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Cover Photo: Purple Martins. Photo by Greg Lasley

Frontispiece. American Kestrel. Painting by Lynn Delvin.


Delvin

BULLETIN OF THE

TEXAS ORNITHOLOGICAL SOCIETY

A ROAD SURVEY OF WINTERING AMERICAN KESTRELS FROM VIRGINIA TO TEXAS AND BACK

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ABSTRACT.—American Kestrel populations in North America are experiencing long-term decline. One potential reason may be reduced overwinter survival of kestrels due to degraded habitats. A winter raptor road survey for kestrels from Virginia to Texas and back (6583 km) was conducted 27 Nov - 7 Dec 2017. Overall, 98% of kestrels counted (n=245 out of 249) were wintering W of 95^{O} W longitude in Texas where the predominate habitat is agricultural areas crisscrossed by unmowed grassy roadside ditches. Protection and enhancement of winter habitat for kestrels may improve overwinter survival and potentially stem their continued population decline.

The American Kestrel (*Falco sparverius*) is the smallest and most widely distributed falcon in North America (Smallwood and Bird 2002). Range-wide, American Kestrels are in long-term decline for reasons not fully understood (Smallwood et al. 2009, McClure et al. 2017).

Large proportions of American Kestrels in North America migrate south, with American Kestrels in northern populations migrating further than those breeding farther south (Farmer and Smith 2009). American Kestrels that breed in middle latitudes are partially migratory and American Kestrels that breed farther south remain year-round (Goodrich et al. 2012). Recently, it has been suggested that more research on wintering American Kestrels' habitat requirements and survivorship may help determine whether mortality outside of the breeding season is a cause of American Kestrel population declines (McClure et. al. 2017).

Road counts are often used to sample distribution and relative abundance of raptors over large areas (Craighead and Craighead 1956, Fuller and Mosher 1981). Kestrels are easily detected and are often observed near roads (Farmer et al. 2007) where they are observed hunting along roadsides from utility wires and poles associated with roadside/ditch habitat (Bildstein and Collopy 1987). We employed this counting technique to identify important American Kestrel wintering areas in a multi-state survey.

METHODS

The road survey for wintering American Kestrels was conducted during daylight hours from 27 Nov through 7 Dec 2017 following the principles of Craighead and Craighead (1956). A person drove the vehicle while a second person recorded raptor sightings with both people searching for raptors perched or flying within 100 m of the vehicle. Both observers are experienced raptor researchers. Interstate highways were traveled at, or below, the posted speed limit ranging from 88-121 km/h. Paved secondary roads and state highways in Texas were traveled at or below the posted speed limit of 40-113 km/h. Unimproved (gravel) roads were traveled at an average rate of 35 km/h. No segments of highways or secondary roads were surveyed twice.

RESULTS

Kestrel survey results (Table 1) lists states surveyed, dates, roads traveled, km surveyed in each section of road, number of American Kestrels observed and relative abundance of American

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Table 1. Wintering American Kestrel road survey from VA to TX and back: 27 November—7 December 2017

State Surveyed	Date	Interstate Highway	Kilometers Surveyed	Number Kestrels Observed	Number of KM per Kestrel
Virginia (VA)	27-Nov	New Market VA to TN Border on I 81	424	1	424
Tennessee (TN)	27-Nov	Bristol TN to AR Border on I 40	823	0	
Arkansas (AR)	28-Nov	AR to TX Border on I 40 and I 30	435	0	
		Total 1st Transect	1682	1	1682

State Surveyed	Date	Texas Highway Systems	Kilometers Surveyed on Route	Number Kestrels Observed	Number of KM per Kestrel
Texas (TX)	28-Nov	TX from AR Border to Franklin Co. Line on I 30	126	0	
Texas	29-Nov	TX from Franklin Co. Line to Abilene on I 30 and I 20	453	10	45
Texas	29-Nov and 30-Nov	North of Abilene on Paved and Gravel Roads	153	53	3
Texas	30-Nov and 1-Dec	Abilene to Tilden on US Highway 83, I-10/I-37, County Highway 99	555	24	23
Texas	1-Dec and 2-Dec	Secondary Roads Within 33 KM of Tilden	377	15	25
Texas	2-Dec	Tilden to Falcon on State Highway 16, Secondary Rds. 649 and 2687	242	16	15
Texas	3-Dec	Rio Grande Valley; From Falcon Lake S.P North and East to Bentsen Rio Grande Valley S.P.	531	37	14
Texas	4-Dec	Linn and Associated Roads Within 40 KM	394	32	12
Texas	5-Dec	Linn to George West on US Highway 281	196	26	8
Texas	5-Dec	George West to Victoria on US Highway 59	294	30	10
Texas	5-Dec	Victoria to Houston on US Highway 59 and I 69	202	0	
Texas	5-Dec	Houston To LA Border on I 10	170	2	85
		Total 2nd Transect	3693	245	15

State Surveyed	Date	Interstate Highway	Kilometers Surveyed	Number Kestrels Observed	Number of KM per Kestrel
Louisiana (LA)	5-Dec and 6-Dec	LA to MS Border	328	1	328
Mississippi (MS)	6-Dec	MS to AL Border on I 59 and I 20	296	0	
Alabama (AL)	6-Dec	AL to GA Border on I 59	399	0	
Georgia (GA)	6-Dec	GA to TN Border on I 59 and I 24	30	1	30
Tennessee (TN)	7-Dec	TN Border to Knoxville (I 40) on I 24 and I 75	155	1	155
		Total 3rd Transect	1208	3	403

SUMMARY

Survey Transect	State	Kilometers Surveyed	Number Kestrels Observed	Number of KM per Kestrel
1	VA to TX	1682	1	1682
2	TX	3693	245	15
3	TX to TN	1208	3	403
	TOTAL	6583	249	26

Kestrels, expressed as number of km traveled per American Kestrel observed. The survey consists of 3 transects with total 6583 km of roads from Virginia to South Texas and back.

The 1st transect is 1682 km of interstate highway from New Market Virginia S and W to the Texas border. The 2nd transect is 3693 km within Texas on interstate and secondary roads. The 3rd transect is 1208 km of interstate highways from Texas N and E to the location in Tennessee at which point the interstate highway meets up with the 1st transect where the survey was terminated to avoid resurveying the same highway and potentially recounting the same wintering American Kestrels.

During the 1st transect of the survey, from Virginia to the Texas border, 1682 km of interstate highway were surveyed during daylight hours with 1 wintering American Kestrel observed in Virginia.

The 2nd transect begins in the NE corner of Texas and proceeds W towards the state's center, where many American Kestrels were counted in Jones County, N of Abilene. The survey continues S to the Mexican border with Texas and then exits the state in the SE corner. Within Texas, more than 98% of wintering American Kestrels were counted W of 95° W longitude. Along the northern route coming into the NE corner of Texas we observed the first wintering American Kestrel in Texas at 162 km E of Dallas near 95° W. Similarly, the last 2 American Kestrels counted in Texas along Interstate 10 on the 3rd transect were observed slightly E of 95° W.

The highest relative abundance of American Kestrels along the survey route was in Jones County, N of Abilene Texas, where American Kestrels were observed at a rate of 1 American Kestrel per 3 km. Figure 1 depicts typical habitat where wintering Kestrels were observed in Texas. Most American Kestrels were counted perching on utility wires and poles hunting near strips of unmowed dense grassy vegetation between roadside and agricultural fields. Some American Kestrels were counted in flight, hovering, or perching on fences, trees or shrubs.

The 3rd and final transect of the road survey is along interstate highways from the Texas border through the Gulf Coast States of Louisiana, MS, and AL, through Georgia into Tennessee, a total of 1208 km with 3 wintering American Kestrels observed. Overall, 98% of wintering American Kestrels counted on the entire road survey from Virginia to Texas and back were observed in Texas (n=245 out

Figure 1. (Left) Depicts typical habitat for American Kestrels wintering in Texas. Note right-of-way between agricultural field and road is unmowed, with dense, grassy vegetation beneath utility wires. (Right) Male kestrel was captured in Jones County Texas. Photo by Allen Zuverino.

of 249), with a few (n=4), one per state, in Virginia, Louisiana, Georgia and Tennessee.

DISCUSSION

During a road survey assessing relative abundance of wintering American Kestrels from Virginia to Texas and back, we found 98% in Texas (n=245) with a few (n=4) scattered in other states. We are confident that we surveyed wintering, rather than migrant, American Kestrels because most American Kestrels have completed migration by the end of Nov (Smallwood and Bird 2002).

In Texas, the flat agricultural landscapes W of 95° W had the most wintering American Kestrels. This is likely because habitats W of 95° W are more suitable for wintering American Kestrels than E of 95° W due to multiple factors including, but not limited to: topography, precipitation and land use patterns. From our observations, the wintering American Kestrel habitat in Texas is unmowed right-of-way along roadsides near agricultural fields, primarily cotton fields. Numerous utility wires intersect the area where we found a relatively high density of American Kestrels wintering in Jones County, N of Abilene Texas, where American Kestrels perch and hunt from poles and wires as previously noted by Bildstein and Collopy (1987). All American Kestrels we observed hunting roadside were associated with grassy, unmowed ditch habitat probably because their winter prey base, i.e. rodents, often inhabit unmowed rights-of-way (ditch) habitat (Cameron and McClure 1988). In contrast, we observed no American Kestrels associated with mowed (i.e. short grass) ditches in the same area.

In addition, further studies are recommended to determine what other factors may beneficially improve winter habitat for this declining species. Road surveys have many variables, including raptor detectability, weather conditions, and observer experience (Fuller and Mosher 1981, Millsap and LeFranc 1988). However, road surveys are a useful technique for recording distribution and relative abundance of raptors (Fuller and Mosher 1981). This data serves as a baseline survey for wintering American Kestrels that is reproducible either in its entirety or by transect or partial transect.

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GEORGE FINLAY SIMMONS: THE LIFE OF A TEXAS ORNITHOLOGIST, EXPEDITION LEADER, MUSEUM CURATOR AND EDUCATOR

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ABSTRACT.—George Finlay Simmons was born in Sherman, Texas, on 22 October 1895. His family later moved to Austin and then to Houston where in 1910 he began collecting eggs and keeping records of birds seen near the city. During the next few years he published a series of popular accounts of birds in The Houston Post, as well as articles in the The Oologist, Auk, Condor and Wilson Bulletin. In 1914, he enrolled in Rice Institute where he worked as an assistant for Julian Huxley. After serving in World War I, he enrolled in the University of Texas where he completed his bachelor's degree and master's thesis, The Birds of the Austin Region, which was later published as a book. Simmons later worked as a deputy for the Texas Game, Fish and Oyster Commission, curator of birds at the Cleveland Museum of Natural History and leader of the museum's expedition to the South Atlantic while also teaching at Western Reserve University and lecturing on his adventures in the South Atlantic. He received his doctoral degree from the University of Chicago in 1934 and took a teaching position at Montana State University where he was soon appointed president of the university. In 1943, he left Montana after receiving a Ridgway Fellowship at the University of Chicago. During his last years, he taught anatomy at Loyola University School of Medicine while also writing articles on birds for Encyclopedia Britannica. Simmons died on 19 July 1955 at his home in Glen Ellyn, Illinois.

Events in the life of George Finlay Simmons could hardly have been anticipated at the time of his birth in Sherman, Texas, on 25 October 1895. His father, David Edward Simmons, was a lawyer and his mother, Virgilia Octavia Finlay, was the daughter of George P. Finlay, a prominent lawyer from Galveston, Texas. It was thus expected that Finlay, as he was called in his youth, would continue the family tradition and enter the legal profession. Although burdened with this expectation, he eventually broke away to follow a life different from his father and his younger brother, David Andrew Simmons, who entered the law profession.

The Simmons family lived at Sherman before moving to Austin in October 1899 where Finlay's father served in the Texas House of Representatives and later as Assistant Attorney General. Finlay joined a scout troop in Austin and soon bewildered the scoutmaster with his "questions concerning flowers, trees, birds and other living things." He also made the acquaintance of the bird enthusiast and dental surgeon Dr. Elton Perry with whom he shared trips into the woods and heard "marvelous tales of bird life" (Tharp 1926). Finlay was an inquisitive and adventurous youngster who would grow to become a knowledgeable and confident individual with a talent for writing and the social skills necessary to enlist the help of influential persons in advancing his interests in natural history.

George Finlay Simmons is mentioned frequently in contemporary records. There has, however, been no comprehensive review of his ornithological contributions and his role as leader of the Cleveland Museum's expedition to the South Atlantic or his work as a teacher and president of Montana State University. The purpose of this paper is therefore to furnish a more detailed account of the life of this unusually talented individual.

EARLY OBSERVATIONS ON BIRDS

In June 1909 the Simmons family moved to Houston where Finlay's father had a law office and

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later served as a judge and district attorney. Finlay received his high school education in Houston and in his sophomore year (1910) began to collect eggs and keep records of birds seen during walks on the outskirts of the city (Simmons 1915). Following graduation from high school, he yielded to the wishes of his father and attended Houston Law School during 1913-1914 while also working as a stenographer and secretary to a law clerk. The law was, however, not to his liking and in his spare time he continued his study of birds.

Finlay's first observations, published in The Oologist during 1913, described the arrival, courtship, nesting and behavior of Scissor-tailed Flycatchers and the occurrence of the nest of the Red-cockaded Woodpecker at Houston (Simmons 1913a,b). His talent as a writer attracted the editor at The Houston Post when young Finlay won first prize in a "nature story" contest sponsored by the paper (Anon. 1936). He was subsequently invited to write a regular column on local birds. Finlay was introduced to readers of The Houston Post as a "youthful but ardent ornithologist" in an unsigned article on 21 September 1913 that listed 228 species of birds found in Harris County (Anon. 1913). Over the next three years a series of 36 of his articles were published in The Houston Post (Simmons 1913c, 1914a, 1915a). These articles focused on the natural history of local birds as well as their economic value and the need for conservation. All of the articles were signed "Finlay Simmons" until 26 July 1914 when he began to use his complete name "George Finlay Simmons." These articles can now be accessed on the Portal to Texas History website.

Simmons soon became acquainted with several individuals in the Houston area who shared his enthusiasm for birds and the study of nature. The articles published in The Houston Post and in professional journals include the names of several people who accompanied him on field trips or supplied information. The person most frequently mentioned is George Breading Ewing (1896-1955) with whom Finlay claimed to have shared a "hundred-odd" field trips. Little is known of Ewing other than that he attended Southwestern University where he studied civil engineering, served in France during World War I and later worked in the oil industry. Other individuals mentioned include William Walter Westgate, a collector of birds' eggs and shells; Ralph A. Sell, a science teacher in the public school; Howard G. Hill, an engineer who worked on the railroad and the meteorologist Ivan R. Tannehill.

JOURNAL PUBLICATIONS 1914-1915

Simmons published not only in The Houston Post and The Oologist but also in professional journals such as The Auk, The Wilson Bulletin and The Condor. His first major article dealt with the natural history of the Louisiana Clapper Rail in Texas based on a review of the literature, his personal observations and the unpublished notes of Edmond Floyd Pope, John Marion Priour and Henry Philemon Attwater (Simmons 1914b). The willingness of these older and more experienced men to share information attests to Finlay's charm and ability to work well with people while advancing his own interests.

The second of Simmons' articles published in The Wilson Bulletin dealt with the migration of birds at Houston during the spring of 1914 (Simmons 1914c). Comments were provided for 37 species of special interest and skins of the Savannah Sparrow (*Passerculus sanwichensis savanna*) were sent to Harry Oberholser at the National Museum of Natural History for identification. An unidentified sparrow seen by Finlay and Julian Huxley was later identified in the field by Ivan Tannehill as being the Western Grasshopper Sparrow (*Ammodramus savannarum bimaculatus*).

Five additional notes were published in The Oologist during 1914. The first of these notes recorded 261 individuals of 54 species seen near Houston on 29 March 1913 (Simmons 1914b). The other four notes documented nesting of the Tufted Titmouse, Plumbeous Chickadee, Florida Gallinule and Wood Thrush in Harris County (Simmons 1914c,d,e,f). The results of a Christmas count conducted by Simmons and published in Bird-Lore tallied 34 species and 308 individuals (Simmons 1914i).

In 1915 Simmons published a list of 33 species and subspecies of birds nesting in the vicinity of Houston (Simmons 1915b). Included in this paper were notes on the location and composition of nests, the measurements of eggs as well as four black and white photographs illustrating typical habitat. A second paper published in The Condor described nesting of the Louisiana Clapper Rail in Harris County. This paper was also illustrated by four black and white photographs, two of which illustrated rail nests and their eggs (Simmons 1915c). A third paper published in 1915 dealt with the nesting of the Red-shouldered Hawk at Houston (Simmons 1915d). The results of a Christmas count in the Houston area and published in Bird-Lore tallied 39 species and 365 individuals (Simmons 1915).

By 1915 Simmons' work had attracted the attention of persons in disciplines other than ornithology. Harry Yandell Benedict and John A. Lomax acknowledged the assistance of Simmons in their classic The Book of Texas published in 1916. H. Y. Benedict, Dean of the College of Arts and Sciences and later President of the University of Texas, was himself an avid birder and remained a lifelong friend of Simmons.

FIELD WORK WITH JULIAN HUXLEY

Julian Sorrel Huxley (1887-1975) was the grandson of the British naturalist Thomas Henry Huxley. He was invited in 1913 by Edgar Odell Lovett, president of Rice Institute (now Rice University) to come to Houston to organize and serve as the chairman of the department of biology. Simmons knew of Huxley's interest in birds and was eager to make his acquaintance. Following their first meeting Simmons published an account of his impressions of the famous Englishman as well as the strange custom of having afternoon "tea" (Simmons 1914a).

> "It was with pleasure on Thursday afternoon, January 29, 1914, that I made my way out to the Rice Institute to keep an appointment with Prof. J. S. Huxley of the department of biology for 4 o'clock that afternoon.
>
> I had never had the pleasure of meeting Professor Huxley, for, indeed, he had only a few days earlier arrived from England to take his chair at Rice, but I had eagerly awaited his arrival, for I felt sure that he would be muchly interested in the study of our local birds.
>
> I arrived at the residential hall a few minutes till 4 and found the only occupant of the building to be Professor Daniels, who very courteously asked me into his study, saying that Huxley would be over from the library in a few minutes and was expecting me to stay for tea.
>
> Sure enough, in a few minutes we heard someone coming up the steps, and it proved to be Professor Huxley. I found myself shaking hands with a youthful looking Englishman, tall and lean, and in contour rather closely resembling myself, both of us being something over six feet in heights and very slender. In fact, I was rather surprised at his youthful appearance. However, as I was soon to learn, Professor Huxley was one of the most careful and scientific, as well as one of the most learned biologists it has ever been my pleasure to meet, coming direct to Rice Institute from the staff of teachers at Oxford College, England.
>
> Shortly in came Professors Axson and Evans, both of whom it was a pleasure for me to meet, and the five of us proceeded to have tea. Now don't laugh! It does seem a little strange to an American to sit down to 4 o'clock tea, but to an Englishman it is the most natural thing in the world, and the Englishmen at Rice have continued the custom since coming to the States. In fact, nearly everyone laughs when he learns of this strictly English custom at Rice, but after they participate they laugh no more. For if it has ever been my good fortune to spend a more pleasant afternoon I fail to remember it. The conversation ranged from politics to arts and sciences, and from arts and sciences to birds.
>
> To use a slang expression, "the whole bunch started talking birds," and we were soon in the midst of a discussion about our local songsters. For men who did not take an especial interest in birds it was surprising to see how much they knew.
>
> After a very pleasant half hour with these gentlemen, Professor Huxley led me off to his study to "talk shop." There we soon became absorbed in discussions on Harris County birds and making plans to get out into the fields and woods together."

Figure 1. Julian Sorrel Huxley at the time of his employment at Rice Institute. Rice University, ca. 1914. Archives, photo files, Woodson Research Center, Fondren Library, Rice University.

Huxley was impressed by Simmons' knowledge of birds, and a date was set for a field trip. On 29 March 1914, the two young men shared their first outing together. Birds were plentiful that beautiful Sunday on the Texas coast and a total of 276 individuals of 27 species were identified (1914a).

