
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

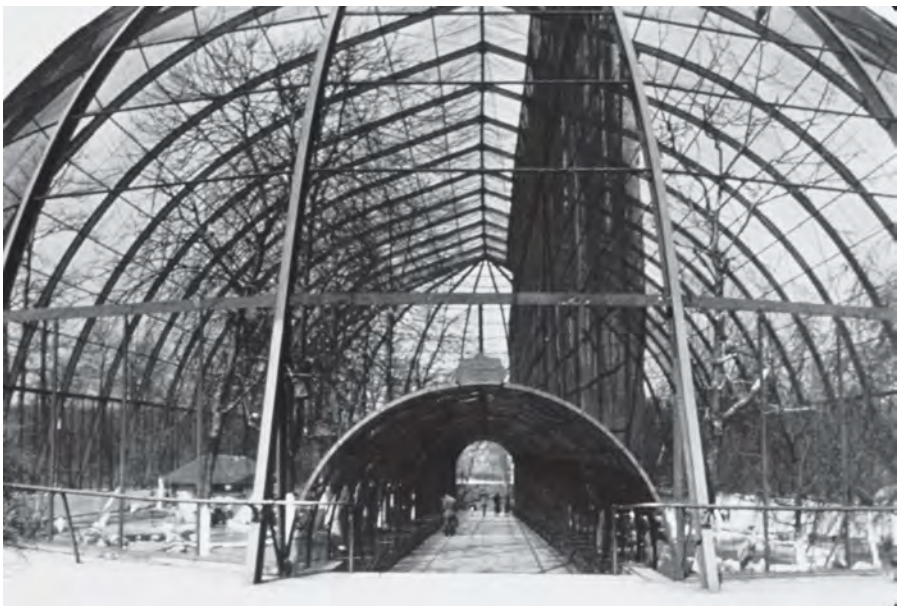

Figure 3. Flight cage at the 1904 World's Fair in which the birds collected by Frank Armstrong were exhibited. Photograph courtesy of the St. Louis Zoo.

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.

ACKNOWLEDGMENTS

Archival records for this history were provided by Dan Cherubin of the Wildlife Conservation Society, Mary Markey of the Smithsonian Institution Archives, Rachel De Caro of the Philadelphia Zoo, and Jill Gordon of the St. Louis Zoo. Frank B. Armstrong, III provided the photograph of his grandfather, and Horace Burke suggested improvements of an early version of the manuscript. This study was supported in part by a Wells Research Professor grant from the University of Mary Hardin-Baylor. My thanks are extended to all of the above-named individuals and institutions for their assistance.

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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.

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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

Jennifer M. Korn[1], Thomas R. Simpson[1], John T. Baccus[1], and Stephen L. Jester[2]

[1]Wildlife Ecology Program, Department of Biology, Texas State University-San Marcos, San Marcos, TX 78666
[2]The Nature Conservancy, 258 Main Street, Suite 200, Lander, WY 82520

