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[1]Starting with this issue, both issues will be combined.

Cover photos by Jess Thompson (Bald Eagle) and Mark Bartosik (Osprey)

BULLETIN OF THE

TEXAS ORNITHOLOGICAL SOCIETY

SPECIAL BALD EAGLE AND OSPREY SECTION

TEXAS BALD EAGLES

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ABSTRACT.—Bald Eagles (*Haliaetus leucocephalus*) were studied in Texas from 1970 to 2009 by the Texas Parks and Wildlife Department. Active nests increased from 5 in 1970 to 156 in 2005 when the last aerial survey was conducted. A total of 547 nest sites in 313 territories in 76 counties were identified thru May 2009. Longevity of 261 nests tracked averaged 4.2 years with a standard deviation of 3.4. Six hundred and sixty-one food items were examined at nest sites. They were comprised of 33.7% birds, 30.7% reptiles and 30% fish. Hurricanes did not appear to have any impacts on nest production. Nest production varied from 1.2 to 1.45 young per active nest. One-hundred and thirty-eight eaglets were banded and color-marked. Fledging success was 97% after 6 weeks of age. Three band recoveries and sightings of 29 adults and 32 immatures were obtained. Twenty sightings occurred outside of Texas with 74% of these occurring from May to August. Texas born eagles were reported from South Carolina to Canada and Arizona. Bald Eagle populations are increasing 13% per year, but there are a number of threats which may limit populations in the future.

INTRODUCTION

The Bald Eagle is the national emblem of the U. S. It is a large, showy and charismatic bird. It has served as a symbol of freedom associated with democracy in the U. S. and in recent years with wilderness and environmental ethic (Buehler 2000). Populations declined greatly after World War II due primarily to eggshell thinning effects of p,p'-DDE, a biodegradation product of DDT (Grier 1982, Bowerman et al. 1995).

The longest running Texas Parks and Wildlife Department (TPWD) project of a nongame species started in 1970 with the initiation of research on the status of the Bald Eagle in Texas (Sweptson 1976). This paper summarizes the results of 4 decades of research by TPWD and provides basic life history information from relevant literature (Buehler 2000).

LIFE HISTORY

The Bald Eagle, a large bird of prey, opportunistically forages and eats a variety of mammalian, avian, and reptilian prey but generally prefers fish over other food types (Buehler 2000). The species typically breeds in forested areas adjacent to large bodies of water. It nests mostly in trees large enough to support their massive nest, and these sites are generally within 1.6 km (1 mile) of permanent water. In some cases, distance to water is not as

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10-week-old eaglet in a typical nest. Photo by TPWD staff.

critical as the quality of the foraging area. Quality of foraging areas is defined by diversity, abundance, and vulnerability of the prey base (Livingston et al. 1990), structure of aquatic habitat, such as the presence of shallow water (MacDonald and Austin-Smith 1989), and absence of human development and disturbance (McGarigal et al. 1991).

Nests are located farther from the shoreline in areas with considerable shoreline development or human activity (e.g., Florida, Chesapeake Bay, Minnesota, etc.) than in less developed areas, such as Alaska (Robards and Hodges 1977, Andrew and Mosher 1982, Fraser et al. 1985, Swenson et al. 1986, Anthony and Isaacs 1989, Wood et al. 1989). The minimum distance from a nest to human development in some populations is less than 91 m, (100 yards), but the average distance in most populations is >450 m (500 yards) and reflects habitat selection away from these developments (Andrew and Mosher 1982, Fraser 1985, Fraser et al. 1985, Anthony and Isaacs 1989, Wood et al. 1989, Livingston et al. 1990). Forested tracts with nests have relatively open canopies, some form of habitat discontinuity or edge, or high levels of foliage-height diversity that provide access to nest trees (Gerrard et al. 1975, McEwan and Hirth 1979, Anthony and Isaacs 1989, Wood et al. 1989).

The Bald Eagle has a complex pattern of migration that is dependent on age of the individual (immature or adult), location of breeding site (north vs. south, interior vs. coastal), severity of climate at breeding site (especially during winter but also possibly during summer), and year-round food availability. Most immature eagles migrate and may move nomadically, presumably because they are not tied to the defense of a nest site. Adult birds, in contrast, migrate when food becomes unavailable. Bald Eagles generally migrate alone but occasionally join other migrants on the wing, but not in kettles or flocks (Buehler 2000).

Bald Eagle migration is quite varied between geographic areas and appears to be influenced by availability of food and severity of climate. Young tend to migrate before adults (Buehler 2000). Migrants from non-breeding populations that frequent Texas, like those from Saskatchewan, winter in a broad region of the southwestern U. S., ranging from California to Texas (Gerrard et al. 1974, Gerrard et al. 1978, Griffin et al. 1980). Some adults from these northern populations might not migrate but instead move locally to seasonal food sources. Bald Eagles that summer around the Great Lakes and adjacent areas in Canada migrate south along major river systems from August to January (Buehler et al. 1991, McCollough et al. 1994).

Adults breeding south of latitudes below Denver, Colorado, usually do not migrate south for winter with some remaining year-round in the vicinity of the nest site but may be less closely associated with the nest than during breeding season (Broley 1947, Buehler et al. 1991, Curnutt 1992, Wood 1992). These southern Bald Eagles migrate north in spring or summer after nesting during winter and return southward from August to December (Broley 1947,

Bald Eagles on nest. Photo by Jess Thompson.

Buehler et al. 1991, Wood 1992). Some Chesapeake Bay area immatures (<10%) move south of the bay in December-February (Buehler et al. 1991).

Feeding

Bald Eagles hunt from perches or while soaring over suitable habitat. They attempt to take most prey on the wing. They use carrion of fish, birds, and mammals extensively wherever encountered at sites that provide disturbance-free access from the ground (Buehler 2000). In most regions, they seek out aquatic habitats for foraging and prefer fish (Wright 1953, Spencer 1976, Steenhof 1976, Stalmaster 1987, DeLong 1990). Bald Eagles are frequently observed near large concentrations of waterfowl in Texas during winter, and waterfowl is an important food item for breeding eagles (Mabie et al. 1995).

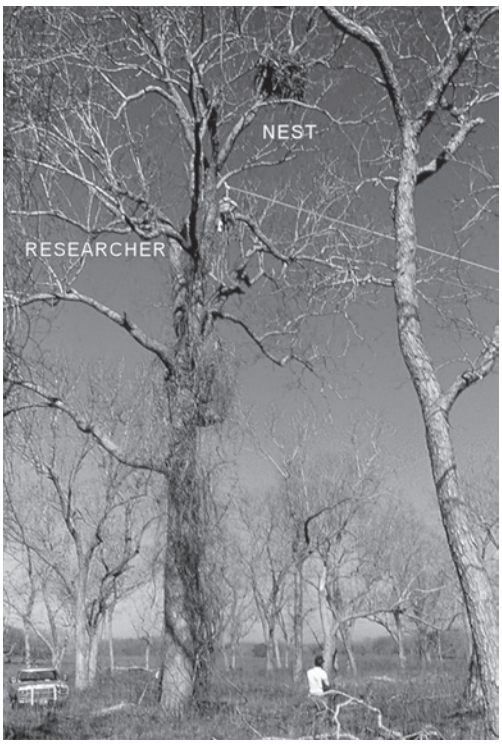
Breeding

Pair formation is thought to occur on the breeding grounds but may also occur on wintering grounds (Harmata 1984). Bald Eagles have spectacular courtship rituals, involving vocalizations and acrobatic flight displays. Perhaps the most noted courtship act is Cartwheel Display, in which the courting pair fly to great altitude, lock talons, and tumble/cartwheel back toward earth; the pair finally break-off the display at the last moment to avoid collision with the ground (Stalmaster 1987).

Pair bonds can last >1 year, but very little data exist because of the difficulty in marking adults. One female eagle hatched in Matagorda County, Texas, nested in Arizona and remained paired for several years (G. Beatty pers. comm.). Eagles very rarely have more than 2 adults in a territory. Three adults have been reported at nests in Alaska, Minnesota, Connecticut, California and Texas (Sherrod et al. 1976, Fraser et al. 1983, Hopkins et al. 1993, Garcelon et al. 1995, Ortego et al. 2006).

Nest building generally begins 1–3 months prior to egg laying. Eagles in southern latitudes start nest building earlier (Buehler 2000). Nest building and maintenance in Florida begin in late September to early October (Broley 1947); whereas, further north in Ohio, these activities usually begin in February (Herrick 1932).

Bald Eagles only raise 1 brood per season and replacement clutches are possible if eggs are taken or destroyed early during incubation, especially at southern latitudes (Buehler 2000). Timing of egg laying and length of the breeding season varies by latitude. Broley (1947) reported incubation began as early as October and as late as April in Florida. Eagles nesting in northern latitudes do not have 7 consecutive months of ice free conditions and thus have a shorter breeding season. Incubation typically lasts 35 d.



Researcher climbing nest tree. Photo by TPWD staff.

Nest trees generally are the largest trees available with accessible limbs capable of holding a nest (Herrick 1924, Andrew and Mosher 1982, Swenson et al. 1986). A large super-canopy nest tree provides good flight access to the nest and good visibility of the surrounding area (Buehler 2000). Both sexes contribute in nest construction. Sticks are collected from the ground or from nearby trees. Typical nest size ranges from 2 m (5–6 ft) in width to 1 m (2–4 ft) in height (Stalmaster 1987) but width of 3 m (9 ft) and height of 6 m (20 ft) are known (Broley 1947).

Territorial defense is common during the breeding season to ensure sufficient food resources to raise young without interference. Defense can involve perching in prominent areas, using threat vocalizations, and, at the extreme, chasing intruders out of the area (Stalmaster 1987).

Estimates of territory size vary widely based on nesting density, food supply, and method of measurement. Many territories are oriented along waterways and density appears driven by available shoreline. Average territory has been reported as 100 ha (250 acres) in Minnesota (Mahaffy and Frenzel 1987), and 400 ha (1000 acres) in Saskatchewan (Gerrard et al. 1992) with a minimum of 50 ha (120 acres) in Alaska (Hodges and Robards 1982).

Clutch size ranges from 1–3 eggs with 2 the most common. Eggs are laid 1 per day and egg laying is generally completed in 3 to 6 d (Stalmaster 1987). Incubation normally takes 35 d (Herrick 1932), and Bortolotti (1986) reported young eagles fledged at 8 to 14 weeks of age. Young eagles associate with adults for several weeks after fledging before dispersing (McCollough 1986, Hunt et al. 1992, McClelland et al. 1996, Wood et al. 1998).

Bald Eagles take 4 years to reach full adult plumage and are capable of breeding at 5 years of life (Buehler 2000). The species lives a relatively long time and has been recorded to survive 28 years in the wild (Schempf 1997) and 36 years in captivity (Newton 1979). They may follow a survival pattern similar to other raptors, with lower first-year survival rates, followed by an increasing survival rate to adulthood. Early estimates of eaglet mortality are largely speculative (Brown and Amadon 1968, Sherrod et al. 1976, Gerrard et al. 1978).

TEXAS PARKS AND WILDLIFE DEPARTMENT BEGINNING

Oberholser and Kincaid (1974) chronicled their dissatisfaction with conservation of raptors and eagles in Texas. Ranchers, hunters and fishermen were reported to continue to shoot, trap and poison Bald Eagles during the 1940s, despite passage of the federal Bald and Golden Eagle Protection Act during that decade. Sentiment in favor of protecting eagles increased during the 1950s, but heavy concentrations of DDT, dieldrin, heptachlor, and other stable, toxic compounds began accumulating in soil and water, especially coastal waters (Oberholser and Kincaid 1974). The 1960s were primarily noteworthy for soaring pollution (Oberholser and Kincaid 1974). Bald Eagles were laying cracking – or even shell-less—eggs by 1970.

Oberholser and Kincaid (1974) reported 6 miracles occurred in Texas in 1971. Six young Bald Eagles flew from 4 nests being monitored by the Texas Parks and Wildlife Department (TPWD) along the central Texas Coast. Oberholser and Kincaid (1974) also reported the only place in Texas where a bird watcher could be sure of seeing Bald Eagles was in the middle of Falcon Dam on the Texas-Tamaulipas boundary where a metal Bald Eagle adorns a monument.

This was the setting in which TPWD began to investigate the status of rare and endangered species

in Texas. Many Texans were unaware of the severity of chemical pollutants in the habitat and diet of fish and wildlife at that time.

TPWD received funding to initiate nongame work in Texas in 1969. Nongame specialists were hired and projects were initiated. This new "Nongame" program placed heavy emphasis on the research of key indicator species such as Bald Eagle, Osprey (*Pandion haliaetus*), Peregrine Falcon (*Falco peregrinus*), colonial waterbirds, and several species of mammals.

NEST SURVEYS

Phase I

After large population declines in the first half of the 20th Century, little was known about the status of Bald Eagles in Texas. A questionnaire requesting information on status of Bald Eagles was mailed annually from 1970 through 1975 to a total of 15,968 federal and state field personnel, members of the Audubon Society, Texas Ornithological Society, falconers, flying organizations and related groups. This phase of the project resulted in 2,340 reports covering most of Texas. The largest Bald Eagle concentrations occurred in Bandera, Grayson, Marion, Newton, Randall and Waller counties with each having reports of at least 100 Bald Eagle sightings during the five years. The study suggested a strong relationship between eagle concentrations and the presence of a river or lake and a readily available supply of waterfowl and fish. Since few Bald Eagles nested in Texas at the time of the questionnaire, almost all reports were of non-nesting, wintering birds (Swepston 1976), but TPWD did receive reports of 5 nest sites.

Bald Eagles were reported in every month with 95% of observations occurring between October and March with peak months from December through February (Swepston 1976).

Wintering Bald Eagles tended to congregate around loafing and roosting sites. In the Texas Panhandle these sites were cottonwood trees (*Populus* spp.), canyon rims, cliffs, and large power lines near lakes and reservoirs. Trees near rivers, lakes, and bays were the predominant roost sites in the central and eastern portions of the state (Sweptson 1976).

In the Panhandle and Trans-Pecos Bald Eagles often shared their feeding and roosting sites with a large number of wintering Golden Eagles (*Aquila chrysaetos*). The largest reported concentration containing both species was 52 eagles feeding on fish at a playa lake in Hutchinson County on 10 February 1975 (Swepston 1976).

Phase II

As information was received on location of nests, TPWD began monitoring nests at least twice annually from the air or ground. The first visit was to determine if nests were still present and being used for nesting. The second visit was to determine how many eaglets survived to fledge.

After the completion of the questionnaire project, most reports of nests were received from cooperating landowners, interested citizens and conservation organizations incidental to normal work activities in association with these people. This inventory of known nesting sites grew to 23 territories and 13 active sites by 1982 (Fig. 1) with all located in the Coastal Prairie Ecoregion of southern Texas.

Phase III

Reports of potential nesting Bald Eagles inland from the coast in the vicinity of major river systems and reservoirs of East Texas were received during the early 1980s. As a result of this reported nesting activity, special funding was obtained from the U. S. Fish and Wildlife Service endangered species office in Albuquerque, NM, to conduct a much broader survey in 1983. Aerial surveys were expanded to include all areas with potential eagle nesting habitat in eastern Texas (Mabie 1983).

During the expanded search, 22 active nests were found with only 5 from areas further inland. Private airplanes were chartered by TPWD to conduct 117 h of low level (<91 m; 300 ft) searches for nests along rivers, major creeks and reservoirs throughout East Texas in March. With airplanes cruising near 185 km/h, (115 mph) observers searched about 16,000 km (10,000 miles) of Texas landscape. It was a search for the "needle in the haystack" in forested areas where pine (*Pinus* spp.) was the dominant tree. It was a little easier to locate nests in hardwood areas because most trees had no leaves in March. However, individual "large" nests in a forest often were difficult to locate and staff likely missed a "few" in this major effort. One of the more memorable new nests was near Lake Murvaul in Panola County that was found during a snow storm; a nest in a large hardwood at the edge of a pasture with an adult incubating as snow drifted across the landscape.

Phase IV

Nesting surveys reverted back to conducting aerial surveys twice each spring (February to April)

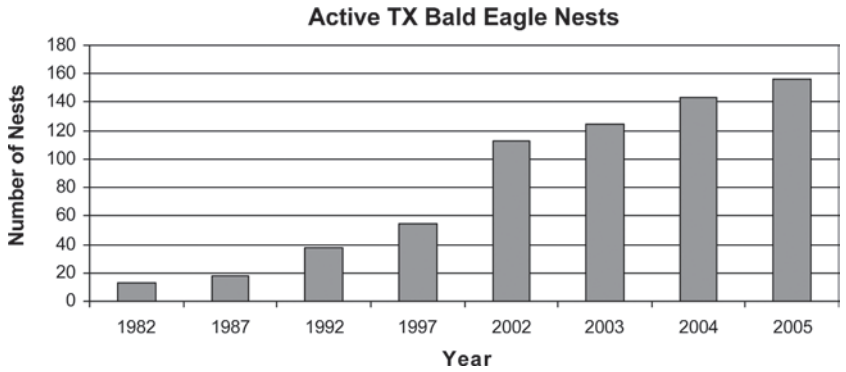


Figure 1. Number of active Bald Eagle nests in Texas from 1982 to 2005.

at known and suspected nesting sites after the major 1983 survey (Ortego et al. 2006). Information about more distant sites from where aircraft were typically flown relied on visits and reports submitted by TPWD staff or reliable observers. Biologists used about 40 airplane hours per breeding season to monitor known nests during the 1980s. This effort required about 80 airplane hours to complete the survey as nest inventories grew in size and space. Aerial surveys were discontinued in 2005 primarily for financial reasons. Nest surveys after 2005 were conducted opportunistically in conjunction with other work, and TPWD continued to log nest locations when reports were received from reliable sources. This combined effort resulted in a total of 547 nest sites within 313 nesting territories in 76 counties (Table 1) being recorded from 1971 through May 2009.

Summary

Nesting Bald Eagles in Texas have exceeded productivity goals (i.e., >0.9 young/occupied site, and >50% success rate/occupied nest) set by the Southeastern States Bald Eagle Recovery Team (US Fish and Wildlife Service 1989) since 1989. Texas nesting production ranged from 1.2 to 1.45 young per active nests from 1971–2005 (Saalfeld et al. 2009). This greatly exceeded the production of >0.74 per active nests suggested by Buehler et al. (1991) as the benchmark of an expanding population. The increased discovery and reporting of active nests reflected an expanding population as the number of active nests increased an average of 13% per year in Texas (Table 2) from 1971 through 2005 (Saalfeld et al. 2009).

MID-WINTER SURVEY

One aspect of monitoring Bald Eagles in Texas was to survey when they were most abundant (Swepston 1976) during the middle of winter. The nesting surveys conducted by TPWD gave a reasonable estimate of nesting population and production trends but did not address total number of Bald Eagles. The earlier questionnaire (1970s) indicated a large number of non-resident eagles wintered in the state.

The National Wildlife Federation initiated the Mid-Winter Bald Eagle survey as a cooperative project between multiple agencies, organizations and citizens across the geographic range of the Bald Eagles in the U. S. Texas started participating in 1984. A summary of the results of the survey can be found at the U. S. Geological Survey (USGS) website: http://srfs.wr.usgs.gov/research/indivproj.asp?SRFSProj_ID=2 10 MAY 2009.

Nationwide counts of eagles were coordinated by the National Wildlife Federation from 1979 until 1992, when the Raptor Research and Technical Assistance Center assumed responsibility for overseeing the count. The USGS established a partnership with the U. S. Army Corps of Engineers to maintain the long-term coordination of the survey, data analysis, and reporting in 2007 and the U. S. Army Corps of Engineers began coordinating the survey in 2008.

Initial objectives of the survey were to: 1) establish an index to the total wintering Bald Eagle population in the lower 48 states; 2) determine eagle distribution during a standardized survey period; and 3) identify previously unrecognized areas of important winter habitat. Millsap (1986) reported results of the mid-winter survey from 1979 through 1986.

Table 1. Documented Bald Eagle nest sites from 1970 to 2009 by county and river basin.

County	River basin	Nests	Breeding territories	County	River basin	Nests	Breeding territories
Angelina	Angelina	17	10	Lee	Brazos	3	3
Austin	San Bernard	1	1	Leon	Trinity	4	2
Bastrop	Colorado	7	4	Leon	Navasota	1	0
Bell	Lampasas	4	1	Liberty	Trinity	8	6
Bosque	Brazos	1	1	Limestone	Navasota	7	4
Bowie	Red	2	1	Llano	Llano	4	2
Brazoria	Brazos	20	8	Marion	Sabine	1	1
Brazoria	San Bernard	5	1	Marion	Red	1	1
Burleson	Brazos	1	1	Mason	Llano	1	1
Burleson	Brazos	3	3	Matagorda	Colorado	19	10
Calhoun	Guadalupe	4	3	McLennan	Brazos	1	1
Cass	Red	2	1	McLennan		1	1
Chambers	Trinity	3	3	Milam	Brazos	4	2
Cherokee	Angelina	1	1	Montgomery	San Jacinto	27	15
Colorado	Colorado	18	5	Morris	Red	2	1
Cooke	Trinity	1	1	Nacogdoches	Angelina	4	3
Dallam	None	1	1	Navarro	Trinity	2	2
Delta	Sulphur	1	1	Newton	Sabine	4	2
Donley	Red	1	1	Orange	Sabine	4	3
Edwards	Dry Frio	1	1	Panola	Sabine	3	2
Ellis	Trinity	1	1	Polk	Trinity	16	8
Falls	Brazos	3	2	Red River	Red	1	1
Fannin	Red	1	1	Refugio	San Antonio	6	3
Fayette	Colorado	7	4	Robertson	Navasota	8	5
Fort Bend	Brazos	28	7	Rusk	Sabine	4	3
Freestone	Trinity	4	3	Sabine	Sabine	37	26
Goliad	San Antonio	15	7	San Augustine	Angelina	23	13
Grimes	Navasota	4	2	San Jacinto	Trinity	7	6
Harris	Trinity	8	4	San Saba	San Saba	1	1
Harris	San Jacinto	4	4	Shelby	Sabine	25	13
Harris	Green's Bayou	1	1	Smith	Sabine	8	5
Harrison	Sabine	1	1	Tarrant	Trinity	1	1
Harrison	Big Cypress	2	2	Travis	Colorado	3	3
Henderson	Trinity	5	4	Trinity	Trinity	14	8
Henderson	Neches	4	4	Tyler	Neches	2	2
Henderson		1	1	Upshur	Sabine	1	1
Hopkins	Sulphur	2	1	Van Zandt	Sabine	2	2
Houston	Trinity	7	2	Victoria	Guadalupe	32	10
Hunt		2	2	Walker	San Jacinto	5	2
Jack	Trinity	1	1	Walker	Trinity	6	3
Jackson	Lavaca	19	9	Wharton	Colorado	9	6
Jasper	Angelina	5	5	Wharton	Navidad	2	2
Kaufman	Trinity	2	2	Wharton	San Bernard	1	1
Kimble	Llano	1	1	Wood	Sabine	8	4
Lavaca	Navidad	2	2				

Table 2. Bald Eagle population trends by Texas survey regions.

	Region	Number of territories	Active nests	Fledged young	Young per active nest*	% Active nest increase
1982	State-wide	23	13	16	1.2	
1987		26	18	21	1.2	38%
1992		46	38	38	1.0	111%
1997		62	54	55	1.0	42%
2002		144	113	152	1.4	109%
2003		154	125	149	1.5	11%
2004		171	143	184	1.6	14%
2005		176	156	204	1.4	11%
1982	W of I-35	0	0	0	0.0	
1987		0	0	0	0.0	
1992		0	0	0	0.0	
1997		0	0	0	0.0	
2002		3	2	2	1.0	
2003		4	2	1	1.0	
2004		4	3	5	1.7	50%
2005		4	3	5	1.7	
1982	Post Oak	0	0	0	0.0	
1987		2	1	2	2.0	
1992		5	5	6	1.2	400%
1997		4	4	5	1.3	−20%
2002		21	12	12	1.5	200%
2003		18	14	16	1.6	17%
2004		26	22	31	1.7	58%
2005		30	25	38	1.7	14%
1982	PINEYWOODS	0	0	0	0.0	
1987		6	1	2	2.0	
1992		15	10	8	0.8	900%
1997		28	23	27	1.2	130%
2002		70	52	68	1.4	126%
2003		75	58	61	1.6	12%
2004		79	64	68	1.5	10%
2005		87	68	85	1.4	6%
1982	SOUTH TEXAS	23	13	16	1.2	
1987		18	16	17	1.1	123%
1992		26	23	24	1.0	44%
1997		30	27	23	0.9	18%
2002		50	47	70	1.6	74%
2003		57	51	71	1.5	9%
2004		62	54	80	1.7	6%
2005		65	60	78	1.4	11%

*Average is only for active nests with known outcome.

The USGS evaluated mid-winter count data from 1986 to 2005 to assess count trends. Their analysis was based on 178,896 observations of eagles during 8,674 surveys of 746 routes in 43 states. Throughout the survey area, counts increased an estimated 17% per year from 1986 to 2005. Sixty-three percent of routes showed increasing trends, and 37% showed decreasing trends during the 20-year period. Model-based estimates of counts in the Northeast increased approximately 6% per year; whereas, those in the Southwest decreased 1.2% annually. Seventy-six percent of survey routes north of 40° latitude had increasing count trends, but only 50% of routes south of 40 degrees latitude (southern Nebraska) showed increasing trends.

This variability in results from wintering population trends did not match results from nesting surveys, which indicated eagle populations across the nation were mostly increasing (Buehler 2000).

Texas mid-winter survey data showed a rapid rise in reported Bald Eagles from 1984 thru 1990, which was mostly related to increasing numbers of sites surveyed rather than an expanding population. From 1990 thru 2004, the number of eagles observed at each survey area was essentially unchanged, indicating the methodology used in Texas was not effective at monitoring eagle population trends. Bald Eagles have been increasing nationally and in Texas at rates >10% per year (Buehler 2000, Saalfeld et al. 2009).

DISPERSAL OF EAGLES

As TPWD monitored nesting of Bald Eagles and worked with landowners for their conservation, one common question arose from landowners was where did “My Eagles” go? Landowners in general reported adults and their young leaving in summer and adults returning in fall with occasional observations of young. In a few territories, landowners reported observing adults in the general vicinity throughout summer.

TPWD staff coordinated a research project from 1985 to 1991 with interested landowners to capture, band, and color tag eaglets in the nest and follow their movements as long as the tags (coded colored leg-bands and patagial markers) lasted (Mabie et al. 1994). Data were also collected on pre- and post-fledging survival, and nest site use of the area prior to migration (Mabie 1985). This was the most exciting and dangerous eagle research conducted by TPWD. Staff devised ways to climb trees to nests which were frequently 18 m (60 ft) above the ground. They placed eaglets in cloth bags, lowered them to the ground for measurements, blood sampling, and attachment of markers. The eaglets were then lifted back to the nest and the staff person rappelled to the ground.

Banding eaglets was extremely challenging as each nest tree offered different obstacles. They were tall, very limby, potentially rotten, and not always in accessible locations. The preferred method to climb trees was securing a rope over a large limb just below the nest and lifting staff via pulley connected to a vehicle (see photo on page 4). The first task was to get a rope over a strong limb near the nest. This was accomplished by shooting a projectile attached to a light line from a modified gun with .22 caliber blanks over the targeted limb. The light line was then used to pull up the main support line which had a pulley that had an additional rope which would be attached to the staff person and vehicle. The staff person with tree climbing gear was lifted by backing the vehicle. It was something similar to an improvised country elevator ride. The staff person then used tree climbing gear to climb further up the tree and into the nest.

Eaglets were banded with a #9 U. S. Fish & Wildlife Service pop rivet band, and a pop rivet color leg band on the opposite leg. Vinyl patagial markers with unique codes and colors for location per bird were attached to each wing. Ground checks were made the day after banding to determine if adults returned to feed the young and weekly ground checks were made to determine fledgling success (Mabie 1985). A total of 85 eagle nest trees, representing 26 nesting territories in 16 counties, were located by aerial surveys, visited on the ground, and climbed if conditions were safe for the birds and researchers. Over the life of the project, 138 eaglets, ages 6 to 11 weeks were banded and color-marked.

Letters and requests for information on observed or recovered marked eagles were sent to all U. S. state and Canadian province nongame/endangered species divisions following each banding season. Reports or sightings of wing-marked eagles were evaluated on the basis of correspondence or telephone conversations with the observer. Consecutive sightings of a single marked bird within one general area and in the same year were recorded as one sighting. Marked nesting birds observed in consecutive years at nest sites were recorded each year as one sighting.

Survival to fledging of color-marked eaglets was determined through fixed-wing aerial surveys

(Nesbitt 1988) and ground checks of all nest sites. Fledging success was determined when marked birds were observed in flight or away from the nest tree. Survival of color-marked eaglets to fledging was 97%. If eaglets survived to 6 weeks, there was a strong possibility they would fledge. Productivity during this project was 1.6 eaglets per nest, which was indicative of an expanding population (Buehler et al. 1991) and as high as any recorded value for productivity (Sprunt et al. 1973).

Three band recoveries were reported from 1985–1993. A juvenile female hatched in Brazoria County died 2 months after fledging in Red River County, a male banded in Matagorda County was hit by a car in LaFourche Parish, Louisiana, and another eagle was shot in Liberty County 3 years after banding in Colorado County.

Sightings of 29 adult and 32 immature color-marked eagles were verified from 1985–1993. Forty-one sightings were reported from within the state with 70% occurring from November to March. A marked eagle observed in Cameron County was the most southerly documentation of a Bald Eagle in Texas.

Twenty sightings were outside of Texas with 74% occurring from May to August. Observations of color-marked eagles indicated a gradual spring-summer northward migration begins in April. Marked birds moved across a broad region from the Rocky Mountains to the Mississippi River and north into Canada. Two sightings occurred on the Atlantic Coast (South Carolina, New York), 1 in Mexico (Sonora), and 1 in Arizona. In 1989, a nesting eagle with a yellow wing tag and black lettering was reported in Sonora, Mexico. The alpha-numeric code was not fully legible, but the first 2 numbers indicated the bird had been banded as an eaglet in Texas in 1985. The eagle sighted in Arizona has recently been confirmed as nesting there. We suspect that Bald Eagles fledged in Texas may enter breeding populations throughout the southern breeding range.

Recruitment into the Breeding Population

Of 138 Bald Eeagles color-marked as eaglets in Texas from 1985–91, 46 are known to have attained breeding age. Twenty percent (9 of 46 eagles) established nesting territories in Texas. These nine eagles occupied 7 nesting territories (Mabie et al. 1994). Two of the 9 birds were males (a 3-year-old and a 4-year-old) that mated with females at established nest sites. The females presumably lost their mates the previous year. One male was observed nesting for 3 consecutive years and the other male for 5 consecutive years. TPWD personnel recorded two instances in which both members of a breeding pair were color marked as eaglets in Texas. One pair nested for 2 consecutive years. Three other new nesting territories located in 1989 and 1990 contained 1 individual color-marked as an eaglet in Texas. All 7 nesting pairs successfully fledged young in consecutive years. We were unsuccessful in identifying the specific nest site from which these color-marked breeding bald eagles were fledged. Data on marked eaglets returning to natal breeding areas as breeding adults establishing nesting territories are lacking (Stalmaster 1987). Many eaglets have been banded and/or radio-tagged (Broley 1947, Gerrard et al. 1978, Buehler et al. 1991, Gerrard et al. 1992, Hunt et al. 1992), but there are few reports of eaglets returning as nesting adults (Swenson et al. 1986, Gerrard et al. 1992). Data indicated that bald eagles fledged in Texas exhibited strong fidelity to natal nesting areas for breeding (Mabie et al. 1994).

The USGS Bird Banding Lab (BBL) Bald Eagle band return data were queried for all recoveries in Texas thru 2008. Twenty-two Bald Eagles banded as nestlings outside of Texas were recovered in Texas. Sixty-eight percent of recoveries occurred during the first year, 9% the second year, 18% the third year and 1 eagle was recovered after 10 years. Roughly equal numbers were recovered from the Panhandle, near San Angelo, the Hill Country, Dallas, and northeast and southeast Texas (Danny Bystrak, pers. comm.).

To date, 8 eaglets of the 138 banded have been recovered (Table 3). In comparison, Bald Eagle nestlings banded in Texas (Table 3) had a higher survival rate than those banded outside Texas. To date, 8 eaglets of the 138 banded have been recovered. Two were recovered during the first year, 1 at 2 years, 2 at 6 years, 1 at 9 years, and 2 at 15 years. These Texas eagles also tended to wander. One was recovered in California after 3 months, 1 recovered in Colorado at 2 years, 1 recaptured in Arizona after 6 years, and 1 was recovered in New Mexico at 6 years (Table 3).

NESTS

With the exception of an increasing number of nests available for public viewing, most nests are located in semi-isolated areas with very low human traffic or near the top of the highest tree in the vicinity, often a cottonwood (*Populus deltoids*),

Table 3. Locations by county or state of banding and recovery sites for Bald Eagles banded in Texas.

Band location	Band date	Recovery date	Recovery location	
Columbus	4/1/1988	3/25/1997	Fayette	9 yrs
Calhoun	3/10/1987	3/17/2002	Matagorda	15 yrs
Sabine	3/29/1988	1/25/2003	McKinney	15 yrs
Matagorda	3/31/1988	5/7/1994	Arizona	6 yrs
Brazoria	4/2/1987	6/1/1987	Tyler	2 months
Grimes	5/3/1988	6/5/1994	Albuquerque	6 yrs
Goliad	3/5/1991	11/30/1993	Boulder	2 yrs
Colorado	4/2/1987	7/3/1987	California	3 months

pecan (*Carya illinoensis*) or sycamore (*Platanus occidentalis*) (Allen 2009).

Bald Eagles tend to nest in the largest tree available that provides an easy flight access, clear view of the surroundings, near permanent water, and within its breeding territory. Water sources in Texas were mostly rivers, creeks and reservoirs. Bald Eagles did not nest near tidal areas in Texas as elsewhere (Buehler 2000). Lack of trees large enough to support nests might be the limiting factor.

Bald Eagle nesting along coastal rivers tended to predominantly use pecan, water oak (*Quercus nigra*), live oak (*Quercus virginiana*), cottonwood and sycamore trees because these were likely the largest canopy trees available. When the eagles started nesting in East Texas, the dominant tree used for nesting was loblolly pine (*Pinus taeda*).

Some Bald Eagle nests last decades (Buehler 2000), but most nests in Texas are only used a few years. The use of 261 nests was tracked by TPWD personnel from first construction until they fell apart. Nest longevity averaged 4.2 years with a standard deviation of 3.4 years (Fig. 2). While the nest that lasted 20 years is very memorable, the normal scenario had nests in use from 1 to 4 years with nests falling apart for a number of reasons which included storms, tree mortality, limbs breaking, etc.

Hurricanes

One potential threat to nest longevity is hurricanes. Broley (1947) reported severe impacts by a hurricane in Florida on nesting eagles with 18 nests blown down by an October hurricane and 27 nests damaged. This was 4 to 6 weeks prior to normal nesting in the area. Although all nests, except 1, were either repaired or rebuilt, the Bald Eagles produced no young that breeding season. Broley (1947) attributed this to stress related to the hurricane.

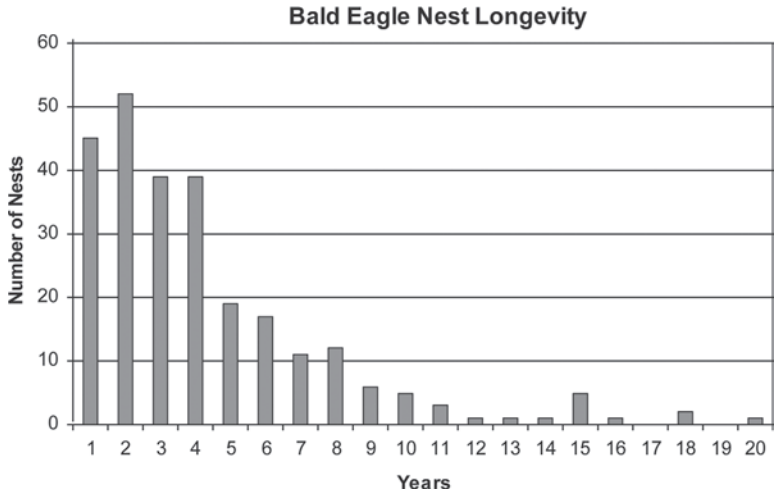


Figure 2. Longevity of 261 Bald Eagle nests in Texas.

