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Research Highlights

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Austin, Texas

Volume 1

ACKNOWLEDGEMENTS

We express our appreciation to those persons who designed these research studies, analyzed the data, drafted the abstracts, and provided photographs for this publication. We are indebted to Chris Bocek and Kirsten Johnson for preparing the manuscript and Mike Diver 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 Federal Aid Project W-129-M.

COVER PHOTO

Wildlife Technician Billy Pat McKinney with radio-collared mountain lion on Big Bend Ranch State Park mountain lion research project. Photo by Gilbert Guzman.

In Memorial

DAN BOONE



Volume 1 of Wildlife Research Highlights is dedicated to the memory of Wildlife Biologist Dan Boone of Jasper, Texas who passed away while conducting a aerial survey of nesting bald eagles in Montgomery County on March 16, 1995. Dan was a native of Austin, Texas and a 1969 graduate of Texas A&M University who faithfully served the Texas Parks and Wildlife Department for 22 years. Dan's interests and research efforts included swallow-tailed kites, peregrine falcons, bald eagles, wading birds, alligators, black-footed ferrets, river otters, and muskrats. Shortly before his death, Dan was preparing new proposals for further research on swallow-tailed kites and alligator snapping turtles. Dan was a productive researcher, an outdoorsman of exceptional skill, a sportsman

of high ethics, a gentleman with a ready sense of humor, and a friend. As his neighbor and colleague, Joe Hamrick, said, "We will miss him, and so too, will the eagles."

Carl Frentress

Wildlife Research Highlights

Wildlife Division Texas Parks and Wildlife Department May 1996

The Wildlife Division of the Texas Parks and Wildlife Department is continuing a process, begun in 1993, to develop a new, coordinated approach to wildlife research. Over the years, the Wildlife 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. Consequently, the Wildlife Division is developing a more coordinated statewide approach to wildlife research, scheduling more staff time to conduct research and publish research results, and seeking more consistent funding for this activity.

In 1993, Wildlife Division biologists identified 120 topics in need of further research. These topics were assigned priorities, and the top 10 percent were selected for immediate funding. Research proposals on these topics were solicited from qualified department and university personnel. A multi-discipline research review committee selected the best proposals, contracts were prepared, and projects begun. Department personnel took the lead on about 40 percent of the projects; university personnel led others. In cases where a university was selected to conduct the research, Department biologists were selected to serve as field advisors, graduate committee staff, and publication coauthors. The research topics list has been updated annually since 1993, and this review process has continued.

The Wildlife Division budgeted over \$1,070,000 for 42 wildlife research projects during FY-96. Funding for this research has come from several sources including: 1) Texas hunting license revenue, 2) federal excise taxes on sporting arms and ammunition, 3) Texas waterfowl, white-winged dove, and wild turkey stamps, 4) nongame funds, 5) EPA grants, 6) mitigation, and 7) private donations. For more information on donations, see page 45.

Funding Sources

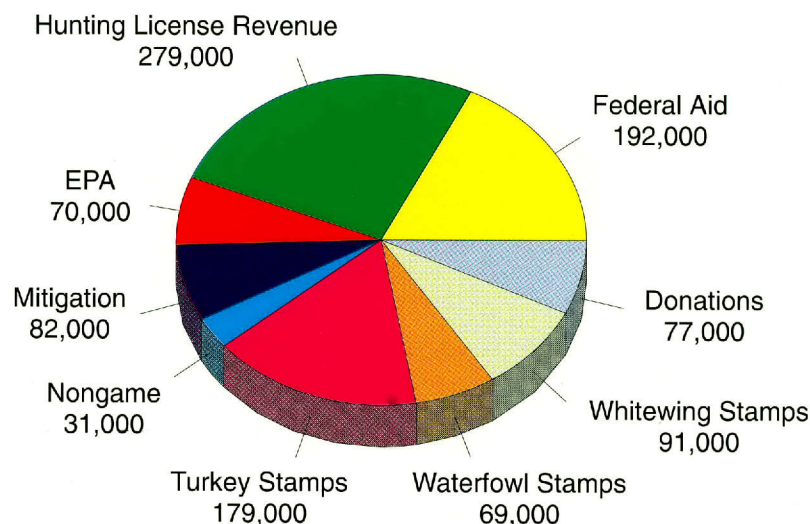


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Evaluation of Desert Bighorn Sheep Habitat and Food Habits in the Sierra Diablo, Beach, and Baylor Mountains, Texas

Tim E. Fulbright, Randy W. DeYoung, and W. Frank Robbins - Caesar Kleberg Wildlife Research Institute, Eric C. Hellgren - Oklahoma State University, and Doug Humphreys - Texas Parks and Wildlife Department



Photo by Glen Mills

Bighorn sheep (*Ovis canadensis*) were once widespread in the mountain ranges of Trans-Pecos Texas. By 1939, the bighorn population was concentrated in the Baylor, Beach, Carrizo, and Sierra Diablo mountains, and the total population was estimated at 300. The last known sighting of Texas bighorns occurred in 1960, when 2 ewes were observed in the Sierra Diablo mountains.

Efforts to reintroduce bighorns in Texas began in 1957. Presently, there are about 300 free-ranging bighorns in the Sierra Diablo, Baylor, and Beach Mountains.

Information on food habits of desert bighorns in Texas is limited. In 1905, Vernon Bailey sampled stomachs of 3 native Texas bighorns and found that mountain mahogany, Mexican tea, yellow trumpetflower, mockorange, silktasselbush, wild onion, penstemon, and pricklypear dominated the diet.

Our objective is to develop a model to estimate nutritional carrying capacity of habitat

for bighorns. Specific objectives are to (1) determine seasonal diet composition of bighorns in the Sierra Diablo, Baylor, and Beach Mountains; (2) determine plant species composition, seasonal forage production, and chemical composition of bighorn forages in the 3 mountain ranges; (3) evaluate the value of fecal indices to estimate diet quality of bighorns; and (4) integrate the first 3 objectives with the estimated forage intake to calculate seasonal carrying capacity.

We collected fresh fecal samples and observed feeding bighorns during 1994-95 in portions of the Baylor, Beach, and Sierra Diablo mountains. Plants that compose >2% of bighorn diets determined from observation and microhistological analysis of feces were sampled seasonally in 1995 to determine biomass and nutritional value. We estimated composite diet quality by summing the products of each dietary item and its nutritional value.

During spring 1994, diets were composed of 49% browse, 39% forbs, and 12% grasses, averaged across the 3 mountain ranges. Important plants in bighorn diets included sage, mountain mahogany, ratany, cactus, buckwheat, globemallow, grama grass, and brome grass.

Summer 1994 bighorn diets were composed of less browse (34%) and more grasses (36%) than spring 1994 diets, averaged across sexes and mountain ranges. Bighorn sheep diets were composed of 31% forbs during summer 1994. Diet composition was similar between sexes during summer, except that ewes consumed more cacti (10% of diets) than rams (2% of diets).

During fall 1994, bighorn sheep consumed more browse (56% of diets) than during summer, less forbs (10% of diets) compared to spring and summer, and more grass (34% of diets) than during spring 1994. In contrast to summer 1994, ram diets were composed of 10% cacti compared to 0% for ewes. Only 1% of ewe diets were composed of grasses, compared to 11% for rams.

Precipitation for 1994 was well below

normal (<4 inches) and may have affected bighorn diet selection. Analysis of fecal samples and summarization and analysis of vegetation data collected during 1995 will be completed during spring 1996.

Funding for this project is provided by the Texas Parks and Wildlife Department and Federal Aid in Wildlife Restoration Grant W-127-R.

Ecology of the Mountain Lion on Big Bend Ranch State Park in Trans-Pecos Texas

Michael T. Pittman, Billy Pat McKinney, and Gilbert Guzman - Texas Parks and Wildlife Department



Photo by Gilbert Guzman

Since 1983, the Texas Parks and Wildlife Department (TPWD) has collected state-wide mountain lion sighting and mortality data. These data seem to indicate an increasing population trend in the west, central, and southern portions of Texas. However, this information alone does not produce accurate estimates of lion population densities in the state and must be supported by research on lion ecology in the respective ecological regions. In January 1993, a 5-year mountain lion research study was initiated by the TPWD on Big Bend Ranch State Park (BBRSP). This study is the first attempt by TPWD to supplement current mountain lion status information with field research. BBRSP, owned and managed by the

TPWD, is located within the Chihuahuan Desert in southern Brewster and Presidio counties and contains approximately 265,000 acres. The objectives of the study are to determine home ranges, investigate population dynamics, evaluate genetic variability, identify diets, and improve the Department's knowledge of the technical requirements needed to conduct mountain lion research.

Male and female resident mountain lions within the study site were captured using trained lion hounds or leg-hold snares, immobilized, and fitted with radio collars operating on specific frequencies. Kittens were captured by hand and fitted with expandable collars. Age, sex, and a series of body measurements were recorded for each captured lion. Blood and tissue samples were collected for DNA and disease analysis. All collared lions were monitored weekly by ground and aerial telemetry to collect data on movements, home range characteristics, habitat utilization, location of den sites, and survival and dispersal of kittens after they become independent. All fecal samples encountered were collected for diet analysis. Lion kills were verified and recorded on base maps. Mule deer, hare, rabbit, and furbearer census data from fall spotlight surveys were used to estimate prey population trends.

Twenty mountain lions were captured on BBRSP from January 1993 through April 1995. Sixteen lions (5 adult females, 2 juvenile females, 7 adult males, 2 juvenile males) were captured and fitted with radio transmitters. Four collared lions were recaptured for attachment of new radio transmitters or collar adjustment. Ground and aerial tracking of collared lions was conducted March 1993 through July 1995. A total of 560 relocations was recorded for 15 lions (6 females, 9 males). Ten lions (6 females, 4 males) had a sufficient number of relocations to estimate home ranges. Mean home range estimates for the females were 80,414 acres and 140,147 acres for the males. Sixty-four fecal samples were collected and analyzed. Analysis

of the samples indicated 4 prey components; collared peccary, mule deer, lagomorphs, and unidentified material. Peccary were the most important prey with a frequency of occurrence of 46.9 per cent. Deer and lagomorphs were the second and third most important prey with frequencies of 42.2 and 14.1 per cent, respectively.

Future activities will include capturing and collaring new resident lions, capturing and collaring juvenile lions born to collared resident females, continuation of telemetry activities of all collared lions, submission of samples for analysis, and the continued inclusion of TPWD personnel to familiarize them with the basics of mountain lion ecology.

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

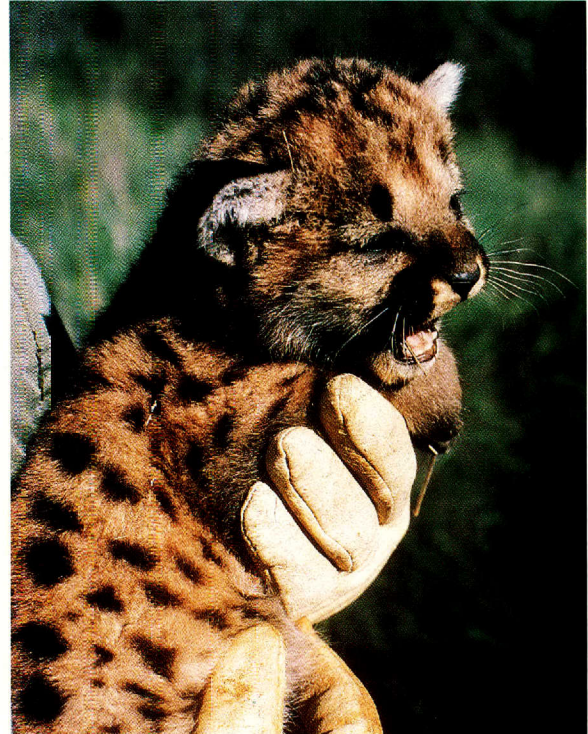


Photo by Michael Tewes

Ecology of Mountain Lions in South Texas

Louis A. Harveson, Michael E. Tewes, J. Frank Smith, and Alan T. Cain - Caesar Kleberg Wildlife Research Institute, and Jimmy Rutledge, John Huff, Leif Henderson, and Jim Hillje - Texas Parks and Wildlife Department

The South Texas Mountain Lion Project (STMLP) is a cooperative research effort by the Caesar Kleberg Wildlife Research Institute (CKWRI), the Texas Parks and Wildlife Department (TPWD), and the landowners and managers of South Texas. The goal of the STMLP is to gather baseline data on the ecology of a South Texas mountain lion population that will aid the TPWD in making a comprehensive, state-wide management plan for mountain lions.

