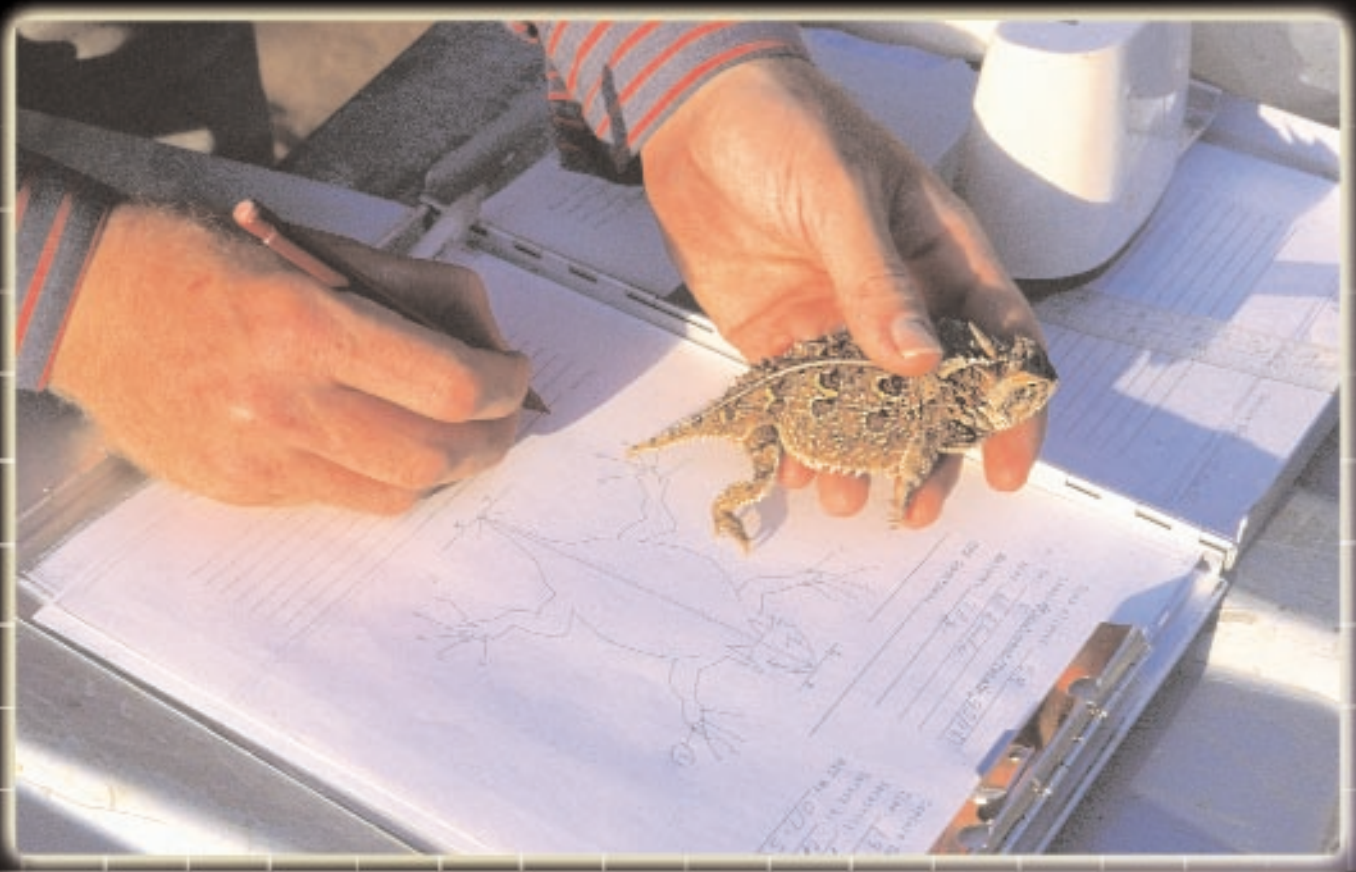
TEXAS PARKS AND WILDLIFE



1999 Wildlife Research Highlights

Volume 4

Edited by Ray C. Telfair II, PhD

TEXAS PARKS AND WILDLIFE

Wildlife Division

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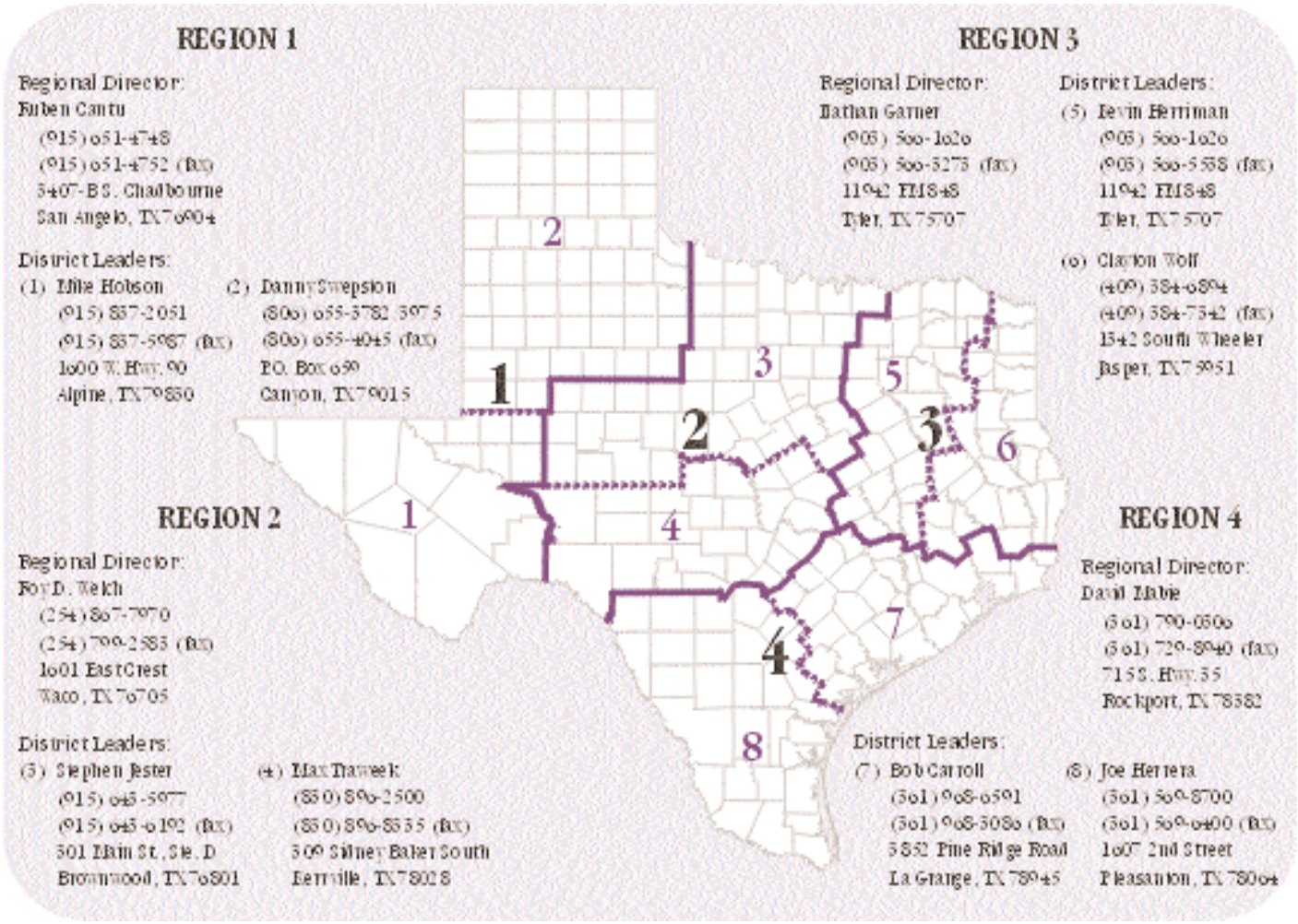


ACKNOWLEDGMENTS

We express our appreciation to those persons who designed these research studies, analyzed data, drafted abstracts, and provided photographs for this publication. We are indebted to Chris Hunt for designing the manuscript and to Marc Koch for coordinating the printing. We appreciate the assistance of all of those individuals, universities, and agencies who cooperated in these studies. We especially thank those persons who donated funds for wildlife research and those private landowners who permitted access to their property for research purposes. This publication is a contribution of the Federal Aid in Wildlife Restoration Act. Printing of this publication was funded, in part, by the **Texas Wildlife Association**, the **Houston Safari Club**, and the **U.S. Fish and Wildlife Service Federal Aid Administrative Funds**.

COVER PHOTOS

Front: Texas horned lizard research on the Chaparral Wildlife Management Area in South Texas. Photo by Ron George.
Back: Texas snowbells, an endangered small tree, native to rocky cliffs and streamsides in the western Edwards Plateau. Photo by Paul Montgomery.

Wildlife Research Highlights

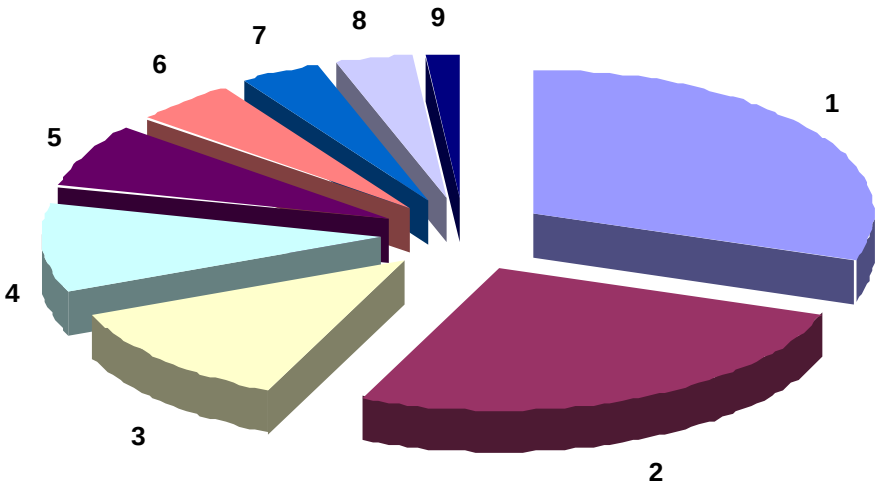
May 1999

The Wildlife Division of the Texas Parks and Wildlife Department is continuing to develop a new, coordinated approach to wildlife research. Over the years, the division has funded numerous wildlife research studies through universities, and department biologists have conducted some excellent studies of their own. However, 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 coauthors.

The Wildlife Division budgeted over $1,679,000 for 75 wildlife research projects during Fiscal Year 99. Funding for this research has come from several sources including: (1) Texas hunting license revenue, (2) federal excise taxes on sporting arms and ammunition (Pittman-Robertson), (3) Texas waterfowl, white-winged dove, and wild turkey stamps, (4) mitigation, (5) state parks conservation series capital projects funds, (6) federal endangered species funds (Section 6), and (7) grants and donations.

FUNDING SOURCES



1 Hunting License Revenue
$510,000

2 Federal Excise Taxes (Pittman-Robertson)
$440,000

3 Federal Endangered Species (Section 6)
$204,000

4 White-winged Dove Stamps
$164,000

5 State Parks Conservation Series Capital Projects
$122,000

6 Mitigation
$86,000

7 Turkey Stamps
$64,000

8 Grants and Donations
$59,000

9 Waterfowl Stamps
$30,000

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UPLAND GAME AND ALLIGATORS

Genetics and Environmental Interaction in White-tailed Deer

Dr. John D. Williams– Texas A&M University, and William E. Armstrong, Eugene R. Fuchs and Donnie Harmel (deceased)– Texas Parks and Wildlife Department

Research studies conducted on the Kerr Wildlife Management Area have demonstrated that genetics had an effect on body size and antler characteristics in white-tailed deer (*Odocoileus virginianus*). Further research in penned deer indicated that in the presence of an optimum ad libitum 16% protein diet, there were some deer which consistently produced yearling offspring with spiked antlers and others which consistently produced yearling offspring with forked antlers.

Departmental check station data indicate that the incidence of spiked antlers increase during extended periods of drought and poor habitat conditions. This supports the hypothesis that poor antler characteristics are caused by nutritional stress. We hypothesize that there may be a group of deer which are genetically capable of producing good antler characteristics in the presence of severe nutritional stress, another group which produce good antler characteristics in periods of "good" nutrition and poor antler characteristics in periods of "poor" nutrition, and a third group which will produce poor antler characteristics regardless of available nutrition.

This study is being conducted in a 16-acre (6.5 ha) research complex consisting of 6 2/3-acre (0.3 ha) breeding pens and 3-4 acre (1.2-1.6 ha) holding pens. Deer used in the study have pedigrees which date back to 1973.

Since 1991, known pedigreed bucks have been placed with 8-14 pedigreed does using single sire herds. Fawns are ear-tagged and matched with their respective dam for pedigree records. In October, fawns are removed from their dams, segregated according to sex and placed in 2 separate pens. Starting in December, buck fawns are placed on a limited 8% protein diet to simulate nutritional stress conditions. The following October, 5 or 6 males which have the best antler production and body size under these nutritionally stressed conditions are used as herd sires. Since the study was initiated, 32 different single-sire breeding herds have produced 161 yearling males which have been reared on an 8% protein ration while growing their first set of antlers. Eighty yearling bucks (50%) have produced antlers with 6 or more points while 30 (19%) have produced spiked antlers.

Blood samples have been obtained from over 300 deer involved in the study for DNA analysis. A research grant has been provided by a private individual to Texas A&M University to conduct DNA gene mapping and Y chromosome marker research from this population of known pedigreed deer.

This study has been funded by the Texas Parks and Wildlife Department and Federal Aid in Wildlife Restoration Grant W-127-R.

Table 1. Antler point classification for 161 yearling bucks on a limited protein ration (8%).

Year	Bucks 1.5 years old (*n*)	Antler point classifcation					
		Forked		Spiked		With 6 or more points	
		n	%	*n*	%	*n*	%
1992[a]	29	18	62	11	38	11	38
1993[a]	19	12	63	7	37	7	37
1994[b]	25	18	72	8	28	5	20
1995[b]	34	31	91	3	9	18	53
1996[b]	31	30	97	1	3	20	65[c]
1997[b]	23	23	100	0	0	19	83[d]

[a]Fawns sired by 2.5 year or older sires; non-stressed diet (16% ad lib).

[b]Fawns sired by 1.5 year old sires; stressed diet (8% limited).

[c]Of the 31 bucks, 10 (32%) had 8 or more points.

[d]Of the 23 bucks, 8 (35%) had 8 or more points.

Molecular Genetic Approaches to Management of White-tailed Deer

Loren C. Skow, Rodney Honeycutt, and John Williams– Texas A&M University, and E. L. Young and Donnie Harmel (deceased)– Texas Parks and Wildlife Department

Assessment of the quality of the gene pool and efforts to improve the genetic stock are important components in the development of successful management programs to produce quality white-tailed deer (*Odocoileus virginianus*) herds in Texas. In this study, modern DNA techniques are being developed and applied to white-tailed deer using the closed, pedigreed wildlife herd at the Kerr Wildlife Management Area. The goal of this research is to produce DNA genetic markers for use in wildlife forensics and as management tools to determine reproductive structure of natural populations, identify biologically distinct stocks, evaluate the effects of deer introductions on the gene pools of existing populations, and determine the genetic fitness of free-ranging and closed deer herds.

Markers in deer can be used for individual identification in archeological and post-mortem samples (museum mounts, carcasses, processed meat, antler or hair) as well as fresh or frozen specimens. We have identified 467 markers in deer using data from white-tailed deer, mule deer (*O. hemionus*), and red deer (*Cervus elaphus*) in this study and in other studies. We have identified 41 markers which can be multiplexed in 8 separate reactions. Currently, samples from herds in 6 regions representing major geographical areas of Texas are being analyzed to assess levels of genetic health and to determine geographic diversity of Texas white-tailed deer. Studies are also underway on 2 high-fenced deer populations to evaluate historical changes in gene pools and to determine reproductive structure of the herds.

This research is part of the international genetics program of the International Society for Animal Genetics (ISAG). As the Coordinating Laboratory for the ISAG, Texas A&M University is helping to develop an internationally accepted panel of genetic markers for use in Cervidae.

This study is funded by the Bass Foundation in cooperation with the Texas Parks and Wildlife Foundation and the Texas Parks and Wildlife Department.

Non-invasive Genetic Techniques for Estimating Sex-ratios in Deer

Olin E. Rhodes– Purdue University, and Nathan P. Garner, E. L. Young, Dale F. Prochaska, Hayden Haucke, and James C. Cathey– Texas Parks and Wildlife Department

TPWD PHOTO

The accurate evaluation of deer population demography has long been a goal of wildlife managers. Reliable data on population size and sex ratio are required to assess various demographic parameters, though such information is often difficult to obtain. Nonetheless, accuracy is paramount when evaluating and implementing management strategies. In the past, many techniques for estimating population size in deer have been explored, including track counts, driving surveys, aerial surveys spotlight surveys, and fecal pellet counts. However, sex-ratio information is calculated primarily through morphological observation data (i.e., presence/absence of antlers) collected from wildlife managers and hunters. Such data is necessarily subjective. The recent revolution in DNA technology suggests that genetic techniques can be utilized successfully to determine the sex-ratios in white-tailed deer (*Odocoileus virginianus*) and related Cervids.

Recently, a genetic test was developed that is diagnostic for each sex within the family Cervidae. One advantage of this test is that non-traditional tissues (i.e., hair, feathers, egg shells, and fecal material) can be used to obtain DNA of sufficient quality for genetic analyses. However, the exact methodology needs to be improved to efficiently amplify DNA from fecal pellets. This will be the first step in this pilot study. Once the methods have been refined, white-tailed deer fecal samples will be collected from known individuals ($n=15$ males and $n=15$ females) from holding pens located at the Kerr Wildlife Management Area (KWMA). Fecal samples will be collected into freezer bags

and numbered 1-30; all information regarding the sex of each sample will be withheld from laboratory personnel who will endeavor to identify the correct sex of each sample.

DNA begins to degrade with time. To determine how long fecal samples can remain on the ground before collection and still provide the desired information, we will isolate DNA from fresh fecal pellets and reserve another portion to leave at ambient temperature, isolating DNA from this source each day until the quality is too degraded to effectively use for sex identification.

We have a potential means to objectively identify the sex of deer, using the diagnostic Zfx/Zfy marker. This proposed work is step 1 in a series of steps to test the efficiency of traditional methods (morphological observations) and genetic methods (DNA sexing). To effectively manage deer populations, biologists need to employ the best available tools. The Zfx/Zfy marker may provide wildlife managers with the best tool for collecting sex composition data for both free-ranging deer herds and those confined by high fence.

Matching funds from Purdue University and Texas Parks and Wildlife Department (Region III and the Upland Wildlife Ecology Program) are being used in this investigation.

White-tailed Deer Subspecies Identification Using Genetic Analysis

Timothy L. Bone– Texas Parks and Wildlife Department

The Carmen Mountains white-tailed deer (*Odocoileus virginianus carminis*) was first described in 1940 and was named for the center of its distribution, the Sierra del Carmen range located in Mexico. External dimensions, cranial details, pelage color, and antler tine-size and spread were used to describe the subspecies. Carmen Mountains white-tailed deer are the smallest of the 4 white-tailed deer subspecies found in Texas.

Initial descriptions of Carmen Mountains white-tailed deer in the United States limited their distribution to mountain ranges within the present boundaries of Big Bend National Park (BBNP). Most of the Carmen Mountains white-tailed deer in BBNP are located in the Chisos Mountains.

Small, isolated populations of deer located in mountain ranges outside of BBNP in Presidio, Jeff Davis, and Brewster Counties resemble Carmen Mountains white-tailed deer but have not been studied. The need for a better understanding of the classification of isolated white-tailed deer populations in the Trans-Pecos has become apparent. The Texas Parks and Wildlife Department has received requests from private individuals for authorization to transplant white-tailed deer from outside the Trans-Pecos to locations close to possible isolated populations of Carmen Mountains white-tailed deer. The acceptability of such transplants may depend on the taxonomic status of endemic white-tailed deer which may be exposed to released white-tailed deer.

DNA analysis may be an important tool in classifying Carmen Mountains white-tailed deer, Texas white-tailed deer (*O. v. texanus*), and the possible intergradation between the 2 subspecies. This study will address: 1) the development of DNA analysis to identify Carmen Mountains white-tailed deer, Texas white-tailed deer, and intergrades thereof and; 2) the sampling of isolated white-tailed deer populations in Presidio, Jeff Davis, and Brewster Counties to locate Carmen Mountains white-tailed deer or Carmen - Texas intergrade populations outside of BBNP. In addition, Texas white-tailed deer populations from other areas in the Trans-Pecos as well as desert mule deer (*O. hemionus crooki*) will be sampled. Samples will be obtained from Carmen Mountains white-tailed deer in Mexico if possible.

Samples were collected from hunter harvested deer during the 1997-98 hunting season. Incidental samples from road kills and illegal deer confiscated by game wardens were also collected through the winter to meet sample size goals, especially regarding both white-tailed deer and mule deer does. A variety of material such as flesh, hide, hoof, bone, and antler were collected for testing. Samples were sent to 2 universities for DNA analysis.

Funding for this study is being provided by the Texas Parks and Wildlife Department.

Seasonal Food Habits/ Preferences of White-tailed Deer in the Cross Timbers and Prairies Ecological Region of North Texas

John D. Baccus and Randy Simpson– Southwest Texas State University and James Dillard and E. L. Young– Texas Parks and Wildlife Department

Deer numbers and physical condition can be limited by the availability food supply. A knowledge of the food habits and preferences of white-tailed deer (*Odocoileus*

virginianus) would allow landowners and deer managers to manipulate conditions to benefit important plant species. Preferred foods vary throughout the white-tailed deer range in Texas. In the Cross Timbers and Prairies ecological region, deer food habits on 2 major soil types supporting different plant regimes will be compared by site and seasonality of use.

Rumen sample collections were completed during February 1998 on each of the 6 study sites located in Bosque, Brown, Jack, Erath, Parker, and Wise Counties. Data was collected on age, weight, sex, date of collection, locality, body condition, antler measurements, pregnancy, number of fetuses, and lactation. Other data collected included blood samples, ectoparasites, rumen fluid, rumen contents, and internal parasites. Vegetative transects were used to sample herbaceous and woody vegetation on each study site.

Seasonal and spatial changes in food availability and preferences will be analyzed to determine correlation with rainfall, soils, and elevation. A TPWD bulletin will be prepared at completion to disseminate information to deer managers and hunters.

This is the third year of a 3-year study funded by Texas Parks and Wildlife Department through Federal Aid in Wildlife Restoration Grant W-127-R. This project will be completed this year and a final report published.

Improving Utility of White-tailed Deer Spotlight Surveys in the Cross Timbers and Prairies Ecological Region of North Texas

Steve Jester and Wildlife District 3– Texas Parks and Wildlife Department

STEVE JESTER

The spotlight survey technique is used in many parts of Texas to monitor white-tailed deer (*Odocoileus virginianus*) density trends and estimate minimum deer densities. This is the primary density estimation technique among both resource agencies and private land managers in the Cross Timbers and Prairies ecological region. This ecological area is typified by highly variable deer densities, deer habitat quality, soil types, and land uses which may confound estimation of deer density. Any improvements in data collection, data analysis or remediation may enhance the utility of the technique for deer management in this region.

Selected regulatory spotlight survey routes will be georeferenced using GPS technology prior to the annual survey. Average transect width will be estimated at 0.1 mile (0.16 km) intervals using laser rangefinders. Spotlight surveys will be replicated twice during the annual survey period. Data will be recorded by observation and will include: GPS location of vehicle, range to observation (deer or group of deer), compass bearing to observation, number of bucks, does, fawns, and unidentified deer in each observation, and classification of habitat for the observation.