A bond quickly developed between Finlay and Professor Huxley, and in April 1915, Huxley offered Simmons employment as his assistant for the coming school year. The pay was $5.00 a week, enough to pay for room and board on campus. Finlay was to be responsible for "collecting specimens—insects, snakes, birds, etc.—mounting or stuffing them—tabulating field records, & helping with [Huxley's] bird-work" (Huxley 1915).

Students were quickly recruited into the department of biology. One of Huxley's first decisions was to organize a Linnaean Club for the study of the local fauna and flora. Membership in the club, known formally as the Rice Institute Biological Society, was open to students and anyone interested in the study of natural history. The officers of the Club, included Ruth Robinson, president; Adele Waggaman, vice president; George Finlay Simmons, secretary-treasurer and George Wheeler, assistant secretary (Anon. 1915). A group photograph of the members of the Society in the 1916 Rice Yearbook shows Huxley and Simmons standing side-by-side.

Simmons and Huxley undoubtedly met on many occasions to discuss birds as well as venturing into the field together. However, the first public mention of their joint activities does not occur until 30 March 1916 when it was reported that they intended to spend several weeks in Louisiana studying the birds on Avery Island (Anon. 1916).

The expedition to Avery Island was made during April 1916. Huxley remembered the trip as his "most exciting (and scientifically profitable) ornithology experience" while teaching and doing research at Houston. He further noted that he was accompanied by one of his students, Finlay Simmons, who was "a first-class field ornithologist." The trip to Louisiana was made in Huxley's recently purchased Ford car into which the two young men loaded their camping equipment, binoculars and a clumsy but efficient quarter-plate camera (Huxley 1970).

Neither Huxley nor Simmons left a detailed account of the three weeks spent studying the birds on Avery Island. Huxley was obviously the leader of the expedition with Simmons functioning as his assistant, perhaps as the photographer and recorder. Two photographs taken during the expedition—A Green Heron at its nest and a Louisiana Heron turning its eggs—were later published in A. C. Bent's *Life History of North American Marsh Birds*. There seems to be no merit to the claim that Huxley and Simmons published a joint report of their work in Louisiana (Anon. 1923i).

The collaboration of Huxley and Simmons ended in September 1916 when Huxley returned to England to aid in the war effort. In October Finlay wrote to Huxley that he had accepted a job on the editorial staff of *The Houston Chronicle* where his duties consisted of "securing data and writing stories on all sensational news, such as criminal stories, murders, suicides, accidents, first and all happening with police and criminal courts." It was not a job he could turn down since it paid $100 a month with free admission to paid public venues and free transportation on the street car (Simmons 1916a).

In a second letter Finlay inquired as to whether Huxley had yet written a paper on "our famous expedition to Louisiana" (Simmons 1916b). If not, or if such a paper was to be eventually written, Simmons offered to share his notes of their trip.

Finlay further informed Huxley that he was working diligently on his *Birds of the Austin Region* which would also include “check-lists” of the principal plants (130 species), amphibians (14), fishes (28), reptiles (42), and mammals (38) which he had found in the Austin region and whose identities had been verified by authorities at the National Museum and American Museum of Natural History.

Huxley later wrote to Simmons noting that “it was a difficult decision” to leave Houston. He had enjoyed working at Rice, but was “not made for Texas” and had to be at the center of things if he was “to do good work” (Huxley 1970). Huxley encouraged Finlay to complete his bachelor’s degree as soon as possible and further suggested that he apply for a Rhodes scholarship which would allow for him to study in England (Huxley 1917). However, this was not to be. Each of the young men was soon deeply involved in the war effort, and all thoughts of ornithology were laid aside.

SERVICE DURING WORLD WAR I

Simmons registered for the draft on 5 June 1917 declaring that he was employed by the City of Houston as a secretary at the police department. In a letter written to Huxley after the end of the war, Finley described his military experience and his desire to continue his studies in the field of zoology (Simmons 1919).

Simmons enlisted during early July in an American Red Cross Field Ambulance unit under promise of immediate deployment to Europe. This promise was not kept, and at the end of the month he enlisted as a private in the Army Ambulance Service, still hoping to be sent abroad as a stretcher-bearer. On the 27th of August he reported to Fort Sam Houston in San Antonio and from there was sent to Camp Travis on the northwestern edge of the city. At Camp Travis he was the receiving clerk for the physicians who determined the fitness of recruits for military service. After two months in this position, he was transferred to the camp hospital where he was made acting first sergeant in charge of the enlisted men.

Promotions came in rapid succession. In late November Simmons was appointed Sergeant in the Medical Department and by April 1918 he had achieved the rank of Hospital Sergeant. In September he was commissioned a Second Lieutenant of the Sanitary Corps and ordered to Mississippi to train, organize and help equip a 500 bed hospital for oversees duty. His position at the camp was that of Adjutant and Company Commander of the enlisted men.

The Armistice was signed about the time Simmons and his command were ready to deploy to Europe. Even so, they were under orders to establish a hospital for the occupation forces. This order was later changed, and in mid-December Simmons’ unit was demobilized and he was discharged on the 18th of December 1918.

On his way home from Mississippi, Finlay stopped in Austin where he visited with Professor John Thomas Patterson, chairman of the Zoology Department at the University of Texas. The result of this meeting was that Patterson offered him a student assistantship for the spring semester. It is likely that Finlay would have preferred to continue his education at Rice Institute but, with Huxley no longer there, he perhaps believed his opportunities for a quality education would be better at the University of Texas.

Figure 2. George Finlay Simmons in World War I military uniform. Photograph posted on Ancestry.com by Victoria Gay Simmons.

ATTENDANCE AT THE UNIVERSITY OF TEXAS

Simmons’ talent in the field of zoology was soon recognized by his teachers. During 1919 he was a lab assistant in general zoology and from 1919 to 1921 an assistant in comparative anatomy. His easy way with people and ability to communicate effectively led to his appointment as an instructor in zoology during 1921-1922.

There were no ornithologists in the zoology department at the time Simmons attended the University of Texas. Although his research on birds undoubtedly had the approval of the Professor Patterson and the rest of the faculty, it would seem that he worked largely on his own without direct supervision. Much of Simmons' support and encouragement for his research probably came from his fellow bird enthusiast, Harry Yandell Benedict, who was at that time Dean of the College of Arts and Sciences.

The plan to publish on the birds of the Austin region began while Simmons was still an undergraduate. In July 1919 it was reported that he was preparing a guide to Texas birds that would be issued as a bulletin of the university and be available for free distribution throughout Texas. The guide was further described as being "profusely illustrated" and that it would contain "descriptions of the birds, their coloring, peculiarities, songs, habits of nesting, and sketches of the country which they frequent" (Anon. 1919). It was further stated that Simmons had published other bulletins and a series of short stories called "Bob's Bird Book." The claim of these additional publications by Simmons has not been documented from contemporary sources. It is known, however, that Simmons attended the 40th Annual Congress of the American Ornithologists' Union held in Chicago in October 1922 where he presented a paper "The Sea-Bird Sanctuaries of Texas" illustrated by lantern slides.

Simmons was somewhat of a renaissance man. Although his main interest was ornithology, he also engaged in activities completely unrelated to biology. He became associated with the *Longhorn Magazine* soon after his arrival at the university serving from 1919 to 1922 as assistant editor and later as chief editor. The *Longhorn Magazine*, published monthly, combined serious literary efforts with humor, short stories, verse, essays, burlesque and cartoons.

Copies of editorials written by Finlay and published in the *Longhorn Magazine* are found in his papers at the Mansfield Library, University of Montana in Missoula. An editorial titled "Getting By" warned students about being lazy, whereas "American Life" praised Theodore Roosevelt's speech on the Strenuous Life and challenged current-day youth to live up to those ideals. A third editorial titled "Error" discussed the role of mistakes in the learning process whereas "Springtime" invited city folks to learn how to read the signs of nature.

Figure 3. George Finlay Simmons from a group photograph of the United Publications Board published in the 1921 year book of the University of Texas.

Simmons was also a member of the Winsonian Dramatic Club, an organization formed for the purpose of furnishing light dramatic entertainment at football rallies and other public events. Membership in the Club was competitive requiring the demonstration of at least a minimum of acting talent. Other memberships included Sigma Upsilon national literary society, Sigma Delta Chi national journalistic fraternity as well as Phi Beta Kappa national honor society. For relaxation, Finlay would occasionally slip away to see a movie, visit a soda shop or go for an early morning skinny dip at a popular swimming hole for students (*fide* Victoria Gay Simmons).

Leadership came naturally to Simmons. He was the president of his class during his junior and senior years as well as being a member of the students' council. Although not known to have been formally engaged in collegiate athletics, Simmons was reportedly a swimmer and boxer as well as a hurdler and sprinter. At six feet three inches tall and weighing only 170 pounds, he was definitely long and lean in physical appearance (Anon. 1923c).

Not all of Simmons' time was spent participating in campus activities and watching birds. He had fallen in love with Armede 'Jack' Victoria Hatcher, a student from Fort Worth who had graduated with a Bachelor of Arts Degree from the university in August 1921. Armede often assisted Finlay with his field work, and she was reported to be a writer of nature stories for children. Given their common interest in nature and writing, it came as no surprise when the couple married in Austin on 2 March 1922. It was a lasting union to which two sons, George Finlay Jr. and Robert MacGregor Simmons were born. The eldest son, Finlay Jr. (b. 1925), did not inherit the love of his father for nature, and instead became an outstanding mathematician, university teacher and author of books on mathematics.

Armede received the nickname "Jack" at the time of her birth when her father came to check on the welfare of his wife. After being assured of her satisfactory condition and believing that the newborn child was a boy, he asked the nursery attendants "And how's my little Jack." The name stuck. She was called 'Jack' by her family, her fellow students at the University of Texas and by Finlay when he was not calling her by some other pet name. She was remembered by her family as having a lively, adventurous personality with a desire to "be one of the boys." (*fide* Victoria Gay Simmons).

Figure 4. Armede Victoria Hatcher Simmons from a photograph posted on Ancestry.com by Victoria Gay Simmons.

Finlay completed requirements for the Bachelor of Arts Degree in 1921 and Master of Arts Degree in 1922. His master's thesis "Birds of the Austin Region, Central Texas" was a massive work of 509 pages that was later published as a book by the University of Texas Press. Having completed all requirements for the master's degree, Simmons left the University for a position with the Texas Game, Fish and Oyster Commission.

WORK WITH THE TEXAS GAME, FISH AND OYSTER COMMISSION

Simmons was still working as an instructor at the University of Texas at the time of his marriage whereas Armede was working in San Antonio as a teacher at Main Avenue High School. Although satisfied with his job at UT, Simmons was also looking for other avenues of employment.

Commissioner William Walter Boyd of the Texas Game, Fish and Oyster Commission consulted Simmons in early 1922 regarding the importation of desert-adapted bobwhites from Mexico and stocking them in West Texas to hybridize with the native birds and produce a more hardy population of birds. Simmons believed this strategy had merit and a large number of quail were subsequently procured from Mexico for this purpose (Anon. 1922a).

The opportunity to work for the Game and Fish Commission came during the summer of 1922 when Finlay and Armede were not teaching. Working together, they spent three weeks sampling fish in the Lower Laguna Madre. This survey was made at the request of fishermen with the hope that the closed season might be opened if fish were not spawning during this time. Following completion of their work at Brownsville, the newly-married couple moved to Corpus Christi where a similar survey was made (Anon. 1922b). These surveys of fish in the Laguna Madre provided the data for a paper read by Findlay at the annual meeting of the National Society of Ichthyology held in Chicago during October 1922 (Anon. 1922c).

In January 1923, based on his previous work for the State, Governor Pat Neff appointed Simmons Chief Deputy Commissioner of the Texas Game, Fish and Oyster Commission. Simmons lost no time suggesting changes in the seining and flounder laws. An early appraisal of his work noted that he was "showing an energy and enthusiasm for the welfare of the department that was never manifest with any of his predecessors" (Anon. 1923a).

Much of Simmons' work was with fish but birds were not forgotten. In a news release in March 1923, he described the competition of cavity-nesting birds for suitable sites (Anon. 1923b). In a second news release he told of a trip to the Gulf Coast where he found a rookery of rare White Ibis with almost 2,000 nests and in this same location 200 nests of the Roseate Spoonbill and 100 nesting Wood Storks. In another location he found 2,400 nests of the White-faced Ibis (Anon. 1923f).

One of Simmons' main concerns was that the animals of Texas were not adequately protected during their breeding season. To remedy this situation, he planned to initiate a campaign to ensure that the laws would be enforced (Anon. 1923e). This campaign was, however, never implemented since on 26 June 1923 Simmons suddenly announced his resignation as Chief Deputy Commissioner effective 10 July (Anon. 1923c). He had been on the job for only a little over six months but an opportunity had presented itself that he could not turn down.

An event with lasting consequences occurred during the time Finlay worked for the Game, Fish and Oyster Commission. Mosquitoes were present in innumerable numbers along the Texas coast, and some were carriers of the organism causing malaria. Finlay contracted malaria while working for the Commission and, although controllable, the disease recurred periodically during the remainder of his life (*fide* Victoria Gay Simmons).

LEADER OF THE SOUTH ATLANTIC EXPEDITION

The idea of collecting specimens from the islands of the South Atlantic was first proposed in 1922 by Dr. Leonard Sanford. The idea was presented to Paul Rea, director of the Cleveland Museum of Natural who convinced Elizabeth Bingham Blossom, a trustee of the museum, to finance the expedition. The ship, a 3-masted schooner, used in the expedition was renamed the "Blossom" after its benefactor.

The qualities necessary for the leader of the expedition included adequate scientific training, field experience, physical strength and health, executive ability and a commitment to return to the Cleveland Museum as curator of the bird and mammal collection. Simmons satisfied all of these criteria having also impressed the museum director and trustees with his experience as a writer and his work with the Texas Game, Fish and Oyster Commission (Anon. 1923d).

Figure 5. George Finlay Simmons, Ruthven Deane Collection, Library of Congress. Photograph taken in 1923 before leaving on the South Atlantic Expedition.

Selecting the personnel for the expedition was an important key to its success. Finlay chose as his crew several students eager for adventure. This was, however, an error in judgment since these young men were not up to the rigors of long weeks on the high seas. He did, however, make excellent choices in the two naturalists who would accompany him. William Kenneth Cuyler, a personal friend and instructor of zoology at the University of Texas, was chosen as chief collector of the expedition while Robert Henry Rockwell of the American Museum of Natural History served as the taxidermist. Other crew members often assisted in collecting but Simmons, Cuyler and Rockwell were the main individuals engaged in this activity.

Collecting natural history specimens was not the entire mission of the expedition. The Inland Bird Banding Association supplied 8,000 bands to use in the rookeries of the South Atlantic (Lyon 1923). In addition, thousands of feet of camera film were taken to visually document the islands and the culture of the native inhabitants. Communication by wireless radio was the only means of communication with the outside world during much of the voyage. All

Figure 6. George Finlay Simmons (L) and William Kenneth Cuyler (R) examining the chicks of a storm petrel on one of the Cape Verde Islands. Photograph from *National Geographic Magazine*, July 1927.

of the necessary supplies for collecting including various types of armaments were part of the inventory carried by the ship (Anon. 1923g,h,i).

The Blossom and its crew sailed from New London, Connecticut, on 19 October 1923 with a crew of 18. After a brief stop for repairs at Gardiner's Bay, Long Island, the ship departed for the South Atlantic on 10 November 1923. Eight days later severe storms with winds 80-90 mph battered the ship. Having survived this tempest the Blossom and its crew arrived at the Cape Verde Islands on the 10th of December. Serious work then began with many birds and other natural history specimens being collected in the following days.

Collecting on the Cape Verde Islands continued until May at which time the Blossom sailed for the port of Dakar on the West African coast. The first report to the United States was that a mutiny had taken place and the ship was stranded in port. In actuality, four of the crew members, tired of hard work and loneliness, had asked to be discharged from their duties. Finlay was said to be ill, and Armede departed for Dakar as the only woman on a Dutch tramp steamer to be at his side. The report of Finlay's illness is perhaps based on the fact that during most of the voyage to the Cape Verdes he had been so sea-sick that he was hardly able to stand (Rockwell 1931). His statement to the press that he was "healthy and husky" was undoubtedly made to reassure the folks at home that everything was under control and that the expedition would continue its work. Nearly 1,000 specimens of rare birds, fish and reptiles, the most complete ever made on the Cape Verde Islands, were said to be ready to ship back to the sponsors of the expedition (Anon. 1924a,b).

The Blossom continued on its voyage after recruiting new crew members. Stops during the next several months included Gambia, St. Helena Island, Ascension Island and Trinidad. After its last stop in Rio de Janeiro the Blossom sailed north arriving at Charleston, South Carolina, on 4 June 1926. The expedition had lasted 31 months and cost $75,000. The fruits of the voyage consisted of over twelve thousand specimens, 4,000 photographs and thousands of feet of film and "notebooks bulging with stories of the interesting creatures of distant isles and seas" (Simmons 1927). Although Simmons undoubtedly viewed the expedition as being primarily biological in nature, it was later characterized as having anthropological significance because of the documentation of native culture in the South Atlantic.

The skins of 3,741 birds representing more than 300 species or subspecies, as well as alcoholic specimens for dissection and birds' eggs and nests were obtained on the voyage (Simmons and Cuyler 1928). Skins of 505 specimens representing 116 species or subspecies were later transferred to the American Museum of Natural History (Anon. 1929b).

Soon after his return to Cleveland, Simmons set about writing a popular account of the voyage that was published in the July 1927 issue of *The National Geographic Magazine*. This article, *Sinbads of Science*, consisted of 75 pages with 87 illustrations, mostly black and white photographs taken by Simmons, Kenneth Cuyler and Robert Rockwell.

The hardships experienced by the crew are detailed in Simmons' article. Only four of the original party returned at the end of the expedition. The others had been sent home ill with tropical fevers or psychologically worn down from exposure to the elements and the dull monotony of life on the ship. Simmons and his collectors, Cuyler and Rockwell, seem to have been spared the afflictions of the rest of the crew.

Fresh meat, other than fish, was in short supply on the ship. Simmons and Cuyler soon discovered that fried cutlets of albatrosses were highly delectable. Simmons' further related that "We found them so delicious that we tried stews, hashes and even braised and boiled" their flesh. The meat "was tender and well flavored and especially tempting was the breast of the yellow-nosed variety." Remembering the *Rime of the Ancient Mariner*, the rest of the crew refused to eat the flesh of albatrosses regardless of the manner in which the meat was prepared.

PUBLICATION OF *BIRDS OF THE AUSTIN REGION*

Simmons' master's thesis was published in book form by the University of Texas Press in 1925 while he was still in the South Atlantic. It is worth noting that Simmons dedicated *Birds of the Austin Region* to his wife, Armede Victoria Hatcher, for her "continued encouragement and for endless assistance in the field and in preparing the manuscript." Armede had, in fact, done much of the editing of the manuscript and had carried the galley sheets of the book with her for Finlay's approval during her visit with him at Dakar, West Africa (Tharp 1926). Other persons acknowledged included Harry Church Oberholser, Harry Yandell Benedict, Elton Perry, Jr. and numerous other observers in the Austin region. The fact that none of the faculty at the University of Texas are acknowledged suggests that Simmons received little assistance from the zoology department.

Dr. Elton Perry (1873-1928) was Finlay's main source of information for local birds. Perry was a talented photographer as well as being a prolific collector of birds' eggs and skins many of which are now in the American Museum of Natural History, Museum of Vertebrate Zoology and the Western Foundation for Vertebrate Zoology. Photographs of Perry's egg collection taken by Simmons appear in the March 1916 issue of *The Oologist* and the 1922 issue of *The American Oologists' Exchange Price List*.

The text of *Bird Life of the Austin Region* consisted of 46 pages of introductory material reviewing the physical features of the Austin region, its soil formation, weather conditions, and early history, how birds are named and classified as well as photographs and brief biographies of local observers. This introductory material was followed by a catalog of 294 species or subspecies describing the geographical distribution, habitat, local haunts, general habits, feeding habits, flight, voice, courtship, nest and eggs, technical descriptions and plumage peculiarities. The palatability of the flesh was noted for several species suggesting that Simmons' opinion was based on personal experience. The merganser, for example, was said to be "A poor bird for the table, tough and with an unpleasant taste" whereas the Green-winged Teal was "greatly desired for the table."