Field work on the STMLP started in spring 1994 on the 4,000 km study area between Cotulla, Tilden, Freer, and Encinal. Trespass privileges were gained on >30 privately-owned ranches within the area. Researchers spent a total of 226 days in the field during the first year of data collection.

The research team captured and radio-

collared 9 mountain lions during the first year. Foot-snare trapping efforts resulted in the capture of 4 male (6 times) and 2 female mountain lions. Capture success (including recaptures) was 104 trap-nights/capture or 139 trap-nights/initial capture. Trained hounds were also used to compliment snare-captures and resulted in the collaring of 2 neonate kittens (1 M, 1 F) and 1 subadult female.

Carcasses of potential prey species were sought throughout the study area. Upon carcass discovery, the species, sex, age, description, and location of the carcass was recorded. Mountain lion involvement was assessed as certain, possible, or not probable. Fecal samples were also collected and analyzed to help determine the composition of mountain lion prey. During the first year, we assessed mountain lion involvement at 57 different carcasses found throughout the study area. White-tailed deer, javelina, and feral hogs accounted for 92% of the carcasses discovered. We also found bobcat, mountain lion, and calf carcasses during field search for prey. Of the 57 carcasses examined,

19% were attributed to dying of other causes (mostly crippling loss from hunting and coyotes). Fifty-four percent of the carcasses were considered possible lion kills and the other 26% were certain lion kills. Fecal samples are currently being analyzed.

Cooperative funding is provided by the Texas Parks and Wildlife Department, the Boone and Crockett Club, and the Houston Safari Club.

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

John T. Baccus and Kevin O'Neal - Southwest Texas State University and Bill Armstrong and Donnie Harmel - Texas Parks and Wildlife Department



Photo by Jim O'Donnell

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 and exotic big game animals.

Research conducted 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 liveoak and shinoak mottes may thereby provide excellent nesting habitat for the vireo on the KWMA.

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.

Pre and post burn vireo populations were surveyed in the North, Middle and South Rock pastures and the North and South Doe pastures on the KWMA from 1993 through 1995 during the period of April through July. Transect lines for vireos were established in inhabited and uninhabited parts of the pastures and strip surveys for vireos were conducted. Territory maps of vireos from previous surveys were used to verify the locations of existing nesting territories. Old known territories and new territories were added to the territory distribution map. Forty nesting sites (motte complexes) and 40 non-nesting sites were mapped horizontally and vertically to scale, vegetation composition was described, and these sites were permanently marked in the field prior to the prescribed burns.

The South Rock and North Doe pastures were prescribed burned in late winter 1994. Because of a lack of ground vegetation as fuel, the burn was "spotty" in the North Doe pasture. The North Rock pasture was burned in winter 1995. Canopy reduction of the study mottes in South Rock and North Doe pastures ranged from no habitat canopy reduction to approximately 80%. The habitat canopy reduction of vegetation in the North Rock pasture was severe.

Preliminary data analysis for pre and post burn pastures has indicated no significant

difference in territory numbers. Field work on site identification and mapping showed 65 territories in the Rock and Doe pastures combined. Forty-six territories were in the Rock pastures and 19 were in the Doe pasture. In 1994, 74 territories were mapped in the Rock and Doe pastures (1 year post burn) while in 1995, 81 territories were mapped in the two pastures (2 years post burn).

This study is scheduled to be continued in 1996 and the Middle Rock pasture is scheduled to be prescribed burned. Preliminary data indicated that prescribed burning under correct weather conditions does not limit vireo use of habitat when done in conjunction with good range and wildlife practices.

This study is funded by the Texas Parks and Wildlife Department's Nongame and Urban Wildlife Program.

Comparative Habitat Use of Neotropical Migratory, Wintering, and Resident Birds in the Lower Rio Grande Valley of Southern Texas

Lois A. Balin and Thomas C. Tacha - Caesar Kleberg Wildlife Research Institute and Matt Wagner and Gary Waggerman - Texas Parks and Wildlife Department

The geographic location and diversity of habitat types of the Lower Rio Grande Valley (LRGV) of Texas provide critical feeding, nesting, and cover habitat for neotropical migrants, wintering, and resident bird species. Our objectives were to document bird density and species richness within major upland habitat types in the LRGV during winter and spring of 1994 and 1995, and to identify habitat types important to neotropical migrants, wintering, and resident landbirds based on relative use. Information gained from this study will aid in habitat acquisition and management and birding tourism.

Bird species were classified into 3 categories: (1) all birds, (2) neotropical migrants. (3) resident groups (permanent, winter, summer, and transient). Line transect sampling with visual and auditory observations was used to estimate bird species richness and densities of birds within 11 habitat types.

The total number of bird species observed was 166. More species of birds were observed during spring than winter in all bird categories except winter residents. There were no habitat and year interactions ($P > 0.05$) for species richness except for permanent residents. A significant interaction occurred between habitat and season ($P < 0.05$) for all bird resident groups. Bird species richness varied among habitat types in all bird categories except transients. Mean species richness was greatest for all birds and neotropical migrant landbirds in coastal brush and ebony woods. More permanent residents were observed in ebony and mixed woods than in other habitats. Mean species richness was greatest for winter and summer residents in shrub-grasslands and hackberry woods, respectively. Density and other analyses are currently in progress.

Funding was provided by the Texas Parks and Wildlife Department's Nongame and Urban Wildlife Program and the Caesar Kleberg Wildlife Research Institute.

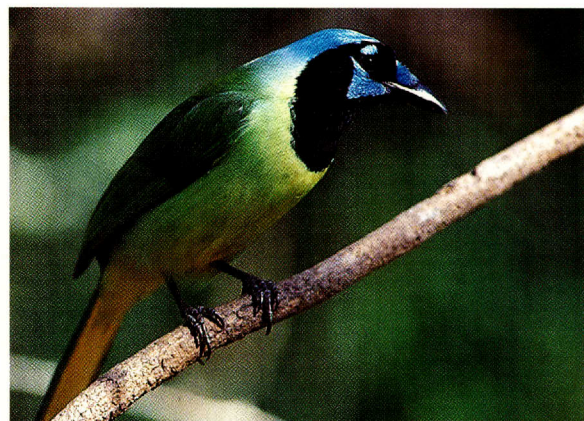


Photo by Mario Gonzalez

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

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



Photo by Rich Kazmaier

The Texas tortoise is a state-listed threatened species due to its limited range, its apparently low reproductive and recruitment rates, and its decline in recent years. Management of any species requires a knowledge of how various land-use practices will affect that species. There is, however, little information on how land-use practices impact Texas tortoises. On the Chaparral Wildlife Management Area (CWMA) in the western Rio Grande Plains, this study is testing the hypothesis that moderate, controlled grazing does not adversely affect Texas tortoises.

Demographic characteristics (density, 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 from June 1994 to October 1997. For assessment of demographic characteristics, data on sex, size, and age is being collected from all tortoises during fortuitous encounters. Population estimates for each area

will be made using mark-recapture methods. In addition, 10 (6F:4M) adult tortoises will be monitored by radiotelemetry in each of 4 pastures (2 grazed, 2 ungrazed) to determine home range, electivity, survivability, and movements. Time budgets are being calculated by intensively following the radio-marked individuals. Fecal samples are being collected for diet analysis.

As of December 1995, 498 captures of 428 individual tortoises have been made, and 40 transmittered tortoises have been monitored for 12,345 transmitter days with 1162 relocations. Population size using mark-recapture methods is estimated to be approximately 3,000 individuals on the 15,200 ac. CWMA. The CWMA population appears to be composed of smaller individuals than other populations studies. Age estimates and growth rates derived from recaptures suggest unusually rapid attainment of sexual maturity for a tortoise.

This study is funded by the Rob and Bessie Welder Wildlife Foundation and the Texas Parks and Wildlife Department's Nongame and Urban Wildlife Program.

Black Bear Habitat Suitability in East Texas

Nathan P. Garner and Sean Willis - Texas Parks and Wildlife Department

A combination of expanding black bear populations in Arkansas and Oklahoma, black bear restoration efforts in Louisiana by the U.S. Fish and Wildlife Service and the Black Bear Conservation Committee, and recent bear sightings in East Texas indicate an increased likelihood of greater bear activity in East Texas in the future. Identification of habitats most suitable for bears in East Texas will assist the Texas Parks and Wildlife Department in future management and restoration decisions.

This study focuses on whether there is enough quality bear habitat remaining in East

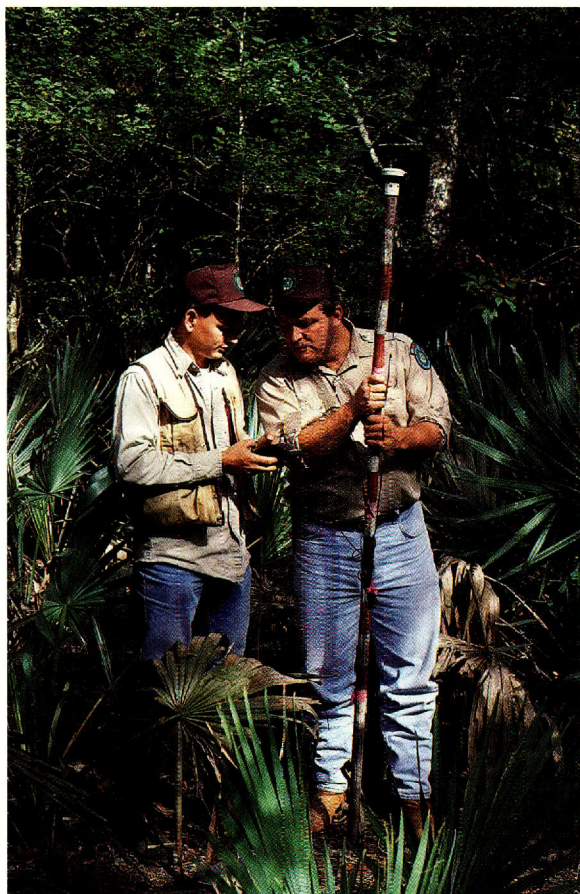


Photo by Ron George

Texas to support a viable population of black bears with minimal bear-human conflicts. We are using a black bear Habitat Suitability Index (HSI) model developed for the Southern Appalachian region to determine the suitability of forested habitats in East Texas for black bears. The model is based on 4 variables to evaluate the availability of summer and fall foods, 2 variables associated with cover requirements, and 2 variables related to human impacts. Suitability index values are assigned to each variable. Application of this HSI model in East Texas is being examined from 1994-1996 through field sampling and analysis of contiguous forests greater than 50,000 acres in size.

During the first year of this study, the Big Thicket National Preserve and White Oak Creek Wildlife Management Area were field sampled. During the second year, calculation of habitat

suitability values were made for both of these previously field sampled areas; Lake Wright Patman Corp of Engineers lands were field sampled and assigned habitat suitability values; and two more candidate forests located along the lower Neches River corridor composed primarily of private timber company and U.S. Forest Service lands were field sampled.

Early results indicated that denning tree densities were extremely limited but protection cover was adequate. Summer and fall food availability scored well. Density of open roads and human/bear conflict zones in some areas had reduced habitat suitability for bears. Preliminary results indicate that overall combined HSI values per area calculated were favorable.

In the remaining months of the study, habitat suitability index values will be determined and finalized for all previously sampled forests. A ranked list will be prepared of forested areas with the most suitable habitats for bears and minimal potential for bear-human conflicts.

This study is funded by the Texas Parks and Wildlife Department and Federal Aid in Wildlife Restoration Grant W-125-R.

Assessment, Classification, Protection, and Management of Southern Forested Wetlands Utilizing Caddo Lake, Texas and Louisiana as a Demonstration Area

Jim Neal, Carl Frentress, Kim Ludeke, Changxiang Liu and Jane Chang - Texas Parks and Wildlife Department

Southern forested systems, also referred to as bottomland hardwood forests, are dominated by hardwood tree species with smaller percentages of coniferous species. These forests are found along rivers and major streams throughout the southeastern United States from Virginia to Texas, and are among the most productive biological systems in the United

States as a result of alternating wet and dry cycles. These systems also perform a number of vital functions recognized as beneficial to society as a whole.