Accumulated density estimates will be calculated in standardized format and remediated. The impact of different interval lengths, average spacing of observations, group size, and composition will also be examined.

Funding for this study is being provided by the Texas Parks and Wildlife Department.

Status of the Mule Deer Poplulation in the Northwestern Portion of Crockett County

Josh Avey and Warren Ballard– Texas Tech University and Mary Humphrey, Doug Humphreys, and Fielding Harwell– Texas Parks and Wildlife Department

The desert mule deer (*Odocoileus hemionus crooki*) population found in the farthest reaches of the western Edwards Plateau has historically been associated with the Pecos River drainage. As land use patterns have changed with time, so has the amount of woody vegetation covering the area. What once was considered typical desert mule deer habitat now comprises heavier amounts of woody vegetation that has supported the increase of Texas white-

tailed deer (*Odocoileus virginianus texanus*) numbers and distribution into the area.

The need for a better understanding of the sympatric use of this portion of Crockett County has become apparent through questions aimed at managing for one or both species of deer. Annual state spotlight-census methods provide little information on mule deer population trends. Most trend information has been collected using typical survey methods developed for censusing white-tailed deer, and is accumulated on a limited, per-ranch basis. Accurate censusing methods are needed to examine landscape and habitat use by mule deer and white-tailed deer. Helicopter surveys and infrared-triggered cameras placed at permanent water sources (to census lactating does during drought periods) could provide more reliable estimates of abundance of both deer species. Use of geographical information systems (GIS) for depicting potential habitat and interactions between sympatric species, along with satellite imagery to predict habitat types, may assist in quantifying available habitat for both species.

FIELDING HARWELL

This study will address: 1) assessment of differences in census techniques – helicopter surveys, spotlight surveys, and infrared cameras – in terms of sex-age ratios and distribution of the 2 deer species; 2) construction of an historical record of the landscape management practices used within the study area throughout the 20th century; 3) use of Wiggers 1989 technique to determine potential habitats for both white-tailed and mule deer within the study site; and, 4) creation of a deer habitat map by overlaying GIS and satellite imagery that delineate the vegetation types and deer distributions.

Ground spotlight surveys were conducted on 2 ranches within the study site in October and November 1998 to estimate deer densities, composition, and distribution. Locations of individual deer and groups of deer were recorded using GPS technology. The distance to the animal from the transect was determined using a hand-held range finder and a compass bearing was taken from the vehicle to the point where the deer was first seen. Results from 10 surveys sampling 10,489 acres (4,245 ha) estimate a mule deer population at 143.69 acres (58.15 ha) per deer with a buck:doe sex ratio of 1:3.89 and 0.66 fawns per doe. Results from the same 10 surveys estimate a white-tailed deer population at 291.37 acres (117.92 ha) per deer with a buck:doe sex ratio of 1:5.75 and 0.39 fawns per doe. Comparative results from helicopter surveys conducted on the same 2 ranches in January 1999 sampling 51,173 acres (20,710 ha) show observations of a mule deer population at 94.42 acres (38.21 ha) per deer with a buck:doe sex ratio of 1:2.51 and 0.41 fawns per doe. Results from the same helicopter surveys show observations of a white-tailed deer population at 139.06 acres (56.28 ha) per deer with a buck:doe sex ratio of 1:4.79 and 0.32 fawns per doe.

This is the first year of a 2-year research project. Funding and support for this project is being provided by the Texas Parks and Wildlife Department, the Texas Tech University System, and the landowners and managers within the study site.

Differential Survival and Reproduction of Two Eastern Wild Turkey Broodstocks Reintroduced into the Post Oak Savannah of Texas

John K. Thorne, Froylan Hernandez, Dale A. Kubenka, and Nova J. Silvy– Texas A&M University, and John D. Burk and Markus J. Peterson– Texas Parks and Wildlife Department

JAMES CATHEY

The objectives of this study were to evaluate differences in survival and reproduction between eastern wild turkey (*Meleagris gallopavo silvestris*) broodstocks of

mid-western and southeastern origin used in restoration efforts in the Post Oak Savannah of Texas. To achieve these objectives, eastern wild turkeys from the mid-west (Iowa $n=39$) and southeast (Texas $n=18$, South Carolina $n=11$) were live trapped, radio-tagged, and released on 2 separate study areas in the Post Oak Savannah. Birds were monitored using radio-telemetry and survival and reproduction were evaluated.

No statistical difference ($P > 0.05$) in total first-year survival between mid-western (50%, $n=28$) and southeastern (50%, $n=22$) hens was found. Total first-year survival for mid-western and southeastern gobblers was 67% ($n=9$) and 80% ($n=5$), respectively. Combined second-year survival for mid-western hens was 66% ($n=12$) and 100% ($n=9$) for southeastern hens. When broodstock and sex were combined (mid-western and southeastern hens and gobblers), second-year survival was higher ($P < 0.006$) than first-year survival. Third-year survival for 1996 initial mid-western hens was 66% ($n=6$) and 0% ($n=2$) for southeastern hens. Third-year survival of 1996 initial mid-western and southeastern gobblers was 100% ($n=2$) and 75% ($n=4$), respectively. Mammalian predation was responsible for 43.5 ($n=10$) and 40.0% ($n=6$) of all mortality on mid-western and southeastern birds, respectively.

There was no statistical difference ($P > 0.05$) in total first-year nesting rate between broodstocks. When broodstocks were combined, total second-year nesting rate (100%, $n=9$) was significantly higher ($P < 0.001$) than combined total first-year nesting rate (61%, $n=38$). Since 1996, only 1 mid-western hen and 2 southeastern hens hatched clutches. No poult survival beyond 2-weeks post-hatch was documented. Habitat conditions in the southern Post Oak Savannah probably are not suitable to support eastern wild turkey populations regardless of origin of broodstock.

The Texas Parks and Wildlife Department (Turkey Stamp fund), Federal Aid in Wildlife Restoration Grant W-126-R, and the Texas A&M University System provided funding for this project.

Eastern Turkey Restoration in the Pineywoods of East Texas: Phase II - Supplemental Stocking

R. Montague Whiting, Jr. and Jimmy D. Kelly– Stephen F. Austin State University, and John D. Burk– Texas Parks and Wildlife Department

Research in the early 1980s indicated that wild-trapped eastern wild turkeys (*Meleagris gallopavo silvestris*) could be used to successfully rehabilitate wild turkey populations in eastern Texas. Therefore, in 1987, the Texas Parks and Wildlife Department (TPWD) began an intensive program to restock the Pineywoods and Post Oak Regions of eastern Texas using wild-trapped eastern turkeys. In 1994, research was initiated to evaluate the success of the restocking programs. In February of that year, 60 wild-trapped turkeys, 30 from Georgia and 30 from Iowa, were radio-tagged and released at 4 sites in Tyler County in the Pineywoods; each site received 12 hens and 3 gobblers. Those birds were radio tracked for 28 months and survival, reproduction, and movements were compared between broodstock. Survival of the Georgia birds was somewhat better than that of the Iowa birds; for gobblers, the difference was significant. However, reproductive success was poor during the 3 springs, with only 11 poults fledged.

In some areas of eastern Texas, restocked populations became established and flourished; spring hunting was allowed in 17 Pineywoods counties in 1998. However, efforts to restock other sites, including the Tyler County study areas, could not be classified as successful. Therefore, TPWD began supplementally stocking some release sites in 1997. Five gobblers and 15 hens are to be released at each site. The general objective of this research project is to evaluate the supplemental stocking program. Specifically, we hope to determine if the supplementally stocked birds are associating with those released in 1994, and to determine if such associations impact survival, reproduction, etc.

In February 1997, 83 radio-tagged eastern wild turkeys were supplementally stocked in Tyler County with each of the 4 original release sites receiving 5 gobblers and 14-18 hens. At each site, approximately half the birds were from southeastern states (including Georgia) and half from midwestern states (including Iowa). At that time, 21 of the original 1994 birds were being radio-tracked; these were 3 gobblers and 9 hens from Georgia and 9 Iowa hens.

Therefore, when the supplemental stocking was completed in Tyler County, we were tracking 104 turkeys, 13 gobblers and 40 hens from the southeast and 10 gobblers and 41 hens from the midwest. Additionally, in Trinity County on the Boggy Slough study area, we were tracking 2 resident hens radio-tagged in March 1995 and 11 Iowa hens released in February 1996, thus as of 1 March 1997, we were tracking 117 turkeys.

During 1997, we lost 37 birds known dead and 8 missing. Only 1 hen, a 1994 Iowa bird, successfully produced poults. She had 10 5-week old chicks when she was probably poached. Fate of the chicks is unknown.

As of 1 January 1998, we were radio-tracking 10 gobblers and 62 hens. Seven of the gobblers were southeastern birds, 3 from the 1994 release. We had 11 hens on Boggy Slough (2 residents and 9 from Iowa) and 51 hens in Tyler County. Forty-two of these hens were from the 1997 release (21 southeastern, 21 midwestern) and 9 from the 1994 release (6 southeastern, 3 midwestern). Eight birds were missing, including 7 hens (4 southeastern, 3 midwestern) and 1 1997 midwestern gobbler.

As of 1 April 1998, the beginning of the nesting season, we were actively tracking 7 gobblers and 62 hens. Six of the gobblers were from the 1997 release (4 southeastern, 2 midwestern), and the other was a 1994 southeastern bird. Three gobblers were killed between 1 January and 1 April 1998. In Tyler County, we had 52 hens with active radios, 9 from the 1994 release and 43 from the 1997 release. No Tyler County hens were lost between 1 January and 1 April 1998, and a long-term missing southeastern hen was found using an aerial search. On Boggy Slough, we had the 2 resident and 8 Iowa hens; 1 Iowa hen was killed in late winter. Seven birds (6 hens, 1 tom) were missing.

Only 3 hens successfully produced poults. Two successful hens were 1997 southeastern birds in Tyler County; these 2 hens produced a total of 6 poults which probably fledged. The third hen was an Iowa bird on the Boggy Slough release site that disappeared immediately after leaving the nest site with 8 chicks. Additionally, 23 hens are known to have produced 24 nests that were unsuccessful; 1 hen did attempt to renest. Evidence indicates that 10 of these nests were destroyed by mammalian predators (common raccoon, *Procyon lotor*, striped skunk, *Mephitis mephitis*); 14 were predated with no evidence of what destroyed the nest. Radio telemetry data suggest that an additional 30 hens attempted to nest. However, the nests were either destroyed or deserted before they could be marked, thus no physical evidence was found. In summary, of the 62 hens that entered the nesting season, we are confident that 57 attempted to nest. Of the 5 birds that may have not attempted to nest, 1 was a 1997 hen in Tyler County, and the other 4 were Boggy Slough birds (1 resident, 3 Iowa).

During 1998, we lost 14 turkeys (3 southeastern hens and 4 gobblers, 5 midwestern hens and 2 gobblers) to bobcats (*Lynx rufus*); 12 of these were at the Tyler County release sites. Three turkeys (2 hens and 1 gobbler) were taken by avian predators and the cause of death for 7 hens is unknown.

As of 1 January 1999, we were actively radio tracking 3 1997 gobblers (2 southeastern, 1 midwestern) and 39 hens (20 southeastern, 17 1997 and 3 1994; 19 midwestern, 17 1997 and 2 1994) in Tyler County. On Boggy Slough, we were tracking 1 resident and 4 Iowa hens. Nine birds were missing including 1 1997 midwestern gobbler and 8 hens. In Tyler County, 3 1994 hens (2 southeastern, 1 midwestern) and 2 1997 hens (1 southeastern, 1 midwestern) could not be found. On Boggy Slough, 1 1995 resident and 2 1996 Iowa birds were missing. Aerial searches will be conducted in the spring, seeking the missing birds. Field data collection will end in midsummer, after the nesting season.

A Study of Texas Turkey Hunters

Denise Harmel-Garza, Clark E. Adams, and John K. Thomas– Texas A&M University, and Markus J. Peterson– Texas Parks and Wildlife Department

Turkey hunting is a popular option for many Texas hunters. The success of turkey management is largely measured by how these efforts compare with the attitudes, activities, and expectations of turkey hunters. This study was conducted to determine the demographic characteristics of Texas turkey hunters and their attitudes and preferences concerning turkey hunting and management. It is the first investigation of Texas turkey hunters, a growing segment of Texas hunters. Specific study objectives were to characterize turkey hunters and their hunting activities; identify key factors that promote and prevent turkey hunter participation; determine hunters' opinions on selected turkey management issues, regulations, programs, and access to hunting areas; and examine county-scale distribution of turkey hunting activities.

A self-administered questionnaire was developed, reviewed by Texas Parks and Wildlife Department program and field staff, modified, produced in mark-sense format, and mailed to a sample of Texas turkey hunters. This sample included 3,500 Texas turkey stamp purchasers chosen

at random and all (n=2,345) members of the National Wild Turkey Federation (NWTF) living in Texas. Questionnaires were returned by 1,300 (37%) turkey stamp purchasers and 748 (32%) NWTF members. Of turkey stamp purchasers and NWTF members, 4% (n=50) and 2% (n=15), respectively, were not turkey hunters. Responses from these 2,048 individuals can be generalized to the Texas turkey hunter population at ±3% (α=0.05). For all questions, NWTF member responses were compared to those of turkey stamp purchasers.

Responses of those purchasing turkey stamps and NWTF members differed in nearly every comparison, so NWTF members should be considered a distinct subset of Texas turkey hunters. Therefore, wildlife managers should consider the opinions and attitudes of turkey hunters in general, as well as those of NWTF members, when formulating management recommendations.

The mean age when people began turkey hunting (29.8 years) was older than that of the general Texas hunter population (18 years). Additionally, women made up < 5% of turkey stamp purchasers and NWTF members, a factor that should be considered during development of outreach programs. Most spring turkey hunters already use shotguns (65 and 85% of stamp holders and NWTF members, respectively), so it is unlikely that creating a shotgun-only spring season would significantly influence the number of turkeys harvested. This change would, however, affect those spring turkey hunters who currently choose to hunt with rifles (29 and 6% of turkey stamp purchasers and NWTF members, respectively).

Although NWTF members harvest more birds than the general turkey hunter population, neither groups' harvest approached the 4-bird bag limit. For example, during the 1 September 1996 through 31 August 1997 license year, 84.3% of both groups harvested ≤1 bird and only 0.95% harvested 4 birds. Therefore, reducing the annual bag limit from 4, all the way to 1 bird, would not be expected to dramatically decrease the number of turkeys harvested. Interestingly, fall turkey hunting was viewed as simply an additional hunting opportunity associated with white-tailed deer (*Odocoileus virginianus*) hunting by >90% of the respondents. For this reason, regulatory changes that removed all or part of the fall turkey season from that of white-tailed deer might be expected to influence turkey hunter participation. Additional data on Texas turkey hunter demographics, hunting intensity, hunting methods, land access, harvest success, hunter distribution, as well as hunter perceptions regarding why they hunt turkeys, participation rates, hunting partners, turkey management, and factors they feel limit turkey populations also were included in this study.

The Texas Parks and Wildlife Department (Turkey Stamp Fund), Federal Aid in Wildlife Restoration (Grant W-126-R), and the Texas A&M University System provided funding and/or other support for this project.

Effects of Feral Hogs on Survival and Reproduction of Eastern Wild Turkeys Relocated into the Gus Engeling Wildlife Management Area

Blake D. Petty, Dale A. Kubenka, and Nova J. Silvy– Texas A&M University, and John D. Burk, James C. Cathey, Markus J. Peterson– Texas Parks and Wildlife Department

JAMES CATHEY

The primary objective of this study is to evaluate the effects of nest predation by feral hogs (*Sus scrofa*) on eastern wild turkeys (*Meleagris gallopavo silvestris*) on the Gus Engeling Wildlife Management Area (WMA) in east Texas. The study also will compare effects of using flags to mark turkey-nesting areas versus monitoring nests without approaching them. High turkey mortality and limited reproduction has kept this population from expanding following previous releases.

In January 1999, 21 (1 male and 20 female) turkeys were released into the WMA. On 9 February, 6 additional males were released. All birds were fitted with battery-powered radio transmitters prior to release. Eleven radio-tagged turkeys from previous releases remained on the area. Through monitoring these radio-tagged birds, movements, mortality, and reproduction will be determined.

To reduce the feral hog population, intensive trapping will be implemented year round on the WMA. Turkeys will

be closely monitored throughout the nesting season and nest success determined. In conjunction with data collected previously on the area, the effects of feral hogs on nesting success will be evaluated. Additionally, one half of the turkey nests will be physically marked (flagged ≤164 feet (50 m) from suspected nest site) for later location, while the other half will be monitored, but not approached and flagged. Differences in predation rates for flagged and non-flagged nests will be determined using a Chi-square analysis.

Funding and support for this project has been provided by Texas Parks and Wildlife Department (Turkey Stamp Fund) and the Texas A&M University System.

Assessment of Scaled Quail Population Dynamics in Texas

Raquel Leyva– Texas Tech University, Nick C. Parker– U.S. Geological Survey, Texas Cooperative Fish and Wildlife Research Unit, and Markus J. Peterson– Texas Parks and Wildlife Department

Scaled quail (*Callipepla squamata*) abundance has declined in many areas of Texas during the past few decades. Changes in habitat characteristics may have caused changes in the population dynamics of this species throughout its historical range. This project tests the hypothesis that long-term habitat changes can account for long-term declines in scaled quail abundance in Texas.

Remotely sensed data and existing databases are being used to describe changes in the biotic and abiotic habitat composition of scaled quail in Texas. A Geographical Information System (GIS) is being used to assemble all the databases for habitat description. These include soil description, scaled quail population surveys, historical climate data, and vegetation description.

Arc/Info was used to create a referenced frame using counties as the sampling unit for this study. This frame was used to overlay the coverages produced from each database. Vegetation coverages are currently being processed. A soil map for the state of Texas was created as one of the several data layers that will be integrated into the spatial model. This model should help explain changes in scaled quail abundance in Texas. The historical climate coverages, created using Kriging techniques, began in the late 1800s and include minimum and maximum temperature, precipitation, and snowfall. A total of 3,860 point locations, representing areas where climate stations are located, were used to create a climatic map for the entire state of Texas.

Population surveys derived from the U.S. Fish and Wildlife Service's Breeding Bird Survey for scaled quail will be incorporated into the GIS and will be spatially delineated using the roads where these surveys were conducted.

Completion of this project is expected to provide a tool for managing scaled quail populations in Texas. The remote sensing techniques employed should prove to be important management tools not only for scaled quail, but other wildlife populations as well.

The Texas Parks and Wildlife Department and Texas Cooperative Fish and Wildlife Research Unit provided funding for this project.

Landscape Changes Related to Scaled Quail Habitat in Texas

X. Ben Wu, Nova J. Silvy, and Fred E. Smeins– Texas A&M University, and Markus J. Peterson– Texas Parks and Wildlife Department

Abundance of scaled quail (*Callipepla squamata*) and northern bobwhite (*Colinus virginianus*) in Texas are eruptive and their populations tend to have simultaneous peaks and valleys statewide. Recent studies conducted by the Texas Parks and Wildlife Department have shown the abundance of scaled quail has declined over the last decade in the Edwards Plateau, Trans-Pecos, and especially the Rolling Plains, whereas no long-term trend is exhibited in the South Texas Plains. Landscape-scale habitat changes, including changes in the composition, abundance, and spatial arrangement of land-cover types, are likely causes for the large-scale decline in quail abundance. Determination of landscape changes and their relationship to trends in scaled quail abundance, as well as the land use and management practices that contribute significantly to these, should provide useful information for the Texas Parks and Wildlife Department and private landowners. Such information can be used to design and implement management plans to reverse the decline in scaled quail abundance.

The objective of this study is to determine whether scaled quail abundance has declined across much of its range in Texas as a consequence of landscape changes that have occurred over the last 2 decades. We focus our analysis on the Rolling Plains, where the decline of scaled quail has been most apparent, and the South Texas Plains, where there is no apparent decline.

Remote sensing, GIS, and landscape analysis approaches are used to determine whether and how the composition and spatial pattern of landscapes have changed in the Rolling Plains and the South Texas Plains from the early 1980s to the mid 1990s; assess how these changes differ in these ecological regions; determine which components of the landscape change are closely related to trends in abundance of scaled quail and northern bobwhite; and evaluate what land use or management practices contributed significantly to the landscape changes. A spatially explicit habitat suitability modeling approach at multiple scales will be taken to explore how changes in components of the landscape and their spatial pattern affect habitat quality, and how they differentially affect the habitat of scaled quail and northern bobwhite; to examine how the amount and spatial pattern of land management practices affect landscape pattern and habitat quality; and, to determine the distribution and connectivity of potential quail habitats. Landsat MSS images from early 1980s and early 1990s were acquired for the Rolling and the South Texas Plains. These images are being classified and analyzed to assess the changes in land-cover patterns at regional scales. Sixteen quail survey transects (8 from each ecoregion) with different population trends for scaled quail and northern bobwhite were selected as intensive study areas. Each of these intensive study areas is 21 sq miles (54.4 km^2) in size and includes a 1 mile wide (1.6 km) buffer area along each transect. Digital orthophoto quadrangle (DOQ) data or aerial photos from 1995 and aerial photos from 1982 were acquired, georeferenced and mosaicked for 8 of the intensive study areas. Image processing for classifying these aerial photo images and landscape analysis of the classified images are underway.

Field vegetation/land-cover surveys along 35 transects in the Rolling Plains and 27 transects in the South Texas Planes, approximately 1,240 miles (1,995 km) of transect length, were conducted in July 1998. These data are compared to those of a historical (1976) survey to determine whether and how scaled quail and northern bobwhite habitat selection have changed in response to landscape changes. A regression analyses was used to determine significant relationships of quail numbers over time for each area. Currently, drought indices are being used to determine if they can account for changes in quail abundance over time.

Funding for this study is provided by the Cross Timbers Chapter of Quail Unlimited, Texas Parks and Wildlife Department, the Rob and Bessie Welder Wildlife Foundation, and Texas A&M University.

Landscape Change in Lesser Prairie-Chicken Habitat in the Texas Panhandle

X. Ben Wu, Nova J. Silvy, Fred E. Smeins, and Robert C. Maggio– Texas A&M University, Markus J. Peterson and John P. Hughes– Texas Parks and Wildlife Department

Grassland birds have shown the most consistent decline in abundance of all groups of birds monitored by the nationwide Breeding Bird Survey. The once common lesser prairie-chicken (*Tympanuchus pallidicinctus*, LPC), which occurs within the plains region of Colorado, Kansas, New Mexico, Oklahoma, and Texas, is one of these species at risk. The historical range of the LPC in Texas has been estimated to extend over most of northwestern Texas grasslands, where they tend to be associated with areas of mixed mid- to tallgrass and shrublands [e.g. sand sagebrush (*Artemsia filifolia*), shinnery oak (*Quercus havardii*)] most often on sandy soils. Records indicate there might have been as many as 2 million LPC in Texas prior to 1900. Today, approximately 5,000-10,000 LPC are found in only 2 separate metapopulations in Texas: one in the eastern and northeastern Panhandle along the Texas-Oklahoma border (~725,970 acres; ~293,800 ha) and the other along the Texas-New Mexico border (~690,388 acres; ~279,400 ha). Habitat loss is suspected to be the major factor causing the decline in LPC abundance.

This study investigates landscape changes in LPC habitat and the relationship between these changes and the contraction of LPC range in the Texas Panhandle at both regional and landscape scales. The regional-scale study involves the development of a GIS database for the 60-county area (~37,064,492 acres; ~15,000,000 ha) in the Texas Panhandle containing coarse-scale data layers of environmental attributes and general vegetation type and land use, as well as LPC range extent for 1940 and 1989. Analyses are being conducted to characterize the landscape attributes of LPC habitat, determine their relationship to the change in LPC habitat area, and assess potential LPC habitat areas in the Texas Panhandle. The landscape-scale study is conducted in several intensive study areas (741,290-1,235,483 acres; 300,000-500,000 ha each) in the Texas Panhandle using GIS and aerial photo-based analyses. We assess temporal change in land-use and LPC habitat characteristics over the past 5 decades and their possible relationship to the decline in area occupied by the LPC.