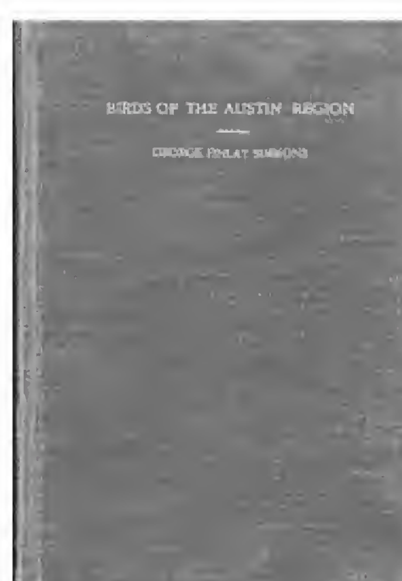

Figure 7. Birds of the Austin Region by George Finlay Simmons, University of Texas Press, 1925.

Reviews of *Birds of the Austin Region* in *The Auk*, *Condor* and *Wilson Bulletin* praised the work as a "substantial contribution" and an "excellent work" in which the author demonstrated a "marked ability for organizing his material upon a consistent plan." It was further noted that the book was the most extensive work on Texas ornithology to date, and that it might serve as a helpful reference for bird students outside the state. The major criticism related to deviations in nomenclature from the A.O.U. Checklist and supplements, a defect that Joseph Grinnell attributed to the influence of Harry Oberholser (Grinnell 1926). This book of 387 pages, which sold at the time of its publication for only $4.00, is now listed on the internet at prices ranging from $125.00 to $250.00.

Simmons' work is often cited in the literature. Those volumes of A. C. Bent's *Life Histories of North American Birds* published after 1925 contain numerous quotes from *Bird Life of the Austin Region*. Connie Hagar of Rockport fame is said to have learned to bird using *Bird Life of the Austin Region* (Strickland 2018). Oberholser (1974) considered *Bird Life of Austin Region* to be one of the "most thoroughly prepared contributions to the literature on Texas birds." More recently, Lockwood (2001) described *Bird Life of the Austin Region* as a "valuable reference" that "provides an important base of information for comparing changes in the avifauna of central Texas."

MUSEUM WORK, TEACHING AND LECTURING

Simmons held several positions following his return from the South Atlantic Expedition. He continued as curator of birds at the Cleveland Museum of Natural History until 1929 while also teaching at Western Reserve University and lecturing on his adventures in the South Atlantic (Anon. 1960). His lectures, which were advertised as a "special illustrated talk for boys who love tales of treasure-trove and adventure, and for boys who have grown into men but who have never grown up", perhaps reveals some insight into his personality and way of thinking (Anon. 1929a).

Simmons was a professional zoologist but he intuitively knew that his audiences wanted to be entertained as well as educated. To achieve this goal, the brochure advertising his lecture featured the map of a real, uninhabited island, fancifully referred to as "Treasure Island", which had been charted by "Ye Scientific Pirates Capt. Finlay SIMMONS and his mate Kenneth CUYLER on Ye good ship BLOSSOM of ye port CLEVELAND being an Island over 3 mi. long and nearly 2 mi. wide." Accompanying this map was an inset with a drawing of "Geo. Finlay Simmons, Captain of the Scientific Pirates" with a red bandana on his head and a large earring in his right ear. One can only wonder if Finlay, a sophisticated academic, actually appeared before his audiences wearing the bandana and large earring. Perhaps he did since in later years he was remembered by his family as being "playful" (*fide* Victoria Gay Simmons). A copy of the lecture brochure is now found in the Simmons Papers at the Maurine and Mike Mansfield Library, University of Montana—Missoula.

SIMMONS AS 'CAPTAIN EASY'

In 1929 the distinguished cartoonist Royston 'Roy' Campbell Crane (1901-1977) introduced a free-wheeling soldier of fortune known as "Captain Easy" into his newspaper cartoon strip. Crane, a native Texan, attended Hardin-Simmons University and later the University of Texas where he made the acquaintance of Finlay Simmons who was at this time dating Armede Hatcher. Crane was most likely introduced to Armede's sister, Evelyn, by Simmons. The relationship between Crane and Evelyn Hatcher matured over the years and the couple married in 1927 making Finley and Roy Crane brothers-in-law.

Roy Crane undoubtedly heard first-hand accounts of the South Atlantic Expedition from his brother-in-law, Captain Finlay Simmons. He would also have been inspired by Finlay's narrative of the voyage "Sinbads of Science" which was a "breathless text [that] rings with the hyperbole of comic strip excitement" (Harvey 2012). In addition, Crane knew of Finlay's lectures on the expedition which featured pirates, treasure, uninhabited islands and adventures on the high seas. Roy Crane made no secret that his brother-in-law was the model for "Captain Easy", the name 'Easy' perhaps referring to Finlay's easy going personality (Harvey 2012). Thus it came to be that an ornithologist and expedition leader from Texas became transformed into a comic book character.

THE MOVE TO MONTANA STATE UNIVERSITY

In 1931 Simmons moved to Chicago where he enrolled as a student in the Hull Zoology

Laboratory at the University of Chicago while Armede remained in Cleveland with the children. In a strange turn of events, he abandoned his previous interest in birds and turned instead to the study of sexual periodicity in ground squirrels while working under the supervision of Professor Carl Richard Moore a specialist in reproductive physiology. He received his doctoral degree in 1934 after which he accepted a position as assistant professor of zoology at Montana State University. His rise through the ranks was remarkably fast. After two years as assistant professor, he was promoted to full professor and, with the support of local businessmen and the governor, appointed president of the university on 1 December 1935. Simmons had once again assumed the mantle of leadership but in a much different setting than his expedition to the South Atlantic.

Figure 8. George Finlay Simmons. Photograph from the Archives and Special Collections, Mansfield Library, University of Montana-Missoula as posted on Ancestry.com

The 1941 Yearbook of Montana State University featured a full-length photograph of "Finlay" Simmons and provided the following description—"He is the "personification of well-polished dignity…A go-getter with looks, drive, initiative… well-liked by the students, supported by them in his doings. A traveler, lecturer—willing to discuss his views on anything, anytime, with anyone. Never misses an athletic contest…A biologist of note, he hails from the University of Texas, his Alma Mater, where he played football…Yet with all his southern heritage, ever present 'suthuhn' drawl, Dr. George Finlay Simmons is a tried and true Montanan."

There were notable accomplishments during the Simmons' presidency. Several campus buildings were erected or renovated, courses in more than half of the departments were reorganized, the chemistry, journalism and pharmacy programs were modernized, the music program accredited and the university returned to the Pacific Coast Football Conference. Then, suddenly, on 15 April 1941 Simmons resigned as president and returned to the zoology department from which he was granted a leave of absence to search for other employment (Anon. 1941).

Simmons' resignation was apparently grounded in politics. Finlay was popular with Montana republicans who wanted him to run for governor. He declined to do so but promised to support the party's candidate provided that the nominee not interfere with the business of the university. However, after the republican candidate won the election, he began to implement policies detrimental to the university and Finlay resigned in disgust (*fide* Victoria Gay Simmons).

LAST YEARS IN CHICAGO

In 1943 Simmons left Montana to accept a Ridgway Fellowship in Zoology at the University of Chicago while also teaching anatomy at Loyola University School of Medicine. His beloved wife and field assistant, Armede 'Jack', died in 1953 at the age of 52. Finlay was suffering at this time from advanced Parkinson's disease but the cause of his death on 19 July 1955 at his home in Glen Ellyn, Illinois, was from a heart attack. Armede had been cremated and her ashes scattered in her rose garden. Finlay was also cremated and his ashes are believed to have also been spread in the rose garden (*fide* Victoria Gay Simmons).

Details of Simmons' activities at the University of Chicago and Loyola University School of Medicine are unknown. No evidence has been found to support the claim that he "returned to his passionate studies in zoology" and published "several more books and articles" following his retirement from the presidency at Montana State University (University of Montana 2017). It is known, however, that he was the author of over 80 articles on birds as well as the biographies of Frank M. Chapman and Glover M. Allen published in the 1955 edition of *Encyclopedia Britannica* (Simmons 1955).

An Associated Press release of Simmons' death printed in several newspapers noted only that he was born in Sherman, Texas, and that he was at one time a newspaper man in Houston. Nothing is said of his work as an ornithologist, expedition to the South Atlantic or work as a museum curator. Even more striking was the omission of any mention of Simmons' ornithological work in the notice of his death published in the *Austin Statesman* (Anon. 1955a). A more complete obituary published in the *Billings Gazette* mentions his leadership of the South Atlantic expedition and his work as the curator of ornithology at the Cleveland Museum but says nothing of his work as an ornithologist in Texas (Anon. 1955b). Sadly, at the time of his death, the outstanding contribution of George Finlay Simmons to the ornithology of Texas seems to have been either forgotten or else not considered worth mentioning.

SIMMONS AS REMEMBERED IN 2018

The discipline of ornithology has moved on since the 1920s when collecting and descriptive accounts of avian natural history were in vogue. Although the ornithological work of Simmons in Texas has been largely forgotten, his role as the leader of the South Atlantic Expedition has recently become the subject of a major museum exhibit.

Interest in the South Atlantic Expedition was rekindled in 2008 when Wendy Wasman discovered documents in the archives of the Cleveland Museum of Natural History relating to the voyage of the Blossom. Her research over the next 10 years involved examination of field journals, specimens, photographs, maps and other memorabilia of the expedition, as well as obtaining recollections from descendants of the crew members of the Blossom. Wasman concluded from her research that the South Atlantic Expedition and subsequent events was, for the most part, the story of Finlay Simmons. He was a leader "so charismatic that he was actually turned into a comic book character" and when "on a speaking tour, people loved him. He was like a movie star" (Mangels 2018, Wasman 2013). The adventures of Finlay Simmons and the expedition crew are now featured in 'The Voyage of the Blossom' exhibit at the Cleveland Museum from 24 March through 5 August 2018.

ACKNOWLEDGMENTS

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A list of the popular and professional articles published by George Finlay Simmons is given in Appendix 1. Newspaper articles relating to the life of Finlay Simmons can be accessed at the Portal to Texas History and Newspaperarchive.com. The basic sequence of events in Simmons' life is taken from the 1960 edition of *Who Was Who in America* and from documents in the Simmons Collection at the Maurine and Mike Mansfield Library, University of Montana—Missoula.

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IMPACTS OF CHANGES IN LAND COVER ON POPULATION TRENDS OF HIGH CONSERVATION PRIORITY BIRD SPECIES WITHIN THE GULF COAST JOINT VENTURE REGION

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ABSTRACT.— Monitoring trends in avian population abundance is a critical component of modern wildlife science, management and conservation. Relating such trends to changes in land cover is essential for identifying potential drivers responsible for long-term changes in bird population abundance. We assessed relationships between land cover changes from 1992 to 2006 to long-term data from Breeding Bird Surveys and Christmas Bird Counts in the Gulf Coast Joint Venture Region in the northwestern part of the coastal and inland regions of the Gulf of Mexico. Northern bobwhite (*Colinus virginianus*) population trends were negatively correlated with changes in grassland-herbaceous cover. Hooded merganser (*Lophodytes cucullatus*) population trends were negatively correlated with changes in amount of Emergent Herbaceous Wetlands and Redhead (*Aythya americana*) population trends were positively correlated with changes in the amount of Open Water. The largely non-significant and highly variable relationships between bird species trends in population abundance and changes in land cover indicate a variety of factors are probably responsible for this pattern, including perhaps abiotic factors not related to changes in land cover. Most likely, (1) either local land cover dynamics are not being detected by the National Land Use Cover Dataset (NLCD) data, or (2) high variation in bird species count data (e.g., results from a companion study by Sands et al. (2017) masked our ability to detect major impacts of land cover changes on most of the high conservation priority bird species within the Gulf Coast Joint Venture Region.

INTRODUCTION

Changes in land cover can impact detectability, occupancy, abundance, and population trends of birds (Bellar and Maccarone 2002, Betts et al. 2007, Niemuth et al. 2007). Thus, determining historic and current composition of land cover surrounding Breeding Bird Survey (BBS) routes and Christmas Bird Count (CBC) circles that have been the basis for long-term monitoring of breeding and wintering birds, respectively, can be potentially useful for understanding why populations of particular species of birds have changed over time.

Joint Ventures were originally designed to implement the objectives of the North American Waterfowl Management Plan (USFWS 1986). Although their initial priority was waterfowl and wetland bird conservation, over the ensuing decades, Joint Ventures have evolved to include a wide spectrum of conservation activities involving many species of migratory and resident birds (Giocomo et al. 2012). Joint Ventures are organized as cooperative partnerships that involve federal and state resource agencies and non-governmental organizations (Brennan et al. 2017).

The Gulf Coast Joint Venture is one of 22 such organizations in the United States, Canada and Mexico. It is funded by the U.S. Fish and Wildlife Service with oversight by a Management Board; habitat and monitoring programs are implemented by a team of wildlife scientists and other cooperators (http://www.gcjv.org/index.php). The Gulf Coast Joint Venture (GCJV) has identified 22 priority

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species of landbirds, shorebirds, and waterbirds that have high priority for the GCJV partnership, along with other avian species of conservation concern that require monitoring (Sands et al. 2017). The GCJV management personnel were interested in evaluating the potential of using existing landscape-scale surveys such as the BBS and/or the CBC at multiple scales within and at the GCJV scale as a potential alternative to implementing de novo individual monitoring programs for individual species or groups of species of birds.

In this paper, we report on how changes in land cover over two decades may have influenced population trajectories of species of birds that are of high conservation priority to the GCJV, based on population trend analyses reported by Sands et al. (2017). Our three objectives in the study reports here were: (1) Quantification of the aerial extent of land cover types within the GCJV at the scale of the entire GCJV region, Bird Conservation Region (BCR) 37, along BBS routes (with 500-m buffer,) and within CBC circles (pooled); (2) Quantification of land cover change along individual BBS routes and within CBC circles; and (3) Evaluation of relationships between changes in habitat classifications and bird population trends along BBS routes and within CBC Circles. Because these analyses were generally exploratory in nature, we did not pose a priori research hypotheses related to these three objectives.

METHODS

We used National Land Cover Dataset (NLCD) data to quantify land cover types and land cover type changes from 1992 to 2006 within the GCJV at four scales: the entire GCJV region, BCR 37, BBS routes (with a 500-m buffer) and CBC count circles. We calculated absolute and percent changes of land cover change among classifications types from 1992 to 2006. We used a chi-square (X^2) analysis to evaluate if 1992 and 2006 land cover classification proportions and changes of land cover classifications from 1992 to 2006 were similar between observed (GCJV scale) and expected (BCR 37, BBS Routes, CBC count circles).

Based on population trends from specific BBS routes and CBC count circles reported by Sands et al. (2017) we compared significant (confidence intervals do not overlap 0) estimates with changes in appropriate absolute land cover classification within corresponding BBS routes and CBC circles (1992–2006). We evaluated this correlation using non-parametric Spearman Rank Correlations in STATISTICA 10.0 (Statsoft, Tulsa, OK).

RESULTS

Land Cover, Landscape Scale Trends and Habitat Change

Generally, land cover proportions (1992 and 2006) along BBS routes and at CBC circles appeared to be representative of the larger landscape (e.g., GCJV, BCR 37), with the most notable exception of Open Water on CBC circles (Figure 1). Land cover change (Figure 2, Figure 3) from 1992 to 2006 was generally proportional among spatial scales; however, changes in Shrub-Scrub, Grassland-Herbaceous, and Pasture-Hay cover types tended to be greater at BCR 37, BBS routes, CBC circles, than at the GCJV scale. Additionally, Shrub-Scrub cover types decreased within BCR 37 and along BBS routes, and increased or remained stable within the GCJV and CBC circles. Pasture-Hay and Open Water decreased on BBS routes and within CBC circles and increased within GCJV and BCR 37.

Based on 1992 (Table 1) and 2006 (Table 2) NLCD land cover data, chi-square results indicated that, in general, observed values of land cover data (BCR37, BBS, CBC) did not differ statistically from expected values (based on the GCJV landscape). A notable exception was that the GCJV landscape differed significantly in the proportion of open water available (1992: X^2 = 45.95; df = 1, $P <$ 0.001; 2006: X^2 = 34.37, df = 1, $P <$ 0.001). This result was consistent across all classification types with the exception of the CBC (df: 14, $P <$ 0.001). Percent changes from 1992 to 2006 among classification types were representative between observed and expected (Table 3) values with the exception of Barren Land (Rock/Sand/Clay) at the BCR 37 and CBC count circle scales (BCR 37: X^2 = 5.99, df = 1, $P <$ 0.05; CBC circles: X^2 = 4.04, df = 1, $P <$ 0.05). This result was consistent across all classification types (Table 5).

Thirteen species of birds declined in abundance at the GCJV scale and 16 increased in abundance from 1966 to 2007 (Table 4 and Table 5). Four species of grassland-associated birds exhibited population declines and two species increased (Table 4 and Table 5). These changes occurred in conjunction with declines of −0.78% or Shrub-Scrubland −3.14% for Grassland-Herbaceous cover types,