Hurricanes hitting the Texas Coast are almost an annual event. About half pass through areas of nesting Bald Eagles. Hurricane Claudette passed through Texas coastal counties during July 2003 as a Level I hurricane during the non-nesting season. This was 4 months before Bald Eagles were expected to begin laying eggs. Nesting data from 8 counties not impacted by the hurricane were compared to 7 counties that were. Noticeable hurricane impacts were mostly knocked-down nests and tall trees that potentially would serve as nests in the future. Seven nests in the 7 counties within the path of the hurricane were destroyed by the storm and all were rebuilt during the following fall when nesting commenced. The 8 adjoining non-impacted counties had 14 nesting attempts that fledged 22 eagles before the hurricane in 2003, and 16 nesting attempts and fledged 32 eagles after the hurricane in 2004. The 7 impacted counties had 19 nesting attempts before the hurricane that fledged 31 eagles in 2003, and 20 nesting attempts fledged 33 eagles after the hurricane in 2004. Short-term loss of nests was the only noted impact.

Hurricanes Ike (2008) and Rita (2005) likely destroyed a number of Bald Eagle nests in Texas, but as long as there were sufficient nest trees surviving in suitable areas for nesting that were relatively isolated and near rivers and lakes the eagles were expected to re-build in the same territories. We do not know if production dropped due to these hurricane related events.

FOOD ITEMS

The Bald Eagle is most associated with wetlands throughout its range (Buehler 2000, Allen 2009) and as human populations increase in Texas, demand for water and society's impacts on wetlands are likely to increase. Understanding food preferences and distribution and density of available foods are important for providing the needs of an increasing population of Bald Eagles.

David Mabie's TPWD team of eagle researchers collected food remains during February to May from 1985 to 1991 at nest sites (Mabie et al. 1995). Most of the 661 food items came from the nest bowl. Food debris around the nest tree was usually scarce or absent and was likely scavenged. Birds represented 33.7% of the remains and American Coots (*Fulica Americana*) accounted for 52.5% of bird remains. The American Coot was also the most abundant prey item in Florida (McEwan and Hirth 1980), Louisiana (Dugoni et al. 1986), and Arizona (Haywood and Ohmart 1986). Other waterfowl represented by 11 species comprised 38.6% of bird remains in Texas. Bald eagles were commonly observed feeding on crippled or diseased geese and ducks in rice fields and typically nested in nearby riparian forests.

Reptiles comprised of 30.7% of prey remains at nest sites, and softshell turtles (*Apolone* spp.) accounted for 89.7% of these. Some eagles seemed to specialize on capturing softshells with 1 nest containing as many as 20 of these turtle shells. This finding of large reptile use is unique to Texas. Studies across the range of the species typically indicated that reptiles comprised $<1\%$ of the diet. The bulk of foraging for softshell turtles occurred along the Brazos, Colorado and Trinity rivers.

Fish comprised 30% of prey remains with freshwater catfish (*Ictalurus* spp.) and carp (*Cyprinus carpio*) being the most common fish, 64.8% and 20.1%, respectively.

Mammals accounted for only 5.5% of prey remains with rabbits making up 63.9%. Eagles were observed scavenging at deer (*Odocoileus virginianus*) carcasses, but no deer remains were observed at nest sites.

These results indicated that food availability was not a limiting factor to the growth of the eagle nesting population during the time of the study. With major prey items mostly associated with wetlands, it was suggested that eventually the availability and quality of wetlands would be an important issue in the future of Bald Eagles (Mabie et al. 1995).

Since this study, Bald Eagles have been frequently observed scavenging on road killed deer and other large mammals particularly in areas of high nesting density. As nesting density increases, opportunistic availability of foods found in wetlands may become more limiting and eagles foraging in competition with vultures (Cathartidae) and Crested Caracara (*Caracara cheriway*) may be more common.

UNIQUE SITES

Bald Eagles nest in many interesting places. Most are in relatively secluded floodplains away from daily visits from the public. One very unique nest was located near Dalhart in the extreme northwestern panhandle far from any permanent water of any size. Other nests were located in full public view and received varying visitations from the public. Some were several hundred meters (yards) from public

roads are hardly noticed, while others were conspicuously located within 100 m (100 yards) of public roads received thousands of human visitors per year.

Panhandle Nest

Boal et al. (2006) observed a breeding Bald Eagle pair nesting in a short-grass prairie and agricultural community on the southern Great Plains of the Texas Panhandle in 2004 and 2005. The nesting eagles produced 1 fledgling in 2004 and 2 fledglings in 2005. Their assessment of land cover types within a 4-km (3-mile) radius of the nest indicated that grasslands accounted for most of the area (90%) followed by agricultural lands (8%). Black-tailed prairie dog *(Cynomys ludovicianus)* colonies occupied 2.5% of the area and a single human residence with associated structures (i.e., barns) occupied <1%. The nearest source of permanent surface water >2.4 ha (6 acres) in surface area was 51.5 km (32 miles) to the nest. An analysis of regurgitated castings collected near the nest revealed a mammalian-dominated, breeding-season diet with black-tailed prairie dogs occurring in 80.9% of castings. Other identified prey included cottontails *(Sylvilagus* spp., 15.9%); black-tailed jackrabbits *(Lepus califomicus,* 3.2%), pronghorn antelope *(Antllocapra americana,* 3.2%), and plains pocket gopher *(Geomys bursarius,* 1.6%). Bird remains were also present in 34.9% of castings. This is the first reported successful nesting of Bald Eagles in the Panhandle region of Texas since 1916; the nest is particularly unique because of its distance from any substantial body of water.

The tree supporting this nest fell after this study, and no trees large enough to support a nest occurred nearby. Clint Boal's team was able to get funding to erect a nest tower at the site during fall 2006, and the eagle pair accepted this man-made structure and successfully nested on it. This was the first nesting of Bald Eagles on a nesting platform in Texas. In addition, eagles in South Texas started using large, steel, transmission-line towers. One pair started nesting in 2007 along the Mission River and successfully fledged young in 2008 and 2009. Another pair nested and fledged 1 young on the same powerline 46.7 km (29 miles) further to the northeast along the Guadalupe River in 2009.

Llano River Eagle Nest

In the fall of 2004 travelers along Texas Highway 29 in Llano County noticed a large nest being constructed just off the highway. A Bald Eagle trio (3 adults) was constructing a nest only 120 m (130 yards) from the roadside. The area, 12.8 km (8 miles) east of Llano, soon became a major tourist attraction for Llano County. Bald Eagle sightings in Llano County had been somewhat common and wintering Bald Eagles have always been easy to spot on Lake Buchanan and up the Colorado River.

The nest is located on the bank of the Llano River in the Llano uplift of the Texas Hill Country. The Llano River is a shallow river with a constant flow year round. The clear running water provides ample food supply for the nesting pair. The banks are lined with large pecan, cottonwood and sycamore trees providing plenty of perching and nesting trees. Currently the nest is located in a pecan tree.

Visitors to the nest site from 2004 to 2007 saw a rare event, an eagle trio. Although rare, the third adult appeared to be an older female. It was so common to see the third adult that most visitors thought that it was common to have more than 2 adults at a nest site. The third adult was allowed on the nest while the eaglets were in the nest. At times the nest became very crowded with more than 1 adult along with 1 to 2 eaglets all in the nest at the same time. The third adult was also active with nest maintenance, feeding the eaglets with food brought in by the other eagles and chasing predators away from the area. She seemed to stay close to the nest looking over the eaglets, often perched in a nearby pecan tree. January 2007 was the last time the third adult was seen at the nest site, it is unclear as to why the adult left the nest and area.

The public soon took notice of this nesting trio and crowds of eagle watchers began flocking to the roadside to get a glimpse of the birds. By the time the first 2 eaglets were big enough to peer over the side of the nest, the public was peering back. By now news media from as far as San Antonio, Houston, Dallas and San Angelo had done stories about the nest site and the popularity had grown. As a result of the large crowds Texas Department of Transportation (TXDOT) had to erect "No Parking" signs 3 m (10 ft) from the pavement on both sides of the highway, but allowed parking from the no parking signs to the fence line. In order to slow highway traffic and protect pedestrians crossing a (70 mph, 113 km/hr) highway two large portable signs were put in place on each end of the area cautioning drivers to slow down. Only a few months earlier this stretch of highway was covered with wildflowers and grass, eventually the area was

paved and a 1.5 m fence was built replacing the old barbed wire fence in order to hold back the growing crowd wanting to see what the eagles were going to do next. Local law enforcement was called on constantly to keep traffic moving and to keep the highway clear. In March 2007 a tragic accident happen involving a tractor trailer rig that veered off of the highway into the parking/observation area. Several people were injured and one person was killed.

Since the nest was so close to the highway and a good chance of seeing bald eagles, many photographers were able to capture detailed photos of the adult bald eagles and the eaglets over the years. Most photographers would show up to the site before sunrise to setup their cameras in the better spots and stay most of the morning. A number of photographers were selling their photo's on the internet and at the nest site. Some photographers went as far as to set up tents with generator, computer and printer so that a visitor could get an up to the minute photo of what they saw when they where at the site. Other vendors sold cold drinks and a chance to look at the nest through a telescope. TXDOT eventually stopped vendors from operating in the area due to the massive crowds that were on the shoulder of the highway.

Even though this is a highly visible and visited nest site, the adult nesting pair continues to raise eaglets. Two eaglets fledged in 2004, 2 in 2005, 1 in 2006, 1 in 2007, 2 in 2008, and 2 in 2009. Public visitation peaks from hatching in December to fledging in March, and during that time, the eagles and eaglets put on quite the show. The morning hours provide the most activity with feeding, nest building and changing of the guards. The nesting pair has been apparently unaffected by the close proximity of the crowd of spectators.

The Llano nest site has allowed people of all ages to experience this national symbol of freedom providing a direct connection with one of nature's wonders. Every fall people want to see if the nesting pair will return to the nest and then how many eggs will hatch. The roadside fills with anticipation as an eaglet takes that first flight, an awe inspiring moment.

POTENTIAL THREATS

Even though Bald Eagle populations are increasing at the rate of 13% per year, there are still few nesting eagles for a state the size of Texas and many threats still exist.

Lead shot contained in prey and eaten by Bald Eagles have been linked to their mortality and lower productivity (Pattee et al. 1981, Pattee and Hennes 1983, Nelson et al. 1989). The U. S. Fish & Wildlife Service has subsequently required steel shot to be used for hunting ducks and geese. However, lead shot is still used to harvest other wildlife, and we have observed increased use of carrion by Bald Eagles.

A number of diseases have the potential to impact Bald Eagles. The most serious to date has not been known to kill any eagles in Texas. Avian vacuolar myelinopathy (AVM) has been associated with the death of over 100 Bald Eagles and thousands of American Coots in South Carolina and Arkansas (Wilde et al. 2005) since 1994. The agent of AVM is an uncharacterized neurotoxin produced by a novel cyanobacterial epiphyte that coats the leaves of hydrilla (*Hydrilla verticillata*). American Coots eat the affected hydrilla and in turn are eaten by Bald Eagles. Though hydrilla is present in most Texas reservoirs, the triggering mechanism which causes the toxicity has not been known to occur in Texas.

The ultimate threat to Bald Eagles is people. Human populations are expanding in Texas. People are attracted to water and consume huge volumes of fresh water (Texas Parks and Wildlife Department 2002). Buehler et al. (1991) found Bald Eagle use of potential foraging habitat was inversely proportional to the density of buildings on the northern Chesapeake Bay. We have also observed that most Bald Eagles try to nest away from high-people-use areas. A few pairs have adapted to human presence and are nesting in relative close proximity to houses.

While additional suitable nesting habitat has been created with development of inland reservoirs and maturation of forested lands surrounding a few of these reservoirs, disease, habitat loss, disturbance, and human tolerance are still major concerns for nesting populations (Saalfeld et al. 2009). Demand for water for human use increases annually, and at some point will limit food resources available to an expanding Bald Eagle population.

Saalfeld et al. (2009) pointed out that two major habitat requirements necessary for nesting by Bald Eagles are suitable nest trees near foraging areas (i.e., large bodies of water and/or permanent flowing creeks and rivers; Murphy 1965, Livingston et al. 1990, Garrett et al. 1993) and freedom from human disturbance (Murphy 1965, Andrew and Mosher 1982, Garrett et al. 1993, Thompson and McGarigal 2002). However, because of increased

Adult pair looking forward to the future. Photo by Jess Thompson.

recreation and development pressure, these habitat characteristics are becoming increasingly rare not only in Texas, but throughout the lower 48 states (McGarigal et al. 1991).

The future is bright for Bald Eagles nesting in Texas. There are many kilometers (miles) of river riparian areas and lake shorelines that are suitable for nesting and are yet to be occupied. When you see a Bald Eagle, enjoy it for its beauty, its representation of wildness in nature and give it some space. It will thrive and we will all be better off for it.

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OSPREY (*PANDION HALIAETUS*): NOTES ON UNKNOWN AND POORLY STUDIED BEHAVIORS

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ABSTRACT.—This paper summarizes selected data collected during my recent field studies of nesting and foraging Osprey (*Pandion haliaetus*) in Florida and Texas, and it includes descriptions of several unknown behaviors documented in photographs. The unknown courtship display of Stick-Breaking-Off-and-Presenting Display was observed several times, performed by males inside the Honeymoon Island semi-colony in Florida. During this courting display, Osprey males broke off sticks in view of their mates and brought those sticks near the female's perching site. Osprey intraspecific kleptoparasitism of nesting materials, never reported before, was observed on several occasions. A curious behavior of Osprey swallowing seagrass was also observed that may be related to the pellet casting process. The author discusses the possibility of Osprey using a low angle strike to avoid the stiff, sharp tips of some fish dorsal fin spines when striking its prey. The male Wings-Drooping-And-Shivering display observed at Honeymoon Island Osprey population is the second known record of this display for *Pandion* sp. and first record for *Pandion haliaetus,* if *Pandion cristatus* is accepted as a separate species. Other selected behaviors reported and discussed include a few comfort movements and cases where observed Ospreys were willing to take dive chances for exchange of small or partially eaten fish with a new larger one.

INTRODUCTION, STUDY AREA AND METHODS

The Osprey (*Pandion haliaetus*) is arguably one of the most-studied raptors in the world (Poole 1989). It can be found nesting, migrating or wintering on all continents except Antarctica. My initial literature search at Peregrine Fund Research Library database using the keyword "Osprey" produced a list of about 2,400 publications. Even though there were a large number of papers published about Ospreys, only a few authors tried to summarize all available data about this species. Perhaps the most important accounts are one monograph (Poole et al. 2002) and one book (Poole 1989) devoted to Ospreys; both works summarized all published material, and both provide a comprehensive list of references. Other published books are either about raptors in general (Bent 1937, Newton 1979, Palmer 1988, Marchant and Higgins 1993, del Hoyo et al. 1994, Olsen 1995, Clark and Wheeler 2001) or, if dedicated only to Osprey (Dennis 1991, Carpenteri 1997), cover basic data about the species biology and ecology and do not provide an extensive list of references. The newest book (Dennis 2008) provides a summary of Osprey history in the British Isles and data about migration, banding and satellite tracking research but only briefly covers data about breeding and ecology and does not provide references. It has been pointed out (Poole 1989) that despite popularity, anyone hoping to learn about Osprey is forced to consult a multitude of different sources, most of them scholarly, narrowly focused, and out of date. Poole's book (1989) and his coauthored monograph (Poole et al. 2002) successfully synthesize knowledge about Osprey, but this bird's behavior still needs more studies and the growing list of papers published in last few years will soon require a new and updated monograph summarizing the latest research.

All my observations included in this paper were collected during opportunistic field trips to study Osprey biology, ecology and behavior. During these trips I observed and documented in photographs several unknown Osprey behaviors. I also had the opportunity to study, in more detail, some of the other poorly documented behaviors that are sometimes based on anecdotal reports and are often misinterpreted in popular articles. In this paper, I concentrate on, and report, specific descriptions of several new and a few other selected behaviors

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observed during the last 3 years. My fieldwork is far from being complete. The vast amounts of data collected so far have yet to be fully summarized, and many observations still need to be verified. My field trips were taken in two states: Texas and Florida. The observations collected in Texas (primarily on the Upper Texas Coast) were in the last 3 years, mostly during the fall-winter when many Ospreys are concentrated in fish-rich spots along the Texas coast in both saltwater and freshwater habitats. In Texas, my observations of wintering individuals were mostly concentrated on Osprey feeding behavior. In April 2008, I visited Florida to collect observations and photographs which illustrate courtship and nesting behavior of the Osprey's residential populations. Many Ospreys nest in Florida in small loose colonies occupying natural habitats and man-made platforms, sometimes located on utility posts in the center of city's busy intersections. My main goal was to study Osprey behavior mostly in their natural settings.

To document my observations, I used Canon cameras 20D (with shutter speed up to 5 frames per second) and 40D (up to 6.5 frames per second) usually with 500 mm lens coupled with 1.4X teleconverter and 100–400mm zoom. I documented some nest activities from close distance. Determination of the sex of observed Ospreys was based on comparing sizes, plumage (size of the breast band) and behavior (courtship feedings, begging for food, copulation). Sexing the American Osprey using secondary sexual characteristic was discussed by Macnamara (1977).

Many of my analyses of observations were base on a collection of my photographs taken during the last few years. Photographs taken by me illustrating many Osprey behaviors can be found at <www.pbase.com/mbb/life_on_the_osprey_time>. This folder includes subfolders with extensive photo-material illustrating all behaviors described in this paper.

RESULTS

DESCRIPTION OF OBSERVED NEW OSPREY BEHAVIORS

Stick-Breaking-Off-And-Presenting Display

During seven days, 20–26 April, 2008, I observed and photographed the activities of a small nesting Osprey semi-colony located on Honeymoon Island in Florida. Observations usually lasted from sunrise to sundown with a few hours break during the mid-day hours. During that time, I observed and documented, in photographs, a very interesting Osprey male courting display that I could not find any reference to in published papers. I propose to name it Stick-Breaking-Off-And-Presenting. I observed this display several times during the week of observations. It was performed by males in the front of their mates who were usually perched on the branch of a neighboring tree near the nest. My first observation of this behavior was intriguing but could not lead to any conclusion. It happened as a single incident when a male flew in at full speed and broke a dead branch from a tree located not too far away from a perching female. The male, after making a small circle in the air, instead of taking the collected stick to the nest, landed a meter or so away from the female while trying to hold the stick in his feet. After a moment, he lost his grip on the stick which fell to the ground. The male did not try to pick it up. This pair was not seen together on the following day and only the male remained near or on the nest that day defending it from the intruders. The day after the nest was aborted for the rest of my observation time. During that day when the Stick-Breaking-Off-And-Presenting was observed, the female begged for food often, but the male never offered her fish he brought to a nearby perch. The pair that day was observed to attempt to copulate once but no cloaca contact was made. During the next few days, I observed more instances in another pair, where the male was bringing sticks to a dead tree with a female perching nearby. At one time the male managed to have 2 sticks balanced on branches and came back with a clump of seagrass in his talons (Fig. 1). I could not determine the purpose of this action, and I could not positively associate this male and female with any nest during the display time. As there were no trees around with easy to break branches, this male was bringing sticks from an unseen location. The answer to understanding of this new behavior came in the late afternoon on 26 April, when I witnessed this display in detail for half an hour. On this day, I observed pair with a more advanced, but still new, nest. Materials were brought several times a day. The female, during this afternoon, was either perching on the nest or on branches nearby. The male brought nesting material and at one time fed the female with a half eaten fish. About 1804 h the male began to perform a display which I observed for the next 33 minutes (to about 1837 h). The male started looking for sticks to break off in the immediate vicinity of his perching mate. After finding one he

Figure 1. Osprey male during his Stick-Breaking-Off-And-Presenting Display in front of a perching female managed to balance 2 sticks on tree branches and come back with a seagrass clump in his talons. Honeymoon Island State Park, Florida. 20 April 2008.

could successfully break off from the tree (Fig. 2), he either flew straight to the perching female and landed not too far away from her with a stick in his talons or, sometimes, he made a full circle flight around the female before landing. Sometimes, the male presented the stick only in flight and did not land on the tree. After circling in flight around the female perching site, he would fly away with the stick in his talons. At first the female remained perched on the nest but later during the display, she moved and joined the male on the tree where the male performed his show. He often tried to perch close to her, while holding sticks with his talons. Most of the time sticks were dropped from the male's talons, but some sticks were anchored to the branch (Fig. 3). The male kept bringing new sticks to the same tree even after the female flew away to another perch. After a few tries, the male was unable to break off a stick from nearby trees. He left the area to go to another part of the island, flying across a small bay, but he was back shortly, usually with the stick in his talons. I observed other Ospreys bringing sticks from various parts of the island, as most trees around the active nests usually did not have many branches that were easily broken. The displaying male would first try to find a stick that could be broken within visible distance of the female, sometimes flying around for several minutes from one tree to another. Only when, after several attempts, no other breakable branches could be found in the area would the male fly away and bring a new stick from a further location. After the last try at 1837 h, the male flew away leaving the female still perching near the nest site. During the whole display, the male brought sticks at least 7 times and usually presented them to the female. The first observed presentation included 2 large sticks in his talons, but I did not observe him collecting this material. The male passed the nest with the female perching there, and after making circling flights

Figure 2. Osprey male attempting to break off a stick from a tree during the Stick-Breaking-Off-And-Presenting Display. This behavior was also the only observed method used to gather nesting material inside this Osprey semi-colony. Honeymoon Island State Park, Florida. 26 April 2008.

lasting about 1 min 14 sec, he flew to another tree near the nest. When trying to land he dropped 1 stick on the branch and left this stick anchored to the branch. Then the male tried to land on a nearby branch, firmly holding a grip on another stick while trying to maintain balance on the perch for next 16 sec. Then he started flying again with the remaining stick in his talons. After making a small circle, he disappeared from sight and was back in about 14 min flying with a new stick. During this time while the male was gone, a single Bald Eagle (*Haliaeetus leucocephalus)* showed up in the area and was chased away by other Ospreys. I could not determine whether the displaying male was a part of the group that chased away the eagle or not. After his return, the male presented a new stick in a few seconds of flight passing the female perched on the nest, and then he flew away. The male was back in sight in about 40 sec, talons empty, and he started checking nearby trees for a new stick. It took him a few seconds to snap off a new stick, but it was a very small one. The male held this stick for about 7 sec in flight, dropped it and went back to search for the next one. After about 3 min, and a few unsuccessful tries, the male broke off a new large stick that he brought to the tree. After about 20 sec circling flight, he presented it to the female who had already left the nest and moved to perch on the tree where the male was bringing the collected sticks. The male did not land, and after passing in the front of the female, made another 17 sec circling flight and then landed on the branch next to the female perched on a nearby branch next to the first stick the male had brought and anchored on the branch. After a couple of seconds of trying to keep his balance on the branch above the female, the male, still holding a stick, flew to a lower branch (about 1 m below the female). After 3 sec he managed to balance himself with the stick in his talons and remain in this position for the next 33 sec. The male then left the last stick he brought anchored to the tree fork and for next 3 sec hovered slightly above or at the level of the perching female. Then he landed again on a lower branch right on the top of the last stick he brought. He spent 2 sec flapping his wings and trying to reposition the stick with one foot. Finally he lost his grip and the stick fell to the ground. For a couple of seconds, after losing a stick, the male

Figure 3. Osprey male bringing another stick (note one stick already balanced on the branch near the female) during his Stick-Breaking-Off-And-Presenting Display. Honeymoon Island State Park, Florida. 26 April 2008.

looked down, then he took off and flew over nearby trees looking for another stick. Again, after a few unsuccessful tries during the next 3 min 17 sec, the male finally broke off a new stick, a small one, but this time he brought this one back to the tree after a direct 5 sec flight – the female had already left and was perching on another tree nearby where she remained for the rest of the display time. This time it took the male about 7 sec to balance himself with the stick on the branch, and after resting for about 1 min he took off and made a circling flight lasting about 15 sec then landed again on the same tree. Then he tried to balance himself with the stick for about 16 sec. He held it resting for a second or so, and then dropped it to the ground while taking off. The male tried to balance himself on a nearby branch for about 17 sec then took flight. He was back at the tree with another small stick in about 1 min 9 sec. It took him about 6 sec to balance, and 15 sec to perch while holding the stick. He took off again letting the stick slide down from the branch. He kept trying to find sticks to break off nearby for 1 min 23 sec, and then he left the area and was back with a small stick after about 2 min and 42 sec. He circled around for 9 more sec. This time he lost his grip on the stick when landing. After perching again, he spent about 1 min 46 sec on the branch before he took flight. For the next 20 sec the male tried twice, unsuccessfully, to break off a new stick then flew away (about 1 h 25 min before sunset), and I did not see him again. During the display time, none of the collected sticks were taken to the nest. The female took flight about 2 min after the male left, but she was back in about 44 sec with a clump of sea grass in her talons. She started to swallow the seagrass shortly after landing on the perch. This incident of swallowing seagrass is described in more detail in another part of this paper. As this was the last day of my observations during this trip, I did not have a chance to collect more data. During the described Stick-Breaking-Off-And-Presenting display, the Osprey male collected sticks at least 7 times (one time double), most in plain view of the perching mate. On average, he was successful in breaking and collecting a stick every 4.7 min with maximum time of about 14 min (but this long break could possibly be related to the Bald Eagle chase) and a minimum of about 1 min between the presentation of a new stick. Although a very small stick was dropped (possibly by accident shortly after breaking it off), at least 6 times different sticks were presented to the female (on average one presentation every 5.5 min). I took 584 photographs during this event for the further analysis.

Figure 4. Pirating nesting material from another Osprey nest. Note more nest material falling down than taken away. Honeymoon Island State Park, Florida. 25 April 2008.

Osprey Intraspecific Kleptoparasitism of Nesting Materials

Intraspecific kleptoparasitism of food by Ospreys was reported by Forbes (1991), but in published papers there are no references to Ospreys collecting nesting material by pirating from other Osprey nests. Ospreys building nests on Honeymoon Island in Florida were observed on several occasions. Some individuals kept coming to other temporarily unguarded nests pirating sticks from them. The thief, being successful and not chased away, often came back and tried to collect more material. In most cases, owners of the nest perched nearby and instantly chased the thief away, but usually some damage to the nest had already been done, often because of the impact of the bird. While trying to grab material in a hurry at high speed, more sticks and other nest materials fell to the ground than grabbed and carried away (Fig. 4).

Swallowing Seagrass by Osprey

On 26 April at Honeymoon Island at 1840 h, I observed a perching Osprey (presumably a female) make a short flight to the shoreline and return with a clump of seagrass in its talons. The bird did not take this material to the nest; instead it landed on the perch and continued holding the seagrass clump (Fig. 5a). Clumps of seagrass collected from shoreline are commonly brought to nests at the Honeymoon Island colony by nesting Ospreys, but this time it was used differently. The Osprey started to take large bits of seagrass blades and proceeded to swallow them. While eating a couple of portions, the process lasted about 1 min; the rest of the clump fell down to the ground (Fig. 5b-g). After swallowing a mouthful, the bird appeared to force swallow material down the throat. After swallowing at least two portions, the Osprey took an erect posture with an extended neck and a bill stretched wide open (Fig. 5j and m-q). This action, repeated two times, started and ended with cleaning the bill by grabbing the end of a branch and rubbing the inside of the bill against the wood (Fig. 5h-i, l and s). Short resting breaks were taken after outstretching the neck and bill (Fig. 5k and r). Then the Osprey resumed a resting position (Fig. 5t) and started to preen (Fig. 5u). The bill was cleaned one more time by rubbing against the branch (Fig. 5v). After that the bird turned around, walked away a few steps and continued to perch in the resting position (Fig. 5w-y).

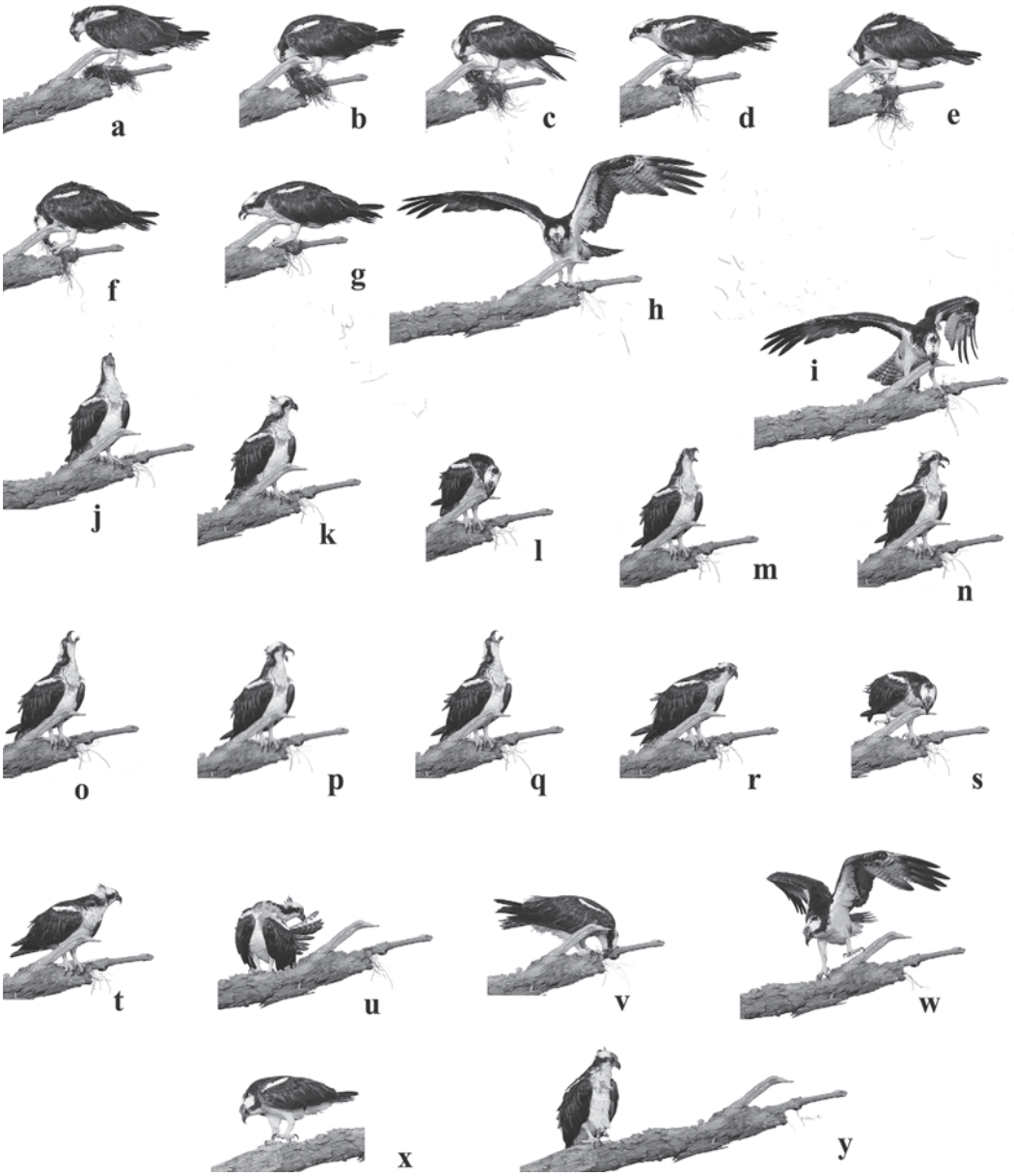

Figure 5. A composite photographic summary of an Osprey swallowing seagrass. Honeymoon Island State Park, Florida. 26 April 2008.

Selected frames, out of about 200 photos taken from 1840 h to 1849 h, are presented on one composite photo (Fig. 5).

Striking Fish at a Low Angle to Avoid Contact with Sharp Tips of Fish Stiff Dorsal Spines

Ospreys hunting fish were observed along the Texas coast during winter between 2005 and 2008. After watching hundreds of dives of up 12 Ospreys fishing in the same place, I saw them plunging into the water feet-and-head first at a low angle, about 45°. Carpenteri (1997) described Ospreys plunging into water at a 45° angle to an almost horizontal position. I only observed Osprey plunging at about 45°, and the only time I saw them take the horizontal position was when the diving bird

Figure 6. Composite photographs illustrating Osprey low angle strikes and position of feet right after the strike. Note the positions of the foot avoiding hard and sharp tips of pinfish dorsal spines. Freeport, Texas. Winter 2007.

aborted the dive just above the water. I observed Osprey foraging on fish with long, stiff and very sharp dorsal spines: pinfish (*Lagodon rhomboides*). In a tidal lake in Freeport, Ospreys during the winter fed on pinfish almost exclusively. I only saw one incident of an osprey taking a red drum (*Sciaenops ocellatus*), even when other fish were abundant in this spot. Small, finger-sized fish were taken only when Ospreys could not find larger sized fish. I began to pay more attention to find out how Ospreys avoided being speared by the stiff spines of pinfish. Any serious damage to the raptor's feet can have fatal consequences, because they depend on their feet for hunting and defense. From my field observations and analyzed photographs, it seems there is an important reason for Ospreys using an angle of about 45° when striking fish. Many fish have long, sharp spines in their dorsal fins protecting them from predators attacking directly from above. It seems Ospreys avoid being speared by these spines by striking the fish from the unprotected lateral side. Normally, by striking at a low angle with claws spread and held in an almost vertical position, the Osprey's feet are avoiding contact with the sharp tips of spines and usually 2–3 talons grip the fish's unprotected lateral side. At the same moment one or two of the remaining talons strike the top of the fish, often through the base of the dorsal fin. It seems that the flexibility of the reversible outer toe might also be used for optimum effect in positioning the talons when striking the lateral side of the fish. In all cases, I observed that usually one foot was used to strike avoiding sharp spine tips. The second foot usually was used soon after emerging from the water to reposition the prey for air transport. Composite photographs (Fig. 6) show various stages of the dive including the Ospreys foot position right before the plunge, and position of the talons after the strike to grab the fish and bring the prey above the water.

Figure 7. The male Wings-Drooping-And-Shivering display when holding partially eaten fish in his talons. Honeymoon Island State Park, Florida. 26 April 2008.

Hunting a Larger Prey with Small or Partially Eaten Fish Hold in the Talons

When studying Osprey foraging during winter along the Texas coast, I observed on several occasions that after getting a small fish, some Ospreys continued flying slowly over the water and sometimes hovered and even dived toward another fish. On one occasion, when an Osprey was flying over the water with a small part of mostly eaten fish, he spotted a new fish. The bird hovered for a moment, dived and plunged into the water, and came out with a large-sized fish in its talons. The leftovers of the old fish were lost during the plunge into the water.

NOTES ON OTHER SELECTED BEHAVIORS

Male Wings-Drooping-And-Shivering Display and Pre and Post-Copulatory Behaviors

There is only one published record (Clancy 2006) of a male displaying in front of a female by drooping and then shaking and shivering his wings. Clancy (2006) observed this display when the pair landed on the nest after flying together. He did not mention the male lowering his head during the display. I observed this display at Honeymoon Island once. The male came to the nest with a half eaten fish, but instead of offering the fish to the female (she was not begging for it) he turned backward to her, lowered his head, dropped his wings and kept shivering his wings for about 30 sec (Fig. 7). The male kept the fish in his claw throughout the entire display. There was neither a reaction from the female, nor did she show an interest in the food. After the male stopped displaying, he took flight with the fish remains in his talon and flew to a nearby perch, where he finished eating the fish.

The male Wings-Drooping-And-Shivering display observed at Honeymoon Island Osprey population is the second known record of this display for *Pandion* sp. and first record for *Pandion haliaetus* if *Pandion cristatus* is accepted as a separate species.