Results of regional-scale analyses, based on the GIS data compiled for the 60-county Texas Panhandle study area, indicate LPC habitat in the Rolling Plains has considerably different landscape characteristics than that in the High Plains. Landscape characteristics of apparently suitable, but unoccupied, habitat differ from currently occupied habitat. A paper based on these results was presented at the Prairie Grouse Technical Council 22nd International Meeting, College Station, Texas on 4-7 February 1998.

Five intensive study areas covering 26 USGS 1:24,000 quadrangles were selected and a GIS database for these areas developed. Historical aerial photos from 1940 and 1995 covering these areas were acquired, scanned, georeferenced, and mosaicked for each intensive study area. Images processing preparatory to classifying these images and landscape analyses are currently underway.

Funding for this study is provided by the Texas Parks and Wildlife Department and Texas A&M University.

Time Difference of Arrival: A New Method of Wildlife Radio Location

Shane Nelson– University of Texas-Austin, and Jerry Cooke– Texas Parks and Wildlife Department

Position information has been, and continues to be, valuable data for better understanding the behavior of animals. It gives insight into animal movements, habitat use, species distribution, feeding, and breeding behaviors. To this end, radio location techniques have been used for decades to monitor animal locations. Applied Research Laboratories has undertaken the design of a new animal radio location system which promises to be highly accurate, operable in most terrains, and confirmable to automatically measure and record 3-dimensional positions in real time.

Position calculations will be based on measurements of signal transit times between an animal's radio transmitter and 3 or more unmanned listening nodes (antennae). The novelty of the approach is in using Global Positioning System (GPS) receivers at each of the listening nodes to provide highly synchronized timing, (10s of nanoseconds) without which such a system could not achieve required accuracy levels. Because GPS receivers also provide position information, these listening nodes are not required to be static and could therefore be moved around to optimize coverage in certain areas or track animals in otherwise inaccessible regions.

Operation of this system will require that animals be fitted with radio transmitters similar in size, weight, and power consumption to those now used for conventional direction-finding radio location techniques. Trends in decreasing size of radio transmitters will allow the tracking of very small animals, and transmission frequencies which are not heavily affected by foliage can continue to be used. System operation will not be as disturbing to the animal as conventional techniques, and it can be configured so that the transmitted signal is unusable to potential poachers.

A Time Difference of Arrival (TDOA) animal tracking system is not a labor intensive tracking method. It can be automated with the data routed to an office computer, and be made to satisfy virtually any sampling interval requirements. Moreover, the output positions require no further processing and will facilitate direct integration of the tracking system with a GIS database.

This project will include a proof of concept demonstration of this system and documentation of both component level system design and likely implementations of a fully developed system. This work is funded as an internal Research and Development project at Applied Research Laboratories in cooperation with the Texas Parks and Wildlife Department and with a Federal Aid in Wildlife Restoration Administrative Grant.

Population Parameters of American Alligators in the Gus Engeling Wildlife Management Area

Lee A. Fitzgerald– Texas A&M University and Dale F. Prochaska, Hayden Haucke, and James C. Cathey– Texas Parks and Wildlife Department

JAMES CATHEY

In spite of their popularity and importance, surprisingly little is known about populations of American alligators (*Alligator mississippiensis*) in Texas. Little is known about alligator populations located in inland, forested areas. We have noted interesting characteristics of alligators in inland areas that appear very distinct from the more studied coastal populations. For example, while alligators seem to be present in creeks and impoundments within their inland range, we suspect they occur at relatively low population densities, and may persist as isolated family groups. Consequently, populations of alligators in these areas are probably structured very differently, both demographically and genetically, from coastal alligator populations. Clearly, these differences need to be quantified and understood for proper management of alligators in different parts of their range.

The Gus Engeling Wildlife Management Area (GEWMA) in eastern Texas provides the ideal location and unique opportunity to study alligators living within forested environments. This property, owned by the Texas Parks and Wildlife Department (TPWD), is located in the Post Oak Savannah ecological region and encompasses approximately 10,956 acres (4,436 ha). There are 7 major spring-fed creeks within the boundaries of the property, all of which flow into Catfish Creek (a tributary of the Trinity River). Catfish Creek gained positive notoriety in 1983, when the creek was designated a National Natural Landmark by the National Park Service. This honor was bestowed because the creek's near pristine qualities represented an ecosystem that is rapidly vanishing throughout much of the United States.

The purpose of our research is to identify factors influencing population structure and dynamics of alligators and integrate information obtained into management strategies. Our research will address the following specific questions:

- What is the size of the alligator population at GEWMA?
- What are dispersal patterns of alligators in forested environments?
- Do males range among different aquatic habitats using creeks as corridors, or do they establish territories along these creeks?
- Are females more sedentary within their home range?
- How are alligator populations structured genetically?
- In what ways are alligators in inland areas different than their coastal counterparts?

To meet the objectives, we will conduct night counts and employ capture/recapture techniques to estimate population size, demographic structure, and the distribution of alligators in Catfish Creek. Radio-telemetry will be used to determine dispersal patterns, male and female movement, and habitat selection. Genetic structure of this population will be studied to determine the extent of metapopulation structure. We predict that single family groups of alligators (i.e., female and her offspring) use individual tributaries or impoundments as breeding and/or nesting locations. Furthermore, we suspect that few mature males actually do the breeding within established territories. By using a panel of genetic markers, paternity analyses will allow us to test this idea. By compiling this information, we will then be able to compare the data from this study to what is known about alligators in other environments. This basic study must be used as the starting point for future management decisions regarding inland alligator populations.

To initiate this project, partial funds were provided by the Texas Parks and Wildlife Department.

Distribution and Growth of American Alligators in a Texas Coastal Marsh

M. Todd Merendino, G. Matt Nelson, Kevin. H. Kriegel, and Justin. P. Hurst– Texas Parks and Wildlife Department

TODD MERENDINO

American alligators (*Alligator mississippiensis*) are common throughout the Coastal Marshes and Prairies ecological region of Texas, being most abundant on the upper Texas Coast. Populations have also spread inland to freshwater reservoirs along the numerous river systems. The alligator has recovered from extremely low population levels in the mid-1900s and is now recreationally and commercially hunted in many southeastern states. The alligator is no longer endangered, however, it is listed as "threatened by similarity of appearance," and as such, harvest and management is governed by the CITES Treaty (Convention in International Trade in Endangered Species).

The management plan for the American alligator in Texas involves various harvest and management techniques for American alligators, most of which are based on intensive research conducted in Louisiana. Most research activity to date in Texas has focused on harvest techniques and harvest rates. Little detailed biological data has been collected, especially from the various habitats occupied by alligators in Texas. Determination of growth rates is needed to verify the applicability of population model assumptions. The mark/recapture study we propose, herein, will provide information on growth rates that will improve our understanding of alligator population dynamics in Texas coastal marsh habitats.

We propose to test the hypotheses that: 1) growth rates of American alligators do not differ along a salinity gradient, and 2) distribution and movements of American alligators are not affected by water salinity.

Study objectives are to: 1) determine growth rates for American alligators in a Texas coastal marsh, 2) assess movements and habitat use along a salinity gradient in a Texas coastal marsh, and 3) provide habitat management recommendations for coastal Texas.

There is likely variation in growth rates among the geographic clines, which will subsequently affect the time it takes alligators to enter the breeding population. Given that such differences in populations exist, research is needed in Texas to improve our harvest management and habitat management for American alligators. Without such critical information such as growth rates, habitat use, and movements, our attempts at alligator management will be a guessing game, at best.

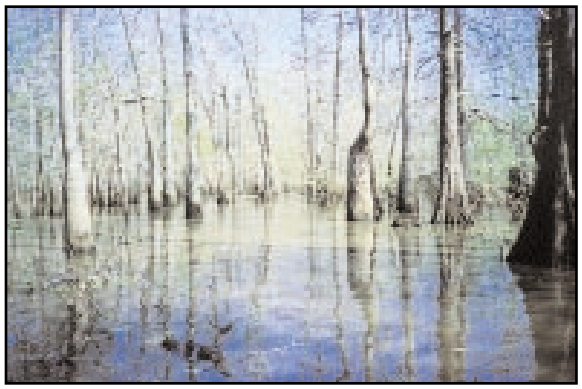
The growth, distribution, and movements of alligators is currently being monitored at Mad Island Wildlife Management Area as part of an ongoing, long-term marsh ecology research project. To date, our efforts have focused on smaller alligators, those generally being <4 feet (1.2m) in length. This mark/recapture effort has been ongoing for 3 years, therefore, some of those alligators are approaching 8 feet (2.4 m) in length. Due to insufficient equipment and safety considerations, we have been unable to capture and measure these larger specimens, but we propose to use nooses and snares to further assess movements and growth rates.

In 1999 and 2000, from March through September, alligators will be captured at night, from airboats. Searches/surveys will be conducted twice monthly. Spotlights will be used to search for alligators throughout the marsh ponds along the salinity gradient. They will be marked with electronic PIT tags, which will be inserted near the base of the tail. Total length will be measured to the nearest millimeter. Sex will be determined via cloacal examination. Subsequent capture efforts will determine movements and growth of marked alligators.

MIGRATORY GAME BIRDS

Evaluation of Nest Site Selection and Nest Success of Breeding Wood Ducks in Blue Elbow Swamp

Douglas Slack and Derrick W. Wolter– Texas A&M University, and James A. Thomas– Texas Parks and Wildlife Department



JAMES A, THOMAS

Wood ducks (*Aix sponsa*) are known to use baldcypress/water tupelo (*Taxodium distichum/Nyssa aquatica*) swamps, mixed bottomland hardwoods, and upland tree species for nesting cavities. However, no study has directly examined nesting preference among these various community types. The majority of previous wood duck nesting studies focused on tree species use in single habitat types and were conducted in the mid-western or southeastern United States. Because artificial nest boxes are not installed on Tony Houseman State Park and Wildlife Management Area at Blue Elbow Swamp, a unique opportunity exists to evaluate the true use of natural cavities and forest communities by wood ducks.

The 3,313-acre (1,341 ha) area is located along the Sabine River and includes forested uplands interspersed within forest wetlands consisting of mixed hardwoods and baldcypress/water tupelo. Logging in Blue Elbow Swamp in the 1940s has transposed the cypress/tupelo community from a baldcypress to a water tupelo dominated community. Little is known about how these changes in forest community and habitat structure may have affected wood ducks that use the area.

This study proposes to examine the cypress/tupelo, mixed hardwoods, and forested upland habitats present within Blue Elbow Swamp and evaluate wood duck natural cavity preference (tree size, species, height, etc.) nest success by tree species and habitat type, identify ages of preferred tree stands, and determine primary nesting habitat. Information obtained from this study will help area managers understand the current state of the nesting wood duck population and determine favorable community characteristics and limiting factors for wood duck production to aid in future forest management.

We will employ radio-marked female wood ducks to find used natural nesting cavities during the nesting season. Following nesting, each cavity will be examined to determine cavity tree characteristics and nest success. Habitat characteristics (species composition, average diameter at breast height, tree density, etc.) will be determined for the vicinity of each cavity tree. Additionally, random locations within each habitat type will be sampled to determine the average number of cavities per species and habitat type. Cavity tree use among available tree species and available natural cavities by habitat type will be evaluated. Radio-marking of females will be conducted during the 1999 and 2000 nesting season.

Funding for this project is provided by Texas Parks and Wildlife Department and Texas Agricultural Experiment Station.

Time Activity Budgets of Wintering American Coots, Gadwalls, and American Wigeon in a Texas Coastal Marsh

M. Todd Merendino, Kevin. H. Kriegel, and G. Matt Nelson– Texas Parks and Wildlife Department

American coots (*Fulica americana*), gadwalls (*Anas strepera*), and American wigeon (*Anas americana*) are 3 of the most abundant waterbirds using Texas coastal marshes during the winter months. These species commonly co-inhabit marshy areas which are characterized by large amounts of submergent vegetation. Wigeongrass (*Ruppia maritima*), a submergent vegetative species, grows throughout a variety of conditions along the Texas coast. Wigeongrass is believed to be an important food

component for many waterfowl species, as well as for coots.

In Texas coastal marshes, large numbers of coots, gadwalls, and wigeon inhabit marsh ponds with an abundance of wigeongrass. Given that all species are utilizing wigeongrass, interspecific competition likely occurs. The study proposed herein, will utilize time activity budgets to determine the amount of inter-specific interactions among coots, gadwalls, and wigeon as it relates to competition for wigeongrass food resources. Temporal abundance of wigeongrass and vertebrate herbivory will be monitored via the construction of "exclosures" in the marsh ponds.

TODD MERENDINO

Study objectives are to: 1) determine temporal abundance and herbivory of wigeongrass, 2) evaluate time activity budgets, 3) determine food habits, 4) determine if the abundance of coots, gadwalls, and wigeon is correlated with the abundance of wigeongrass.

During October 1998, 50 exclosures (1m x 1m) were randomly placed in stands of wigeongrass at Mad Island Wildlife Management Area. Baseline abundance of wigeongrass was determined by clipping 10 1m x 1m quadrats at the time exclosures were placed on the area. From October to February, monthly abundance of wigeongrass was compared between exclosed and un-exclosed sites. In exclosures, wigeongrass declined an average of 41% per month. Outside the exclosures, wigeongrass declined an average of 80% per month. A direct comparison of exclosures versus non-exclosures showed 33, 75, and 98% more wigeongrass inside than outside, during November, December, and January, respectively. Overall, herbivory by coots, gadwalls, and wigeon appears to account for about 20% of the loss of wigeongrass biomass. By late December, wigeongrass is nearly completely gone from the marsh as shown by the 93% decline outside the exclosures.

During the first segment of the waterfowl season (24 October - 30 November), hunters harvested over 2.5 gadwalls or wigeon per day, whereas during the second segment (12 December - 17 January), hunters harvested less than 1 gadwall or wigeon per day. The decrease directly mirrors the depletion of wigeongrass, i.e., by late December, 93% of wigeongrass had either deteriorated or been consumed.

Time activity budgets were conducted once weekly to monitor aggression, locomotion, feeding, preening, and resting. Feeding (combined with locomotion) accounted for 95, 92, and 96% of the activity for gadwalls, wigeon, and coots, respectively. There was little inter- or intra-specific aggression.

We attempted to document food habits via an examination of hunter-shot gadwalls and wigeon. Of the 20 ducks that we examined, no hunter-shot ducks contained any food resources. Coots were collected monthly. Nearly 50% of all coots contained food resources, with wigeongrass being the predominant food.

We propose to repeat this study in 1999/2000.

Genetic Determination of Subspecific Composition in the Gulf Coast Subpopulation of Sandhill Cranes

Jonathan E. Thompson and Bart M. Ballard– Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville, Travis C. Glenn and Jeff French– Department of Biological Sciences, University of South Carolina, and Jay A. Roberson– Texas Parks and Wildlife Department

Based on morphological variation, the Gulf Coast Subpopulation of mid-continent sandhill cranes (*Grus canadensis*) contains 3 subspecies including lesser (*G. c. canadensis*), Canadian (*G. c. rowani*), and greater sandhill cranes (*G. c. tabida*). Previous studies that have investigated subspecific composition of wintering sandhill crane populations have relied primarily on discriminant function equations developed from morphological measurements on birds of known sex and subspecies. However, recognition of subspecies based on morphological characteristics is subject to several potential biases that often go unstated. First, variation in measurement of morphometric characters between observers or even between a single observer and the individual that originally developed the discriminant equation can introduce substantial bias in estimation of subspecific composition. A second concern

with using morphology to identify crane subspecies is the possibility that subadult cranes are not morphologically mature. Morphological studies of subadult birds from other species with delayed sexual maturation (e.g., geese) suggest that completion of skeletal growth may require more time than initially expected. Third, there is still debate on whether there are actually 3 subspecies of migratory sandhill cranes or merely clinal variation in morphology between 2 subspecies that inhabit a vast breeding range. If the latter scenario is correct, our existing morphological models are flawed because they recognize 3 migratory sandhill crane subspecies. Conversely, morphological discrimination of sandhill crane subspecies may prevent recognition of cryptic subspecies (i.e., morphologically similar sandhill cranes may have markedly different genotypes). To combat these problems, a variety of genetic techniques have been developed to construct more accurate avian phylogenies. Analysis of mitochondrial DNA (mtDNA) is probably the best approach for genetic discrimination of avian subspecies because it is maternally inherited, has a more rapid rate of evolution than nuclear DNA, and is selectively neutral despite morphological variation. Furthermore, there is close correspondence between mtDNA and morphological divergence in several other species of birds, despite that most genes influencing morphology are located in the cell nucleus.

This study is using comparative analysis of mtDNA samples to obtain the most reliable estimates of subspecific composition in the Gulf Coast Subpopulation of mid-continent sandhill cranes. Additionally, we plan to compare subspecific discrimination of cranes using genetic and morphological techniques to assess the reliability of using the latter procedure to monitor subspecific harvest of sandhill cranes. We obtained genetic samples from 225 sandhill cranes that were collected during a larger study on the demographics of the Gulf Coast Subpopulation of mid-continent sandhill cranes. Currently, these samples are being sequenced to determine the number of mtDNA haplotypes present in the Gulf Coast Subpopulation. Several states have proposed or have been conducting subspecific harvest surveys on sandhill cranes using morphological discrimination, which in turn will structure future management decisions for mid-continent cranes. The results of our mtDNA study will provide state personnel with critical information to evaluate the validity of using morphological identification to determine subspecific composition in migrating or wintering sandhill cranes.

Cooperative funding for this study is being provided by the Texas Parks and Wildlife Department, Webless Migratory Game Bird Research Program (U.S. Fish and Wildlife Service and the U.S. Geological Survey-Biological Resources Division), and the Caesar Kleberg Wildlife Research Institute at Texas A&M University-Kingsville.

Sub-lethal Effects of Organophosphorus Pesticides on the Productivity and Reproductive Behavior of White-winged Doves

Nathan A. Burkepile, David G. Hewitt– Caesar Kleberg Wildlife Research Institute, and Gary Waggerman– Texas Parks and Wildlife Department

White-winged dove (*Zenaida asiatica*) populations in the Lower Rio Grande Valley (LRGV) of Texas have been declining since the 1920s. One factor contributing to this decline may be the wide-spread use of organophosphorus pesticides (OP) on agricultural lands. These pesticides inhibit cholinesterase (ChE) enzymes resulting in behavioral or physiologic changes or death. Past studies found doves in the LRGV had significantly inhibited ChE levels. Our study is designed to determine if exposure to OP pesticides affect white-winged dove productivity and to determine the likelihood that doves are exposed to pesticides in drinking water.

Forty pairs of white-winged doves were randomly placed in individual breeding pens and assigned to 1 of 2 drinking water treatments: (1) distilled water; and (2) water with 4.5 ppm methyl parathion (MP) once every 6 days. There was no effect of pesticide exposure on the proportion of pairs laying eggs, but the number of eggs/pair and hatching success decreased with exposure to MP. The reduced hatching success was caused in part by a reduction in incubation time from 78 to 33%. These results, along with results from 2 previous years of productivity studies, show that exposure to MP can reduce productivity in white-winged doves.

We collected irrigation water from cotton fields after they had been sprayed with pesticides to determine if pesticide concentrations were high enough to affect white-winged dove productivity. None of 44 samples collected in 1997 and 1998 had pesticide levels necessary to reduce productivity in white-winged doves. Furthermore, white-winged doves in captivity avoided drinking water containing concentrations of pesticides sufficient to impact productivity. These results suggest that doves are unlikely to be exposed to pesticides through irrigation water. The results

of this study will help wildlife managers determine where to concentrate their efforts in restoring white-winged dove populations in the LRGV.

This project was funded by the Texas Parks and Wildlife Department White-winged Dove Stamp Fund and Caesar Kleberg Wildlife Research Institute.

Parasitic Diseases in White-winged Doves from Texas

Jason W. Glass, Alan M. Fedynich– Caesar Kleberg Wildlife Research Institute, Michael F. Small– Sul Ross University, and Steve Benn– Texas Parks and Wildlife Department

White-winged doves (*Zenaida asiatica*) have expanded their breeding range from the Lower Rio Grande Valley (LRGV) and shifted their density distribution to more northerly areas in Texas. To determine if disease-related factors may, in part, influence these observed distributional changes, we are surveying white-winged doves for endoparasites and parasite-associated diseases.

During summer 1997, we collected 171 fledged white-winged doves from 3 geographic regions: the LRGV (57 birds), San Antonio and surrounding area (60 birds), and north central to southeast Texas from San Angelo to Galveston (54 birds). These areas represent the historic breeding area, an intermediate area, and the breeding periphery, respectively.

Trichomonas gallinae was found in 170 birds (99% infected). However, no signs of trichomoniasis were evident, which suggested minimal pathogenicity in fledged white-winged doves. Of concern is the high prevalence of *T. gallinae*, which is a known pathogen, particularly in more susceptible hosts such as mourning doves (*Zenaida macroura*). This takes on added significance as white-winged doves continue to expand into areas traditionally occupied by mourning doves.

Blood parasites found included *Haemoproteus columbae* (76% prevalence), Haemoproteus sacharovi (15% prevalence), and *Plasmodium*-like spp. (15% prevalence). Additionally, a *Sarcocystis* sp. was found in 1% of the birds. We did not observe pathology attributable to these infections; however, others have reported negative impacts of blood parasites.

Nine helminth species were found; 50% of the birds were infected with at least 1 species. The most common was *Ascaridia columbae*, occurring in 26% of the birds. Each of the remaining species occurred in ≤12% of the birds. Three helminth species were found across all geographic regions, 1 was found only at the breeding periphery, 2 were found only in the LRGV, and 4 were absent from the periphery. Currently, we are evaluating which of these helminth species are considered pathogenic.

This study, funded with Texas Parks and Wildlife Department White-winged Dove Stamp revenue and the Caesar Kleberg Wildlife Research Institute at Texas A&M University- Kingsville, will provide important information that can be used to assess the impact of parasites on the eastern population of white-winged doves in Texas.

Mitochondrial DNA Anlaysis of Subspecies of White-winged Doves in Texas

Christin L. Pruett and Scott E. Henke– Caesar Kleberg Wildlife Research Institute, Kelly M. Hogan, Steven S. Smith, and James R. Pierce– Texas A&M University-Kingsville, Michael F. Small– Sul Ross University, and Jay A. Roberson– Texas Parks and Wildlife Department

White-winged doves (*Zenaida asiatica*) in Texas inhabit several diverse ecosystems ranging from semitropical in the southeast to the Chihuahuan desert in the west. However, a recent northward range expansion led to questions about which subspecies are found in Texas and whether they have separate breeding ranges. Historically, 4 subspecies of white-winged doves (*Z. a. asiatica, Z. a. mearnsi, Z. a. monticola,* and *Z. a. grandis*) were thought to occur in Texas, with each subspecies having a limited and allopatric range along the Rio Grande. The subspecies were recognized by differences in size and coloration, but significant overlap in measurements made it difficult to accurately identify birds from the expansion area. Currently, scientists do not agree as to which subspecies occur in Texas. Knowledge of the systematic status and geographic range of various subspecies is needed to assess genetic diversity and overall fitness. Therefore, the objectives of this study were to reevaluate the systematic status of the subspecies, to determine which ones are involved in the recent range expansion, and to determine whether the subspecies have overlapping ranges.

We collected 274 white-winged doves from 34 locations in Texas, New Mexico, and Arizona and analyzed a 300 base-pair of mitochondrial DNA and morphological measurements to differentiate subspecies. Based on geography, morphology, and mtDNA, there are at most 2 subspecies of white-winged doves in Texas, best defined as

eastern and western subspecies. Both subspecies are involved in the range expansion; however, there appears to be unequal rates of colonization with the eastern subspecies expanding their population in Texas more so than the western subspecies. This could be a result of geographic proximity, larger population size, or earlier date of colonization initiation. Also, based on the mtDNA sequence data, a possible zone of contact may exist between the subspecies in central Texas.