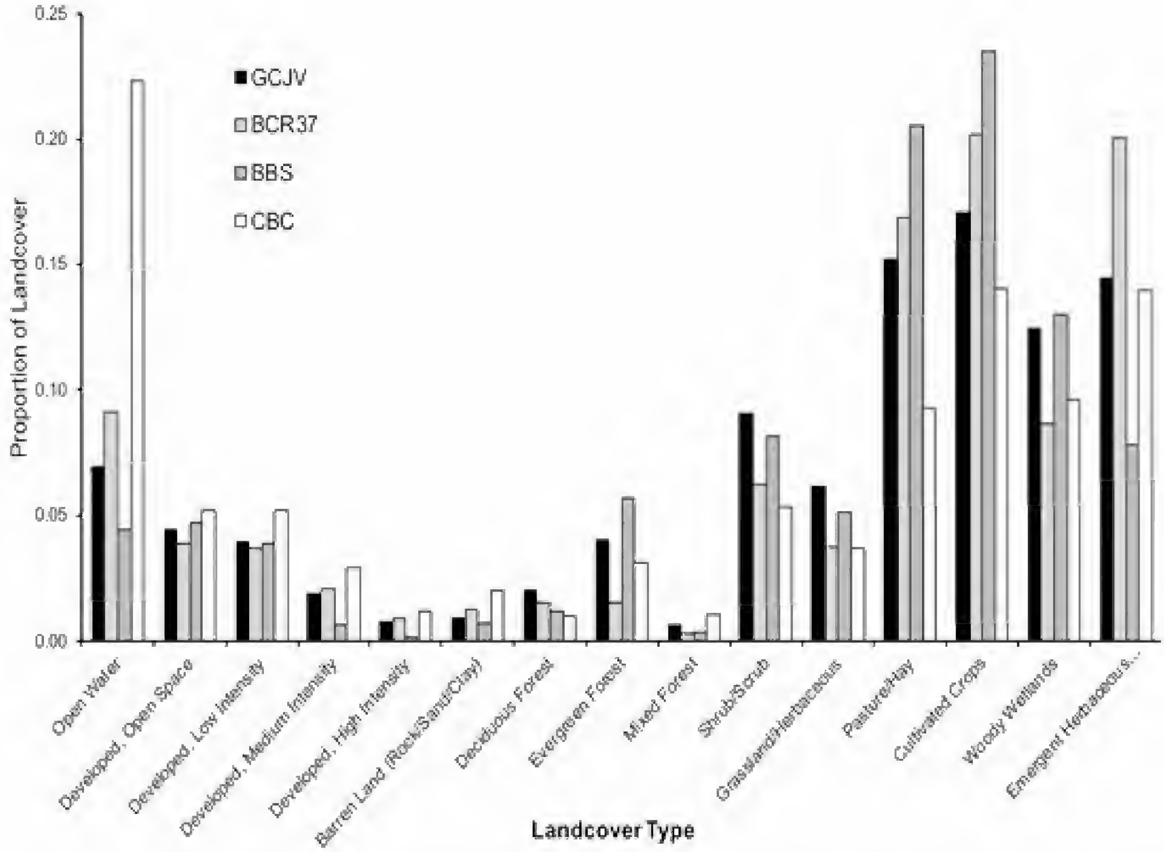


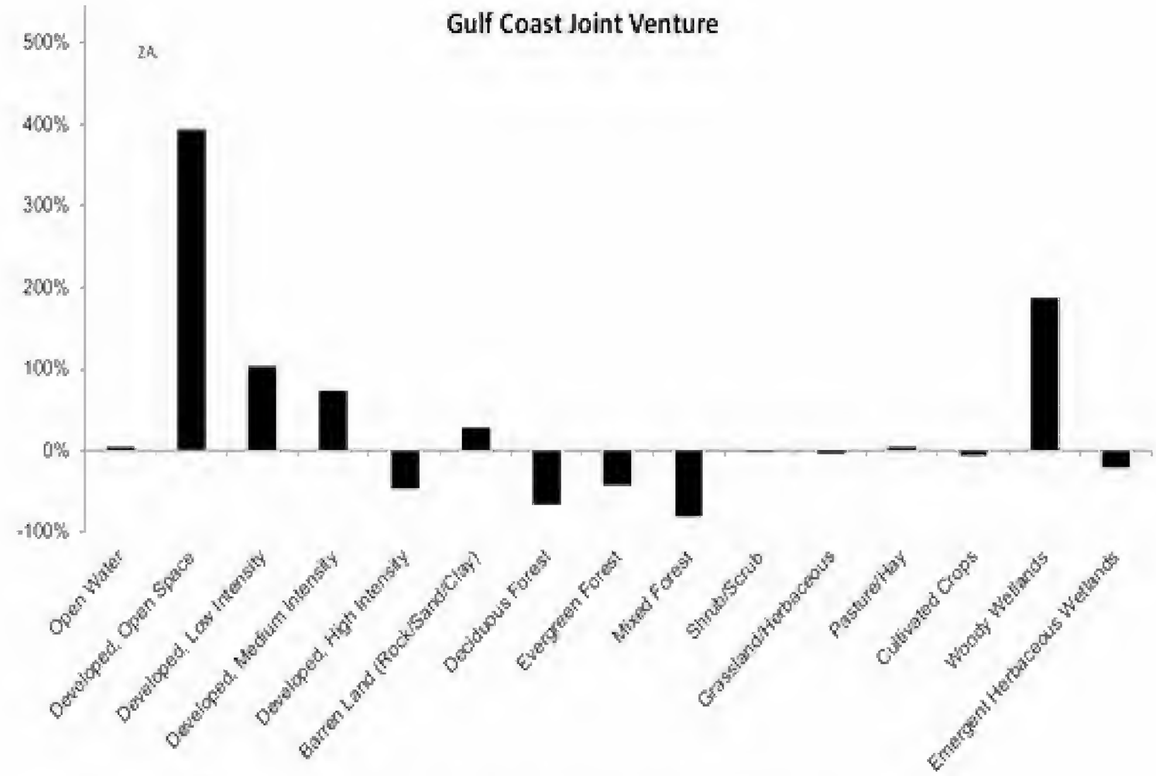
Figure 1. Landcover proportions of National Landcover Dataset cover types in 2006 at Gulf Coast Joint Venture, Bird Conservation Region 37, Breeding Bird Survey Routes (500 m buffer) and Christmas Bird Count Circles.

and a 4.85% increase of the Pasture-Hay cover type. Three species of forest-associated birds exhibited declines and one species increased (Table 6, Table 7). These changes occurred in conjunction with declines in Deciduous Forest, Evergreen Forest, and Mixed Forest at all spatial scales. Four species of waterfowl and waterbirds exhibited declines at the GCJV scale, and 11 species increased. These changes occurred in conjunction with declines in Emergent Herbaceous Wetlands (EHW) at all spatial scales and declines in Open Water at the BBS Route and CBC circle scale. Woody Wetlands increased at all spatial scales in this study.

Northern bobwhite (*Colinus virginianus*) route trends were negatively correlated ($r = -0.84$, $P < 0.05$) with decreases in Grassland-Herbaceous cover along BBS routes. All other correlations between population trends and land cover changes were statistically insignificant for this species. Two waterfowl species population trends were significantly correlated with land cover changes. Hooded merganser (*Lophodytes cucullatus*) population trends were negatively correlated with changes in amount of Emergent Herbaceous Wetlands ($r = -0.90$, $P < 0.05$). Redheads (*Aythya americana*) were positively correlated with changes in the amount of Open Water ($r = 0.90$, $P < 0.05$).

DISCUSSION

Monitoring trends in vertebrate abundance is a critical component of modern wildlife science and conservation. Relating these trends in relation to changes in land cover and land use is essential for identifying potential drivers responsible for such changes in population abundance. Even with robust indices, ecologists developing monitoring programs are confronted with sampling issues, including how many plots to sample, how often to survey plots within any given year, and what interval and how many years to sample (Cyr et al. 1992). In addition to this, identifying relationships between habitat changes and species population trends



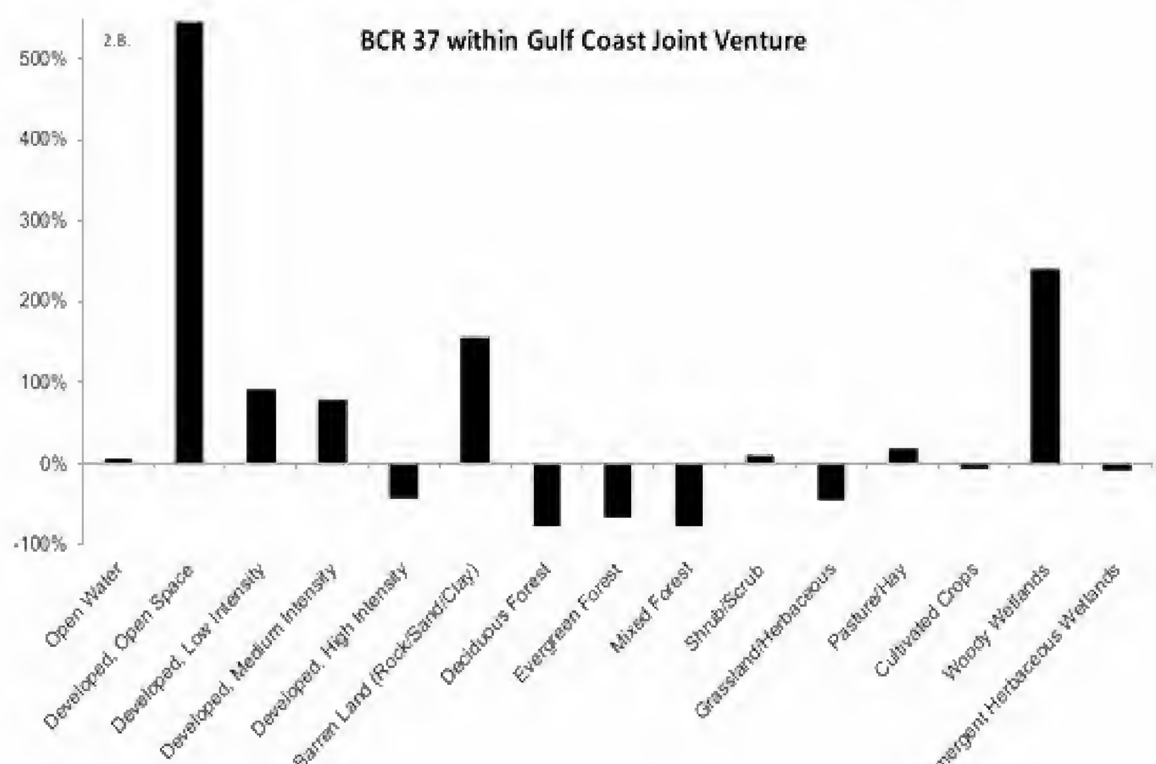
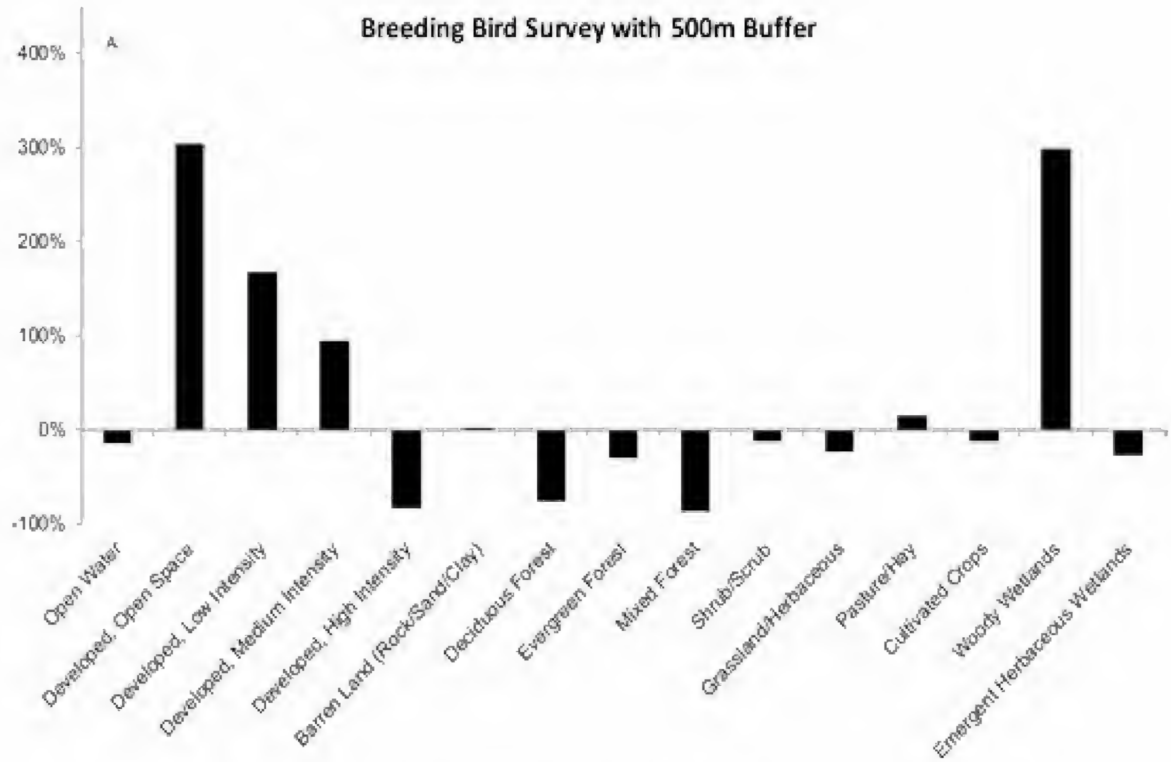


Figure 2. Percent changes in National Landcover Dataset classes from 1992 to 2006 at the (A) Gulf Coast Joint Venture and (B) Bird Conservation Region 37 scale.



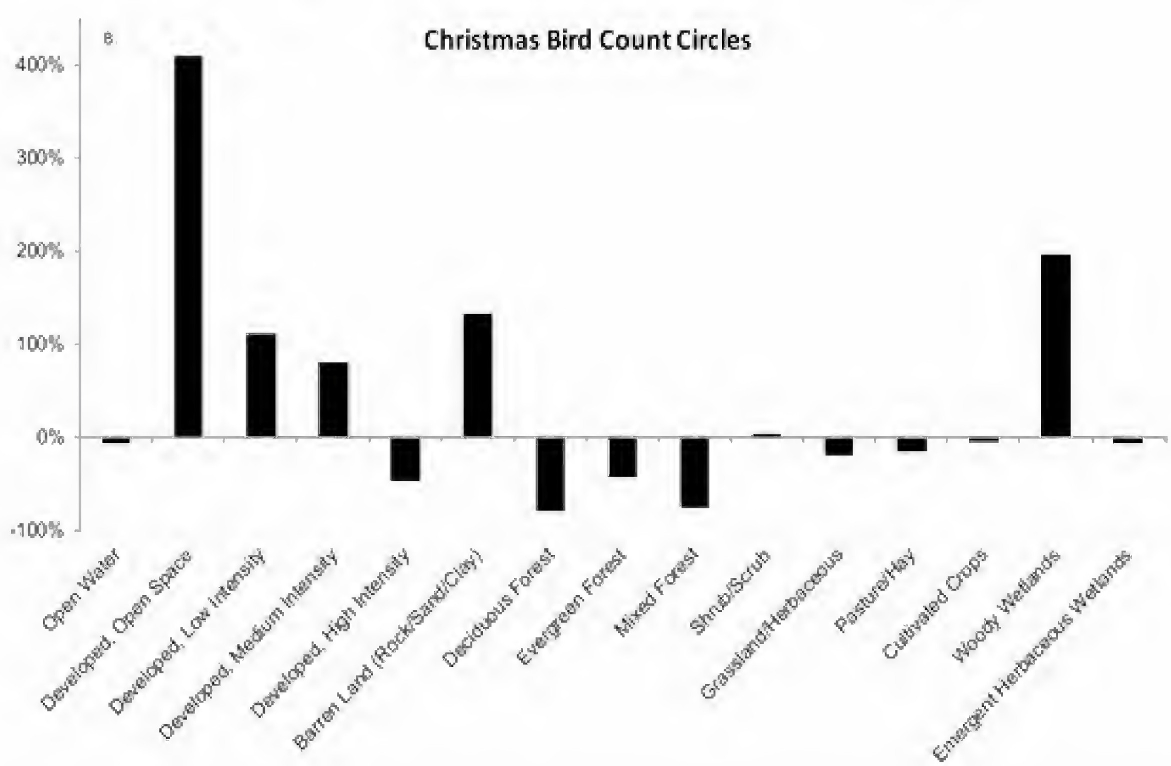


Figure 3. Percent changes in National Landcover Dataset classes from 1992 to 2006 along (A) Breeding Bird Survey routes (with 500m buffer) and (B) within Christmas Bird Count Circles.

Table 1. Land cover proportions and chi-square (X^2) values for land cover classifications between observed (BCR 37, CBC, BBS) and expected (GCJV) in 1992. Cumulative X^2 results based on df = 14. Individual X^2 results based on df = 1 and significant ($P \leq 0.05$) results are indicated by a *.

	Landcover Proportions					X^2 Values		
Class	GCJV	BCR37	CBC	BBS (500m)		BCR37 X^2	CBC X^2	BBS500M X^2
Open Water	6.56	8.69	23.92	5.21		0.70	45.95*	0.28
Developed, Open Space	0.90	0.61	1.02	1.16		0.09	0.02	0.08
Developed, Low Intensity	1.94	1.91	2.47	1.45		0.00	0.15	0.12
Developed, Medium Intensity	1.08	1.16	1.62	0.33		0.01	0.27	0.53
Developed, High Intensity	1.45	1.59	2.23	1.03		0.01	0.41	0.12
Barren Land (Rock/Sand/Clay)	0.72	0.48	0.86	0.73		0.08	0.03	0.00
Deciduous Forest	6.06	6.56	4.53	4.80		0.04	0.39	0.26
Evergreen Forest	7.03	4.42	5.61	8.11		0.97	0.29	0.17
Mixed Forest	3.20	1.41	4.34	2.85		1.00	0.40	0.04
Shrub/Scrub	9.14	5.66	5.12	9.23		1.33	1.77	0.00
Grassland/Herbaceous	6.39	6.71	4.50	6.66		0.02	0.56	0.01
Pasture/Hay	14.53	14.18	11.00	17.78		0.01	0.86	0.73
Cultivated Crops	18.39	21.89	14.62	26.78		0.67	0.77	3.83
Woody Wetlands	4.32	2.54	3.24	3.26		0.74	0.27	0.26
Emergent Herbaceous Wetlands	18.29	22.18	14.90	10.63		0.83	0.63	3.21
					Total	6.47	52.74	9.64
					P	0.95	<0.001	0.79

Table 2. Landcover proportions and chi-square (X^2) values for land cover classifications between observed (BCR 37, CBC, BBS) and expected (GCJV) in 2006. Cumulative X^2 results based on df = 14. Individual X^2 results based on df = 1 and significant ($P \leq 0.05$) results are indicated by a *.

	Landcover Proportions				X^2 Values		
Class	GCJV	BCR37	CBC	BBS (500 m)	BCR37 X^2	CBC X^2	BBS 500m X^2
Open Water	6.90	9.14	22.30	4.44	0.72	34.37*	0.88
Developed, Open Space	4.44	3.92	5.20	4.70	0.06	0.13	0.01
Developed, Low Intensity	3.97	3.67	5.22	3.89	0.02	0.40	0.00
Developed, Medium Intensity	1.88	2.07	2.94	0.63	0.02	0.60	0.83
Developed, High Intensity	0.78	0.91	1.21	0.18	0.02	0.24	0.46
Barren Land (Rock/Sand/Clay)	0.91	1.24	2.01	0.74	0.11	1.31	0.03
Deciduous Forest	2.05	1.51	0.96	1.17	0.14	0.58	0.38
Evergreen Forest	4.01	1.51	3.16	5.72	1.56	0.18	0.73
Mixed Forest	0.61	0.31	1.03	0.39	0.15	0.28	0.08

Table 2. *Continued.*

Class	Landcover Proportions GCJV	BCR37	CBC	BBS (500 m)		X^2 Values BCR37 X^2	CBC X^2	BBS 500m X^2
Shrub/Scrub	9.07	6.25	5.36	8.17		0.88	1.52	0.09
Grassland/Herbaceous	6.19	3.73	3.67	5.14		0.97	1.02	0.18
Pasture/Hay	15.24	16.89	9.27	20.56		0.18	2.33	1.86
Cultivated Crops	17.09	20.20	14.02	23.53		0.56	0.55	2.42
Woody Wetlands	12.43	8.62	9.63	12.97		1.17	0.63	0.02
Emergent Herbaceous Wetlands	14.43	20.05	14.00	7.79		2.19	0.01	3.05
					Total	8.78	44.15	11.02
					P	0.85	<0.001	0.68

Table 3. Percent changes in land cover proportions and chi-square (X^2) values for land cover classifications between observed (BCR 37, CBC, BBS) and expected (GCJV) from 1992 to 2006. Cumulative X^2 results based on *df* = 14. Individual X^2 results based on *df* = 1 and significant ($P \leq 0.05$) results are indicated by a *.

Class	Percent Change of Landcover Proportions GCJV	BCR37	CBC	BBS 500M		X^2 Values BCR37 X^2	CBC X^2	BBS 500m X^2
Open Water	5.23%	5.09%	−6.85%	−14.78%		0.00	0.28	0.77
Developed, Open Space	394.06%	545.50%	409.24%	304.39%		0.58	0.01	0.20
Developed, Low Intensity	104.22%	91.53%	110.79%	167.23%		0.02	0.00	0.38
Developed, Medium Intensity	73.66%	78.90%	80.61%	94.42%		0.00	0.01	0.06
Developed, High Intensity	−46.39%	−43.13%	−45.87%	−82.72%		0.00	0.00	0.00
Barren Land (Rock/Sand/Clay)	27.34%	155.36%	132.38%	1.84%		5.99*	4.04*	0.24
Deciduous Forest	−66.18%	−77.05%	−78.84%	−75.63%		0.00	0.00	0.00
Evergreen Forest	−42.96%	−65.97%	−43.79%	−29.55%		0.00	0.00	0.00
Mixed Forest	−80.87%	−78.32%	−76.31%	−86.22%		0.00	0.00	0.00
Shrub/Scrub	−0.78%	10.46%	4.56%	−11.46%		0.00	0.00	0.00
Grassland/Herbaceous	−3.14%	−44.43%	−18.50%	−22.88%		0.00	0.00	0.00
Pasture/Hay	4.85%	19.07%	−15.82%	15.60%		0.42	0.88	0.24
Cultivated Crops	−7.06%	−7.75%	−4.22%	−12.14%		0.00	0.00	0.00
Woody Wetlands	187.52%	239.69%	196.71%	297.86%		0.15	0.00	0.65
Emergent Herbaceous Wetlands	−21.14%	−9.60%	−6.13%	−26.65%		0.00	0.00	0.00
					Total	7.16	5.22	2.53
					P	0.93	0.98	0.99

Table 4. Population trends[a] and root mean square error (RMSE) for 16 priority bird species (with significant trends) in the Gulf Coast Joint Venture based on Breeding Bird Survey data, 1966–2007[b].