I only witnessed one attempt to copulate shortly after a male brought a partially eaten fish to a female. The male brought the fish to the nest and the female took it from him, flew to a perch on another tree and began to eat it. The male after a few minutes of standing on the nest joined her and perched close to her for another few minutes. Then he flew up and

landed on the female's back. The female allowed the male to land on her while still holding an uneaten part of the fish. For a few seconds the male tried to copulate but no cloacal contact was made during this attempt. All other copulation attempts I observed were not related to feedings.

Notes on Osprey Feeding Behavior

I had numerous opportunities to observe, in detail, the whole process of Ospreys eating fish from the beginning to the end, sometimes at a very close distance (6 to 10 m) to the dining bird. Perhaps, the most complete feedings I observed were several different incidents of Ospreys eating large specimens of the largemouth bass (*Micropterus salmoides*) taken from ponds between freshwater marshes on the upper Texas coast during winter. When Osprey eat large bass, the whole process can last an hour or longer. All parts of the fish were consumed except those that unintentionally fell. I did not observe the Osprey intentionally discarding any fish parts during eating. All Ospreys followed a typical sequence of fish consumption. They usually started with the tips of the fish mouth, consuming the jaws, then eyes, and opercula. Opercula and gills were eaten in fragments, only involuntarily dropped fragments were lost. Next the viscera were removed piece by piece. Large viscera parts from large fish very often fell to the ground when the Osprey tried unsuccessfully to swallow them. With one foot used to stand on the perch and the other one used to hold the prey, the Osprey had no way to tear small, bite-size pieces from the large fish viscera held in its bill. When trying to swallow large pieces of fish viscera or when making some effort with its bill to hold it, the bird usually lost the fish organs when it lost grip of them, and the viscera fell to the ground. Also, soft organs, like liver, etc., were smashed inside the bill and parts would fall to the ground. The next step was consumption of the rest of the fish's body, tearing off small pieces of flesh and bones. The tail was usually swallowed in one piece, if it did not accidentally fall to the ground. After consuming the last piece of fish, the Osprey usually spent some time picking small pieces of the fish stuck to its feet and cleaning its bill by wiping it against the branch or sometimes (observed in Honeymoon Island semi-colony) clean the inside of its mandibles by grabbing small ends of branches and rubbing the inside of its bill against the wood.

Selected frames illustrating Osprey consuming parts of largemouth bass are shown in composite photographs (Fig. 8).

Ospreys Releasing Too Large Fish from Their Talons into the Water

I observed several Ospreys catch and hold in their talons a large vigorously fighting fish. In some cases the fish was released back into the water after a few unsuccessful tries to get airborne with the prey in its talon. Sometimes the Osprey rested for a longer moment on the water with its wings spread above the water surface before getting ready for the next try to lift with its prey. Ospreys usually were able to lift to in the air with very large fish that did not fight but released large ones that did not stop fighting.

Notes on Selected Osprey Comfort Movements

I observed two interesting Osprey comfort movements during my field studies at Honeymoon Island State Park. I could not find any references in published data. One was the way Ospreys were cleaning their bills. The well-known behavior of rubbing their bill sideways against the branch was used very often but also, in many observed cases, another way of cleaning the bill was applied as well. To clean inside parts of the mandibles, Ospreys grabbed small ends of dead branches or small parts of wood sticking out from the tip of a broken end of the branch and rubbed both inside parts of their mandibles. Often their tongues would stick out allowing thorough cleaning inside the bill without a tongue in the way (Fig. 9).

The second interesting Osprey comfort movement was scratching the head. In most cases typical direct scratching using the talons was used but on one occasion I also noticed an Osprey scratching its head by rubbing it against a branch (Fig. 10).

I observed Ospreys dragging their feet in the water (sometimes 2 to 3 times in a row, one after another for several meters each time) at Honeymoon Island during hot afternoons. I did not observe this behavior during mornings. I did not observe this behavior in wintering Ospreys on the upper Texas coast.

DISCUSSION

Despite the fact that the Osprey is such a well-studied species, its behaviors need more field studies in different locations and habitats for comparative

Figure 8. A composite photo of an Osprey eating a largemouth bass. Only large or soft tissue organs of viscera were involuntarily dropped. San Bernard National Wildlife Refuge, Texas. Winter 2007.

Figure 9. An Osprey cleaning the inside parts of his bill. Note the tongue sticking out on the side of the bill allowing thorough cleaning of the inside of the bill. Honeymoon Island State Park, Florida. 21 April 2008.

Figure 10. An Osprey scratching its head by rubbing it against the branch. Honeymoon Island State Park, Florida. 20 April 2008.

data. It was one of the key species in discovering effects caused by chlorinated hydrocarbons on eggshells (Poole 1989). Also, observation of Osprey migration especially using GPS and radio transmitters is another popular subject and one of the best studied aspects of Osprey life (del Hoyo et al. 1994, Dennis 2008). Perhaps, the most studied areas include breeding biology, ecology and behavior as many nests in different parts of the world are watched closely and often for extended periods of time (Poole 1985, Birkhead and Lessels 1988, Green and Krebs 1995, Rose 2000, Widen and Richardson 2000, Clancy 2005a, Dennis 2007). There is limited work on other Osprey behaviors (Bretagnolle and Thibault 1993); these authors studied Ospreys communicative behavior.

Osprey populations in many locations around the world, including those in the United States, are changing nesting behavior (Poole 1989), and Ospreys are also altering their aggressive behavior toward humans, who are either sharing or frequently visiting their nesting territories. These behavioral changes seem to show a trend towards Ospreys becoming less or non-aggressive toward humans visiting places with active nests. Allen (1892) reported this behavioral change on a privately owned island where a large Osprey semi-colony was protected from harassment. As a consequence of the Osprey's acceptance of humans' close presence in a growing number of places, nest observations are becoming a much easier task and allow data collection without disturbing nesting pairs. It also seems that Ospreys adapt quickly to habitat changes if nesting requirements and a fish supply are available. Ospreys readily accept artificial nest sites on human-made platforms. In Florida, it seems that these birds not only readily accept man-made nest structures, but some nesting pairs even favor platforms over natural trees and often leave their old nesting sites and move to urban areas to nest on platforms or utility posts with artificial nest structures (Poole 1989). In Florida, only a few decades ago, any attempt to photograph active Osprey nests in a remote location (like small islets not visited often by humans) were not only difficult but also dangerous to the photographer or observer as many Ospreys fiercely defended their nesting territories and often dived at visitors. As this aggressive behavior has changed due to habituation, now it is possible to spend time close to many active Osprey nests without disturbing the pairs' or nestling's normal activities. Poole (1981) showed that human disturbance when visiting habituated Ospreys on their nesting sites had little or no affect on nesting success. On the other hand, human disturbance when visiting isolated colonies or nests can possibly have a negative impact on the nesting success (Poole 1981, Clancy 2006). In west-central Idaho van Daele and van Daele (1982) found Osprey nests located more than 1,500 m from human disturbance produced more offspring, yet the birds frequently nested close to humans and habituation to human activities appeared to vary depending on the frequency of disturbance. High nest failures and desertion of territories associated with increasing tourism and disturbance have been reported (Palma et al. 2004, Dennis 2007).

It is also possible that different populations may show some differences in behavior depending on the habitat where they court and nest. Because of such a broad worldwide distribution, Osprey populations need to be studied by many field researchers.

Stick-Breaking-Off-And-Showing Display and Osprey Intraspecific Kleptoparasitism of Nesting Materials

The courting behavior of a male breaking sticks off in front of his mate would be more likely to occur in natural habitats with ample trees available with dead branches of the right size for the Osprey to break. Individuals nesting in urban areas or on platforms in open areas might not have the opportunity to perform this type of courtship display because a lack of sticks to break off in close vicinity, lack of suitable perching places to present the stick to the female or both. The male bringing other nesting material, such as a clump of sea grass, between stick presentations was witnessed only once. During the full length display I observed the male did not bring any seagrass despite its availability on the shore in visible range of the female. More observations are needed to establish how often material, other than sticks, are used in the presenting display, but it is also possible that maybe some males prefer to present only sticks.

Kleptoparasitism of nesting materials might occur only in some Osprey semi-colonies where many nests are located relatively close to each other and there is a shortage of available nesting material. In places where another nest is located several kilometers away this behavior is probably non-existent. As I did not collect any information

documenting the final purpose of pirated nesting material, this behavior needs more study. There could be two reasons for this behavior: using pirated material for building one's nest or bringing it to the mate during the Stick-Breaking-Off-And-Presenting display. The latter reason could explain an incident I observed one time when the male brought 2 sticks (collected outside of visible area) in his talons and present them to his mate.

Questions can be raised and argued about possible benefits of the female sitting and guarding the nest during the nest construction before eggs are laid. This behavior of nest material kleptoparasitism, at least practiced by some Ospreys, gives a good reason for the need to guard the nest by a nesting pair at all times. Without full-time protection during a nesting activity period, nests can be damaged quickly and the process of repairing can become a never-ending task. I also observed a few cases when a single male left his nest (nest construction was in the beginning stage) to feed or to look for more nesting material, another male came to steal sticks from his nest. I only observed Ospreys stealing material from occupied nests and never from old aborted ones.

Also, at the Honeymoon Island semi-colony, I observed Ospreys only collecting sticks by either breaking them off from pine trees or by stealing them from other nests in the colony. There are many observations published on Osprey methods used to gather nesting material, but the reports often differ from each other on what is the preferred method. Poole (2001) suggested Ospreys often snatch sticks from the ground rather than break them off from trees. Stinson (1976) observed that an Osprey pair carried a substantial portion of the sticks to the nest that were pulled directly from trees. Kennard and Kennard (2006) reported an Osprey pair only collected sticks from trees during the first stages of nest building and when maintaining an existing nest. It seems that some Osprey behaviors, including gathering nest materials, vary in different habitats and locations. The sticks for nest construction and lining materials vary depending on locally available materials (Poole 1989, Clancy 2006). Despite many sticks lying around, I never saw any Osprey at Honeymoon Island colony trying to pick them up from the ground.

It is unlikely that any behavior observed inside the Honeymoon Island Osprey semi-colony is unique and restricted only to this population. Questions can be raised as to why in so many long-term observations of courting and nesting Ospreys no one has ever observed and reported similar behaviors. Granted, some long-term observations were done on single nests (Birkhead and Lessels 1988, Rose 2000). Perhaps the Stick-Breaking-Off-And-Presenting display is not performed in remote places during the observers' presence that may have disturbed normal Osprey activities. Also, it is possible that this courting display is only practiced by males trying to get a new mate or ones from freshly formed pairs. Studies on large Osprey nesting semi-colonies in the past (Allen 1892, Abbott 1911) were in areas occupied by migrating populations, but no similar observations were reported. It is possible that some behaviors are restricted only to non-migrating individuals living year round in one area and courtship can occur during extended periods without having time restrictions of migrating individuals who have limited time together before females start to lay eggs.

There is a description indicating that the Stick-Breaking-Off-And-Presenting display may have been observed in the past but possibly only partly witnessed by an observer. Rose (2000) described an incident that could have been a single stick presenting event. Text taken from his paper: "*The male then flew to a dead tree, seized a stick, while fluttering, flew past the other bird, then circled. He settled briefly in the nest-tree then on the top nest, then flew out of sight with the stick*". Some single events I observed several times before witnessing repeated displays were similar to this although no male brought sticks to the nest.

Swallowing Seagrass by Osprey

I do not have any definite explanation for the behavior of swallowing seagrass by an Osprey. This behavior needs more study in the future. I was not able to make a positive identification of the swallowed seagrass blades. Most likely it was manatee grass (*Syringodium filiforme*) blades that were swallowed. This clump had a few fragments of turtle grass (*Thalassia testudinum*), but I did not notice the wide blades inside the Osprey's bill when it was taking bites. Grass was found sometimes as part of regurgitated material during the process of casting a pellet by some Ospreys (Poole 1989) but this author makes a note that grass must have been ingested accidentally. As I observed the Osprey intentionally swallowing a few bites of seagrass and forcing it down the throat, it seemed to be a possibility that these birds might need, at least

sometimes, grassy material to help them in the process of regurgitation of some pellets. Casting pellets by Ospreys is a well-documented behavior but it is not observed often and pellets are usually very small (Poole 1989). I only witnessed an Osprey casting a small pellet once despite countless hours of observation. In the observed case of casting a pellet, the process starts with a similar posture and movements that the Osprey took after swallowing seagrass: erected neck, head pointing upward with an open bill. The pellet was cast with the head down forcing a small pellet out. Even then, the Osprey, after swallowing mouthfuls of seagrass took a similar posture with its head up and bill wide open but did not lower its head down and I did not notice any pellet being cast out.

Striking Fish at a Low Angle to Avoid Contact with Sharp Tips of Fish Stiff Dorsal Spines

My suggestion about the possibility of Ospreys using a low angle to strike a fish to avoid possible damage to its feet by the stiff spines of a dorsal fin of some fish species needs to be confirmed by more field observations. There are published records of an Osprey possibly taking a substantial number of triggerfish (*Balistidae*) and surgeonfish (*Acanthuridae*) (Smith 1985) and porcupinefish (*Dicotylichthys* sp.) (Savory 1989) although these records are based on remains found around the feeding perches (Smith 1985) or under a nest (Savory 1989) and not an actual observation of an Osprey taking those species alive in the water. Some prey 'middens' found around feeding perches contained a large percentage of small birds identified as terns *Sterna* spp. (Smith 1985), but these data need verification by further studies. Marchant and Higgins (1993) assumed that Ospreys are able to avoid sharp spines present on these fishes but did not offer any suggestion as to how it is done. More data collected from different places on an Osprey's final strike on different fish species equipped with stiff sharp dorsal spines will help to find out if a low angle attack is always applied and if it is useful to protect the Osprey's feet. Comprehensive observation is also needed to determine what technique is used to avoid the sharp lateral spines located on the caudal peduncle of surgeonfish, if indeed these fish are taken. I did not find any other references confirming that Osprey prey on triggerfish or surgeonfish.

The behavior of striking every fish near the water surface at a low angle seems to be a very safe way of attack without taking chances of a possible misjudgment in case a prey has stiff dorsal spines. Avoiding the stiff, sharp dorsal spines is probably one of multiple benefits in using a low angle to strike a fish. Tucker (2001) suggested that because of more acute sideways vision, raptors might favor a spiral flight path when approaching the prey. No studies were done on Osprey's attacking flight paths and estimating the position of the attacked fish in an Osprey's field of view can be very difficult, if not impossible, to follow as the fish's movement and position are usually not visible to the observer. Analysis of all my photographs and my close observations show that Ospreys, after submerging into the water will come back above water in the following sequence. First, the tips of the wings, then part of the wings will come above the water surface followed by the head. When the bird's wings, head and breast are above the surface, the Osprey will shake its head, removing most of the water from it. Only sometimes will it rest for a moment lowering its wings and partially submerging them into the water but, usually it will try to get airborne right after coming out of the water. Its feet, with or without prey, emerge above the surface when the bird is practically airborne. I observed only one exception. In one instance I collected an interesting photograph taken after a shallow unsuccessful plunge. The Ospreys feet, talons closed, were in a horizontal position and lifted above the water at the same time as the whole body (Fig. 11). This leg position suggests that the Osprey possibly tried to strike the fish's lateral side when holding its feet at a horizontal position. The Osprey plunged with its feet held out at about a 45° angle so it had to raise them to a horizontal position right under the water surface and probably by not hitting the target the feet went above the water surface in this position.

All my field observations indicate that Ospreys are most likely depending on visual contact with the fish during the final dive and plunge to strike the prey. In the last moment before the plunge, just above the water, the Osprey places its head with an extended neck right behind its claws while trying to keep visual contact with its prey at the moment of plunging into the water. Most authors call this feet-first plunge (Palmer 1988, Poole 1989, Marchant and Higgins 1993, del Hoyo 1994). Sibley (2001) used the name head-and-feet-first. Personally, I think the term feet-and-head-first should be used as that name describes the position during the plunge more precisely.

Figure 11. An Osprey coming out of the water after an unsuccessful shallow dive. Note the horizontal position of the legs. Freeport, Texas. Winter 2007.

Hunting a Larger Prey with Small or Partially Eaten Fish Hold in the Talons

The success rate for hunting Osprey varies (Swenson 1978, Swenson 1979, Edwards 1988, Poole 1989), and many factors have to be taken under consideration: individual experience and skills, weather conditions and most importantly seasonal availability of the fish (Ueoka and Koplin 1973, Dunstan 1974, Grubb 1977, Edwards 1988). I could not find any references about Ospreys searching for new prey before completely consuming the one already caught or right after catching a small one. During my observations, I noticed numerous Ospreys trying to find and hunt large fish in spots where they had successfully fished before, but after many unsuccessful dives or when they could not locate a prey, they left the place and went to small shallow tidal lakes with ample finger-sized fish. In all observed cases, Ospreys did that only after spending longer time in places where they usually were able to get a bigger prey.

Male Wings-Drooping-And-Shivering Display and Pre and Post-Copulatory Behaviors

The Osprey male Wings-Drooping-And-Shivering display observed at the Honeymoon Island semi-colony is the second documented record of this male behavior. Palmer (1988) described precopulatory behavior as: "Females were on the nest rims and facing away from the males on the nests. Each male partly extended his wings and lowered his head for 5–7 sec. Then he flew, immediately turned, and hovered over the female. The male then alighted on the back of the female and remained there 7–10 sec." Although my observation seems to be the most complete display observed (lowering head, drooping and shivering wings plus holding fish in talons), this event did not end with copulation. Clancy (2006) also did not observe copulation after the male performed this display. More observations are needed to classify the Wings-Drooping-And-Shivering display as a possible precopulatory behavior. In the case observed by me, not only was copulation not attempted, but the female did not beg or show interest in the fish remains the male had brought to the nest. The female was fed earlier so she should not have been hungry at this moment, and the male reaction could have been triggered by her lack of interest in the food he brought.

Even though Osprey copulatory behavior has been intensively studied and collected data is extremely comprehensive (Birkhead and Lessels 1988**,** Poole

1989, Green and Krebs 1995, Widén and Richardson 2000), it mostly includes information on time periods, frequency, ratio between copulation attempts with and without cloacal contact, and analysis of observations regarding the question whether the female Osprey is trading food for sex or not. There are limited data published on the pre or postcopulatory behaviors of these birds. Studies done on the possibility of trading copulation for food suggest that Osprey females do not practice this behavior (Birkhead and Lessels 1988, Green and Krebs 1995, Widén and Richardson 2000), although Poole (1985) described the case when a poorly fed female traded food for sex with other males who offered her fish when she begged.

Birkhead and Lessels (1988) observed Ospreys copulate frequently, an average of 160 times per clutch, range: 88-338, starting 14 d before, and peaking a few days before the start of egg laying. According to this study, pairs averaged a rather low number of successful copulations per clutch: 59 (39%), range 20–97 (15.1–63.8%). Similar success rates of copulations were recorded by other authors for this species (46.5%, Levenson 1979; 47%, Poole 1985; 64% in low density and 69% in high density area, Widén and Richardson 2000). Also Birkhead and Lessels (1988) argued frequent copulation of male Ospreys include protecting their paternity by frequent copulation and by maximizing their time with the female when she is most fertile. At Honeymoon Island, I observed the copulation attempts between a male and female on the nest in the beginning stage. This may suggest that copulation attempts, even if unsuccessful, can possibly play a role in helping build a social bond between the newly formed pair, and frequent copulation attempts may help to maintain this bond later. Widén and Richardson (2000) summarized arguments about the social bond hypothesis and suggested that the fertilization and the predation hypotheses cannot explain differences in copulation frequency between the high and low density Osprey populations. More field observations of copulatory behavior, its frequency and seasonal periods should to be studied within residential Osprey populations to compare copulatory behavior of migrating pairs that have a limited time on the nest together before the female is ready to start laying eggs.

Notes on Osprey Feeding Behavior

There are many studies on Osprey hunting and feeding behaviors (Swenson 1979, Poole 1985, Edwards 1988, Poole 1989, McLean 1991, Silva e Silva and Olmos 2002, Clancy 2005a, b) including an example of handling dangerous prey (Forbes 1989). Detailed descriptions of the process of consuming fish have been also published (Silva e Silva and Olmos 2002, Clancy 2005a, Kennard and Kennard 2006).

In general, my observations are very similar to those already recorded about the Ospreys eating sequence, but there were some differences. Ospreys did not discarding the viscera of the fish voluntarily and swallowed most of the opercula and gills, if these parts did not accidentally fall to the ground. Clancy (2005a) reported that some Ospreys consumed the fish viscera and some did not, but he did not specify the sizes of the fish. He also suggested a possibility of gut contents or a bird's degree of hunger as a factor of eating fish viscera. Olsen (1995) offered similar suggestions but neither of these authors offered specific suggestions of what gut contents attract raptors to eat it. Silva e Silva and Olmos (2002) reported opercula, gills and viscera of all mullets discarded during eating. During my observations in Honeymoon Island, where mullets were an important part of the Osprey diet, I did not notice the discarding of any parts of these fish by Ospreys, but I never had an opportunity to observe the complete eating process at a very close distance. Kennard and Kennard (2006) observations agreed with mine that the Osprey consume the whole fish including viscera, gills and opercula.

Ospreys Releasing Too Large Fish from Their Talons into the Water

In some publications, especially early ones (Abbot 1911, Bent 1937) and also in popular articles and on various Internet sites, one can find anecdotal information on a drowning Osprey that locked its talons into a very large fish and was unable to release the prey. Poole (1989) and Dennis (2008) both disagree with those stories of the Osprey not being able to open its talons in the water after locking them on the prey. My observations fully support their view.

Notes on Selected Osprey Comfort Movements

Comfort movements utilized by Osprey are not described in great detail in most of the available literature. Poole (1989) and Poole et al. (2001) only discussed this subject in general terms and did not list many details or references. Probably many comfort movements like the inside of the

bill cleaning technique or the rubbing of a head against the branch were simply overlooked by many observers.

The Osprey behavior of dragging the feet in water has a few possible explanations (Abbott 1911, Clark and Wheeler 2001, Poole 2002 et al.); this practice has usually been associated with cleaning feet or cooling. Dunstan (1974) described Osprey's short flights along emergent vegetation while dragging their feet for 2 to 10 m before returning to the hunting perch as a fishing method but this suggestion should be verified by more field data. I only observed Ospreys dragging their feet in the water during hot days in Florida (not related to hunting), but I never observed Ospreys practicing this behavior during the winter in Texas, even during warm days. My observations suggest that cleaning the feet might not be a primary purpose, but could be an additional benefit. Practicing this behavior during the hot part of the day supports thermoregulation.

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My observations on courting and nesting Ospreys would never have been possible without the help from Honeymoon State Park in Florida. Park Manager, Peter Krulder provided me with all the necessary permits to access the Park's grounds. I am greatly thankful for that. I need to thank the many Osprey researchers for their help: T. R. Birkhead, T. Bischoff , G. P. Clancy, L. Christidis, T. E. Dennis, D. J. Green, D. Kennard, S. Kennard and L. Solonen; they all acted very fast to provide me with copies of their published papers. I also received unsolicited help from R. DeCandido and J. Olsen in locating some papers as well as with extra information they were eager to share. T. Rosenberry from the Peregrine Fund Research Library provided me with copies of papers that I could not find access to anywhere else. H. D. Hoese was very kind to check some photos of pinfish and confirmed my identification of that species. Thank you everyone for all your help. Tracy Palmer proofread parts of the draft while I was working on it. But this paper will never pass the manuscript stage without the help of Joshua Symmank who edited and corrected my grammar mistakes. I am very grateful and appreciative for all his work and help.

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FEATURE ARTICLES

TEXAS BIRD RECORDS COMMITTEE REPORT FOR 2008

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The Texas Bird Records Committee (hereafter "TBRC" or "committee") of the Texas Ornithological Society requests and reviews documentation on any record of a TBRC Review List species (see TBRC web page at http://texasbirds.org/tbrc/ or Lockwood 2008). Annual reports of the committee's activities have appeared in the Bulletin of the Texas Ornithological Society since 1984. For more information about the Texas Ornithological Society or the TBRC, please visit www.texasbirds.org. The committee reached a final decision on 117 records during 2008: 96 records of 46 species were accepted and 22 records of 21 species were not accepted, an acceptance rate of 82% for this report.

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Masked Ducks are always of interest, but this individual near Seagoville, Kaufman County, 14–25 June was a first record for north-central Texas. Photograph by Peter Billingham.

There were 140 observers who submitted documentation (to the TBRC or to other entities) that was reviewed by the committee during 2008.

In 2008, the TBRC accepted the first state records of Yellow-legged Gull and White-crested Elaenia. These actions brought the official Texas State List to 634 species in good standing. This total does not include the four species listed on the Presumptive Species List.

In addition to the review of previously undocumented species, any committee member may request a review of a record of any species. The committee requests written descriptions as well as photographs, video, and audio recordings if available. Information concerning a Review List species may be submitted to the committee secretary, Mark Lockwood, 402 E. Harriet Ave., Alpine, Texas 79830 (email: mark.lockwood@tpwd.state.tx.us). Guidelines for preparing rare bird documentation can be found in Dittmann and Lasley (1992) or at http://www.greglasley.net/document.html.

The records in this report are arranged taxonomically following the AOU Check-list of North American Birds (AOU 1998) through the 49th supplement (Banks et al. 2008). A number in parentheses after the species name represents the total number of accepted records in Texas for that species at the end of 2008. All observers who submitted written documentation or photographs of accepted records are acknowledged by initials. If known, the initials of those who discovered a particular bird are in boldface but only if the discoverers submitted supporting documentation. The TBRC file number of each accepted record will follow the observers' initials. If photographs or video recordings are on file with the TBRC, the Texas Photo Record File (TPRF) (Texas A&M University) number is also given. If an audio recording of the bird is on file with the TBRC, the Texas Bird Sounds Library (TBSL) (Sam Houston State University) number is also given. Specimen records are denoted with an asterisk (*) followed by the institution where the specimen is housed and the catalog number. The information in each account is usually based on the information provided in the original submitted documentation; however, in some cases this information has been supplemented with a full range of dates the bird was present if that information was made available to the TBRC later. All locations in italics are counties.

TBRC Membership—Members of the TBRC during 2008 who participated in decisions listed in this report were: Randy Pinkston, Chair, Keith Arnold, Academician, Mark Lockwood, Secretary, Eric Carpenter, Brad McKinney, Cin-Ty Lee, Jim Paton, Martin Reid, Willie Sekula and Ron Weeks. During 2008, Paton's second term ended and Martin Reid was elected as a voting member. The Chairman, Secretary and Academician were re-elected.

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A highlight of 2008 was this Jabiru near Raymondville, Willacy County, from 10–22 August. This individual represented the eighth record for the state. Photograph by Jan Dauphin.

Engleman, **DH -** Doug Hanna, **DJ -** Dan Jones, **DM -** David McDonald, **DN -** David Nelson, **DR -** Dan Roberts, **DT -** Daniel Trevino, **DW -** David Wolf, **EBe -** Earl Berkson, **EBr -** Erik Breden, **EC -** Eric Carpenter, **EJ -** Erica Judd, **ErB -** Eric Bents, **GB -** Gailon Brehm, **GC -** Greg Cook, **GL -** Greg Lasley, **GLa -** Greg Lavaty, **GM -** Gail Morris, **GR -** Gemma Radko, **GS -** Georgina Schwartz, **GW -** Greer Willis, **HH -** Havar Hveding, **HT -** Heidi Trudell, **IG -** Ivan Getting, **JaP -** Jay Packer, **JaW -** Jana Whittle, **JBi -** Jim Bishop, **JBo -** Justin Bosler, **JD -** Jan Dauphin, **JdV -** Jim deVries, **JF -** Jose Fuentes, **JGa -** Jay Gardner, **JGr -** Joe Grzybowski, **JH -** Jay Hand, **JiK -** Jim Kelly, **JKe -** Jerri Kerr, **JM -** John Muldrow, **JoW -** John Whittle, **JPa -** Jim Paton, **JSp -** John Sproul, **JSw -** James Swartz, **JT -** Jane Tillman, **JY -** John Yochum, **KB -** Kelly Bryan, **KC -** Katherine Cullen, **LBa -** Lynn Barber, **LBo -** Larry Botkin, **LBr -** Lamont Brown, **LHa -** Laurie Hawkins, **LHe -** Linda Hedges, **LM -** Lynn Miller, **LPa -** Lee Pasquali, **LPh -** Lisa Pham, **M&AC -** Mel & Arlie Cooksey, **M&ME -** Marc & Maryann Eastman, **MA -** Mike Austin, **MBo -** Malkolm Boothroyd, **MBS -** Mary Beth Stowe, **MCh -** Maria Chavarria, **ME -** Marc Eastman, **MF -** Mark Flippo, **MGo -** Mariann Golden, **MGr -** Michael Gray, **MGu -** Mary Gustafson, **MH -** Mitch Heindel, **MK -** Mark Klym, **ML -** Mark Lockwood, **MLi -** Michael Lindsey, **MMa -** Matthew Matthiessen, **MMe -** Margaret Meyers, **MP -** Max Pons, **MQ -** Martin Quest, **MRe -** Martin Reid, **MRo -** Miguel Rouco, **MT -** Michael Tarachow, **MW -** Matt White, **NP -** Nathan Pieplow, **PA -** Peter Assmann, **PD -** Pat DeWenter, **PG -** Peter Gottschling, **PKi -** Phillip Kite, **PKu -** Peggy Kuhn, **PS -** Patrick Shaw, **RB -** Rik Brittain, **RD -** Rich Damron, **ReS -** Rex Stanford, **RH -** Ruth Hoyt, **RO -** Robert Ohmart, **RoW -** Ron West, **RPa -** Ruben Palomares, **RPi -** Randy Pinkston, **RSt -** Robert Stone, **RWa -** Robert Wallace, **RWe -** Ron Weeks, **SB -** Steve Bentsen, **SCo -** Sheridan Coffey, **SD -** Stacy Duckett, **SL -** Stephan Lorenz, **StC -** Steve Collins, **T&PF -** Tony & Phyllis Frank, **TB -** Tony Bennett, **TeF -** Terry Ferguson, **TFe -** Tim Fennell, **TJ -** Tom Johnson, **TP -** Tom Pincelli, **WS -** Willie Sekula.

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This Flame-colored Tanager had an extended stay in the Chisos Mountains, Brewster County, from 12–28 June. It provided the seventh record for Texas. Photograph by Malkolm Boothroyd.

like to thank Chris Benesh, Alvaro Jaramillo, Greg Lasley, Steven McGehee, Peter Pyle, and Frank Rheindt for providing the TBRC with expert opinion concerning records reviewed during 2008. The author thanks Randy Pinkston, Martin Reid, and Ron Weeks for reviewing previous drafts of this report.

Additional Abbreviations—AOU = American Ornithologists' Union; NP = National Park; NWR = National Wildlife Refuge; SHS = State Historic Site; SNA = State Natural Area; SP = State Park; TBSL = Texas Bird Sounds Library (Sam Houston State University); TCWC = Texas Cooperative Wildlife Collection (Texas A&M University); WMA = Wildlife Management Area.

ACCEPTED RECORDS

Brant (*Branta bernicla*) (25). One (Black) Brant at Andrews, *Andrews*, from 3–13 November 2007 (**EBr**, GM, HT, TeF, ML, RD, GW; 2007-82; TPRF 2517; *TCWC 14,569). One at Lubbock, *Lubbock*, from 21 November-7 December 2007 (**PKi**; 2007-86).

Eurasian Wigeon (*Anas penelope*) (47). A male at El Paso, *El Paso*, from 20 November–15 December 2007 (**JSp**; 2007-90; TPRF 2522). A male at Lake Ray Hubbard, *Dallas*, on 16 December 2007 (BG; 2007-96; TPRF 2527).

Masked Duck (*Nomonyx dominicus*) (77). One near Riviera, *Kleberg*, on 15 October 2007 (**BFr**; 2007-80). Ten (two adults with eight ducklings) near Lagarto, *Live Oak*, from 30 October–2 December 2007 (**JSw**, **RoW**, AG, M&AC, RPi, LBo, DR, MT; 2007-81, TPRF 2516). Up to eight on the King Ranch, *Kleberg*, from 17 November 2007–1 June 2008 (PKu, LBa, DN, EBe, MMa; 2008-04; TPRF 2574). One at Aransas National Wildlife Refuge, *Aransas*, on 8 January 2008 (KC; 2008-06; TPRF 2534). One at Seagoville, *Kaufman*, from 14–17 June 2008 (**RSt**; 2008-43; TPRF 2585).

Greater Shearwater (*Puffinus gravis*) (14). One off South Padre Island, *Cameron*, on 19 July 2008 (**BMc**, **T&PF**, **BT**, **EC**, **RPi**, **BW**, **DM**; 2008-65; TPRF 2594).

Red-billed Tropicbird (*Phaethon aethereus*) (11). An adult at South Padre Island, *Cameron*, from 7–8 June 2008 (**BMc**; 2008-42).

Brown Booby (*Sula leucogaster*) (30). An immature bird off South Padre Island, *Cameron*, on 8 September 2007 (**BMc**, **EC**, **RPi**, **AG**; 2007-75;

Ruffs were detected three times in the state during 2008. This female was on west Galveston Island, Galveston County, 31 August–1 September. Photograph by David McDonald.

TPRF 2512). An immature bird off Bolivar Peninsula, *Galveston*, on 11 December 2007 (**SL**; 2007-88). An immature bird on the North Packery Jetty, *Nueces*, on 16 July 2008 (**JGa**; 2008-68; TPRF 2595).

Jabiru (*Jabiru mycteria*) (8). One near Raymondville, *Willacy*, from 10–22 August 2008 (RH, DDa, JD, MGu, BP, GM, AHo, JY; 2008-75; TPRF 2600).

Short-tailed Hawk (*Buteo brachyurus*) (34). A light-morph at Utopia, *Uvalde*, and Lost Maples SNA, *Bandera*, from 8–24 April 2008 (**MH**; 2008-57).

Ruff (*Philomachus pugnax*) (31). An immature bird at Anahuac NWR, *Chambers*, on 20 September 2007 (**MRo**; 2007-84; TPRF 2519). A female at Austin, *Travis*, from 12–27 April 2008 (**DW**, GL, TFe, RPi; 2008-26; TPRF 2546). A female near Raymondville, *Willacy*, from 24 August–14 September 2008 (RPi, EC, MGu; 2008-84; TPRF 2607). A female at West Galveston Island, *Galveston*, from 31 August-1 September 2008 (**HH**, MA, DM; 2008-80; TPRF 2604).

Red Phalarope (*Phalaropus fulicarius*) (34). One near Seagoville, *Kaufman*, on 19 October 2008 (**DDC**, **GC**; 2008-87; TPRF 2608). One at Mitchell Lake, San Antonio, *Bexar*, on 19 October 2008 (**MGo**, **GS**, **LPa**, MRe; 2008-91; TPRF 2610).

Black-headed Gull (*Chroicocephalus ridibundus*) (26). One adult at Big Creek Lake and Cooper Lake, *Delta*, from 17–27 December 2007 (**MW**; 2008-10; TPRF 2536).

Little Gull (*Hydrocoloeus minutus*) (56). One adult at Lake Tawakoni, *Hunt*, from 13–29 December 2007 (**MW**; 2008-11). One adult at Lake Ray Roberts, *Dallas*, on 16 December 2007 (**BG**, **PA**; 2007-95; TPRF 2526). One adult at Lake Lavon, *Collin*, on 26 December 2007 (**GB**; 2007-100). One adult at Lake Tawakoni, *Rains*, on 15 January 2008 (**MW**; 2008-12; TPRF 2537). An adult at White Rock Lake, *Dallas*, from 1–8 March 2008 (**RSt**; 2008-14; TPRF 2538).

Mew Gull (*Larus canus*) (33). A first-winter bird at El Paso, *El Paso*, from 19 November–7

The most spectacular find of 2008 was this White-crested Elaenia found on South Padre Island, Cameron County, 9–10 February. Examination of photographs and audio recordings strongly point to the migratory southern population *Elaenia albiceps chilenesis*. Photo by Erik Breden.

December 2007 (**JPa**; 2007-91; TPRF 2523). A first-winter bird at Fort Hancock and McNary Reservoirs, *Hudspeth*, from 15–23 December 2007 (**JPa**; 2007-92; TPRF 2524). A first-winter bird at El Paso, *El Paso*, from 10 February–31 March 2008 (**JPa**; 2008-16; TPRF 2540).