This study, funded with Texas Parks and Wildlife Department White-winged Dove Stamp revenue and the Caesar Kleberg Wildlife Research Institute at Texas A&M University-Kingsville, should aid in the future management of white-winged doves in Texas.

Technique Development, Evaluation, and Implementation Recommendations for Implanted Radio Transmitters on White-winged Doves

Michael F. Small, James F. Scudday– Sul Ross University, and Jay Roberson– Texas Parks and Wildlife Department

White-winged Doves (*Zenaida asiatica*) have historically used the lower Rio Grande Valley (LRGV) of Texas as their primary breeding range in the U.S. However, changes in their range in this country have gone from peripheral, to large areas of expansion. This expansion may be due to acclimation to urban areas and previously unused and/or unavailable food and water resources.

With this as one of the primary motivating factors, we have been evaluating various forms of radio transmitter attachment. Because radio telemetry may be the most efficient and cost-effective method of large volume data collection in Columbid species, we are investigating which attachment technique/methodology impacts the overall behavior of the individual the least.

To this end, we constructed 30 aviaries 6.5 x 6.5 x 6.5 feet (2x2x2 m) and 2.2 feet (0.67 m) above the ground to house captive doves for radio transmitter attachment technique evaluation. During 1998, 10 pens housed adult males, 10 pens housed adult females, and 10 pens housed hatching-year birds of unknown sex. Each individual pen housed 7 doves, each from a different treatment group: control, backpack harness, glue-on transmitter, subcutaneous implant, subcutaneous surgery (no implant), intra-abdominal implant, and intra-abdominal surgery (no implant).

More than 300 hours of video-taped behavior was recorded. In addition, blood samples were taken 7 times and packed cell volume, total plasma solids, and white cell differentials recorded. This information is being analyzed to determine which of the treatment groups deviates the least from the control.

Based on the information from 1998, the implant and external attachment techniques which have the least impact on doves will be used for a productivity study during 1999. One pair (male and female) from 3 treatment groups (control, preferred implant, preferred external) will each be placed in 10 breeding pens. Number of eggs layed, number of eggs hatched, and number of young surviving to fledging will be recorded.

Additionally, behavior will be analyzed via continuation of video recording and periodic testing of blood for reproductive hormones using radio immunoassy techniques. The analyses of this unique combination of data from a 2 year period will allow researchers to implement radio telemetry techniques with minimal impact to the individual.

This project is funded by the Texas Parks and Wildlife Department's White-winged Dove Stamp.

NONGAME WILDLIFE

Genetic Research on the State Bison Herd

James Derr, Joe Templeton, and Todd Ward– Texas A&M University College of Veterinary Medicine, and Danny Swepston and Roy Welch– Texas Parks and Wildlife Department

Less than 200 years ago, millions of bison (*Bos bison*) roamed over the North American continent. However, in the 1800s, habitat loss, hunting, and introduced diseases resulted in one of the most dramatic and well documented population reductions in history. By the late 1800s, fewer than 1000 bison remained in the United States. Beginning in 1878, legendary Texas cattleman Charles Goodnight assembled a herd from the remnants of the vast Southern Plains Bison Herd that remained in the Texas Panhandle. His interest in bison was twofold. First, he was a conservationist and was interested in preventing the extinction of this magnificent species. Second, Goodnight was also one of the first to investigate the economic potential of bison. His work with hybridization of bison and domestic cattle was an effort to produce an animal that would withstand the harsh Panhandle environment and still produce a monetary return for the rancher. He also sold bison breeding stock, meat, robes, and mounts.

The owners of the JA Ranch donated Mr. Goodnight's bison to the Department in 1996 to develop a Texas State Bison herd. However, due to the history of these animals, it was possible that some were the offspring of Mr. Goodnight's hybridization experiments. Researchers at Texas A&M University recently developed a genetic test that can identify cattle mitochondrial DNA (a genetic marker) in bison. Using their genetic test, these researchers determined that 6 of the 38 Goodnight bison tested have cattle mitochondrial genes. Also, this herd was found to contain some genetic markers not found in any other bison herd in the United States. Genetic testing will be conducted on all offspring produced in the breeding facilities and will be used to ensure maximum genetic variability is maintained in the bison herd. Additional work will be conducted to compare the genetic makeup of the existing herd with samples taken from bison bone material found at archeological sites within the range of the Southern Herd.

Visitor Impact on Bat Emergence Behavior at the Old Tunnel Wildlife Management Area

John T. Baccus, Marian Bailey, Max Sears, Kelly Harper, Trevor Tanner and Cris Hein– Southwest Texas State University, and Tim A. Lawyer– Texas Parks and Wildlife Department

Texas has 32 bat species, more than any other state, and some exceptionally large colonies which are characteristic of the Southwest. The majority of bats in Texas are insectivorous, and some colonies consume large quantities of insects nightly. Bats are the major predators of night-flying insects and are helpful to farmers and ranchers by controlling certain species of destructive insects.

The Old Tunnel Wildlife Management Area (OTWMA) is a 10.5-acre (4.3 ha) tract of land owned and operated by the Texas Parks and Wildlife Department. The OTWMA, located in northern Kendall County about 14 miles (22.5 km) north of Comfort, Texas, contains an abandoned railroad tunnel which serves as an annual roosting site for about 1-2 million Brazilian (Mexican) free-tailed bats (*Tadarida brasiliensis*). The OTWMA was purchased for the specific purpose of preserving and protecting this important bat colony. With the dramatic increase in public interest about bats, bat biology and life history, the OTWMA has become an extremely popular and important site in terms of public education and public bat-viewing opportunities. In 1998, 13,863 visitors participated in public tours at the OTWMA. As public awareness of the tunnel continues to increase, the potential of detrimental human disturbances to the bat colony also could increase. Little is known about the effects of human disturbance on Brazilian free-tailed bat colonies, but at some point, harassment and roost disturbance cause roost abandonment and a general decline in bat populations. Concern over the effect of visitors watching the emergence of bats has been and will continue to be addressed as part of this research project.

The objectives of this study are to: (1) determine effects of visitors on bat emergence behavior, (2) evaluate the tunnel as a natal site, (3) determine the temporal changes in the composition of the bat population regarding sex and age ratios, (4) estimate bat populations in the tun-

nel, (5) delineate migratory periodicity, (6) determine crepuscular flight patterns, (7) identify species composition, and (8) evaluate continuous site-use by free-tailed bats.

The nature of the colony composition with respect to age and sex will be studied. This will require bimonthly (May to October) collections of bats using a "Harp-Type" bat trap. Bats collected will be aged and sexed, marked, and reproductive information will be recorded. Surveys of the tunnel during late June and early July will verify the presence or absence of pups. Data collected will be used to develop a population profile for the resident bat colony. Use of the tunnel by migrating bats will be assessed during February to May and August to November by trapping and surveys of the tunnel.

The results of this on-going research will be used to properly manage the extensive public-use on the OTWMA without impinging upon the integrity of the resource. A major benefit of this research will be the development of a long-term operational policy for the OTWMA. These policy guidelines are necessary for site-specific management of public lands containing important bat colonies.

This is year 8 of the study funded by the Texas Parks and Wildlife Department and Southwest Texas State University.

Population Structure of the Nine-banded Armadillo on the Gus Engeling Wildlife Management Area

James C. Cathey, Dale F. Prochaska, Jeffrey W. Gunnels, John K. Thorne, Todd E. Richards, and Hayden Haucke– Texas Parks and Wildlife Department

The focus of this study is on population structure, distribution, and abundance of the nine-banded armadillo (*Dasypus novemcinctus*) on the 10,956-acre (4,434 ha) Gus Engeling Wildlife Management Area (GEWMA) in Anderson County, Texas. The GEWMA is typical of both upland and bottomland riparian zones historically found throughout the Post Oak Savannah ecological region. However, much of the native wildlife habitat in this ecological area has been altered and drastically degraded due to changes in land use practices. The GEWMA allows the opportunity to conduct long-term investigations on many species, such as the nine-banded armadillo. Based on our observations and personal communication with local residents, we suspect that armadillo populations may be declining in the area. It is our desire to establish a long-term project to monitor armadillo populations and increase our knowledge of this species in eastern Texas. In this study, we will accomplish the following objectives:

- Establish a long-term monitoring scheme for armadillo populations on the GEWMA.
- Establish transects to quantify armadillo population trends.
- Document armadillo habitat preferences, distribution, and movement patterns.
- Document armadillo population parameters such as age structure, sex ratio, recruitment, longevity, and growth rates.
- Provide blood samples for leprosy studies to researchers at Louisiana State University.
- Establish a tissue data bank for future genetic analysis.

HAYDEN HAUCKE

This project will begin in the spring of 1999. However, some of the methodology was refined during the summer of 1998. Survey lines were established encompassing both upland and bottomland habitats. Transect data were collected from 1 hour prior to sunset and ending approximately at midnight. Area personnel searched for armadillos from a jeep, using spotlights and armadillos were captured with long-handled fishnets. Sex, weight, and age (adult, juvenile, and young) were recorded for each armadillo. A biopsy of the ear was collected and placed into a vial containing 80% ethanol for future genetic work and to visually mark the animal. Finally, a PIT tag was injected in the interstitial space between the abdomen and carapace, to individually mark each individual. To date, survey lines have been searched 3 times and 5 armadillos have been captured.

Results from this project will enhance our understanding of armadillo ecology and population status in the Post Oak Savannah. In some cases, certain species may act as barometers of healthy ecosystems and aid biologists

in assessing impacts of land use practices on wildlife habitat. Such is the case in the Post Oak Savannah where large-scaled habitat manipulations are occurring (conversion of pastures for livestock grazing, timber harvest, urbanization, and overgrazing). A long term monitoring study of armadillos on the GEWMA will show if current observations warrant concern, or indicate if armadillos are experiencing natural population fluctuations.

This project is funded by Texas Parks and Wildlife Department.

Food Habits, Reproduction, Diseases, and Condition of Feral Hogs in the Central Rolling Plains

Duane Lucia, Brad Simpson, and Calvin Richardson– Texas Parks and Wildlife Department

Feral hogs (*Sus scrofa*) have increased dramatically in the past decade in the central and northern portions of the Rolling Plains ecological area. Therefore, this study was initiated in September 1996 to gather biological information and to assess impacts on native wildlife of the colonizing population of feral hogs in the central Rolling Plains.

The objectives of this study are to: (1) determine seasonal food habits of feral hogs in the central Rolling Plains, (2) assess direct impacts of feral hog depredation on vertebrate wildlife species including potential impacts on deer, quail, and turkey production, (3) assess the potential for competition between feral hogs and native wildlife for hard and soft mast, (4) evaluate breeding chronology and reproductive potential relative to site, season, nutrition, and age, (5) determine the role of feral hogs in the Rolling Plains as vectors for human, livestock, and wildlife diseases, and (6) establish management recommendations for feral hogs in the Rolling Plains.

A major portion of the study is being conducted on the 28,000-acre (11,332 ha) Matador Wildlife Management Area, located in Cottle County. Other study sites are in the 4 surrounding counties, Motley, King, Kent, and Dickens. Sampling is conducted seasonally, with a minimum of 25 hogs collected each season for a total sample size of 100+ hogs/year. Hogs are collected by ground shooting, trapping, and aerial gunning in cooperation with Wildlife Services (formerly Animal Damage Control).

One hundred forty-nine hogs have been collected for the study. Thirty percent of all hogs collected were ≤1 year of age with a mean dress weight of 43 lbs., 38% were 1 to 2 years of age with a mean dress weight of 93 lbs., and 7% were 2 to 3 years of age with mean dress weight of 115 lbs., 20% were 3 to 4 years of age with a mean dress weight of 128 lbs., and 5% were 4 to 5 years of age with a mean dress weight of 177 lbs.

Eighteen percent ($n=16$) of feral hog sows collected, contained fetuses. Forty four percent of the sows carrying fetuses were 18 to 22 months of age with a range of 8 to <72 months. Average number of fetuses were 5/sow, ranging from 1 to 10 fetuses/sow, with a male to female sex ratio of 1:1. Farrowing dates were 7% in the fall, 71% in the winter, and 21% in the spring. Conception rates were 38% in the fall, 25% in the winter, 6% in the spring, and 31% in the summer.

Stomach contents for food habits analyses are being categorized into 10 food classes: grasses, forbs, woody plants, roots/tubers, cactus pads, cactus fruits, hard mast, soft mast, vertebrates, and invertebrates. Preliminary analyses indicate seasonal use of food resources. Feral hogs consumed, by volume, 25% grass and 35% roots/tubers in spring, 49% soft mass in summer, 43% grain crops in fall, and 55% roots/tubers in winter. Frequency of roots/tubers in hog diets was higher in spring (74%) and winter (83%) than any other food item. Roots/tubers and soft mass were found at the same frequency (71%) in the summer. In the fall, grain crops and invertebrates were found more often (61%) than any other food item.

Funding for this project is provided by Texas Parks and Wildlife Department, Central and South West Environmental Services; West Texas Utilities Division and USDA/Wildlife Services. This project is scheduled for completion in FY 99.

Small Mammal Research at Matador Wildlife Management Area

Melinda L. Clary, Robert J. Baker, and Robert D. Bradley– Texas Tech University, and Brad Simpson– Texas Parks and Wildlife Department

Researchers at Texas Tech University and the Texas Parks and Wildlife Department (TPWD) have initiated investigations on the response of small mammals to burning and grazing practices. An experimental design was developed to examine these effects at the Matador WMA. Twenty-six small mammal transects were established in 6 pastures corresponding to pre- and post-burn sites. Initial

pre-burn sampling occurred from 6-8 February 1998. Fifteen species of small mammals were collected during this sampling period. Plans are to resample these transects during February 1999 and at regular intervals in order to determine the effects of post-burning. It is expected that future research will incorporate the effects of grazing practices on small mammal communities; we anticipate beginning this portion of the study in fall 1999. Data generated from burning and grazing experiments will be combined with GIS and vegetational information in order to provide a bioinformatic approach that will identify small mammal response to these 2 practices.

Funding for this project is derived from a joint effort between the Texas Parks and Wildlife Department and Texas Tech University.

Spring and Summer Diets of Greater Roadrunners in South Texas

Richard T. Kazmaier– Oklahoma State University, and Donald C. Ruthven III and David R. Synatzske– Texas Parks and Wildlife Department

Greater roadrunners (*Geococcyx californianus*) are locally common throughout the western two thirds of Texas. Little information is available on the diet of the greater roadrunner; however, anecdotal information suggests that reptiles are important prey items. Of potential concern, are the impacts of greater roadrunners on threatened reptiles such as the Texas horned lizard (*Phrynosoma cornutum*). Our objective is to investigate the diets of roadrunners during the spring and summer months when reptiles are generally most active.

The study area is the Chaparral Wildlife Management Area (CWMA) which is a site of relatively high greater roadrunner and Texas horned lizard abundance. Fifty-four and 64 greater roadrunners were collected by shooting during spring and summer 1997 and 1998, respectively. Stomachs were analyzed for proportion of occurrence of prey items based on families.

Stomachs contained remains representing 49 families of insects, 6 families of spiders, 1 family each of scorpion, wind scorpion, and centipede, 2 families of terrestrial snails, 3 families of reptiles, 2 families of amphibians, 3 families of mammals, and 3 families of birds, as well as various fruits. Grasshoppers (Acrididae and Tettigonidae) were the most common prey item being found in more than 93% of the stomachs studied. Other commonly occurring arthropods were leaf-footed bugs (Coreidae), darkling beetles (Tenebrionidae), dung beetles (Scarabaeidae), and jumping spiders (Salticidae). Terrestrial snails (Bulimulidae) were also a common food item. Reptiles occurred in 35% of the stomachs examined. Because of the rapid rate of digestion, many reptile remains could not be identified to species. Identified reptiles include Texas spotted whiptail (*Cnemidophorus gularis*), Texas horned lizard, southern prairie lizard (*Sceloporus undulatus*), Texas spiny lizard (*Sceloporus olivaceus*), Schott's whipsnake (*Masticophis schotti*), ground snake (*Sonora semiannulata*), Texas blind snake (*Leptotyphlops dulcis*), Texas patchnose snake (*Salvadora grahamiae*), and a hatchling yellow mud turtle (*Kinosternon flavescens*). Six Texas horned lizards were found in 5 stomachs. Mammals detected in the diet include desert cottontail rabbit (*Sylvilagus audubonii*), hispid cotton rat (*Sigmodon hispidus*), and Merriam's pocket mouse (*Perognathus merriami*). Birds in the diet included 2 northern bobwhite quail (*Colinus virginianus*), 1 pyrruhoxia (*Cardinalis sinuatus*), and 1 juvenile greater roadrunner. Pricklypear cactus (*Opuntia engelmannii*) fruit was the most common fruit encountered the stomachs examined.

Greater roadrunners appear to be very opportunistic foragers. Insect production appeared high during the wet spring and summer of 1997 resulting in high utilization by greater roadrunners. However, predation on vertebrates was also common. The dry spring and summer of 1998 allowed us to test the hypothesis that predation on vertebrates would increase during drought. Preliminary results indicate that predation on mammals, birds, and whiptail lizards (*Cnemidophorus* spp.) increased during 1998. Consumption of arthropods generally decreased. However, darkling beetle and butterfly (larva and adults) consumption increased during 1998. Roadrunners containing caterpillars were collected in late August and early September following August rains which apparently stimulated caterpillar production. Utilization of pricklypear fruit also appeared to increase during 1998.

In areas of high greater roadrunner density and low to moderate Texas horned lizard density, predation by greater roadrunners may adversely affect Texas horned lizard populations or hamper reintroduction efforts. However, on the CWMA, Texas horned lizard numbers appear to remain stable despite high greater roadrunner numbers.

Colonial Waterbird Survey and Management

Brent Ortego– Texas Parks and Wildlife Department

The Colonial Waterbird Survey is an on-going cooperative effort between Texas Parks and Wildlife Department (TPWD), the U.S. Fish and Wildlife Service, Texas General Land Office, Texas Colonial Waterbird Society, and other interested organizations and volunteers. The TPWD has participated with this survey since 1968. Department activities have been funded by the Federal Aid in Wildlife Restoration Grant W-125-R and have included conducting bird banding research; serving as the primary manager of the data from cooperative surveys and maps of colony locations; conducting aerial and ground surveys of colonial waterbird sites, both inland and along the coast; providing information to the public about colonial waterbirds in the form of pamphlets and signs at colonies and public boat ramps near colonies; and assisting in managing selected colonies along the coast. Today, TPWD participates by conducting aerial surveys of remote colony sites along the Gulf Coast during even numbered years between May 15 and June 1. Data generated are pooled into a common data base that frequently is used by participants, consultants, and developers to avoid damaging colonial waterbird nesting sites. Data are also used to monitor coastal population trends of 25 species of colonial waterbirds whose populations are very good biological indicators of the health of the coastal wetlands and estuaries. This Texas survey is viewed as one of the best of its kind in the nation and is the longest running one.

A total of 23 active colonial waterbird colonies and 64,614 nesting pairs were found during the biennial aerial survey of the upper to central Texas coast. The number of pairs is about twice that found during the drought year of 1996, but is about the same as during the normal rainfall year of 1994. Populations along the lower Guadalupe River (14,831 in 1998 vs. 25,970 in 1994) and Trinity River (14,725 in 1998 vs. 24,051 in 1994) are still much lower than in 1994. They were considerably higher in the marshes of Jefferson County (10,773 in 1998 vs. 1,430 in 1994), and about the same in the marshes of Matagorda County (11,801 in 1998 vs. 8,339 in 1994) and along the Brazos River (12,684 in 1998 vs. 10,982 in 1994).

Geographic Information System staff continued to develop computer generated maps of the colonial waterbird nesting sites along the coast. A meeting with colonial waterbird survey cooperators was held in Corpus Christi to coordinate upcoming survey efforts and plan for data storage and management.

Distribution, Use of Habitat, and Nesting Success of Breeding Shorebirds in the Playa Lakes Region of Texas

Warren C. Conway, Research Assistant, Loren M. Smith– Caesar Kleberg Professor of Wildlife Ecology, Texas Tech University, and James D. Ray– Texas Parks and Wildlife Department

The Playa Lakes Region (PLR) of Texas is one of the largest, most featureless, landscapes in North America, covering over 31,660 sq miles (82,000 km^2) and containing over 22,000 playa wetlands. Other wetlands, such as saline lakes, manmade, and riparian wetlands occur in this otherwise agriculturally dominated region. These wetlands provide suitable habitat for many migrating shorebirds and wintering waterfowl, but no studies have investigated distribution, habitat use, and nesting success for shorebirds breeding in the PLR. The objectives of this project are to: (1) determine species composition of breeding shorebirds in the PLR of Texas, (2) examine macro- (i.e., among wetlands) and micro- (i.e., within wetlands) habitat selection by shorebird species during the breeding season, (3) determine factors affecting nesting success and nest site selection among breeding shorebirds, and (4) develop conservation and management plans for shorebirds breeding in the PLR.

During the 1998 breeding season, we surveyed playa and manmade wetlands in Armstrong, Briscoe, Carson, Floyd, Gray, and Randall counties, saline lake wetlands in Bailey, Lynn, and Terry counties, and riparian wetlands in Childress, Hall, Motley, Potter, and Wheeler counties. At each study wetland, we collected macrohabitat data at the beginning and end of the breeding season, performed bird counts on an approximate 10 day rotation, and searched for and monitored shorebird nests. American avocets (*Recurvirostra americana*), black-necked stilts (*Himantops mexicanus*), killdeer (*Charadrius vociferus*), and snowy plovers (*C. alexandrinus*) were observed nesting in study wetlands. All species nested in saline lake wetlands; avocets and killdeer nested in playa wetlands; but, only snowy plovers nested in riparian wetlands.

Between early and late sampling periods, there were large-scale changes in measured macrohabitat characteristics for playa and manmade wetlands,. Due to below normal precipitation in 1998, many playa wetlands lost most surface water, making these habitats unsuitable for nesting shorebirds. Saline lake wetlands were more resilient to the hot, dry conditions, but "used" saline wetlands (i.e., wet-

lands where nesting shorebirds were observed) had more water and mudflats than "non-used" (i.e., wetlands where no shorebirds were observed nesting). Adjusted Mayfield nest success estimates were similar between avocets (26.6%) and black-necked stilts (27.0%), but these 2 species had lower nest success than killdeer (57.8%) and snowy plovers (58.2%).

After the next field season, a management and conservation plan will be developed to make recommendations to land managers and landowners concerning reducing nest failure and enhancing habitat suitability for shorebirds breeding in the PLR. This project has been funded by the Texas Parks and Wildlife Department; Texas Tech University's Department of Range, Wildlife, and Fisheries Management; the Playa Lakes Joint Venture; the U.S. Fish and Wildlife Service; and the Texas Panhandle Audubon Society.

Demography and Activty Patterns of Western Diamondback Rattlesnakes in the South Texas Plains

Donald C. Ruthven III, James F. Gallagher, and David R. Synatzske– Texas Parks and Wildlife Department

JOE MOODY

Western diamondback rattlesnakes (*Crotalus atrox*) are the most common venomous serpent found throughout much of Texas. South Texas is well known for its high density of diamondback rattlesnakes and exceptionally large specimens. In this region, diamondback rattlesnakes can be encountered during all months of the year. However, the ecology of this species in the south Texas ecosystem is not well documented. The objective of this study is to document activity patterns and demography of diamondback rattlesnakes.

The study site is the Chaparral Wildlife Management Area in Dimmit and LaSalle Counties, Texas. Diamondback rattlesnakes were captured during fortuitous encounters while road cruising during 1996-98. Upon capture, snakes were measured (snout-vent and total length), sexed, and marked by the subcutaneous insertion of a passive integrated transponder (PIT) tag. Snakes were then released.