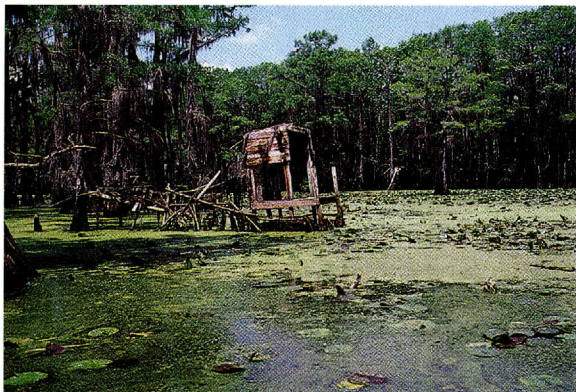


Photo by Jim Neal

Notwithstanding the system's value to society, forested wetlands have experienced the greatest losses of any wetland type in the United States. Only about 30% of bottomland hardwoods remain in Texas. In addition, the quality of most of the remaining hardwood stands is only poor to fair. It appears that new threats to these forests, resulting from increasing demands for hardwood pulp, will further increase the rate of change of these systems. A thorough analysis of the remaining forested wetlands is important for understanding the long-term impacts on the State's wildlife resources.

Caddo Lake, located in northeast Texas and adjacent Louisiana, represents a perfect area for a model demonstration project. The Texas Parks and Wildlife Department recently purchased over 7,000 acres at Caddo and has begun work on a master plan. The area also has recently been designated a Ramsar Wetland of International Significance and is the 1st in Texas and the 13th in the United States to be so designated. After techniques have been refined at Caddo Lake, all or most of the remaining forested wetlands in East Texas will be analyzed.

This study will assess and evaluate southern forested wetlands along floodplain basins

through the use of remote sensing techniques by delineating the areal extent and classifying these wetlands. This data will be utilized in a risk-based assessment of forested wetland habitats.

Extant wetlands will be compared to wetlands present in the early 1980's, and utilized as a baseline against which future threats and losses can be judged. This will allow conservation entities to better establish wetland protection priorities in the future. Hopefully, this will lead to more effective and publicly acceptable methods of safeguarding these areas through landowner incentives as well as more traditional efforts like easements and fee land acquisition.

This study is funded through a U.S. Environmental Protection Agency (EPA) grant with supplemental funding by the Texas Parks and Wildlife Department.

Demonstration of Bottomland Hardwood Forest Restoration for Wildlife Habitat and Timber Production

Hayden Haucke, Carl Frentress, and Dale Prochaska - Texas Parks and Wildlife Department



Photo by Hayden Haucke

Bottomland hardwood forests are among the most ecologically important habitats in Texas. These forests provide the hub, or nucleus from which many resident and migrant wildlife species radiate out to adjoining upland sites.

Nationally, the 70-80% original presettlement floodplain forest acreage has been lost due to human land use changes. In Texas, about 60% of the original floodplain forest has been lost. Recently, new national and international markets have increased demand for hardwood saw timber and pulp. In Texas, this market is predominately supplied from bottomland hardwood forests.

The objectives of the study are to improve the species composition of trees on approximately 200 acres of existing high-graded forests using an improvement cut method of timber harvest followed by tree seedling plantings using native oaks and pecan and to develop information products and conduct outreach events to private landowners concerning options for bottomland timber management.

The timber harvest/replanting treatment site has been selected within the Trinity River floodplain on the South Unit of the Richland Creek WMA. This site was chosen as representative of the 10,000 acre high-graded elm-hackberry-green ash forest on this management area. The 200-acre site is located in close proximity to the management area's main access road to provide easy access during timber harvest and future private landowner demonstrations. The treatment site is surrounded by cleared rights-of-way that are useful as travel lanes in accessing the study area and for removing side limbs and tops of harvested trees. The Texas Forest Service conducted a complete timber inventory of the treatment site and marked all trees to be harvested. The first inventory was analyzed using the Inventory Processor computer program for two interest variables, sawtimber and pulpwood. Analyzed data indicated 36.7 trees per acre or 1,419.4 board-feet (Doyle Scale) available for sawtimber. Analyzed data also indicated 54.1 trees per acre or 7.6 cords of pulpwood per acre. The timber sale and harvest occurred during August and September, 1995.

All marked trees were removed from the replanting areas and stacked within adjoining rights-of-way. The timber harvest, known as "thinning from above," resulted in a total of 1,586.8 tons of sawtimber and pulpwood removed from the study area. Using a conversion factor of 2.8 tons per cord, the total timber harvest was estimated at 566.7 cords. The study site was replanted in February 1996 using 150 native oak and pecan and other hardwood producing seedlings per acre. Outreach literature and landowner demonstrations will follow.

This is the third year of a four year study funded primarily through a grant from the United States Environmental Protection Agency (EPA). Assistance in timber harvest and replanting procedures was obtained through an interagency agreement with the Texas Forest Service.

Wildlife Value Orientations and Information Needs of Non-Industrial Private Forest Landowners in East Texas

Carter P. Smith and Stephen R. Kellert - Yale University and Kirby Brown - Texas Parks and Wildlife Department

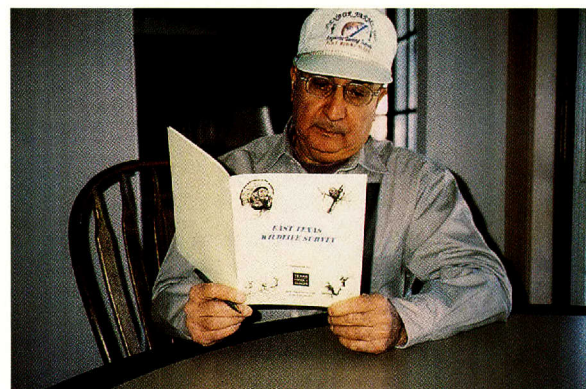


Photo by Carter Smith

One of the greatest problems facing resource managers is the lack of awareness and interest among many private landowners regarding wildlife stewardship. A comprehensive

understanding of landowner attitudes, interests, and objectives regarding wildlife is essential for wildlife professionals working to develop more successful extension programs designed to promote key game species, protect critical habitats, and conserve imperiled species. Nowhere is this challenge more striking than within the borders of a predominately private lands oriented state such as Texas.

To assist wildlife biologists in East Texas with this endeavor, we initiated an attitudinal study of non-industrial private forest landowners to investigate the following items of interest: (1) basic attitudes and values regarding wildlife (2) perceptions of the role of government in wildlife conservation on private lands (3) incentives/disincentives for engaging in wildlife management (4) wildlife information needs and preferred mediums for information transfer.

To ensure an adequate geographical representation of landowners, we employed a multi-stage cluster sampling scheme to randomly select 18 counties distributed throughout the northern, central, and southern portions of the Pineywoods and Post Oak Ecological Regions. Within each county, a stratified cross sectional sample of landowners (n=150/county) representing three strata of land ownership size categories (20-99 acres, 100-499 acres, >500 acres) was randomly selected from County Tax Appraisal District Office records.

After extensive personal interviews with private landowners and pre-testing of preliminary questionnaires, a final survey instrument was developed and disseminated to 2700 landowners. A \$2 bill was included in the initial survey mailing as an incentive to encourage landowner response. A 70% total response rate was achieved through two survey mailings.

Project funding for this 1 year study has been provided through the Private Lands Enhancement and Migratory Wildlife Programs of the Texas Parks and Wildlife Department.

Baseline Inventories for Wildlife and Vegetation Monitoring on State-owned Lands

M. Todd Merendino and Matt Wagner - Texas Parks and Wildlife Department



Photo by Ron George

Texas Parks and Wildlife Department Wildlife Management Areas (WMAs) contain diverse plant communities and provide habitat for a wide variety of game and nongame wildlife species. The Baseline Inventory project was initiated on selected WMAs to obtain baseline information on plant and animal species and measure their responses to management activities. Habitat management activities often include controlled burning, cattle grazing, water-level management, and mechanical/chemical control of vegetation designed primarily to provide quality habitat for waterfowl, white-tailed deer, turkey, quail, and

doves. In addition to game species, the baseline inventories will also evaluate the response of vegetation, small mammals, reptiles, amphibians, neotropical songbirds, and waterbirds to the management activities.

Point intercept vegetation transects are used to monitor species composition, diversity, and density. Sherman live traps and drift fence arrays are used to assess small mammal, reptile, and amphibian species composition and distribution. Mist netting, point counts, and time area counts are conducted to monitor neotropical songbirds. One-acre enclosures serve as controls to assess the effects of "no management activity" on vegetation.

Baseline inventory projects are being conducted by Wildlife Division staff on Elephant Mountain, Matador, Mad Island, Chaparral, Kerr, Walter Buck, Engeling, Cooper, and J.D. Murphree WMAs.

To date, baseline inventories on Mad Island WMA have documented 296 bird species, 43 species of reptiles and amphibians, and 47 fish species. Inventories on Chaparral WMA have documented 125 bird species, 25 mammal species, 5 amphibian species, and 35 reptile species.

The Salt Bayou Project: Effects of Water Control on Vegetation and Salinity

Jim Sutherlin and Terry Turney - Texas Parks and Wildlife Department

Loss of coastal wetlands along the Upper Texas Gulf Coast during the past century has been attributed to many factors. One of the more significant impacts is from the development and maintenance of navigation channels in Jefferson County, which bisect formerly fresh to intermediate coastal marshes. The Port Arthur Canal (now the west shoreline of Sabine Lake) constructed in 1898 to the mouth of Taylors Bayou and the Gulf Intracoastal Waterway (GIWW) constructed through

Jefferson County in 1933 and 1934 are the two most important canals in the southern portion of the County. Tidal circulation of seawater in this formerly fresh to intermediate system is believed to be the primary cause of vegetation loss in marshes within the Salt Bayou drainage.

In 1990, the Salt Bayou Project, a joint water management plan for Sea Rim State Park, McFaddin National Wildlife Refuge, and the J.D. Murphree Wildlife Management Area was approved for restoration of wetland habitats to former salinity regimes. This management plan involves the construction of the Salt Bayou Water Control Structure at the eastern confluence of the GIWW and Salt Bayou on Sea Rim State Park. The new structure, completed in October 1995, will enhance the ability of Texas Parks and Wildlife Department's (TPWD) Wildlife Division staff to manage salinity and tidal energy within the Salt Bayou drainage.

To monitor vegetation changes within Sea Rim State Park and the Lost Lake Unit of the J.D. Murphree WMA, TPWD staff developed 21 km of vegetation line transects to be monitored in the late summer each year. Monitoring began in 1993, 2 years prior to construction of the Salt Bayou Structure. Salinity stations have been monitored within the system twice monthly since 1993.



Photo by Jim Sutherlin

The basis for all water management decisions will be the long-term welfare of plant communities, predominately fresh and intermediate species. The management plan will

attempt to duplicate the former hydrologic scheme whereby fresh water flowed east to be met by brackish waters near Sabine Lake. Management strategies will be aimed at curtailing the present marsh deterioration trend of intruding salt water eliminating salt intolerant plants and erosional export of organic materials. Vegetation transect and salinity monitoring will continue for 5 years after the completion of the Salt Bayou Water Control Structure.

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: Ecosystem Response to Management Strategies

M. Todd Merendino, D.W. Mabie, J. Brent Ortego, and Dennis L. Brown - Texas Parks and Wildlife Department

Saltwater intrusion, as a result of natural subsidence, river channelization, reduction of freshwater inflows, and canal dredging is a major cause of coastal wetland deterioration. As saltwater invades formerly "fresher" sites, salt intolerant plant species die and organic matter erodes, resulting in large expanses of open water areas. Natural drainage patterns along many areas of the Gulf Coast have been altered by construction of the Gulf Intracoastal Waterway (GIWW) and other channelization projects. Specifically, a comparison of 1930, 1973, and 1991 aerial photography indicates that natural drainage patterns and vegetative dynamics in Robbins Slough Drainage at Mad Island Wildlife Management Area in Matagorda County, Texas, have been altered by the GIWW and Culver Cut Ditch (CCD). These projects accelerated the loss of fresh water and increased saltwater intrusion. Concomitant with changes in freshwater and saltwater flow patterns has been a change in

vegetation species composition from that which is more characteristic of fresh, intermediate, and brackish marshes to that more characteristic of brackish and saline marshes, and also, an increase in unvegetated open water areas. Also, erosion of shorelines and organic matter has occurred due to barge traffic in the GIWW.