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

[1]E-mail: JB026txstate.edu

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

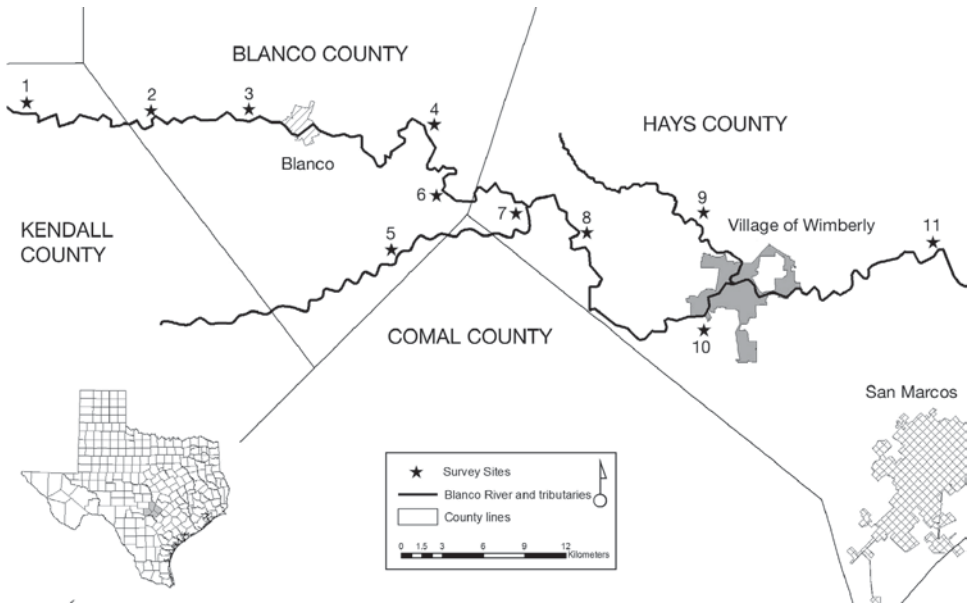

Figure 1. Map of the Blanco River Valley with major tributaries showing 11 bird survey sites.

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.

ACKNOWLEDGMENTS

We thank the landowners who graciously allowed access to their properties for our bird surveys. We thank the Nature Conservancy in Texas for funding this project. R. Ranft of the Nature Conservancy provided assistance with landowners. K. Williams, Hays County Tax Appraisal Office, and A. Hulburt, Blanco County Tax Appraisal Office, allowed access to landowner survey data.

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

Daniel M. Brooks[1]

Houston Museum of Natural Science; Department of Vertebrate Zoology; 1 Hermann Circle Dr.; Houston, Texas 77030-1799, USA

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.

[1]E-mail: dbrooks@hmns.org

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.

ACKNOWLEDGMENTS

Kind thanks to Mark Bittner for providing the data on a feral *A. acuticaudata* in San Francisco for comparative purposes. Also thanks to Grace Schirrmeister, Nico Barientes and Dennis Shepler (the Kinkaid School) for creating Figure 1, and to Ian Wilkinson (HMNS) for facilitating both

Figures. The manuscript was improved by the editorial comments of Jack C. Eitniear.

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

Zachary P. Holderby[1], M. Clay Green[2], and Thomas R. Simpson

Wildlife Ecology Program, Department of Biology, Texas State University, San Marcos, TX 78666

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).

[1]Present address: 307 Painter Roth Road, Kelso, WA 98626.

[2]Corresponding author: M. Clay Green; E-mail: claygreen@txstate.edu

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),

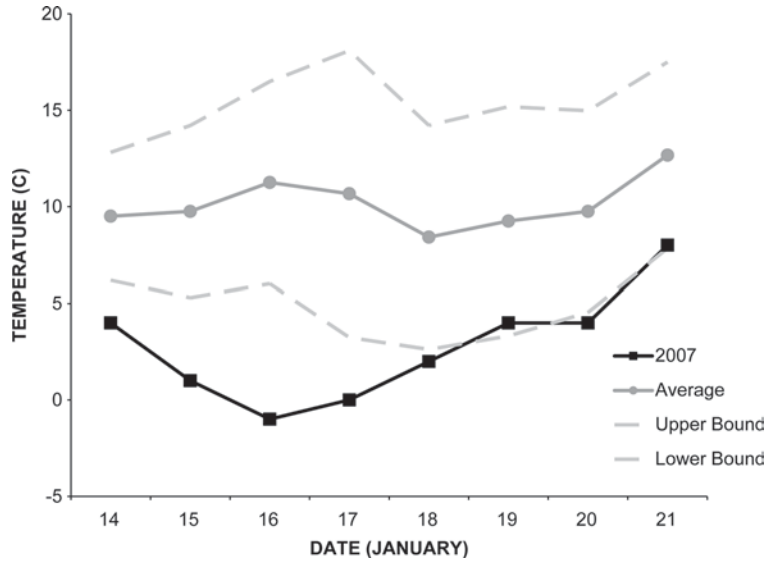

Figure 1. Mean air temperature in San Marcos, TX, USA for January 2007 and mean January temperatures from 1996 to 2008 bounded by one standard deviation above and below.

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.