A total of 129 diamondback rattlesnakes were captured, with 3 (2.3%) individuals being recaptured during the 1996-98 study period. Males [37 inches (94 cm), total length] were significantly larger than females [32 inches (81 cm), total length]. The largest individual captured measured 56 inches (142 cm) in total length. The observed sex ratio of 1:3.7 was skewed towards males. Snakes were encountered during all months of the year except January. Snakes were most active during mid-spring with 50% of total captures occurring during the months of April and May. Diurnal activity appeared to decrease throughout summer with a slight increase in activity in early fall before decreasing in winter.

The high activity period associated with spring was most likely a result of snakes becoming more active with the onset of warmer temperatures, followed by extensive searches for prey items, and males seeking females. The uneven sex ratio can also be explained by greater activity of males in search of females. Decreased activity during the summer months indicates increased nocturnal activity by rattlesnakes to take advantage of optimum temperatures. Too few rattlesnakes were recaptured to estimate population size. However, recapture data indicates that rattlesnakes in south Texas may have relatively small home ranges as all recapture events occurred within 100 yards (92 meters) of the original capture site.

Fear of rattlesnakes generally leads to their death when human-rattlesnake encounters occur. Most human activity on south Texas rangelands occurs during hunting seasons (September-May). Our data indicate that rattlesnakes are most vulnerable to harvest by hunters during spring turkey season. A better understanding of rattlesnake ecology combined with greater education efforts may decrease fatal encounters between humans and rattlesnakes. The impacts of hunter harvest on rattlesnakes are unknown and warrant further investigation.

ENDANGERED RESOURCES

Texas Nature Trackers: Monitoring the Status of Rare Species Using Citizen Volunteers

Lee Ann Linam– Texas Parks and Wildlife Department

LEE ANN LINAM

In 1992, the Texas Parks and Wildlife Department 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 a program called Texas Nature Trackers.

Statewide projects include Texas Horned Lizard Watch, Texas Mussel Watch, and Texas Amphibian Watch. In 2 years, volunteers have collected data on Texas Horned Lizards (*Phrynosoma cornutum*) at approximately 175 sites. Data have helped to document the current distribution of the species and to establish a correlation (Cochran-correct chi-square; ($\alpha = 0.05$) between presence of the red imported fire ant (*Solenopsis invicta*) and the absence of horned lizards. Over 25 volunteers have been trained in workshops for Texas Mussel Watch. In the past year these volunteers have recorded over 31 site visits and have documented 2 new records for mussel species not previously found in Austin county. Texas Amphibian Watch was initiated in spring 1999, with several workshops offered to potential volunteers. Volunteers may participate in an atlassing effort, conduct amphibian monitoring at sites they select, or conduct surveys on routes established by the North American Amphibian Monitoring Program.

Site-specific projects have been developed for 8 species at 14 different sites. Species include big red sage (*Salvia penstemonoides*), bracted twistflower (*Streptanthus bracteatus*), Rydberg's scurfpea (*Pediomelum humile*), Texas salamander (*Eurycea neotenes*), Jollyville Plateau salamander (*Eurycea* sp. 1), horseshoe liptooth snail (*Polygyra hippocrepsis*), palmetto pill snail (*Euchemotrema cheatumi*), and maritime pocket gopher (*Geomys personatus maritimus*). Project volunteers are trained on site by TPW biologists. Volunteers have documented new populations for some species (Rydberg's scurfpea), have collected the first ever quantitative data for others (horseshoe liptooth snail), and have monitored the results of flood and drought damage to several plant populations (big red sage and bracted twistflower).

Partial funding for this work is being provided by Section 6 of the U.S. Endangered Species Act.

Assessment of Habitat Features at Potential Reintroduction Sites for Attwater's Prairie-Chickens

Lee Ann Linam– Texas Parks and Wildlife Department

This project will examine 3 potential reintroduction sites in Brazoria, Matagorda, and Aransas Counties for the purpose of assessing habitat requirements associated with the Attwater's prairie-chicken (*Tympanuchus cupido attwateri*). Currently, the Attwater's prairie-chicken is the most endangered animal in the state of Texas. In particular, this study will assess habitat characteristics including total native grassland area, degree of habitat fragmentation near the potential release sites, composition of grass and forb communities, insect abundance, predator abundance, evidence of disease (based on local galliformes, especially northern bobwhite, *Colinus virginianus*), and topography with regards to flooding. In addition, this study will assess local land-use trends, concerns and support of local landowners and the local community, and the success of the reintroduction effort in addressing those concerns at the 3 potential reintroduction sites.

Funding for this work is being provided by Section 6 of the U.S. Endangered Species Act.

Southern Pine Beetle Infestation of Red-cockaded Woodpecker Cavity Trees

Richard N. Conner and D. Craig Rudolph– Southern Research Station, Robert N. Coulson– Texas A&M University, and Ricky W. Maxey– Texas Parks and Wildlife Department

Substantial new information was discovered during this 3 year investigation of relationships between southern pine beetles (*Dendroctonus frontalis*) and Red-cockaded Woodpeckers (*Picoides borealis*). But, the basic cause for elevated infestation rates of active woodpecker cavity trees and their apparent attractiveness to southern pine beetles remains unknown.

Losses of active cavity trees to infestation by southern pine beetles continue to impact woodpecker cavity trees and populations, but not as severely during the past 2 years because southern pine beetle populations were very low. Management's ability to use artificial cavity inserts continues to aid Red-cockaded Woodpecker populations which continue to be impacted by southern pine beetle activity, particularly those populations located in loblolly (*Pinus taeda*) and shortleaf (*P. echinata*) pine habitat.

We checked all active and inactive cavity trees on the Angelina National Forest from 1983 through 1998. During the field work, approximately 139 loblolly pine, 52 shortleaf pine, 17 slash pine (*P. elliottii*) and 360 longleaf pine (*P. palustris*) were examined for status and possible bark beetle activity. A total of 568 pines were examined each season. About 62 cavity trees were infested and killed by bark beetles during the study. Other causes of cavity tree mortality were wind damage (20, most killed during the storm in February 1998), and 3 were killed by lightning.

We examined southern pine beetle infestation rates of pines with natural vs. artificial cavities in loblolly and shortleaf pine habitat on the northern portion of the Angelina National Forest. No significant difference existed in the rate at which southern pine beetles infested and killed pines with natural cavities vs. those with artificial cavity inserts. Southern pine beetles infested and killed 20 natural cavity trees (25.6%) during a 5-year period (78 cavity-tree years) and 19 artificial cavity trees (18.8%; 101 cavity-tree years). Data for the entire Angelina National Forest indicate that 40% (25 of 62) of the cavity trees killed by southern pine beetles between 1984 and 1996 had been the nest tree during the preceding breeding season.

Data on southern pine beetle activity for 1984-1998 in the forest compartments on the north end of the Angelina National Forest were obtained from the Forest Pest Management section of the U.S. Forest Service in Pineville, Louisiana. We now have 14 years of complete data available to explore relationships between southern pine beetle infestation of single cavity trees and "ambient" population levels of southern pine beetles.

Data obtained during the study has strengthened our understanding of the relationship between southern pine beetle activity in the forest habitat that surrounds active Red-cockaded Woodpecker cavity-tree clusters and the impact these beetles have on active cavity trees. We have determined that southern pine beetle population levels are significantly correlated with the infestation and mortality of Red-cockaded Woodpecker cavity trees. We do not know why southern pine beetles appear to single out active cavity trees for infestation at a higher rate than infest inactive cavity trees. However, southern pine beetle attraction may be related to resin volatiles produced when woodpeckers excavate resin wells and/or changes in the levels of infestation-inhibiting tree volatiles as a result of cavity and resin well excavation. We also do not know why southern pine beetles appear to prefer the active cavity tree that was used as the nest tree during the preceding breeding season.

Atlas of Piping Plover Sightings along the Texas Gulf (1992-1998)

Tammy L. White and Lee F. Elliott– Texas Parks and Wildlife Department

LEE ELLIOTT

Until the Piping Plover (*Charadrius melodus*) was listed as threatened in 1986, little was known about this species on its wintering ground. Since that time, some attention has been focused on this important period in the species' life cycle. This Atlas attempts to provide a single

source for distributional information on the Piping Plover as they winter in Texas. It draws on information from many sources and provides a snapshot of our current understanding of its distribution in Texas. Information sources include studies performed or funded by Texas Parks and Wildlife Department, surveys performed in the process of obtaining permits from the U.S. Army Corps of Engineers, academic studies, observations by skilled field ornithologists, results from Christmas Bird Counts, results of the 1996 International Piping Plover census, and studies funded by the U.S. Fish and Wildlife Service.

Locational information from many sources was transferred to standard topographic maps and digitized into a Geographic Information System (Atlas GIS for DOS, version 2.1). The polygons were overlaid on U.S.G.S. topographic maps and presented in a format that allows easy interpretation. Information about each of the digitized polygons was entered into an associated database. The produced Atlas represents a hard copy of the developed GIS, to be used by resource agencies, researchers and others interested in wintering Piping Plovers. This Atlas and the associated GIS contains 5,440 polygons, representing 67,395 individual sightings of Piping Plover. Acquisition of sighting information focused on the period between 1992 and 1998, however, some information outside of this time frame is included.

Bald Eagle Nesting and Wintering Surveys

Mark Mitchell, Kevin Herriman, and Annice Storey– Texas Parks and Wildlife Department

Nesting bald eagles (*Haliaeetus leucocephalus*) have been monitored in Texas since the 1960s, at which time there were an estimated 3 known active nesting territories. In the 1970s, efforts were increased to find and document active nesting territories. From 1975 to 1998, the number of active territories increased from 7 to 62, respectively. This increase was due to a combination of an increasing bald eagle population, an increase in agency effort, and an increase in public awareness and reporting of nests.

The nesting population of bald eagles is estimated using aerial and ground surveys of known and newly reported bald eagle nests. Surveys are conducted annually January through March. Data collected include nest location, general site description, activity status, productivity, and estimated hatching date. These data are used extensively to aid in the preparation of environmental impact statements for development projects in areas of known nesting activity.

Annual surveys of non-nesting wintering bald eagles are conducted on 22 standardized locations during mid-January. Survey sites include the Laguna Atascosa National Wildlife Refuge, Attwater Prairie Chicken National Refuge, the Garwood/Eagle Lake Rice Prairies, and 19 reservoirs throughout north, central, and east Texas. These surveys are coordinated by Texas Parks and Wildlife Department personnel but utilize volunteer labor. Volunteers conducted surveys on all of the 22 sites during January of 1996, 1997, and 1998 and counted 248, 305, and 325 bald eagles, respectively.

These are ongoing annual surveys funded by the Texas Parks and Wildlife Department through Federal Aid in Wildlife Restoration Grant W-125-R.

The American Peregrine Falcon in Western Texas and Adjacent Northern Mexico

Bonnie R. McKinney– Texas Parks and Wildlife Department

The U.S. Fish and Wildlife Service has begun delisting procedures for the American peregrine falcon (*Falco peregrinus anatum*). Although recovery criteria are being met in some areas of the Southwest, the peregrine falcon population in Texas has the poorest production and numbers in the United States. The west Texas population is found in the rugged canyon country in the lower Big Bend Region, primarily along the Rio Grande corridor, which forms a boundary with the state of Coahuila and Chihuahua, Mexico. Nearly half of the total known population (15 pairs) are located on the Mexican side of the Rio Grande. The population is geographically isolated due to its location outside the central flyway and has not been manipulated through cross-fostering or hacking captive-raised peregrines. This population could possibly be the purest strain of *anatum* peregrines found in the United States today.

From 1974 to the present, from 2 to 19 breeding areas have been closely monitored. In 8 of 24 years, production has reached, or exceeded the 1.25 young fledged per adult pair, which was deemed necessary by the U.S. Fish and Wildlife Service for population stabilization. A total of 159 young have been produced during the 24-year period (young observed) with 148 total young fledging.

The 1998 field season yielded a total of 19 sites that were checked for peregrine activity. Of these, a total of 11

breeding areas were occupied by peregrines along the Rio Grande corridor in Texas, in the Chisos Mountains of Big Bend National Park, and adjacent Mexico. These 11 breeding areas (1 pair per breeding area) fledged a total of 2 young, resulting in an average of 0.18 young fledged per adult pair.

Nest failure during the incubation stage and mortality of nestlings is common. In addition, recruitment rate is very low, sometimes taking several years for a lone adult to recruit a new mate. Immature adults are seldom seen which may indicate a high mortality rate in this non-migratory population. Contaminants may be a possible factor responsible for poor reproductive success. Opportunistic collections of peregrine feathers, egg shell fragments, and selected prey species have been analyzed for possible DDE, mercury, and other contaminant effects. These results will be combined with future sample analyses to understand possible factors of low reproduction.

Current and future research needs will continue to focus on contaminants, reproductive success, and more extensive surveys in the nearby mountains of Coahuila, Mexico.

Funding for this research has been provided by the Texas Parks and Wildlife Department, U.S. Fish and Wildlife Service, and from private donations.

Roadside Survey for Black-capped Vireo Habitat on the Edwards Plateau

John P. Maresh; Gareth A. Rowell; Kevin O'Neal– Texas Parks and Wildlife Department

The purpose of this study was to assess the availability and occupancy of black-capped vireo (*Vireo atricapillus*) habitat along public roadways in each county of the Edwards Plateau physiographic region of Texas. Previous studies have surveyed public lands and nonsystematic highway rights-of-way associated mostly with road construction/improvement projects.

Black-capped vireo breeding habitat generally consists of scrub-type vegetative communities. These vegetative communities include oaks (*Quercus* spp.) and have extensive low-level <10 ft (<3 m) brush. Texas persimmon (*Diospyros texana*) and Texas mountain laurel (*Sophora secundiflora*) are also important components in the southwest portion of the region. Brush canopy is highly variable but usually ranges from 30-70% cover. It may include adjacent open areas and woody areas with up to 100% canopy closure. Woody shrubs at 0-10 feet (0-3 m) appear to be a critical component of breeding habitat and provide the supporting vegetation for nest sites.

A strip census approach was used along roads and highways in each county of the Edwards Plateau beginning in July 1996 and ending in June 1998. Two transects, each of 30 miles (48 km), were driven per county. The length of the habitat along each route was recorded by odometer to the nearest 0.10 mile (0.16 km). Strips of roadside were also recorded using differentially corrected GPS. Digital locational data were recorded using a Motorola 6 channel GPS receiver and PC-based GEOLINK GPS software (GeoResearch, Inc). Census of the number of individuals was either conducted during the habitat survey or deferred to site revisits during the 1998 breeding season.

A total of 2,070 survey miles (3,331 km) were driven over the 35-county area. From this, 76.9 miles (124 km) of potential black-capped vireo habitat was observed based on vegetation composition and structure. Using these amounts, approximately 3.7% of the total distance driven was observed to have potential black-capped vireo habitat. Total habitat per county ranged from 0.1 miles (0.16 km) in Schleicher County to 10.2 miles (16.4 km) in Val Verde County. Counties in the top 20th percentile by amount of potential black-capped vireo habitat included Crockett, Gillespie, Kerr, Kinney, McCulloch, Medina, and Val Verde. The number of black-capped vireos observed for the entire 35 county survey area was 59 individuals. The number of individuals ranged from 0 (several counties) to 13 (Val Verde County). Counties with 3 or more observed individuals (the upper 20% of all counties surveyed) included Edwards, Kerr, Mason, Real, Sutton, Tom Green and Val Verde counties.

Funding for this project was provided by the Section 6 Endangered Species Program of the U.S. Fish and Wildlife Service.

Assessment of Burning and Juniper Control on Black-capped Vireo Habitat

John T. Baccus and Jane Nelka– Southwest Texas State University, and Bill Armstrong and Donnie Harmel (deceased)– Texas Parks and Wildlife Department

The black-capped vireo (*Vireo atricapillus*) is listed as an endangered species by the U.S. Fish and Wildlife Service. The species nests in scrub brush habitats throughout the Edwards Plateau ecological region of Texas.

A number of factors may be contributing to the decline of the vireo. Habitat is being lost because of natural plant succession, encroachment and dominance of regrowth Ashe juniper (*Juniperus ashei*), or poor range management practices associated with livestock grazing and overpopulation of white-tailed deer (*Odocoileus virginianus*) and exotic big game animals.

Research at the Kerr Wildlife Management Area (KWMA) has demonstrated that prescribed burning is an effective and economical range management tool for controlling regrowth Ashe juniper. A combination of juniper control, proper grazing with cattle, and deer population control resulted in a resurgence of low-growing brushy vegetation. The development of dense escarpment live oak (*Quercus virginiana* var. *fusiformis*) and Bigelow shin oak (*Q. sinuata* var. *breviloba*) motts may thereby provide excellent nesting habitat for the vireo on the Kerr WMA.

The objective of the study is to determine the effect of prescribed burning as a range management tool to control regrowth Ashe juniper on black-capped vireo nesting habitat, distribution, and production.

In 1996, Middle Rock Pasture was burned. There were 91 vireo territories located and studied. This was an increase of 10 territories from the previous year. The number of vireos increased in all pastures except North Doe and South Doe, which remained the same as the previous year at 11 and 16, respectively. Rock Pasture had the largest increase in territories from 15 in 1995 to 22 in 1996. There has been a significant increase in the number of territories in Rock and Doe Pastures from 64 in 1993 to 91 in 1996 ($P[t=13.5] < 0.001$). The greatest change in the numbers of territories has occurred in the pasture (North Rock) burned under a "hot" fire environment. Nesting activity and production in 1996 were similar in burned and nonburned pastures. There were 3.2 young per active nest ($n=5$). The parasitism rate by brown-headed cowbird (*Molothrus ater*) was 17% (nests observed=12).

In 1997, no sites within the study area were burned. There were 105 territories located from the previous year. Five territories were also confirmed outside of the study area. The number of territories in 1997 increased in all pastures. There has been a substantial increase in the study area from 64 in 1993 to 105 in 1997. Nesting and production in 1997 was similar in previously burned and nonburned pastures. There were 3.5 young per active nest ($n=3$). There was no nest parasitism by brown-headed cowbirds in these nests. The field part of this study ended in 1997.

At 4 years post burn, we conclude that prescribed burning does not limit black-capped vireo use of habitat when done in conjunction with standard range and wildlife management practices.

In 1998, the analysis of 5 years of field data began. The goal is to produce a model of black-capped vireo population restoration using prescribed burning as a management tool. This study is funded by the Nongame and Urban Wildlife Program.

Population Biology and Habitat Manipulation of Black-capped Vireo at the Camp Barkeley Training Site

Troy Ettel and David Wolfe– The Nature Conservancy of Texas, Paul Turner– Druid Environmental, and John Maresh and Craig Farquhar– Texas Parks and Wildlife Department

CRAIG FARQUHAR

A small population of the endangered black-capped vireo (*Vireo atricapillus*) has been monitored at Camp Barkeley (Taylor County) by Wildlife Diversity Program staff (Craig Farquhar and John Maresh) since its discovery in 1994. Because they occupy a portion of the Callahan Divide, which is a disjunct erosional remnant of the Edwards Plateau, the 4 to 6 territories recorded at this site represent perhaps the most geographically isolated population of black-capped vireos currently documented in Texas. In view of the need for further information on the ecological and conservation needs of this species at Camp Barkeley, a project was initiated in collaboration with The Nature Conservancy of Texas and Texas Army National Guard in 1995 and continued through the present to delineate and map the black-capped vireo territories, quantitatively characterize the habitat features that are critical in the protection and maintenance of the existing population, and develop site-specific management plan alternatives to

protect and maintain their habitat. Results of that project indicated that the current black-capped vireo habitat at Camp Barkeley was limited in extent and marginal in quality. In short, the vegetation was too tall, too dense, and had too high of an Ashe juniper (*Juniperus asbei*) density. Past disturbances (e.g., fire, bulldozing, demolitions) appear to have created and maintained the habitat, but no disturbances of this type have occurred for many years.

Population size and productivity of the black-capped vireo at Camp Barkeley have been below that required to sustain a viable population most likely due to habitat in advanced seral stages of succession. Therefore, in the winter of 1996-1997, we initiated a habitat manipulation project designed to return the vegetational community to an earlier stage of succession marked by low shrubs and trees and heterogeneous open spaces. Using chain saws and loppers, we have opened up approximately 2 acres (0.8 hectares) of habitat. Regrowth of shrubs and trees has begun and we anticipate that additional colonization by understory vegetation will provide habitat for black-capped vireos within 2 to 3 years. We will continue our manipulation project this year by conducting prescribed burning over a larger area.

Habitat Use, Diet, Home Range, and Seasonal Movement of Resident and Relocated Black Bears in West Texas

Bonnie R. McKinney and Michael T. Pittman– Texas Parks and Wildlife Department

BONNIE R. McKINNEY

Newly established black bear (*Ursus americanus*) populations in western Texas, and expansion into its former historic range, have produced a need for research and management strategies for this species. Results of recent studies in northern Coahuila, Mexico indicate an increasing population. This northern Mexican population has logically provided the egress into western Texas.

The objectives of this research are to determine bear density, and life history parameters (survival, mortality, reproduction, home range, and diet) and, through DNA testing, to determine maternal lineages of transient, resident, and relocated bears. Benefits derived from this research should provide a case study on natural recolonization and population growth of black bears into once vacant historic range. Management techniques and habitat components will also be developed to assist in recommendations for relocated nuisance bears, as well as management guidelines for private landowners that coexist with black bears.

Study efforts are being concentrated on the Black Gap Wildlife Management Area and adjacent private ranches. Currently, 6 bears have been captured and fitted with radio collars (3 adult males, 2 yearling males, and 1 yearling female). Ground telemetry as well as bi-weekly aerial telemetry flights are conducted to determine home ranges. All telemetry locations as well as trap sites and bait stations are being assigned Universal Transverse Mercator (UTM) coordinates and integrated into computer generated programs to determine movement patterns and habitat preference. Horizontal ground cover estimates and random sampling of food availability in suitable habitat are being conducted on a seasonal basis using LeCount's methods. Over 350 scats have been collected and air-dried for point frame analysis to determine major food items in the diet. Fall food samples were collected and sent to the Texas State Chemist for analyses of percentage of moisture, fat, protein, and fiber content. This sampling will also be conducted in spring/summer when different food items are utilized.

All captured bears are weighed, measured, and ear-tagged. Blood, tissue, and hair samples are being taken to obtain mtDNA for determination of maternal lineages, as well as origin of transient, resident, and relocated bears. These samples are being pooled with those from northern Coahuila, Mexico and a study is being conducted in Big Bend National Park to provide a larger sample size of the west Texas population. One upper or lower pre-molar is being extracted from adult bears for age determination by cementum annuli analyses.

Effect of Coyotes on the Distribution, Productivity, and Survival of Swift Foxes in the Texas

Jan Kamler and Warren Ballard– Texas Tech University, Kevin Mote– Texas Parks and Wildlife Department, Rick Gilliland– USDA-APHIS-Wildlife Services

CELINE PERCHELLET

The swift fox (*Vulpes velox*) is currently designated as a federal candidate for listing as threatened. Historically, it inhabited the short and mixed grass prairies from Texas to Canada. Swift foxes are currently found in 9 states and Canada. Recent surveys conducted by TPWD biologists located swift foxes in 3 counties in the Panhandle. Although relatively large tracts of suitable habitat currently exists, swift foxes have been detected in only a fraction of available habitat. The goal of this project is to determine what impacts coyotes (*Canis latrans*) have upon the distribution, productivity, and survival of swift foxes.

Two, 25 sq mile (64.7 sq km.) study sites have been selected in the northwest portion of the Texas Panhandle. One site is located within a large tract of short grass rangeland on the Rita Blanca National Grassland. The other site is interspersed rangeland, cropland, and Conservation Reserve Program fields under private ownership. Beginning in September 1998, 26 swift foxes and 14 coyotes were captured and fitted with radio-collars. Both species are being monitored by radio telemetry to determine survival, home range, and habitat use. During the second year of the study, coyotes will be removed from one of the study areas in order to determine the effects coyotes have on the ecology of swift foxes.