We are proposing to restore freshwater inflow and regulate saltwater intrusion into Rattlesnake Island Marsh and Savage Marsh at Mad Island Wildlife Management Area by constructing several structures, levees, and small



Photo by Ron George

channels. These activities will replenish sediments and soil nutrients in the Rattlesnake Island and Savage marshes. Numerous plant and animal species will be monitored over a 3-4 week period during each phase of management activity. Fish will be sampled bi-weekly via trammel nets and bag seines. Invertebrates will be sampled quarterly via benthic sleds and soil cores. Select water chemistry constituents will be monitored bi-weekly, others will be monitored monthly. Soil chemistry will be monitored annually. Changes in abundance, distribution and species diversity of submergent and emergent vegetation will be monitored twice during the year. We will conduct aerial and boat surveys for water birds and spotlight and nest surveys for alligators.

One year of baseline monitoring has been completed. To date, 47 fish species have been recorded. Further analysis will be conducted to

determine species composition and relative abundance. We have tagged 75 red drum. This tagging will provide information on fish movements within the Robbins Slough estuary and the adjacent bay systems. We have tagged 100 alligators from 18" to 6' in length. Future recapture efforts will provide information on movements, growths, and survival in response to marsh management strategies.

This project is funded by the Texas Parks and Wildlife Department, Wildlife Division, Region 4.

Evaluation of Aquatic Macrofaunal Populations in a Coastal Marsh: Mad Island Wildlife Management Area, Matagorda County, Texas

Susan A. Cox, E.H. Smith, and J.W. Tunnell - Texas A&M, Corpus Christi and R.L. Lehman and M. Todd Merendino - Texas Parks and Wildlife Department

Saltwater intrusion resulting from natural subsidence, channelization, reduction of freshwater inflow, dredging, alteration by construction, and other drainage projects has contributed to the deterioration of coastal wetland systems. The Mad Island Wildlife Management Area (MIWMA), located adjacent to Matagorda Bay, is currently being examined as part of a long range goal to re-establish the freshwater integrity of the Rattlesnake Island marsh community within the MIWMA. This project is Phase I, a baseline study, of a three-phase investigation being conducted by the Texas Parks and Wildlife Department, Wildlife Division. Erosion of the Gulf Intercoastal Waterway and the dredging of Culver Cut Ditch have been determined as sources of saltwater intrusion. Sampling parameters were pre-determined by the investigating agency and adopted by the principal investigators. Six lakes within the sampling area are being surveyed quarterly (seasonal) to determine species

richness, diversity, density and frequency associated with benthic and macronektonic fauna. Four quarters of sampling indicate grass shrimp (*Palaeomonetes pugio*), water boatman (*Hesperocorixa* sp.) and naked goby (*Gobiosoma boscii*) as the most abundant species collected. Average salinity for the four quarters ranged from 7 ppt (Cane Lake) to 18 ppt (East Lake). Results suggest that saltwater intrusion due to erosion and Culver Cut Ditch construction has facilitated the settlement of brackish-water tolerant organisms into the system.

This project is funded by Texas Parks and Wildlife Department using Waterfowl Stamp funds.

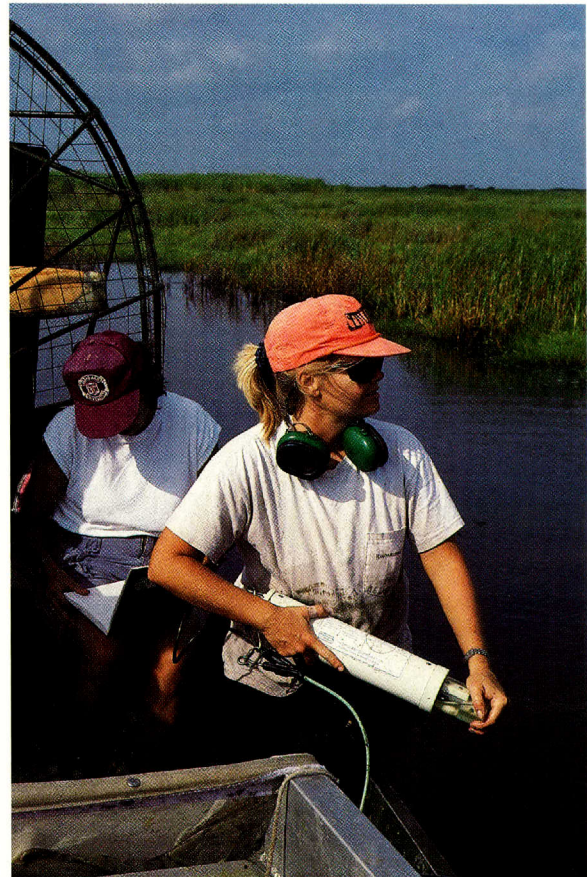


Photo by Ron George

Chinese Tallow Tree Control

Jim Sutherlin and Terry Turney - Texas Parks and Wildlife Department and Ron K. Jones - U.S. Fish and Wildlife Service



Photo by Paul Montgomery

Chinese Tallow (*Sapium sebiferum*) is an aggressive, introduced exotic tree which readily invades and out competes native species in wetlands, fallow agricultural land, pasture and coastal prairie. Because it does not have any apparent natural control mechanism, Chinese tallow can become dominant over story, shading out the natural diversity of emergent and submergent plants, and grassland communities. Loss of native plant species production ultimately decreases total productivity. Decreased primary production may result in lowered levels of dissolved oxygen, thereby affecting nutrient cycling. Finally, roots of mature Chinese tallow trees may cause structural damage and soil erosion causing increased maintenance and repair costs for levees.

Chinese tallow has resulted in the degradation of coastal prairie, wetland management levee systems, and habitat for migratory and ground nesting birds. The Texas Parks and Wildlife Department will conduct this study on the J.D. Murphree Wildlife Management Area with the objectives of 1) restoring coastal prairie habitat, 2) determining the mortality of tallow following application of Grazon P+D herbicide, 3) evaluate the success of secondary control measures (burning, hand clearing, shredding, and follow-up chemical treatment, and 4) Identify impacts on non-target plant species.

This study should result in determining the most suitable control and follow-up treatments for Chinese tallow control and management along the Upper Texas Gulf Coast. This is the first year of a 3-year project funded by the Texas Parks and Wildlife Department.

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

Eric J. Taylor, Len Polasek, Jerry M. Mambretti - Texas Parks and Wildlife Department, Richard W. Griffin - Prairie View A&M University, and William A. White and Robert A. Morton - Bureau of Economic Geology

The most extensive, contiguous loss of wetlands along the entire Texas Coast has occurred along the Lower Neches River (White et al. 1987). From 1956-78, 3,811 hectares (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 (Morton and Paine 1990, White 1993).

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 further inland during periods of high tide. Saltwater intrusion into fresh marsh in turn causes loss of salt intolerant emergent and submergent aquatic plants (Chabreck 1981, Pezeshki et al. 1987) and erosion and net loss of soil organic matter (Craig et al. 1979).



Photo by Terry Turney

To examine the potential role of saltwater intrusion in marsh degradation, Texas Parks and Wildlife Department will plug two 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 box culverts under State Highway 87 will allow tidal waters and the ingress/egress of marine organisms to enter the 600 ha marsh. Specific objectives of this research are to examine: (1) water conductivity, salinity, temperature and dissolved oxygen using continuous recording instrumentation; (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 allow differentiating potential habitat perturbations 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, area extent of emergent marsh will be compared between the periods of 1956-78 and 1978-1990s. Field work will begin Winter 1995 and continue through Winter 1998.

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

Liquid Carbonics Pipeline Study

Jim Sutherlin, Len Polasek, and Terry Turney - Texas Parks and Wildlife Department

Pipelines are used to move large quantities of gas and liquid materials along the Gulf Coast to market and from one industrial facility to another. Moving products by pipeline can be much more efficient than other transport methods which include barge, ship, truck and rail transport. Many of the pipelines along the Gulf Coast are constructed through coastal marshes. Wetland loss as a result of pipeline construction must be mitigated.

This study on the Lower Neches Wildlife Management Area is to determine factors responsible for the success or failure of revegetation to determine the best construction procedures and learn which wetland habitats are most susceptible to long-term damage. Objectives of this research include determining factors, processes, and conditions associated with both successful revegetation and failed areas within a pipeline corridor.

Pre-pipeline construction field data were collected in the early fall of 1995 to determine vegetation and wetland types, soils, and water quality data. High altitude color infrared aerial

photography of the pipeline corridor through Orange County prior to construction was obtained. Field data collection and aerial photography will be duplicated 12 months after pipeline completion to determine exact measurements of wetland impacts within the pipeline construction corridor. This data will be used to determine the actual mitigation owed for wetland losses due to construction of a 10" pipeline through coastal wetlands.

This study is funded by TI Energy Services, Houston, Texas.

Development of Techniques for and Evaluation of the Texas Prairie Wetland Project

Michael Dammarell and Thomas C. Tacha - Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville and David Lobpries - Texas Parks and Wildlife Department



Photo by Ron George

This study evaluates wetland development projects completed under the Texas Prairie Wetland Project (TPWP) of the Gulf Coast Joint Venture. Under the TPWP, private landowners develop and manage wetlands according to guidelines set forth in Wetland Development Agreements (WDA's). Management of the wetlands is primarily aimed at benefitting ducks wintering along the Gulf Coast.

Projects completed under 30 WDA's are

being monitored to determine the quantity and quality of the waterfowl habitat being provided. A cost analysis of the projects will increase spending efficiency and, ultimately, provide more benefits to waterfowl.

Each of the project wetlands was designed to be managed as either a flooded rice field, a seasonally flooded moist soil unit, or a permanently flooded fresh marsh. Between September 1994 and March 1995, 14% to 18% of the wetlands were of a type previously recommended as priority for management. Between 52% and 83% of the potential wetland habitat held standing water. Average densities of all duck species combined did not differ between rice field, moist soil, or fresh marsh wetlands.

Field work for this study will be completed in March 1996. A final report will be completed by September 1996. Financing of this study came from Texas Waterfowl Stamp funds and Federal Aid Project W-128-R funds.

Estimating Breeding Pairs and Production of Ducks in the Coastal Plains of Texas

Russel H. Terry and Thomas C. Tacha - Texas A&M, Kingsville and M. Todd Merendino - Texas Parks and Wildlife Department

Accurate annual population and production estimates are needed for effective waterfowl management. The North American Waterfowl Management Plan cites the Gulf Coast as one of

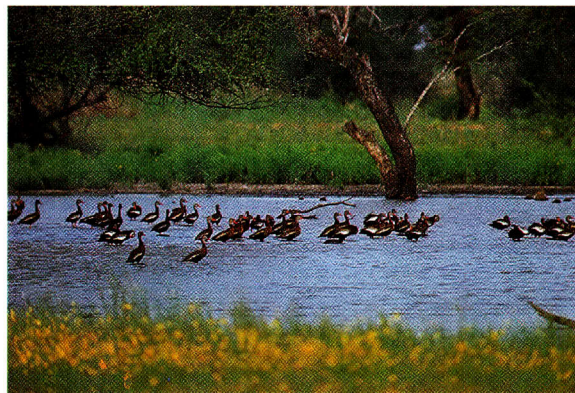


Photo by Bill Reaves

34 high priority waterfowl habitat areas of concern in the U.S. and Canada. Specifically, development and implementation of techniques for estimating duck breeding populations in the Texas coastal plains will be of substantial importance and assistance to management of Texas waterfowl populations. Mottled ducks (*Anas fulvigula*), black-bellied whistling ducks (*Dendrocygna autumnalis*), and fulvous whistling ducks (*D. bicolor*) nest throughout the Texas coastal plains, but few data exist on population status or habitat use during the breeding season. The objectives of this study are to: 1) develop techniques to estimate numbers of breeding waterfowl, 2) develop techniques to estimate numbers of ducklings produced by each species of waterfowl, and 3) determine critical breeding pair and brood-rearing wetlands required by each species nesting in the Gulf Coastal Plains of Texas.

Three survey methodologies will be evaluated: 1) ground "beat-outs" of 300 randomly selected wetlands, 2) aerial surveys of the same 300 randomly selected wetlands, and 3) aerial transect surveys. The surveys will be conducted simultaneously to evaluate the effectiveness and feasibility of each methodology. "Beat-out" surveys will be conducted during March, April, May, June, July, and August; aerial surveys of random wetlands will be conducted during March and May; aerial transects will be flown March, April, May, June, July, and August. This is a 2-year study that was conducted March 1993 through August 1995.

