle counties, Texas. All rattlesnakes encountered are being captured and uniquely marked using passive integrated transponders. Individuals are measured, weighed and sexed. Rattle measurements are also taken. Recaptures will allow us to measure growth and shedding frequencies. A subset of individuals is being outfitted with radiotransmitters implanted interabdominally to study movements and habitat selection.

Sixteen rattlesnakes have been implanted with radiotransmitters and monitored for > 2,000 radiolocations. Home ranges have been larger for males [mean = 22 ha (54 ac)] than females [mean = 8 ha (20 ac)]. From 1996-2003, we have captured 883 individuals. Males averaged 1080 mm (42 inches) snout-vent length and females averaged 924 mm (36 inches) snout-vent length. Snakes were captured in all months of the year, but appear to be most active in March through May. The observed sex ratio is 2.5 M:1F, but this male bias may be the result of the larger home ranges and greater movements of the males. Preliminary data suggests adults grow slowly and shed only once a year. Rattlesnakes on Chaparral WMA tend to use areas with pronounced woody cover, with >86% of radiolocations being either under woody canopy or in Southern Plains woodrat (*Neotoma micropus*) middens.

Information derived from radiotelemetry should help us determine movements, habitat selection, the impacts of land management practices, and reproductive behavior. Through mark-recapture, we should be able to obtain information on growth and demography. Collectively, these data should help us to make wise management decisions for this species.

Funding provided by TPWD.

Other Critters

Activity Patterns and Metabolic Rates of Male Tarantulas during the Mating Season

Todd B. Stoltey and Cara Shillington, Eastern Michigan University;
James F. Gallagher, TPWD

Despite their large size and general notoriety, tarantulas (*Aphonopelma anax*) remain a poorly-studied group of animals, especially within their natural environment. Females remain within close proximity to their retreats throughout their entire lives (~20) years and typically reach sexual maturity between 7-8 years. In contrast, males are short lived and, once they reach sexual maturity (~ 6 years of age) they abandon their retreats and search actively for females during the summer mating season. Our study provides an excellent opportunity to investigate the life history and ecology of tarantulas. These much-needed data will allow better analyses of the relative costs of reproduction, which will in turn provide new insight into the evolution and ecology of mating systems.

Our research focused on male tarantulas located on the Chaparral Wildlife Management Area in Dimmit and La Salle counties in Texas. At this site, sexually mature males actively search for females from May to July. For males, reproductive success is likely contingent upon the rate and distance an individual can search during the mating season. Metabolic rate and movement patterns can directly affect locomotory performance. Our specific objectives were: 1) to determine if there is a correlation between metabolic rates and distance traveled by individual males, and 2) to investigate differences in locomotory patterns among males. We hypothesize that males with higher metabolic rates will be more active and travel greater distances, and thus be more likely to find females.

Beginning in May 2004, 40 active males were captured. Metabolic rate, weight, carapace length and tibia length were measured at this time to estimate body condition. Radio transmitters were attached to 16 individuals to monitor daily movement patterns. Metabolic measurements were repeated every 10 days for these tagged individuals for as long as they were alive. Preliminary data suggest that mortality rates can be very high for active males. Six of the sixteen males were paralyzed and buried by tarantula hawk wasps (*Pepsis* spp.).

Distances traveled ranged from 6-106 meters/day. One individual traveled 1,600 meters over 19 days before being paralyzed and buried by a tarantula hawk wasp. Another male was tracked for 31 days and only moved 700 meters. The average for all 16 males was 46 meters/day.

Partial funding for this project was provided by Eastern Michigan University. We thank TPWD and the Chaparral Wildlife Management Area for providing housing and access to facilities onsite.

Seasonal Changes in Plasma Calcium and Bone Dynamics of the Texas Tortoise

Matt Stone and Eric Hellgren, Oklahoma State University; Richard T. Kazmaier, West Texas A&M University; James F. Gallagher, TPWD

Turtles are a remarkably successful group of vertebrates that owe their success partially to their heavily calcified bony shell that offers increased protection from predation. The large demand of calcium required for their bony armor may place restrictions on availability of calcium; however, a robust bony skeleton offers a substantial reserve of calcium in times of high demand (e.g. reproduction). Although calcium investment into egg production may hamper a female's calcium status, few studies have investigated the importance of reproduction on bone density in turtles.