Preliminary results indicate that the current distribution and numbers of swift foxes may be affected by coyotes. During the fall of 1998, coyotes killed a total of 8 radio-collared swift foxes, none of which were consumed by coyotes. This indicates that coyotes may routinely kill swift foxes in order to remove competition for limited resources. Results from this study will allow biologists to make better decisions concerning the overall suitability of remaining habitat for swift foxes, and thus improve conservation efforts throughout its range.

Status of a Population of the Texas Diamondback Terrapin

Lee F. Elliott and Kimberly Halbrook– Texas Parks and Wildlife Department

Prior to initiation of this study, little was known about the population status of the Texas Diamondback Terrapin (*Malaclemys terrapin littoralis*) in Texas waters. Earlier work had identified the distribution of the terrapin in Texas, but relative abundance of the species was unknown. This study begins to address the question of population status in one bay system of the central coast of Texas and identifies additional information required to evaluate the status. Initial scouting trips were made to Lavaca, San Antonio, and Nueces Bays to determine the feasibility of beginning trapping studies in each bay. A few terrapins were seen in Lavaca Bay, no terrapins were seen in San Antonio Bay, but by far the most terrapins were seen in Nueces Bay. This study focused on Nueces Bay in order to approach the number of recaptures necessary to provide adequate population estimates. While more terrapins were captured than had been expected at the outset of the study, recaptures were still inadequate to provide population estimates with reasonable standard errors.

LEE ELLIOTT

Modified crab traps were baited with various fish species, usually mullet, to accomplish captures of terrapins. Traps were set at water depths of no greater than one meter. Typically, traps were set at approximately 0830 and checked at approximately 1630. Ten to 15 traps were set at approximately weekly intervals between June 4 and October 30, 1997. One hundred and twenty-four captures were made using approximately 1,410 trap-hours. One hundred and nine individuals were captured and individually marked using marginal scute notching. Most captures and observations were made in the vicinity of shell islands located in the central portion of Nueces Bay adjacent to oyster reefs. Although crab-trapping has been identified as a potential threat to populations of Diamondback Terrapins, most terrapins were captured in areas not frequented by crab-trapping activity.

Effects of Grazing by Cattle on the Demography and Ecology of the Texas Tortoise

Richard T. Kazmaier and Eric C. Hellgren– Oklahoma State University and Donald C. Ruthven III, Jimmy Rutledge, and Matt Wagner– Texas Parks and Wildlife Department

CHIP RUTHVEN

The Texas tortoise (*Gopherus berlandieri*) is listed as threatened by the State of Texas as a result of its limited range, its apparent low reproductive and recruitment rates, and its decline in recent years. Knowledge of how land use practices affect a species is imperative to the successful management of any species. Currently, little information is available on how land use practices impact the Texas tortoise. This study on the Chaparral Wildlife Management Area (CWMA) in the western Rio Grande Plains is testing the hypothesis that moderate, controlled grazing does not adversely affect the Texas tortoise.

Demographic characteristics (relative abundance, adult survival, sex ratio, size structure, and age structure) and spatial, temporal, and dietary dimensions of the realized niche of Texas tortoises are being compared between grazed and ungrazed areas. Field work was initiated in April 1994 and was completed in August 1997. This study focused on 4 pastures (2 grazed, 2 ungrazed). To assess demographic characteristics, data on sex, size, and age were collected from all tortoises during fortuitous encounters and intensive searches within these 4 pastures. In addition, an attempt was made to monitor 10 (6 female, 4 male) adult tortoises within each pasture using radiotelemetry to determine home range, resource utilization, survivability, and movements. Fecal samples from both tortoises and cattle were collected for diet analysis. Data were gathered using line intercept and Daubenmire frame methods for comparisons of vegetative characteristics between grazed and ungrazed sites.

Capture effort resulted in 132 captures of 106 individuals in the ungrazed pastures and 324 captures of 237 individuals in the grazed areas. Radiotelemetry effort consisted of 25 individuals monitored for 15,355 radio-days in the grazed pastures and 22 individuals monitored for 14,619 radio-days in the ungrazed pastures. Comparisons of relative abundance, size structure, age structure, body size, size dimorphism index, sex ratio, adult survival, clutch size, proportion of females gravid, proportion of juveniles, and growth rates revealed no differences between tortoises on grazed and ungrazed areas. Minimum convex polygon home ranges (100%) averaged 12 acres (5 ha) ($n=13$) and 17 acres (7 ha) ($n=9$) for females and 23 acres (9 ha) ($n=7$) and 78 acres (32 ha) ($n=7$) for males on grazed and ungrazed sites, respectively. Analyses of 100% minimum convex polygon home ranges suggests larger home ranges in ungrazed areas, but home ranges are not different if calculated based on the adaptive kernel method. We believe differences in home range size reflect an inability to adequately pair grazed and ungrazed sites due to unexpectedly large home ranges rather than a treatment effect. No differences in habitat selection based on grazing were detected, but tortoises seem to preferentially avoid extreme habitat types such as old field (high grass component, no woody component) and dense woodland along drainages (essentially no herbaceous component, high woody component), but they utilize the broad spectrum of brush communities between these extremes. Analyses of diet between the grazed and ungrazed areas are forthcoming. Our preliminary analyses suggest that the grazing system employed by CWMA does not adversely affect its tortoise population.

Funding for this project is provided by the Rob and Bessie Welder Wildlife Foundation, the Nongame and Urban Wildlife Program, and the Texas Chapter of the Nature Conservancy.

Conservation Ecology of the Texas Horned Lizard: the Influence of Land Use Practices

Richard T. Kazmaier, Anna Burrow, Eric C. Hellgren, and Charles C. Peterson– Oklahoma State University and Donald C. Ruthven III– Texas Parks and Wildlife Department

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. Causative factors for this decline may include direct and indirect effects of the red imported fire ant (*Solenopis invicta*), habitat alteration for other land uses (e.g., agriculture, development), highway mortality, and commercial exploitation.

The primary objectives of this study are to examine the effects of livestock stocking rate and prescribed burning on ecological characteristics of horned lizards (range size, habitat preferences, and population parameters) and expand a long-term ecological monitoring of horned lizards to include temporal responses of the horned lizard population to anthropogenic (e.g., increased public use, road-building, prescribed burning, disking, fire ant invasion) impacts.

The study area is the Chaparral Wildlife Management Area, a site of relatively high horned lizard abundance in southern Texas. Vegetation on the area is dominated by mesquite/mixed-brush communities characteristic of the South Texas Plains. Horned lizards are captured by hand during fortuitous encounters on roads and in the brush and in drift fence arrays. Selected individuals are fitted with radio transmitters. Transmitters have been placed on individuals in each of 5 treatment sites: nongrazed/nonburned, grazed at moderate stocking rates/nonburned, grazed at moderate stocking rates/burned, grazed at heavy stocking rates/nonburned, and grazed at heavy stocking rates/burned. Radiotransmittered individuals are relocated at least twice-weekly. Microhabitat characteristics (e.g., grass, forb, or shrub cover; bare ground; understory height; etc.) for each location will be determined. Range size, habitat selection, and survival rates of radioed individuals will be compared among treatments.

Surveys are also being conducted to determine densities of harvester ants (*Pogonomyrmex* spp.) and other invertebrates between treatments and within lizard home ranges. Harvester ant densities are estimated at activity stations baited with millet and other invertebrates are sampled utilizing pitfall traps.

Twenty-seven horned lizards were outfitted with radio transmitters during 1998. Sufficient data was collected from 5 females and 7 males to estimate home range size, which was 1.9 acres (0.8 ha) for females and 3 acres (1.2 ha) for males. Current data are insufficient to make season or treatment comparisons. Two predation events were recorded, with a greater roadrunner (*Geococcyx californianus*) and a Texas indigo snake (*Drymarchon corais*) consuming radioed lizards. Four lizards were followed into hibernation. One lizard entered hibernation on October 30, while the remaining 3 did not begin hibernation until December. All lizards completely buried themselves near the edges of shrub clumps at depths of 0.5 to 1 inch (1 to 3 cm) below the soil surface. Preliminary analysis indicate that harvester ant densities were highest on the nongrazed/nonburned and both burned treatments. Vegetation analyses are forthcoming to help address these effects.

Funding for this project is provided by Texas Parks and Wildlife Department, the Wildlife Diversity Program, and the South Texas Research Fund.

Activity Patterns of the Texas Horned Lizard in Southern Texas

Eric C. Hellgren and Richard T. Kazmaier– Oklahoma State University and Donald C. Ruthven III and David R. Synatzske– Texas Parks and Wildlife Department

In the past decade, the importance of herpetofauna in conservation biology has risen. Recent calls have been made for standardized monitoring techniques and collection of ecological data to better meet management and conservation needs. In Texas, these calls are being met with road cruising and drift fence array trapping to document presence/absence and relative abundance of reptiles and amphibians We used road cruising data to index activity patterns of the Texas horned lizard (*Phrynosoma cor-*

nutum), a species of conservation concern in Texas and the southwestern United States.

Collection of horned lizard data began on the Chaparral Wildlife Management Area in the South Texas Plains in 1991. Individuals were measured by snout/vent length (SVL) and total length, sexed, and marked by either a series of toe clippings or the implantation of passive integrated transponder (PIT) tags. We recorded time of capture and converted this time to hours after sunrise or before sunset.

CHIP RUTHVEN

A total of 1,322 horned lizard captures were made in April-August, 1991-1997. An additional 126 captures were made in other months. The pattern of capture frequencies varied monthly. The pattern was bimodal in all months, with a morning and late afternoon peak in activity. However, the shape of the pattern varied among months. In April and May, lizards were captured at all times of the day, and peaks in captures occurred 3-4 hours after sunrise and 1-2 hours before sunset. Later in the activity season, captures during the middle of the day decreased in June and ceased in July and August, with most captures occurred closer to sunrise and sunset and a substantial number of captures after sunset. Activity patterns did not vary by gender during April-May and July-August, but varied during June. Male lizards were more likely to be captured during the late afternoon and females were more likely to be captured in the morning. When large adults (mostly females), were deleted from the analysis, the same pattern was observed. No differences in activity patterns between males and females of the same size class were observed in April-May and July-August, but in June, males were more active in the afternoon and females were more active in the morning. Capture frequencies did not vary by time across 3 size classes of horned lizards during April-May (361), June (255), or July-August (277).

Activity patterns that we observed in the Texas horned lizard were consistent with previous information on this and other species of horned lizards. The decrease in captures in the hottest part of the day in July and August also was consistent with theory on how lizards regulate their body temperature. Our data provide information relevant to public education efforts and demonstrate the utility of data collected from road-cruising for ecological and management use.

Funding was provided by Texas Parks and Wildlife Department and the Horned Lizard Conservation Society.

Effects of Prescribed Burning on the Houston Toad

Andrew H. Price– Texas Parks and Wildlife Department

The Houston Toad (*Bufo houstonensis*), endemic to Texas, was known from only a single locality prior to 1990. As the result of a 3-year comprehensive survey conducted by Jim Yantis assisted by several other Texas Parks and Wildlife Department personnel during the breeding season, it is now known from 9 counties in central Texas. The species is restricted to deep sandy soils supporting ephemeral wetlands within native post oak/loblolly pine (*Quercus stellata*/*Pinus taeda*) woodlands and savannas which have been subjected to minimal landscape-scale disturbance. Except for 2 sites, nothing is known about the newly-discovered populations. A total of 1,937 (1,463 male, 474 female) adult Houston Toads have been marked with PIT tags in one watershed within Bastrop State Park from 1990-1998. Breeding choruses of up to 200 individuals form under specific climatic conditions over 1-4 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 frequently as 22 times. Maximum longevity appears to be 6 years for males and 5 years for females. Individual toads have been recorded traveling distances of up to 0.81 miles (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.

A study to determine the effects of prescribed burning on the Houston Toad began during the 1996 season in Bastrop State Park. The adult breeding population at the 2 permanent ponds censused since 1990 will be used as control sites. An identical census protocol was initiated at 2 additional ponds in 1996; these will serve as experimental sites. The management units within which they occur

will be subjected to prescribed fire following an appropriate pre-experimental census period, and total toad numbers utilizing the 2 ponds within the proposed burn area will be compared with control ponds following treatment. Despite the fact that both the 1996 and 1998 breeding seasons occurred during abnormal drought years, all 4 ponds behaved identically in terms of capture and recapture trends with the exception of pond #2 in 1998. We propose to continue this study as part of the long-term management objective of conserving the Houston Toad in Bastrop State Park.

Funding for this work is being provided by the Texas Parks and Wildlife Department.

Floristics of Muck Bogs in East Central Texas

Michael H. MacRoberts and Barbara R. MacRoberts–Bog Research and Don B. Frels and James C. Cathey–Texas Parks and Wildlife Department

TPWD PHOTO

The goal of this work was to document the location and assess the species richness (an indicator of health) of bog habitats in eastern Texas and Louisiana. This type of basic work has become increasingly important, because the number and quality of bogs have been reduced by human activities. In 1997 and 1998, a systematic study of the floristics of 2 muck bogs on the 10,956-acre (4,434 ha) Gus Engeling Wildlife Management Area (GEWMA) was conducted. This wildlife management area, located in Anderson County, historically represents the Post Oak Savannah region of east central Texas. The area is gently rolling to hilly with upland soils that are rapidly permeable sands. There are many streams, which are spring fed and flow year round, that eventually drain into Catfish Creek, a tributary to the Trinity River.

Detailed floristics were done on 2 bogs located at the northern ends of GEWMA: Chester's Bog located on Gibson Branch below Lake #2 and Andrew's Bog located east of DD Spring. Surveys were conducted, using standard sampling methods, on a monthly basis, except for the midwinter months. From July 1997 to July 1998, both bogs were surveyed 10 times. The northern edge of Andrew's Bog was surveyed at 2 sites totaling about 7.5 acres (3 ha) and an area of approximately 5 acres (2 ha) was surveyed at Chester's Bog. Additionally, voucher specimens were collected and will be deposited into credited herbaria. Soil samples were taken and sent to A&L Laboratories, Memphis, Tennessee for analysis.

There were 42 families, 78 genera, and 118 species collected from Chester's Bog. Similarly, 42 families, 71 genera and 104 species were collected from Andrew's Bog. Sorenson's Index of Similarity between the bogs was 80, meaning that they were essentially identical floristically. Combining both lists, dicots account for 45% of the plants collected, while monocots, ferns, and others accounted for 55% of the species.

Soil samples taken from 3 vertical zones within the bogs (bog edge, bog proper, and bog deep [13.65 inches (35 cm) below the bog proper]) were acidic, with an average pH of 4.6 and 4.7 for Chester's and Andrew's Bog, respectively. Organic matter, measured by combustion, was high in the soil samples taken from the bog deep site at both bogs. Organic matter was calculated to be 14.4 and 11% for Chester's and Andrew's Bog, respectively.

With this basic information in hand, results from management decisions (i.e., the impact on species diversity as a result of prescribed burning) will now have meaning. Simply put, prior to this investigation, there was no basis for comparison of vegetation communities when a treatment was applied. Furthermore, state-owned sites such as Chester's and Andrew's Bogs are invaluable, because our stewardship of the property assures the longevity of these bogs, thus providing a standard for bogs located on other property.

This project was funded by the Biological Resources Division of the U.S. Geological Survey.

Status Update on the Tobusch Fishhook Cactus

Jackie M. Poole and Gena K. Janssen– Texas Parks and Wildlife Department

The purpose of this research is to determine the current status of the federally-listed Tobusch fishhook cactus (*Ancistrocactus tobuschii*). Currently, 10 populations of the species are being monitored twice a year to check the health of individual plants. Efforts are also underway to contact private landowners for written permission to survey for additional populations. If the data from status research reflect healthy populations and ample numbers are found, recovery and delisting of this species may be well on the way.

Funding for this work is being provided by Section 6 of the U.S. Endangered Species Act.

Survey and Monitoring of Rare Species in West Texas

Bonnie R. McKinney– Texas Parks and Wildlife Department

BONNIE McKINNEY

The major objective of this research is to determine the current status of several state and federally listed species found in the Trans-Pecos area of western Texas. Species include 3 cacti; Lloyd's mariposa (*Neolloydia mariposensis*), Davis' green pitaya (*Echinocereus viridiflorus* var. *davisii*), and Nellie cory (*Coryphantha minima*); Terlingua Creek cat's-eye (*Cryptantha crassipes*); and the black-capped vireo (*Vireo atricapillus*). Current data indicate recovery criteria are being met for delisting of all 3 cacti species.

The Terlingua Creek cat's-eye is a small endemic plant found in southern Brewster County. All known populations are on private lands and survey efforts are being conducted to monitor known populations as well as search for new ones.

Black-capped vireo populations in western Texas are being monitored each year and, searches are being conducted for new populations on adjacent private lands. Data from state lands are shared with Big Bend National Park to ensure continuity in research objectives.

Monitoring and research on these 5 species will continue for an additional 2 years. Funding is currently provided by Section 6 of the U.S. Endangered Species Act.

Site Characteristics and Management of Johnston's Frankenia

Paula S. Williamson– Southwest Texas State University, and Gena K. Janssen– Texas Parks and Wildlife Department

Johnston's frankenia (*Frankenia johnstonii*) is a low growing perennial shrub known from Starr and Zapata counties of South Texas, and from Nuevo Leon, Mexico. Johnston's frankenia was listed as endangered by the U.S. Fish and Wildlife Service on August 7, 1984 and was listed as endangered by the state of Texas soon afterward. When the species was listed, there were only 4 known populations in Texas. The purpose of this research has been to survey Johnston's frankenia populations and examine their association with soils, geology and other plant species collected at each site. In addition, the floral morphology, phenology, and pollination biology of Johnston's frankenia is being studied. This work has led to the discovery of 50 new Johnston's frankenia populations and has addressed landowner and community outreach. Many landowners have entered into voluntary conservation agreements with the Texas Parks and Wildlife Department to protect Johnston's frankenia on their ranches. The final report, which includes 6 separate manuscripts, will be completed in 1999. Based on this study, the U.S. Fish and Wildlife Service is now considering Johnston's frankenia for delisting.

Demographics of Texas Snowbells

Jackie M. Poole– Texas Parks and Wildlife Department

PAUL MONTGOMERY

Fifteen naturally occurring populations of Texas snowbells (*Styrax platanifolius* ssp. *texanus*) are currently known. Most populations consist of fewer than 10 mature individuals, and have no juveniles or seedlings. An exclosure study indicated that high concentrations of large, browsing mammals (native, domestic, and exotic) are the probable cause of the lack of establishment. However, the largest known population which occurs in Val Verde County appears unaffected. Monitoring of the Val Verde County population and the second largest population (in Real County) continues on an on-going basis to determine what differences might exist between the two.

Funding for this work was originally provided through a cooperative agreement with the U.S. Fish and Wildlife Service. The project is now funded by the Texas Parks and Wildlife Department.

Survey of Abundance, Distribution, and General Biology of the Texas Hornshell and other Unionids in the Rio Grande, Texas

Robert G. Howells– Texas Parks and Wildlife Department

This project, being done jointly with New Mexico Game and Fish Department, focuses on the status and biology of Texas hornshell (*Popenaias popei*) and other freshwater mussels in the Rio Grande drainage. Prior to 1992, when one shell each of endemic Texas hornshell and Salina mucket (*Potamilus salinasensis*) shell was found by Texas Parks and Wildlife Department personnel, none of the endemic species had been documented since the 1970s. In 1997-1998, work in the Pecos River drainage, New Mexico, confirmed a surviving population of Texas hornshell in the Black River. Field work during this period largely focused on upriver areas of the Rio Grande from the Big Bend Ranch downstream to Dryden Crossing. No living specimens were found, but shells or valves from 5 Texas hornshell and 17 Salina muckets were located between La Linda and Sanderson Canyon. Among these, some specimens appeared not to have been dead more than a few weeks. A limited number of Asian clam (*Corbicula* spp.) shells was also recorded. However, no evidence of other unionids was detected and no quality mussel habitat was found. River bed scouring following precipitation in conjunction with heavy input of silt and organic material appears to have degraded most potential habitat in the areas surveyed.

HABITAT MANAGEMENT

Hydrologic Restoration of Historically Logged Bottomlands of Blue Elbow Swamp

James A. Thomas– Texas Parks and Wildlife Department

JAMES A. THOMAS

Large tracts of baldcypress/water tupelo (*Taxodium distichum/Nyssa aquatica*) forested community within Tony Houseman State Park and Wildlife Management Area (SP/WMA) at Blue Elbow Swamp are significantly degraded due to alteration of the historic hydrologic patterns. Natural drainage has been impacted by spoil banks deposited during logging canal excavation in the early 1940s and construction of Interstate Highway (IH) 10 in the 1950s. The canal banks and highway have resulted in increased flooding of the swamp into the growing season, and the forest community exhibits signs of stress from prolonged inundation (i.e., poor tree health, organic material build up, and low seedling recruitment).

The primary objective of the project is to enhance the vegetative community of the swamp habitat through the restoration of seasonal hydrologic patterns. Removal of portions of the logging canal spoil banks will allow seasonal flooding to aid in removal of deep organic materials, allow mineral deposition, and encourage drawdown to create favorable conditions for seedling recruitment.

Portions of 3 logging canal spoil banks will be excavated to restore the seasonal hydrologic pattern to a 100 to 150 acre (40.5-60.7 ha) portion of the SP/WMA. The project will include a total of 18 excavations (6 per canal bank) approximately 15-20 feet (4.6-6.1 m) in width. A baseline habitat survey will be completed prior to excavation to allow quantification of project impacts. A nested plot sampling design will be used to measure woody vegetation, herbaceous vegetation, seedling recruitment and mortality, and tree health variables. Water depth recorders have been installed to determine the effect of the excavations on surface hydrology, particularly drawdown rates. Additionally, flow readings will be recorded before and after excavation to allow determination of changes in water flows due to the restoration effort. Excavation of canal banks is scheduled to be completed in May 1999. Data will be collected 1 year prior to and 2 years following excavation in the area with prolonged flooding and a control area.

Funding for this project is provided by the Gulf Coast Joint Venture (GCJV) and through wetland mitigation by Bomac, Inc.

The Salt Bayou Marsh Restoration Project

Amos Cooper– Texas Parks and Wildlife Department

The Salt Bayou Marsh Restoration Project encompasses over 60,000 acres (24,282 ha) of intermediate to brackish coastal marsh in Jefferson County, Texas. A water control structure was placed on Salt Bayou at the Gulf Intracoastal Waterway in October 1995. The structure's purpose is to decrease wetland degradation by reducing drastic water and salinity level fluctuations; thus promoting desired emergent and submergent vegetation. Monitoring of water salinities, climatic influences, vegetation, and wildlife populations was initiated in 1993 by TPWD personnel to acquire baseline data documenting habitat response to direct management strategies before and after structure completion. Monitoring efforts have keyed on vegetation, salinities, and the utilization of annual wildlife surveys of the area. Vegetation monitoring is conducted to document species composition, frequency of occurrence, distribution, and density along 21, 0.6-mile (1-km) transects. To achieve this, line and point intercept methods are utilized with the Robel pole reading taken along each transect line. Preliminary data analyses indicate increases in (*Spartina patens*) marshhay cordgrass coverage and decreases in open water. Bi-weekly salinity readings are taken at 13 locations throughout the area. Climatic factors have had

dramatic effects on salinity readings. Annual TPWD alligator nest counts results are incorporated in the analyses. Final results will be used to evaluate the effectiveness of the Salt Bayou structure for restoring wetland diversity, functions, and dynamics throughout the marsh system.

Funding and support for this project has been provided by the U. S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, Ducks Unlimited, and the Texas Parks and Wildlife Department.