First year results indicated that considerably more breeding pairs were observed with either the "beat-out" or aerial surveys of the random wetlands than with the transect methodology. A comparison between the "beat-out" methodology and the aerial survey of the random wetlands indicated that similar numbers of breeding waterfowl were observed. In March, 82 and 108 mottled duck pairs were observed on the "beat-out" and "aerial random"

surveys, respectively. In May, 206 and 204 mottled duck pairs were observed on the "beat-out" and aerial random surveys, respectively. Mottled ducks were the most common breeding waterfowl observed on all surveys. Few pairs of other species were observed. Few broods were observed. Data from the 1995 surveys is not yet available.

This study was funded by the Texas Parks and Wildlife Department using Waterfowl Stamp funds and Federal Aid in Wildlife Restoration Grant W-128-R.

Habitat Selection of Wood Duck and Cavity-nesting Nongame Birds in Northern Rolling Plains Riparian Zones

Robert T. Magill and Loren M. Smith - Texas Tech University and James D. Ray - Texas Parks and Wildlife Department



Photo by Jim Ray

Little information exists on wood ducks or wood duck habitat in the Rolling Plains, particularly in the northern and western Rolling Plains. Cottonwoods and other trees are abundant on riparian areas in the northern Rolling Plains. These maturing forests, in concert with riparian wetlands (streams, beaver ponds, man-made impoundments) are providing habitat to an expanding wood duck population as well as populations of cavity-nesting nongame birds. Our objectives for this 2-year study are to (1) characterize wood duck

and cavity-nesting nongame bird habitat in the northern Rolling Plains, (2) evaluate habitat/placement characteristics affecting occupancy and nest success of man-made nest boxes, and (3) compare success of nests in natural cavities versus nests in boxes.

Potential nest sites in natural tree cavities will be located in randomly-selected plots during the winter months. Cavities will be revisited during and immediately following the nesting season to determine occupancy and nest success. Wood duck and cavity-nesting nongame bird habitat will be characterized by such variables as cavity orientation, tree species, diameter at breast height, densities, basal area, and distances to water, permanent water, and nearest forest openings. Cavities occupied by wood ducks or nongame species will be characterized by type, orientation, entrance size, and bole size.

Eighty wood duck boxes with compartments for small nongame birds also will be monitored for occupancy and nest success. Comparisons will be made of nest success of nests in boxes vs. natural cavities, and between boxes with predator guards and those without. Effects of independent variables (cavity orientation, box height, depth of water under the box, distance to water, distance to shore, distance from nearest permanent water, distance from nearest tree canopy) on nest box occupancy and nest success will be explored.

Information gained from this study will aid in the development of region-specific recommendations for managing wood duck and cavity-nesting nongame bird habitat, including placement of nest boxes for maximizing occupancy and nesting success. This is the first year of a 2 year study funded by Texas Waterfowl Stamp and Nongame Stamp funds, hunting license revenue, and the Southwestern Public Service Company.

Distribution, Abundance, Subspecific Composition and Recruitment of the Gulf Coast Subpopulation of Mid-continent Sandhill Cranes

Bart Ballard, Thomas C. Tacha, and Fred Guthery - Caesar Kleberg Wildlife Research Institute and M. Todd Merendino, James D. Ray, Jay Roberson - Texas Parks and Wildlife Department



Photo by Tom Tacha

Very little information exists on the demographics of the Gulf Coast subpopulation, one of two subpopulations, of sandhill cranes (*Grus canadensis*) in the Mid-continent population which winters in Texas. Estimates of the Gulf Coast subpopulation size range from as few as 30,000 to as many as 166,000. This subpopulation is composed of three subspecies, but the proportion of each is not well defined. The Greater (*G. c. tabida*) subspecies which winters almost exclusively in the Gulf Coast subpopulation, is the most limited in distribution and number of the three. Recruitment rates for this subpopulation have been determined for only one year and are considerably higher (18%) than rates reported from various other studies of other crane populations (~11%).

The objectives of this study are to:

- (1) delineate the distribution and estimate numbers of the Gulf Coast subpopulation,
- (2) determine subspecies composition of this subpopulation, particularly the number and

distribution of Greater sandhill cranes, and (3) determine annual recruitment rates.

Knowing subspecies composition, numbers, distribution and recruitment is very important to insure that recreational harvest and crop depredation control are compatible with long term crane population viability.

In the first field season, 172 adult cranes have been collected from the southern Rolling Plains, Cross Timbers, South Texas Plains, and mid- and lower-Gulf Prairies and Marshes ecological areas. Morphological measurements were taken and preliminary results indicate 28% of the cranes taken on the Gulf Coast were classified as belonging to the Greater subspecies while 18% of the cranes from the southern Rolling Plains/Cross Timbers were Greater, and only 3% of the South Texas Plains birds were Greater. Age ratios from 223 flocks classified along the Gulf Coast was 10.6% juvenile. Seventy paired 20-mile long variable-width aerial transects were located randomly within a tier of three counties inland from the Gulf Coast. Fifty-seven of these have been flown yielding a preliminary estimate of 50,761 cranes (SE=10,193).

This is the first year of a two year study funded jointly by the Texas Parks and Wildlife Department, the Webless Migratory Game Bird Research Program (USFWS), and Caesar Kleberg Wildlife Research Institute.

Factors Affecting Reproduction of White-winged, White-tipped, and Mourning Doves in the Lower Rio Grande Valley of Texas

Steven E. Hayslette and Thomas C. Tacha - Caesar Kleberg Wildlife Research Institute and Gary L. Waggenerman - Texas Parks and Wildlife Department

Efficient and cost-effective land acquisition to benefit white-winged, white-tipped, and mourning doves in the Lower Rio Grande Valley

(LRGV) of Texas depends on understanding factors limiting production of each species. Such factors potentially include destruction or degradation of nesting habitat, nest predation by great-tailed grackles, and lack of high-quality foods. This 2-year study will quantify relationships between each of these habitat characteristic factors and productivity of the 3 dove species. Our objectives are to (1) determine the importance of habitat type, and to rank-order the importance of woodlot size, foliage density, abundance of great-tailed grackles, adjacent land use, and distance to the Rio Grande and Laguna Madre on productivity of the 3 species; and (2) identify nest-site preferences and their effects on nesting success and production for each species.

All wooded tracts 100 x 10 yards in size were inventoried in the LRGV, and 75 woodlots, stratified by habitat type, were randomly selected as study sites in 1994. One to 3 transects, 100 x 10 yards in size, were randomly established in each woodlot (1-2 along the edge and 1-2 in the interior, based on woodlot size). Foliage density on each woodlot was indexed during April-May, and land-uses within 1 mile of each tract were surveyed during May-June. Distances from the center of each woodlot to the Rio Grande and Laguna Madre were also measured.

Each transect was surveyed for nests of the 3 dove species and great-tailed grackles each week from 1 May to 15 August. Height, nest tree species, and fate of each nest was documented.



Photo by Brenda Hayslette

We found 171 mourning dove, 66 white-winged dove, and 15 white-tipped dove nests in 1994. Peak weeks of nesting were 27 May-2 June for mourning doves and 10-16 June for white-winged and white-tipped doves. Mean date of nest initiation was 9 June for mourning doves, 11 June for white-winged doves, and 16 June for white-tipped doves.

Mean number of eggs/nest was 1.9 for mourning doves and white-winged doves and 1.7 for white-tipped doves. Overall egg success (percent of eggs laid that hatched) was 48% for white-winged doves, 85% for white-tipped doves and 39% for mourning doves. Overall fledging success (percent of eggs hatched that fledged) was 100% for white-winged doves, 82% for white-tipped doves, and 87% for mourning doves.

Habitat type had a significant effect on egg and fledgling densities for all 3 dove species, but habitat type had no significant effect on egg or fledging success for any species.

Grackle abundance was positively associated with white-winged dove egg and fledgling densities, and distance to the Rio Grande was positively associated with white-winged dove egg success. Grackle abundance was positively associated with mourning dove egg density, vegetation foliage density was negatively associated with mourning dove egg success, and distance to the Rio Grande was positively associated with mourning dove fledging success.

Mourning doves selected edge nest sites over interior sites, and white-winged doves selected interior sites over edge sites. White-tipped doves did not selectively use edge or interior sites. Mean nest height was significantly greater for white-winged doves (15.0 feet) than for mourning doves (9 feet) or white-tipped doves (8.9 feet). Nest height, nest tree species, nest location (edge or interior), of nesting had no effect on egg or fledging success for any species.

Field work was repeated in 1995 using a stratified random sample of 75 new woodlots.

We found 210 mourning dove, 64 white-winged dove, and 12 white-tipped dove nests on transects in these 75 woodlots during the second year. Combined analysis of data from both years of the study should be completed soon, and our final report for this 2-year study will be submitted by mid-year 1996.

Cooperative funding for this study was provided by Texas Parks and Wildlife Department White-winged Dove Stamp funds, Federal Aid in Wildlife Restoration Grant W-128-R, and the Caesar Kleberg Wildlife Research Institute.

Sublethal Effects of Organophosphorus Pesticides on Reproductive Behavior, Physiology, and Productivity of White-winged Doves

Michael F. Small - Caesar Kleberg Wildlife Research Institute and Gary Waggerman - Texas Parks and Wildlife Department



Photo by Bill Reaves

White-winged dove populations have been declining in the Lower Rio Grande Valley (LRGV) of Texas since the early 1920's. This phenomenon is of particular concern because the LRGV constitutes the primary breeding area for the species in the United States. The adverse effects of organophosphorus (OP) pesticides on

bird populations is well documented and are due to the inhibition of the critical enzyme, cholinesterase. Significantly depressed levels of acetyl cholinesterase have recently been documented in white-winged doves, although the effects on behavior, reproduction, and productivity are yet to be quantified.

In January 1995, we initiated a study to describe the sublethal effects of field-applied OP pesticides on reproductive behavior and productivity in white-winged doves and to document the route of exposure. This will be accomplished via a captive breeding program coupled with field observations.

We trapped several hundred juvenile white-winged doves and are currently holding them in specially designed pens. After overwintering, 60 breeding pairs will be formed and randomly assigned to 1 of 3 OP treatments (0, 20, and 40%). Behavioral, nutritional, and reproductive measures will be monitored for 2 breeding seasons. Courtship and nest-building behaviors, percent of birds completing nests and laying eggs, clutch size, egg mass, egg hatchability, nest success, and nestling survival to 14 days are among the parameters we will be recording and comparing between the groups. Random blood samples will be taken at 14-day intervals to track changes in acetyl cholinesterase depression. During the second breeding season, a single sublethal doses of a commonly used (in the LRGV) carbamate pesticide will be added to treatments between first and second nesting attempts. Food and water intake of adult birds will be monitored daily.

Finally, we will document the route of exposure of OP pesticides to white-winged doves. We hypothesize that exposure occurs via consumption of contaminated irrigation water. We will, therefore, make quantitative observations of white-winged doves drinking from irrigated cotton fields and run-off channels. In addition, we will take weekly water samples from 10 irrigated cotton fields during July 1995 and 1996. These samples will be analyzed and

pesticide concentrations documented.

This study is funded with Texas Parks and Wildlife Department White-winged Dove Stamp revenue.

Genetics and Environmental Interaction in White-tailed Deer

John D. Williams - Texas A&M University, College Station, and William E. Armstrong, Eugene R. Fuchs and Donnie Harmel - Texas Parks and Wildlife Department



Photo by Eugene Fuchs

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

Departmental check station data indicate that the incidence of spike antlers increased during extended periods of drought and poor habitat conditions. This supports the hypothesis that one of the causes of poor antler characteristics can be 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 research complex consisting of 6-2/3 acre breeding pens and 3-4 acre holding pens. Deer used in the study have pedigrees which date back to 1973.

Since 1991, known pedigreed bucks have been placed with 8-12 pedigreed does using single sire herds. Fawns are ear tagged and matched with their respective dams for pedigree records. In October, fawns are removed from their dams, segregated according to sex and placed in 2 separate pens. Starting in November, buck fawns are placed on a limited 8% protein diet to simulate nutritional stress conditions. The following October, 6 males which have the best antler production and body size under these nutritional stress conditions are used as herd sires. Since the study was initiated, 25 different single sire breeding herds have produced 91 yearling males which have been reared on an 8% protein ration while growing their first set of antlers. Twenty-two yearling bucks (24%) have produced antlers with 6 or more points while 42 (46%) have produced spike antlers.

Blood samples have been obtained from over 300 deer involved in the study for DNA analysis. A separate 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.