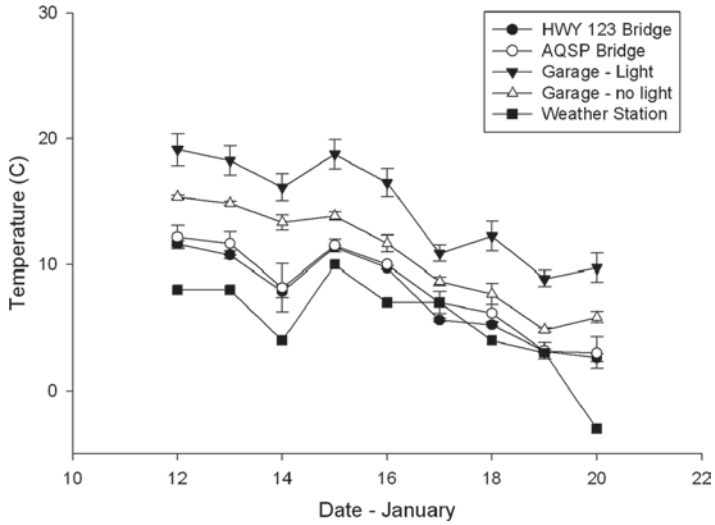

Figure 2. Mean daily low temperatures of Cave Swallow roost substrates in San Marcos, Texas, USA from 12–20 January, 2008. Temperature was recorded at two Interstate 35 bridges (Hwy 123 underpass 29° 53' 09.00" N, 97° 56' 20.61" W and Aquarena Springs Road underpass (29° 53' 34.18" N, 97° 54' 44.49" 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

Steven G. Platt[1], Kendall B. Craig[2], and Stanlee M. Miller[3]

[1]Department of Biology, Box C-64, Sul Ross State University, Alpine, Texas, 79832
[2]School of Arts and Sciences, Box C-95, Sul Ross State University, Alpine, Texas, 79832
[3]Department of Biological Sciences, 132 Long Hall, Clemson University, Clemson, South Carolina, 29634

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

[1]E-mail: splatt@sulross.edu

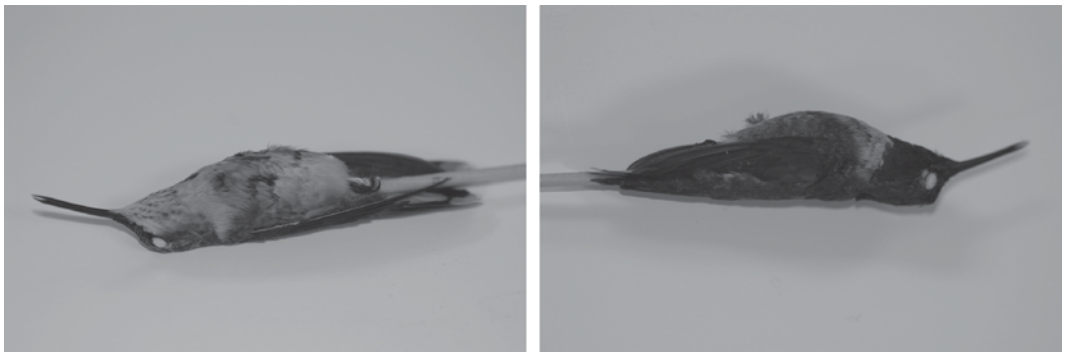

Figure 1. Ventral and lateral views of an adult male (right) and immature (left) Ruby-throated Hummingbird collected in Alpine, Texas on 25 July and 26 September 2007, respectively. Specimens deposited in James F. Scudday Vertebrate Collection at Sul Ross State University (SRSU 2001, 2002).