Species	n	Trend Estimate[a] (95%CI)	RMSE
Bachman's Sparrow	26	−5.82% (-10.42−−1.98%)	2.27
Black-bellied Whistling-Duck	41	3.56% (1.71−5.55%)	2.57
Fulvous Whistling-Duck	40	3.67% (1.71−5.55%)	2.28
Gull-billed Tern	35	5.23% (3.25−7.214%)	1.66
Kentucky Warbler	39	−2.18% (-3.82−−0.50%)	1.75
Least Bittern	31	3.46% (0.70−6.29%)	1.97
Little Blue Heron	42	3.56% (1.61−5.55%)	3.44
Loggerhead Shrike	42	−1.39% (-208−−0.60%)	1.31
Mottled Duck	41	−3.34% (-4.21−−2.47%)	1.26
Northern Bobwhite	42	−4.50% (-5.16−−3.92%)	1.18
Painted Bunting	41	−1.00% (-1.78−−0.10%)	1.42
Prairie Warbler	35	5.83% (3.73−7.98%)	1.62
Prothonotary Warbler	42	3.87% (2.12−5.71%)	1.98
Swainson's Warbler	30	−3.44% (-5.73−−1.09%)	1.43
Wood Duck	33	4.08% (1.71−6.72%)	2.68
Wood Thrush	42	−1.78% (−3.05−−0.58%)	1.56

[a] Percent change per year based estimate from natural logarithm transformed BBS counts.

Table 5. Population trends[a] and root mean square error (RMSE) for 19 priority bird species (with significant trends) in the Gulf Coast Joint Venture based on Christmas Bird Count data, 1967-2008.

Species	n	Trend Estimate[a] (95%CI)	RMSE
American Wigeon	42	−1.88% (−3.73−−0.20%)	3.92
Black Skimmer	42	2.02% (0.90−3.56%)	2.12
Black-bellied Whistling-Duck	40	11.63% (9.42−15.03%)	3.92
Blue-winged Teal	42	2.12% (0.09−3.36%)	2.41
Canada Goose	42	−6.76% (−8.61−−4.59%)	4.20
Gadwall	42	2.02% (0.70−3.36%)	2.64
Greater White-fronted Goose	42	6.29% (3.87−8.65%)	4.49
Green-winged Teal	42	−1.00% (−2.86−0.90%)	3.92
Gull-billed Tern	42	3.56% (1.98−5.13%)	2.95
Hooded Merganser	42	5.34% (3.87−6.82%)	2.84
LeConte's Sparrow	42	4.08% (2.53−5.55%)	2.81
Loggerhead Shrike	42	−1.59% (−1.98−−0.80%)	1.44
Northern Bobwhite	42	−2.47% (−3.25−−1.59%)	1.71
Reddish Egret	42	2.33% (0.70−4.08%)	2.77
Redhead	42	5.55% (2.94−8.00%)	4.81
Snow Goose	42	2.94% (1.71−4.29%)	2.54
Snowy Plover	42	3.67% (2.63−4.71%)	1.46
Stilt Sandpiper	42	9.20% (6.61−11.63)	4.26
Western Sandpiper	42	2.53% (0.44−4.60%)	3.94

[a] Percent change per year based estimate from natural logarithm transformed CBC counts.

Table 6. Changes in habitat types and values of statistically significant declining trends of birds found in related habitats.

	Grassland Bird Habitat Types					
	Shrub/ Scrub	Grassland/ Herbaceous	Pasture/Hay	Grassland-Shrubland Birds		
Scale	Percent Change[a]	Percent Change[a]	Percent Change[a]	Survey	Species	Trend
GCJV[b]	−0.78	−3.14	4.85	BBS[c]	Bachman's Sparrow	−5.82% (−10.42−−1.98%)
BCR 37[b]	10.46	−44.43	19.07		Loggerhead Shrike	−1.39% (−208−−0.60%)
BBS Routes[b]	−11.46	−22.88	15.60		Northern Bobwhite	−4.50% (−5.16−−3.92%)
CBC Circles[b]	4.56	−18.50	−15.82		Painted Bunting	−1.00% (−1.78−−0.10%)
				CBC[c]	Loggerhead Shrike	−1.59% (−1.98−−0.80%)
					Northern Bobwhite	−2.47% (−3.25−−1.59%)

	Forest Bird Habitat Types					
	Deciduous	Evergreen	Mixed	Forest Birds		
Scale	Percent Change	Percent Change	Percent Change	Survey	Species	Trend
GCJV[b]	66.18	-42.96	−80.87	BBS[c]	Kentucky Warbler	−2.18% (−3.82−−0.50%)
BCR 37[b]	−77.05	−65.97	−78.32		Swainson's Warbler	−3.44% (−5.73−−1.09%)
BBS Routes[b]	−75.63	−29.55	−86.22		Wood Thrush	−1.78% (−3.05−−0.58%)
CBC Circles[b]	−78.84	−43.79	−76.31	CBC[c]	NA	NA

	Wetland Habitat Types					
	Woody Wetlands	Emergent Herbaceous Wetlands	Open Water	Waterfowl-Waterbirds		
Scale	Percent Change[a]	Percent Change[a]	Percent Change[a]	Survey	Species	Trend
GCJV[b]	187.52	−21.14	5.23	BBS[c]	Mottled Duck	−3.34% (−4.21−−2.47%)
BCR 37[b]	239.69	−9.60	5.09	CBC[c]	American Wigeon	−1.88% (−3.73−−0.20%)
BBS Routes[b]	297.86	−26.65	−14.78		Canada Goose	−6.76% (−8.61−−4.59%)
CBC Circles[b]	196.71	−6.13	-6.85		Green-winged Teal	−1.00% (−2.86−0.90%)

[a] Percent change in cover class based on National Landcover Dataset 1992 and 2006 and data.
[b] GCJV = Gulf Coast Joint Venture; BCR 37 = Bird Conservation Region 37; BBS Routes = Breeding Bird Survey Routes with 500- m buffer; CBC Circles = Christmas Bird Count Circles 1966-2007.
[c] BBS = Breeding Bird Survey; CBC = Christmas Bird Count 1967-2008.

Table 7. Changes in habitat types and values of statistically significant increasing trends of birds found in related habitats.

	Grassland Bird Habitat Types					
	Shrub/ Scrub	Grassland/ Herbaceous	Pasture/ Hay		Grassland-Shrubland Birds	
Scale	Percent Change[a]	Percent Change[a]	Percent Change[a]	Survey	Species	Trend
GCJV[b]	−0.78	−3.14	4.85	BBS[c]	Prairie Warbler	5.83% (3.73−7.98%)
BCR 37[b]	10.46	−44.43	19.07	CBC[c]	LeConte's Sparrow	4.08% (2.53−5.55%)
BBS Routes[b]	−11.46	−22.88	15.60			
CBC Circles[b]	4.56	−18.50	−15.82			
	Forest Bird Habitat Types					
	Deciduous	Woody Wetlands	Mixed		Forest Birds	
Scale	Percent Change	Percent Change	Percent Change	Survey	Species	Trend
GCJV[b]	−66.18	187.52	−80.87	BBS[c]	Prothonotary Warbler	3.87% (2.12−5.71%)
BCR 37[b]	−77.05	239.69	−78.32	CBC[c]	NA	NA
BBS Routes[b]	−75.63	297.86	−86.22			
CBC Circles[b]	−78.84	196.71	−76.31			
	Wetland Habitat Types					
	Woody Wetlands	EHW	Open Water		Waterfowl-Waterbirds	
Scale	Percent Change[a]	Percent Change[a]	Percent Change[a]	Survey	Species	Trend
GCJV[b]	187.52	−21.14	5.23	BBS[c]	Black-bellied Wh.-Duck	3.56% (1.71−5.55%)
BCR 37[b]	239.69	−9.60	5.09		Fulvous Whistling-Duck	3.67% (1.71−5.55%)
BBS Routes[b]	297.86	−26.65	−14.78		Wood Duck	4.08% (1.71−6.72%)
CBC Circles[b]	196.71	−6.13	−6.85		Least Bittern	3.46% (0.70−6.29%)
					Little Blue Heron	3.56% (1.61−5.55%)
				CBC[c]	Black-bellied Wh.-Duck	11.63% (9.42−15.03%)
					Blue-winged Teal	2.12 (0.09−3.36%)
					Gadwall	2.02% (0.70−3.36%)
					Hooded Merganser	5.34% (3.87−6.82%)
					Redhead	5.55% (2.94−8.00%)
					Snow Goose	2.94% (1.71−4.295)
					Reddish Egret	2.33 (0.70−4.08%)

Table 7. *Continued.*

	Wetland Habitat Types				Waterfowl-Waterbirds	
	Woody Wetlands	Emergent Herbaceous Wetlands	Open Water			
Scale	Percent Change[a]	Percent Change[a]	Percent Change[a]	Survey	Species	Trend
GCJV[b]	187.52	−21.14	5.23	CBC[c]	Black Skimmer	2.02% (0.90−3.56%)
BCR 37[b]	239.69	−9.60	5.09		Gull-billed Tern	3.56% (1.98−5.13%)
BBS Routes[b]	297.86	−26.65	−14.78		Snowy Plover	3.67% (2.63−4.71%)
CBC Circles[b]	196.71	−6.13	−6.85		Stilt Sandpiper	9.20% (6.61−11.63
					Western Sandpiper	2.53% (0.44−4.60%)

[a] Percent change in cover class based on National Landcover Dataset 1992 and 2006 data.
[b] GCJV = Gulf Coast Joint Venture; BCR 37 = Bird Conservation Region 37; BBS Routes = Breeding Bird Survey Routes with 500-m buffer; CBC Circles = Christmas Bird Count Circles 1966-2007.
[c] BBS = Breeding Bird Survey; CBC = Christmas Bird Count 1967-2008.

could potentially help managers stop or reverse negative population trends for certain species. Our results were largely unclear with respect to these relationships. The largely non-significant and highly variable results between species trends and changes in land cover indicate that perhaps 1) a variety of factors are driving changes in species abundance (e.g., broad scale shifts in distribution, climate change, being out competed by other species, etc.); 2) local land cover dynamics are not being detected using NLCD data, or 3) high variation (Power Analysis results reported by Sands et al. 2017) in species counts are masking the influence of land cover changes on those species. Land cover classifications based on NLCD (e.g., cultivated crops) are relatively broad and may not reflect fine-scale structural components of a habitat needed to support a species' population. For instance, increases in Shrub-Scrub habitat should theoretically result in increases in abundance of Northern Bobwhites, however, bobwhite population trends tended to show little relation to changes in this cover type. Additionally, bobwhite trends were negatively related to increases in Grassland-Herbaceous land cover along BBS routes, which is counterintuitive given what is known about the habitat needs of this species. Counterintuitive results such as these indicate the need to ground-truth land cover data for evaluation of site-specific potential for habitat to support various species of birds.

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Appendix 1. Common and scientific names of bird species mentioned in this paper.

Common Name	Scientific Name
American Wigeon	*Mareca americana*
Bachman's Sparrow	*Peucaea aestivalis*
Black-bellied Whistling-Duck	*Dendrocygna autumnalis*
Black Skimmer	*Rynchops niger*
Blue-winged Teal	*Spatula discors*
Canada Goose	*Branta canadensis*
Fulvous Whistling-Duck	*Dendrocygna bicolor*
Gadwall	*Mareca strepera*
Greater White-fronted Goose	*Anser albifrons*
Green-winged Teal	*Anas crecca*
Gull-billed Tern	*Gelochelidon nilotica*
Hooded Merganser	*Lophodytes cucullatus*
Kentucky Warbler	*Geothlypis formosa*
Least Bittern	*Ixobrychus exilis*
LeConte's Sparrow	*Ammospiza leconteii*
Little Blue Heron	*Egretta caerulea*
Loggerhead Shrike	*Lanius ludovicianus*
Mottled Duck	*Anas fulvigula*
Northern Bobwhite	*Colinus virginianus*
Painted Bunting	*Passerina ciris*
Prairie Warbler	*Setophaga discolor*
Prothonotary Warbler	*Protonotaria citrea*
Reddish Egret	*Egretta rufescens*
Redhead	*Aythya americana*
Snow Goose	*Anser caerulescens*
Snowy Plover	*Charadrius nivosus*
Stilt Sandpiper	*Calidris himantopus*
Swainson's Warbler	*Limnothlypis swainsonii*
Western Sandpiper	*Calidris mauri*
Wood Duck	*Aix sponsa*
Wood Thrush	*Hylocichla mustelina*

THE INFLUENCE OF NEAREST NEIGHBOR SPACING ON NESTING SUCCESS OF GREEN HERONS (*BUTORIDES VIRESCENS*) IN TEXAS

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ABSTRACT.—Green Herons (*Butorides virescens*) are small herons found throughout much of the United States and southwards into Mexico, Central America and the Caribbean. The species generally forages solitarily and often nests singly, with a breeding pair defending a breeding territory but sometimes form loose breeding colonies presumably as a function of habitat availability and/or predator pressure. We monitored a breeding colony of at least 35 Green Heron pairs along a tidal creek in Port Lavaca, Texas. Our study sought to examine the nesting ecology of colonial Green Herons and to investigate relationships between nest density, nearest neighbor distance and nest success. Nest success was much lower in 2015 than 2014 likely due to extreme weather events and human disturbance in 2015. AIC model selection favored models containing the quadratic effect of nearest neighbor estimate, Julian lay date, and year suggesting a possible optimum nearest neighbor distance for Green Herons at this location.

Colonial nesting is well documented in birds and is used as a breeding strategy for many species (Gill 2007, Varela et al. 2007). The benefits of shared protection from predators and/or easy access to a reliable food source often outweigh the costs of breeding in close proximity to other birds (Gill 2007). Most species of bird can be categorized as either a solitary nesting species or a colonial nesting species with about 13% of all bird species nesting in colonies (Gill 2007).

Solitary nesting birds usually do not place their nests adjacent to other bird nests and will defend a breeding territory from which they acquire necessary resources to rear their young. Conversely, colonial nesting birds show a lesser degree of territoriality towards other birds breeding in the colony and must share resources. Colonies must therefore be placed in areas of relative resource abundance and/or afford some protection from predators to outweigh the cost of having to share resources with a lot of neighbors (Gill 2007).

The distinction between solitary nesting and colonial nesting birds is not mutually exclusive, however. Several species of bird have been known to show varying degrees of sociality while nesting, ranging from solitary nesting to nesting in colonies (Rising and Williams 1999, Nuechterlein et al. 2003, Wjacek 2015). Varying degrees of sociality occurs in such wide ranging taxa as Barn Swallows (*Hirundo rustico*) (Dardenne et al. 2013) magpies, Bullocks Orioles (*Icterus bullockii*) (Rising and Williams 1999), harriers (Wjacek 2015), grebes (Nuechterlein et al. 2003) and Green Herons (*Butorides virescens*) (Kaiser and Reid 1987, Maccarone and Gress 1993). In these species and many others, there is not a defined pattern to nesting sociality, and the density and number of birds nesting in close proximity to each other is variable. Sociality is dependent on a number of factors including individual preference, predator pressure, available nesting sites, and available food (Kaiser and Reid 1987, Hötker 2000, Drachmann et al. 2002, Nuechterlein et al. 2003).

Colonial nesting is a common breeding strategy for long-legged wading birds (*Order Ciconiiformes*) in North America. Many members of the Ardeidae family, such as Great Egrets (*Ardea alba*), Snowy Egrets (*Egretta thula*), and Great Blue Herons (*Ardea herodias*), commonly form large nesting colonies during the breeding season (Kenyon et al. 2007), and 77% of Ciconiiformes nest colonially (Varela et al. 2007). Colonial nesting North American herons are often large and conspicuous species that nest colonially presumably as a

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strategy to lessen nest predation pressure (Kenyon et al. 2007, Hafner 1997, Gill 2007), or to centralize nesting around optimal sites or large concentrations of food (van Vessem and Draulans 1986, Kaiser and Reid 1987, Naugle et al. 1996, Hafner 1997, Gill 2007).

The nesting strategy of wading birds is dependent on a number of factors including productivity of the environment, available cover, density of predators, and life history of each species. For some species, including the Green Heron nesting strategy is variable across the species and the degree of sociality involved in nesting appears to be flexible depending on the habitat and circumstances where nesting is taking place (Davis and Kushlan 1994, Kaiser and Reid 1987).

Green Herons are relatively small members of the Ardeidae family found throughout the state of Texas during the breeding season and on the Gulf Coast of Texas year round (Davis and Kushlan 1994). Although common and listed as a species of least concern, Green Herons have been declining (-1.74 ± 0.25 percent/year) in the United States since at least 1966 (Sauer et al. 2014). Green Herons are cryptically colored, tend to forage in fairly concealed areas along river and pond banks, and are considerably more secretive than larger closely related species (Davis and Kushlan 1994, Moore et al. 2016). Green Herons likely rely on crypsis to avoid predation and this is reflected in their typical breeding strategy (Davis and Kushlan 1994, Telfair 2007).

Their nests are commonly hidden in foliage sometimes high in trees (< 10 m) (Kaiser and Reid 1987). Nest height and substrate is, however, highly variable for the species. While trees may be utilized when available, Green Herons will also place nests low in shrubs, sometimes < 0.5m above the water's surface (Kaiser and Reid 1987). Nests are relatively flat, messy collections of sticks and are usually placed in branches overhanging water (Hernández-Vázquez and Fernández-Aceves 1999, Telfair 2007). Green Herons commonly lay 2-5 eggs per clutch (Gonzalo and Dickerman 1972, Davis and Kushlan 1994, Telfair 2007). Nestlings can make short flights around three weeks of age (Gonzalo and Dickerman 1972) and re-nesting can occur after a brood fledges or following the destruction of eggs or nestlings (Gonzalo and Dickerman 1972).

The nesting strategy and degree of sociality associated with nesting for this bird is variable (Davis and Kushlan 1994, Kaiser and Reid 1987). While they are often solitary nesters, they also sometimes form loose breeding aggregations or colonies of dozens of pairs during breeding season that disband shortly after breeding (Maccarone and Gress 1993, Davis and Kushlan 1994, Hernández-Vázquez and Fernández-Aceves 1999, Kaiser and Reid 1987).

Though a widespread and charismatic bird found throughout wetlands across the U.S.A., little is known about factors regarding breeding success and mechanisms of this species' varying breeding strategy (Davis and Kushlan 1994). Green Herons have been shown to nest both singly and in colonies in the same geographical area and to place nests anywhere from an exposed shrub overhanging water < 0.5m above the water to the tops of trees hundreds of meters from the water's edge (Kaiser and Reid 1987). Unlike their more conspicuous larger relatives, Green Herons are able to utilize their smaller size and cryptic plumage to avoid detection from predators and create solitary nests that are safe from predation. Unlike another cryptically colored North American Ardeid, the Least Bittern, Green Herons are not confined to reeds and marshes but inhabit a wider range of wetland and riparian habitats (Davis and Kushlan 1994, Poole et al. 2009). The combination of crypsis and versatility of habitat choice have led this bird to be able to utilize differing habitat types for breeding and thus develop different breeding strategies depending on habitat characteristics. The exact mechanisms on what drives the decision to nest socially for Green Herons is unknown but likely is related to one or any combination of factors including individual preference, the presence of nest predators, available food, and suitable nesting substrate; these driving factors may vary across sites.

Areas where Green Herons nest colonially may serve as important sources of new birds clumped into relatively small space. Information on these nesting sites may be critical in maintaining numbers of this species as well as preserving species with similar life histories. Predators such as Green Herons are integral parts of wetland ecology, a habitat that has seen dramatic human induced reduction and change in Texas and across the southeastern U.S. Wetland ecosystems have often been exploited, destroyed and damaged in this state and across the southeastern U.S. and wetland preservation is a serious conservation concern for many species. The

Texas coast has experienced a 30% decline in fresh and mixed wetlands over the past 40 years due to human activity (Fitzsimmons et al. 2012). Green Heron heronries are an area of bird behavior and wetland ecology that needs further study (Davis and Kushlan 1994).