Molecular Approaches to Management of White-tailed Deer

Loren C. Skow, Rodney Honeycutt, and John Williams - Texas A&M University-College Station and E. L. Young and Donnie Harmel - Texas Parks and Wildlife Department



Photo by Media Resources, College of Vet. Medicine, Texas A&M Univ.

White-tailed deer are the principal source of wildlife-related income for Texas landowners. The management of white-tailed deer habitat, harvest, and genetics have become increasingly important to the resource. Deer are often transported to new habitats or herds manipulated to "improve" genetics without an understanding of the effects of the management practices.

There is a lack of genetic information concerning traits such as antler development, growth, and disease resistance. This research will improve knowledge for reproductive studies, stocks identification, forensic identification, effects of deer transplants and genetic management, genetic fitness, and genetic analysis of production trials.

The research will utilize DNA technology to identify genetic variation in a closed, known-pedigree herd on the Kerr Wildlife Management Area. The research will increase the number of genetic markers in deer and analyze their occurrence in a collection of 500 frozen samples from KWMA deer and antler shavings from bucks held at the facility since 1974.

There are three research goals: 1) Identify

genetic variation at the molecular level; 2) Assess levels of genetic heterozygosity and diversity; 3) Seek genetic markers for desirable traits. Attainment will contribute to construction of a genetic map of white-tailed deer to reveal molecular mechanisms (allelic distribution) that affect differences in body weight, antler size, mass, and configuration.

This is the first year of a three year study funded by donations of the Lee M. Bass Foundation in cooperation with the Texas Parks and Wildlife Foundation and the Texas Parks and Wildlife Department.

Seasonal Food Habits/Preference of White-tailed Deer in the Cross Timbers and Prairies 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



Photo by Ron George

Deer numbers and physical condition can be limited by the available food supply. A knowledge of the food habits and preferences of white-tailed deer 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 Region, deer food habits on two major soil types supporting different plant regimes will be compared by site and seasonality of use.

Currently, six study sites in Jack, Parker, Erath, Bosque, and Brown counties are being reviewed by the research team and field work will begin during April-May, 1996. Seasonal vegetative and rumen samples will be collected over a 2-year period with final analysis the third year.

Seasonal and spatial changes in food availability and preference 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 three-year study is funded by the Texas Parks and Wildlife Department through Federal Aid in Wildlife Restoration Grant W-127-R.

Effect of Baiting on Female White-tailed Deer Movements and Harvest

Royce W. Jurries - Texas Parks and Wildlife Department

A majority of the Post Oak Savannah landownership consists of small tracts of land. Hunting pressure is heavy on many of these small tracts. Attracting deer with corn and food plots is the normal method of hunting.

A 70-acre study area was selected in Colorado County to determine the effects of baiting on doe deer movement and harvest. Two corn feeders and one oat patch were used to attract deer to two hunting blinds. Observations were made prior to the hunting season to determine approximately how many deer were using the feeders and oat patch. A spotlight census line was conducted on the study area and surrounding ranches 3 times each fall to determine the deer population in the area. The population estimate was one deer per 11.8 acres and 8.6 acres in 1994 and 1995, respectively.

The baited areas were hunted each morning and evening for the first 6 days of the hunting



Photo by Leroy Williamson

season. Normal hunting procedures were followed and only does were harvested. Six does were harvested in 1994 and 10 in 1995. This was 1 doe harvested per 11.7 acres and 7 acres in 1994 and 1995, respectively.

This is the second year of a three-year study funded by Wildlife Division Region 4 funds.

Inheritability of Breeding Dates for Female White-tailed Deer

Bob K. Carroll - Texas Parks and Wildlife Department

The Texas Parks and Wildlife Department (TPWD) has trapped and transplanted thousands of deer in Texas during the past 40 years. The majority of deer restocking involved trapping deer in South-central Texas and moving them to the eastern half of Texas. Breeding and fawning dates were not considered when relocating deer from one ecological area or climate to another. A better understanding of white-tailed deer breeding dates and how they are impacted by relocating a deer herd to a different ecological area could influence future policies on trapping and transplanting.

The objective of this study is to determine if breeding dates can be significantly altered by trapping a group of white-tailed deer on a South Texas ranch and relocating them on a ranch in the Post-Oak Savannah. A 300-acre high-fenced

pasture of the Crier Creek Ranch in Colorado County was selected as the study site. TPWD personnel eradicated almost all of the native deer herd on the study site during the fall of 1993.

A total of 14 bucks, 52 does, and 10 doe fawns were trapped on 3 South Texas ranches and transported to the study site in February of 1994. All South Texas deer were ear-tagged to enable field identification and selective harvest in following years. Between July 5 and August 26, 1994, 32 male and 27 female fawns were captured on the study area and ear-tagged with color coded ear tags to indicate year of capture. An additional 18 male and 27 female fawns were captured and ear-tagged between June 27 and July 28, 1995.

Following the first breeding season of the transplanted South Texas deer herd, 5 ear-tagged does were collected in February and March 1995, and embryos were measured to



Photo by Bill Reaves

determine breeding dates. These breeding dates were December 9, 15, 25, 31, 1994 and January 24, 1995. Breeding dates for 6 ear-tagged does collected in March 1996 were December 13, 24, 24, 29, 1995 and January 4, 6, 1996. Data from the "Breeding Chronology Study" conducted by TPWD in the western counties of the South Texas Plains indicated the earliest breeding date in a 3-year study was November 29 and the latest breeding date was February 1. The mean breeding dates for each of the 3 years were December 21, 22, and 28, respectively. Breeding chronology data collected in Colorado and Lavaca Counties in 1991 and 1992 indicated the earliest breeding date was September 28 and the latest breeding date was November 22. The mean breeding dates for 1991 and 1992 were October 28 and October 24, respectively.

Data collected during the first 2 years of this study indicate that the breeding dates of the transplanted South Texas deer herd have remained consistent with the breeding dates of the deer in the western counties of the South Texas Plains. Embryos will be collected from the original transplanted South Texas does and from their ear-tagged offspring next year to further document breeding dates of this deer herd.

This is the second year of a 3-year study. The study is being funded by Crier Creek Ranch and state funds from the TPWD Wildlife Region 4 budget.

Mortality, Reproduction, and Movements of Eastern Wild Turkeys Relocated into the Post Oak Savannah of Texas

Roel R. Lopez, Charles K. Feuerbacher, Jeffery W. Gainey, and Nova J. Silvy - Texas A&M University, College Station and John Burk - Texas Parks and Wildlife Department

A total of 82 eastern wild turkeys (*Meleagris gallopavo silvestris*) was released into 4 areas in winter 1994-95. Prior to release, all birds were

fitted with a battery-powered radio transmitter, and mortality, reproduction, and movements were monitored. Annual mortality for gobblers and hens was 70% and 50%, respectively. Poultry survival during the 1st- and 2nd-year nesting



Photo by Kirk Feuerbacher

season was zero. The effectiveness of supplemental releases was evaluated. Initial survival rates (7-180 days, gobblers) for supplemental (2nd year release, gobblers present) and non-supplemental (2nd year release, no gobblers present) birds were compared to relocated birds (1st year release). The hypothesis that gobbler survivorship was equal was rejected ($P=8.31, 2 \text{ df}, P<0.05$), suggesting that supplemental releases increase bird survivorship. Furthermore, home ranges were calculated for supplemental birds and non-supplemental birds, and compared with home ranges for relocated birds. Relocated birds were found to have larger home ranges (452 ha) than supplemental and non-supplemental birds (51 and 63 ha, respectively).

Funding for the project was provided by Texas Parks and Wildlife Department (Turkey Stamp funds), Federal Aid in Wildlife Restoration Grant W-126-R, and Texas A&M University System.

Eastern Turkey Restoration in the Pineywoods of East Texas

R. Montague Whiting, Jr. and James R. George - Stephen F. Austin State University and John D. Burk - Texas Parks and Wildlife Department

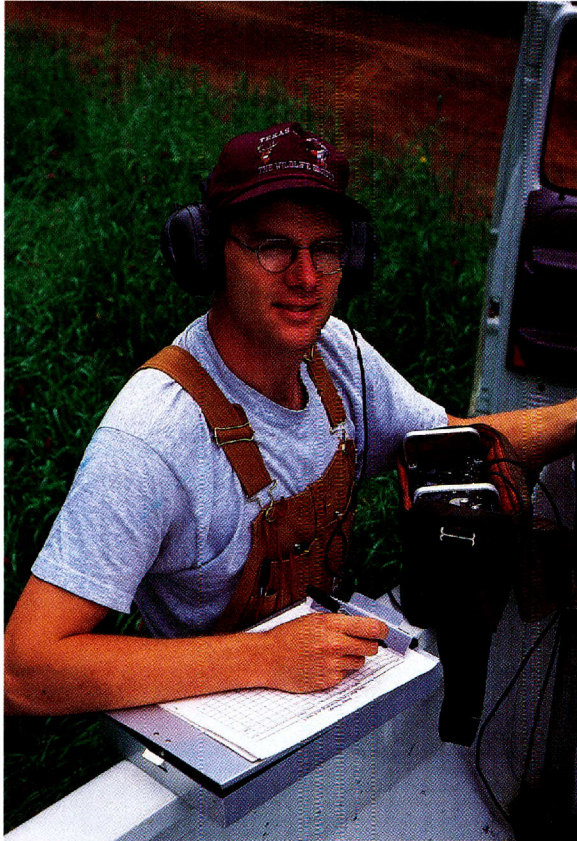


Photo by Ron George

Success of eastern wild turkey restoration programs using relocated wild-trapped broodstock has been well documented. Many restoration efforts have resulted in populations increasing almost exponentially. Most successful programs used wild turkeys that were captured in habitats very similar to those of the release sites.

In East Texas, many early restoration attempts failed. However, in the late 1970s, eastern wild turkeys from Louisiana and Mississippi were successfully stocked at several intensively managed sites. In 1987, the Texas Parks and Wildlife Department (TPWD), in

cooperation with the National Wild Turkey Federation (NWTF), began an intensive restoration program using broodstock from several midwestern and southeastern states for relocation. Between 1987 and 1995, over 4,600 turkeys were released in 49 counties in the Pineywoods and Post Oak Regions of east Texas. Approximately 88% of these birds were acquired from midwestern states. This study, and a parallel study in the Post Oak Region, were initiated to evaluate the restocking efforts that began in 1987. Specifically, the study compares survival, reproduction, and movements among Iowa, Georgia, and Texas broodstock. Also, the habitat composition of release sites where restoration has been successful will be extrapolated from home ranges of radio-tagged turkeys.

In February 1994, groups of 12 hens and 3 gobblers were released at each of 4 sites in Tyler County, Texas. At each site, the hens were equally divided between Georgia and Iowa broodstock. The gobblers were divided such that each site had 2 from one state and 1 from the other. All birds were fitted with backpack transmitters and have been radio located at least twice a week since release. In February 1995, 8 Texas resident hens were captured, radio tagged, and released at the capture site on Boggy Slough Hunting Club in Houston and Trinity Counties. These birds have been monitored on a schedule similar to that of the Tyler County birds.

From the beginning of the project until 1 August 1995, survivorship of known-fate birds has been 58.6% (17 of 29), 39.3% (11 of 28), and 62.5% (5 of 8) for the Georgia, Iowa, and Texas broodstock, respectively. Mammalian predators took 12 of the 31 birds killed; 9 of these were from Iowa, including 4 gobblers. A fifth Iowa gobbler was lost to an avian predator and the sixth is missing. Losses to avian predators, undetermined predators, disease, and other causes were 4, 5, 4, and 6 turkeys, respectively.

During spring 1994, 37 hens were

monitored. Seven definitely attempted to nest and 1 successfully produced 1 fledged poult. The behavior of 20 others suggested that they attempted to nest and failed. During spring 1995, 29 Tyler County and 8 Boggy Slough hens, were monitored. There were 11 confirmed nests of which 3 were successful; 2 of these hens, one each from Georgia and Iowa, successfully fledged a total of 6 poults. One Texas hen had 2 confirmed nesting attempts; both failed. Sixteen other hens exhibited nesting behavior.

During the 2 nesting seasons, Georgia and Iowa hens fledged 2 and 5 poults, respectively. The 15 unsuccessful nests were lost to mammals (5), snakes (6), unknown (2), and abandonment (2). Georgia, Iowa, and Texas hens had 16, 18, 2 assumed nests, respectively. The project will continue through the 1996 nesting season.