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

[1]Daniel M. Brooks

Houston Museum of Natural Science; Department of Vertebrate Zoology;
1 Hermann Circle Dr., Houston, TX 77030-1799

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

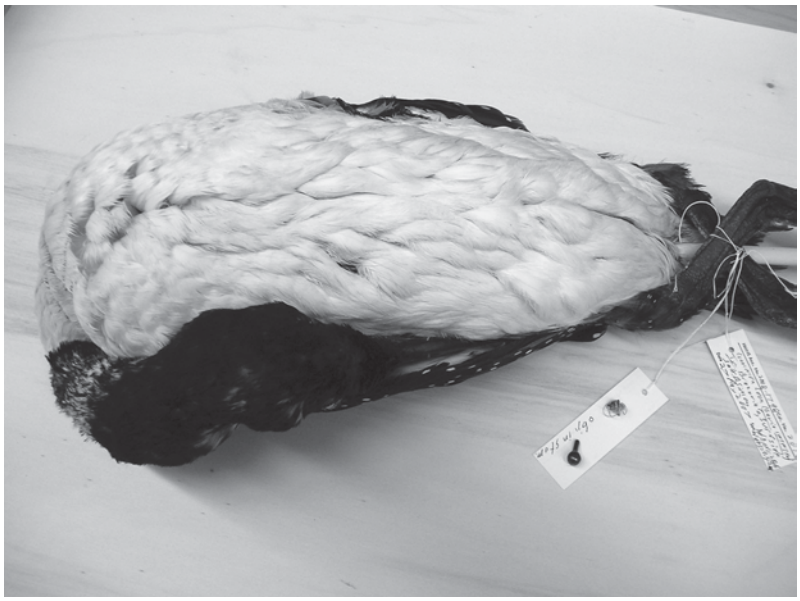

Figure 1. Female Common Loon (HMNS VO-2076) with fishing tackle found in stomach mounted on 7.5 cm wide tag in foreground (photo by D. M. Brooks).

[1]E-mail: dbrooks@hmns.org

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*

[1]Brush Freeman

120 North Redbud Trail, Elgin, Texas 78621

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

[1]E-mail: Brushf@earthlink.net

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

[1]Mark B. Bartosik

3100 Jeanetta #810, Houston, TX 77063

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.

[1]E-mail: MBB22222@aol.com

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.

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Michael Patrikeev, John T. Baccus and Kent Rylander provided useful comments on the manuscript.

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

[1]Jack Eitniear

218 Conway Drive, San Antonio, Texas 78209-1716

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.

[1]E-mail: jce@cstbinc.org

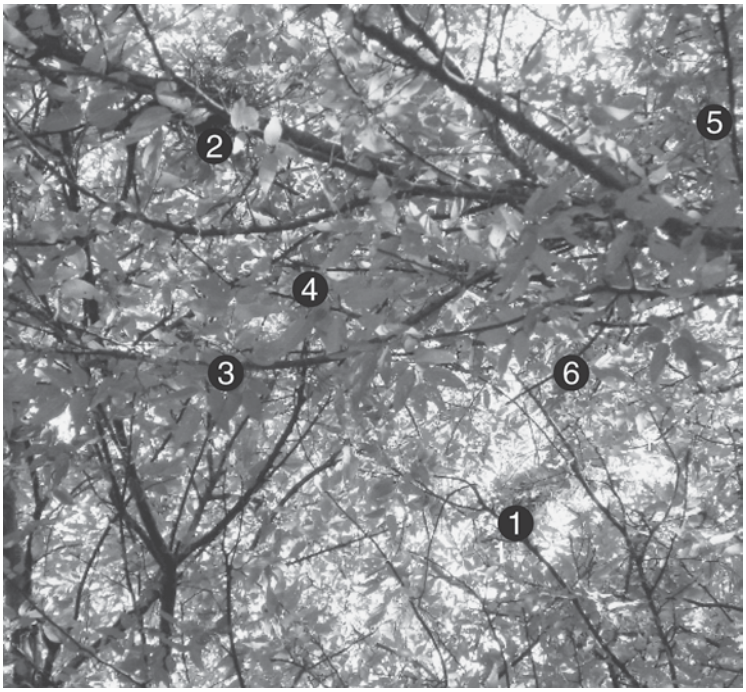

Figure 1. Location of Great-tailed Grackle (1) and White-winged Dove nests (2–6) in netleaf hackberry tree. Photo by author.