An Ecological Investigation of Robbins Slough Drainage: Ecosystems Response to Management Strategies

M. Todd Merendino, G. Matt Nelson, J. Brent Ortego, and Justin P. Hurst– Texas Parks and Wildlife Department

We proposed to restore freshwater inflow and regulate saltwater intrusion into Rattlesnake Island Marsh and Savage Marsh at Mad Island Wildlife Management Area by constructing several water control structures, levees, and small channels. These activities will replenish sediments and soil nutrients. Numerous plant and animal species were monitored over a 3-4 year period during each phase of management activity. Construction has been completed and some monitoring is still being conducted.

To date, 47 fish species have been recorded. Analysis will be conducted to determine species composition and relative abundance. We have tagged 221 red drum (*Sciaenops ocellata*) in an attempt to determine movements and growth rates within the marsh. To date, 14 red drum have been recaptured. Preliminary results indicate that red drum remain with the same marsh system and exhibit little movement. We have tagged 240 American alligators (*Alligator mississippiensis*), ranging in size from 18 inches (0.45 m) to 6 feet (1.8 m) in length in attempt to document movements and growth within the marsh system. Data from 46 recaptures indicate that growth of small alligators is about 0.8 inches (2 cm) per month, and that the movements and distribution is correlated with water salinity. Manuscripts on fish, alligators, and birds are planned.

This project is funded by the Texas Parks and Wildlife Department.

Evaluation of Earthen Plugs in Restoring Coastal Marsh on the Lower Neches Wildlife Management Area

Richard W. Griffin– Prairie View A&M University, William A. White and Robert A. Morton– Bureau of Economic Geology, and Len G. Polasek, Stacey A. Fischer and Jerry M. Mambretti– Texas Parks and Wildlife Department

The most extensive, contiguous loss of wetlands along the entire Texas Coast has occurred along the Lower Neches River. From 1956-78, 9,417 acres (3,811 ha), 395 acres/yr (160 ha/yr), of vegetated open marshes were converted to open water. Loss of these wetlands is attributed to: (1) an aggradation deficit relative to sea level rise and sediment deposition; (2) subsidence associated with active faulting or induced by extraction of groundwater, oil, and gas; and (3) the direct and indirect effects of dredged canals.

Pipeline canals, navigation channels, and borrow ditches change the natural hydrology of coastal marshes by: (1) facilitating rapid drainage of interior marshes during low tides or low precipitation, (2) reducing or interrupting freshwater inflow and associated littoral sediments, and (3) allowing salt water to move farther inland during periods of high tide. Saltwater intrusion into freshwater marsh in turn causes loss of salt intolerant emergent and submergent aquatic plants and erosion and net loss of soil organic matter.

To examine the potential role of saltwater intrusion in marsh degradation, the Texas Parks and Wildlife Department will plug 2 borrow ditches connecting the Gulf States Utilities Intake Canal with the Lower Neches Wildlife Management Area. Placed at marsh level, the earthen plugs will prevent daily tides from entering the marsh at this location, but will allow extreme high tides and storm tides to overtop the plug. Four 5-foot by 5-foot (1.5 x 1.5 m) box culverts under State Highway 87 will allow the ingress/egress of marine organisms and tidal waters to enter the 1,483 acre (600 ha) marsh. Specific objectives of this research are to examine: (1) water conductivity, salinity, temperature, and dissolved oxygen using continuous recording instruments; (2) morphology, distribution, and vegetative association of wetland sediments; (3) distribution, density, and cover of emergent and submergent vegetation; and (4) diversity, density, and size of aquatic macro invertebrates and fishes during spring, summer, and fall. Field data will be collected 1 year prior to plug construction

and 2 years post-construction. Data will also be collected from a control marsh to compare habitat changes due to earthen plug effects versus habitat changes caused by natural events (storm tides, low or high annual rainfall, etc.) To examine if subsidence is continuing at a rate sufficient to produce marsh loss, the extent of emergent marsh will be compared between the periods of 1956-78 and 1978-1990s. Field work began Summer 1996 and will continue through Spring 1999.

This project is being funded as a mitigation project by the Port of Beaumont.

Effectiveness of Geotubes and Hay Bale Fences in Reducing Wetland Vegetation and Soil Losses along a Newly Constructed Pipeline

Len Polasek– Texas Parks and Wildlife Department, and Richard W. Griffin– Prairie View A&M University

Air Liquide America Corporation constructed a 12 inch (30 cm), gaseous oxygen pipeline, within the Texas Parks and Wildlife Department's (TPWD) Lower Neches Wildlife Management Area during Fall 1997. Air Liquide utilized a double-ditching technique in its construction. Double ditching is a technique in which an amphibious trackhoe excavates the pipeline ditch and stacks the soil in piles adjacent to the trench. After laying the pipe in the trench, the operator replaces the excavated soil and attempts to maintain topsoil on the surface. TI Energy Services, Inc. also utilized double ditching to construct a pipeline in the same marsh in 1995. Research on TI Energy's line revealed significant soil and emergent vegetation losses of 6.4 acres (2.6 ha) 1 year after the pipeline was constructed. Therefore, TPWD proposed the use of geotubes and hay bale fences to minimize soil and vegetation losses along the newly constructed pipeline.

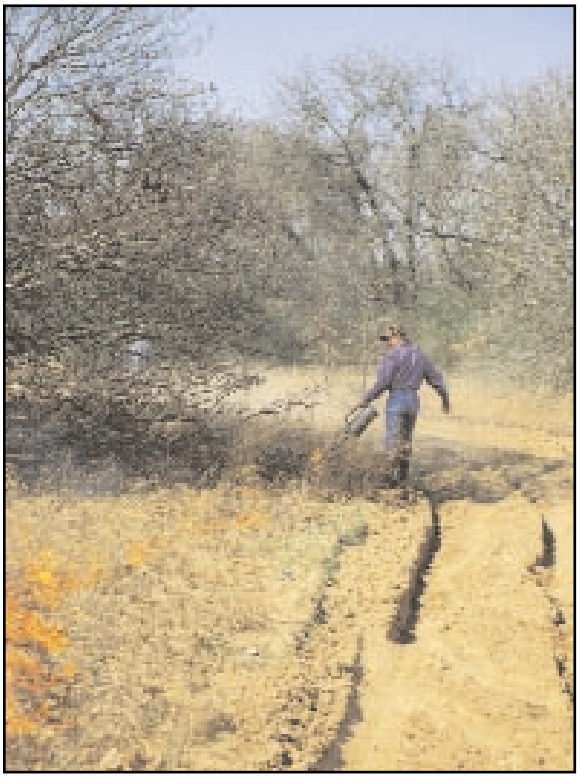
Geotubes, constructed from polyester fabric, were fitted to the size of the pipeline trench, filled to marsh elevation with excavated soil, and covered with topsoil. Geotubes were placed at the intersections of the pipeline trench and bayous and major ditches to serve as rigid plugs to minimize tidal scouring along the pipeline trench. In addition, hay bale fences, wrapped with 100% coconut fiber matting, were placed over the geotubes and at all locations where emergent vegetation intersected open water.

Vegetation and soil sampling occurred just prior to construction within 2 pipeline corridor treatments (pipeline ditch and construction equipment/soil deposit) and a control corridor where no construction occurred. Vegetation sampling consisted of both field quadrats and Geographic Information System (GIS) analysis of aerial photography. Soil plugs were collected to determine changes in profile thickness. Sampling will be repeated annually to determine changes in vegetation (submergent and emergent) composition and coverage and soil thickness. Results will be compared to the TI Energy pipeline study and a control section of the pipeline where only unwrapped hay bales were used.

This project is funded by the Texas Parks and Wildlife Department.

An Ecological Assessment of a Post Oak Savannah Burning Regime

Jason R. Singhurst, Dale F. Prochaska, James C. Cathey, and Hayden Haucke– Texas Parks and Wildlife Department



JASON SINGHURST

Gus Engeling Wildlife Management Area (GEWMA) is a 10,956-acre (4,434 ha) research and demonstration area owned by Texas Parks and Wildlife Department (TPWD). This eastern Texas property represents a portion of the Post Oak Savannah ecological region. Much of the property is comprised of deep xeric sandhills, rich in plant diversity. Prairies, oak savannahs, and oak woodlands are fire-maintained communities dependent upon frequent burning to prevent fuel load build up and the invasion of woody species. A landscape ecology approach was used to explore the relationship among land use, tree canopy cover, tree growth rates, fuel loads, and competition among vegetation communities. We sought to gain a better understanding of patterns seen in dated tree rings and the ecological factors, such as fire, that may influence them. Additionally, we used fire scars in tree rings as an ecological clock by which to determine the natural frequency of fires in post oak savannah systems. Moreover, GEWMA's vegetation was classified using remote sensing techniques and overlaid in a Geographic Information System (GIS). Digital soils, terrain model, percent slope, aspect, and stream flow networks were also created in GIS. Recent (1996) color infra red aerial photography mosaic was compared with a historical (1940) black and white aerial photography mosaic to identify changes in vegetation pattern prior to the conception of TPWD's ownership. With these data, we can evaluate current prescribed burning strategies and possibly mimic the natural burning regime that shaped this unique area.

Since GEWMA was purchased to represent the unique and rapidly disappearing Post Oak Savannahs of eastern Texas, a systematic inventory of the habitat is imperative for proper management. Information from this study will influence the staff's ability to deal effectively with development projects, mineral exploration, and easements that may impact the area's plant communities and ecosystems.

Project objectives also include developing a baseline vegetation inventory and analysis of permanent survey plots for documenting change of plant communities over time. The program will assist in defining age, land use, and land cover classes in the Post Oak Savannah. This research provides data for future restoration and characterizing historical plant communities by defining natural successional stages with the use of historical black and white and current color infra red aerial photography. Geographic Information System vector modules are used to delineate habitat polygons of existing vegetation conditions. Land cover vegetation classification (following National Vegetation Classification System) of landscape level post oak savannah conditions was processed utilizing Thematic Mapper (TM) imagery and image processing software unsupervised and supervised classification techniques.

Inceptive data aggregation for this project started in September 1998 and is scheduled for completion in August 1999. This project was funded by Texas Parks and Wildlife Department.

Effects of Fire on Herbaceous Vegetation and Nongame Wildlife in the Western South Texas Plains

Donald C. Ruthven, III, David R. Synatzske, and James F. Gallagher– Texas Parks and Wildlife Department

Prescribed burning is a common management technique utilized to enhance rangeland productivity and improve wildlife habitat. However, the effects of fire on vegetation and wildlife in the western South Texas Plains are not clearly understood. Our objective was to compare herbaceous plant diversity and herpetofauna and small mammal diversity and abundance on prescribe burned rangelands and untreated rangelands under controlled conditions.

Rangeland sites that were prescribe-burned during winter 1997 and 1998, along with untreated sites were selected on the Chaparral Wildlife Management Area (CWMA). Forb and grass canopy cover and density were estimated with 8- x 20-inch (20-x 50-cm) quadrats (50 per site) during late spring (May-June) 1997 and 1998. Herpetofauna and small mammals were monitored during spring and summer of 1998 only on sites burned during winter 1998. Herpetofauna were sampled utilizing drift fence arrays (60 drift fence days per site). Small mammals were sampled with Sherman live traps (420 trap nights per site), as well as drift fence arrays.

Forb coverage was greater on burned than nonburned sites. Species diversity and richness were similar between treatments. Important seed producing annuals such as prairie sunflower (*Helianthus petiolaris*) and croton (*Croton* spp.) were more prevalent on burned sites. However, increases in annuals did not persist into the second growing season following burning. Day flower (*Commelina erecta*), an important forage plant for white-tailed deer (*Odocoileus virginianus*) and the Texas tortoise (*Gopherus berlandieri*), was also more common on burned sites. Perennial grasses such as Lehmann's lovegrass (*Eragrostis lehmanniana*), an introduced species, and red lovegrass (*Eragrostis secundiflora*) decreased following burning. Threeawn grass (*Aristida* spp.) was more

common on burned areas. There were no differences in herpetofauna diversity and abundance between burned and nonburned areas. Abundance of Merriam's pocket mouse (*Perognathus merriami*), a species which prefers open habitats, increased following burning, while white-footed mouse (*Peromyscus leucopus*), a woodland dwelling species, decreased in numbers.

Prescribed burning is a cost effective management tool which can be utilized to control woody plants and enhance wildlife habitat by promoting forb production in south Texas. It appears that many nongame species are not dramatically affected by winter burns. Monitoring of the response of vegetation and nongame wildlife to the prescribed burning program on the CWMA will continue.

Effects of Herbicide Type and Season of Application on Russion Olive Control at the Gene Howe Wildlife Management Area

J.F. Cadenhead– Texas Agricultural Extension Service, Vernon, Texas and John Hughes– Texas Parks and Wildlife Department, Canadian, Texas

JOHN HUGHES

Russian olive (*Elaeagnus angustifolia*) is an exotic woody plant found in riparian areas throughout the western United States. Russian olive aggressively competes with native riparian vegetation and decreases the biological diversity of riparian areas. This species has degraded native wet meadow habitats on the Gene Howe Wildlife Management Area (GHWMA) in northwestern Texas and has reduced habitat suitability for ground nesting and migratory birds. Its presence on the GHWMA is in direct conflict with the goal of conserving native landscapes.

The Texas Parks and Wildlife Department (TPWD), in conjunction with the Texas Agricultural Extension Service (TAES) and the Texas Department of Criminal Justice (TDCJ), initiated a Russian olive control study in the spring of 1998 on the GHWMA. The objectives of this study are to evaluate the effectiveness of diesel, 10% triclopyr (Remedy™, and 25% triclopyr (Remedy™ treatments on cut stumps during 4 different application dates (spring, summer, fall, and winter). A total of 12 season/herbicide treatment combinations will be analyzed using a split-plot experimental design. TPWD and TAES personnel, with assistance from TDCJ inmates, have finished the cutting phase of the study and will evaluate the effectiveness of the 3 herbicide treatments in June of 1999. Expected benefits include the restoration of wet meadow habitat on the GHWMA and the development of cost-effective Russian olive control techniques for private landowners and other interested parties.

Effects of Three Range Management Practices (Livestock Grazing, Prescribed Burning, and Juniper Cutting) on the Population Ecology of Tobusch Fishhook Cactus at the Walter Buck Wildlife Management Area

John T. Baccus and Tom Rueckle– Southwest Texas State University, and Terry Turney and Max Traweek– Texas Parks and Wildlife Department

The Tobusch fishhook cactus (*Ancistrocactus tobuschii*) was federally listed as an endangered species on 7 November 1979 with confirmation action by the state of Texas on 29 April 1983. The cactus was originally described by W. T. Marshall in 1952 from a single plant collected on a private ranch east of Vanderpool, Bandera County, Texas.

Actual and presumed threats to Tobusch fishhook cactus include livestock grazing and trampling, insect parasitism, real estate developments, flooding and erosion of habitat, and collection by cactus fanciers. Most sites inhabited by the species are on private lands with various intensities of land use that alter the plant community. It has been suggested that limited vegetative disturbances benefited the species by controlling competing grasses.

The control of regrowth Ashe juniper (*Juniperus ashei*) and manipulation of community succession can be accomplished by a combination of livestock grazing, prescribed burning, and juniper cutting. These range management techniques are practiced on thousands of acres of private lands and are in the operational plans of the Edwards Plateau Wildlife Management Areas (WMA) of the Texas Parks and Wildlife Department. The objective of this study is to determine the measurable effects (none, detrimental, or beneficial) of common range management practices on the Tobusch fishhook cactus.

Field work began on this study in September 1995 and will continue for 5 years through August 2001. Eight study sites were selected with 7 of the sites to receive 1 of the 7 possible treatment scenarios (cut, graze, burn, cut-graze, burn-graze, burn-cut, and cut-burn-graze) and site 8 to serve as a control.

A cattle herd was rotated through the grazing plots during winter, spring, and summer 1997. A prescribed burn was conducted on the burn plots in January-February 1997. Juniper was cut in the appropriate study sites during the period 1994-1996.

By the end of this report period, a total of 757 Tobusch fishhook cacti had been located and marked on the Walter Buck WMA. Cacti located within each study site were monitored using 1-m2 quadrats. Forty-one other species of vegetation were identified occurring within the quadrats. The median number of plant associates per quadrat was 5. Average percent vegetative ground cover was calculated at 33% for the quadrats. The primary vegetative type found in the quadrats was grass, with *Bouteloua* spp. having the highest composite percent cover. Limestone bedrock and coarse rock fragments were the major physical features identified in the immediate area of Tobusch fishhook cacti habitat.

Overall mortality during the study period September 1995 to May 1998 was 30.3%, with observed mortality increasing slightly from 20.7% before treatment (September 1995 through December 1996) to 20.8% after treatments were applied (December 1996 to May 1998), including the control site. The before and after treatment periods yielded significant differences in overall mortality between the control site and the graze, cut-graze, and cut-burn-graze sites and no significant differences between the control site and the burn, cut, burn-cut, and burn-graze sites.

The mean flowers/cacti was 1.74 before treatments were applied. There was no significant difference in flower production by cacti based on treatment. Comparison of the mean diameter of cacti, measured using a hand-held caliper, at the control site and the treatment sites showed confounding results. Cacti at treatment sites and control sites both increased and decreased in size. Both mortality and size classes differences were attributed to drought conditions, which complicated measuring the effects of the various treatments on the plants.

This project is funded by the Texas Parks and Wildlife Department.

Effects of Grazing on Herpetofauna Diversity and Abundance in the South Texas Plains

Richard T. Kazmaier– Oklahoma State University and Donald C. Ruthven III, James F. Gallagher, and David R. Synatzske– Texas Parks and Wildlife Department

There has been much debate on whether grazing by domestic livestock adversely affects wildlife populations. Of particular concern, is how grazing may affect threatened and endangered species. To address these issues, we investigated the effects of grazing by cattle on reptile and amphibian populations on the Chaparral Wildlife Management Area (CWMA), located in the South Texas Plains. The CWMA not only has a diverse herpetofauna population but lies within the range of 4 state threatened species: the Texas horned lizard (*Phrynosoma cornutum*), Texas tortoise (*Gopherus berlandieri*), Texas indigo snake (*Drymarchon corais*), and reticulate collared lizard (*Crotaphytus reticulatus*).

Historically, the CWMA has been grazed by cattle since the late 19th century. Upon purchase by the State of Texas in 1969, rotational grazing programs were initiated to replace continuous grazing. The CWMA was deferred from grazing during the period 1984-89. Cattle grazing resumed in 1990 at low to moderate stocking rates under a high intensity-low frequency rotational system, with stocker animals replacing the previous cow/calf operation and the annual grazing period reduced from 12 to 7 months.

To monitor the effects of grazing, 4 drift fence/pitfall arrays were installed in each of 2 ungrazed pastures and 2 management units subjected to grazing by cattle. One ungrazed pasture had been deferred from grazing since 1976, the other since 1984. Drift fences were monitored during late spring and early summer 1997 and 1998. Through 1998, each array was monitored for an average of 1,169 hours. Pitfalls were checked twice daily. Upon capture, specimens were identified, measurements (total and

snout-vent lengths) taken, lizards marked by toe clipping, then released.

Eighteen species of reptiles and 6 species of amphibians were encountered in pitfall traps. Species diversity was greater on grazed sites and total number captured was greater on ungrazed areas. The only 2 species which showed differences between treatments were Great Plains narrowmouth toad (*Gastrophryne olivacea*) and Texas toad (*Bufo speciosus*), with the former being more abundant on ungrazed sites, the latter on grazed areas. The Texas horned lizard was the only threatened reptile which can be effectively captured in pitfall traps. There was no treatment effect for horned lizard abundance, although total horned lizard captures (32) was relatively low.

A large number of Great Plains narrowmouth toads encountered in one of the ungrazed pastures accounted for the lower species diversity on ungrazed treatments. This increase in narrowmouth toads may be a result of habitat differences rather than grazing effects. It appears that rotational grazing at low to moderate stocking rates had no effect on herpetofauna populations. In late 1997, stocking densities were increased and are anticipated to remain relatively high through 2000. Monitoring of drift fence arrays will continue to determine the effects of higher stocking rates on herpetofauna.

Effects of Aeration/Roller Chopping on Vegetation, Herpetofauna, and Small Mammals in the South Texas Plains

Keith L. Krakauer and Steve Smith– Texas A&M University-Kingsville, and Donald C. Ruthven III, David R. Synatzske, and James F. Gallagher– Texas Parks and Wildlife Department

CHIP RUTHVEN

Mechanical brush management techniques such as root plowing and roller chopping are commonly utilized to revert south Texas brushlands back to grasslands. Mechanical brush control was originally utilized to increase forage production for livestock; however, with the increasing economic importance of white-tailed deer (*Odocoileus virginianus*), brush is increasingly manipulated to improve white-tailed deer habitat and increase visibility for hunters.

Vegetation responses to brush management has been the focus of most past studies. Once root-plowed rangelands are revegetated by woody species, woody species diversity is dramatically reduced, while conventional roller chopping results in moderate reductions in woody plant diversity. Mechanical top growth removal stimulates sprouting of many brush species, while temporarily increasing the nutritional quality, availability, and yield of browse. Herbaceous vegetation usually flourishes following mechanical treatments. Past research has shown white-tailed deer are not adversely affected by root plowing in the eastern South Texas Plains; however, little information is available on the ecological effects of mechanical treatments on nongame wildlife. Nongame wildlife, especially amphibians, are considered "indicator" species because they are least able to cope with environmental changes associated with habitat loss and fragmentation. Responses of nongame wildlife may be an effective tool is assessing overall ecosystem response to mechanical treatments.

We seek to determine some of the ecological effects of aeration/roller chopping in the western South Texas Plains. We propose to address the following objectives: 1) compare woody and herbaceous vegetation responses on treated and untreated sites; 2) compare diversity and relative abundance of herpetofauna and small mammals on treated and untreated sites; and 3) initiate long-term monitoring of floral and faunal responses to mechanical aeration/roller chopping.

The study area is the Chaparral Wildlife Management Area (CWMA) in Dimmit and LaSalle Counties, Texas. Vegetation is dominated by mesquite/mixed brush communities characteristic of the South Texas Plains. Approximately 289 acres (117 ha) were treated by mechanical aeration/roller chopping during the summer 1998. Individual treatments range from 5 to 12 acres (2 to 5 ha) each. A mechanical aerator differs from a conventional roller chopper in that the blades are intermittent (toothed) rather than one continuous blade across the face of the drum and the blades are angled across the face of the drum rather than parallel.

Five treated sites with paired control sites were randomly selected for monitoring. Permanent vegetation transects will be established on all sites. Woody vegetation

cover and density will be monitored during the late spring and summer (May-July) utilizing the line intercept method. Herbaceous vegetation cover and density will be monitored biannually in the spring (March-April) and fall (September-October) utilizing the Daubenmire frame method.

Herpetofauna will be sampled utilizing drift fence arrays. Sampling will be conducted during the late spring and early summer (May-June) when herpetofauna are most active. Drift fences will also be opened during the spring and summer following periods of heavy rainfall to effectively sample amphibians.

Small mammals will be sampled utilizing Sherman traps set in modified grids. Trapping will be conducted during all seasons of the year. Drift fences will also be utilized to sample small mammals.

Data will be analyzed utilizing a 2-way analysis of variance with treatment as the main effect and a season/year interaction.

Funding for this project is provided by the Texas Parks and Wildlife Department.

Habitat Analysis, Vegetation Survey, and GIS Mapping of Big Lake Bottom Wildlife Management Area

Kay M. Fleming and Jason R. Singhurst– Texas Parks and Wildlife Department

The degradation and loss of bottomland hardwood cover types have reached critical proportions in Texas. At the turn of the century, these hardwoods occupied an estimated 16 million acres (6.5 million ha) throughout the state. Recent estimates place this number at less than 6 million acres (2.4 million ha) with most being scattered into small disjunct tracts within the eastern third of the state. The 3,221-acre (1,303 ha) Big Lake Bottom Wildlife Management Area (BLBWMA) lies adjacent to the Trinity River and is one of the largest remaining bottomland hardwood tracts of its type in the central Trinity River basin. This alluvial bottomland has originated from the periodic flows and sediments of the river as it cut through the Blackland Prairies and Post Oak Savannah ecological regions of northeastern Texas. The poorly drained clay soils and uniform topography, have produced a forest dominated by hydrophytes and includes an overstory of overcup oak (*Quercus lyrata*), water oak (*Q. nigra*), willow oak (*Q. phellos*), and water hickory (*Carya aquatica*).