This study is funded by the Texas Parks and Wildlife Department using Turkey Stamp revenue and Federal Aid in Wildlife Restoration Grant W-126-R and by the College of Forestry, Stephen F. Austin State University, and the National Wild Turkey Federation.

Developing Biological Control of Imported Fire Ants

Lawrence E. Gilbert - The University of Texas, Austin and Don E. Wilson, Robert Perez, and Markus Peterson - Texas Parks and Wildlife Department

During the past 50 years the spread of the imported fire ant (*Solenopsis invicta*) has resulted in dramatic negative consequences for wildlife and overall biological diversity in the eastern half of Texas and the southern United States. Recently it has become increasingly apparent that the spread has been accelerated by indiscriminate use of broad spectrum pesticides. In the native range of *S. invicta* in South America, it is "just another ant." An important reason for its lack of dominance on its home continent is the presence of specific biological



Fire ants in Brazil (left) assume defensive posture in response to phorid fly (right). Photo by L.E. Gilbert

agents such as phorid flies of the genus *Pseudacteon*, species of which are specific parasitoids of *Solenopsis* species. In Texas, the native fire ant *S. geminata* is harassed by two *Pseudacteon* species, neither of which have shown interest in the imported pest. Our research is focused on "leveling the playing field" for native ants by introducing *S. invicta*-specific *Pseudacteon* phorids from Brazil and Argentina.

Funds from the Texas Parks and Wildlife Department and the Texas Department of Agriculture are helping to construct the first experimental rearing facility for these tiny flies, which are currently the best prospect for biological control of the imported fire ant. Our research to date has been funded by National Science Foundation, several private foundations, and the Houston Livestock Show and Rodeo Education Committee.

The Effects of Radio Transmitters on the Mortality of Bobwhite Quail

Mark Mitchell, David Reid, and Robert Korenek - Texas Parks and Wildlife Department

Research on bobwhite quail has been conducted since the early 20th century. Many earlier studies relied on leg bands, tedious observation, and the age structure of harvested birds to estimate productivity, survival, and



Photo by Mark Mitchell

mortality. With the advent of radio telemetry, researchers were quick to utilize this technology for its ability to simplify and enhance quail research. Radio telemetry increased the ability of researchers to monitor movements, covey fidelity, home range size, nesting success and many other aspects of bobwhite quail biology. But little information is available to determine if the telemetry equipment itself influenced mortality thereby biasing the outcome of research.

The survival of radio-collared quail is being monitored to determine if there is an increased mortality due to the telemetry equipment. Five hundred birds were trapped during October and November 1995. Half of the quail were fitted with 5-gram necklace-mounted pseudo radio transmitters and half fitted with leg bands only. Retrapping efforts during January and February will determine if there is an induced mortality by the presence of the pseudo radio transmitter.

This 1-year study is being conducted in Matagorda County in the Gulf Coast Prairie of Texas. The project is funded by the Texas Parks and Wildlife Department.

Survival, Flight Speed, and Movement Behavior of Captive-raised Quail in the Coastal Sand Plain of Texas

Don E. Wilson, Robert M. Perez, Karen D. Gruen, Carol Feather, William Wilson, and Cynthia Wilson - Texas Parks and Wildlife Department

The failure of captive-raised quail to survive in the wild is well documented but the causes of the failures are poorly understood. The breeding, rearing, transport and release of captive raised birds is a multi-variate process and a failure of the process at any step could result in excessive mortality of the birds. Failure to avoid predators, imprinting on humans, and failure to recognize natural food items are considered three of the major reasons why captive-reared birds do not survive. In addition, flight speed, use of escape cover, movement behavior and cohesiveness of coveys may also affect survival. It is our hypothesis that fear of predators is innate and that wild quail exhibit greater survival than captive-raised quail because they fly faster, make more efficient use of cover types and remain together as a cohesive unit.

We compared the movement behavior and mortality rates of four groups of 50 northern bobwhite. There were two groups of captive-raised quail, which were minimally exposed to



Photo by Joe Herrera

humans in order to avoid imprinting. The first group of birds was from typical game farm stock. And the second was first-generation birds (F's) from wild stock. The remaining two groups of quail were translocated wild birds and wild birds resident to the study site. During November 1993, a total of 200 radio-collared quail were released in approximate units of 10 on a 500-acre pasture at a ranch located in Kenedy County. Resident birds were released at the trap site as natural covey units and all other groups were released at random sites in "forced coveys." Upon release, the weather conditions, direction of departure, speed, and time required to reach cover was recorded. Flight speed was recorded with a Doppler radar gun.

Our results indicate a significant difference in flight speeds between wild and captive-reared birds. The mean flight speeds for F₁ and game farm quail were both approximately 19 miles per hour (mph), while flight speeds for native and translocated birds were 28 and 29 mph, respectively. Resident birds were significantly different from the other groups and had a much greater randomness in direction of departure. Preliminary analysis of mortality indicates a considerable difference in mortality rates between wild and captive-reared groups. Game farm and F₁ quail reached 50% mortality in eight days, while native and translocated birds reached a 50% loss in 47 and 32 days, respectively. Home ranges of game farm birds were significantly smaller than the home ranges of all other groups. Although F₁ quail superficially behaved like wild birds, their mortality rate equaled that of the typical game farm stock. Changes in the rearing process which can improve the ability of birds to recognize food items, avoid predators and achieve greater flight speed, might improve survival for future restocking efforts of upland game bird species.

This study was funded by the Texas Parks and Wildlife Department.

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

Shane Nelson - Applied Research Laboratories, University of Texas, Austin and Jerry Cooke - Texas Parks and Wildlife Department



Photo by Duane Kurtin

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, (10's 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 currently being funded as a one-year internal Research and Development project at Applied Research Laboratories in cooperation with the Texas Parks and Wildlife Department.

Characterizing the *Modus Operandi* of Various Ground Nest Predators and a Preliminary Evaluation of Lithium Chloride (LiCl) as a Taste Aversion Agent for Detering Nest Depredation

Fidel Hernandez - Angelo State University, Dale Rollins - Texas Agricultural Extension Service, and Ruben Cantu - Texas Parks and Wildlife Department

Nest predation can be a potential limiting factor for ground-nesting game birds such as



Photo by Dale Rollins

wild turkey (*Meleagris gallopavo*) and northern bobwhite (*Colinus virginianus*). Species-specific depredation rates are necessary to better understand the processes of nest predation. Current methods for identifying nest predators have met with limited success.

In an attempt to develop a dichotomous key to ground nest predators of West Texas, we monitored approximately 100 each of simulated turkey and quail nests (3 chicken eggs and 5 quail eggs, respectively) with remotely-triggered "trip" cameras. Physical evidence found at depredated nests was recorded and linked to corresponding picture frames, and thus predators. On only 3 of 92 occasions (3.3%) were quail eggshell fragments found at depredated nests. Chicken eggshell fragments were found at nests on 89 of 96 occasions (92.7%). With simulated turkey nests, we found intraspecific variability and interspecific similarities in physical evidence. As a result, a dichotomous key could not be constructed. However, general eggshell characteristics for nest predators were obtained. Raccoons (*Procyon lotor*) usually left eggshells in 2 distinct fragments of approximately equal size within 5 m of the nest. Skunks (*Mephitis mephitis*) tended

to bite the end of eggs, leaving fragments 3/4 complete within 1 m of the nest. Gray foxes (*Urocyon cinereoargenteus*) left eggshells with a small opening in the lower base of the egg, and eggshells were found > 25 m from the nest. Bobcats (*Felis rufus*) left eggshells in the nest with a small opening in the center of the egg. This study provides helpful information to more objectively assign ground nest predators.

We also evaluated aversive conditioning as a nonlethal means of deterring nest predators. Twenty simulated nests were constructed using chicken eggs treated with 0.4 g LiCl / ml of distilled water. Nests were placed along the perimeter of a 40-ha pasture at 2 study sites in Tom Green County during June 1995. Nests were monitored daily and depredated nests were replenished with treated eggs throughout a 21-day conditioned taste avoidance (CTA) trial. To determine relative nest survival rates following the CTA trial, 24 nests/treatment were constructed within a treated and control pasture at each site. Nests were monitored every 7 days to determine the relative depredation rates. Depredation at one study site was predominantly by raccoons (*Procyon lotor*), whereas at the other site it was turkey vultures (*Cathartes aura*). Our data suggests that CTA may be more effective in reducing egg depredation by raccoons than by turkey vultures. Further studies are warranted to assess interactions among available nesting cover, predator densities and communities, and different taste-aversive chemicals and concentrations. If aversive conditioning is effective, it may provide a relatively inexpensive and socially acceptable means for deterring nest depredation.

This study was funded, in part, by the Texas Parks and Wildlife Department using Turkey Stamp revenue.

The 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 Kari Sutton - Southwest Texas State University and Jim Perkins 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. This cactus was originally described by W. T. Marshall (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. Keeney (1987) suggested limited vegetative disturbances benefitted the species by controlling competing grasses.

The control of regrowth Ashe juniper and manipulation of community succession can be accomplished by a combination of livestock



Photo by Max Traweek

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 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 five years through August 2001. Maps of the distribution of the species on the Area will be used to select four study sites. One plot will function as a control with the other three plots receiving a livestock grazing, prescribed burning, or juniper cutting treatment.

A cattle herd will be stocked in the grazing plots based on U.S. Natural Resource Conservation Service recommendations. The time of stocking will be that recommended by the Area manager. A prescribed burn will be conducted in February-March 1996 on the burn plots. Juniper will be removed by cutting in the spring-summer of 1996 in the appropriate plots.

The population density of cactus plants in each of the 4 study sites will be determined by making a total count during the flowering season (February-April). All cacti located within each study site will be monitored using 1-m² rectangular quadrants, each situated with a cactus as the center point. Annual natality, mortality, and recruitment of cactus plants occurring in each of the 1-m² quadrants will be determined by mapping to scale using a 10x10 cm grid and by recording annual production of flower buds, flowers, and fruits for each plant. Population vigor will be assessed by semi-annual measuring (May and December) the diameter and height of each cacti using a hand-held caliper. Plant community ecology will be determined semi-annually (May and December) in each of the quadrats by measuring and calculating percent ground cover, species

composition, diversity, distribution, dominance, and frequency of the vegetation.

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

Texas Horned Lizard Population Structure, Abundance, and Growth Rates

Melisa M. Montemayor and Donald C. Ruthven III - Texas Parks and Wildlife Department

Populations of Texas horned lizards have shown dramatic decreases in the last 30 years, especially in the eastern portions of their range. Suspected causes for these reductions include habitat loss, exploitation by collectors, pesticide use, disease, and an increase in imported fire ant populations. To address these problems, a better understanding of horned lizard ecology is essential. Collection of horned lizard data began on the Chaparral Wildlife Management Area (CWMA) in the South Texas Plains in 1991 and has continued through 1995. To investigate differences between separate populations, as well as to add to the data base, collections were initiated on the Matador Wildlife Management Area (MWMA) in the Rolling Plains in 1995. Individual horned lizards were measured (snout/vent length and total length), sexed, and marked by either a series of toe clippings or the implantation of passive integrated transponder (PIT) tags.

Through 1995, 858 individuals have been captured and marked on the CWMA. Horned



Photo by Glen Mills

lizards have been recorded during every month of the year except January; however, most lizards (88%) were captured from April through July with May being the most active month (36% of all captures). Observed adult sex ratios are 67% females and 33% males. Typical reptilian sexual dimorphism was evident with females being larger (snout/vent length $x = 93.4\text{mm}$, total length $x = 130.5\text{mm}$) than males (snout/vent length $x = 88.2$, total length $x = 125.5$). Juvenile representatives of the population averaged 31%, with yearly fluctuations ranging from 14% in 1992 to 48% in 1994.

Seventy-seven horned lizards have been recaptured on the CWMA since 1991. Preliminary analysis of 1991-94 data estimates yearly population densities ranging from 1 horned lizard/9.4 acres in 1991 to 1 horned lizard/4.3 acres in 1994. This increase in density could be a result of more intensive sampling during the latter years of this study. During an individual year, 8 juveniles showed an average growth of 3.92mm (snout/vent length)/week, while 10 adults increased growth by an average of 1.68mm/week. Of individual horned lizards which were recaptured during a different year than their original capture, 5 juveniles produced an average growth of 32.9mm/year and 4 adults grew an average of 5.52mm/year. The longest interval between captures of an individual was 2 years and 24 days.