The Texas tortoise (*Gopherus berlandieri*) has a relatively thin shell and the implications of a small reserve of calcium to a female's ability to invest calcium into offspring have not been studied. Long-term investment of calcium into offspring could lead to reduced bone density in adult females and could reduce survival in older individuals. A previous study has documented a female-biased incidence of bone perforations in the carapace that could be related to a calcium deficiency. Therefore it is important to understand the dynamics of calcium regulation in this state-threatened reptile.

We are investigating changes in blood calcium in Texas tortoises as it relates to seasonal and lifetime changes in reproduction to address the effects of reproduction on female calcium status. We are measuring seasonal changes in plasma calcium in relation to sex, age and reproductive status. Additionally, this study will be evaluating changes in bone growth and remodeling based upon hormonal assays of urine biochemicals.

Texas tortoises were collected while crossing roads at the Chaparral Wildlife Management Area. Morphometric, age and location data were collected from all individuals. Additionally, blood and urine samples were collected from select tortoises. Reproductive status was determined when possible with a portable ultrasound scanner. A total of 152 Texas tortoises were collected for use in this study. A total of 20 (6M:13F:1J) tortoises were repeatedly captured and sampled for blood and urine using radiotelemetry. Approximately 120 blood samples and 110 urine samples were collected during May through August 2004. Results from the determination of plasma calcium and urine hormones are still pending.

This project was supported by grants from the Chelonian Research Foundation and Southwestern Association of Naturalists.

Texas Nature Trackers: A Citizen-Based Volunteer Monitoring Program

Lee Ann Linam and Marsha May Reimer, TPWD

In 1992 TPWD began developing a strategy for monitoring Species of Concern (then Candidate Species) using citizen volunteers. Several statewide and site-specific projects are now offered under the umbrella of Texas Nature Trackers (TNT).

Statewide projects include Texas Horned Lizard Watch, Texas Mussel Watch and Texas Amphibian Watch. In seven years 164 volunteers have collected data on Texas Horned Lizards (*Phrynosoma cornutum*), at nearly 250 sites in 151 counties.

Data have helped to document the current distribution of the species and to show a relationship (Cochran-correct chi-square; a<=0.001) between presence of the red imported fire ant (*Solenopsis invicta*) and the absence of horned lizards.

Since its inception in 1997, Texas Mussel Watch, through statewide workshops, has trained over 140 volunteer mussel monitors. Volunteers have documented four new records for mussel species; Texas lilliput (*Toxolasma texasiensis*) and tapered pondhorn (*Uniomerus declivis*) not previously found in Austin County, rare golden orb (*Quadrula aurea*) in the San Marcos River, rare sandbank pocketbook (Lampsilis satura) in the Neches River and live, rare Texas fawnsfoot (*Truncilla macrodon*) in the Brazos River. The presence of Asian clams (*Corbicula fluminea*) has not been recorded in many Texas counties. The U.S. Geological Survey is currently collecting the county records on this species. Texas Mussel Watch volunteers have added a few new counties to this list.

Since 1999, about 300 volunteers have been trained at Texas Amphibian Watch workshops. Volunteers conduct amphibian monitoring at sites they select, or conduct surveys on routes established by the North American Amphibian Monitoring Program. Data have been received from 56 counties. Volunteer data have revealed an upward trend for one widely-introduced species, the Rio Grande chirping frog (*Syrrhophus cystignathoides*), while indicating stable trends for most other species of frogs and toads.

Other programs under the TNT umbrella include Texas Hummingbird Round-up, Texas Monarch Watch, Project Prairie Birds and Midwinter Bald Eagle Survey.

Funding for these projects is provided by TPWD with partial funding provided by Section 6 of the U.S. Endangered Species Act.