This study aimed to provide observational data on aspects of Green Heron breeding ecology such as nest success and nest density in a colonial setting. We hypothesized that a relationship would exist between nest success and nearest neighbor estimates for Green Herons at this location.

METHODS

Study Area

The location of the breeding colony is a treeless tidal wetland with the shrub Marsh Elder (*Iva frutescens*) lining the banks of a small tidal creek offshoot of the much wider Garcitas Creek near Port Lavaca, TX (28° 45' 56.95° N, 96° 40' 36.84° W). These shrubs are utilized by the Green Herons for placement of their nests. *Iva frutescens* at this location ranges from 1-2 m in height and is the tallest foliage and the only woody vegetation in the immediate vicinity of the colony. This shrub has a relatively high tolerance to salinity, but a relatively low tolerance to flooding, causing it to grow in narrow bands in upper regions of salt marshes (Thursby and Abdelrhman 2004). In the marsh investigated for this study, *Iva florescensis* lines the banks of the creek but is largely absent from the slightly lower areas away from the creek bank, which are dominated by herbaceous plants. Because Green Herons prefer woody vegetation over water for nest sites (Kaiser and Reid 1987, Gonzalo and Dickerman 1972, Maccarone and Gress 1993), it was assumed that the bulk of their nests were concentrated along the creek. Nests were generally found no more than 1m from the creek bank, though searching by foot was difficult due to the density of the vegetation. Some limited searches on land were carried out early in the season but no nests were found away from the bank. It is possible that some birds were nesting in areas away from the water where *Iva frutescens* grew farther from the bank but were missed in surveys due to the majority of searching being done by boat.

The shrub *Iva frutescens* was also utilized as nesting substrate for other birds in the vicinity of the Green Heron colony at Garcitas Creek, including Least Bitterns (*Ixobrychus exilis*), Red-winged Blackbirds (*Agelaius phoeniceus*) and, most notably, Boat-tailed Grackles (*Quiscalus major*). Boat-tailed Grackles also utilized the Marsh Elder along the water's edge as a location for a breeding colony and are present in large numbers during the spring and summer months. Their nests were found interspersed between, and directly adjacent to, Green Heron nests in the site for this study, sometimes < 0.5m away. Direct observations at the colony in Port Lavaca were made of Green Herons defending their nests from grackles and of grackles eating Green Heron eggs in 2014. Observations of other Green Heron colonies have also observed the presence of Common Grackles (*Quiscalus quiscula*), Great-tailed Grackles (*Quiscalus mexicanus*) or Red-winged Blackbirds (*Agelaius phoeniceus*) nesting in the same area (Maccarone and Gress 1993, Hernández-Vázquez and Fernández-Aceves 1999, Reed 1927,), and Taylor and Michael (1971) in a study at a heronry in East Texas observed Green Heron nest depredation by Crows (*Corvus brachyrynchos*), and Kelly et al. (2005) found that Common Ravens (*Corvus corax*) sometimes rely on predation of heronries as a major food source, suggesting that the presence of these species could pose substantial predation pressure for Green Herons (Taylor and Michael 1971, Kelly et al. 2005). Green Heron nests were potentially susceptible to heavy avian nest predation at the location of this study.

Non-avian potential predators were detected at the study site as well. Raccoon (*Procyon lotor*) tracks were observed along the creek banks. The Green Heron nests in this area were placed low to the ground and were fairly open and conspicuous, suggesting that the Green Herons nests might also have been vulnerable to predation from raccoons at this location. One western diamondback rattlesnake (*Crotalus atrox*) was found on the ground at the study site and an unidentified non-venomous snake was found climbing in the shrubs containing Green Heron nests. It is possible that Green Heron nests were vulnerable to predation from snakes. At least one fairly large (> 2m) American alligator (*Alligator mississippiensis*) also built basking platforms at the site.

Data Collection

In Texas, Green Herons begin nesting in late March (Telfair 2007) though no nests were found that early in this location. Nest surveys and monitoring began April 8, 2014 and April 6, 2015 and continued until nest activity ceased for each season. Final surveys were completed on August 6, 2014 and July 22, 2015. Sampling was done every four to seven days, with more frequent visits during late May and June when nesting is at its peak, although in 2015 severe flooding extended some sampling intervals to eight days. One sampling session was cut short on June 17, 2015 due to severe thunderstorms and flooding, so much of the colony went unsurveyed between June 12 and June 24 of 2015. Observations were taken from a 3.5m boat with an outboard motor. All nests were marked with flagging. Protocol for nest searching and checking included slowly monitoring one side of the creek at a time. One side of the creek was systematically searched by boat for nests. At the end of the study plot, the boat was turned around and the opposite side of the creek was systematically searched. Nest checks were done while systematically searching for new nests in the order they were spaced along the creek during each survey. Clutch size and/or nestlings were noted on nest cards for each nest as well as notes on nestling age, parent behavior, and any additional observations.

Nestling Green Herons (> 5 d old) were also momentarily removed from the nest and banded with both USGS aluminum bands and alphanumeric colored bands (USGS Banding Permit to M. Clay Green, #23546, IACUC protocol: #201532811). This allowed us to determining what nest young birds sighted or captured outside of the nest came from. Green Herons are able to leave the nest after about a week of age and scramble away if threatened (Davis and Kushlan 1994). They become very difficult to catch at about two weeks of age and banding and success of individual chicks becomes difficult to determine at this point (Gonzalo and Dickerman 1972). Nests were counted as successful if at least one chick survived to this stage in development and signs of activity at the nest site, such as fresh droppings, parental calls, or re-sighting or hearing of chicks were detected. Nestlings were banded until they were too mobile to be captured.

Additional visits to the colony site were made after the breeding season was over to take nearest neighbor estimates. Nearest neighbor estimates (m) were done manually by measuring the distance of each nest from its nearest neighbor on either side of the creek with a tape measure. Nest locations were also marked on an overhead satellite photograph of the study site. These data were used to assess and provide visual representation of where on the creek the nests were concentrated. Plant species of nest placement was also recorded.

Statistical Analysis

Nests that produced at least one chick mobile enough to leave the nest to escape detection were counted as successful. Number of chicks was not factored into analysis because the number of chicks that survived was difficult to determine due to the mobility of older chicks, close proximity to neighboring nests and the density of vegetation. Nest success for the colony was calculated using the Mayfield method (Mayfield 1961). Nest success was defined by the period between nest initiation (lay date or date of discovery if already containing young) and date of departure from the nest by chicks. Chicks around eight days old were able to leave the nest to avoid detection. This behavior was used to signify nest success as survival of the young became difficult to assess after this point (Gonzalo and Dickerman 1972). Nesting period was set to 35 d (6 d laying period, 21 d incubation period, 8 d nestling period) (Davis and Kushlan 1994, Gonzalo and Dickerman 1972).

Model selection was used to assess the effect of nearest neighbor estimate on nest success (Burnham and Anderson 2002). Nearest neighbor estimates (NNE), Julian Lay Date (JLD) of each nest, and year were tested in different combinations as linear predictors of nest success in logistic regression models. We also tested for a quadratic relationship between nest success and NNE. Models were compared using Akaike information criteria adjusted for small sample size (AIC_c). All analyses were performed using program R (R Core Team 2013).

RESULTS

During the 2014 season, a total of 59 nesting events were recorded between April 18 and August 6. Of these nests, 35 were considered to have successfully raised at least one chick. Mayfield analysis yielded a success rate of 53.57%. A total of 16 nests produced eggs in April and 29 in May. New nest initiation slowed down considerably in June and July with only seven nests producing eggs in June and four in July. No new nests were discovered in August. Laying peaked in late April/early May with 22 nests producing eggs between April 23 and May 5. Three nests found never produced any eggs or the eggs were lost before the nest was discovered or in between surveys. Nesting activity peaked in late May with around 38 active nests by May 31. Some of the nesting events recorded likely represent a second nesting attempt. At least nine nesting events took place on a previously used nesting platform or in the same location of another nest after the original nest failed or fledged chicks. In some cases, dilapidated nests were rebuilt and reused. It is likely that these events represent re-nesting attempts by the same breeding pair although adult birds were not marked.

The 2015 season showed much lower nesting success. A total of 61 nests were recorded between April 20 and July 22 but only nine nests successfully raised chicks. Mayfield analysis yielded a success rate of 12.25%. This dramatic decrease in nest success for 2015 was largely due to density independent factors, including severe flooding in late May and mid June and apparent damage from a fan boat. Laying was again most concentrated in late April and early May with 28 nests producing eggs between April 21 and May 4. In total, 22 nests produced eggs in April, 19 in May, and 17 in June. No nests produced eggs in July. Three nests never contained eggs during any surveys. Nesting activity peaked in mid May with 35 active nests by May 12. At least twelve nests were assumed to be a second nesting attempt because they were either nests that previously failed or successfully fledged chicks, or were built in the exact location of an older nest that had failed or fledged chicks and then disappeared. Severe weather in late May and mid June, including a major flooding event on June 16 likely slowed down nesting considerably in the second half of the nesting season and contributed to the especially low nesting success for clutches laid after mid May. Seven of eight nests created after the mid June flooding failed. Clutch size ranged from 1-5 eggs for both years with a mean of 3.1 (SE = 0.11) for 2014 and 3.43 (SE = 0.163) for 2015.

Model selection favored the additive model containing year, JLD, and a quadratic effect of Nearest Neighbor Estimate (NNE) (Table 1). The full model including these variables plus an interaction between year and JLD received nearly equal support in the data ($\Delta AIC_c = 0.52$). These two models combined account for 0.843 of the model weight. None of the other models tested were competitive ($\Delta AIC_c > 4$). Nests were clumped at greater densities at tighter bends in the creek (Figs. 1-2). More tightly packed nests, however, did not necessarily show greater nest success. This suggests

Table 1. Model selection table for Green Herons (*Butorides virescens*) nesting colonially in a small tidal creek offshoot adjacent to Garcitas Creek near Port Lavaca, Texas during the 2014 and 2015 breeding seasons.

Model	AIC_c	df	ΔAIC	Likelihood	Weight
NNE^2 + NNE + julian lay date + year	**122**	**5**	**0**	**−55.738**	**0.476**
NNE^2+ NNE + julian lay date * year	**122.6**	**6**	**0.52**	**−54.881**	**0.367**
Julian lay date + year	126.4	3	4.37	−60.097	0.054
Julian lay date * year	127.1	4	5.04	−59.358	0.038
NNE + julian lay date + year	127.3	4	5.23	−59.45	0.035
NNE + julian lay date * year	127.8	5	5.72	−58.6	0.027
NNE^2 + NNE + year	132.9	4	10.84	−62.265	0.002
Year	134.9	2	12.83	−65.388	0.001
NNE + year	135.7	3	13.62	−64.725	0.001
NNE + julian lay date	150.7	3	28.67	−72.247	0
NNE^2 + NNE	153.7	3	31.63	−73.733	0
Julian lay date	153.9	2	31.81	−74.877	0
NNE	157	2	35	−76.471	0
Intercept	159.8	1	37.7	−78.859	0

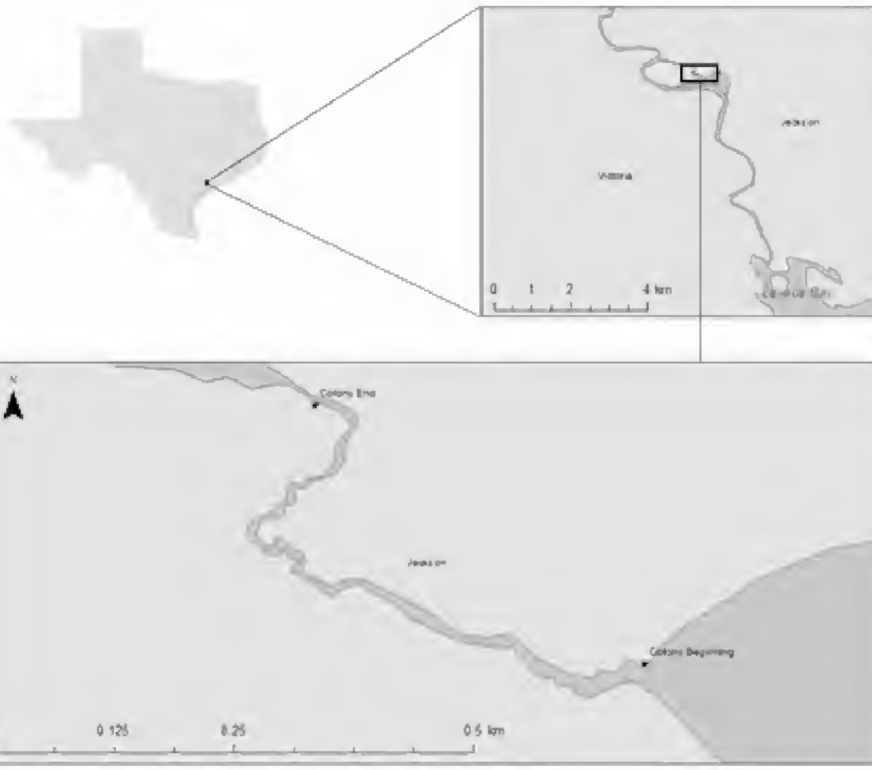

Figure 1. Map of Green Heron (*Butorides virescens*) nesting colony located in a small tidal creek offshoot adjacent to Garcitas Creek near Port Lavaca Texas.

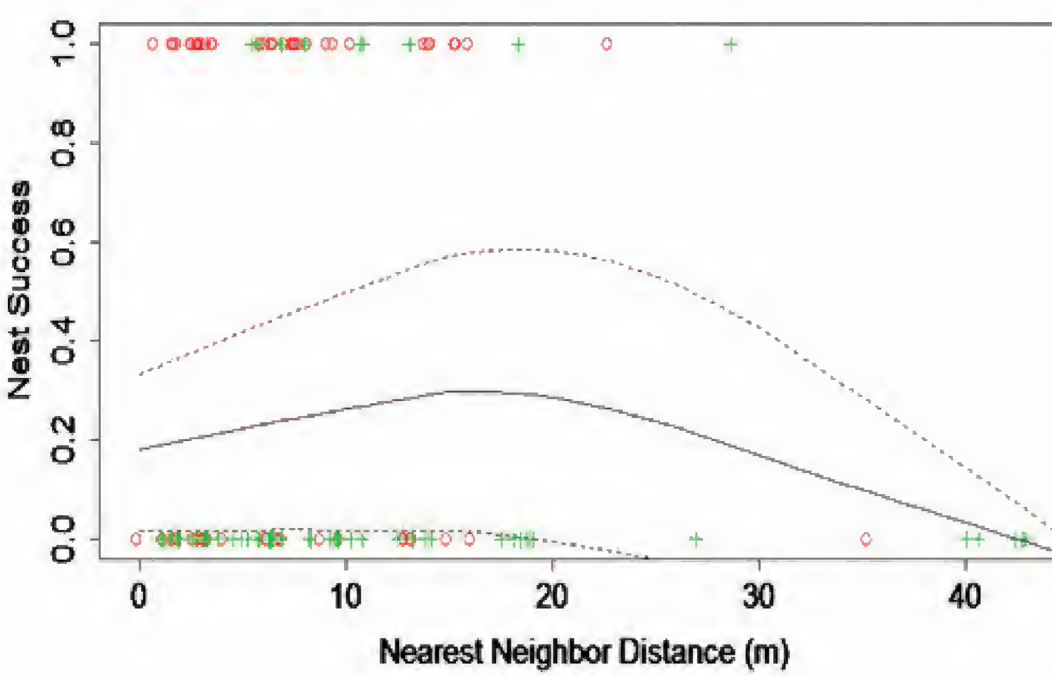

Figure 2. Nest success (y-axis) of colonial Green Heron (*Butorides virescens*) nests in a small tidal creek offshoot adjacent to Garcitas Creek near Port Lavaca, Texas is predicted by nearest neighbor estimate (x-axis). Data from the 2014 and 2015 nesting seasons are combined. Red circles represent nests from 2014 and green crosses represent 2015 nest. All points represent observed nests and were given a value of 1 (i.e. success) if the nest fledged at least one chick or 0 (i.e. failure) if the nest fledged no chicks. The solid line represents the probability that a nest will produce at least one fledgling, and dotted lines represent the 95% confidence interval.

the possibility that an optimum nest density exists for Green Herons at this location, and that nests placed around 16m from their nearest neighbor had the highest probability of success (Fig. 3). All nests with nearest neighbor estimates of > 30m failed although five out of six of these nests occurred in 2015 and could have been lost by flooding rather than predation or any density dependent variable.

All nests were placed in the shrub Marsh Elder (*Iva frutescens*).

DISCUSSION

Nesting success varied greatly between the two study seasons. 2014 showed a nest success rate comparable to other studies of socially nesting Green Herons (Kaiser and Reid 1987, Hernández-Vázquez and Fernández-Aceves 1999). A study done by Hernández-Vázquez and Fernández-Aceves carried out in Jalisco, Mexico in 1999 showed between 50-53% fledging success for Green Herons nesting colonially in a mangrove swamp. Another study of Green Herons nesting socially in Missouri showed a nest success rate ranging from 42.9-95.2 depending on year and location (Kaiser and Reid 1987). 2015 nest success was substantially lower than reported by previous studies (Kaiser and Reid 1987, Hernández-Vázquez and Fernández-Aceves 1999). This combined with weather records (Dolce et al. 2015)

Figure 3. Banded fledgling Green Heron (*Butorides virescens*) captured in a small tidal creek offshoot of Garcitas Creek near Port Lavaca, TX, 2015.

Table 2. Main effects table of the quadratic effect of nearest neighbor estimate, Julian lay date, and year on nest success for Green Herons (*Butorides virescens*) nesting colonially in a small tidal creek offshoot adjacent to Garcitas Creek near Port Lavaca, Texas during the 2014 and 2015 breeding seasons.

Variable	Slope	Standard Error	P-value
NNE^2	−0.007	0.003	0.038
NNE	0.229	0.1	0.022
JLD	−0.024	0.011	0.03
Year	−2.372	0.519	<0.01

and observations taken during this study indicate that density-independent mortality was unusually high for this year. Analysis of nest success in this study suggest that this colony site provides breeding habitat for Green Herons of sufficient quality during years with typical weather patterns but with high mortality during especially wet years (Kaiser and Reid 1987, Hernández-Vázquez and Fernández-Aceves 1999, Dolce et al. 2015). Clutch size was consistent with previous studies of nesting Green Herons (Gonzalo and Dickerman 1972, Hernández-Vázquez Fernández-Aceves 1999, Maccarone and Gress 1993, Kaiser and Reid 1997).

In a 1987 study of Green Herons nesting in two different ecosystems, Kaiser and Reid found nest success and sociality for Green Herons to be correlated with habitat. They monitored herons nesting both along a stream and in a Mississippi River floodplain in Missouri. Birds nesting on the floodplain showed significantly higher nest success than birds nesting along the stream but this appeared not to be related to sociality. While no birds nested solitarily on the floodplain and some did nest solitarily along the stream, solitary nests along the stream showed high survivorship. The authors of this study suggest that sociality at this location is based on aggregations around abundant food supply. Their data also suggest fairly large differences in Green Heron nest success based on location although any relationship between nest density and nest success was not tested.

It is possible that, like Kaiser and Reid (1987) suggest, Green Herons are clumping their nests around higher-quality nesting sites and subordinate birds are excluded from the most favorable locations, thus experiencing lower nest success. Certain areas of the colony, especially at tighter bends in the creek, showed higher than average nest density. These densely packed nests, however, did not show higher than average success rates. It is possible that especially closely packed nests could have to deal with more intense competition with neighbors (Hill et al. 1997).

Contrary to the findings or Kaiser and Reid (1987), all solitary nests (> 30m to nearest neighbor) in our study failed. Also, the best supported model in our model selection analysis included the quadratic effect of nearest neighbor estimates, as well as a linear effect of Julian lay date, and a year effect. Taken together, these results suggest the possibility of an optimal nest density for Green Herons at this location. It is possible that some nearest neighbor estimates may be overestimated due to nest placed away from the creek bank that were undetected. This likely did not significantly affect the result since no nests were found over a meter from the water's edge even when the banks were searched on foot.