Since BLBWMA was purchased to preserve the unique and rapidly disappearing bottomland habitat along the Trinity River, a systematic inventory of the habitat was imperative for proper management. Information from this study will influence the area manager's ability to function effectively when dealing with land trades, undivided interests, mineral exploration, and rights-of-way that impact the area plant communities and ecosystems.

The project objectives include developing a baseline vegetation inventory and analysis of Globally Positioned (GPS) permanent survey plots for documenting change of plant communities over time. To date, 449 specimens plant in 95 families have been collected from the various vegetational communities. The completed study will assist in defining age, land use, and land cover classes of bottomland hardwoods. The research also provides data for future restoration and characterizing historical plant communities by defining natural successional stages with the use of historical black and white, and current color infra-red aerial photography. Geographic Information System vector modules have been used to delineate habitat polygons of existing vegetation conditions. Land cover vegetation classification (following National Vegetation Classification System) of landscape level bottomland hardwood conditions was also processed utilizing Thematic Mapper (TM) imagery and image processing software unsupervised and supervised classification techniques. A digital elevation model (DEM) was created and spatial analysis software established regional slope and aspect influences on the area.

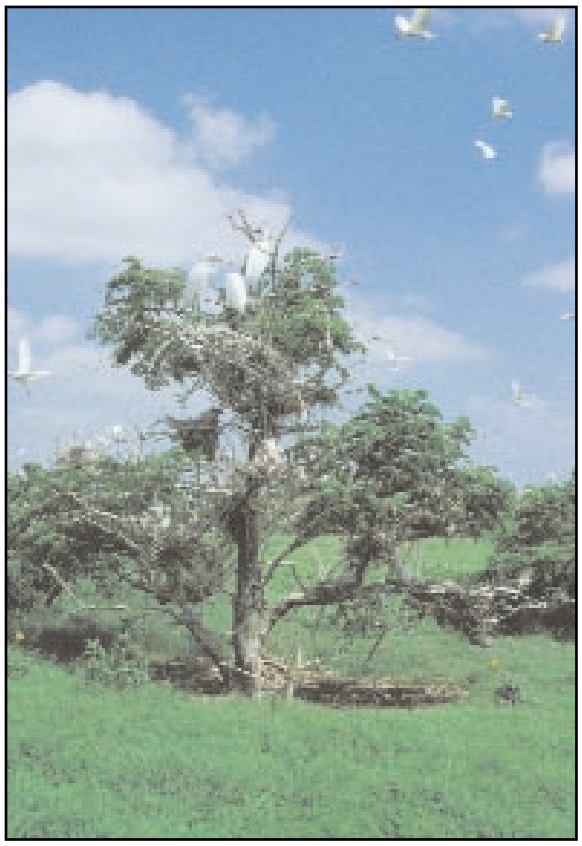
Inceptive data aggregation for this project began in September 1997 and was scheduled for completion in August 1998. Final analysis of data is underway and reports and publications are being prepared. This project is funded by the Texas Parks and Wildlife Department.

Dynamics that Influence Changing Vegetation Patterns and Local Flora of Cedar Creek Islands Wildlife Management Area

Kay M. Fleming and Jason R. Singhurst– Texas Parks and Wildlife Department

Cedar Creek Islands Wildlife Management Area (CCIWMA) is composed of 3 islands on the upper end of Cedar Creek Reservoir. Big Island is located about 3 miles (4.8 km) southeast of Kemp in Kaufman County, Texas and covers approximately 144 acres (58.3 ha). Telfair and Bird

Islands are about 11 and 4 acres (4.4 and 1.6 ha) in size and lie approximately 2,000 feet (610 m) apart. They are located about 6 miles (9.6 km) south of Big Island and 1 mile (1.6 km) west of Gun Barrel City in Henderson County, Texas.



KAY FLEMING

The CCIWMA is within the transition zone between the Post Oak Savannah and Blackland Prairie ecological regions. Big Island is the remains of an upland fluviatile terrace deposit ridge located at the fork of Cedar Creek and Kings Creek. The topography is 30 feet (9.1 m) higher than the historical surrounding bottomland. Big Island is almost entirely covered in Post Oak Woodlands except for the site of a previous residence and old rights-of-way. The smaller 2 islands were historically dominated by post oak (*Quercus stellata*), winged elm (*Ulmus alata*), and green ash (*Fraxinus pennsylvanica*) but have been replaced with chinaberry (*Melia azedarach*), western soapberry (*Sapindus saponatia*), and eastern red cedar (*Juniperus virginianus*). No history of timber cutting could be documented on Big Island. Big Island's vegetation is currently dominated by oaks, hickories (*Carya* spp.), elms, and eastern red cedar.

In this study, multi-date (1940s, 1960s, and 1990s) aerial photography scenes will be compared to determine changing vegetation patterns over time. The 1990s aerial photography will be used to classify vegetation and used as the base map in which prior dates will be interpreted. Potential influences on microhabitat vegetational patterns from waterbird colonies, fluctuation in lake levels, as well as wave action will be documented.

Floristic level (species) vegetation classification in Geographic Information System (GIS) will be produced for CCIWMA to determine if Big Island still contains remnant old growth post oak woodlands. This classification will also include mapping features such as significant plant populations, historical rights-of-way, the old home site, and microhabitat. A plant checklist will be produced and specimens will be deposited at regional herbaria including Baylor University at Waco, Texas and possibly the University of Texas at Tyler.

Evaluation of Submergent and Floating-leaved Plants for Water Treatment Wetlands at Richland Creek Wildlife Management Area

Chetta S. Owens– Ascl Corporation, Woody Frossard– Tarrant Regional Water District, and Jeffrey W. Gunnels, John K. Thorne, James C. Cathey, and Carl D. Frentress– Texas Parks and Wildlife Department

JEFFREY W. GUNNELS

Tarrant Regional Water District (TRWD) supplies water to over 1.2 million customers in North Texas through Richland-Chambers and Cedar Creek Reservoirs. To prepare for increased demand in the future, TRWD personnel have developed methods to divert flows from the Trinity

River into existing water supply reservoirs. Throughout most of the year, Trinity River flows consist of highly treated municipal wastewater. However, these flows must be further treated prior to introduction into existing reservoirs. The primary treatment alternative selected by TRWD is constructed wetlands. This process involves pumping raw water from the Trinity River, cycling it through a series of constructed shallow water treatment wetlands for purification, and then re-lifting it into Richland-Chambers Reservoir. If effective on a large scale, this process will prevent the loss of valuable wildlife habitat, as well as, subvert the cost of construction and operation of new reservoirs.

In 1996, TRWD finalized a Memorandum of Understanding (MOU) with Texas Parks and Wildlife Department (TPWD), which allows TRWD to construct and operate a 2,350-acre (951 ha) wetland system on the North Unit of Richland Creek Wildlife Management Area (RCWMA). The MOU ensures TPWD will have input in design and operation of the wetlands in order to maximize wildlife habitat values. The project will be constructed in phases over the next 15 years.

The project began in 1992 with the construction of a pilot scale wetland system used to test the efficiency of raw water treatment wetlands in purifying Trinity River flows. The pilot scale project was comprised of 3 separate wetland trains consisting of an initial settling pond and 3 consecutive wetland cells. The cells were planted with different wetland plant communities of which water purification abilities have been evaluated. Results from the pilot scale phase indicate that constructed wetlands were effective at removing contaminants from Trinity River flows. However, deep water areas, approximately 5 feet (1.5 m) deep, were needed to ensure adequate denitrification.

In 1998, 3 deep water zones were developed within existing wetland cells to evaluate denitrofication abilities. TPWD suggested establishing submergent and floating-leaved plant communities in the deep water zones. Four species of aquatic plants, shining pondweed (P*otamogeton illinoensis*), long-leaf pondweed, (*Potamogeton nodusus*), grassleaf mud plantain (*Heteranthera dubia*), and American wild celery (*Vallisneria americana*) were planted in separate plots within the deep water zones in September 1998. Nursery-grown plants were obtained from and planted under supervision of U.S. Army Corps of Engineers, Waterways Experiment Station, Lewisville Aquatic Ecosystem Research Facility personnel. Survival will be evaluated formally during the spring 1999; however, initial observations indicate 100% survival.

Construction of the 275-acre (111 ha) field scale phase on RCWMA is scheduled to begin in June 1999. This phase will be monitored for 5 years before additional construction will begin. The field scale units will be an expanded version of the pilot scale model. In this phase of operation, pilot scale results will be employed to provide more diverse wildlife habitat and guide temporal and spatial distribution of waterfowl using the various plant communities. This latter objective is an important responsibility of TPWD under the MOU provisions. Aside from plant survival, this is a major focus of the studies in the pilot scale experiment. In other words, manipulation of waterfowl feeding behavior will be needed to prevent degradation of treated water exiting the wetlands. Increased turbidity caused by dabbling ducks is not desirable. The pilot scale plant experiment is expected to yield insights useful for influencing waterfowl feeding activity according to selected patterns of plant composition and habitat location. Hopefully, application of these findings will eliminate or substantially reduce the deleterious effects of waterfowl feeding behavior on water quality variables.

The alliance between TRWD and TPWD could become a model that will lead to partnerships between natural resource and water supply agencies that will create or enhance wetland habitats and reduce the destruction of bottomland hardwood forests which are some of the most productive and important ecosystems known.

Funding for this project was provided by the Tarrant Regional Water District and the Texas Parks Wildlife Department.

DATABASES

Baseline Survey and Monitoring on Texas State Parklands

David H. Riskind, Keith Blair, Wm. Lynn Pace, Kelly Bryan, Ted Hollingsworth, Jeff Sparks, Mark Lockwood, Jason Singhurst, Linda Hedges and Michelle Valek– Texas Parks and Wildlife Department and Collaborators*

One hundred twenty-five state parks with approximately 700,000 acres (283,290 ha) distributed across Texas represent significant examples of the state's habitat diversity. Ongoing floral, faunal, and natural community surveys are the basis for resource planning documents that detail stewardship strategies for each site. Geological, hydrological, and soils data as well as land use history also are integral components of such plans. Resource inventories and baseline data gathering follow uniform standards system-wide with all data sets being fully integrated into a GIS using ArcInfo/ArcView software. Protocols have been established for long-term ecological monitoring on selected sites. All specimens taken as vouchers are accessioned to accredited institutions; a database of collections is maintained at TPWD for use in the department's Texas Biological Conservation System and/or Texas Wildlife Information System as appropriate. The more significant completed reports include *The Mammals of Big Bend Ranch State Park*, *Geology of the Solitario Dome*, *TransPecos Texas*, and *Baseline Herpetofauna of Brazos Bend State Park*. This project is funded by the Texas Parks and Wildlife Department.

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*Collaborators: TxDOT, Texas Tech University, Sul Ross State University, Cesar Kleberg Institute, Texas A&M - Kingsville, University of Texas at Austin, Texas Christian University, Baylor University, University of Texas El Paso, Lamar University, University of Houston, West Texas A&M University, Southwest Texas State University, Texas A&M University - College Station, Abilene Christian University.

Baseline Survey of Fishes, Amphibians, Reptiles, and Mammals at Richland Creek Wildlife Management Area

Toby Hibbitts, Lee A. Fitzgerald, Rodney Honeycutt, Fran Gelwick– Texas A&M University and Jeffrey W. Gunnels, John K. Thorne, and James C. Cathey– Texas Parks and Wildlife Department

JAMES CATHEY

The ecological, economic, and esthetic values of biodiversity are widely cited and managing for diversity is emerging as an important priority for natural resource agencies. A network of Wildlife Management Areas (WMAs) was created by Texas Parks and Wildlife Department (TPWD) for numerous outdoor activities including hunting, fishing, non-consumptive uses of wildlife, and for research. In order to make informed management decisions, it is necessary to gather baseline data on biodiversity and establish long-term monitoring programs for biodiversity at WMAs. Baseline and monitoring data are necessary to gauge the effects of future changes in land use, management practices, and environmental factors.

The objectives of this project were to gather baseline information on fishes, amphibians, reptiles, and mammals at Richland Creek Wildlife Management Area (RCWMA) and to establish a system to allow long-term monitoring of biodiversity. RCWMA was created in 1987 to compensate for habitat loss associated with the construction of Richland Chambers Reservoir. The management area is comprised of 13,795 acres (5,583 ha) and is located in Freestone and Navarro counties. The area is situated in an ecotone separating the Post Oak Savannah and Blackland Prairie ecolog-

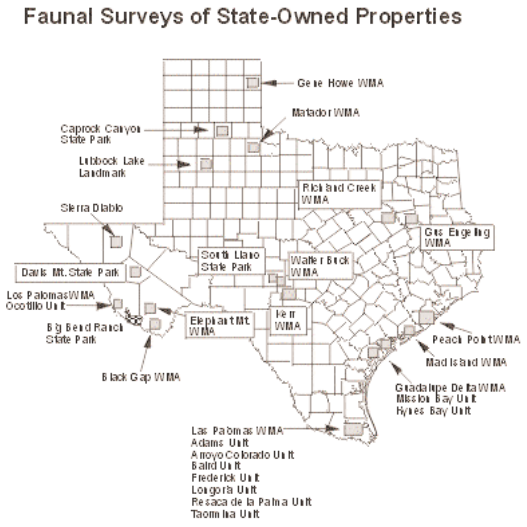
ical regions, and the majority of the area lies within the Trinity River floodplain.

Sampling protocols generally followed procedures outlined by TPWD in "Baseline Inventory and Monitoring Procedures on Texas Parks and Wildlife Department Lands." In some cases, procedures were adapted for specific habitats on RCWMA. Sampling was conducted from March to September 1998 by Texas A&M University (TAMU) investigators. Representatives of each species were archived in the Texas Cooperative Wildlife Collection located at TAMU. More specifically, 42 species of fish, 7 species of amphibians, 19 species of reptiles, and 19 species of mammals were documented. The project has been extended for a second year and sampling will begin in February 1999.

Funding for the project was provided by Texas Parks and Wildlife Department.

Faunal Surveys of State-Owned Properties

Robert D. Bradley, Robert J. Baker, Clyde Jones, Nick C. Parker and David J. Schmidly– Texas Tech University, and Vivian Ackerson, David H. Riskind and Ronnie R. George– Texas Parks and Wildlife Department



Over the past 3 years, researchers at Texas Tech University have collaborated with the Texas Parks and Wildlife Department (TPWD) in conducting faunal surveys on state-owned properties. The focus of these endeavors was to: (1) assist TPWD with its ongoing base-line inventories; (2) archive voucher specimens (skins and skeletal material) for historical documentation of existing biodiversity and for future reference; (3) archive tissue samples for future studies pertaining to systematics, genetics, ecotoxicology, and emerging viruses (e.g. rabies, hantavirus, and arenavirus); (4) provide Geographic Information System localities of traplines for use in habitat preference studies or future base-line studies; and (5) provide data and information to the TPWD and the scientific community.

As of February 1999, we have conducted surveys on 25 state-owned properties, with a majority of our efforts being focused on Wildlife Management Areas. These surveys generally have focused on small mammal species with the major emphasis being on rodents and bats. The results of these surveys have ranged from producing the first base-line data for poorly studied properties to supplementing and updating existing data for those properties which have been studied in more detail. To date, we have discovered at least 28 county records and several property specific records as a result of these inventories.

We hope that this collaboration will enhance our knowledge of the biodiversity of state-owned properties, as well as serve as an indicator of the biological status of wildlife species across the state of Texas. It has been 100 years since the Biological Survey of Texas was conducted by Vernon Bailey and his colleagues. Not only has a significant amount of time passed, but the land use practices and human activities of Texans have changed significantly since the initial survey. Data such as those being generated through the interactions of TPWD and Texas Tech University will be instrumental in addressing the current and future issues concerning the biodiversity of Texas.

The Natural Science Database and the World Wide Web

Robert J. Baker, Robert D. Bradley and Richard Monk– Texas Tech University, Nick C. Parker– U.S. Geological Survey-Texas Cooperative Fish and Wildlife Research Unit, and Don McCarty, John Herron and Ronnie R. George– Texas Parks and Wildlife Department

The Natural Science Research Laboratory (NSRL) of the Museum of Texas Tech University and the Texas Cooperative Fish and Wildlife Research Unit are constructing the Natural Science Database (NSD) as a reference tool for wildlife biologists and academicians, but also as a reservoir of biological data to address public health issues. Database management software linked to Geographic

Information Systems (GIS) will provide interactive queries and map production through a World Wide Web (WWW) interface. Wildlife data will include currently archived, but inaccessible, historical records for distribution of species and quality and quantity of habitat from a variety of sources. The NSRL currently has 70,000 cryopreserved tissue samples and a total holding of over 100,000 cataloged vertebrate and 250,000 invertebrate specimens which will be included in NSD. Additional data will be included from, or linked to, the Texas Parks and Wildlife Department, other museums in Texas, and the Texas Department of Health (TDH) which collect specimens with the potential of possessing rabies or other human pathogens. The Natural Science Database will provide dynamic analysis and evaluation of factors influencing resource management and public health in a user friendly environment to anyone with Internet access.

It is possible to search the NSRL Texas mammal collection by genus, species, collector, and county through the WWW. Products currently available through the WWW include *The Mammals of Texas* by W.B. Davis and D.J. Schmidly, the 1897 *Manual of Fish Culture*, several Occasional Papers of the museum with many photographs and line drawings, and information on current projects. The field notes, photographs, and records from the 1895 to 1905 Biological Survey of Texas by Vernon Bailey are currently being prepared by D. J. Schmidly for publication on *www.nsrl.ttu.edu*.

The Texas Plant Information Database

Ray C. Telfair II, Roy G. Frye, and Robert W. Spain– Texas Parks and Wildlife Department and Collaborators*

The Texas Plant Information Database (TPID) is being developed to provide comprehensive information about native and a few selected naturalized plants that have value for erosion control and wildlife habitat, and can be used to restore disturbed landscapes and improve wildlife habitat.

The feasibility for developing a user-interactive plant information system was investigated in the mid 1980s in response to active surface mine reclamation efforts and where habitat restoration efforts were required by other development projects that adversely affect wildlife habitat. By 1988, a commitment was made by the Department's Resource Protection Division to develop and implement an interactive plant information database. This project was transferred to the Wildlife Division in 1996 and continues to be an inter-divisional cooperative research effort.

TPID is designed to allow selection of specific plants and use of compiled information that is available for each plant. Plant selection is based on the user specifying up to 10 selection criteria. Such criteria include the geographical location of the site, physical form of plants desired (trees, shrubs, grasses, etc), soil requirements, and desired level of value for either erosion control or wildlife use. In response to specific queries, TPID provides a candidate list of plants from a statewide pool of currently 336 species, with each plant species exhibiting up to 73 different descriptive attributes. Color photographs will also be included where available. Major categories of information include: state ecological distribution, associated species, habitat and site descriptions, growth characteristics, soil requirements, economic and ecological impact characteristics, wildlife/livestock values, erosion control values, seed/plant material availability, propagation characteristics, seeding and planting notes, and literature references. While the database does not represent an exhaustive list, it does contain those plants for which the most information is generally known.

TPID was originally designed for PC use with potential users required to purchase necessary software and be provided with a copy of the database, or make inquiries to Department staff that had access to the database for hard copy printouts. However, significant modifications have been made to allow access to the database through the World Wide Web (WWW). Modifications have required the interface of a number of software packages allowing internal development and connections to web servers. The database is now accessible to Department staff through the agency's Intranet (Wildnet) by referencing: Intranet, Wildlife Division, Migratory and Wetland Ecology Program, Wildlife Habitat Assessment Program, Texas Plant Information Database. At the time of submission of this report, development and implementation has been largely completed with only minor modifications and associated testing anticipated. Internet connection allowing general public access is planned for early 1999.

*Collaborators: Jane Connelly; Connelly and Associates, Kaufman and Associates, Texas Tech University, Patricia A. Head.

Land Condition-Trend Analysis (LCTA) at Camp Bowie, Brown County, Texas

Kathleen M. O'Connor and Amy M. Winters– Southwest Texas State University, Paul E. Powell– The Adjutant General's Office (Texas Army National Guard), and Craig Farquhar– Texas Parks and Wildlife Department

CRAIG FARQUHAR

The U.S. Army is responsible for 12.4 million acres (5.2 million hectares) of land covering a vast array of habitats and communities on 186 major military installations world-wide. Sound, scientifically-based management is critical to ensuring long-term sustainability of these lands. As a major component of the Integrated Training Area Management (ITAM) program, and developed at the U.S. Army Construction Engineering Research Laboratory (USACERL) the Land Condition-Trend Analysis project is part of a long-term program to promote sustained yield, land stewardship, and multiple use of military land resources. The major objectives are to: (1) evaluate the capability of land to meet the training requirements of the U.S. Army on a sustained basis; (2) delineate the biophysical and regulatory constraints to use of the land; (3) monitor changes in land resource condition and evaluate change in terms of current land use; (4) develop and refine land management plans to ensure long-term resource availability; (5) characterize installation natural resources; and (6) implement standards in collection, analysis, and reporting of the acquired data that enable Army-wide data compilation.

In 1998, the Wildlife Diversity Program of the Texas Parks and Wildlife Department was awarded first-year funding for establishment and maintenance of LCTA plots for Texas Army National Guard sites beginning with Camp Bowie, Brown County, Texas. In order to track changes in vegetation, soils, hydrology, and wildlife due to training and management activities at this installation permanent inventory and monitoring plots were established. Baseline inventory data were collected and are currently being summarized and analyzed. We plan to return there this summer for annual monitoring. In addition, this year we will establish LCTA plots at Camp Swift, Bastrop County, and at Fort Wolters, Parker County. Funding for this project has allowed us to employ and train students from local universities.

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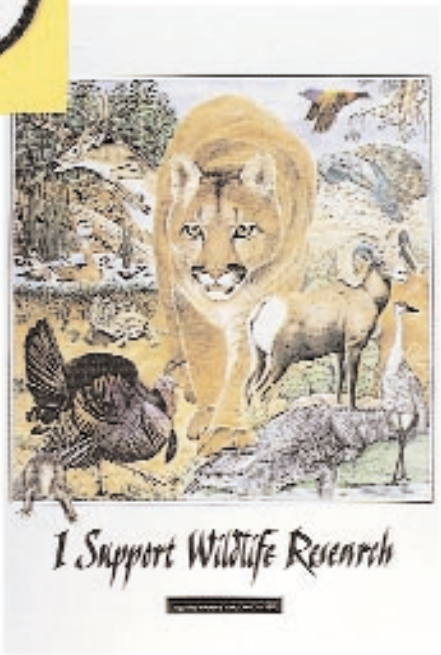

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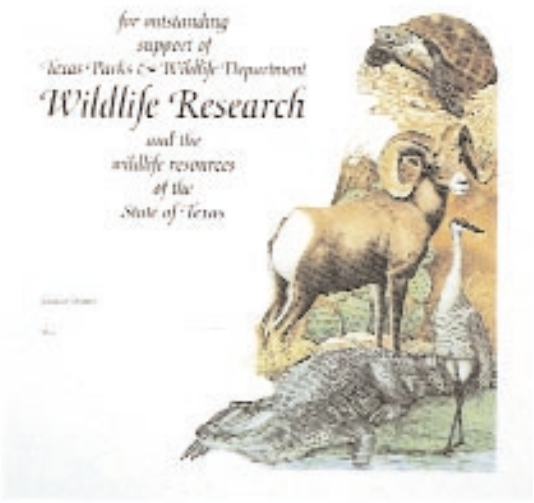

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