Ecology of the Houston Toad

Andrew Price, TPWD

The Houston Toad (*Bufo houstonensis*), a small member of the Bufo americanus species group endemic to East-Central Texas, has resided longer on state, national, and international endangered species lists than most other taxa. This species disappeared from most of its historically known range following its discovery in the Houston, Texas, area after World War II. It was known from only a single locality during the three decades prior to 1990. Surveys by Texas Parks and Wildlife Department personnel and associates have resulted in the discovery of new populations in nine counties in Central Texas. This species is restricted to deep sandy soils supporting ephemeral wetlands within native post oak/loblolly pine woodlands and savannas that have been subjected to minimal landscape-scale disturbance. Except for two sites, nothing is known about the demographics of the newly-discovered populations. The most robust population known still resides in Bastrop County.

More than 3,000 adult Houston Toads have been marked with PIT tags in one watershed within Bastrop State Park from 1990-2004. Breeding choruses of up to 200 individuals form under specific climatic conditions over one-four nights during February and early March, separated by intervals of several days to several weeks. Individual females are rarely recaptured during the same breeding season, whereas males have been recaptured as often as 22 times in one year. Maximum longevity appears to be six years for males and five years for females. Individual toads have been recorded traveling distances of up to 1.3 km during the breeding season.

Regional climatic regimes have a profound effect upon Houston Toad recruitment and survivorship, compounded by the current fragmented status of the species' populations. These data provide the scientific foundation for ongoing community efforts to implement a Habitat Conservation Plan for the Houston Toad in Bastrop County as provided under the U.S. Endangered Species Act.

Regional Variation in Demography of Texas Horned Lizards: Implications for Conservation and Management

Richard T. Kazmaier, West Texas A&M University; Donald C. Ruthven, III, TPWD

Demographic variables provide insight into many of the processes that can cause population growth or decline and provide opportunities to address management needs for any species. Likewise, recommendations developed for the management of a species on one area may not be applicable to another area if regional variation in demography exists. We are beginning to examine variation in demography of Texas horned lizards (*Phrynosoma cornutum*), state-threatened since 1967, throughout Texas in an attempt to elucidate variability in this species of conservation concern.

Sufficient data have been collected from two sites to allow some preliminary comparisons of demography. Samples used in these analyses were obtained from Chaparral Wildlife Management Area (WMA) in Dimmit and La Salle counties (3,367 individuals, 1992-2003) and Matador WMA in Cottle County (260 individuals, 2004). Size dimorphism indices (SDI) indicated females are larger than males on both sites. Horned lizards on Chaparral WMA were much larger than on Matador WMA. However, SDI did not vary between sites. Males appear to mature at smaller sizes at Matador WMA relative to Chaparral WMA. Because clutch size is often related to body size, these data suggest that the more northern populations of horned lizards probably have smaller clutch sizes than southern populations. Additionally, longer growing seasons in southern populations make the probability of multiple clutching higher relative to more northern populations. These differences in demography suggest that more southern populations may be better able to respond to perturbations or management practices, but concomitant measures of survival are needed to examine if demographic trade-offs are occurring.

This is intended to be a long-term project and data collection continues. In 2005, we will begin to collect data on at least seven additional populations in Texas, with the intent to add many more. Examination of variation in reproduction and survival will also be possible with the expansion of radiotelemetry-based studies on some of these additional sites.

Effects of Fire and Grazing on the Ecology of the Texas Horned Lizard in South Texas

Richard T. Kazmaier and Jeremy S. Lane, West Texas A&M University; Donald C. Ruthven, III, TPWD; Eric C. Hellgren, Beth A. Moeller and Anna L. Burrow, Oklahoma State University

Little information is available to evaluate ecological effects of land uses such as grazing and burning on herpetofauna in general and the Texas horned lizard (*Phrynosoma cornutum*) in particular. Protected by Texas legislative mandate in 1967, the horned lizard has experienced apparent declines throughout its range, but particularly in Texas. We are studying the effects of livestock grazing and prescribed burning on horned lizards (range size, habitat preferences and population parameters).