Yellow-legged Gull (*Larus michahellis*) (1). A first-year bird at Corpus Christi, *Nueces*, on 4 March 2004 (**MRe**, **WS**, B&JR; 2004-25; TPRF 2508). This represents the first documented record for Texas. Plumage details of this individual strongly suggest that this bird does not belong to nominate *L. michahellis* but instead is from an Atlantic population closer to *L. m. atlantis*.

Iceland Gull (*Larus glaucoides*) (5). A first-year bird at Houston, *Harris*, from 6–15 March 2008 (**MRe**, RPi; 2008-22; TPRF 2544).

Brown Noddy (*Anous stolidus*) (15). One off South Padre Island, *Cameron*, on 8 September 2007 (**BMc**, **EC**, **RPi**, **AG**; 2007-76; TPRF 2513). One off South Padre Island, *Cameron*, on 11 June 2008 (**AC, CC**; 2008-52; TPRF 2590).

Arctic Tern (*Sterna paradisaea*) (8). One at San Antonio, *Bexar*, on 10 May 2008 (**SCo**, **MRe**; 2008-38; TPRF 2582).

Long-tailed Jaeger (*Stercorarius longicaudus*) (21). One at Braunig Lake, San Antonio, *Bexar*, from 17–19 August 2007 (**MRe**, RPi, RWe; 2007-69; TPRF 2511). One off South Padre Island, *Cameron*, on 6 September 2008 (**BMc**, **RPi**, **EC**, **MGu**; 2008-82; TPRF 2606).

Ruddy Ground-Dove (*Columbina talpacoti*) (16). A male at Anzalduas County Park, *Hidalgo*, on 8 January 2008 (**DDa**; 2008-02).

Northern Pygmy-Owl (*Glaucidium gnoma*) (4). Two at Pine Canyon, Big Bend NP, *Brewster*, from 17 August–7 October 2007 (**DJ**, BP, RD, DE, JBo, T&PF, RPi, RWe, MRe, ML, DN, MMa, JH; 2007-66; TPRF 2510). One along the Pinnacles Trail, Big Bend NP, *Brewster*, on 28 March 2008 (**NP**; 2008-24; TBSL 242). Vocal and plumage details strongly suggest that these birds belong to *G. g. gnoma*.

Northern Saw-whet Owl (*Aegolius acadicus*) (30). One at Hueco Tanks SP, *El Paso*, on 5 May 1987 (**RPa**; 2008-77; TPRF 2602).

Green Violetear (*Colibri thalassinus*) (60). One at Grey Forest, *Bexar*, from 1–8 June 2008 (**LHa**, ChC, CK; 2008-81; TPRF 2605). One at Austin, *Travis*, from 15–21 July 2008 (**JT**; JdV, MK; 2008-69; TPRF 2596). One near Conroe, *Montgomery*,

from 29–30 July 2008 (**DDu**; 2008-71; TPRF 2598).

White-eared Hummingbird (*Hylocharis leucotis*) (30). An adult male at the Davis Mountains Resort, *Jeff Davis*, on 29 September 2007 (**ME**; 2007-78; TPRF 2515). Up to eight at the Davis Mountains Resort, *Jeff Davis*, from 5 May–21 September 2008 (ML, MK; 2008-34; TPRF 2578). Up to two birds at Boot Spring, Big Bend NP, *Brewster*, from 27 July–2 August 2008 (**BG**, EC; 2008-70; TPRF 2597).

Violet-crowned Hummingbird (*Amazilia violiceps*) (13). One at Alpine, *Brewster*, from 15–22 September 2007 (**B&WB**, ML; 2007-77; TPRF 2514). One at Lubbock, *Lubbock*, from 30 November–25 December 2007 (**PS**; 2007-87; TPRF 2520). One near Fort Davis, *Jeff Davis*, on 22 December 2007 (**LHe**; 2007-98; TPRF 2529). One at Fort Davis, *Jeff Davis*, from 22 December 2007–2 January 2008 (**CE**, ML; *LSUMNS; 2008-01; TPRF 2532).

Costa's Hummingbird (*Calypte costae*) (21). An immature male at Terlingua, *Brewster*, on 26 October 2008 (**MF**; 2008-90).

White-crested Elaenia (*Elaenia albiceps*) (1). One at South Padre Island, *Cameron*, from 9–10 February 2008 (**DJ**, BMc, DBo, EBr, GM, AHo, JKe, MRe, SB, JBo, LBr; 2008-09; TPRF 2535). This represents the first documented record for Texas, the United States, and all of North America and refers to *Elaenia albiceps chilensis*.

Greater Pewee (*Contopus pertinax*) (21). One heard in the Davis Mountains Preserve, *Jeff Davis*, on 13 June 2007 (**JaP**; 200-78).

Buff-breasted Flycatcher (*Empidonax fulvifrons*) (20). Two at Madera Canyon, Davis Mountains Preserve, *Jeff Davis*, from 16 April–19 July 2008 (**ML**; 2008-27; TPRF 2576). One at Road and Wolf Den Canyons, Davis Mountains Preserve, *Jeff Davis*, from 16 April–19 July 2008 (**ML**; 2008-28; TPRF 2577). One at Elbow Canyon, Davis Mountains Preserve, *Jeff Davis*, from 14–21 June 2008 (**ML**; 2008-44; TPRF 2586). One in upper Madera Canyon, Davis Mountains Preserve, *Jeff Davis*, from 21 June–19 July 2008 (**ML**; 2008-50; TPRF 2589).

Dusky-capped Flycatcher (*Myiarchus tuberculifer*) (40). One at Sabal Palm Sanctuary, *Cameron*, from 22 December 2007–27 February 2008 (**DBe**, LBa; 2007-97; TPRF 2528). Up to eight at No-Name Canyon, Davis Mountains Preserve, *Jeff Davis*, from 10 May–12 July 2008 (**ML**; 2008-36; TPRF 2580). Up to eight at Limpia Canyon, Davis Mountains Preserve, *Jeff Davis*, from 10 May–12 July 2008 (**ML**; 2008-37; TPRF 2581). Two near Pinnacles Pass, Chisos Mountains, Big Bend NP, *Brewster*, from 15 June–6 July 2008 (**DJ**, MBo, ML; 2008-53; TPRF 2591). Two at Boot Spring, Big Bend NP, *Brewster*, on 28 June 2008 (**ML**; 2008-54; TPRF 2592). Two at Tobe Spring, Davis Mountains Preserve, *Jeff Davis*, from 4–19 July 2008 (ML; 2008-63; TPRF 2593). Two subspecies are involved in these records with Lower Rio Grande Valley records pertaining to *M. t. lawrencei* while Trans-Pecos records refer to *M. t. olivascens*.

Sulphur-bellied Flycatcher (*Myiodynastes luteiventris*) (18). One at McAllen, *Hidalgo*, from 9 June–5 July 2008 (DJ, ReS, DE, RPi, MGu, DDa, SCo, MBS, BR, BW, JiK, JY, TP; 2008-49; TPRF 2588).

Piratic Flycatcher (*Legatus leucophaius*) (5). One found dead in Pasadena, *Harris*, on 28 September 2007 (**MCh**, CF; 2007-99; TPRF 2530; *LSUMNS). One at Corpus Christi, *Nueces*, from 3–6 May 2008 (DR, RB, DE, MRe; 2008-32; TPRF 2549).

Gray Kingbird (*Tyrannus dominicensis*) (10). One at Corpus Christi, *Nueces*, from 6-21 November 2007 (**CT**, RPi, LBo; 2007-83; TPRF 2518). One at Port O'Connor, *Calhoun*, from 13–16 May 2008 (**BFr**; 2008-41; TPRF 2584).

Fork-tailed Flycatcher (*Tyrannus savana*) (20). One at Sabine Pass, *Jefferson*, from 15–18 March 2008 (**JaW**, **JoW**, GLa, MLi, LBa; 2008-21; TPRF 2543). One at Brownsville, *Cameron*, from 16–29 March 2008 (**CB**, **EJ**, **LPh**, PG, BMc, LBr, MP, TP, DN, MMa; 2008-18; TPRF 2541). One at Balmorhea, *Reeves*, from 28–30 August 2008 (**MGr**, MRe, KB; 2008-79; TPRF 2603).

Brown Jay (*Cyanocorax morio*). Up to three present at Salineno and Chapeno, *Starr*, from 1 January-late May, 3 August, 10 October, and 17 November 2007 (CM, PD, LBr, LM, StC; 2007-63; TPRF 2509). Four at the La Puerta unit of the Lower Rio Grande Valley NWR, *Starr*, from 9–11 June 2008 (**DT**; 2008-48). Details of sightings of Brown Jay after 21 July 2007 are requested by the TBRC. Brown Jay was added to the list of Review Species on this date because of the precipitous decline in this species in the United States.

Clark's Nutcracker (*Nucifraga columbiana*) (23). One near Panhandle, *Carson*, from 22 February–7 April 2008 (BP, RO; 2008-15; TPRF 2539). One near Canyon, *Randall*, on 18 October 2008 (**BP**; 2008-88; TPRF 2609).

Tamaulipas Crow (*Corvus imparatus*). One at the Brownsville landfill, *Cameron*, on 31 March 2008 (**RWa**; 2008-23; TPRF 2575). The TBRC has requested details of sightings of Tamaulipas Crow since 18 November 2000 because of the precipitous decline in this species in the United States.

White-throated Thrush (*Turdus assimilis*) (12). One at Pharr, *Hidalgo*, from 18 March–12 April 2008 (LBa, DDa, JD, LBr, DH, MMa; 2008-19; TPRF 2542).

Bohemian Waxwing (*Bombycilla garrulus*) (17). One at Gruver, *Hansford*, on 13–17 December 2007 (**BG**; 2007-94; TPRF 2525).

Olive Warbler (*Peucedramus taeniatus*) (8). A female at Guadalupe Mountains NP, *Culberson*, on 9 August 2008 (**BG**; 2008-72; TPRF 2599).

Gray-crowned Yellowthroat (*Geothlypis poliocephala*) (44). An adult at Brownsville, *Cameron*, on 1 July 2008 (**CR**; 2008-76; TPRF 2601).

Golden-crowned Warbler (*Basileuterus culicivorus*) (19). One at Progreso Lake, *Hidalgo*, from 29 December 2007–5 January 2008 (**MGu**; 2008-03; TPRF 2533).

Flame-colored Tanager (*Piranga bidentata*) (7). One (or possibly two) at Boot Spring, Big Bend NP, *Brewster*, from 12–28 June 2008 (**MBo**, MA, ML; 2008-47; TPRF 2587).

Baird's Sparrow (*Ammodramus bairdii*) (61). One near Vanderpool, *Bandera*, on 21 April 2008 (**GL**; 2008-30; TPRF 2548). One at Rio Grande Village, Big Bend NP, *Brewster*, on 27 April 2008 (**GR**; 2008-64). One at Rio Grande Village, Big Bend NP, *Brewster*, on 29 April 2008 (**MF**, **JBi**; 2008-29; TPRF 2547). One at Rio Grande Village, Big Bend NP, *Brewster*, on 13 May 2008 (**JGr**; 2008-39; TPRF 2583). Baird's Sparrow was removed from the list of Review Species at the TBRC meeting n September 2008.

Golden-crowned Sparrow (*Zonotrichia atricapilla*) (33). An adult near Robert Lee, *Coke*, from 15 December 2007–15 April 2008 (TeF, RO, DDC, MRe, DBo; 2007-89; TPRF 2521). An adult at El Paso, *El Paso*, on 3 May 2008 (**JPa**; 2008-33).

Dark-eyed (White-winged) Junco (*Junco hyemalis aikeni*) (7). One at Davis Mountains SP, *Jeff Davis*, from 24 December 2007–8 March 2008 (**MRe**, BS, SD; 2007-103; TPRF 2531).

Lawrence's Goldfinch (*Carduelis lawrencei*) (19). Six in n. *Jeff Davis* on 13 December 2007 (**TJ**; 2007-93). One at Davis Mountains SP, *Jeff Davis*, on 12 March 2008 (**JM**; 2008-25; TPRF 2545). One at El Paso, *El Paso*, on 15 March 2008 (**JPa**; 2008-17). One at El Paso, *El Paso*, on 23 March 2008 (**JPa**; 2008-20). One at El Paso, *El Paso*, on 27 March 2008 (**BZ**; 2008-35; TPRF 2579).

NOT ACCEPTED

A number of factors may contribute to a record being denied acceptance. It is quite uncommon for a record to not be accepted because the bird was obviously misidentified. More commonly, a record is not accepted because the material submitted was incomplete, insufficient, superficial, or just too vague to properly document the reported occurrence while eliminating *all* other similar species. Also, written documentation or descriptions prepared *entirely from memory* weeks, months, or years after a sighting are seldom voted on favorably. It is important that the simple act of not accepting a particular record should by no means indicate that the TBRC or any of its members feel the record did not occur as reported. The non-acceptance of any record simply reflects the opinion of the TBRC that the documentation, as submitted, did not meet the rigorous standards appropriate for adding data to the formal historical record. The TBRC makes every effort to be as fair and objective as possible regarding each record. If the committee is unsure about any particular record, it prefers to err on the conservative side and not accept a good record rather than validate a bad one. All records, whether accepted or not, remain on file and can be re-submitted to the committee if additional substantive material is presented.

Trumpeter Swan (*Cygnus buccinator*). Near Bonham, *Fannin*, on 11 December 2007 (2007-102).

Masked Duck (*Nomonyx dominicus*). Santa Ana NWR, *Hidalgo*, on 7 October 2007 (2007-79).

Arctic Loon (*Gavia arctica*). Lake Tawakoni, *Van Zandt*, from 14 January–18 February 2008 (2008-05).

Sooty Shearwater (*Puffinus griseus*). Off Port Aransas, *Nueces*, on 20 July 2008 (2008-67).

Leach's Storm-Petrel (*Oceanodroma leucorhoa*). Off Port Aransas, *Aransas* on 22 June 2008 (2008-55).

Brown Booby (*Sula leucogaster*). Off Port Aransas, *Nueces*, on 13–14 July 2008 (2008-67).

Northern Goshawk (*Accipiter gentilis*). Friendswood, *Harris*, on 19 November 2007 (2007-85).

Short-tailed Hawk (*Buteo brachyurus*). Lost Maples SNA, *Bandera*, on 7 May 2008 (2008-58).

Ruff (*Philomachus pugnax*). Near Gilchrist, *Galveston*, on 16 April 2007 (2007-27).

Black-headed Gull (*Chroicocephalus ridibundus*). Hagerman NWR, *Grayson*, on 23 December 2007 (2007-101).

Roseate Tern (*Sterna dougallii*). Off Port Aransas, *Aransas* on 22 June 2008 (2008-56).

Green Violetear (*Colibri thalassinus*). Quinta Mazatlan, *Hidalgo*, on 21 February 2008 (2008-13). Fredericksburg, *Gillespie*, from 25 May–15 June 2008 (2008-46).

Azure-crowned Hummingbird (*Amazilia cyanocephala*). Harlingen, *Cameron*, on 12 May 2007 (2008-45).

Arizona Woodpecker (*Picoides arizonae*). Near Dripping Springs, *Hays*, on 16 July 2008 (2008-61).

Variegated Flycatcher (*Empidonomus varius*). Houston, *Harris*, on 29 May 2006 (2007-53).

Gray-breasted Martin (*Progne chalybea*). Utopia, *Uvalde*, on 15 October 2007 (2008-07).

Clark's Nutcracker (*Nucifraga columbiana*). Guadalupe Mountains N.P., *Culberson*, on 2 September 2007 (2007-72).

Black-capped Chickadee (*Poecile atricapillus*). Near Dripping Springs, *Hays* on 16 July 2008 (2008-59).

Mexican Chickadee (*Poecile sclateri*). Near Kerrville, *Kerr*, on 26 April 2008 (TBRC 2008-31).

Slate-throated Redstart (*Myioborus miniatus*). Near Dripping Springs, *Hays*, on 16 July 2008 (2008-60).

Blue Bunting (*Cyanocompsa parellina*). Sabal Palm Sanctuary, *Cameron*, on 9 February 2008 (2008-08).

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LONG-DISTANCE DISPERSAL RECORDS FOR THE BLACK-CAPPED VIREO

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ABSTRACT.—Information on dispersal of the endangered Black-capped Vireo (*Vireo atricapilla*) is limited due to the inherent difficulty of relocating marked individuals in subsequent breeding seasons. We report on three relatively long-distance dispersals for this species. All three birds (two males and one female) were banded as nestlings on Fort Hood Military Reservation in Coryell County, Texas, and recaptured on Balcones Canyonlands National Wildlife Refuge in Williamson and Burnet Counties where they appeared to be attempting to breed. Upon recapture, these birds were 75.2, 78.1, and 49.6 km, respectively, from their natal sites. To our knowledge, these are the longest known dispersal movements for this species, and they suggest movements of this magnitude may not be unusual. Our observations also suggest that source populations separated by as much as 78 km are likely not genetically isolated.

Information on a species' dispersal behavior is requisite to modeling and ultimately predicting the ability of a species to colonize new habitat patches. In addition, direct measurements of dispersal complement molecular studies of gene flow across a species' range. Grzybowski (1995) noted the lack of dispersal information for the endangered Black-capped Vireo (*Vireo atricapilla*) and the acquisition

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Figure 1. Male Black-capped Vireo at Balcones Canyonlands National Wildlife Refuge, 20 April 2007. This bird was banded as a nestling on Fort Hood Military Reservation, 6 May 2005. Photo by Greg Lasley.

of such data has been cited as a research priority for the species (Grzybowski 1991). However, dispersal events are difficult to document because marked individuals can disperse across large areas making them difficult to relocate (Koenig et al. 1996). This is especially true of natal dispersal (i.e., movements from hatch site to first attempted breeding site). Consequently, collection of such data often requires effort beyond the capabilities of most research programs. From 1987 to 2007, biologists at Foot Hood Military Reservation (Fort Hood) in Bell and Coryell Counties, Texas, banded 4,247 nestling Black-capped Vireos. Subsequently, 179 of these were observed as adults, yielding information on natal dispersal of the species. We report three noteworthy records that represent the longest natal dispersal movements observed to date. All three cases involved birds banded as nestlings on Fort Hood and recaptured as adults on Balcones Canyonlands National Wildlife Refuge (the Refuge).

STUDY SITE/METHODS

Biologists at Fort Hood marked nestling Black-capped Vireos with a single band on each leg: a numbered United States Geological Survey (USGS) aluminum band on the right leg and a colored plastic band on the left leg. Within a given year, all nestlings were marked with a plastic band of the same color, but a different color was used each year. In contrast, adult vireos were marked with a USGS band and a unique combination of several plastic color bands. Thus, it was possible to recognize that any individual wearing only a single color band had been banded as a nestling and its age could be determined by the band's color. However, to determine the exact identity of such birds, it was necessary to capture them and read band numbers.

RESULTS

On 11 April 2007, PKM observed an adult male Black-capped Vireo with a pink band on its left leg and a USGS band on the right on the Gainer tract of the Refuge in southwestern Williamson County, Texas. PKM and CWS saw the bird again two days later in the same area. On 20 April 2007, GL photographed a similarly banded vireo on the Refuge (Fig. 1), 0.6 km from the earlier location, also in southwestern Williamson County. On the latter date, it was unclear whether these observations represented the same or separate individuals. The situation was clarified when DAC and CWS captured the two separate male vireos on 24 April 2007, each in the area where originally encountered (Fig. 2).

The first male vireo was banded as a nestling on 3 May 2005 on the west side of Fort Hood in Coryell County (Fig. 2). We used banding and recapture

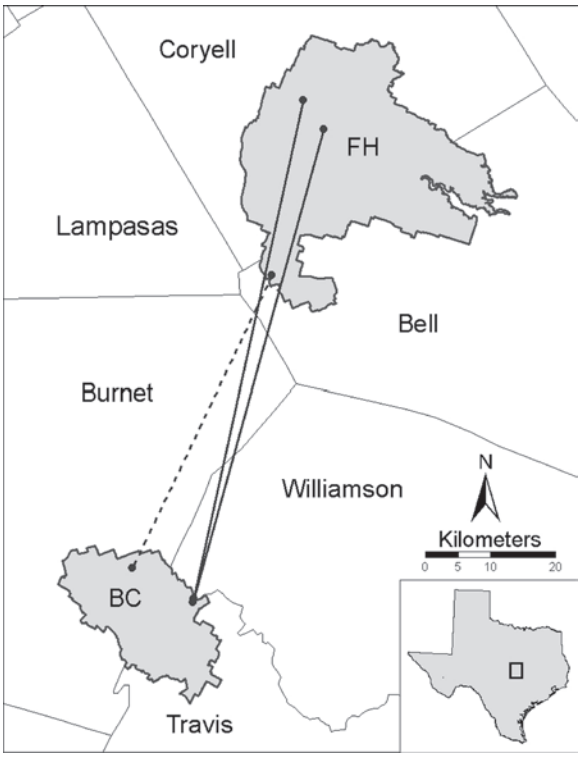

Figure 2. Natal and apparent breeding sites of Black-capped Vireos banded as nestlings at Fort Hood Military Reservation (FH) and recaptured as adults at Balcones Canyonlands National Wildlife Refuge (BC). Lines connect the natal and recapture sites of two males (solid lines) and one female (dashed line).

coordinates along with ArcMap version 9.2 (ESRI Inc. Redlands, California) to determine that the recapture site was 75.2 km from its natal site. The second male was banded as a nestling on 6 May 2005 on the west side of Fort Hood 5.5 km northwest of the natal site of the first male (Fig. 2). When recaptured, the second male was 78.1 km from its natal site.

On 6 June 2008, WSS captured a banded female Black-capped Vireo on the Simons tract of the Refuge in eastern Burnet County, Texas. This bird was originally banded as a nestling in the southwestern corner of Fort Hood on 28 May 2006 (Fig. 2) and was recaptured 49.6 km from its natal site.

The three Black-capped Vireos recaptured on the Refuge appeared to be breeding residents rather than transient migrants. The two males in 2007 were present on the Refuge for >1 week and exhibited territorial behavior (i.e., each remained within a restricted area, sang frequently, and reacted strongly to the broadcast of conspecific song). Additionally, each was seen in company of a female vireo, although no nesting activity was confirmed. Although the first-encountered male was not resighted after its recapture on 24 April, the second banded male was observed with a female on 1 June 2007 (the date of the last field visit to the site for that season). The June 2008 recapture date of the banded female was after the species' spring migration in March and April yet before its fall migration from August to early October (Grzybowski 1995).

DISCUSSION

These three observations are the longest reported dispersals of Black-capped Vireos from their natal sites. We have observed other movements within Fort Hood as far as 30 km for individuals banded as nestlings (DAC, unpubl. data). Grzybowski (1995) observed a natal dispersal of 21 km for this species in Kerr County, Texas. Hopp et al. (1995) noted a movement of 20 km for the closely related White-eyed Vireo (*Vireo griseus*) from its natal site in Massachusetts.

Most of the observed dispersal distances for the three Black-capped Vireos recaptured on the Refuge

likely resulted from natal dispersal versus movement between subsequent breeding seasons. All three birds were in their third calendar year of life (i.e., their second possible breeding season) when recaptured on the Refuge. We have no information regarding locations of the three birds during their first possible breeding season. For this reason, it is possible that the distances from their natal sites to where we recaptured them may differ from their initial natal dispersal distances. However, natal dispersal in birds typically involves longer movements than later movements between breeding sites (Greenwood and Harvey 1982, Drilling and Thosmpson 1988, Paradis et al. 1998). Furthermore, we found that the median distance of Black-capped Vireos recaptured on Fort Hood in their second breeding season ($n = 40$) was only 0.7 km farther from natal sites than for birds recaptured in their first ($n = 74$). This suggests that the three birds may have spent their first possible breeding season on or near the Refuge.

Analysis of natal dispersal is complicated by the distribution of potential breeding habitat which will rarely be homogenous within the dispersal capabilities of a species and in the case of the Black-capped Vireo is particularly patchy (Grzybowski 1995, CWS unpubl. data). For example, between Fort Hood and the Refuge, only a few small patches of suitable vireo habitat are known and no well-established breeding populations have been detected (CWS, unpubl. data). The Refuge probably harbors the nearest substantial patches of suitable vireo habitat to the south of Fort Hood.

Assuming that the maximum natal dispersal distance for the Black-capped Vireo equals the longest of the three we observed (78.1 km), then dispersing young from Fort Hood, or any other source population, have the potential to colonize suitable habitat across relatively large areas. Regular natal dispersals over such an area could also allow substantial genetic interaction among populations breeding in different parts of the species' range. However, available evidence indicates that gene flow among populations of this species is restricted and lower than that reported for other migratory songbirds (Fazio et al. 2004, Barr et al. 2008). Furthermore, Barr et al. (2008) reported genetic differentiation between the populations on the Refuge and Fort Hood. These genetic results appear to conflict with our observation of three dispersals between these sites in just two years. Because we banded only a small percentage of the fledglings produced on both sites (<5% produced on Fort Hood only) and our ability to find them after they reached adulthood was limited, the actual number of dispersers that moved between the two areas could have been much greater than the total we observed. However, G. Athrey and K. Barr (pers. comm.) estimate that even if as many as 20 dispersers per generation moved between these two populations, this would not be sufficient to decrease the degree of genetic differentiation between them. Our observations of vireo dispersals between Fort Hood and the Refuge suggest that such movements may occur regularly and that these two populations may currently interact to a greater degree than previously indicated by genetic studies.

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GEORGE E. MAXON – "A CAPABLE FIELD-MAN, A TRUE BIRD LOVER"

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ABSTRACT.—George Emmett Maxon (1894–1957) began collecting birds' eggs at Fort Worth, Texas, during his teenage years. During 1916-1917, while serving in the National Guard, he collected eggs and made observations in the Big Bend Region of Texas. Maxon worked as a Deputy United States Game Warden and a florist in Fort Worth before moving to Vernon, Texas, where he opened a plant nursery and began to collect with Robert Lee More. Maxon's eggs were eventually incorporated into More's much larger collection, which is still housed in Vernon. All of Maxon's observations and reports were published in *The Oologist*, a trade journal for collectors.

Few people today recognize the name George Emmett Maxon (1894–1957) or know of his work in north-central Texas. He was not a member of any ornithological society, and his short, anecdotal articles were published in *The Oologist*, a trade journal for egg collectors. Although not widely known, Maxon was highly regarded by contemporary collectors and ornithologists such as Ramon Graham, Robert Lee More, John Kern Strecker, and Herbert Brandt. Maxon's life experiences include service as a national guardsman in the Big Bend during the bandit raids of 1916, a soldier in Germany during World War I, a Deputy United States Game Warden, a florist in Fort Worth, and the owner of a plant nursery in Vernon. This paper reviews the life of George Maxon with an emphasis on his ornithological activities.

EARLY LIFE AND EDUCATION

George Emmett was the third son of Thomas and Phronie Maxon. Thomas (b. 1860) worked for the railroad and moved often as the railroad system expanded westward. The eldest Maxon son, Edmond, was born in Kentucky and the second son, Richard, in Arkansas. By the early 1890s the family was living in Houston, Texas, where George was born on 9 July 1894. Sometime around 1903 the Maxons moved to Fort Worth where Thomas worked as a conductor for the Chicago, Rock Island and Gulf Railroad. Although the family permanently settled in Fort Worth, George saw little of his father, who was often away from home (Maxon 2001). Given these long absences, it is probable that he was strongly influenced by his mother and his two elder brothers. George was presumably educated in the public schools of Houston and Fort Worth. Maxon became interested in hunting as a child and perhaps began to collect and exchange eggs as early as 1910 or 1911. The events that stimulated his life-long interest in nature, particularly birds and plants, are unknown.

COLLECTING IN TARRANT COUNTY

There were few practitioners of oology in Fort Worth during the early 1900s. George Miksch Sutton, later famous as an ornithologist and artist, lived in Fort Worth from July 1911 until June 1914 (Sutton 1938), but there is no evidence that he knew Maxon. It is likely that Ramon Graham (1893–1969) was Maxon's earliest companion in egg collecting. Graham, a taxidermist, probably began collecting eggs around 1910, and the first of his many notes on the birds of Tarrant County was published in *The Oologist* during 1912. George and Ramon were approximately the same age and perhaps had known each other since childhood. Both men were enthusiastic collectors and often shared their adventures in short communications to *The Oologist.*

Maxon and Graham were particularly active during the spring of 1915. On 10 March they searched unsuccessfully for nests on the Trinity River west of the city. The following day yielded

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five sets of American Crow eggs. On 18 March, at another location 20 miles north of the city, they were again unsuccessful. However, on the following day eggs of Krider's Red-tailed Hawk, Black Vulture, Barred Owl, Great Horned Owl, and American Crow were taken (Graham and Maxon 1915).

An attempt to acquire the prized eggs of the Belted Kingfisher was not successful. After five years of searching, three occupied nest holes were found during the spring of 1915. A "drag hook" was unsuccessful in extracting the eggs from the first hole, which was 10 feet up the bank. They next tried digging down from the top of the bank but after a half-day of labor without striking the nest tunnel, they gave up in exhaustion. The second hole was too high up the bank to reach, and from the third hole the drag hook extracted only the broken shells of the already hatched eggs. After describing their "awful poor luck", Graham humbly requested advice on collecting techniques from readers of *The Oologist*, who might have had more experience in taking eggs of the Belted Kingfisher (Graham 1915).

Maxon and Graham had often taken eggs of Krider's Red-tailed Hawk. However, on one occasion a parent bird outsmarted them. A nest was found with green leaves in its bed suggesting that it either contained eggs or that it would soon be put to use. As Maxon climbed to the nest, a female Krider's flew over as if he were invading her territory. The nest was empty, but assuming that it would soon contain eggs, the boys returned at a later date. Although the nest was still empty, the female again made an appearance. Believing that the nest would eventually be used, they again returned several days later to find the female still at the nest even though it was empty. Suspecting that something was awry, a search was made of the surrounding area, and a nest with young was found nearly a half-mile away. Surprised at this finding, the two men concluded that the hawk had twice "tricked them" into believing that the empty nest was the one into which she was going to lay her eggs (Graham 1915).

Nests of the Common Nighthawk were difficult to locate, but Maxon believed that he had discovered how to find them. His observations had revealed that the Common Nighthawk liked "freshly turned earth" on which to deposit their eggs and that the best place to look for their nests was a new addition or town site where the roads had been recently graded. By walking these roads and keeping a close watch for birds flushing from the nest, Maxon collected enough clutches to satisfy all of the requests he received for eggs (Maxon 1915a).

Maxon was an avid collector of vulture eggs. In the spring of 1915, he noted that there were twice as many Black and Turkey Vultures around Fort Worth than in previous years. The vultures appeared to be mating, but five or six trips to their nesting grounds produced only about one set per trip. In contrast, the same nesting grounds in previous years had yielded 10 to 12 sets per trip. Puzzled by the paradox of more vultures yet fewer eggs, Maxon posed the question of whether vultures might take a year off and not lay (Maxon 1915b).

BANDITS AND BIRDS IN THE BIG BEND

Maxon was attracted to military service at an early age. On 17 July 1911, while only 17 years old and still a student, he enlisted in the Texas National Guard. After graduation from school, he worked as a clerk before re-enlisting in April 1913 for a second tour of duty. On 9 May 1916, Maxon again re-enlisted in the Guard with the rank of Sergeant. He was working at this time as a florist, an occupation to which he would later return following his service in World War I and a brief period of employment as a Deputy United States Game Warden.

On 10 May 1916, the day following Maxon's re-enlistment, the Texas Guard was ordered to the border between Texas and Mexico to suppress the bandits that were crossing the Rio Grande and attacking isolated American settlements. Maxon and the soldiers of Company A, 4th Texas Infantry, were immediately summoned to San Antonio. After being briefed and equipped for their mission, they went by motor convoy to Hot Wells, a small village of a few dozen people in Hudspeth County. Maxon described this desolate location as a country of "cactus, sage, and sand, and no trees . . ." Many of the birds seen at Hot Wells were new, and Maxon was uncertain of their identification. The most common species were Chihuahuan Raven, Scaled Quail, Common Nighthawk, Curve-billed Thrasher, "Oven Bird", Greater Roadrunner, Hooded Oriole, and Brown-headed Cowbird. The Cactus Wren, or "Oven Bird" as Maxon inexplicably called it, was the most abundant bird with as many as three to eight of its nests occasionally being found in a single yucca.

Maxon first thought the Chihuahuan Ravens were crows, and he made no effort to search for their nests. After discovering his mistake, he collected several sets of their eggs, which because of a shortage of cotton were packed in oatmeal to

prevent breakage (Maxon 1916d). Two shipments of raven eggs that had not been "blown" were made to Henry Ward Carriger, an ornithologist in Oakland, California. Another set of these fertile eggs hatched in Maxon's trunk before he could obtain packing material for shipment (Maxon 1916a). With forethought, Maxon had arranged to have *The Oologist* forwarded to west Texas, yet had somehow forgotten to bring the drills and blow pipes necessary to prepare the eggs that he might collect.

On 28 June Sergeant Maxon and his company were sent to Boquillas on the banks of the Rio Grande. Different birds were found at this location – cliff swallows, owls, and hawks were common, and two pairs of Golden Eagles were seen at their nests on the Mexican side of the river. Maxon considered crossing the river to collect their eggs but was deterred by the obvious danger should he be captured in Mexico. Eggs of the Vermilion Flycatcher and Northern Cardinal were taken in a grove of cottonwoods at Boquillas. Numerous nests of Verdin were present but none contained eggs. Common Nighthawks were abundant, but no nests were found.

Company A was transferred from Boquillas to Terlingua on 17 July. Many birds were seen along the road between the two villages that Maxon was unable to identify. The company was soon moved to Lajitas where Maxon noted that there were more Verdins and Common Ground Doves than in previous locations.

A significant find was made at Lajitas during a "hike" into the countryside. An exceptionally large sotol attracted Maxon's attention, and he had the men gather around the plant so he could take their photograph. The First Sergeant stood beside the sotol while Maxon focused his camera. Suddenly, he shouted "Come here, Mack, darned if it ain't some shapperels (*sic*)." The sergeant then reached into the center of the plant and withdrew four eggs of a Greater Roadrunner. The prized eggs were carefully carried back to camp where they were drilled with a shingle nail and blown using a syringe. Maxon then placed his treasures in a cigar can packed with oatmeal, and mailed them to his home in Fort Worth (Maxon 1917). These eggs, taken on 10 October 1916 represent the latest known nesting date for the Greater Roadrunner (Oberholser 1974: 437).

Maxon's activities in the months from October 1916 until his discharge from the National Guard at Camp Funston in San Antonio on 14 August 1917 are unknown. There is no evidence that he was involved in any hostile action in the Big Bend, although he did accompany a patrol to Glenn Spring where three soldiers and a young boy had been killed earlier in the year (Maxon 1916b).

Figure 1. George Maxon in his World War I uniform. Photograph courtesy of George Maxon, Jr.

Maxon enlisted in the 90th Infantry Division with the rank of lieutenant following his discharge from the National Guard (Fig. 1). He was later assigned to the 344th Machine Gun Battalion and given aviation training at Camp Travis in San Antonio. Maxon was fascinated with flying and declared to readers of *The Oologist* that he could do anything with his plane that birds could do except "stand still in the air." His expressed hope was that he would someday fly to Berlin and collect a set of eggs from the Kaiser's lawn (Maxon 1918).

The 90th Division was deployed to France during June 1918 where it participated in several major battles near the end of the war. Although the Division remained in France for several months, there is no evidence that Maxon collected the eggs of any European birds. During June 1919, the 90th Division returned to the United States and was deactivated.

RETURN TO CIVILIAN LIFE

Maxon was discharged from the army sometime after June 1919. In November of that year he

accompanied Ramon Graham from Austin to Fort Worth while noting the birds seen along the way (Graham 1919). By December, Maxon was employed as a Deputy United States Game Warden stationed at Lake Worth on the West Fork of the Trinity River. He was an efficient officer and was soon recognized for his assistance in the seizure of $500.00 worth of aigrettes, as well as his strict enforcement of the duck law (Editor 1920, Graham 1920a). On 28 December 1920, near his camp on the lake, Maxon observed the unusual occurrence of five Long-eared Owls (Maxon 1920a).