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

Keith A. Arnold[1] and Ben D. Marks

Texas Cooperative Wildlife Collection and Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, Texas 77843-2258

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).

[1]E-mail: Kaarnold@tamu.edu

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

Bradley N. Strobel[1] and Carey L. Haralson-Strobel

Department of Natural Resources Management, Texas Tech University, 218 Agriculture Sciences Building, Lubbock, Texas, USA 79409-2120
Rob and Bessie Welder Wildlife Refuge, P.O. Box 1400, Sinton, Texas, USA 78387

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

[1]E-mail: bradley.strobel@ttu.edu

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.

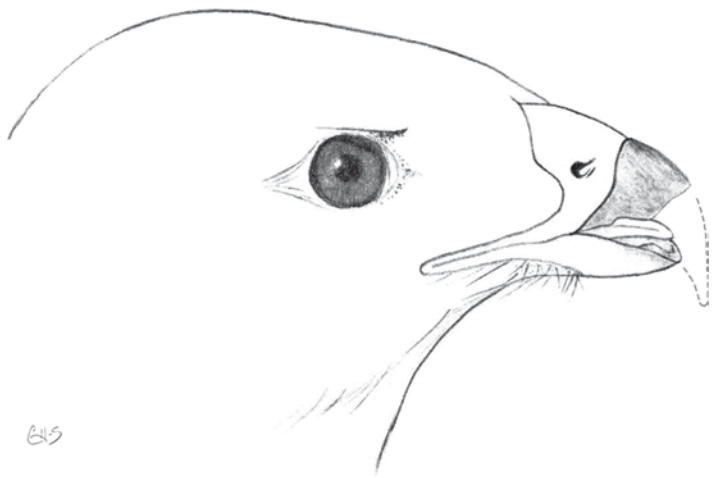

Figure 1. A Red-shouldered hawk with a damaged bill that demonstrated a unique prey handling behavior near Refugio Texas. Dashed line indicates normal bill structure.

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.

ACKNOWLEDGMENTS

We thank the Rob and Bessie Welder Wildlife Foundation and the USGS Texas Cooperative Fish and Wildlife Research Unit for logistic and financial support. Comments from C. Boal, S. Glasscock and R. Wilson improved earlier versions of this manuscript. This is Welder Contribution Number 685.

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

Michael Patrikeev[1]

PO Box 189, Tobermory, Ontario N0H 2R0, Canada

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

[1]E-mail: mpatrikeev@hotmail.com

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

Daniel Saenz[1] and Joshua B. Pierce

Southern Research Station, U.S. Forest Service, 506 Hayter Street, Nacogdoches, TX 75965–3556

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

[1]E-mail: dsaenz@fs.fed.us

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.

ACKNOWLEDGMENTS

We thank Clifford Shackelford and Richard Schaefer for helpful suggestions on an earlier draft of this manuscript.

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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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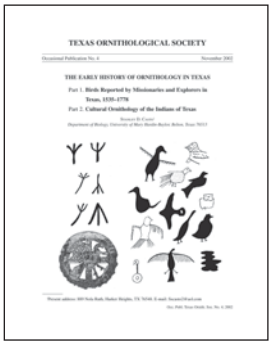

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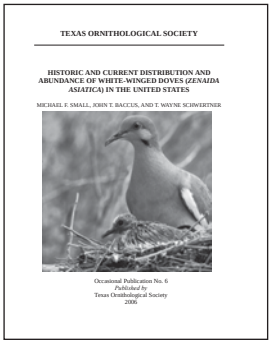

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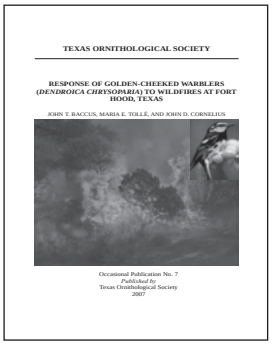

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Jack Clinton Eitniear, Editor, E-mail: Bulletin@Texasbirds.org
John T. Baccus, Associate Editor, E-mail: jb02@txstate.edu

Printed by Cadmus (a Cenveo company), Ephrata, PA 17522, USA