The study area is the Chaparral Wildlife Management Area (WMA), a site of relatively high horned lizard abundance in southern Texas. Horned lizards were captured by hand during fortuitous encounters on roads and in the brush. Selected individuals are fitted with radio transmitters. From 1998-2001, our intent was to examine the interaction between heavy or moderate grazing with winter burning. Our more recent focus (2002-2005) has shifted to address seasonality of burning (winter, summer, non-burned). This is being accomplished by placing transmitters on individuals in each of four treatments: non-grazed/non-burned, grazed/non-burned, grazed/winter burned and

grazed/summer burned. Grazing for this current focus consisted of a short duration rotational system from October to May using a moderate stocking rate. Range size, habitat selection and survival rates of radioed individuals will be compared among treatments. Surveys were also conducted to determine activities of the predominant food of horned lizards (= harvester ants; *Pogonomyrmex rugosus*) between treatments. Harvester ant activity was estimated using stations baited with millet.

For the entire study, >200 lizards have been monitored for >11,000 radiolocations. Home ranges were not affected by grazing treatment, but tended to be smaller in summer burned sites relative to non-burned or winter burned sites. Horned lizards had shorter average movement distances in the summer burned treatment compared to the winter burned or non-burned sites. Survival rates were lowest in heavily grazed sites and highest in non-grazed sites. Survival estimates for the summer burned treatments are forthcoming, but survival rates between non-burned and winter burned areas were not different. In general, ant activity increased with grazing intensity. Additionally, ant activity was 3-5 times greater on burned sites relative to non-burned sites; however, there was no difference in ant activity between winter and summer burning. These data suggest that some level of grazing and burning is beneficial for the management of Texas horned lizards in the western Rio Grande Plains.

Funding for this project was provided by the Wildlife Diversity Program and the South Texas Research Fund of TPWD, the Wells Texas Foundation, and the Rob and Bessie Welder Wildlife Foundation.

Long-term Assessment of Demography for a Texas Tortoise Population

Richard T. Kazmaier, West Texas A&M University; Donald C. Ruthven, III, TPWD; Eric C. Hellgren, Oklahoma State University

The Texas tortoise (*Gopherus berlandieri*) is the smallest, and most sexually dimorphic of the North American tortoises. In the United States, Texas tortoises are primarily restricted to southern Texas, generally south of a line from Del Rio to San Antonio to Aransas National Wildlife Refuge. In this region, they inhabit mesquite (*Prosopis glandulosa*)-acacia (*Acacia* spp.) thornscrub habitats of the Rio Grande Plains Ecoregion and coastal prairie habitats down to the thornscrub habitats of the Lower Rio Grande Valley. This testudinid was listed as state-threatened by Texas Parks and Wildlife Department in 1967, but it continues to be the least well-studied of the North American Gopherus.

We initiated a long-term demographic study on Texas tortoises in 1994 at Chaparral Wildlife Management Area (WMA) in Dimmit and La Salle counties, Texas, to begin collection of the basic ecology and life history data necessary to allow the formulation of better management plans for this poorly known, but protected species. Tortoises were captured via road cruising and fortuitous encounters during other activities on the WMA. Body size was measured as straight-line carapace length using dial calipers, tortoises were sexed using sexually dimorphic criteria, individually marked using a scute notching system, and released at the site of capture. Additionally, we assessed age by counting growth lines on the shell (= scute annuli). This technique requires that tortoises add one annulus per year to their scutes, and 10 years of recapture data support this hypothesis for the population at Chaparral WMA.

As of September 2003, we collected data from 2,489 captures of 1,807 individuals. Adult sex ratio was not different from 1:1 and juveniles consistently comprise about 35% of the individuals captured annually. Sexual maturity is reached in five-six years and average clutch size is two. Annual adult survival rates ranged 73-79% for females and 79-83% for males, depending on method of calculation. Texas tortoises appear to have adopted a strategy of rapid growth and early maturity to compensate for these relatively high mortality rates. Thus, Texas tortoises have assumed a more r-selected ecological strategy compared to the other North American tortoises and should be managed accordingly.

Wildlife Habitats

Hydrogeomorphic Assessment and Evaluation of Andrew's Bog, Gus Engeling Wildlife Management Area

Carol Thompson, Tarleton State University; John G. Himes, TPWD

The Texas Wetlands Conservation Plan recommends developing a regionalized hydrogeomorphic assessment method to track wetland quantity and quality change through time. This method would be used to assess long-term restoration project success and to determine the effect of management practices.