Maxon and Graham soon resumed their previous habit of collecting. During the spring of 1920, they drove to Jefferson Crossing 40 miles upriver from Lake Worth where they collected several sets of the eggs of Black and Turkey Vultures (Graham 1920a). On another outing they noticed several Black Vultures fly from the ground. Upon arriving at the location from which the vultures had flown, a half-dead Turkey Vulture was found which had presumably been injured in a fight with the Black Vultures (Graham 1920b).

Maxon was instrumental in solving an unusual case during January 1921. An article and photograph showing two prominent San Angelo ranchers holding a large white bird they had killed was published in one of the Fort Worth newspapers. Suspecting that the bird was a protected species, Maxon sent the article to the federal warden, George Shupee, stationed in San Antonio. Shupee identified the bird as a "Siberian Swan" and initiated an investigation resulting in the ranchers being found guilty and fined for their violation of the game law (Maxon 1921a, 1921b). This "Siberian Swan" was undoubtedly a Tundra Swan.

Maxon continued to collect eggs while employed as a warden, and he gleefully reported taking a set of pure white Turkey Vulture eggs, the first he had ever seen, at a location 18 miles north of Fort Worth (Maxon 1921c). He also reported having seen only seven Cedar Waxwings during the winter of 1920–1921 as compared with previous winters when they had migrated through the area by the thousands (Maxon 1921d).

Things began to change for George Maxon in 1921. His marriage to Florence Ten Eyck on 17 January of that year brought about a redirection of his interests and a change in occupation. By 1922 he was the owner of "The Flower Shop," a business operated out of the family home on South Adams Street. A daughter, Emily, was born in that same year and a son, George Jr., the following year. The responsibilities of family and business, as well as his experiences as a game warden apparently changed his outlook on the practice of oology. This new perspective was poetically expressed as a nocturnal encounter in which Maxon's eggs suddenly come alive and began to tell their side of the story while extracting revenge upon their persecutor.

AN EGG-HOARDER'S NIGHTMARE

In 1922 *The Oologist* published a series of poems submitted by its readers. One of these poems "An Egg-Hoarder's Nightmare" was written by George Maxon. In this "nightmare," Maxon's eggs suddenly came alive and began to chastise him for his excessive collecting.

My cabinet starts a moving,
with trays all open wide,
And my eggs begin to speaking,
while my face I try to hide.
Says one egg of the Blue Bird,
as if speaking for the rest,
"What do you want with all of us –
why take us from our nest?"
The Robins then came dancing thru
and shoved the Blue Bird Egg aside,
A hundred eggs you have of me,
A hundred birdies have died."

The hawk eggs then arose and accused him of taking a dozen sets from their mother. Shamed by this accusation, Maxon turned to stare down the hall only to see his eggs "All dancing in a circle, from the large down to the small . . . ."

"*Little Hummer," says the Eagle,*
as they danced around my bed,
That dirty brute has hoarded us,
let's go climb on his head."
"You worry him about the ears and
pull his eye-brows out,
But leave that ruffian's face to me,
you know my claws are stout."
The Hummer started buzzing,
with only a Hummer's grace,
And the Eagle sank his talons deep in
my shameful face.
Oh God, how my face was aching,
as I recalled the Eagle's nest,
And me gloating o'er the prospects of
hoarding them with the rest.

The little Hummer unconcerned,
still pulled my eye-brows out,
By now I plainly saw her nest,
which the summer winds switched about.
The Eagle was still clawing me,
as I prayed God leave me rest,
And alas, I was awaken,
with the house-cat on my breast.

As a postscript, Maxon appended a final stanza to make clear to his fellow collectors the meaning of his poem.

Now friends and ornithologists may
my dream to you be clear.
Don't try and hoard them all at once,
there'll be another year.

What was the motive and intent of this composition? Was Maxon ashamed of the excessive collecting of his earlier years? Was the poem an expression of regret or an admonition to his fellow oologists that they should limit the number of eggs collected each year? Whichever might have been the case, the poem provides some insight into Maxon's thoughts on the indiscriminate collecting of eggs.

THE MOVE FROM FORT WORTH TO VERNON

Nothing is known of Maxon's activities between 1922 and 1926. The responsibilities of a wife, small children, and a business undoubtedly limited the amount of time that he could spend in the field. Domesticity had seemingly dampened his fervor for collecting, and this condition would perhaps have become permanent had not an influential and persuasive guest visited his flower shop.

Sometime in 1926, Robert Lee "Bob" More, general manager of the Waggoner Estate in Wilbarger County, made a business trip to Fort Worth. While passing Maxon's flower shop, he noticed a display of eggs in the window. Bob More was a well-known oologist from Vernon, Texas, who after taking his first egg in 1888 had amassed a huge collection. More entered the store and introduced himself to Maxon, and thus began a life-long friendship based on a mutual interest in birds' eggs (Dobie 1941, Maxon 2001).

Bob More was an astute businessman and a booster for the economic development of Vernon, the county seat of Wilbarger County. Either at their initial meeting or shortly thereafter, More proposed that Maxon move to Vernon and establish a plant nursery. More would furnish the capital and the land upon which the nursery would be built, and Maxon would be the co-owner and manager of the business. This proposal was found acceptable, and Maxon closed his flower shop and moved to Vernon sometime in 1927 (Dobie 1941, Maxon 2001).

The arrangement between More and Maxon was mutually beneficial. The nursery was a success, and More acquired a friend and fellow enthusiast with whom to share his adventures in the field. The two men made many collecting trips together, and George assisted in blowing, shipping and curation of the eggs. Maxon continued to collect for himself, but all of his eggs were eventually incorporated into More's much larger collection. While Bob More corresponded with and was consulted by the leading ornithologists of the period, George Maxon remained in the shadow of his better-known friend (Dobie 1941, Maxon 2001). Maxon's only recognition in a major ornithological paper came in 1929 with publication of "The Summer Birds of Wilbarger County" by R. L. More and J. K. Strecker. In this paper the authors acknowledged the assistance of George E. Maxon "an active field naturalist [who] has an extensive knowledge of the bird life of middle northern Texas."

AN IMPORTANT VISITOR ARRIVES IN VERNON

In early May 1937, Herbert Brandt, a businessman and amateur ornithologist left his home in Cleveland, Ohio, for a month-long birding tour of Texas. Accompanying Brandt was his banker friend, Frank Phelps, and Frank Tobin, the bird preparator from the Bird Research Foundation in Cleveland. The group drove first to the Big Bend where they visited, among other sites, Marathon, Glenn Spring, and the Chisos Basin. After several days in the Big Bend the three men left for a scheduled visit with Bob More.

They arrived in Vernon on the evening of 16 May, and over the next four days were taken on a series of local excursions in search of birds. The evenings were spent in discussion of bird topics of mutual interest and in examining the oological treasures in the "More Museum."

One day, because of a business appointment, Bob More could not accompany his guests, and he asked George Maxon to be their guide. Brandt was eager to add the Rio Grande Wild Turkey to his life list, and Maxon assured him that this species could be found at Lake Kemp on the southern portion of the Waggoner Ranch. Maxon hurriedly drove the party

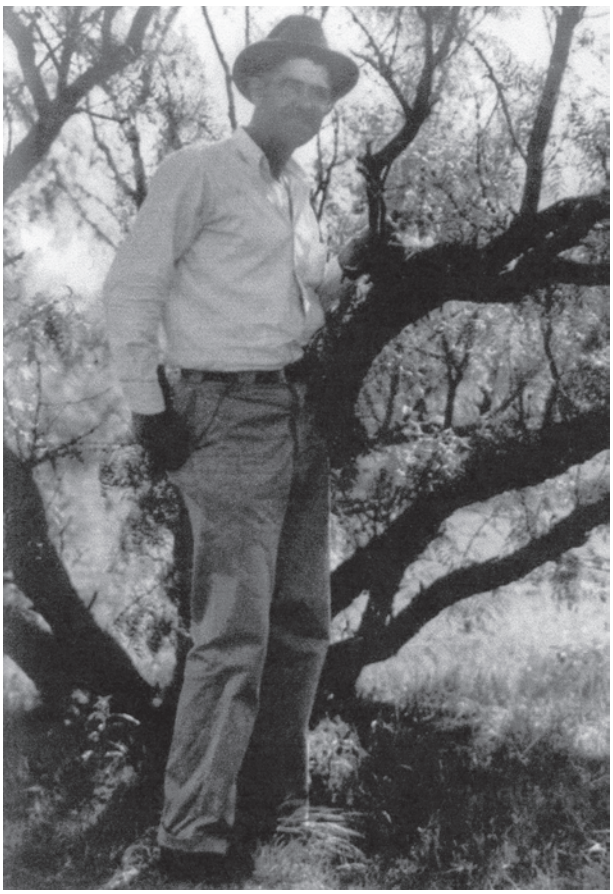

Figure 2. George Maxon at the nest of a Mississippi Kite. Photograph taken by Herbert Brandt at Vernon during 1937. On the bottom of the photograph Brandt has written "To George Maxon – a capable field-man, a true bird lover." Photograph courtesy of George Maxon, Jr.

to the lake but an extensive search did not reveal the presence of the wily gobblers. Brandt was, however, delighted to find Bullock's Oriole, House Finch, Golden-fronted Woodpecker, Bell's Vireo, Painted Bunting, Lesser Goldfinch, and the Scissor-tailed Flycatcher.

Later in the afternoon, Maxon drove Brandt and his party to the Pease River north of Vernon to search for the western form of the Blue Jay. Just before the sun was setting a nest was finally found some 40 feet above the ground in a huge cottonwood. Brandt, eager for a closer examination, undertook the precarious climb to the jay's nest, which contained four eggs. The climb to the nest was strenuous, and Brandt later remarked that it was one of the most difficult that he had made the entire season.

Herbert Brandt left Vernon on 21 May after spending 4 days with Bob More and George Maxon. The pleasant recollections of those days were deeply etched in Brandt's memory. Nearly a third of his book, *Texas Bird Adventures* (1940), was devoted to the time spent on the Waggoner Ranch. The book was dedicated to Robert Lee More with whom Brandt had established a lasting friendship. Brandt also thought highly of Maxon who he described as "a careful student of Texas bird life..." He perhaps also recognized in Maxon a kindred soul. A photograph taken by Brandt of Maxon looking at the nest of a Mississippi Kite is inscribed "To George Maxon – a capable field-man, a true bird lover – from Herbert Brandt" (Fig. 2).

MAXON'S COLLECTION OF EGGS

Maxon undoubtedly exchanged eggs with many other individuals during his early days of collecting in Tarrant County. It would thus be expected that

some of these eggs would eventually end up in museums across the country. This does not seem to be the case. A survey of major collections shows only two museums to contain eggs taken by Maxon: the eggs of a Black-capped Vireo taken during 1915 (Yale Peabody Museum) and a set of Swainson's Hawk eggs taken during 1928 by More and Maxon (Carnegie Museum of Natural History).

After Maxon's move to Vernon, his egg collection was incorporated into the larger collection owned by Bob More. At the time of More's death his collection contained the eggs of approximately 750 species of birds and totaled somewhere between 12 and 15,000 eggs (Anon. 1940, 1996, Dobie 1941). The number of eggs in these totals that belonged to Maxon or were collected by him after moving to Vernon is unknown.

The events of 1941 changed George Maxon's life. During that year Bob More died and publication of *The Oologist* was discontinued. His old friend, Ramon Graham, had left taxidermy to work in construction and was no longer an active collector. In addition, public attitudes toward egg collecting had grown increasingly negative. Without the support of friends who shared his interests, Maxon's enthusiasm for fieldwork diminished, and he turned his attention to the cultivation of plants at his nursery. He died on 1 March 1957. Sadly, his obituary contains no mention of his lifelong interest in birds and their eggs (Anon. 1957a,b).

THE END OF AN ERA

The practice of oology (the collection and study of birds' eggs) was at its peak when George Maxon was born in 1894. It first became popular in the 1870s and soon had a large following throughout the United States and Canada. Oology perhaps reached its zenith in Texas during the 1880s and early 1890s when at least 25 to 30 young men were active in the collection and trading of eggs (Davis 1895, Casto 2001). So great was interest in the subject that Texas had its own journal the *Sunny South Oologist* that was published briefly during 1886 at Gainesville, Texas (Casto 1991).

Most egg collectors became active during their teenage years. Searching for nests and retrieving eggs from seemingly inaccessible locations undoubtedly provided a sense of adventure and camaraderie. Taking eggs may also have satisfied a curiosity about birds, and for a few commercial collectors such as J. A. Singley, E. C. Davis, F. B. Armstrong, and the Rachford family at Beaumont, it was also a source of income (Casto 2001). For the majority; however, it was a passing fancy quickly abandoned as the responsibilities of adulthood redirected their interests. The eggs they had spent years collecting were then packed away and forgotten. Years later, these neglected treasures were often rediscovered by their descendants, who could only faintly remember that they had been collected by someone in their family.

George Maxon was in many ways a typical collector. Early in childhood he became intensely interested in hunting and fishing (Maxon 2001). His letters to *The Oologist*, long in narrative and short on ornithological information, indicate that he derived great pleasure in telling of his adventures in the field. He apparently did not view birds in a scientific way nor did he aspire to a higher knowledge of their biology. He did, however, have affection for birds and an awareness that their numbers were declining. The content of "An Egg Hoarder's Nightmare" suggests that he believed the collecting practices of some oologists were at least partially responsible for this decrease. In this sense, Maxon was a conservationist who believed that the number of eggs taken each season should be limited to ensure a sustained harvest for the years to come. His outlook in this regard was similar to that of Bob More, who believed strongly in conservation and managed the Waggoner Ranch not only for cattle but also for the benefit of birds and other types of wildlife (Anon 1940, Dobie 1941).

Bob More and George Maxon collected together for 14 years. When More died in 1941, the collection passed first to his son and later to his grandson (Warren 2005). The collection is still housed in Vernon, but there is no available inventory and nothing is known of the number and variety of eggs that bear Maxon's label (Fig. 3).

George Maxon was one of the last of the old-time egg collectors. By the time of his death in 1957, practitioners of oology were as scarce as the proverbial hen's teeth. Interest in what had once been a popular activity supported nationwide by hundreds of adherents was nonexistent, and the public perception of oology was generally negative. One can only wonder if George Maxon had any regrets for the years he spent studying the eggs and nests of birds. He had made no significant discoveries nor had he written any important scientific papers. Alone at the end of an era, his only comfort may have been the memories of his youthful collecting adventures and the fact that he had been judged "a capable field-man, a true bird lover."

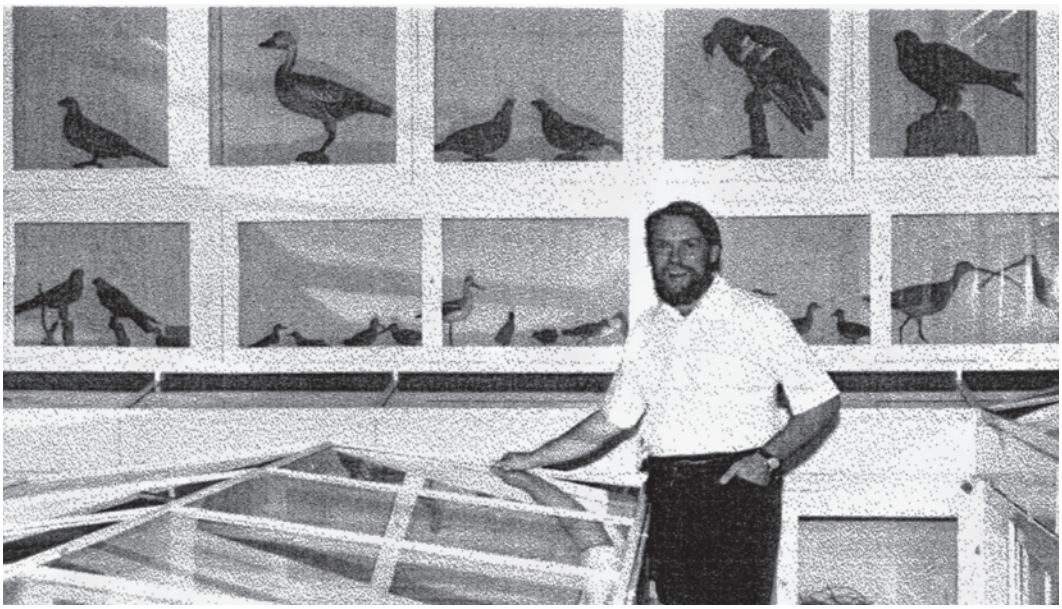

Figure 3. The Robert Lee More Museum in Vernon, Texas. Patrick More, shown standing beside the egg cases, is the grandson and caretaker of the museum. Photograph from Jones (1986).

ACKNOWLEDGMENT

The authors gratefully acknowledge the assistance of George E. Maxon, Jr. (1923–2005) who fondly recalled the "mountains" of nature lore learned from his father during the many happy days spent collecting eggs on the Pease River.

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INTRA-ANNUAL VARIATION IN WHITE-WINGED DOVE DENSITY IN THE TEXAS HILL COUNTRY

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ABSTRACT.—White-winged Dove populations in Texas have extended their range over the past 50 years. Concurrent with this range expansion has been the establishment of new, urban populations which usually include some proportion of non-migratory residents. We conducted distance sampling point counts for White-winged Doves on 17 occasions between February 2006 and February 2007. We obtained White-winged Dove density estimates for all 17 distance sampling occasions. In addition, we trapped and banded White-winged Doves from January through August 2006 and recorded ages (hatching year or after hatching year). Winter population size was about 30% smaller than summer peak population size. The peak in summer population size also corresponds strongly with peak numbers of HY captures, indicating population growth is most likely the result of reproductive recruitment and not immigration.

Prior to the early 20th Century, eastern White-winged Doves (*Zenaida asiatica asiatica*) in Texas had a breeding range restricted to the lower Rio Grande Valley (LRGV) (Cottam and Trefethen 1968). White-winged Doves predominantly nested in large colonies of riparian habitat along the terminal reach of the Rio Grande. As mechanized agriculture became more prevalent in the 1920s, large tracts of riparian habitat were destroyed for crop production (Purdy and Tomlinson 1991). About that time White-winged Doves in Texas began expanding their range northward to areas with suitable, alternative nesting habitat (Small et al. 2006).

During the 1950s, habitat destruction in the LRGV increased from growth of agricultural, municipal, and industrial land use (Jahrsdoerfer and Leslie 1988, Lonard and Judd 2002). Subsequently, the northward range expansion of White-winged Dove breeding populations accelerated and continues today. White-winged Doves remaining in the LRGV began using mature citrus groves as nesting habitat, however, periodic freezes killed mature trees and consequently this habitat proved unreliable over time (Schwertner et al. 2002).

Currently, more White-winged Doves in Texas occur outside the traditional breeding area than within (George et al. 1994). In addition, concurrent with this range expansion, White-winged Doves which established breeding populations outside the LRGV did so almost exclusively in urban and suburban areas. Also, a portion of these northern Texas populations have become year-round residents, foregoing the annual migration to southern Mexico typical of traditional populations.

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White-winged doves now breed in all 10 ecoregions of Texas (Gould et al. 1960, Small et al. 2006).

Very little information exists for urban populations of White-winged Doves. In particular, the migratory versus resident make-up of urban populations has not been investigated. The objectives of this study were to (1) document changes in White-winged Dove density over the course of a calendar year, (2) determine when peak and low densities occur as reference points in delineating the proportion of individuals that are resident and, (3) trap and leg-band White-winged Doves to assess the relationship in total density over time to number of hatching-year (HY) individuals captured (i.e., recruitment).

METHODS

Study area.—We conducted our study in and around Mason, Texas (Mason County, 30.75° N, 99.23° W) of the Edwards Plateau ecoregion (Gould et al. 1960). Mason encompasses 958.3 ha with a population of about 2,211 (City-data.com 2005). Our study was conducted continuously from January 2006 through February 2007.

Distance sampling protocol.—We used the 1992 National Land Cover Data Set (US Geological Survey 1999) to delimit urban land classification for Mason, Texas and global information systems (GIS) ArcView (Environmental Systems Research Institute, Inc., Redlands, California, USA) to buffer this area by 500 m (Schwertner and Johnson 2006). Thus our sample area encompassed 998 ha.

We used distance point transect sampling methodology (Buckland et al. 2001, Buckland 2006) to estimate White-winged Dove density on 17 occasions from February 2006 to February 2007. To establish a sampling transect, we first used GIS to create a pool of 125 random points within the study area, and the snap-to-layer function in GIS to move each point to the nearest road. From this pool, we randomly selected 100 points as a sampling transect. Because an entire transect of 100 points could not be completely sampled within a morning or evening period of just a few hours, we randomly divided each transect into 5 sets of 20 points each. Variation in protocol occurred during the first sample period, which required more than 5 d to complete.

We sampled mornings beginning shortly after official sunrise (Best 2001) with some variation occurring depending on weather conditions (overcast days required a slightly later starting time to allow enough light to make accurate counts) (Shields 1977, Robbins 1981). We followed Texas Parks and Wildlife Department sampling guidelines (Schwertner and Johnson 2006) with some modification.

Our sampling protocol used 2-min sample periods at each point. We used only visual counts to avoid bias associated with estimating distances using only auditory cues. Distances to White-winged Doves were determined to the nearest meter using a Bushnell™ Yardage Pro Legend laser range-finder (Bushnell, Inc, Overland Park, KS, USA). We also used cluster protocol (observations may consist of $\geq$1 dove) with doves considered to be clustered (dependent) when observed in a tree or when flying in flocks. Doves perched on artificial structures (i.e., power lines) or on the ground were counted as individuals (independent). All data were recorded on a standardized data sheet and recorded into a database upon completion of each survey. Data from all sampling efforts were originally combined into a single data set and imported into program DISTANCE. Individual sample periods were stratified at the region level. Two observation categories, cluster size and radial distance, were designated. All observations were made in meters with hectares as the unit of area.

The combined data were analyzed in program DISTANCE using detection functions for half normal with a cosine adjustment key, uniform with a cosine adjustment key, and hazard rate with a hermite adjustment key. All models were restricted to two terms, strictly monotonic, and data were right-truncated for outliers. Akaike Information Criterion corrected for sample size (AICc) was used to select the most parsimonious model (Burnham and Anderson 2003) for each density estimate.

Capture-recapture sampling protocol.—We trapped White-winged Doves between 18 January and 11 December 2006 using standard wire funnel traps (92 $\times$ 60 $\times$ 15 cm) (Reeves et al. 1968) baited with a mixture of commercial chicken scratch, black oil sunflower seeds, sorghum, and commercial wild bird feed (Purina Corp, St. Louis, Missouri) (Fig. 1). We set 12 to 18 traps each trap day on 160 d. Variation in number of traps used was contingent on landowner permission at available trap sites.

We marked all captured birds with U.S. Fish and Wildlife Service numbered aluminum butt-end bands on one leg and a colored band on the other and recorded all captures and recaptures.

All activities were conducted in accordance with Texas State University – San Marcos IACUC approval #06-05CC59736D, state permit #SPR-0890-234, and federal permit #06827.

Figure 1. White-winged Doves in a walk-in trap. Photo Michael Small

RESULTS

We calculated 17 density (Table 1) and population size estimates (density × 998 ha; Fig. 2) between February 2006 and February 2007. Low and high density estimates occurred from 8 to 19 February 2006 (0.93 doves/ha) and 24 to 28 July 2006 (3.25 doves/ha), respectively, although density estimates were essentially identical between 24 July and 31 Aug 2006. Coefficients of variation never exceeded 20% and was >13.02% on only one occasion. Distance sampling estimates indicated White-winged dove density peaked near the end of July and was lowest in mid-February. White-winged Dove density estimates were lowest for mid-February 2006 with density only 28.5% (95% CI = 27.6 to 29.5%) of estimated peak density obtained in late July 2006 (Fig. 2).

Table 1. White-winged Dove density estimates (per hectare) with corresponding 95% confidence intervals (CI) and associated coefficients of variation (CV) derived from distance sampling in Mason, Texas.

Sample Date	Density (95% CI)	CV
8–12, 15-19 Feb 2006	0.93 (0.736 – 1.167)	11.72
8–12 Mar 2006	1.45 (1.173 – 1.784)	10.63
30 Mar–2 Apr 2006	1.19 (0.955 – 1.482)	11.16
27 Apr–1 May 2006	1.43 (1.161 – 1.767)	10.64
17–20 May 2006	1.52 (1.254 – 1.846)	9.82
5–8 Jun 2006	1.73 (1.391 – 2.156)	11.11
26–30 Jun 2006	2.06 (1.254 – 1.846)	13.02
17–21 Jul 2006	2.36 (1.911 – 2.923)	10.78
24–28 Jul 2006	3.25 (2.672 – 3.961)	9.99
7–11 Aug 2006	3.25 (2.614 – 4.029)	10.98
27–31 Aug 2006	3.12 (2.538 – 3.844)	10.53
20–24 Sep 2006	2.40 (1.958 – 2.951)	10.41
18–22 Oct 2006	1.92 (1.490 – 2.469)	12.82
8–12 Nov 2006	2.31 (1.807 – 2.965)	12.56
7–11 Dec 2006	2.14 (1.725 – 2.667)	11.05
9–13 Jan 2007	1.18 (0.949 – 1.470)	11.10
10–14 Feb 2007	1.03 (0.695 – 1.520)	19.94

We captured a total of 2,071 doves comprising 1,745 individuals (909 adults, 779 young, 57 age unknown). We recaptured 326 White-winged Doves for an overall recapture rate of 15.74%. Recaptures involved 250 individuals: 198 recaptured once, 37 twice, 9 three times, 5 four times, and 1 seven times for an extremely high individual recapture rate of 14.33% (Schaeffer et al. 2006). Captures indicated a shift in the age composition of the population from AHYs to HYs beginning in June with HYs as the dominant cohort in the population (Fig. 3).

DISCUSSION

Techniques for monitoring avian populations have improved dramatically in recent years (Bibby et al. 2000, Rosenstock et al. 2002, Conway et al. 2004). In addition, as habitat fragmentation increases (Fletcher et al. 2006), urban populations have become the focus of more research (Klump 1996, Marzluff et al. 2001, Brum 2004, Blewett and Marzluff 2005). Comparative studies of avian populations in different habitats (Grue et al. 1981) and factors affecting results have also elucidated the need to tailor techniques to species (Pagen et al. 2002, Norvell et al. 2003, Howell et al. 2004).

Because White-winged Doves are expanding their breeding range in Texas, the need to effectively monitor populations is necessary to begin understanding intra- and inter-specific interactions in newly colonized areas. As populations increase and

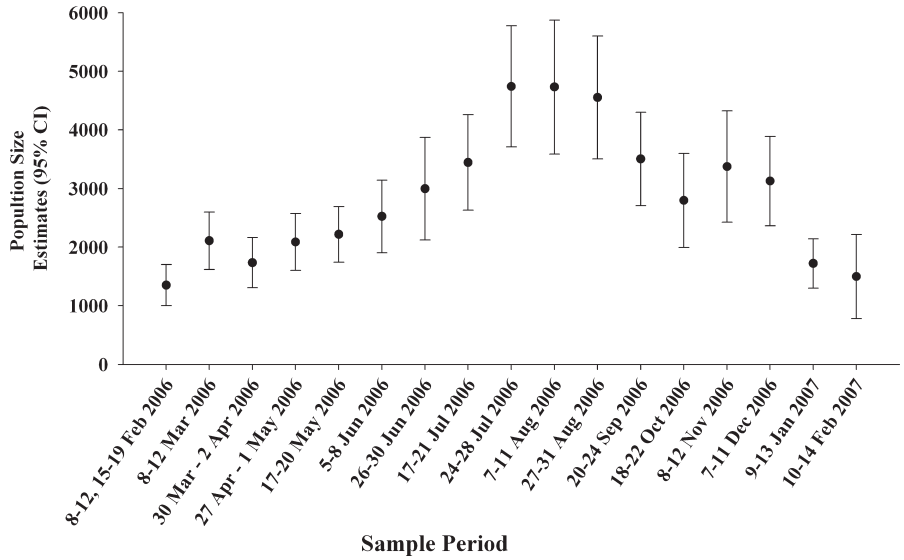

Figure 2. Population size estimates (95% confidence intervals) for White-winged Doves in Mason, Texas derived from distance sampling for 17 periods between February 2006 and February 2007.

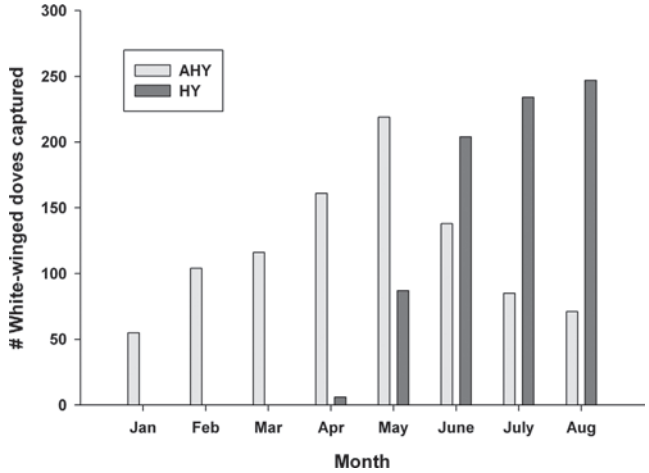

Figure 3. Number of new hatching year White-winged Doves captured during the summer breeding season in Mason, Texas, 2006.

new populations become established consequences are inevitable. The presence of White-winged Dove populations outside their traditional breeding range is likely to affect other avian species as competition for resources occurs. In particular, niche partitioning with other species is likely to become a demonstrative selective pressure in newly colonized areas.

Also, the status of White-winged Doves as a game species and its affinity for urban habitats in range expansion areas pose an especially delicate problem for management. White-winged Doves in urban habitats have shown a high degree of reliance on anthropogenic food and water resources making them unpredictable as a game species in the field in relation to established hunting seasons. Further, difficulty in establishing hunting season dates, length, and bag limits are exacerbated because a portion of these new populations are non-migratory residents. As a result, reliable estimates of population density, age composition of populations and movement are critical for sustainable management of this species.

Our study demonstrates that important demographic and natural history information can be effectively obtained for urban White-winged Dove populations. Additional testing should be conducted to determine the degree of bias (if any) present in sampling from roads as opposed to completely random sampling. Also, if further research to determine whether proportions of migratory to resident White-winged Doves vary temporally and spatially is still required. Additionally, there is no information on whether the same individuals comprise the resident winter population over time or what factors (i.e., individual age, gender) influence winter populations. Until a more complete understanding of White-winged Dove populations in Texas is reached, fully informed management and policy decisions regarding this unique species can not be made.

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FRANK B. ARMSTRONG'S TRADE IN LIVE BIRDS

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ABSTRACT.—Frank B. Armstrong and his agents collected live birds, mammals and reptiles in southern Texas and adjacent Mexico from 1900 through 1907. Organizations purchasing birds from Armstrong included the National Zoological Park, New York Zoological Park, New England Forestry, Fish and Game Association of Boston and the Philadelphia Zoo. A large collection of birds for exhibit in the Smithsonian flight cage at the 1904 World's Fair in St. Louis, Missouri, represents Armstrong's most ambitious undertaking.

Frank B. Armstrong (1863–1915, Fig. 1) of Brownsville, Texas, is considered one of the most productive bird collectors ever to work in southern Texas and adjacent Mexico (Oberholser 1974, Casto 1994). He prepared outstanding taxidermy mounts of birds but is best known for the thousands of study skins and egg sets bearing his tag that are found in museums throughout the United States and Europe (Casto 1994). Less known is the fact that Armstrong also traded extensively in live birds, reptiles, and mammals. This paper describes the trade in birds conducted by Frank B. Armstrong from 1900 until the sale of his live animal business in 1907.

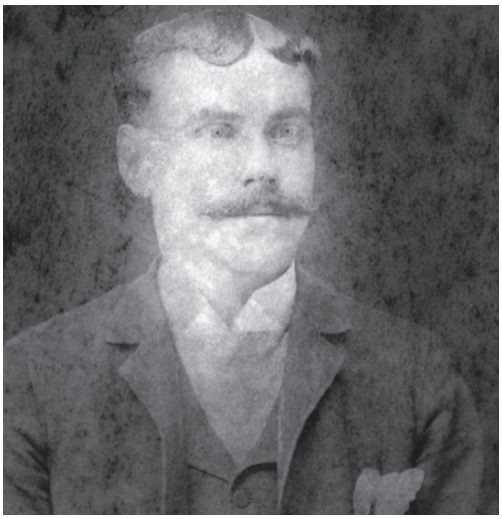

Figure 1. Frank B. Armstrong the "collecting naturalist" from Brownsville, Texas. Photograph courtesy of Frank B. Armstrong, III.

FIRST EFFORTS TO SELL LIVE BIRDS

Armstrong apparently conceived the idea of selling live birds while spending the winter of 1899–1900 at Corpus Christi. His method of advertising involved writing to zoos describing the birds that he could supply. One of his first orders was from William

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Hornaday, Director of the New York Zoological Park. In February 1900, Armstrong informed Hornaday that in addition to the birds already ordered, he could also supply two nearly full-grown Bald Eagles and four Canada Geese. In May 1900, Armstrong again wrote to Hornaday letting him know that Brownsville would henceforth be his permanent residence and that his "agent" in Corpus Christi had shipped to the zoological park a White Pelican, Snow Goose, White-fronted Goose, and three Canada Geese (Armstrong 1900a).

A FORCE OF COLLECTORS IS RECRUITED

The efforts at Corpus Christi to supply all of the birds ordered by Hornaday were unsuccessful, a fact attributed by Armstrong to his busy schedule and the need to entrust the care of the animals to others. To remedy this situation, Armstrong decided to alter his approach. In the future he would collect not only birds but other animals as well, and he would personally care for the animals himself.

By July 1900, Armstrong had recruited a "force of collectors" at various places along the Texas coast and in Mexico. Ducks, geese and pelicans were obtained from individuals at Corpus Christi. Trappers searched the ranches near Brownsville for mountain lions, jaguarundis, ocelots and peccaries, and a man was being trained to trap beavers. Screen wire cages in Armstrong's back yard allowed him to give captive birds his "special attention" and "raise them into healthy condition" (Armstrong 1900b).

In late September, Armstrong wrote to Hornaday that he would soon leave on a trapping expedition for jaguarundis and ocelots. Several Black-bellied Whistling-Ducks were doing well in his backyard cages that had been enlarged to include ponds of water. Armstrong was particularly appreciative that Hornaday had referred him to a gentleman from Easton, Pennsylvania, who had placed an order for Whooping Cranes (Armstrong 1900c).

Armstrong moved his camp in late November to another location where he continued his quest for the animals and birds ordered by Hornaday. Twenty or 30 ducks and geese were in stock, and he would soon have Rio Grande Wild Turkeys. His men had also located a flock of swans and were endeavoring to catch some of them (Armstrong 1900d).

BEAVERS AND BIRDS

The year 1901 began with Armstrong preparing for an expedition to trap beavers in the Rio Grande. Hornaday had placed an order for seven animals but Armstrong believed that he could secure as many as 40 or 50. Considerable planning and expense were involved in preparing for the operation. Armstrong and his crew of four men would put into the Rio Grande 200 miles above Brownsville. Rafts would be used to haul the captive beavers, and paddleboats carrying the men would tow the rafts. With all preparations made, Armstrong left Brownsville on 14 January 1901 for what would be a memorable adventure (Armstrong 1901a).

Armstrong and his crew arrived back in Brownsville on 8 March after being on the river for nearly a month and a half. Innumerable things had gone wrong. The rafts became waterlogged causing them to catch on snags and sandbars, and new ones had to be constructed each week. The beavers that were captured suffered from sinking rafts, high winds and waves, extreme temperature changes, as well as a lack of variety of food. Worse yet the beavers often bit one another, and the wounds became infected by screwworms. Swarms of curious Mexican visitors at Armstrong's camp stole supplies and their loud talking kept the beavers in a state of agitation. Some beavers died without apparent cause in spite of Armstrong's close attention. The expedition was also hard on Armstrong. He had been continually wet for a month and a half, but the most difficult part was seeing the beavers die. Only 22 animals of an unknown number that were captured made it to Brownsville alive, and of this number, several required rehabilitation (Armstrong 1901b).