During 1995, 8 male and 2 female horned lizards were captured and marked on the MWMA with 1 recapture. Juveniles comprised 10% of the sample. There was no difference in size between male horned lizards on the CWMA and MWMA.

Monitoring of these two populations will continue with the possible expansion of data collection on other wildlife management areas. Funding is provided by the Texas Parks and Wildlife Department and the Horned Lizard Conservation Society.

Visitor Impact on Bat Emergence Behavior at the Old Tunnel WMA

John T. Baccus, Marian Bailey, Max Sears, Kelly Harper - Southwest Texas State University and Tim A. Lawyer - Texas Parks and Wildlife Department



Photo by Tim Lawyer

Bats are an important link in the world's ecosystems. They comprise the second largest group of mammalian species worldwide. Unfortunately, over 40% of the species of bats found in the United States are endangered, threatened or official candidates for listing. With few exceptions, little is known about most bat species.

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 (WMA) is a 10.5-acre tract of land owned and operated by the Texas Parks and Wildlife Department. The WMA, located in northern Kendall County about 14 miles north of Comfort, Texas, contains an abandoned railroad tunnel which serves as an annual roosting site for 2-3 million Mexican free-tailed bats (*Tadarida brasiliensis*). The WMA 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 Old Tunnel WMA has become an extremely popular and important site in terms of public education and public bat-viewing opportunities. From April through October each year, about 5,000 people visit the Old Tunnel WMA. As public awareness of the tunnel continues to increase, the potential of detrimental human disturbances to the colony also could increase. Little is known about the effects of human disturbance on Mexican free-tailed bat colonies, but at some point, harassment and roost disturbance causes roost abandonment and a general decline in bat populations.

The objectives of this study are to: (1) determine effects of visitors on bat emergence and 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 tunnel, (5) delineate migratory periodicity, (6) determine crepuscular flight patterns, (7) identify species composition, and (8) evaluate continuous site-use by free-tailed bats.

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 design of this study is to compare bat emergence time and behavior with visitors in the viewing area at the start of the emergence (experimental unit) with the emergence time and behavior with no visitors in the viewing area (control). Data will be collected for at least 20 nights for each of the units. Minimum numbers of visitors present for data use will be 20. Colony reactions will be noted for each experimental unit night. The number of visitors viewing the emergence, use of flashlights, crowd noise, weather, and moon phase will be recorded. Variation in the time of nightly emergence will be assessed by ANOVA, and the potential impact of visitors by regression analysis.

The nature of the colony composition with respect to age and sex will be studied. This will require bimonthly (March to October) collections of bats using a "Harp-Type" bat trap. Bats collected will be aged and sexed, 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 project should be applicable to the information needs of the site-specific management plan for the Old Tunnel WMA. The research results should assist in determining how to properly manage the WMA with extensive public-use without impinging upon the integrity of the resource. A major benefit of this research project will be the amassing of information that will be a part of the guidelines for development of a long-term operational policy for the area. These guidelines are necessary for site-specific management of public lands containing important bat colonies.

This is the fifth and final year of a five-year study funded by the Texas Parks and Wildlife Department and Southwest Texas State University.

The Use of Artificial Nest Sites by Elf Owls in Western Texas

Bonnie R. McKinney - Texas Parks and Wildlife Department

The elf owl (*Micrathene whitney*) is the smallest owl in North America and a neotropical migrant. Wintering in Central Mexico, they return to West Texas, as well as other parts of the Southwest, to nest and raise their young. In the lower Chihuahuan Desert, elf owls are almost totally dependent on ladder-backed



Photo by Bonnie McKinney

woodpecker (*Picoides scalaris*) holes for nest sites. Trees are scarce in this region, and woodpeckers use fence posts, yucca stalks, dead tree limbs and power poles as nest sites. The power poles are heavily utilized as nest sites. As more electric lines are placed underground, significant loss of power pole nest sites could impact the breeding population of elf owls as well as other cavity nesters.

To offset this loss, a 4-year study was initiated to determine if elf owls would use nest boxes. In addition, other aspects of the ecology of this little-known species are being studied. Both adult and young elf owls are color banded for identification purposes, weighed, measured and photographed. Nesting success, pair fidelity, site fidelity, longevity, diet, and return of young to natal areas as breeding adults are major objectives of the research.

In 1994, 80 nest boxes were constructed and placed in various habitats on the Black Gap Wildlife Management Area in southeastern Brewster County. Thus far, there has been a 22% occupancy rate of nest boxes by elf owls in 1994 and 30% in 1995. Fledging success was 66% in 1994 and 100% in 1995. A total of 19 adult females and 19 nestlings were banded in 1994. In 1995, 5 females banded in 1994 returned to the study area to breed, and 18 new adult females and 30 nestlings were banded. No young banded in 1994 were captured during the 1995 field season. A total of 21 prey items in the diet have been identified.

Continued research will focus on site fidelity, pair fidelity, return of young to natal areas and diet analysis.

Funding for this project is provided by the Texas Parks and Wildlife Department's Nongame and Urban Wildlife Program.

The Ecology of the Peregrine Falcon in the Chihuahuan Desert, Texas

Bonnie R. McKinney - Texas Parks and Wildlife Department

Currently, the American peregrine falcon (*Falco peregrinus anatum*) is both federally and state-listed as an endangered species. The United States Fish and Wildlife Service (USFWS) has recently proposed a ruling for delisting this species because recovery criteria are being met in some areas of the southwest.

In Texas, the breeding population of peregrine falcons is confined to the rough and rugged canyon country along the Rio Grande in



Photo by Bill Reaves

Western Texas and adjacent Northern Mexico. This small, but integral, population has suffered erratic reproductive rates for 21 years. The 1995 production reached a dangerously low level of 2 young fledged from the total breeding population of 15 pairs (0.13 young fledged/adult pair).

The objectives of this long-term research project are to determine causes of poor reproduction, mortality, and low recruitment rates. Breeding and winter range, nesting success, pair and site fidelity, as well as other aspects of the ecology of this species are being investigated. Prey collections and peregrine feathers are being analyzed for heavy metal contaminants and organochlorine pesticide levels.

The research project is funded by the Texas Parks and Wildlife Department's Nongame and Urban Wildlife Program through private donations and proceeds from the sale of specially designed peregrine falcon t-shirts.

Colonial Waterbird Survey and Management

Brent Ortego - Texas Parks and Wildlife Department



Photo by Brent Ortego

The Colonial Waterbird Survey is an on-going cooperative effort between Texas Parks and Wildlife Department (TPWD), U.S. Fish & 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 program and has 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 a few 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 is frequently 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.

The TPWD Geographic Information System (GIS) staff used funds from a U.S. Navy grant to manage colonial waterbird sites along the central Gulf Coast to develop computer generated maps of 95% of the colonial waterbird nesting sites along the coast. Data will be shared with the Texas General Land Office and other interested agencies and organizations.

Bald Eagle Nesting and Wintering Surveys

Mark Mitchell and Kevin Herriman - Texas Parks and Wildlife Department



Photo by Leroy Williamson

Surveys are conducted annually to monitor breeding and wintering populations of bald eagles in Texas. Surveys of nesting bald eagles are conducted beginning in December and continuing through March. A mid winter survey is conducted during January to monitor the population of non-nesting eagles.

Nesting bald eagles have been monitored in Texas since the 1960s, at which time less than 5 active nests were known. In the early 1970's efforts were increased to find and document nests. From 1975 to 1995 the number of known active nests increased from 7 to 40, respectively. This increase in known nests 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.

Aerial surveys are conducted January through March of known and newly-reported bald eagle nests. Data collected included nest location, status, productivity, and hatching date. Ground surveys are conducted by local Texas Parks and Wildlife Department, U.S. Fish and Wildlife Service, and the Southern Bald Eagle Recovery Team in assessing the nesting population in Texas. These data also are used extensively to aid in the preparation of environmental impact assessments on projects of development in areas of known nesting activity.

Surveys of 22 standardized locations are monitored during mid January to estimate the non-nesting winter bald eagle population. Nineteen of the 22 sites are reservoirs in central and east Texas. These surveys are coordinated by Texas Parks and Wildlife Department personnel but utilize volunteer labor. Over 170 volunteers conducted surveys on 21 of the 22 sites in 1995 and 1996 and reported 303 and 248 bald eagles, respectively. During January 1996, the highest numbers were on Lake Palestine and Lake Fork with 37 eagles each.

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

The Texas Monarch Watch

William H. Calvert and Matt Wagner - Texas Parks and Wildlife Department

The Texas Monarch Watch is a non-profit enterprise designed to 1) learn as much about the biology of the monarch butterfly as possible using volunteers to extend the range of observation throughout Texas, and 2) use the monarch butterfly to teach basic concepts of ecology and reproductive and migration biology. Along the way, we hope to instill in those who come in contact with this beautiful creature an appreciation of science, and especially of nature. We are affiliated with the



Photo by Leroy Williamson

national Monarch Watch directed by Chip Taylor at the University of Kansas. We hope to continue the program indefinitely as long as there is public interest.

We conduct 2 "watches" per year - one corresponds with the return of migrants to Texas in the spring from their Mexican overwintering grounds and the second corresponds with the main migration through Texas from northern breeding grounds to the overwintering sites in Mexico during the fall. We ask volunteers to participate in two activities:

- 1) keep a daily calendar of the presence and abundance of monarchs in their area and to report unusual occurrences of monarchs to the Texas Monarch Hotline. The Monarch Hotline is a toll-free service where information about the monarch migration is exchanged through reports from volunteers and a recorded message that represents a compilation of recently received information about the migration.

- 2) raise or capture butterflies, tag them with tags that we supply, and release them in the hope that someone will find them and report the tag.

By means of these two activities, we can trace the movement of migrants through Texas

and determine what effect the weather has on migration. We also have begun a series of special projects to learn more about specific aspects of the migration. Results of volunteer participation and notice of special projects are announced in two newsletters per year preceding the spring and fall migrations, respectively.

The Texas Monarch Watch is coordinated by William Calvert. This project is sponsored by the Nongame and Urban Wildlife Program of the Texas Parks and Wildlife Department with support from the Margaret Cullinan Wray Charitable Lead Annuity Trust.

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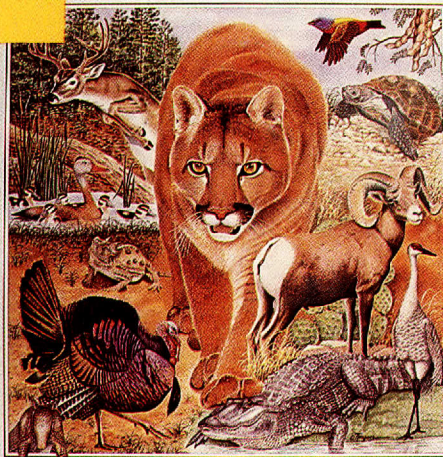
WILDLIFE RESEARCH DONATIONS

The Wildlife Division of the Texas Parks and Wildlife Department is conducting research studies on Texas horned lizards, white-tailed deer, eastern wild turkeys, desert bighorn sheep, white-winged doves, waterfowl, black bears, mountain lions, neotropical birds, monarch butterflies, elf owls, and other species. Some of this research is funded through private donations. As a means of recognizing private donors, those persons donating \$25 to wildlife research will receive a Texas horned lizard shoulder patch. Persons donating \$250 will receive the patch and a limited-edition art print featuring a mountain lion and 10 other species of Texas wildlife. There is also a color certificate signed by the Texas Parks and Wildlife Department Executive Director for donations of \$1,000 or more. Donations in any amount are welcome. Checks or money orders should be payable to "Texas Parks and Wildlife Department" and clearly marked "For Wildlife Research." Contributions should be sent to:

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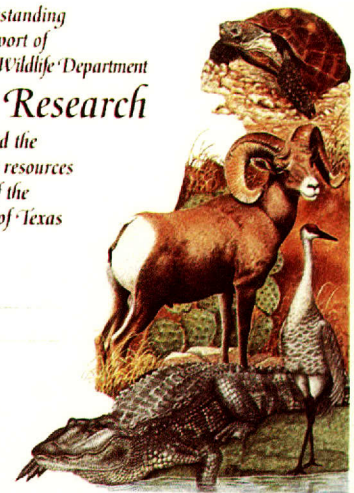
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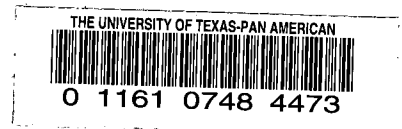
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