To implement such a system, it is necessary to collect information on a number of wetland sites and types in East Texas. A study was begun in late 2003 at Gus Engeling WMA (Anderson County). The objectives of this study are to define the hydrology of hillslope bogs on Gus Engeling WMA. Within that goal there are several specific objectives, including determination of the hydrogeomorphic setting, and the age and geologic history of these hillslope bogs.

Andrew's Bog, a large muck wetland, was selected for detailed study. Topographic surveys and coring have allowed the stratigraphic setting to be reconstructed. The larger site is a combination hillside seep possibly grading into an old oxbow. The muck varies in thickness and character. Radiocarbon results from the bottom of two cores show that organic materials began to accumulate about 19,000-20,000 years before present during the Full Glacial period when it would have been moister and cooler. Wells were installed late in 2003 and instrumented for continuous water levels. The water levels in the peat wells are very stable as expected in groundwater-fed wetlands. Wells will be monitored through late spring 2005. A reconnaissance of other sites in close proximity to Andrew's Bog in winter 2004 showed that seep areas occur around the edges of most sites, while in the interior of some of the sites there are mounds present, which represent areas of groundwater upwelling. Further investigation of some of these sites is warranted.

This project is funded by Tarleton State University.

Long-term Effects of Rootplowing on Vegetation and Non-game Wildlife in the Western South Texas Plains

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Of the various mechanical treatments developed to reduce woody plant cover and increase herbaceous cover in South Texas, root plowing is the most effective at controlling woody vegetation. Little data is available on the response of non-game wildlife to reduction in woody plant diversity as a result of root plowing. A better understanding of the long-term impacts of mechanical brush management practices on nongame wildlife is essential to address future management of previously treated rangelands. The objective of this study is to investigate the long-term effects of root plowing on vegetation and nongame wildlife communities in the western South Texas Plains.

The study area is on Chaparral Wildlife Management Area in Dimmit and LaSalle counties, Texas. Vegetation is dominated by mesquite (*Prosopis glandulosa*)-mixed brush communities characteristic of the South Texas Plains. Five sites root plowed in 1965 and five non-treated sites were selected for study. In contrast to previous studies, beta diversity, species richness, Shannon's diversity index and evenness were similar ($P > 0.05$) on nontreated areas than root-plowed areas for herbaceous and woody vegetation. Overall woody canopy cover was similar ($P = 0.681$) on nontreated (20 ± 4%) and root-plowed (18 ± 5%) areas. Canopy cover of herbaceous vegetation was also similar ($P = 0.734$) on nontreated (73 ± 6%) and root-plowed (75 ± 11%) sites. Species richness, Shannon's diversity index and evenness of small mammals were similar ($P > 0.05$) on nontreated and root-plowed areas. Species richness and diversity of herpetofauna were similar ($P > 0.05$) on nontreated and root-plowed sites; however, evenness was lower ($P = 0.047$) on root-plowed sites and population sizes were almost double on root-plowed sites compared to non-treated sites.

Our results indicate that root-plowed sites on the Chaparral Wildlife Management area support species richness and diversity of vegetation and small mammals similar to that on nontreated sites 40 years post-treatment. Greater herpetofauna populations exist on root-plowed sites; however, numerical abundance is less evenly distributed among herpetofauna species than on nontreated sites. We plan to conduct further data analyses to compare long-term effects of root plowing on vegetation, small mammal, herpetofauna, and arthropod species composition.

Funding for this project was provided by TPWD.

Development of Management Strategies for the Conservation of Wildlife in a Bottomland Forest Ecosystem, Old Sabine Bottom Wildlife Management Area

Neil B Ford and Darrell W. Pogue, University of Texas-Tyler; Kevin R. Herriman, TPWD

Bottomland hardwood forests are among the most diverse ecosystems in East Texas and are home to approximately 500 vertebrate and 1,150 plant species. However, it is estimated that approximately 75% of these forests originally found in Texas have been lost since the state was settled. Old Sabine Bottom Wildlife Management Area (OSBWMA) is a 2,318 ha (5,727 ac) tract of bottomland hardwood forest along the Sabine River in Smith County. TPWD manages OSBWMA to protect this critical habitat type, maintain species diversity and provide public recreational opportunities.

A three-year study to examine the effects of current management practices and recreational activities on vertebrate communities was initiated in 2003. Specifically, the study will evaluate: (1) community dynamics of herpetofauna at ephemeral pools; and (2) reproductive success of breeding birds in managed areas.