Armstrong spent April, May and June 1901 caring for his beavers while taking orders for Whooping Crane, Tundra Swan, Roseate Spoonbill, American White Pelican and other birds to be delivered in the fall. In mid-July he made a brief trip to Laredo to catch beavers in the Rio Grande (Armstrong 1901c). By October he had assembled the birds and animals ordered by Hornaday and was awaiting instructions on how to route the shipment to New York (Armstrong 1901d). The request for shipping instructions was followed by a second letter asking Hornaday for an advance of one hundred dollars on the birds and animals that he was ready to send. Considerable money had been lost on consignments to New York during the previous year, and Armstrong was "cramped for funds to work with." The crates of animals eventually sent to New York were hauled the 30 miles from Brownsville to Port Isabel by wagon and loaded onto a schooner bound for Corpus Christi and Galveston (Armstrong 1901e).


Frank B. Armstrong,
Collecting Naturalist and Dealer in
Mexican & Southern Bird & Mammals Skins.
Bird Eggs in Sets
Living Wild Animals and Birds for Scientific and Propagating Purposes.
Brownsville, Texas, _____ 190

Figure 2. Armstrong's business letterhead advertising the sale of "Living Wild Animals and Birds for Scientific and Propagating Purposes" as it first appeared in November 1901.

Armstrong had an inventory in fall 1901 of 500 ducks that included over 200 Redheads described as "real beauties [that] feed like pigs." All of his ducks were tame and would almost eat from the hand. The crates Armstrong used to ship ducks consisted of six compartments partitioned by burlap. The bottom of the each crate was slatted and the frame covered with doubled burlap so the ducks could not see through but would allow the passage of sufficient air. The bottom of each compartment was a slide-out pan that could be removed and filled with food and water. Six ducks were placed in each compartment for a total of 3-dozen birds per crate (Armstrong 1901e).

Armstrong redesigned his business letterhead in the fall of 1901. Earlier letterheads had described him in a four-line heading as a "Collecting Naturalist – and Dealer in – Mexican and Southern Bird and Mammals Skins – Bird Eggs in Sets." The new letterhead added the words "Living Wild Animals and Birds for Scientific and Propagating Purposes" (Fig. 2).

ACTIVITIES DURING 1902–1903

Armstrong began corresponding with Frank Baker, Director of the National Zoological Park in Washington, D. C., in 1900 but apparently did not sell the Park any birds until early 1902. In February of that year, Armstrong wrote to Baker that he did not have any Whooping Cranes but might be able to get some before spring. Tundra Swans had not been seen in the locations where 11 had been taken during the past year, a fact attributed to the relatively mild winter. However, Armstrong was sure that Snowy Egret, Great Egret, and Roseate Spoonbill could be taken in the spring (Armstrong 1902a). In April, Armstrong notified Baker that he had sent the two jaguarundis and the bobcat that had been ordered. Egrets, herons, spoonbills, waders of various species, and ducks could be supplied upon request. Young Great Horned Owl, Aplomado Falcon, White-tailed Hawk and Harris's Hawk were available, as well as other species indigenous to the area (Armstrong 1902b). In August, Armstrong notified Baker that he had a "nice flock of Roseate Spoonbills" (Armstrong 1902c).

The transport of animals to the National Zoological Park was difficult. Animals shipped north were loaded on the Brownsville stage for the 36-h ride to Alice, Texas, where they were transferred onto the railroad for the remainder of the trip. The hot and rough stage ride was hard on the animals and the freight cost for this section of the trip was more than the total cost for the remainder of the trip by rail. Because the buyer paid shipping costs, Armstrong was informed that he needed to find a more affordable method of transport, or the National Zoological Park would be forced to limit its purchases (Baker 1902a). This dilemma was, however, soon resolved. Regular steamship service became available between Port Isabel and Galveston in April 1902, and in July 1904 the railroad finally made its way to the tip of Texas.

The National Zoological Park ordered a pair of Roseate Spoonbills and a Snowy Egret in September 1902 (Baker 1902a). These birds were sent by steamer to Galveston. However, three pairs of spoonbills were sent rather than the single pair that had been ordered. Armstrong's rationale for including the additional birds was to ensure that at least one pair would arrive alive and in good health. An invoice for six birds was enclosed provided that they all arrived in good shape (Armstrong 1902d). However, only a single box containing four birds eventually arrived in Washington. Three of the birds were in good condition and one was dead. The National Zoological Park agreed to take the three birds at $10.00 each (Baker 1902b).

Following receipt of the spoonbills, Frank Baker asked Armstrong if he would provide natural history information about the species and the method used in their capture. Armstrong's reply to this request, particularly the method used to capture the birds, is of some interest. – "Habiting along the bay shore

where they [the spoonbills] are accustomed to see lights from sail boats they are easily captured by hunters approaching them cautiously with hunting lamps. So intent are they [the spoonbills] in their feeding that they pay no attention to a light until they are blinded by its rays. One man carries the light & another behind him throws a cast net over them [the spoonbills]" (Armstrong 1902e).

Armstrong apparently sold very few birds during 1903. A shipment of 27 birds consisting of Sandhill Crane, Snow Goose, White-fronted Goose, American Avocet, Black-necked Stilt, Willet, Gadwall, Northern Shoveler, American Widgeon, Black-bellied Whistling-Duck, and Fulvous Whistling-Duck was sent to the New York Zoological Park in mid-December (Armstrong 1903). Records of other shipments have not been found, and it is believed that Armstrong was concentrating his efforts during the fall and winter of 1903-1904 on assembling the collection of animals that the Smithsonian had ordered for the 1904 World's Fair.

BIRDS SENT TO THE 1904 WORLD'S FAIR

A collection of birds and snakes for the Smithsonian exhibit at the 1904 World's Fair in St. Louis represents Armstrong's most ambitious undertaking. The list of birds wanted for the exhibit has not been found. However, the order must have been placed several months before the opening of the exposition in order to allow sufficient time for the capture and transport of the animals requested. During the first week of May 1904, the *Brownsville Daily Herald* reported that Armstrong was filling an order for 5,000 pounds of snakes, mainly rattlers, to be shipped to the World's Fair (Anon. 1904a). The following week it was reported that Armstrong and his "corps of trappers" had been busy for several months preparing a collection of birds that would soon be sent to St. Louis (Anon. 1904b).

Visitors to Armstrong's compound on Adams Street during the second week in May were amazed to find that many of the birds destined for the World's Fair were so tame that they could be fed by hand (Anon. 1904b). However, a major disaster was in the making. Birds were dying steadily due to the hot weather and an epidemic disease attributed to "fermented water." Four apparently healthy pelicans had died, as well as 40 geese and many ducks. In some cases the stronger birds attacked and killed the weaker ones. In addition to the problem of mortality, there was no immediate way to ship the birds from Brownsville. The steamer to Galveston had left in late April before Armstrong had received instructions on how to route the birds to St. Louis. It had since returned to Brownsville, but because of a heavy load and low water level, the *Manteo* could not cross the sand bar in Brazos Santiago Pass to enter the harbor. Armstrong thus found himself in a waiting situation in which he was a "heavy loser" with the prospect of fulfilling his obligations very bleak (Armstrong 1904a).

The collection of birds originally intended for the World's Fair included 15 species of ducks – Northern Shoveler, Redhead, Lesser Scaup, Ruddy Duck, Canvasback, Blue-winged Teal, Green-winged Teal, Cinnamon Teal, Black-bellied Whistling-Duck, Fulvous Whistling-Duck, Northern Pintail, American Widgeon, Gadwall, Mallard, and American Black Duck. Geese were represented by Canada Goose (three forms), Ross's Goose, Snow Goose (three forms), and White-fronted Goose. Other waterfowl included the White-faced Ibis, White Ibis, Long-billed Curlew, Snowy Egret, Great Egret, Sandhill Crane, Willet, Roseate Spoonbill, Black-necked Stilt, American Avocet, Caspian Tern, Royal Tern and Ring-billed Gull, as well as other gulls, sea hawks [osprey?], and waders. Northern Bobwhite, Scaled Quail, Blue Jay, Green Jay, and "many other birds of bright plumage" were also to be included (Anon. 1904b). However, because of high mortality, the number of species and individual birds that eventually reached St. Louis was greatly reduced.

Armstrong's shipment of birds, reptiles and mammals was loaded onto the steamship *Manteo* on 20 May 1904 for the first leg of their journey to St. Louis. The arrival of the *Manteo* in Galveston with its load of wildlife created considerable excitement and many residents of the city made their way to the dock to view the collection, which was said to be the largest ever sent out of the Brownsville district (Anon. 1904c). The animals were then transferred from the *Manteo* to railroad cars for the trip to St. Louis where they arrived on 24 May (Baker 1904a). The invoice for the shipment listed 101 birds as having been sent. However, six Northern Shovelers never arrived and of the 95 birds received, 22 were dead (Armstrong 1904b). Records of the Smithsonian [RU70, Box 71, Folder 7] indicate that Armstrong was paid $313.75 for the "miscellaneous lot" of birds that arrived in St. Louis. What had begun as a grand venture with prospects of profit had ended in disappointment and financial loss.

The birds sent to St. Louis were exhibited in the "Government Bird Cage" near the Texas State

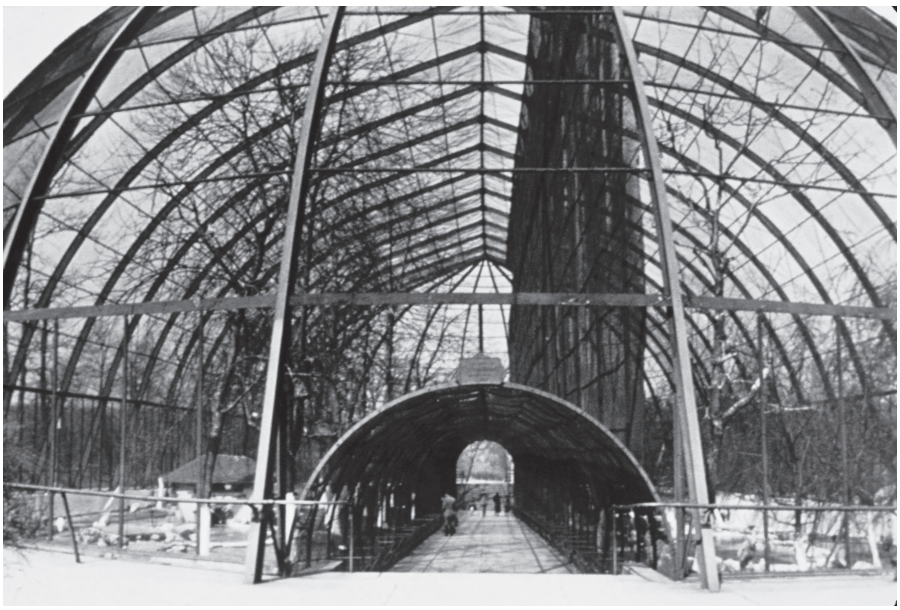

Figure 3. Flight cage at the 1904 World's Fair in which the birds collected by Frank Armstrong were exhibited. Photograph courtesy of the St. Louis Zoo.

Building in the Plateau of States Section of the fairgrounds. The flight cage, designed by Frank Baker and specially built for the Smithsonian, was at the time of its construction considered to be the largest in the world – 228 feet long, 84 feet wide and 50 feet high. A screened tunnel passing through the center of the cage allowed visitors to walk through the cage and view the birds in a natural setting (Fig. 3). The cage was to be dismantled at the end of the fair but was instead sold to the City of St. Louis where it remains today as a major attraction of the St. Louis Zoo (Anon. 2003).

Armstrong was not deterred by the loss of time and money resulting from the World's Fair fiasco. By late August 1904, he had assembled a large collection of birds that was offered to the New York Zoological Park. In addition to the usual ducks, geese, spoonbills, pelicans and egrets, Armstrong now had in stock White Ibis, White-faced Glossy Ibis, Tricolored Heron, Little Blue Heron, Laughing Gull, Royal Tern, Caspian Tern, Wilson's Tern, Cabot's Tern, Gull-billed Tern, Willet, Long-billed Curlew, Black-necked Stilt, American Avocet, Black-crowned Night-Heron, Florida Gallinule, Purple Gallinule, American Coot, Clapper Rail and Neotropic Cormorant. A second offer made to Hornaday in late October included Greater Roadrunner, Plain Chachalaca, and Whooping Crane (Armstrong 1904c). An offer of a Reddish Egret, as well as a large number of ducks, geese and other birds including large hawks and small perching birds was also extended to Frank Baker (Armstrong 1904d), who responded that the need for additional ducks and geese could not be evaluated until those birds presently in St. Louis were returned to Washington (Baker 1904b).

Shipping birds during the summer months presented a special challenge, and Armstrong occasionally received complaints of birds dying of thirst during transit. To avoid this hazard, he developed a self-watering device consisting of a five-gallon can placed in each crate that would drip water for several days into a trough from which the birds could drink. This method also saved money since the water tanks were filled after the crates had been weighed, and Armstrong was not charged either for the extra weight or for any care of the birds provided by the express agents (Armstrong 1904f).

A NEW ANIMAL COMPOUND

Armstrong began to diversify his trade in live animals during 1905. Rattlesnakes, armadillos, bobcats, coyotes, and badgers were in demand, and a rare jaguarundi valued at $100 was sent to the National Zoological Park (Anon. 1905a). To accommodate this diversity of wildlife, Armstrong purchased five acres adjacent to the Brownsville city cemetery where holding pens and coops, as a

well as a cottage for a permanent caretaker were constructed. Only a few animals requiring his special attention were kept at the Adams Street location (Anon. 1905b).

The sale of birds was slow during most of 1905. During July four boxes of birds were shipped to unspecified locations (Anon. 1905c), and White-tailed Hawk, Crested Caracara, Greater Roadrunner and Plain Chachalaca were sent to the New York Zoological Park (Anon. 1905d, Armstrong 1905a). Two Reddish Egrets and two White-tailed Hawks were sent to the Philadelphia Zoo during August (De Caro 2008). Two Roseate Spoonbills sent to the National Zoological Park died shortly after arrival and their study skins (USNM 149701 and 149703) were donated to the United States National Museum. Although there was a good market for animals during 1905, an outbreak of yellow fever in New Orleans and the accompanying quarantine restrictions resulted in many orders being delayed because prompt delivery was almost impossible (Anon. 1905b).

Roseate Spoonbills sent to the New York Zoological Park during July died shortly after arrival. Armstrong did not charge for dead or sickly animals and promised to replace them with strong, healthy birds. However, he did suggest to Hornaday that the newly arrived spoonbills should be force-fed small pieces of meat worked well down into their crop-stomach so they could not be spit out. After each feeding the bird should be released and allowed to wade in the water before they were again fed. This procedure was to be repeated for a couple of days until the birds began to feed for themselves. Armstrong used this technique when bringing spoonbills in from the wild and found it to be a successful way of adapting them to captivity (Armstrong 1905b).

Armstrong's largest sale of 1905 was to Walter P. Geers, a representative of the New England Forestry, Fish and Game Association of Boston. Thirty-two crates of birds of "a large variety too numerous to mention" were purchased by Geers and checked as personal baggage when he boarded the train to leave Brownsville (Anon. 1905e). When the train stopped in Beeville one of the city's residents, W. F. Baldwin, peeked into a crate of birds and was pecked in the eye by a hawk causing an injury requiring a visit to an ophthalmologist in San Antonio (Anon 1905f). The birds purchased by Geers were eventually exhibited in the Boston Zoological Garden.

MORE SNAKES, FEWER BIRDS

Armstrong had over a ton of snakes at his compound during January 1906, as well as an "immense collection of other animals and fowls" (Anon. 1906a). A lucrative market for the venom of rattlers, as well as their use as attractions at zoos and circuses were undoubtedly market factors that led to more of these animals being collected. Snakes also required less attention than birds and could be cared for by assistants thereby allowing Armstrong more time to attend to other aspects of his business.

Armstrong left Brownsville in early 1906 for a "prospecting trip" into Mexico from which he did not return until the end of May (Anon. 1906b). The presumed purpose of this trip was to identify collecting sites and to arrange with Mexican agents for the collection of various animals. Known shipments or birds during 1906 include four Gadwall and a Greater Roadrunner that were sold to the Philadelphia Zoological Society (De Caro 2008).

Visitors to Armstrong's animal compound during July were treated to the "a never to be forgotten sight" of over 100 rattlesnakes, many of which were of an "immense" size. The assortment of birds at this time consisted of some owls, herons, pelicans, and Roseate Spoonbills which "were well worth seeing" but obviously not as exciting as the snakes (Anon. 1906c).

The increased importance of snakes in Armstrong's business was emphasized in an article "Brownsville's Snake Farm" published in the *St. Louis Republic* and reprinted in the *Brownsville Daily Herald* (Anon. 1906d). In this article of over 1400 words, it was mentioned only in passing that there were a few birds in the compound – "the whooping crane, the heron, the hawk." Birds were still a component of Armstrong's animal trade but the emphasis had shifted to snakes and animals such as ocelots, jagaurundis, javelinas, coyotes, bobcats, badgers and armadillos. After 1906, almost without exception, Armstrong's animal compound was referred to in the press as the "Snake Farm." This increased emphasis on snakes was also reflected in Armstrong's new business letterhead to which was added the words '**SNAKES & REPTILES**" (Armstrong 1906).

INCORPORATION AND SALE OF THE ANIMAL COMPOUND

The details of the incorporation and sale of Armstrong's business are obscure. The letterhead for the business was changed in March 1907 to carry

the designation "**FRANK B. ARMSTRONG & CO.**" and the addition of the line "**Ornamental Water Fowl, Game Birds, Iguanas, Gila Monsters, Parrots, Macaws, Paraquets**" (Armstrong 1907). How or why Armstrong became involved in the sale of exotic animals is unknown. However, he apparently found little satisfaction in the exotic animal trade and near the end of the year decided to sell his business to William Odell Learn (1861–1932), a dealer in reptiles and parrots from San Antonio. The sale was apparently consummated in December 1907 when Learn and his wife, Martha, 'We-No-Nah' the snake dancer, arrived at the Miller Hotel in Brownsville (Anon. 1907). The purchase was made public in January 1908 with an announcement in the *Brownsville Daily Herald* that W. O. Learn had recently purchased the "snake farm" (Anon. 1908). Whether Learn purchased the business outright or only a controlling interest is unknown. Learn operated the business as its president until at least February 1909 under the name "**F. B. ARMSTRONG WILD ANIMAL COMPANY**" (Anon. 1909a). Learn later moved his headquarters to Laredo where he reportedly became the largest importer of Mexican and central American parrots in the United States (Anon. 1924).

A LOOK BACK

Frank Armstrong was a self-described "collecting naturalist." He was particularly knowledgeable of the animals of southern Texas and northern Mexico, how to identify them, where to find them, as well as the methods necessary to catch and keep them alive. Birds were his specialty, but he was also knowledgeable of the reptiles and larger mammals of the brush country.

Armstrong's knowledge of natural history and his skill in the husbandry of animals were combined with a common sense approach to business. His birds were reasonably priced (see appendix) and he did not charge for animals that died in transit or were sickly upon arrival. Information regarding the natural history and care of the animals that he sold was freely shared with his customers who often recommended him to other potential buyers.

Other dealers would fill the vacuum left by the sale of Armstrong's live animal business. His immediate successor, W. O. Learn, developed a profitable business from the sale of snakes and parrots. The Gulf Coast Wild Animal Farm owned by Albert Mason, Edgar McDavitt and James McDavitt briefly imported animals from Mexico and Central America during 1909 (Anon. 1909b,c,d). William A. 'Snake' King (1875–1952), the flambouyant proprietor of "Snakeville", would later establish an extensive trade in snakes, parrots, and exotic animals imported from all parts of the world (King 1964). However, as successful as they were in the live animal trade, none of these men achieved the recognition and respect that the biological community had given Frank Armstrong, the original "collecting naturalist" from Brownsville, Texas.

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DE CARO, R. 2008. Records of animal acquisitions of the Philadelphia Zoo provided to the author by Rachael De Caro, Animal Records and Library Services Manager. From November 1903 through March 1908, the Philadelphia Zoo purchased an assortment of ducks and geese, a Roseate Spoonbill, White Ibis, White-faced Ibis and a Greater Roadrunner from Armstrong. Reptiles purchased included Rio Grande River Cooter, Texas Tortoise, Graham's Crayfish Snake, Central Texas Whip Snake, Texas Rat Snake, Great Plains Rat Snake, Checkered Garter Snake, Western Ribbon Snake, Bull Snake, Yellow-bellied Water Snake, Western Diamondback Rattlesnake and Texas Indigo Snake.

KING, W. A., Jr. 1964. *Rattling yours . . . Snake King*. Brownsville: Springman-King Lithograph Company.

OBERHOLSER, H. C. 1974. *The bird life of Texas*. University of Texas Press, Austin.

Appendix. Birds offered for sale 1900–1907 by Frank B. Armstrong of Brownsville, Texas. The date(s) in parenthesis indicates the year in which the price quote was made. It was Armstrong's practice not to charge customers for birds that died during shipment or that arrived in an injured or sickly condition. The price of some birds remained constant throughout the years whereas the price of others increased or, in a few cases, decreased.

American White Pelican (1901, '06) — $10.00
Brown Pelican (1906) — $8.00
Neotropic Cormorant (1904) — $4.00
Night-Herons (1905, '06) — $5.00 $4.00
Tricolored Heron (1904, '06) — $3.00, $4.00
Little Blue Heron (1906) — $4.00
Reddish Egret (1904, '05) — $5.00
Snowy Egret (1906) — $10.00
Great Egret (1906) — $12.00
Great Blue Heron (1904, '06) — $6.00
White-faced Ibis (1904, '06) — $3.00, $4.00
White Ibis (1904, '06) — $3.00, $5.00
Roseate Spoonbill (1901, '06) — $8.00, $10.00
Tundra Swan (1901, '06) — $20/25.00, $50.00
G.White-fronted Goose (1900, '06) — $2.50, $5.00
Snow Goose (1900, '06) — $2.50, $4.00,
Snow Goose "blue" (1903, '06) — $4.00, $8.00
Ross's Goose (1904) — $4.00
Canada Goose (1900) — $6.00
Fulvous Whistling-Duck (1903, '06) — $2.00
Blk-bld Whistling-Duck (1903, '06) — $1.50, $2.00
Clapper Rail (1904) — $1.50
Purple Gallinule (1904) — $1.50
Common Moorhen (1904) — $1.00
American Coot (1904) — $1.00
Sandhill Crane (1906) — $10.00
Whooping Crane (1901, 04, 06) — $25, $50, $75
American Avocet (1904, '06) — $1.50, $3.00
Black-necked Silt (1904, '06) — $1.50, $3.00
Willet (1904) — $1.50
Long-billed Curlew (1904, '06) — $3.00, $4.00
Laughing Gull (1904) — $2.00
Ring-billed Gull (1904) — $8.00
Sandwich Tern (1904) — $3.00
Royal Tern (1904) — $3.00
Caspian Tern (1904) — $8.00
Gull-billed Tern (1904) — $2.00
Greater Roadrunner (1904) — $3.00
Great Horned Owl (1905, '06) — $4.00, $3.00
Green Jay (1905) — No Quote
Great-tailed Grackle (1905) — No Quote
Mallard (1904, '06) — $1.50, $2.00
Amer. Black Duck (1904, '06) — $1.50, $3.00
Gadwall (1903, '06) — $1.50, $2.00
Green-winged Teal (1904, '06) — $1.50, $3.00
American Wigeon (1903, '06) — $1.50, $2.00
Northern Pintail (1904, '06) — $1.50, $2.00
Northern Shoveler (1903, '06) — $1.50, $2.00
Blue-winged Teal (1904, '06) — $1.50, $2.00
Cinnamon Teal (1906) — $5.00
Canvasback (1901, '04) — $3.00, $6.00,
Redhead (1904, '06) — $1.50, $2.00
Scaup (1904, '06) — $1.50, $2.00
Bald Eagle (1900) — $2.00
Harris's Hawk (1904, '06) — $4.00, $3.00
White-tailed Hawk (1905, '06) — $4.00, $3.00
Aplomado Falcon (1905) — $4.00
Crested Caracara (1905, '06) — $4.00, $3.00
Plain Chachalaca (1904) — $6.00
Wild Turkey (1904) — $10.00
Northern Bobwhite (1904, '06) — $1.50, $2.00
Scaled Quail (1905) — No Quote

EVALUATING AVIAN COMMUNITIES OF THE BLANCO RIVER VALLEY USING OCCUPANCY MODELING AND LANDOWNER CONDUCTED SURVEYS

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ABSTRACT.—Abundance and distribution of species tend to be linked, such that as outside forces cause changes in population size, there is often a change in the number of sites occupied. Presence-nonpresence surveys are a simple method for monitoring these changes and obtaining valuable information on avian assemblages and are arguably more accurate than point counts. We conducted presence-nonpresence surveys during spring, summer, and winter at 30 stations along the Blanco River in central Texas. We recorded 98 avian species on 267 presence-nonpresence surveys. Thirty species were analyzed in PRESENCE to obtain occupancy and detectability values. We compared survey results to birds observed on landowner surveys using the Jaccard Similarity Coefficient (*J*). There was not a strong similarity between the two types of surveys. Landowner surveys had a 51% similarity to our year-round presence-nonpresence avian surveys and 56% similarity to our spring and summer avian surveys.

Abundance and distribution of species tend to be linked, such that changes in abundance result in modification of the number of sites occupied (Gaston et al. 2000). Simple bird survey methods can monitor such changes and provide valuable information on avian assemblages impacted by residential developments and changing land use practices. Generally, point counts or distance sampling techniques are used to conduct avian surveys at the habitat or geographical region scales (Bohning-Gaese 1997). Bart and Klosiewski (1989), however, suggested using only presence-nonpresence surveys instead of the fore mentioned techniques to increase sample size, delineate range, and measure changes in density. They argued that presence-nonpresence surveys might be more accurate if surveyors did not count all individuals, and in the case of Breeding Bird Surveys (BBS), surveyors could conduct more routes and increase the coverage area and overall sample size.

Presence-nonpresence surveys are a commonly used occupancy modeling method for monitoring broad-scale changes (Rhodes et al. 2006). Occupancy is defined as the fraction of sampling units in a landscape where a species is present (MacKenzie and Royal 2005). Detectability of a species will affect the calculated occupancy and should be assessed to avoid biased results. To offset biases from imperfect detections, surveys should be replicated within a short period of time. Some methods for estimating detection probabilities can be expensive in both time and effort (Royle and Nichols 2003). Therefore, finding easily conducted surveys which provide reliable information is a constant challenge for applied biologists (Hui et al. 2006).

Many organizations and individuals, from federal agencies to local Audubon chapters and non-governmental agencies, such as the Texas Ornithological Society and The Nature Conservancy, use volunteers and members to collect data on bird populations (Delaney 2007, Greenwood 2007, Cohn 2008). In Texas, reports filed by landowners to maintain open space valuation of their land are another potential source of avian population data (Combs 2002). A portion of landowners receiving 1-d-1 open space land tax exemptions conduct bird censuses or employ environmental consulting organizations for that purpose. These bird surveys, typically conducted once annually, might be useful for monitoring avian populations across a large geographical area such as a river basin, provided the data are accurate and

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reliable. Using data on a geographical scale may provide valuable insight into the relationship between avifauna populations, and vegetative and landscape changes. As more people move from cities to "ranchettes", especially in the Hill Country of Texas, it is important to track changes in avian populations. If landowner surveys are scientifically defensible, then their use would be a significant contribution to wildlife management and conservation (Nupp and Swihart 2000).

Our objectives were (1) to monitor the avian assemblage of the Blanco River Valley using occupancy modeling, (2) to compare bird lists generated by typical landowner bird surveys to our multi-season presence-nonpresence list, and (3) to assess the similarity between the two lists, and thus, the scientific value of land owner generated bird lists.

METHODS

Study area.—The Blanco River begins as a spring in northwestern Kendall County. The river flows for approximately 140 km, through Kendall, Blanco, Comal, and Hays counties to a confluence with the San Marcos River southeast of the City of San Marcos (Texas Parks and Wildlife Department 2007). Topographic features of the river valley consist of limestone ledges and cliff faces covered with herbaceous vegetation, ashe juniper (*Juniperus ashei*), and oak (*Quercus* spp.) trees, as well as streambanks dominated by bald cypress (*Taxodium distichum*), pecan (*Carya illinoinensis*), and elm (*Ulmus* spp.) (Texas Parks and Wildlife Department 2007). Most properties along the river are privately owned ranchland, although some substantial residential development occurs in and near Wimberley, Texas. We selected 11 privately owned ranches along the Blanco River and major tributaries (Cypress Creek and Little Blanco River) from near the headwaters in Kendall County, through Blanco and Comal counties to Hays County with the assistance of The Nature Conservancy personnel. Depending on the length of river frontage, each site contained two to four survey stations for a total of 30 survey stations (Fig. 1). Stations were spaced at least 250 m apart to minimize the probability of double detection (Ralph et al. 1993). Locations were recorded with a Garmin eTrex Legend (Garmin™, Olathe, Kansas) GPS unit.

Presence-nonpresence surveys.—We sampled multiple seasons in spring, summer and winter by visiting each bird survey station three times because seasonal changes can affect detectability (Best and Peterson 1985). We surveyed spring stations (n = 30) from 13 April 2007 to 2 June 2007, summer stations (n = 29) from 5 August 2007 to 4 September 2007, and winter stations (n = 30) from 20 December 2007 to 26 January 2008. When possible, we visited all sites within a four-week period. Occasionally weather or landowner availability extended the survey period but never

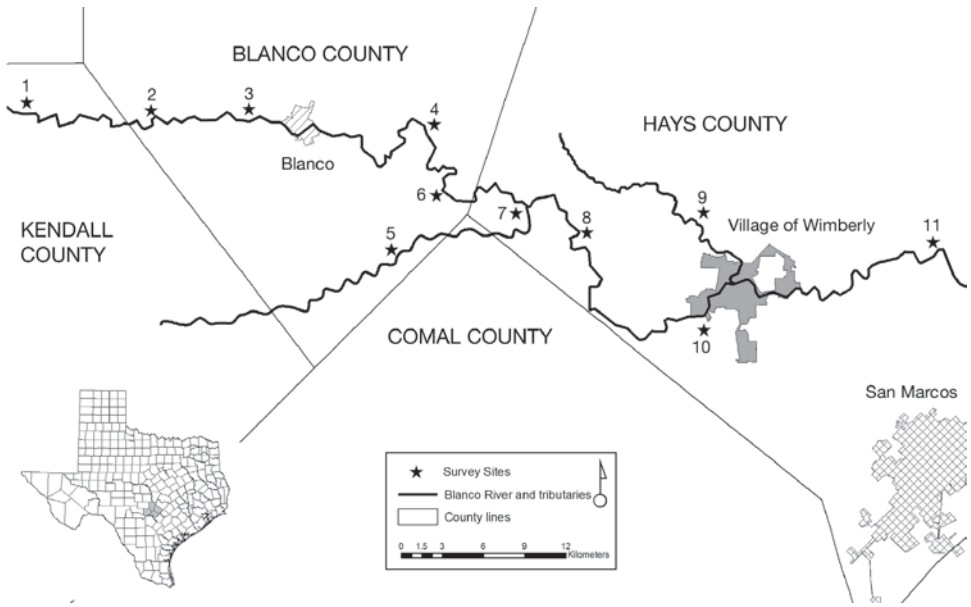

Figure 1. Map of the Blanco River Valley with major tributaries showing 11 bird survey sites.

past the season. Morning surveys were conducted from sunrise to approximately 1030 h in all seasons. Afternoon start times varied due to seasonal changes in temperature and sunset time. Afternoon spring surveys were conducted from 1530 h to sunset, summer surveys from 1630 h to sunset, and winter surveys from 1430 h to sunset. We approached each station quietly and waited 5 min, allowing birds to acclimate to our presence, before starting a survey. We recorded all species detected aurally and visually for 10 min. We also recorded birds detected aurally and visually during the 5 min rest period, but did not include these data in occupancy analysis.

Landowner data.—We obtained landowner survey records for properties declaring 1-d-1 open space land tax exemptions from County Appraisal District offices in Hays and Blanco counties. We used only species present on landowner surveys from properties adjacent to the Blanco River for comparison to our data.

Analyses.—We analyzed presence-nonpresence of avian species on surveys using occupancy modeling in the program PRESENCE (MacKenzie et al. 2006). We examined 3 models (Table 1): a single season model with occupancy (ψ) and probability of detection (p) held constant, a multi-season model with colonization (γ), extinction (ε) and probability of detection (p) held constant but allowing for changes in occupancy (ψ) by season, and a multi-season model with colonization (γ), and extinction (ε) held constant but allowing occupancy (ψ), and probability of detection (p) to vary by season.

Since presence-nonpresence information is binary data, we used the Jaccard Similarity Coefficient (J) to compare our species richness data (bird species list) to landowner species richness data (Krebs 1999). Landowner surveys were only conducted in spring and summer; therefore, J was calculated comparing landowner data to our total yearly data, as well as comparing landowner data to only our spring and summer data. Jaccard Similarity Coefficient measures similarity where 0 is no similarity and 1 is identical data sets.

RESULTS

We observed a total of 98 bird species during 267 presence-nonpresence surveys at 30 stations in spring, summer and winter (Table 1). Seventy-three species were identified on spring and summer landowner surveys (Table 1). Fifty-eight species were common to both surveys, and 40 species were unique to our surveys. There was a weak similarity between the list of bird species recorded on all our seasonal surveys and bird species listed on landowner surveys (J = 0.51). In a comparison of same season surveys (spring and summer), we detected 74 species with 21 species being unique to our survey. Landowner surveys listed 73 species with 21 species unique to those surveys. Although the two types of surveys yielded similar numbers of species, there were 29 unshared species and a slightly higher similarity (J = 0.56).

We analyzed 30 species in PRESENCE. The majority of these species (n = 20) did not have occupancy and detectability affected by season. Of the common resident bird species (n = 11), six had 75–100% occupancy (ψ) and high probabilities of detection (p) (Table 2). Nine of these species were also detected on landowner surveys (Table 1). The Brown-headed Cowbird (*Molothrus ater*) was present at 100% of sampling stations in spring then declined during summer and winter (spring ψ = 1.000, summer ψ = 0.206, winter ψ = 0.043). It had consistently low detections (p = 0.09) in all seasons. Indigo Buntings (*Passerina cyanea*) (ψ = 0.573, p = 0.219) and Yellow-billed Cuckoos (*Coccyzus americanus*) (ψ = 1.00, p = 0.102) had low detectability and differed in presence on landowner surveys. Yellow-billed Cuckoos occupied 100% of sites and were detected on landowner surveys, while Indigo Buntings occupied 57% of sites, but did not appear on landowner surveys.

Twenty species fit the simplest, constant single season model (Table 2). Northern Cardinal (*Cardinalis cardinalis*), Turkey Vulture (*Cathartes aura*), Brown-headed Cowbird, Carolina Wren (*Thryothorus ludovicianus*), Field Sparrow (*Spizella pusilla*) and Downy Woodpecker *(Picoides pubescens)* fit the multi-season model. Northern Cardinal occupancy decreased from spring to winter (spring ψ = 0.996, summer ψ = 0.911, and winter ψ = 0.898). Turkey Vulture occupancy was high in spring (ψ = 0.765), but declined in summer (ψ = 0.204) and winter (ψ = 0.109). Carolina Wren, Field Sparrow, Brown-headed Cowbird and Downy Woodpecker occupancy also decreased from spring to winter (Table 2).

Black-crested Titmouse (*Baeolophus atricristatus*), Painted Bunting (*Passerina ciris*), Eastern Phoebe (*Sayornis phoebe*) and Canyon Wren (*Catherpes mexicanus*) fit the multi-season model that allowed for variation in seasonal occupancy results and detectability. Occupancy and probability of detection declined from spring to winter for the Canyon Wren. Black-crested Titmouse and Painted

Table 1. Bird species recorded on presence-nonpresence surveys ([1]), landowner submitted surveys ([2]), or both ([1, 2]).