Density-dependent factors could be influencing nest survival leading to an optimal nest density. Nests left alone are likely more vulnerable to the large number of potential nest predators at this location, especially Boat-tailed Grackles. It is possible that nests placed near conspecific neighbors benefited from being surrounded by other Green Heron nests, all with parents willing to chase away intruding Grackles. While nests placed in high densities may have suffered from intraspecific competition (Hill et al. 1997, Hötker 2000), those placed far from any neighbors may have been more susceptible to predators without the benefit of group defense from grackles and other predators. Additionally, eight nesting events took place after the June flooding in 2015, but only one successfully reared chicks. Active nest density of the colony decreased sharply after the flooding, as adults may have abandoned the site. This could have left the nests of remaining birds more vulnerable to predation and caused many late-season nests to fail (Rising and Williams 1999, Drachmann et al. 2002). However, adult birds were not banded, and colony abandonment could not be quantitatively tested.

Two models including the quadratic effect of nearest neighbor estimates proved to be the most well supported in our analysis. This suggests a tradeoff between solitary and colonial nesting. Green Herons at this location, like several other species of bird, likely benefit from social breeding or from aggregating at better nesting sites but suffer negative consequences of sociality when packed too densely

(Hill et al. 1997, Gilchrest 1999, Hötker 2000). For the two years of this study, optimal nearest neighbor estimate was found to be around 16m. The unusually extreme conditions of 2015, however, may have affected this result because of the increase in density-independent nest failure during this year.

A number of density-independent factors contributed to nest failure, especially in 2015. Spring in Eastern Texas saw unusually severe weather and rainfall during this year. May 2015 was the wettest month on record for Texas. At least two major flooding events occurred at the colony during 2015, one during late May and one during mid June. While water levels clearly rose from the normal tidal fluctuations during the late May flooding, most nests were placed high enough to be safe from rising waters and this period represented the highest fledging success during the 2015 season, with 23 nestlings banded on May 30 alone. The mid June flooding, however, had catastrophic consequences for the colony. On June 16, 2015, Tropical Storm Bill made landfall on Matagorda Island at 11:45 a.m., about 35 miles from the Green Heron colony observed in this study. A visit to the colony on June 17 around 24 hours later revealed water levels much higher than previously seen during 2014 or earlier parts of the 2015 season. Unfortunately, dangerous weather conditions and rising waters prevented a complete survey on that occasion; however, many of the nests normally visible from the boat were clearly underwater. At least nine active nests were likely lost by this flooding event, although the actual number is probably higher because the June 17 survey was cut short due to dangerous weather and the colony was inaccessible until June 24 due to flooded roads. This late season mortality in 2015 likely caused the effect of JLD to be included in the highest ranked models.

Of the six solitary nests monitored in this study, five were from 2015, which is also the year that saw high density-independent mortality. Several nests also were destroyed by human disturbance (i.e., a fan boat) in 2015, another source of mortality not present in 2014. At least four nests were destroyed by local fan boat drivers steering around the vegetation of the marsh and several others likely had eggs blown out of their nests. The unexpected sources of mortality during the 2015 season contributed heavily to the large difference in nest success between 2014 and 2015. It is possible that the solitary nests found in 2015 were destroyed by density-independent factors because so many nests failed that way. 2015 saw both an increase in solitary nests and density-independent mortality, likely influencing the strength of models containing both NNE and year.

More years of data may provide stronger evidence for a quadratic effect of NNE, and thus an optimal nest density. The extreme conditions of 2015 likely influenced the effects of NNE, JLD and year on nest success because of the large amount of density-independent nest failure during this year. We were also unable to measure nearest neighbor estimates for some nests in 2015 because the flags were lost either by flooding or by grackles taking the flagging for nest material. There were four nests in which the nest and flag disappeared and could not be included in the analysis. Additional years of data will be needed to reveal a strong trend in nest distance and nest survival. This study did not determine the proximate factors driving colonial breeding in Green Herons but does suggest some benefit to nesting colonially in this location. Reasons for social nesting can be complex and varied, and multiple factors are likely at play when individual Green Herons decide where to nest and how tolerant to be of neighbors. Additional studies involving measurements of predator density, habitat characteristics, food resources, and sources of nest mortality are needed to decipher this species' varying breeding behavior.

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A RANGE EXTENSION OF THE EASTERN PURPLE MARTIN (*PROGNE SUBIS SUBIS*) INTO NEW MEXICO AND OTHER NOTEWORTHY RECORDS OF PURPLE MARTINS NESTING IN THE SOUTHERN GREAT PLAINS

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ABSTRACT.—Most published maps depict the western boundary of the breeding range of the eastern Purple Martin (*Progne subis subis*) to be east of the actual distribution. On the western extent of its breeding range the eastern Purple Martin occurs in low densities and primarily in towns, where it nests almost exclusively in provisioned and managed bird housing. Our photo documentation of eastern Purple Martins nesting in provisioned housing in Clovis, New Mexico, was the second record of nesting in Eastern New Mexico, and we believe justified an adjustment to the described breeding range of this subspecies. In addition to our own records, our review of the literature revealed several records of nesting that are worthy of elaboration in context to uniqueness in location on the western periphery of the eastern Purple Martin's breeding range, the timeframe of the record, or type of nest structure used. Records of this type may be useful in terms of growing conservation interest in this declining aerial insectivore, particularly as it relates to the eastern Purple Martin's historical occurrence in the Great Plains and its past and future adaptability.

The eastern race of the Purple Martin (*Progne subis subis* Linnaeus 1758) is a broadly-distributed aerial insectivore occurring E of the Rocky Mountains in the United States, northern Mexico, and in southern areas of Canada (Tarof and Brown 2013). The subspecies differs from *P. s. arboricola* (Behle 1968, Baker et al. 2008) and *P. s. hesperia* (Brewster 1889) of western areas of the United States, Canada, and Mexico, not only in range and size, but also in that it nests almost exclusively in bird housing provisioned and managed by humans (Tarof and Brown 2013).

Bird houses and gourd clusters provisioned by humans are believed to have led to westward expansion of the eastern Purple Martin into Western Nebraska, the Texas Panhandle, and Western Oklahoma (Allen 1872, Sharpe and Wyatt 1885, Nice and Nice 1924, Ray 1995, Johnsgard 2009, Tarof and Brown 2013). However, there is some question as to the early natural distribution of the eastern Purple Martin in the Great Plains and their later presence and abundance as influenced by "expansion in range" due to the introduction of provisioned housing versus "increases in numbers of local birds" due to their adaptation to, and productivity in provisioned and managed housing (Allen 1872, Raleigh et al. in press). While most of the Great Plains were treeless, natural nesting strata were available in the drainages (cavities in cottonwood [*Populus spp.*]), and on the escarpments (cavities in Ponderosa Pine [*Pinus ponderosa*] in New Mexico, Colorado, and the Western Oklahoma Panhandle, and holes and niches in cliffs and other rocky formations; Tate 1923, Sutton 1934, Ray 1995, Ducey 2000).

The historical and current distribution of the eastern Purple Martin in western portions of the Great Plains is poorly understood (Ray 1995, Wiggins 2005, Tarof and Brown 2013). For example, it is believed to be largely absent as a nesting species in western areas of the Southern Great Plains (SGP) of Southeastern Colorado, Southwestern Kansas, Eastern New Mexico, and western areas of the Oklahoma and Texas panhandles (Sharpe and Wyatt 1885, Andrews and Righter 1992, Ray 1995, Ryke et al. 2003). Many published range maps continue to show the western boundary of the eastern Purple Martin's breeding range to be E of the actual

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boundary (e.g., Johnsgard [2009], Tarof and Brown [2013] or any map based on Breeding Bird Survey data [BBS; Robbins and Van Velzen 1967]). This is a product of low densities and a sporadic distribution of the eastern Purple Martin in western areas of the SGP, and their almost-exclusive association with towns and cities, where BBS survey routes only rarely occur (Hill 1988; Ray 1995, 2015).

Ray (2015) delineated the western boundary of the breeding range of the eastern Purple Martin in Texas and included mention of Lord and Lord's (2010) account of a few pairs nesting in provisioned housing in the southeast corner of New Mexico. More recently, observations of Purple Martins nesting in provisioned bird housing elsewhere in Eastern New Mexico further justify the inclusion of a portion of that state in the breeding range. Our primary objective, here, is to consider the New Mexico records and describe the western boundary of the breeding range of the eastern Purple Martin in the SGP.

We conducted a review of the literature and Internet, including eBird records (Sullivan et al. 2009) of "Purple Martins" and "*P. s. subis*" in the SGP (and its individual states), which we defined as Southeastern Colorado, Southwestern Kansas, Eastern New Mexico, the Oklahoma and Texas panhandles, and S through the eastern Trans Pecos region of Texas. We based our description of the breeding range on confirmed nesting records and treat "possible breeding" and "probable breeding" separately, and as defined by Robbins and Van Velzen (1967), Sullivan et al. (2009), and Breeding Bird Atlas Explorer (2018).

Unless otherwise noted, we made the assumption that all nesting records for Purple Martins E of the Rocky Mountains were of the eastern subspecies due to descriptions of range, habitat and nesting ecology described by Behle (1968) and Baker et al. (2008) for *P. s. arboricol*a, and Tarof and Brown (2013) for both *P. s. arboricola* and the eastern Purple Martin. A wide expanse of the Great Plains (>150 km) and also elevation separates the known ranges of distribution of these 2 subspecies. In New Mexico, Colorado, and Wyoming, *P. s. arboricola* nests above 2000 m in mountainous and mesa habitats (Bailey and Niedrach 1965, Behle 1968, Ray and Yaksich 1999). We use the term "breeding" primarily in the context of the range of distribution of the eastern Purple Martin and "nesting" in terms of specific habitat or records of nesting.

During our review of the literature we found several records of nesting that are worthy of elaboration in context to uniqueness in location on the western periphery of the eastern Purple Martin's breeding range, the timeframe of the record, or type of nest structure used. Records of this type may be useful in terms of growing conservation interest in this declining aerial insectivore (Tautin et al. 2009, Ray 2015, Birdlife International 2016), particularly as it relates to the eastern Purple Martin's historical occurrence in the Great Plains and its past and future adaptability.

A RANGE EXTENSION AND CURRENT DISTRIBUTION

At least 2 cities in Eastern New Mexico have hosted nesting eastern Purple Martins during the last decade. Records include Lord and Lord's (2010) documentation of eastern Purple Martins nesting in provisioned bird housing in Eunice (32° 26' 14.79" N, 103° 9' 32.75" W; Lea County) and eastern Purple Martins were observed and photographed feeding chicks in a multi-compartment birdhouse in Clovis (34° 24' 36.88" N, 103° 12' 23.11" W; Curry County; Fig. 1 and Fig. 2) in 2014 (GB, pers. obs.).

Although breeding range descriptions of the eastern Purple Martin often include eastern Colorado, these are almost always based on nests reported in 1961 and 1971, and isolated in Yuma County of Northeast Colorado (39° 58' 44.64" N, 102° 25' 25.33" W [center of county; Svoboda et al. 1980). We found two nesting records from Southeast Colorado which helped affirm that the eastern Purple Martin is more widely distributed in that state. These nest records were from Baca (37° 19' 5.43" N, 102° 36' 54.03" W [center of county]) and Prowers (37° 56' 6.87" N, 102° 23' 32.11" W [center of county] counties (Bailey and Neidrach 1965, Svoboda et al. 1980). The Baca County record was from 1902 and the Prower's County record was described as "an early record." There were no mentions of the precise locations or whether the birds were nesting in natural cavities or in provisioned housing.

Considering these records, the eastern Purple Martin has nested as far west in the SGP in recent years as a line extending from St. Francis (39° 46' 27.46" N, 101° 48' 2.00" W; Cheyanne County), Kansas; through Lamar (38° 5'13.85" N, 102°37' 13.04" W; Prowers County), and Campo (37°

Figure 1. Purple Martin with nestlings using provisioned bird housing in Clovis, Curry County, New Mexico, 2014. Photo courtesy of G. Beauprez.

Figure 2. Western boundary of the current known distribution of the eastern Purple Martin in the Southern Great Plains.

6' 18.46" N, 102° 34' 46.69" W; Baca County), Colorado; Keyes (36° 48' 35.38" N, 102° 15' 19.60" W; Cimarron County), Oklahoma; Spearman (36° 53' 11.99" N, 101° 11' 32.47" W; Hansford County), Amarillo (35° 13' 20.04" N, 101° 49' 52.82" W; Potter and Randall counties), and Canyon (34° 58' 9.28" N, 101° 55' 7.70" W; Randall County), Texas; Clovis, and Eunice, New Mexico; and Monahans (31° 35' 39.47" N, 102° 53' 33.52" W; Ward County), Fort Stockton (30° 53' 38.93" N, 102° 52' 45.55" W; Pecos County), and Sanderson (30° 8' 32.76" N, 102° 23' 38.53" W; Terrell County), Texas (Bailey and Neidrach 1965, Svoboda et al. 1980, Ray 2002, Lord and Lord 2010, Ray 2015, Reid 2016, Purple Martin Conservation Association [PMCA] 2018, GB pers. obs.).

NOTEWORTHY RECORDS

We found several records in the literature that are noteworthy in context to the use of the SGP by nesting eastern Purple Martins. An Oklahoma record, in particular, represented 1) an early record of nesting by the eastern Purple Martin in the SGP, 2) a late record of natural cavity use in the east, and 3) was W of the current known distribution in Oklahoma. Others involved descriptions of rare use of anthropogenic structures other than provisioned bird housing, or met criteria for "possible breeding" in areas near the western limit of the breeding range.

A Historical Record of Natural Cavity Use

Tate (1923) considered the Purple Martin to be a rare summer resident in the extreme western Oklahoma Panhandle and described a nest of "*Progne s. subis*" consisting of straw and three eggs in a hollow tree on a ranch near Kenton (36° 54' 11.81" N, 102° 57' 58.45" W; Cimarron County) in June 1914. Interviews with residents of the area confirmed that the ranch was located E of Kenton in the breaks of the Cimarron River (~ 36° 52' 58.14" N, 102° 36' 0.77" W; 36 km from the New Mexico state line).

Unique Nesting Structure

Eastern Purple Martins nesting within a missing lens and bulb port of an abandoned traffic light in Clarendon (30° 56' 14.68" N, 100° 53' 17.45" W, Donley County), Texas, were photographed around 1990 (Fig. 3a/3b; D. Lowe pers. comm.). This was within the current range of distribution of the eastern Purple Martin in the Texas Panhandle.

In 2016, Purple Martins were observed nesting at 4 locations just inside the known western extent of the eastern Purple Martin breeding range in the Trans Pecos of Texas (Reid 2016). Several pairs were observed at three locations: in Sheffield (30° 41' 16.87" N, 101° 49' 30.69" W; Pecos County) and Sanderson, as well as at rural roadside rest areas on I-10 (30° 51' 40.56" N, 102° 4' 55.76" W and 30° 51' 21.69" N, 102° 4' 12.32" W; Pecos County) southwest of Iraan (Reid 2016). Nesting was confirmed under canopies of an old gas station and within light fixtures. In 2017, we found them nesting in Sheffield under two canopies that shade picnic tables (Fig. 4; JDR, S. Ray, and R. Martin pers. obs.). The nests, including one with nestlings, were unique in that they were barely over head-height of users of the picnic tables.

DISCUSSION

Our description of the western boundary of the breeding range of the eastern Purple Martin includes nesting records from the central and southern areas of the eastern edge of New Mexico. We also found a sufficient number of records of nesting and possible nesting to substantiate the eastern Purple Martin's occurrence in extreme Eastern Colorado. Although sometimes mentioned as part of the breeding range, rarely is the state included in range maps other than an isolated dot representing the Yuma County records (e.g., PMCA 2018).

The eastern Purple Martin had been considered absent as a nesting species in the plains of New Mexico and remains so in the northeastern section of the state (Sharpe and Wyatt 1885, Johnsgard 1979, 2009). Nesting may also be occurring in Hobbs (32° 42' 9.51" N, 103° 8' 9.61" W; Lea County), New Mexico, which is located within our newly described western boundary between Clovis and

Figure 3a/3b. Paired photos showing use of an abandoned traffic light by several pairs of eastern Purple Martins in Clarendon, Donley County, Texas. In Fig. 3b, begging nestlings can be seen in the port where the lense of the green light is missing. Photos courtesy of D. Lowe.

Figure 4. Nestlings of shelf-nesting eastern Purple Martins under a picnic table canopy in Sheffield (Pecos County) of the eastern Trans Pecos region of Texas. Photo courtesy of Susan K. Ray.

Eunice. During May and June in 2013 and 2014, and 2016 and 2018, birders in Hobbs photographed or observed foraging ASY male eastern Purple Martins, and sightings almost always included other conspecifics (paired birds, etc.; Hawksworth 2013, 2014, 2016; Collins 2017; Hetrick 2018).

The nesting records in New Mexico represent an extension of the breeding range of the eastern Purple Martin to west of the 103rd Meridian in the SGP, although BBS data suggest a similar but unconfirmed boundary in the eastern Trans Pecos region of Texas (Brewster, Pecos, Ward, and Winkler counties; Sauer et al. 2017). Records in the Trans Pecos are all E of that latitude, although Monahans and Fort Stockton (confirmed breeding) are both < 12 km to the east. Northward, eastern Purple Martins do not occur west of the 103rd Meridian again until extreme Northwestern North Dakota (PMCA 2018).

The eastern Purple Martin is considered rare or absent in Colorado (Andrews and Righter 1992, Ryke et al. 2003, Johnsgard 2009). However, Cooke (1887) maintained that the Purple Martin was common in Kansas and extended a little way across the border into Colorado. Levad (1965) suggested that Southeastern Colorado may represent an outpost of the eastern Purple Martin. Colorado's first Breeding Bird Atlas (1987 to 1995) included a June record of "possible breeding" of eastern Purple Martins in rural habitat of Prowers County (Levad 1998), but nesting was not indicated in the second edition (2007 to 2012; Colorado Breeding Bird Atlas Partnership 2016). May and June observations of foraging eastern Purple Martins, including pairs, were observed in Baca County (year not reported; Bailey and Neidrach 1965), in Campo (2016; Geiger 2016), and at Neenoshe Reservoir (2017; 38° 20' 3.99" N, 102° 41' 4.49" W; Kiowa County), Colorado (Drucker 2017). These fit criteria for "possible breeding."

Nice and Nice (1924) reported the eastern Purple Martin to be a summer resident at Gate (36° 51' 12.12" N, 100° 3' 20.26" W; Beaver County), Oklahoma. Beaver County is the eastern-most county of the Panhandle and Gate is 196 km E of the western boundary of the breeding range at Keys, Oklahoma.

BBS data suggests that the breeding range of the eastern Purple Martin in Texas extends into Brewster and Winkler counties (Sauer et al. 2017), although we could not find nesting records for those counties in the literature. Strecker (2012) considered the Purple Martin to be inhabitants of the entire state of Texas, but very rare and only as a migrant in western areas of the Trans Pecos (Peterson and Zimmer 1998). Eastern Purple Martins nesting in the Texas Panhandle were first mentioned by Carlander (1934, 1936), while Strecker (1910), Hawkins (1945), Johnsgard (1979), and McCauley (1988) either did not mention them or referred to them as rare. Carlander (1934, 1936) reported a pair at Wellington (34°51'22.16"N, 100°12' 49.48"W; Collingsworth County) in the southeastern Texas Panhandle; 259 km within the breeding range. An extensive banding and outreach program further confirmed and added to the distribution of the species in northwest Texas and Western Oklahoma (1997 to present; Ray 1995, 2004, 2012), as did Seyffert (2001).