Species richness, diversity and abundance of herptofauna will be compared among fire-managed grasslands, forested areas, active oil pump sites and comparable forested areas, and recreational use areas. Various snake species will be marked with pit tags to obtain information about movements, growth and annual natural life history.

Data collection methods will include the use of cover boards, minnow traps, drift fences, dip nets and incidental captures. Nesting success of breeding birds will be evaluated among contiguous forest, oil production sites and the fire-managed grassland. Parasitism by brown-headed cowbird (*Molothrus ater*) will be monitored. Data collection methods will include the establishment of 10-ha sampling plots in habitats with 3 levels of fragmentation and disturbance. Vegetation in the sampling plots will be searched for nests ($\leq$ 12m) during the peak of the breeding season. Information on clutch size, predation and cowbird parasitism will be recorded.

Funding for this study was provided by TPWD.

Water for Texas Demonstration Plots on the Kerr Wildlife Management Area

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Sixty percent of the land surface in Texas is rangeland. Rangeland resources are the basis for many of the State's livestock and outdoor recreation industries and provide habitat for large numbers of native plant and wildlife species. Rangeland comprises most of the watersheds, is the primary water source for the major rechargeable aquifers and provides more than 60% of the surface flow to rivers.

"Water for Texas" is a range watershed management program conducted by the Rangeland Ecology and Management Unit, Texas Cooperative Extension. One component of the program is the use of paired watershed results demonstrations, following EPA's "Paired Watershed Study Design" protocol. The objectives of these demonstrations are to identify the amount of runoff and sediment production under current management and following implementation of best management practices (BMP) which include proper grazing, seeding and or brush management (herbicides and prescribed fire).

The Kerr watershed will compare differences between grassland and brush dominated sites with differences in soils, slopes and grazing by deer only versus cattle and deer. BMPs will involve: 1) complete brush removal, except for live oak and shin oak. The project will last two years after BMPs are installed. During the first year of collection (calibration period of runoff events), all plots received the same treatment (current management by the landowner). After calibration one catchment out of the pair received a BMP for that situation based on resource needs and landowner objectives. The other catchments continued with landowner management practices.

Sites are monitored for daily rainfall and amount of runoff. Reports and information developed from this site will be prepared by TCE for use by the landowner and the County Extension agent for educational programs and handbooks.

Continuous monitoring for ten plus years is desired to understand the full impact of management and rainfall cycles on the hydrological cycle. This length of time is necessary for normal success ional change to occur following treatment and allow "stabilization" before concluding effects.

Effect of Exotic Plant Species in Central Texas Urban Habitats on Neotropical Migrant Bird Species Composition, Relative Abundance and Distribution

Kelly Bender, TPWD; Randy Simpson, Texas State University

Urban areas are composed of a mosaic of residential areas, businesses, infrastructure, drainage systems and undeveloped land, generally characterized by reduced plant species diversity and natural habitat features. Additionally, urbanized areas in Central Texas often include exotic plant species such as ligustrum, red-tipped photinia, and Japanese honeysuckle that are invasive and can become a nuisance in nearby natural areas. Our objectives were to: identify non-native plant species that have invaded natural areas near Austin, Texas, identify the effects of specific non-native plant species on neotropical migrant bird species, and produce land management recommendations for the benefit of Golden-cheeked Warbler, Black-capped Vireo, and other neotropical migrant birds. In addition to providing valuable land management recommendations for large natural areas, this study will provide information that can be developed into an educational campaign targeted to land managers in areas adjacent to sensitive nesting habitat.

This study is being conducted throughout the year, and multiple years of data will be required to adequately assess the effect of non-native invasive species on neotropical migrant bird species presence, distribution and relative abundance. Researchers are conducting vegetation surveys of the study area using standard techniques including the point-centered quarter method and vegetation profile board. To date, red-tipped photinia, wax-leaf ligustrum, heavenly bamboo, pyracantha, Japanese honeysuckle, Chinese privet, Chinaberry tree and Chinese Tallow are the most abundant non-native invasive species. Fixed-radius point counts and distance measures are being used to assess bird species richness, diversity, evenness and relative abundance among study plots of different categories. At least two counts per month per site are being conducted. Based on the results of data analysis, outreach information will be prepared for use by local, state, and federal organizations that will provide technical assistance to area land managers, residents, landscape and nursery professionals, and volunteer educational organizations.