Species	Spring	Summer	Winter
Black-bellied Whistling-Duck (*Dendrocygna autumnalis*)[2]	—	—	—
Muscovy Duck (*Cairina moschata*)[2]	—	—	—
Wood Duck (*Aix sponsa*)[1]	—	X	—
Mallard (*Anas platyrhynchos*)[2]	X	—	—
Northern Shoveler (*A. dypeata*)[1]	—	—	X
Northern Pintail (*A. acuata*)[1]	—	—	X
Lesser Scaup (*Aythya affinis*)[1]	—	—	X
Ring-necked Pheasant (*Phasianus colchicus*)[1]	—	—	X
Wild Turkey (*Meleagris gallopavo*)[1, 2]	X	X	X
Northern Bobwhite (*Colinus virginianus*)[2]	X	—	—
Great Blue Heron (*Ardea herodias*)[1, 2]	X	X	X
Green Heron (*Butorides striatus*)[1]	X	X	X
Black Vulture (*Coragyps atratus*)[1, 2]	X	X	X
Turkey Vulture (*Cathartes aura*)[1, 2]	X	X	X
Sharp-shinned Hawk (*Accipiter striatus*)[2]	X	—	—
Cooper's Hawk (*A. cooperii*)[1]	X	—	X
Red-shouldered Hawk (*Buteo lineatus*)[1, 2]	X	X	X
Broad-winged Hawk (*B. platypterus*)[2]	X	—	—
Red-tailed Hawk (*B. jamaicensis*)[1, 2]	X	—	X
Crested Caracara (*Caracara cheriway*)[1]	—	—	X
Spotted Sandpiper (*Actinis macularius*)[1, 2]	X	X	X
Upland Sandpiper (*Bartramia longicauda*)[2]	X	—	—
White-winged Dove (*Zenaida asiatica*)[1, 2]	X	—	X
Mourning Dove (*Z. macroura*)[1, 2]	X	X	X
Inca Dove (*Columbina inca*)[2]	X	—	—
Yellow-billed Cuckoo (*Coccyzus americanus*)[1, 2]	X	X	—
Greater Roadrunner (*Geococcyx californianus*)[2]	X	—	—
Great Horned Owl (*Bubo virginianus*)[1]	X	X	—
Common Nighthawk (*Chordeiles minor*)[1, 2]	X	—	X
Chuck-will's-widow (*Caprimulgus carolinensis*)[2]	X	—	—
Chimney Swift (*Chaetura pelagica*)[1, 2]	X	X	—
Ruby-throated Hummingbird (*Archilochus colubris*)[1, 2]	X	X	—
Black-chinned Hummingbird (*A. alexandri*)[1, 2]	X	X	—
Belted Kingfisher (*Megaceryle alcyon*)[1]	X	X	X
Green Kingfisher (*Chloroceryle americana*)[1]	—	—	X
Golden-fronted Woodpecker (*Melanerpes aurifrons*)[1, 2]	X	X	X
Ladder-backed Woodpecker (*Picoides scalaris*)[1, 2]	X	X	X
Downy Woodpecker (*P. pubescens*)[1, 2]	X	X	X
Northern Flicker (*Colaptes auratus*)[1]	—	—	X
Eastern Wood-Pewee (*Contopus virens*)[1, 2]	X	X	X
Acadian Flycatcher (*Empidonax virescens*)[1]	X	X	—
Least Flycatcher (*E. minimus*)[1]	—	X	—
Eastern Phoebe (*Sayornis phoebe*)[1, 2]	X	X	X
Vermilion Flycatcher (*Pyrocephalus rubinus*)[1]	X	—	X
Ash-throated Flycatcher (*Myiarchis cinerascens*)[2]	X	—	—
Great Crested Flycatcher (*M. crinitus*)[2]	X	—	—
Western Kingbird (*Tyrannus verticalis*)[1]	X	—	—
Scissor-tailed Flycatcher (*T. forficatus*)[1, 2]	X	—	—
White-eyed Vireo (*Vireo griseus*)[1, 2]	X	X	—
Red-eyed Vireo (*V. olivaceus*)[1, 2]	X	X	X
Blue Jay (*Cyanocitta cristata*)[1, 2]	X	X	X
Western Scrub-Jay (*Aphelocoma californica*)[1, 2]	X	—	X
American Crow (*Corvus brachyrhynchos*)[1, 2]	X	X	X

Table 1. (*Continued*)

Species	Spring	Summer	Winter
Common Raven (*Corvus corax*)[1, 2]	X	—	X
Purple Martin (*Progne subis*)[1, 2]	X	X	—
Northern Rough-winged Swallow (*Stelgidopteryx serripennis*)[1, 2]	X	X	—
Barn Swallow (*Hirundo rustica*)[1, 2]	X	—	—
Carolina Chickadee (*Poecile carolinensis*)[1, 2]	X	X	X
Black-crested Titmouse (*Baeolophus atricristatus*)[1, 2]	X	X	X
Red-breasted Nuthatch (*Sitta canadensis*)[1]	—	—	X
Canyon Wren (*Catherpes mexicanus*)[1, 2]	X	X	—
Carolina Wren (*Thryothorus ludovicianus*)[1, 2]	X	X	X
Bewick's Wren (*Thryomanes bewickii*)[1, 2]	X	X	X
House Wren (*Troglodytes aedon*)[1]	—	—	X
Ruby-crowned Kinglet (*Regulus calendula*)[1, 2]	X	—	X
Blue-gray Gnatcatcher (*Polioptila caerulea*)[1, 2]	X	X	—
Eastern Bluebird (*Sialia sialis*)[1]	X	—	X
American Robin (*Turdus migratorius*)[1, 2]	X	—	X
Gray Catbird (*Dumetella carolinensis*)[2]	X	—	—
Northern Mockingbird (*Mimus polyglottos*)[1, 2]	X	—	X
Cedar Waxwing (*Bombycilla cedrorum*)[1]	X	—	X
Orange-crowned Warbler (*Vermivora celata*)[1]	—	—	X
Nashville Warbler (*V. ruficapilla*)[1, 2]	X	—	X
Northern Parula (*Parula americana*)[1, 2]	X	—	X
Yellow Warbler (*Dendroica petechia*)[1]	—	X	—
Yellow-rumped Warbler (*D. coronata*)[1, 2]	X	—	X
Golden-cheeked Warbler (*D. chrysoparia*)[1, 2]	X	—	—
Black-throated Green Warbler (*D. virens*)[1, 2]	X	—	—
Black-and-white Warbler (*Mniotilta varia*)[1, 2]	X	X	—
American Redstart (*Setophaga ruticilla*)[1]	X	—	—
Prothonotary Warbler (*Protonotaria citrea*)[1]	—	X	—
Ovenbird (*Seiurus aurocapilla*)[1]	—	—	X
Louisiana Waterthrush (*S. motacilla*)[1]	X	—	—
Common Yellowthroat (*Geothlypis trichas*)[1]	X	—	—
Summer Tanager (*Piranga rubra*)[1, 2]	X	X	—
Scarlet Tanager (*P. olivacea*)[1]	X	—	—
Spotted Towhee (*Pipilo maculatus*)[1]	—	—	X
Rufous-crowned Sparrow (*Aimophila ruficeps*)[1, 2]	X	—	—
Chipping Sparrow (*Spizella passerine*)[1]	—	—	X
Field Sparrow (*S. pusilla*)[1, 2]	X	X	—
Lark Sparrow (*Chondestes grammacus*)[1, 2]	X	—	X
Savannah Sparrow (*Passerculus sandwichensis*)[1]	—	—	X
Grasshopper Sparrow (*Ammodramus savannarum*)[1]	X	—	—
Fox Sparrow (*Passerella iliaca*)[1]	—	—	X
Song Sparrow (*Melospiza melodia*)[1]	—	—	X
Lincoln's Sparrow (*M. lincolnii*)[1]	—	—	X
White-throated Sparrow (*Zonotrichia albicollis*)[1]	—	—	X
White-crowned Sparrow (*Z. leucophrys*)[1, 2]	X	—	X
Dark-eyed Junco (*Junco hyemalis*)[1]	—	—	X
Northern Cardinal (*Cardinalis cardinalis*)[1, 2]	X	X	X
Blue Grosbeak (*Passerina caerulea*)[1, 2]	X	X	—
Indigo Bunting (*P. cyanea*)[1]	X	X	—
Painted Bunting (*P. ciris*)[1, 2]	X	X	—
Dickcissel (*Spiza americana*)[1, 2]	X	—	—
Common Grackle (*Quiscalus quiscula*)[2]	X	—	—
Great-tailed Grackle (*Q. mexicanus*)[1, 2]	X	X	X

Table 1. (*Continued*)

Species	Spring	Summer	Winter
Brown-headed Cowbird (*Molothrus ater*)[1, 2]	X	X	X
Orchard Oriole (*Icterus spurius*)[1]	—	X	—
Scott's Oriole (*I. parisorum*)[2]	X	—	—
House Finch (*Carpodacus mexicanus*)[1, 2]	X	—	X
Lesser Goldfinch (*Carduelis psaltria*)[1, 2]	X	—	—
American Goldfinch (*C. tristis*)[1]	—	—	X
House Sparrow (*Passer domesticus*)[1, 2]	X	—	—

Bunting had consistent 100% occupancy of all stations (Table 2). Black-crested Titmouse detection declined from spring to summer (spring $p = 0.622$, summer $p = 0.345$, then increased in winter winter $p = 0.433$) (Table 1). Painted Bunting detection declined from spring to summer (spring $p = 0.467$, summer $p = 0.275$). The Eastern Phoebe was the only species that had occupancy increase from spring ($\psi = 0.846$) to summer ($\psi = 0.898$), and winter ($\psi = 0.926$). Sixty-eight species lacked sufficient detections to be analyzed in PRESENCE.

DISCUSSION

Species expected to be detected by even novice birders did appear on landowner surveys. Common, year-round residents (Northern Cardinal, Carolina Chickadee (*Poecile carolinensis*), Carolina Wren, etc.) had high occupancy and were easily detectable by both presence-nonpresence surveys and landowner surveys. Of the 30 species capable of analysis in PRESENCE, the majority ($n = 20$) did not have occupancy and detectability affected by season. In theory this means the species is detectable any time of the year. Of these 20 species, four were not detected on landowner surveys. Those affected by seasonal changes were common species (Tables 1 and 2) and were detected on landowner surveys. This might indicate that landowners did not have difficulty detecting species in different seasons (i.e., spring and summer). With all but one seasonally affected species, occupancy declined from spring to winter. Many birds vocalize less outside the breeding season, making detection more difficult during non-breeding periods. The only species with which occupancy and probability of detection increased from spring to winter was the Eastern Phoebe. This species frequents areas near water, such as rivers. All our stations were located adjacent to the Blanco River, which might have made detection easier for this species associated with riparian habitats. The Eastern Phoebe is also known for vocalizing often and in any season, thus increasing detection (Weeks 1994).

The Acadian Flycatcher (*Empidonax virescen*), Indigo Bunting, Belted Kingfisher (*Megaceryle alcyon*) and American Goldfinch (*Carduelis tristis*) were unique to our surveys. The Acadian Flycatcher had both low occupancy and detection probabilities. Furthermore, *Empidonax* species are difficult to identify, even among professionals. All are small, similar in color and markings, and usually detected by song rather than sight. The Indigo Bunting is easily identified by sight. It occupied much of the same habitat as the Painted Bunting, which had 100% occupancy and high detection in spring and was also detected by landowners. The Indigo Bunting occupied 57% of sampling sites and had low detection probabilities. The species has a similar song to the Painted Bunting (Forsythe 1974), which may explain why they were not differentiated from Painted Buntings by landowners and were also not easily detected on presence-nonpresence surveys. The female Indigo Bunting is a drab brownish color (Payne 2006) and very similar to the drab olive-yellow color of the female Painted Bunting (Lowther et al. 1999), which could have further complicated detection by landowners. The Belted Kingfisher is almost entirely encountered near water. Landowner surveys did not focus on riparian areas, which may explain why they did not detect this species. And lastly, the American Goldfinch would not likely be detected, because it is a winter resident to this area and landowner surveys were typically conducted in spring and summer.

Jaccard Similarity Coefficient did not indicate a close similarity between our species list and landowners' species list. An index J of 0.90 must be obtained to claim similarity (Krebs 1999). Landowner surveys detected slightly more than 50% of the species on our presence-nonpresence surveys. The majority of the 40 species unique to our surveys were either winter only residents (43%), migratory (30%), or wading or water-foraging birds (17.5%). Landowner data were primarily breeding bird surveys, so winter resident species were largely absent. Some

Table 2. Occupancy (ψ), probability of detection (*p*), and standard error (SE) by species fitting multiseason and single season occupancy models.

Species	ψ	SE	*p*	SE
Multiseason Model				
Turkey Vulture				
Spring	0.7649	0.1644	0.2870	0.0689
Summer	0.2037	0.1068	0.2870	0.0689
Winter	0.1085	0.0594	0.2870	0.0689
Downy Woodpecker				
Spring	0.0526	0.0540	0.2650	0.1230
Summer	0.2078	0.0914	0.2650	0.1230
Winter	0.2631	0.1379	0.2650	0.1230
Eastern Phoebe				
Spring	0.8459	0.1337	0.3809	0.0764
Summer	0.8980	0.0772	0.1809	0.0464
Winter	0.9256	0.0868	0.5138	0.0674
Black-crested titmouse				
Spring	1.0000	0.0000	0.6222	0.0510
Summer	1.0000	0.0000	0.3448	0.0509
Winter	1.0000	0.0000	0.4333	0.0521
Canyon Wren				
Spring	0.6080	0.1270	0.1828	0.0589
Summer	0.4417	0.0880	0.4169	0.0903
Winter	0.3208	0.0929	0.5084	0.1071
Carolina Wren				
Spring	0.3534	0.1570	0.3247	0.1100
Summer	0.1739	0.0737	0.3247	0.1100
Winter	0.1520	0.0712	0.3247	0.1100
Field Sparrow				
Spring	0.1365	0.0636	0.6464	0.1213
Summer	0.0699	0.0480	0.6464	0.1213
Winter	–	–	–	–
Northern Cardinal				
Spring	0.9958	0.0369	0.7229	0.0321
Summer	0.9110	0.0453	0.7229	0.0321
Winter	0.8897	0.0546	0.7229	0.0321
Painted Bunting				
Spring	1.0000	0.0000	0.4667	0.0526
Summer	1.0000	0.0000	0.2753	0.1068
Winter	–	–	–	–
Brown-headed Cowbird				
Spring	1.0000	0.0000	0.0897	0.0295
Summer	0.2064	0.1343	0.0897	0.0295
Winter	0.0426	0.0554	0.0897	0.0295
Single Season Model				
Rio Grande Turkey	0.5336	0.1893	0.1049	0.0413
Black Vulture	0.0668	0.0457	0.4989	0.1189
Red-shouldered Hawk	0.5206	0.1550	0.1289	0.0418
Mourning Dove	0.6864	0.1401	0.1536	0.0369
Yellow-billed Cuckoo	1.0000	0.0000	0.1017	0.0227
Chimney Swift	0.2078	0.0925	0.2426	0.0946
Belted Kingfisher	0.6620	0.3966	0.0565	0.0372
Golden-fronted Woodpecker	0.8125	0.4917	0.0506	0.0337
Ladder-backed Woodpecker	0.5034	0.2939	0.1007	0.0640

Table 2. (*Continued*)

Species	ψ	SE	*p*	SE
Eastern Wood-Pewee	0.2078	0.0925	0.2426	0.0946
Acadian Flycatcher	0.2078	0.0925	0.2426	0.0946
Red-eyed Vireo	0.5602	0.0964	0.4189	0.0543
White-eyed Vireo	0.8056	0.0948	0.3309	0.0471
Carolina Chickadee	1.0000	0.0000	0.5580	0.0304
Bewick's Wren	0.6620	0.3966	0.0565	0.0372
Ruby-crowned Kinglet*	0.4864	0.1717	0.3198	0.1188
Blue-gray Gnatcatcher	0.4830	0.2236	0.1282	0.0647
Summer Tanager	0.8319	0.1126	0.2774	0.0468
Indigo Bunting	0.5728	0.1455	0.2098	0.0592
American Goldfinch*	0.8056	0.2157	0.3034	0.0937

*Present in winter only.
–No estimates.

early landowner surveys could detect late departing winter residents, but they did not detect this group of birds as well as our surveys. Only a slight increase in similarity was obtained by comparing our spring and summer data to landowners' surveys. Thirty percent of species undetected by landowners were migratory, so they were uncommon or only in the area for a short time. This would make them difficult to detect on a survey, especially for a novice birder or for surveys only conducted once per year.

Species that we found difficult to detect such as the Eastern Wood-Pewee (*Contopus virens*) and Downy Woodpecker were also present on landowner surveys, which indicate landowner data may have limited usefulness for biologists. Many species detected by landowners and absent from our surveys ($n = 21$), such as Greater Roadrunner (*Geococcyx californianus*), were not found in the riparian zone and domesticated species of ducks, such as Mallard Duck (*Anas platyrhynchos*) and Muscovy Duck (*Cairina moschata*) generally occur on man-made ponds and tanks near residential areas of properties. Furthermore, 68 species detected on presence-nonpresence surveys had insufficient detections to run in PRESENCE. Had these data been analyzed more insights may have provided into the similarities between presence-nonpresence surveys and landowner surveys.

In order for landowner surveys for open land wildlife exemptions to be a viable tool for biologists, we suggest several modifications. Most importantly is the necessity for environmental consulting firms and/or landowners to conduct multiple year-round surveys. At least one survey a season would record not only breeding and migrating avifauna but summer and winter residents. Survey replicates would increase sample size, validity of surveys, decrease error, and validate their scientific usefulness. Additionally, if properties adjoin a significant riparian area, survey stations should be located in that habitat. These changes would probably increase the similarity index and species with low occupancy or detection probabilities recorded on landowner surveys in comparison to our surveys.

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BEHAVIORAL ECOLOGY OF A BLUE-CROWNED PARAKEET (*ARATINGA ACUTICAUDATA*) IN A SUBTROPICAL URBAN LANDSCAPE FAR FROM ITS NATURAL RANGE

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ABSTRACT.—I tracked an escaped captive Blue-crowned Parakeet (*Aratinga acuticaudata*) for several months in suburban Houston, Texas, to study aspects of its behavioral ecology. The parakeet was in flight 6% of detections and perched 94%, primarily in a tree, and less frequently on a power line or roof top. Tree species most frequently perched in were pecan (*Carya illinoinensis*), and less frequently in hackberry (*Celtis occidentalis*) or water oak (*Quercus niger*). The parakeet was associated with Rock Doves (*Columba livia*) 11 times (mean flock size = 22.8, r = 3–40). Total MCP home range size of perched locations was ~200 m^2, with the main core area of use ~10 m^2. Comparisons are made with a feral individual that lived among a flock of Red-masked Parakeets (*A. erythrogenys*) in San Francisco.

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Introduced birds are interesting study subjects, as they are outside their natural range and consequently are forced to adapt ecologically or perish. Whether the species fails or thrives in the new environment is a strong indicator of its niche breadth. Indeed, some introduced species that are successful pose an environmental threat as they displace native species (e.g., collared dove, *Streptopelia* sp.), whereas others never really have the numbers to comprise a substantial founder populations (e.g., several species of parrots and finches). While individuals of species introduced in small numbers fail to establish a stable population, their persistence, even if non-permanent, is of interest in terms of how they adapt and live within the new environment (Brooks 2008).

The Blue-crowned Parakeet (*Aratinga acuticaudata*) has a wide range with three allopatric populations in the Guiana Shield of northern South America, northeastern Brazil, and the Chaco (Forshaw 1989). Despite its abundance in at least some areas (c.f., Brooks 1998), there have been relatively few studies on this species. However, Carillo (2007) studied factors affecting reproduction in the Critically Endangered Margarita Island subspecies (*A. acuticaudata neoxena*); whereas Garrett et al. (1997) studied food habits of an introduced population in southern California. However, no studies have focused on certain aspects of behavioral ecology, such as preferred perch type or home range (Forshaw 1989), albeit in a suburban environment far from the species natural distribution. Herein I provide behavioral and ecological observations on an individual Blue-crowned Parakeet that escaped from its owner's house in suburban Houston, Texas.

METHODS

The study area encompassed the following streets borders, all in Houston, Tx (77019): Haddon St. (north border), Woodhead St. (east), Indiana St (south) and McDuffie St. (west). Searches for the parakeet were made during several months (22 June–24 November 2005), and were generally done twice a week (r = 1–4 times/wk) with one or more days between consecutive searches. I rode a standard one-speed bicycle approximately 1–2 km each morning no later than 1 h after sunrise looking for the parakeet. Searches were made in the area where the parakeet was last seen, and then listening for its unmistakable dawn calls until it could be located with its voice. Upon spotting the bird, its location and perch type (including identification of tree, where applicable) was noted, as well as any additional observations (behavior, other species associated with, etc.). For the sake of comparison, data are included for a single *A. acuticaudata* that lived with a very large feral flock of Red-masked Parakeets (*A. erythrogenys*) in San Francisco (Bittner 2005, in litt.), and this group will be referred to as 'the SF population', below.

RESULTS AND DISCUSSION

The parakeet was located 37 times during 31 d of searches, observed once/day except for 6 d when it was observed twice during a given morning.

The parakeet was in flight upon detection twice (6%) and was perched 32 times (94%). Of the 32 observations where the parakeet was perched, it was mostly found in a tree, with less frequent observations on a power line or roof top (Table 1). Most of the observations of the parakeet perching in a tree involved foraging on young fruits or resting; however, it was also observed sunbathing in the crown of a large hackberry once (1 November 2005). More than two-thirds of the trees the parakeet was perched in were pecans (*Carya illinoinensis*), with a few observations in a hackberry (*Celtis occidentalis*), water oak (*Quercus niger*), or unspecified (pecan or hackberry; Table 2). The SF population roosted most frequently in poplar (*Populus sp.*), and used loquat (*Eriobotrya* sp.), pine (*Pinus* sp.), eucalyptus (*Eucalyptus sp.*) and cypress (*Cupressus* sp.) trees to a lesser degree, nesting almost exclusively in palm trees (Bittner in litt.).

Table 1. General perch type used by the Blue-crowned Parakeet in Houston, Texas.

Perch	**#**	**%**
Tree	20	62%
Power line	7	22%
Roof	5	16%
Total	**32**	**100%**

Table 2. Tree species used for perching by the Blue-crowned Parakeet in Houston, Texas.

Tree Species	**#**	**%**
Pecan (*Carya illinoinensis*)	14	70%
Hackberry (*Celtis occidentalis*)	2	10%
Water oak (*Quercus niger*)	2	10%
Unidentified	2	10%
Total	**20**	**100%**

The parakeet was associated with Rock Doves (*Columba livia*) 11 times, with flock size of the perched doves averaging 22.8 (r = 3–40). The majority of the observations (n = 8, 73%) involving the parakeet's association with the doves were during the latter half of the study (September–November), when the parakeet was being offered peanuts each morning by an elderly lady who fed the doves each morning. The parakeet was not observed in association with any other species during the study duration. While doves are not related to *Aratinga*, the parakeet may have associated with a large flock of birds to reduce predator risk, even if they were unrelated. However, if there had been other psittacids in the area, it is likely the parakeet would have associated with such confamilials. For example, as mentioned previously, an individual feral *A. acuticaudata* lived in association with a flock of Red-masked Parakeets (*A. erythrogenys*) (Bittner 2005).

Total home range size as measured with a minimum convex polygon of perched locations was approximately 200 m^2 (Fig. 1). On 8 August 2005 the bird flew in a broad circle spanning approximately 400 m^2 (2 square blocks). In contrast, a home range of approximately 35–55 km^2 was found for the SF population (Bittner in lit.). While home range size will fluctuate substantially with flock size, it also may vary depending upon season and resource availability. Seasonal movements apparently do not occur in nature however for *A. acuticaudata*. For example, in the Paraguayan Chaco this species was present at the same study site year round (Brooks 1997).

Site fidelity of the parakeet was comparatively conservative, with the main core of use being approximately 10 m^2 (Fig. 1). The reason for the small area of core usage was due to the consistent resource of peanuts being offered by the elderly lady. A newly escaped psittacid would have much broader core use, or lack any form of site fidelity entirely. For example, an escaped pet Green-winged Macaw (*Ara chloroptera*) was reported at no less than four individual locations, with a flight path exceeding 6 km (Fig. 2). The first location was

Figure 1. Map of the study region with scale in the lower left corner. **Color Key:** blue = pecan tree (*Carya illinoinensis*), red = hackberry tree (*Celtis occidentalis*), purple = water oak tree (*Quercus niger*), green = phone line, yellow = roof top. Image

Figure 2. Map of site locations of an escaped Green-winged Macaw (*Ara chloroptera*), spring 1995 (D. Brooks and L. Schoen, unpubl. data). Image google.com.

the high-rise apartment the bird escaped from, and the last two reports were from members of the public dining outdoors on restaurant patios when the tame bird flew onto their table begging for food (D. Brooks and L. Schoen, unpubl. data).

This study provides observations of an urban Blue-crowned Parakeet which were unknown prior, including preferred perch type and tree species, and home range size. Even though the study area is not indicative of the parakeet's true range of distribution, it will be interesting to see whether the data differ from the species in its natural habitat. Comparative studies await data recorded within the natural range of distribution.

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THE EFFECTS OF BODY SIZE AND ROOST SITE ON WINTER DIE-OFF OF CAVE SWALLOWS

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ABSTRACT.—An unusually cold and wet weather event occurred in San Marcos, Texas, USA during January 2007, resulting in large numbers of dead Cave Swallows (*Petrochelidon fulva*). Surveys of all known roosting areas within the city limits revealed a complete die-off of Cave Swallows; we collected 123 dead swallows from eight roost sites. Measurements of dead swallows indicated the birds that died along Interstate underpasses during the cold spell had smaller bodies yet were heavier than those in a parking garage. Thermometers placed at the two roosting site types revealed that the underpasses were ~5 °C colder than the parking garage site during the coldest part of the day. Extreme temperatures may have affected Cave Swallows using underpasses more so than swallows roosting in the parking garage. Higher post-mortem body condition (log mass/log tarsus length) may suggest death from starvation for birds in garage and cold exposure for birds under bridges. Future studies that examine environmental differences between multiple roost sites may provide stronger support for our findings and have implications for northward range expansions of species in the face of global climate change.

The effects of winter mortality have long been speculated as a driving force in the evolution of animal morphology in temperate climes (Darwin 1859). Cave Swallows (*Petrochelidon fulva*), at the northernmost extent of the their range in Texas and New Mexico, occasionally encounter extreme low temperatures and long periods of precipitation in winter and early spring (Witzeman et al. 1979, West 1995). Historically, caves serve as primary nesting and roosting sites for Cave Swallows, but breeding colonies have been reported in sinkholes, under bridges, in culverts, and similar structures (West 1995). Human-made structures have been hypothesized to facilitate the northward expansion of Cave Swallows (Martin and Martin 1978, Martin 1981, West 1995). Cave Swallows expanded their breeding range in Texas dramatically and colonized portions of central and south Texas by the 1990s (West 1995, McNair and Post 2001, Kosciuch et al. 2006). Most Cave Swallows are resident, but breeding populations in New Mexico and Texas may migrate south in winter (West 1995).

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Cave Swallows forage primarily on a wide variety of flying insects (West 1995). Temperatures below freezing can limit flying insects and lead to emaciation and death of swallows (Pearson 1953, Stewart 1972, Ruge 1974, Dubowy and Moore 1985, West 1995, Brown and Brown 1998, 2000). Heavy precipitation can also keep swallows at their roost site for long periods, limiting foraging opportunities. One such event in late September 1978 (Witzeman et al. 1979) killed several hundred Cave Swallows at Carlsbad Caverns (West 1995).

Central Texas experienced prolonged sub-freezing temperatures accompanied by precipitation from 15–19 January 2007 (Fig. 1). The objectives of our study were to survey known roosting sites for live and dead Cave Swallows in the San Marcos, Texas, USA area and examine variation of body mass and body condition between dead and surviving swallows and within roost sites.

METHODS

In San Marcos, Texas, Cave Swallows roost at Alkek parking garage (hereafter Alkek) on the campus of Texas State University (TSU) and beneath underpasses of Interstate 35 (hereafter Bridges). Cave Swallows were initially reported dead on 21 January, 2007 at the Alkek Library Parking Garage (29° 53' 18.34" N, 97° 56' 43.29" W) on the TSU campus. Following the discovery, a comprehensive search for dead and living Cave Swallows from other structures on the campus and along the interstate (e.g., overpass bridges) was conducted daily. We surveyed nine known roosting sites for living and dead Cave Swallows in the greater San Marcos area every day between the dates of 21–26 January 2007. For each daily search, we collected all dead Cave Swallows found intact and searched for any individuals that survived. We found no surviving Cave Swallows at any of the nine sites.

All birds found were weighed and measured for tail length, wing chord (right and left), bill length, bill width, and tarsus length (right) upon collection. Weights were taken with a digital scale accurate to 0.01 g. Tail length was measured by abutting a metal ruler from the base of the underside of the tail and recording the length of the longest rectrice. Wing chord was measured using a standard metal ruler along the leading edge of the wrist joint to the most distal primary feather tip. Bill width and length were measured with digital calipers from where the base of the bill attaches to the frontal bones of the skull to the tip. Tarsus was measured from the intertarsal joint to the distal edge of the last scale anterior to the toes.

In January 2008 during a similar but not as severe cold weather event (temperature range −3° C to 8° C),

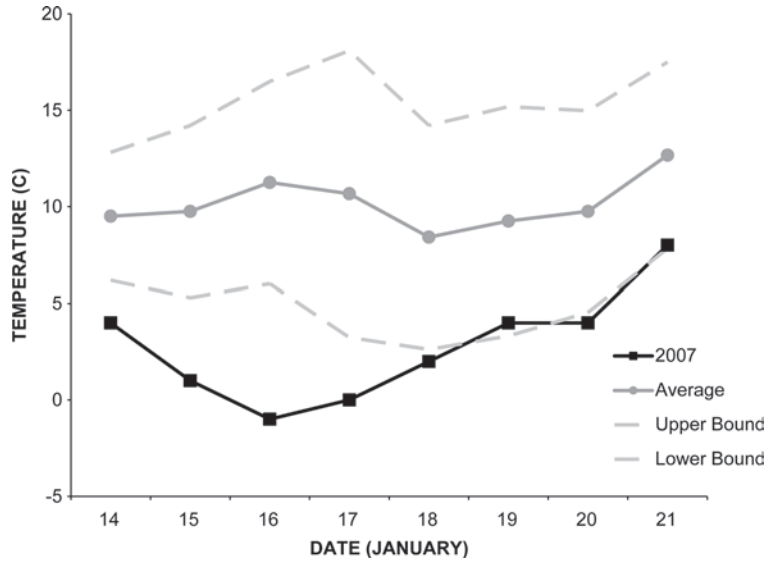

Figure 1. Mean air temperature in San Marcos, TX, USA for January 2007 and mean January temperatures from 1996 to 2008 bounded by one standard deviation above and below.

we measured the ambient temperature at Alkek and the Bridges where majority of the carcasses were found in 2007. Temperatures were recorded with Thermochron DS1920 iButtons® (Dallas Semiconductor Maxim, Maxim Integrated Products, Inc. 120 San Gabriel Drive, Sunnyvale, California). The devices were set to record temperature every 30 min for a week spanning the same time period that the swallow mortality occurred in 2007. All iButtons® were placed in previously used swallow nests to adequately measure actual nest temperature (without a bird present). Eight iButtons® were randomly placed in Alkek, which Cave Swallows often use as winter roosting sites (Green, pers. obs.); four of these were in nests on light fixtures and four were in nests attached to the wall or ceiling. For the Bridges along I-35, four iButtons® were placed in old nests under the State Highway 123 underpass (29° 53' 09.00" N, 97° 56' 20.61" W), and four under the Aquarena Springs Road underpass (29° 53' 34.18" N, 97° 54' 44.49" W).

We conducted a MANOVA to examine differences in mass, morphometric measurements, and body condition between two different roost structures – Alkek and Bridges (Program R, version 2.3.1). Body condition was calculated using log(mass)/log(tarsus length) to separate the effects of body size on mass (Brown and Brown 1998). Paired *t*-tests were used to compare mean temperatures between sites and between nesting substrates.

RESULTS

We found 123 dead Cave Swallows near eight roost site locations. No other species of swallow were found dead or alive at any site. For our analyses, we only used 88 carcasses as some of them had already been damaged (n = 21) from scavengers (e.g., feral cat) and some were waterlogged (n = 14). A MANOVA that included 34 carcasses from Alkek and 54 carcasses from Bridges indicated significant differences between sites (Pillai = 0.6998, df = 1, $P < 0.001$). Between roost sites, Cave Swallows found dead at Alkek had significantly less mass (g) and significantly greater tarsus and tail length than swallows found dead at the Bridges (Table 1). Body condition was also significantly greater in Bridge birds than Alkek birds. The differences in wing chord lengths were not considered significant.

Mean daily low temperature from 12–20 January, 2008 was significantly different between roost sites. The Alkek site was 4.32° C–5.82° C warmer than the Bridge sites ($t_8 = 15.62$, $P < 0.001$; Fig. 2). Also, within the Alkek site, nests on lighting fixtures were significantly warmer than nests on the ceiling of the garage ($t_8 = 14.64$, $P < 0.001$). Nests within Alkek not on lighting fixtures were significantly warmer than Bridge sites ($t_8 = 7.59$, $P < 0.001$).

DISCUSSION

We found no live birds after the weather event in 2007 and therefore were unable to compare the masses of dead and living birds. The inability to compare any surviving birds to the swallow carcasses limits our inferences we can draw about selection events. The birds we found dead were emaciated as body mass averaged 13.9g ($n = 102$), considerably less than reported mean mass of ~20.4g for *P. fulva pallida* (Selander and Baker 1957).

Table 1. Mean ± Standard Error (S.E.) mass (g) and morphometrics (mm) of Cave Swallows (*Petrochelidon fulva*) found dead at wintering roost sites in San Marcos, Hays County, Texas, U.S.A. between 21–26 January 2007[A].

	Garage		Bridges			
	Mean	**S.E.**	**Mean**	**S.E.**	***F***	***P***
Weight	12.16	0.16	14.39	0.13	111.42	<0.001
Tail Length	50.18	0.30	49.42	0.21	4.35	0.040
Right Wing Chord	108.21	0.40	107.24	0.30	3.82	0.054
Left Wing Chord	108.27	0.40	107.39	0.31	3.02	0.086
Tarsus	14.44	0.08	14.19	0.08	4.79	0.031
Bill Length	9.36	0.07	9.42	0.08	0.30	0.586
Bill Width	9.26	0.08	9.10	0.07	1.85	0.178
Body Condition[B]	0.94	0.01	1.01	0.01	124.54	<0.001

[A]Garage, n = 34; Bridges, n = 54.
[B]Body Condition = log(mass)/log(tarsus length); Brown and Brown 1998.

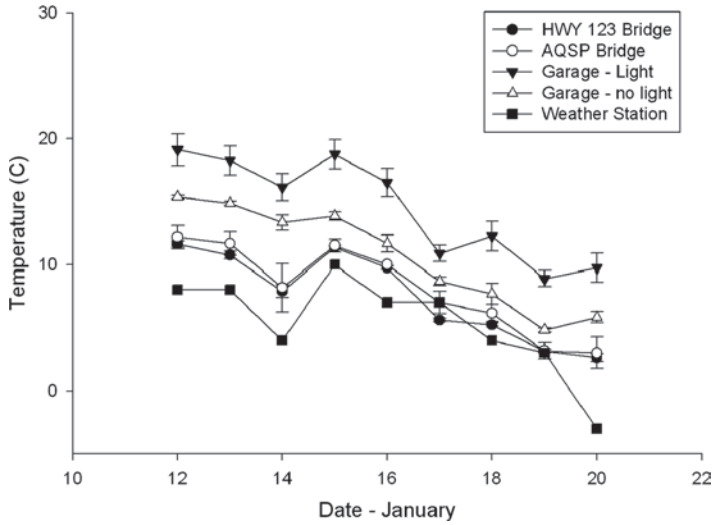

Figure 2. Mean daily low temperatures of Cave Swallow roost substrates in San Marcos, Texas, USA from 12–20 January, 2008. Temperature was recorded at two Interstate 35 bridges (Hwy 123 underpass 29° 53' 09.00" N, 97° 56' 20.61" W and Aquarena Springs Road underpass (29° 53' 34.18" N, 97° 54' 44.49" W) and at two sites (nest on light fixture and nest on garage support) in Alkek parking garage 29° 53' 18.34" N, 97° 56' 43.29" W) on Texas State University campus. Weather station data comes from National Weather Service data for San Marcos, Texas, USA.