This study is being funded through a Conservation Action Grant and the donations of 3M Corporation and anonymous corporate donors. Researchers are supported by TPWD and Texas State University.

Comparison of Avian Communities Within Traditional and Wildscaped Residential Neighborhoods in San Antonio, Texas

Amanda Hunter Aurora and Thomas R. Simpson, Texas State University; Kelly Bender, TPWD

Incorporating wildlife habitat into residential areas is becoming increasingly common for homeowners and developers, and is touted as a way to reduce some of the impacts of residential development on wildlife populations. However, few studies have tested this claim. We tested the hypothesis that a residential neighborhood in San Antonio, Texas that was certified by the Texas Parks and Wildlife Department as a Texas Wildscape in 1996 had a more diverse bird community than an adjacent traditionally developed residential neighborhood. We also hypothesized that the bird community at a nearby natural area (Government Canyon State Natural Area) was more similar to the bird community at the Wildscaped neighborhood than at the traditional neighborhood. Further, we hypothesized that differences in the density and structure of the habitat (primarily woody vegetation) influenced potential differences in the bird communities at the three sites. After two years of bird surveys, bird diversity (including independent measures of species richness and evenness) at the Wildscaped neighborhood was significantly greater than at the traditional neighborhood or the natural area. The density of woody plants and the amount of vertical cover were moderately to strongly correllated with bird diversity measures at the residential sites. This study shows that residential areas that incorporate natural landscapes (Wildscapes) into their design can attract a greater variety of birds than traditionally landscaped residential areas. These areas may provide valuable habitat for some declining species and reduce the impacts of residential development, especially where urbanization is encroaching on natural areas.

This study was funded through a TPWD grant and the support of Texas State University and TPWD.

Wildlife and Water: Assessing the Social and Conservation Characteristics of Selected Landowner Associations in Texas

Matt Wagner, TPWD; Urs Kreuter and Ronald Kaiser, Texas A&M University

To facilitate effective wildlife management on a larger scale, while reducing the effects of land fragmentation, wildlife management associations or cooperatives have been formed in over 20 counties in Texas. Over 100 such groups representing nearly 5,000 landowners and approximately two million acres have been organized in the state. Opportunities for direct landowner involvement in watershed management, protection of groundwater resources and development of riparian corridors exist within the framework of wildlife management associations or similar local public/private partnerships. In addition to wildlife associations, groundwater cooperatives in various forms are being organized by private entrepreneurs in partnerships with landowners over significant aquifers in the state. Opportunities for land and water conservation education followed by the implementation of various management practices exist within these various organizations, but more needs to be known about the needs and motives of these groups. A questionnaire was mailed to 768 landowners within eight wildlife associations and one groundwater cooperative in the Post Oak Savanna Region. The survey will compare various aspects of social capital (trust and civic participation) with actual land and water conservation practices performed by the associations. In addition, the attitudes of landowners within associations regarding sustainable groundwater marketing as an indirect economic alternative for ranch viability will be assessed. At the time this abstract was submitted, the response rate to the questionnaire was 49%.

Funding and support for this research is provided by the National Water Research Institute, the Texas Water Resources Institute and TPWD.

Pastures For Upland Birds: Restoring Native Plants in Bermudagrass Pastures

Matt Wagner, TPWD; Urs Kreuter and Ronald Kaiser, Texas A&M University

The conversion of large areas of the Post Oak Savannah to improved forage grasses, such as bermudagrass (*Cynodon* spp.) and bahiagrass (*Paspalum notatum*), has been a major reason for the decline of wildlife species in the region. Bobwhite quail (*Colinus virginianus*) and Eastern wild turkey (*Meleagris gallopavo silvestris*) are two important game species that have been impacted by this vegetation conversion. Pastures for Upland Birds (PUB) is a research, management, and demonstration program designed to determining cost-effective strategies for establishing native grasses and forbs in bermudagrass pastures, while providing technical assistance and cost-share incentives to private landowners.

Study sites were established in Falls, Grimes and Washington counties. At each site, two rates of Glyphomax Plus herbicide (41% glyphosate) and a combination of different native seed mixes and planting methods were applied. Two years after herbicide application, the two rates averaged 86% bermuda grass control on sandy soil, 90% on sandy loam and 52% on clay soil. Foliar cover of native grasses averaged about 50%, 40% and 15% on sandy, sandy loam and clay soils respectively, while forbs averaged 10%, 50% and 40% respectively. Funding and support for this study was provided by the Texas Parks and Wildlife Department, Texas Agricultural Experiment Station, Texas Cooperative Extension, Cross Timbers Chapter of Quail Unlimited, Dow AgroSciences, National Fish and Wildlife Foundation, Natural Resources Conservation Service and the National Wild Turkey Federation.

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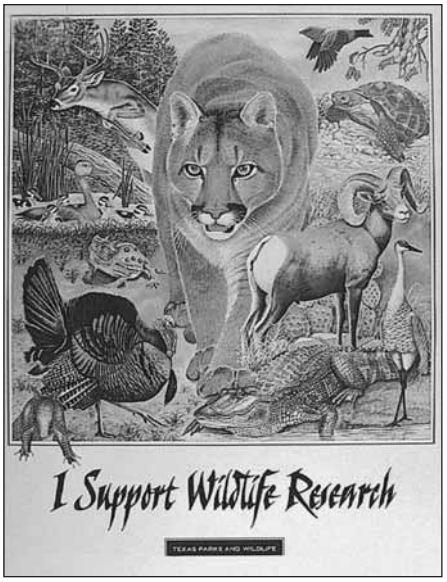

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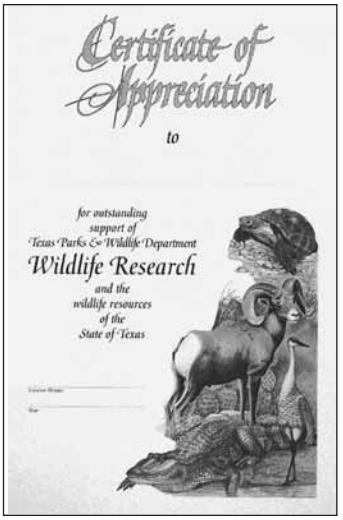

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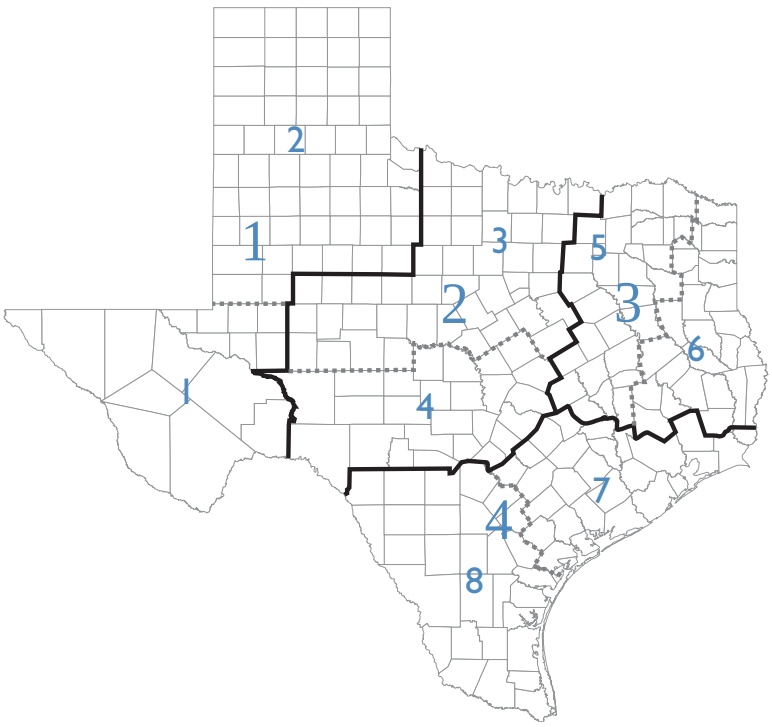

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