Only tarsus length and mass were significantly different between roost sites. The differences were the inverse of what would be expected. Tarsus length has been suggested as an indicator of body size (Rising and Somers 1989, Freeman and Jackson 1990) and therefore one would expect that birds with longer tarsi would also have greater mass. This relationship of tarsus to mass can be used to indicate body condition (Jakob et al. 1996, Brown and Brown 1998). Our results suggest that birds from the Bridge roost sites had smaller tarsus lengths but had greater body mass. Based on body condition indices, the Bridge birds died with higher amounts of body fat than birds at the Alkek site.

Although all birds collected eventually succumbed to the weather event, roost site appeared to influence the cause of mortality. Our lack of replication for roost sites limits the conclusions we can draw about observed roost site differences. We did observe differences in body condition between roost sites. The Alkek site appears more protected from the elements (e.g., wind chill and precipitation) than the Bridge sites, and has lighting fixtures that may keep the structure more thermally stable. Colder roost sites could cause birds to succumb to hypothermia at higher fat ratios than birds in more thermally stable environments. Support for this was a significant difference of 5.6° C between roost sites during the coldest time of the day and a significant difference in body condition between roost sties. Birds within Alkek may eventually have succumbed to hypothermia or starved as a result of over 3 d of sub-freezing temperatures and precipitation that presumably diminished food availability.

From our study, parking garages appear to serve as better alternatives for over-wintering Cave Swallows than underpasses. Coupled with potential climate change and evolution of body design, parking garages and equitable structures may provide the habitat needed to further promote expansion of the Cave Swallow's range. During spring months of 2008 when temperatures were warmer, Cave Swallows returned to Alkek. These are presumably individuals that migrated soon after the winter event. The following winter, we were only able to observe a few Cave Swallows present at roosting sites in January 2008. By fall-winter 2008–2009, the population at Alkek and Bridges had rebounded.

Our opportunistic study only looked at temperature differences between roost sites and

did not have any replicated sites for the Alkek garage. Humidity, air flow, solar exposure and other environmental factors are potentially important parameters in nest site selection and in determining the fate of nest occupants. Additionally, measurements of nest site selection parameters within structures would be an interesting comparison. Future studies that examine environmental differences between multiple roost sites may provide stronger support for our findings and have implications for northward range expansions of species in the face of global climate change.

ACKNOWLEDGMENTS

Birds were collected under salvage permits to M. Clay Green (Texas Parks and Wildlife permit #SPR-0106-005 and U.S. Fish and Wildlife Service permit #MB-121162-0). Live birds captured at Alkek parking garage were permitted under IACUC #0830_0930_30 and Master Banding Permit #23546 to M. Clay Green. We thank Francis Rose for the use of Thermocron© iButtons for temperature data, and Austin Hill for assisting in placement and collection of thermometers. We thank William Simper, Meaghan McMonagle, Amy Connolly, and Johnny Scalise for assistance in live capture of Cave Swallows. We also thank Butch Weckerly, Charles Brown, Steve West and two anonymous reviewers for their insightful comments on earlier drafts of this manuscript.

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SHORT COMMUNICATIONS

TWO RECORDS OF RUBY-THROATED HUMMINGBIRDS FROM THE TRANS-PECOS REGION OF TEXAS

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The Ruby-throated Hummingbird (*Archilochus colubris*) occurs throughout eastern North America, north into southern Canada, west into the Great Plains, and southwards to southern Texas and the Gulf Coast (Johnsgard 1997). In Texas, the breeding range of the Ruby-throated Hummingbird encompasses the eastern half of the state, and it may be encountered during migration from the Panhandle south into the Rio Grande Valley (Oberholser 1974, Johnsgard 1997, Shackelford et al. 2005). In the Trans-Pecos region of Texas the Ruby-throated Hummingbird has been listed as a "rare migrant" (Oberholser 1974), and a "very rare spring, summer, and fall straggler" (Peterson and Zimmer 1998). Wauer (1973) considered the Ruby-throated Hummingbird a "rare migrant or post-nesting visitor", but speculated the birds might be more common in the region because males are easily overlooked and females are extremely difficult to distinguish from female Black-chinned Hummingbirds (*Archilochus alexandri*) in the field. More recent visual observations suggest Ruby-throated Hummingbirds may indeed be more common in the Trans-Pecos region than initially thought, with moderate numbers occasionally sighted from early August through late October (Lasley and Sexton 1992, 1993, 1994, Lockwood 2004), and two winter records (Lockwood 2003, Lockwood et al. 2007). We regard an early report (Montgomery 1905) that Ruby-throated Hummingbirds were "common" in the Del Norte Mountains near Alpine (Brewster County) as erroneous, and attribute it to the misidentification of Black-chinned Hummingbirds.

Here we report the collection of two Ruby-throated Hummingbirds during 2007 from the campus of Sul Ross State University (30°21.81′N; 103°38.98′W; altitude = 1395 m) in Alpine, Brewster County, Texas (Fig. 1). These hummingbirds were found dead below the Warnock Science Building after colliding with plate glass windows, prepared as study skins, and deposited in the James F. Scudday Vertebrate Collection (SRSU) at Sul Ross State University. Standard measurements (wing cord – longest retrice – culmen – tarsus) are given in mm followed by mass in grams (Hall 1962). A male (SRSU 2001) in adult plumage was found on 25 July (40–29–16–3–2.8; testes length = 1 mm), and an immature (SRSU 2002) was found on 26 September (43-27–18–4–2.7). The plumage of the immature specimen is somewhat similar to a female Black-chinned Hummingbird; however, the culmen length of both specimens is within the range given for Ruby-throated Hummingbirds (15.0 to 19.5 mm) and less than that of Black-chinned Hummingbirds (Johnsgard 1997). We are unable to confidently determine the sex of the immature bird; based on plumage it appears to be a female, but small (length < 1.0 mm) paired structures resembling testes were noted during preparation of the skin. Notably, these were the only two hummingbirds of any species that we found dead as a result of window collisions

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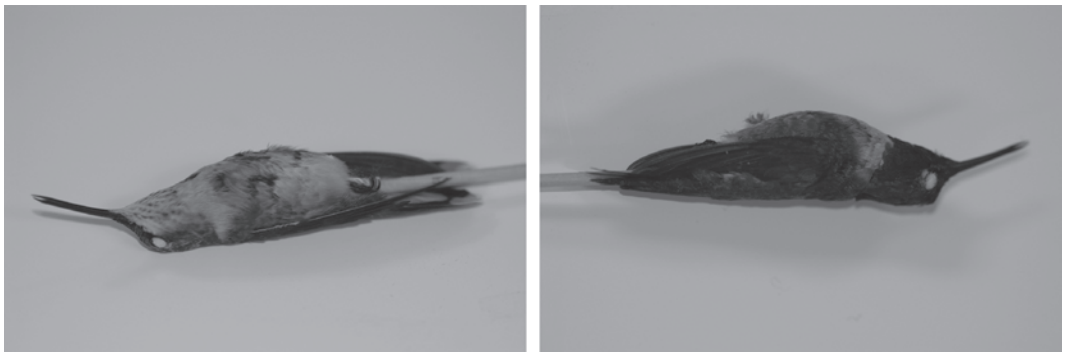

Figure 1. Ventral and lateral views of an adult male (right) and immature (left) Ruby-throated Hummingbird collected in Alpine, Texas on 25 July and 26 September 2007, respectively. Specimens deposited in James F. Scudday Vertebrate Collection at Sul Ross State University (SRSU 2001, 2002).

in 2007 despite frequent inspection of the Warnock Science Building perimeter. To our knowledge, a male Ruby-throated Hummingbird collected in Jeff Davis County on 20 July 1998 and deposited in the Natural History Collection at Angelo State University, and our two birds represent the only museum specimens of Ruby-throated Hummingbirds available from the Trans-Pecos region of Texas. Importantly, these specimens confirm previously published visual observations from the region, and provide documentation of the inland migratory path followed by Ruby-throated Hummingbirds, which at present is poorly understood (Robinson et al. 1996).

ACKNOWLEDGMENTS

We thank Mark Lockwood for confirming our identification of the immature Ruby-throated Hummingbird, and Steven W. Cardiff for searching the collections of the Museum of Natural Science at Louisiana State University. Insightful comments by Mark Lockwood greatly improved an initial draft of this manuscript. Lewis Medlock assisted with searching for window-killed birds.

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A CASE OF A COMMON LOON (*GAVIA IMMER*) INGESTING FISHING GEAR

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Although rarely documented in nature, avian mortalities may occur due to prey blocking the esophagus, ultimately choking the bird (e.g., Holte and Houck 2000, Brooks and Steingreaber 2002) or foreign objects such as fishing tackle. With respect to fishing tackle, uncommon birds have died due to ingestion (e.g., Arnold 1994, Magee and Brooks 2007), whereas others have had fishing hooks lodged in the mandibles and/or oral cavity (e.g., Chatwin 1956, Bennett and Erickson 1962). In all cases (frigatebird, grebes, gull) the birds were aquatic or maritime piscivores. Herein I report a case of a Common Loon (*Gavia immer*) ingesting fishing tackle, although it is uncertain if this is what led to its demise.

Houston Museum of Natural Science's Department of Vertebrate Zoology received a salvaged Common Loon (HMNS VO-2076) that was found on Surfside Beach, Brazoria County, Texas, on 27 May 2007. This full breeding plumaged adult female (skull completely ossified, ovary = 6 × 26 mm [ovules ranging 0.5 – 2.0 mm]) was prepared as a study skin on 3 September 2008 by Martha Magee.

The data that arrived with the deceased specimen from salvager Dana Simon indicated it died of a chest impact and was emaciated, which was confirmed, as the bird had zero fat content and weighed 2.13 kg. As part of the process of standard specimen preparation, the stomach was opened so that its contents could be measured and recorded. All that was found in the stomach was 6.6 g of gravel, a ball of fishing line (~1.15 cm maximum diameter), and a small pear-shaped

Figure 1. Female Common Loon (HMNS VO-2076) with fishing tackle found in stomach mounted on 7.5 cm wide tag in foreground (photo by D. M. Brooks).

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fishing weight (1.5 cm high × 0.65 cm maximum width).

There was extensive bruising on the skin, which confirmed that this loon was impacted (M. Magee in lit.). The situation leading to the chest impact is unknown however. It is possible that this loon was emaciated from suffering chronic lead poisoning due to the swallowed fishing weight; then being weak, was unable to move out of the path of a boat or jet ski and was impacted (D. Simon in lit.).

ACKNOWLEDGMENTS

Kind thanks to Dana Simon for providing the salvaged specimen, and to Martha Magee for alerting me to the fishing tackle ingested by this specimen. Also to both of these individuals for proof-reading the manuscript before it was submitted.

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CATTLE ECTOPARASITES USED AS A WINTER FOOD SOURCE BY EASTERN PHOEBE *SAYORNIS PHOEBE*

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On 23 December, 2004, with a high temperature of only −2° C and a low of −13° C, per notes taken that day, I noted an Eastern Phoebe (*Sayornis phoebe*) on about two dozen occasions, fly from a fence to the nearby wooly shoulders of pasturing cows on a farm near Milo, Carter County, Oklahoma, (34 19′53.49″ × 97 22′ 49.97″).

The phoebe was observed as it hovered in flight to probe the approximately 3.5–4.5 cm. long hairs immediately on or just behind the cattle's shoulders. This behavior was seen from inside a pick-up truck at a distance of 4–8 m using 8 × 42 mm binoculars and the naked eye. The cattle present anticipated being fed and as a result were close for this observation. The phoebe flew from one cow to another, obviously seeking something. I saw no signs of hair collection by the bird. It appeared to be searching for ectoparasites, at least I suspected this was the case.

Three years later also on 23 December 2007, I noted another phoebe, engaged in the same behavior at the same location. While I failed to record the temperature at the time of this observation, I did record −9° C as a low that morning. During this time I could clearly see that the phoebe had captured and consumed something it had found on several of the approximately 20–22 visits to the cattle over approximately 25 min of observation. After the previous observation in 2004, I made an effort to find the source of the bird's attraction to the cattle. I approached a tame heifer and ran my fingers through the longer hairs of the shoulder. There I discovered a number of groups of clumped flies, (*Diptera*), possibly face flies (*Musca autumnalis*). These flies seemed to have survived the cold under those warmer and more protected conditions. The phoebe was clearly penetrating the long hairs to capture these insects. This behavior has not been documented previously for this species. (Weeks and Harmon 1994).

I later watched as the phoebe continued this feeding behavior for approximately 10 more min. There were no other obvious food resources nearby

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given the stated temperature conditions, including berries that I was aware of. The roost site of the phoebe was on a hanging roll of wire in tool shed about 28–30 m away from where these observations were made. This same roost site was used by the 2004 individual, perhaps the same bird.

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NOTES ON BROWN-HEADED NUTHATCH BEHAVIOR

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I spent several hours daily from 28–29 April 2007 observing two Brown-headed Nuthatches (*Sitta pusilla*) foraging on large pine trees (*Pinus sp*) in a suburban area of northwest Houston. I documented unreported behaviors in the literature, including the *The Birds of North America* species account (Withgott and Smith 1998).

A well-known behavior of most birds is scratching the head with the feet. Withgott and Smith (1998) specifically stated head-scratching behavior had not been observed in the Brown-headed Nuthatch. Such behavior is also unknown for the other species of North American nuthatches (Pravosudov and Grubb 1993, Ghalambor and Martin 1999, Kingery and Ghalambor 2001). It seems any bird with this kind of foot structure would have difficulty using them as a scratching tool, and I have never observed such use. But, as with all other birds, they should have a need to scratch their heads, an area of the body not accessible to their bills. I observed Brown-headed Nuthatches accomplish head-scratching by rubbing their heads against branches (Fig. 1). This process is

Figure 1. Brown-headed Nuthatch scratching its head by rubbing it against branches. Photo copyright ©Mark B. Bartosik.

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Figure 2. Nuthatch performing body shaking sometimes followed by head flipping. Photo copyright ©Mark B. Bartosik.

Figure 3. Brown-headed Nuthatch when it found a snail. The snail was taken to a horizontal branch (high in the canopy), hammered and consumed. Photo copyright ©Mark B. Bartosik.

quite different from bill cleaning, where the bird's head does not come into contact with a branch. I observed Brown-headed Nuthatches performing this operation several times on different occasions, and the process lasted several seconds.

I also observed body shaking (shaking whole plumage) and head flipping (Fig. 2) in Brown-headed Nuthatches. These behaviors were not mentioned by Withgott and Smith (1998).

Finally, I observed Brown-headed Nuthatches consuming a snail (Fig. 3). The snail was taken to a horizontal branch (high in the canopy), hammered, and consumed. I found no references for consumption of snails by Brown-headed Nuthatches (Withgott and Smith 1998). I could not determine, however, if the whole snail was consumed or just pieces of the shell.

Even short-term opportunities for observing birds in the field can yield interesting noteworthy results. Many more photographs of Brown-headed Nuthatches and their behaviors can be found using this link on the Internet: http://www.pbase.com/mbb/_brownheaded_nuthatch_april28_2007.

ACKNOWLEDGMENTS

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LACK OF AGGRESSION BETWEEN COHABITING NESTING WHITE-WINGED DOVES AND GREAT-TAILED GRACKLES

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Great-tailed Grackles (*Quiscalus mexicanus*) are considered predators of White-winged Dove (*Zenaida asiatica*) eggs and nestlings (Cottam and Trefethen 1968, Schwertner et al. 2002). However, the actual impact the grackle has on dove production remains unresolved (Hayslette et al. 2000). This note documents the nesting of five pairs of White-winged Doves in close proximity to a pair of Great-tailed Grackles, in a netleaf hackberry tree (*Celtis laevigata var. reticulata*).

Both the Great-tailed Grackle and White-winged Dove occur sympatric though out central Texas and prefer the same urban habitat, although the grackle has a greater preference for areas with water (Small et al. 2006). Both species nest between mid-March and July though the grackle often reaches its peak production before the dove (Williams 1971). Additionally, the dove may produce multiple clutches extending the breeding period into August (Schaefer et al. 2004).

On 5 April 2008 a pair of grackles began constructing a nest in the crown of a netleaf hackberry tree in an urban lot in San Antonio, Texas as described in Eitniear (2008) and West (1993). The tree was within 15 m of the author's kitchen window allowing for random observations throughout the daylight hours. The female grackle could not be located on 15 April; therefore, it is assumed incubation had begun. This appears consistent with the literature as the young fledged 9 May and incubation is stated as between 13–14 d (Johnson and Peer 2001). During the incubation five pairs of White-winged Doves constructed nests in the hackberry (Fig. 1). In only one dove nest did the eggs hatch prior to the fledging of the grackle, who after 3 d left the area.

Both sexes of Great-tailed Grackles were dominate over White-winged Doves at a feeder 10 m from the hackberry tree. Female grackles were dominate over male grackles and on several occasions displayed aggressively towards them at locations some distance from the feeder. Grackles were never observed to disturb the nesting doves which incubated and reared their young without event.

Blankinship (1966) considered removal of Great-tailed Grackles from areas within White-winged Dove colonies important in reducing fledgling mortality. Hayslette et al. (1996) questioned Blankinship and suggested that the level of predation was likely density dependent as two of their high density White-winged Dove areas also had high densities of grackles.

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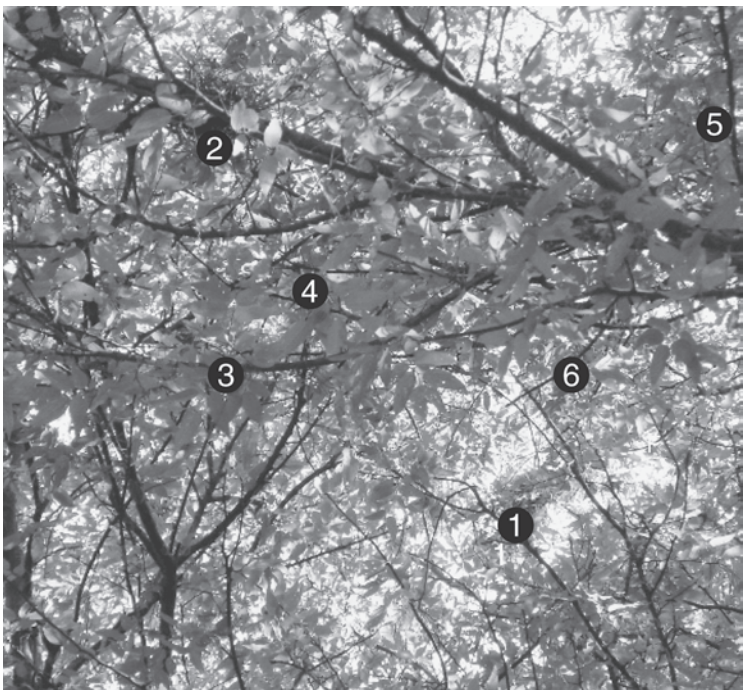

Figure 1. Location of Great-tailed Grackle (1) and White-winged Dove nests (2–6) in netleaf hackberry tree. Photo by author.

Great-tailed Grackles are territorial although such territories vary in size from a single tree to several trees (Johnson and Peer 2001). Grackles nesting in the hackberry tree mobbed (both audibly and physically) domestic cats (*Felis domestica*), Blue Jays (*Cyanocitta cristata*) and humans walking under the tree. Such predator repellant behaviors are not only beneficial to the grackles but likely limit predation of doves. While doves appeared to have had a preference for the hackberry tree over other adjacent trees (used in previous years) the role the nesting grackles played in the dove's nest site selection remains unresolved.

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RECENT TEXAS SPECIMENS OF RED-FOOTED AND BROWN BOOBIES

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The work of Harry Church Oberholser has left a lasting impression on our understanding of Texas bird life. His book, *The Bird Life of Texas* (Oberholser 1974) remains a benchmark publication for students of the distribution, abundance and life-histories of birds in Texas. In the 35 years since its publication, our knowledge of the Texas avifauna continues to augment the materials compiled in that landmark publication. Through the efforts of a growing network of citizen and professional ornithologists, along with the oversight of the Texas Ornithological Society's Bird Record Committee, our knowledge of the Texas avifauna continues to grow. In an effort to further document the presence of birds occurring in Texas, we report here on three voucher specimens of two species of boobies (Sulidae, *Sula*) that provide additional documentation of these species in Texas and add to our understanding of their overall distribution and abundance.

RED-FOOTED BOOBY (*SULA SULA*)

Oberholser (1974) reported two records for the Red-footed Booby, one specimen and one sight record:

Specimen Record

The only specimen record of this species from Texas was taken near Rockport by Andrew Sorenson before 1910 (Aransas County) and preserved as a taxidermy mount in his store.

Sight Record

The single sight record was made by Barton German on 26 August 1968 (Cameron County, S. Padre Island).

Since Oberholser

In the *Texas Ornithological Society Handbook of Texas* Birds, Lockwood and Freeman (2004) added a photographic record from 27 March 1983 (Galveston County, off Galveston). They also stated that the aforementioned mounted specimen had been lost and that the 1958 sight record from Cameron County lacked sufficient documentation to be accepted by the Texas Bird Records Committee.

Here we report two recent specimens of *Sula sula* from Texas: a female recovered on 29 October 2002 by A. F. Amos (Aransas County, Rockport; TCWC No. 14626), and a second female found alive on the beach on 10 June 2007 (Galveston County, Galveston; TCWC 14601). The latter bird was taken to a veterinary clinic where it died on 12 Jun 2007. These two individuals represent the second and third specimens for Texas.

BROWN BOOBY (*SULA LEUCOGASTER*)

Oberholser (1974) documented one specimen, one photographic record and five sight records for the Brown Booby:

Specimen Record

The specimen is a bird found alive on 21 September 1971 in Port Aransas (Nueces County.) The bird died on 25 September and was preserved in the University of Dallas Collection (No. 18640). This bird is now in the collection of the Western Foundation of Vertebrate Zoology (WFVZ No. 50106).

Photographic Record

Oberholser's photographic record was of an immature bird found ill on 19 August 1967 (Kleberg County, North Padre Island, 16 miles south of Bob Hall pier); the bird was rehabilitated and released on 28 August, and the photographs are deposited at the Welder Wildlife Foundation (Sinton, Texas; WWF ph P-16).

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Sight Records

Oberholser's five accepted sight records for the state are: 1.) 25 June 1948 (Calhoun-Aransas Counties, Second Chain-of-Islands); 2.) 10 August 1961, an adult (Nueces County, 12 miles offshore from south Mustang Island); 3.) 18 August 1961 (Jefferson County, 8 miles offshore and 17 miles southwest of Sabine Pass); 4.) 23 September 1967 (Nueces County, North. Padre Island, after Hurricane Beulah); and 5.) 8 June.

Since Oberholser

Of these records, Lockwood and Freeman (2004) accept only the specimen record and the photographic record from August 1967. They also list 13 unconfirmed records of the species from Texas. The Review List of the Texas Bird Records Committee currently accepts 26 records documented by photographs (11) or submitted sight records with sufficient details (14); it also includes a second specimen found on 11 August 1980 (Nueces County, Mustang Island; WFVZ No. 50107).

Here we report the occurrence of an immature *Sula leucogaster* found alive on 29 September 2005 (Nueces County, Port Aransas, "mud" boat docks; TCWC No. 14328), this individual represents only the third specimen record for the state.

We thank A. F. Amos of the University of Texas Marine Science Center for the two Red-footed Booby specimens, and Ted L. Eubanks for the Brown Booby specimen. This is Contribution No. 1195 from the Texas Cooperative Wildlife Collection, at Texas A&M University.

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FORAGING BY A RED-SHOULDERED HAWK (*BUTEO LINEATUS*) WITH SEVERE BILL DAMAGE

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Bill structure is a key adaptation for successful foraging by birds (Gill 2000). Multiple studies have described the importance of bill structure for prey selection (size, type, etc.), foraging behavior and survival (e.g., Schoener 1975, Smith and Temple 1982). Two possible causes of abnormal bill structure are: developmental mutations and incidental damage. Because bill structure is critical to successful foraging, individuals with deleterious bill traits will likely have lower survival and productivity rates. Many studies have explored the importance of bill structure to survival and productivity (e.g., Grant and Grant 1979). Bill abnormalities occur infrequently in most bird species (usually $<0.5\%$ of individuals in a population; Craves 1994), and appear to occur less frequently than leg, foot or wing related injuries in raptors (Bedrosian and St.Pierre 2007). Because of their rarity, observations of bill abnormalities are valuable for learning how individuals cope with injuries to this highly adaptive foraging tool (e.g., Fox 1952, Craves 1994).

This report describes an observation of foraging by a Red-shouldered Hawk (*Buteo lineatus*) with a

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significant abnormality to its upper mandible. On 2 March 2009, we noticed the hawk standing in the mowed highway right-of-way on FM 774 in Refugio County, Texas (28°17'26" N, 97°14'10"). The hawk remained at this location allowing us to turn the vehicle and stop within 20 m in the opposite ditch. Using binoculars, we noted the hawk was an adult, based on plumage (Wheeler 2003) and was mantling over a prey item it had captured. During this time we noticed the bird's bill was misshapen and the roughness of the commisure suggested the bill had been severely damaged. The distal portion of the maxilla was completely absent, leaving the hawk's tongue exposed and bill to appear continuously open. The condition appeared to be the result of a fracture beginning approximately 2 mm in front of the cere, continuing upwards and away from the gape at an approximate 45° angle, leaving approximately 7 mm of culmen in front of the cere (Fig. 1). After several minutes the bird transferred the prey from its talons to its bill, and after making >3 positioning tosses similar to those made by herons to orient their prey for ingestion, bolted the prey item. We identified the prey item as a small mammal; either *Peromycus* sp. or *Reithrodontomys* sp. based on physical characteristic (Davis and Schmidly 1994). Shortly thereafter the bird perched on a nearby fencepost where it feaked briefly prior to departing. We watched the hawk for approximately 10 min while it continued foraging through mixed brush and grassland cover-types before departing from sight.

Bill injuries have obvious negative implications for birds and are so deleterious that the risk of bill damage has been shown to alter the prey selected by Oystercatchers (*Heamatopus ostralegus*) from larger more nutrient rich prey to smaller lower risk prey (Rutten et al. 2006). Red-shouldered Hawks forage on a diverse suite of prey types (Dykstra et al. 2008), which in south Texas includes many prey species far too large to be swallowed whole, such as Texas rat snakes (*Elaphe obsolete*), bullfrogs (*Rana catesbieana*), cotton rats (*Simodon hispidus*) and pocket gophers (*Geomys bursarius*, Strobel 2007). Although the deformity this hawk sustained likely narrowed the suite of available prey, the hawk's proficiency at manipulating prey with the damaged bill suggested it had been foraging this way long enough to become adept at this unusual swallowing technique. Avian bills can regrow subsequent to injuries (Fox 1952) but little is known regarding the injury severity's influence on potential regrowth. Despite the severity of this bird's bill damage, it had survived to the point of our observation; however, its long-term survival and productivity will likely depend on the permanency of its abnormality and its sex.

As with many raptors, breeding male Red-shouldered Hawks forage widely throughout their home range and return prey to the female and young (Dykstra 2008). Because an abnormal mandible probably does not alter the ability to catch, kill, and transport prey, the productivity of male raptors may be largely unaffected by such abnormalities.

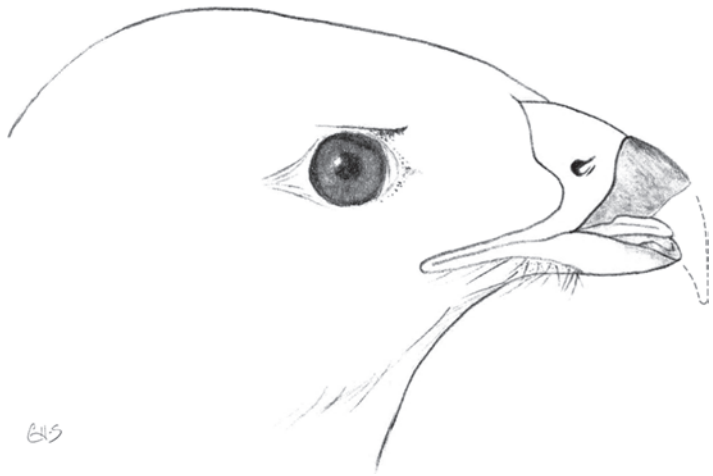

Figure 1. A Red-shouldered hawk with a damaged bill that demonstrated a unique prey handling behavior near Refugio Texas. Dashed line indicates normal bill structure.

However, breeding female Red-shouldered Hawks must tear large prey items into pieces appropriate for ingestion by nestlings, and therefore would be greatly hampered by bill abnormalities. Our observation provides some evidence the acute effects of mandible damage in raptors may not directly cause mortality and the severity of chronic effects may depend on the prey types available and sex of the individual.

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FIRST CONFIRMED NESTING OF THE RED-SHOULDERED HAWK IN STARR COUNTY, TEXAS

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The Red-shouldered Hawk (*Buteo lineatus*) was once a fairly common species in the Lower Rio Grande Valley in summer, with confirmed breeding records in Cameron and Hidalgo counties (Oberholser 1974). Brush and Cantu (1998) and Brush (2008) reviewed recent changes in the avifauna of the Lower Valley and concluded the last verified nesting records of this species were 1994 (successful) and 1995 (unsuccessful) nestings at Santa Ana National Wildlife Refuge (Hidalgo County). Brush (2008) further reported two adults observed in the same nesting tree at Santa Ana on 22 December 2006, and one adult and two juveniles in southwestern Cameron County on 13 March 2005 but concluded these were likely wintering (non-breeding) birds; another adult was seen at Santa Ana on 16 June 2007 (Brush 2008). This species is only a "possible" breeder in the valley (Brush 2008).

I report a Red-shouldered Hawk nest found on 12 April 2001 on an island in the Rio Grande ~1 km downstream from Salineño (Starr County), 26°30'26N, 99°6'37W. This elongated unnamed island clinging to the Texan shore is ~900 m long and up to 100 m wide. The island was mostly covered by closed canopy riverine deciduous forest in 2001, although there were also small patches of thorn scrub, and areas overgrown with the introduced giant cane (*Arundo donax*). The nest

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was built in a side branch of Mexican ash (*Fraxinus berlandieriana*), far from the trunk, and ~18 m above the ground. A lack of climbing gear did not allow me to examine the next, but I saw the tail, the yellow lores, and the eye of the incubating bird on 12 and 13 April. A second hawk was observed perching on the top of the same tree, or soaring and calling in the vicinity. On some occasions both birds were seen on the wing over that nest. This nest was last visited on 25 April, and one bird was still on the nest, presumably incubating. Interestingly, an adult Red-shouldered Hawk was seen at a nest ~1 km downstream from Salineño, Starr County, on 20 February 2005 by S. G. Monk (reported to T. Brush). This report may be the same pair if not indeed the same nest.

Thus, the Red-shouldered Hawk still nests in the Lower Rio Grande Valley albeit in insignificant numbers.

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BLUE JAY ATTACKS AND CONSUMES CEDAR WAXWING

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Blue Jays (*Cyanocitta cristata*) are known to be common predators on bird nests (Wilcove 1985, Picman and Schriml 1994). In addition to predation on eggs and nestlings, Blue Jays occasionally prey on fledgling and adult birds (Johnson and Johnson 1976, Dubowy 1985). A majority of reports involve predation on House Sparrows (*Passer domesticus*) and other small birds (Chase 1899, Lamore 1958, Master 1979, Cink 1980, Atkins 1991).

On 8 April 2009 at approximately 1830 h CST in a residential neighborhood in Nacogdoches, Texas, we observed a Blue Jay on the ground, pinning a smaller bird beneath its feet. The Blue Jay violently pecked at the smaller bird which was flapping its wings. At this point we could not identify the prey, so we decided to flush the Blue Jay. We discovered it had attacked an adult Cedar Waxwing (*Bombycilla cedrorum*). Upon inspection, the waxwing laid motionless with significant wounds to its head. We then moved approximately 15 m away from the waxwing, and the Blue Jay immediately returned from a nearby perch and began to attack again. It became apparent that the waxwing was not dead when it resumed flapping its wings as the Blue Jay repeatedly struck its head. Soon afterwards, a passing car appeared to startle the jay, at which time, the jay picked up the waxwing with its beak and laboriously flew approximately 15 m, gaining approximately 3 to 4 m of altitude, before dropping the bird to the ground. We then left the area for 20 min.

Upon returning, we found the jay in the same place where it had dropped the waxwing. Our presence apparently startled the Blue Jay, and it once again carried the waxwing in its beak for about 20 m where it landed on the ground in some brush. We watched for a few minutes and could see the jay pulling off flesh with its beak and consuming the dead bird. Again, we decided to flush the jay so we could inspect the waxwing. The jay retreated to a perch approximately 25 m from the waxwing and watched us as we examined the carcass. The Blue Jay had almost completely removed, and presumably consumed, the head of the waxwing while the body appeared to be completely unharmed. We then returned the waxwing to its previous position on the ground and walked away. We had moved little more than 10 m from the dead bird when the jay darted in and picked up the

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waxwing with its beak and flew approximately 10 m into some shrubs. At this point, we decided to no longer disturb the Blue Jay and left the area.

Cedar Waxwings are prey to several species of birds (Meyerriecks 1957, Fisk 1970, Ritchison 1983, Kennedy and Johnson 1986, Sodhi 1992) and may be killed in aggressive interactions with other birds such as the Northern Mockingbird (*Mimus polyglottos*) (Hedrick and Woody 1983). Several factors may increase the susceptibility of Cedar Waxwings to predation from birds that may not normally prey on them. For example, waxwings frequently collide with windows and other objects often causing injury or death (Shaw and Culbertson 1944, Klem 1989), making them easy prey for a variety of birds and mammals. Also, Cedar Waxwings are frequently reported to have fermented-fruit intoxication. Birds affected by naturally occurring fermentation products are reported to appear disoriented and have difficulty flying (Fitzgerald et al. 1990). This intoxication may make them more susceptible to predation (McClure 1962).

We did not witness the initial attack by the Blue Jay; thus, we do not know how it transpired. When we initially noticed the attack, the birds were already on the ground and the jay was in a dominant position over the waxwing. We do not know if the waxwing was healthy or injured prior to the attack by the jay. This account represents the first reported account of a Blue Jay attacking and consuming an adult Cedar Waxwing.

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Gamebirds were the subjects of half of all published papers from 2005–2007. Photo by Greg Lasley

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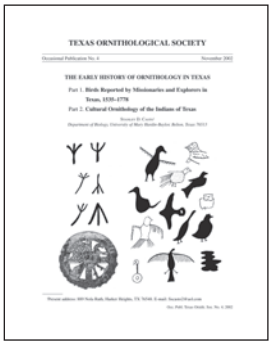

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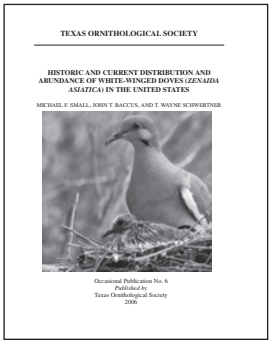

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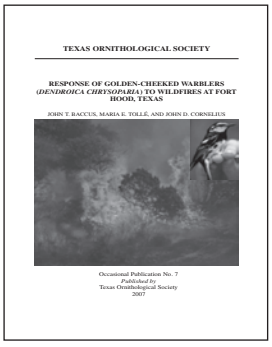

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