The locations and timeframe of the Cimarron County, Oklahoma, and Baca County, Colorado, records are intriguing. These were most likely eastern Purple Martins due to longitude, elevation, and proximity to eastern Purple Martins that currently nest in provisioned housing in Keyes, Oklahoma (32 km E of the Cimarron County site). However, these records—in adjacent counties—precede the description of *P. s. arboricola*, a widely-distributed western race that continues to nest in natural cavities in the west (Behle 1968, Reynolds 2002, Baker et al. 2008). In addition, these nests were near Black Mesa (< 40 km), part of an extension of pinyon-juniper, and even ponderosa pine communities, from the Rocky Mountains through a region of mesas, extinct volcanos, and canyons associated with the Cimarron River (Colfax and Union counties, New Mexico; Cimarron County, Oklahoma). Mesas and volcanic mountains in this area reach elevations of 1,500 to 2,400 m, which is consistent with the lower limit of altitudinal distribution of *P. s. arboricola* in the adjacent Rocky Mountains and foothills (Behle 1968, Ray and Yaksich 1999, Baker et al. 2008). P. s. arboricola nests at elevations as low as 2,000 m near Raton (36° 54' 12.39" N; 104° 26' 20.49" W; Colfax County), New Mexico (173 km west; Ray and Yaksich 1999). BBS maps (Sauer et al. 2008) depicting the occurrence of Purple Martins in the Jesus Mesa/Mesa de Maya/Seven L Buttes/Black Mesa area of Las Animas County in Southeast Colorado is intriguing, and these are in very close proximity to the Baca County, Colorado, and Cimarron County, Oklahoma, records to the E (< 40 km to Black Mesa and < 175 km to the western end of the mesa-volcano complex). Many montane birds extend easterly into Cimarron County, Oklahoma, from the Rocky Mountains due to the topography and associated plant communities (Sutton 1934). Consequently, any nesting Purple Martins found from Black Mesa westward in montane or mesa topography should not be automatically assumed to be the eastern subspecies.

Similarly, if the Purple Martin was found to be nesting in more western, mountainous areas of Southeastern New Mexico and West Texas (west of the current boundary), they would most likely be *P. s. arboricola* (Behle 1968, Baker et al. 2008, Ray 2015). Specimens of Purple Martins exist for the Big Bend National Park and the Davis Mountains of Texas (Peterson and Zimmer 1998), and a bird list for Guadalupe National Park lists the Purple Martin as accidental in occurrence (Carlsbad Caverns Guadalupe Mountains Association 1997). There are no supporting citations of nesting occurring in those areas but *P. s. arboricola* is known to nest further west in mountainous areas of Southern New Mexico (Baker et al. 2008, Ray 2015).

The nesting of the eastern Purple Martin in other types of anthropogenic structures in the eastern Tran Pecos of Texas and, at least short term, in other areas, continues to demonstrate the adaptability of this species (Bent 1942, Nelson 1993, Velelli 1994, Cleland 1997, Kratz 2003, Reid 2016). Nesting under canopies by the eastern Purple Martin was mentioned by Velelli (1994); within streetlights by Bent (1942), Nelson (1993), Cleland (1997), and Kratz (2003); and in traffic lights by Kroenke (2002), Maehr et al. (2005), and Sebastiani (2011). Shelf-nesting like we observed under canopies in Sheffield allows the Purple Martins a competitive advantage over European Starlings (*Sturnus vulgaris* Linnaeus 1758) which prefer enclosed cavities, and to a lesser degree, the more versatile House Sparrow (*Passer domesticus* Linnaeus 1758; Airola and Grantham 2003). However, depending on the characteristics of the shelf, e.g., lack of a physical barrier on the edge of the shelf, nestlings may be susceptible to falling out of the nest (Airola and Grantham 2003). Inevitably, anthropogenic structures other than provisioned bird housing are eventually repaired, replaced or moved, or competition from European Starlings or House Sparrows result in the abandonment of the site (Ray 2012, 2015; Tarof and Brown 2013).

We do acknowledge that persistence of these isolated colonies of the eastern Purple Martin in New Mexico depends on continued management against European Starlings and House Sparrows (Ray 2012, 2015; Tarof and Brown 2013; Raleigh et al. in press). In addition, small, isolated colonies within areas of low densities of this bird are more susceptible to total colony loss following episodes of predation, as well as prolonged cold, heat and wet spells, in comparison to larger colonies or those within areas with high densities of this bird (Allen and Nice 1952; Robbins et al. 1986; Hill 1990; Ray 2014, 2015).

In the absence of confirmed nesting in Hobbs, New Mexico, and especially, the single sightings in Campo, Colorado, and at Neenoshe Reservoir, Colorado, we cannot rule out that these were birds in migration towards more northern areas of the breeding range. For example, first arrivals of ASY males were reported during the last days of April and into May as far S as South Dakota during each year, 2013 to 2018 (PMCA 2018). ASY eastern Purple Martins continue to arrive at nesting sites for 7 or more weeks following the first arrivals (Morton and Derrickson 1990). Conversely, the sightings could also have involved local nesters because ASY eastern Purple Martins nesting in the SGP should have already been well established at nesting sites by May (Morton and Derrickson 1990, PMCA 2018).

Provisioned and managed bird housing, and proximity to cities with confirmed nesting of the eastern Purple Martin in the Texas Panhandle are likely key components leading to their expansion into Eastern New Mexico and Southeastern Colorado (Ray 1995). During a long-term banding program in northwest Texas and Western Oklahoma, 7.9 % of color-marked eastern Purple Martins were observed nesting at sites ≥ 100 km from their natal colony site, and some had dispersed up to 422 km (Ray and Schoenhals 2011). Thus, sites in western areas of the SGP are well within reach of second-year (SY) birds dispersing from colonies in Garden City (37° 58' 18.36" N, 100° 52' 21.43" W; Finney County), Kansas; Keyes, Oklahoma, and Amarillo, Canyon, Lubbock (33° 34' 40.99" N, 101° 51' 17.99" W; Lubbock County), Andrews (32° 19' 5.27" N, 102° 32' 44.12" W; Andrews County), and Monahans, Texas [Ray 2002, 2015; PMCA 2018]). Eastern Purple Martins may eventually be observed nesting in provisioned and managed bird housing in other areas up to and west of the 103rd Meridian.

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IMPACTS OF RANGELAND RESTORATION PRACTICES FOR NORTHERN BOBWHITES ON WINTER USE BY RANGELAND BIRDS

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ABSTRACT.—Non-native grasslands may represent areas that are less usable to grassland birds due to lower plant diversity and arthropod abundance. Coastal bermudagrass (*Cynodon dactylon*) is a common grass planted in the southeastern United States for growing hay and-or cattle grazing. Conversion of bermudagrass to pastures dominated by forbs and warm season bunchgrasses has the potential to improve the site for grassland birds. The objectives of this study were to compare wintering avian abundance and richness, as well as vegetation variables in fallow bermudagrass pastures, a native shrubland, and an old bermudagrass hayfield that was restored for Northern Bobwhites (*Colinus virginianus*). This study was conducted in Karnes and Live Oak counties, Texas in 2014–2016. We sampled line transects at each site twice a month November–February. In 2014–2015, we detected 10 species in the restored site, 11 species in the bermudagrass site, and 23 species in the native site. In 2015–2016, we detected 13 species in the restored site, 9 in the bermudagrass site and 20 in the native site. We detected 154 individuals in 2014–2015 and 149 individuals in 2015–2016 in the restored site, 283 individuals in 2014–2015 and 385 individuals in 2015–2016 in the bermudagrass site, and 212 individuals in 2014–2015 and 164 individuals in 2015–2016 in the native site. Our results show that both active restoration of warm season grasses in bermudagrass sites and cessation of fertilization and spraying for weeds can produce sites usable for wintering grassland and rangeland birds.

Many species have been introduced outside their historical range across the majority of the globe either directly or indirectly by humans (Vitousek et al. 1996). Introduced species can increase the likelihood of extinction of native species and can also alter community composition and disturbance regimes. Invasive plants can reduce the fitness and growth of native plants, as well as lead to changes in community structure caused by a decrease in plant abundance and diversity. Vilà et al. (2011) reported a decrease in animal abundance and fitness following plant invasions. Animal behavior, diversity, production, and growth all showed negative trends as well. Allelopathic effects may further increase introduced grasses ability to limit and outcompete native plants (D'Antonio and Vitousek 1992, Bais et al. 2003). Introduced grasses can alter fire cycles which can negatively affect native vegetation and ecosystem functions (D'Antonio and Vitousek 1992).

Grassland, shrubland, and barrens top the list of ecosystems that have seen the most drastic declines in the United States (Noss et al. 1995). The loss of grasslands has negatively affected many species which are adapted to those habitats. Many grassland bird populations have declined throughout much of their range (Knopf 1994), and this decline has been referred to as "an unfolding conservation crisis (Brennan and Kuvlesky 2005)." Alterations of grasslands caused by introduced grasses can affect grassland birds, and non-native grasslands have been shown to have lower avian abundance and species richness (Flanders et al. 2006, Hickman et al. 2006).

Using 87 published articles, Litt et al. (2014) compiled a literature review on the effects of invasive plants on arthropods. Total arthropod abundance was lower in invasive-dominated areas in a majority of the studies (67%), while taxonomic richness, herbivorous arthropods and predaceous

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arthropods decreased in a plurality of studies (48%, 48% and 44%, respectively) (Litt et al. 2014). Arthropods are crucial to many game and nongame bird species by providing chicks a food source that meets the high protein requirements of growth and development (Nestler 1940). For example, arthropod density explained 75% of chick survival of Ring-necked Pheasant (*Phasianus colchicus*) (Hill1985). Campbell-Kissock et al. (1985) found arthropods in 100% of Northern Bobwhite (*Colinus virginianus*) and Scaled Quail (*Callipepla squamata*) crops collected during June and September, and in 96% of crops collected during fall and winter in southwestern Texas. Arthropods are also important in the diets of many other grassland birds, such as Grasshopper Sparrows (*Ammodramus savannarum*), Eastern Meadowlark (Sturnella magna), and Sprague's Pipit (*Anthus spragueii*) (Vickery 1996, Jaster et al. 2012, Davis et al. 2014). Non-native grasses can also lower plant species richness and forb cover (Flanders et al. 2006, Sands et al. 2009, Cord 2011). Fewer seed producing native plants and fewer arthropods could lead to trophic cascades that negatively affect avian communities.

Bermudagrass is an introduced warm season perennial grass that is commonly planted for cattle grazing or haying operations. Currently, this grass covers more than 4 million ha in the southeastern United States (Larson et al. 2010). Bermudagrass (*Cynodon dactylon*) pastures are sometimes maintained with fertilizer and herbicide applications. Like many other non-native grasses, bermudagrass may be less usable for grassland birds such as the Northern Bobwhite (Guthery 1986, Larson et al. 2010, Hernández and Guthery 2012). Cook (2004) observed that Northern Bobwhite broods avoided bermudagrass, and he attributed this avoidance to lower maneuverability and lower heat dissipation. However, Miller et al. (2013) found no significant difference in clutch size or nesting success of Botteri's Sparrows (*Peucaea botterii*) nesting in native and introduced grasses, with more than 50% of nests located in bermudagrass. Conversion of nonnative pasture to native dominated rangeland could potentially increase habitat for grassland birds, as it has been shown to increase usable space for Northern Bobwhite (Bond et al. 2005, Larson et al. 2010).

The objectives of this study were to compare wintering avian abundance and richness and vegetation variables in fallow bermudagrass pastures, a native shrubland, and an old bermudagrass hayfield that was restored for Northern Bobwhites." Grasslands contain relatively few avian species compared to more structurally diverse sites (Graul 1980). Igl and Ballard (1999) found higher avian species richness in habitat types with more woody cover. Thus, we hypothesized that total avian abundance and species richness would be highest in the more structurally diverse native site than in the restored site and bermudagrass sites. We also hypothesized the actively restored site would have a greater abundance of grassland birds than the fallow bermudagrass site. Throughout this paper, we refer to grassland birds as species included as endemics or secondary grassland species by Knopf (1994, Table 4). We refer to rangeland birds as all species found within this study.

METHODS

Study area

We conducted this study on the San Christoval Ranch and an adjacent property located in Karnes and Live Oak counties in the South Texas Plains. Woody species on the ranch included brasil (*Condalia hookeri*), granjeno (*Celtis ehrenbergiana*), honey mesquite (*Prosopis glandulosa*), narrowleaf foresteria (*Forestiera angustifolia*), Texas persimmon (*Diospyros texana*), twisted acacia (*Acacia schaffneri*), and whitebrush (*Aloysia gratissima*). Common native grasses on this study area included Texas wintergrass (*Nassella leucotricha*), purple threeawn (*Aristida purpurea*), bristlegrasses (*Setaria spp.*), and grama species (*Bouteloua spp.*). Common non-native grasses on the study area included bermudagrass, kleingrass (*Panicum coloratum*), Old World bluestems (*Dicanthium* and *Bothriochloa spp.*), and Willman's lovegrass (*Eragrostis superba*). Average annual precipitation (1961–1990) for Karnes County is 69.5 cm with 2 years in 10 averaging 42.2 cm and 2 years in 10 averaging 87.2 cm (Molina 1999).

Study design

We included 3 sites in this study, a bermudagrass site, a restored site, and a native site (Fig. 1). The bermudagrass site was composed of 4 fields within two sections. The first section contained two adjacent fields (east and west) comprising 33 ha, and the second section contained 2 adjacent fields (north and south) comprising 61 ha. An oat field separated

Figure 1. Study sites used for avian and vegetation sampling. Yellow lines represent the 350 m line transects. Study conducted in Karnes and Live Oak, counties Texas in the 2014–2016.

these 2 sections and was either planted with oats or left fallow depending on the year. Both sections were historically managed as cropland with corn and wheat as the primary crops grown. In 1996, the owners planted the fields with bermudagrass and actively managed them as bermudagrass hay fields (fertilization and herbicide applications). In 2010 the managers ceased fertilization and herbicide application for broad leaf plants in all of the fields, although the east field was sprayed for weeds in 2014. Brush was cleared using a shredder in the winter of 2015 in the east and west fields. Grazing varied from year to year. The east and west fields were grazed heavily in 2014 and lightly in 2015. The north and south fields were heavily grazed in 2014 and very lightly grazed in the spring of 2015 (north pasture only). Pipelines were installed in 2013 leaving some bare patches during the study. Tall powerlines were present throughout some of the field.

The native site was a 73 ha shrubland consisting of a diverse native plant community dominated by woody plants and forbs. With the exception of periodic aeration via a Lawson Aerator® and prescribed fire, this area has received little disturbance. The aerated strips were planted with a seed mix, containing primarily warm season bunchgrasses and forbs at a rate of 2.39 kg/ha. The site is lightly to moderately grazed most years.

The restored site was 58 ha and was previously managed as a bermudagrass hay field with strips of Kleingrass planted throughout. With the goal of restoring the site for Northern Bobwhites, the San Christoval Ranch treated all of the bermudagrass (Kleingrass strips not treated) within this field (36.4 ha) with a 41% mixture of glyphosate herbicide (Roundup®) at a rate of 11.7 L/ha in May and July 2005. Two weeks after spraying, a seed mix (native and exotic forbs and warm season bunchgrasses) was planted using a no-till Truax® seed drill at 4.48 kg pure live seed/ha. The site is lightly grazed most years. The maximum linear distance between the restored and bermudagrass site was 7,732 m, thus each site should have comparable annual precipitation and weather effects.

Avian line transects

We used line transects to estimate abundance of individual species and total avian abundance, as well as avian species richness. We established three 350 m line transects in each site. Using ArcMap 10.1 (ArcGIS, Environmental Systems Research Institute, Redlands, CA.), we established a 125 m buffer in the restored and bermudagrass sites, and within this buffer we generated 3 random points with a minimum of 150 m allowed between each point. From these points, we randomly assigned a cardinal direction (N, E, S, W) as the transect direction. If the 350 m transect crossed outside of the study site, or crossed within 150 m of another transect line, we generated a new random direction. Woody cover on the native site was too dense to navigate on a random straight line. As a result, we identified 4 roads or aerated strips ≥ 350 m long as potential transects. We then randomly chose the first one of these corridors to be used as one of our line transects. If another road or strip fell within 150 m of this transect line, we no longer considered it available as a potential transect. We continued this methodology until three roads and or strips were chosen. We then randomly assigned a side of these roads or strips the transect started on and used a random distance that would still allow for a 350 m transect. This random distance from the start of the road and/or strip served as the starting point of the transect.

We surveyed each line twice per month from November–February when the wind was ≤ 19 km/hour with no precipitation. While sampling the line transects, we walked at a slow pace and counted all birds seen (stopping was allowed to count birds, measure distances, and locate calling birds). Although we used calls to help identify birds, we did not count auditory only detections. We measured the perpendicular distance to each bird from the line using a Nikon Pro Staff 3 Rangefinder (Nikon Inc., Tokyo, Japan), and only included individuals found within 75 m of the line. We measured the distance to the center of the flock for groups of 2 or more birds. We excluded flyovers. We alternated between starting a transect near sunrise and during early morning (≈2 hours after sunrise). We did not sample more than two sites (6 transects) a morning, and surveyed all transects within 4 hours of sunrise.

Vegetation transects

For vegetation data collection and analysis, we split the bermudagrass site into two sections bermuda (E & W) and bermuda (N & S). In ArcMap 10.1, we clipped out well traveled dirt roads, caliche roads, ponds, and a 25 m area around each site. After clipping out these components, we generated 15 random points within each site with a 35 m minimum distance between all points. These random points served as the starting point of a 25 m transect. We randomly assigned 1 of 8 directions (N, NE, E, SE, S, SW, W, and NW) to each point to determine the transect direction. We collected vegetation data on bermudagrass sections (1 and 2), restored site and native site in late August and early September in 2014 and 2015. On these transects, we estimated woody plant canopy cover to the nearest cm using the line intercept-method (Canfield 1941). To determine forb and bermudagrass cover, we placed a 20 × 50 cm quadrat 0.5 m on the right side of the transect at 5, 10, 15, and 20 m, for a total of 4 quadrats per transect. Within these quadrats we estimated absolute forb cover and bermudagrass cover. We estimated percent canopy cover for each species to the nearest 5%, unless it was $< 5\%$ in which case we estimated to the nearest 1%.

Statistical analysis

We excluded hawks, owls and vultures from the analyses since the sampling sites were relatively small and these birds can travel over the entire site quickly. Because a deer feeder was located on one of the native transects, we excluded all birds seen under the feeder or near the feeder. We did not think these birds were representative of the site, nor would they naturally occur there in such high numbers. We also excluded all birds seen on the tall powerlines over the bermudagrass site. Because of the similarity of Eastern Meadowlarks and Western Meadowlarks (*Sturnella neglecta*), we combined these observations and treated them as one genera.

We used descriptive statistics (mean and standard error) to report the number of individual birds seen/day (three 350 m transects) on each site and the number of species seen/day (three 350 m transects) on each site. We used descriptive statistics (mean and standard error) to report absolute woody canopy coverage, absolute forb canopy coverage, and bermudagrass canopy coverage in each site (split bermudagrass into two sections). We also report the number of species seen in each year/site using species accumulation curves. Since sites are not replicated in space, inferences are limited to the particular experimental units in this study (Wester 1992).

RESULTS

We identified 1,349 individuals from 36 species (excluding hawks, owls, vultures, birds around the deer feeder in the native site, and birds on the tall powerlines over the bermudagrass site) over the 2-year study. This included 651 individuals from 28 species in 2014–2015 and 698 individuals from 29 species in 2015–2016 (Table 1).

The native site had higher total avian species richness during both years. In 2014–2015, we detected 10 species in the restored site, 11 species in the bermudagrass site, and 23 species in the native site. In 2015–2016, we detected 13 species in the restored site, 9 in the bermudagrass site, and 20 in the native site. Species accumulation curves had started to level off through the 8 sampling days. However, they still showed some increases in later sampling days, so this likely means we underestimated species richness in these sites (Fig. 2). The average number of species detected/sampling day (daily species richness) was also greater in the native site with an average of 5.125 and 4 species greater than the restored site/day and 4.25 and 4.125 greater than the bermudagrass site in 2014–2015 and 2015–2016 (Fig. 3). The average number of species per/day in the restored site (4.0 ± 0.5, 3.9 ± 0.4) was comparable to the bermudagrass site (4.8 ± 0.7, 3.8 ± 0.4) in both years.

The average detection distance was lowest in the restored site in 2014-2015 (13.3 ± 1.3m), while the bermudagrass and native site had similar average detection distances (22.6 ± 1.5, 22.0 ± 1.4m). In 2015-2016, the average detection distances were more similar across sites and ranged from ($17.5 \pm 1.3 - 21.7 \pm 1.7$m) (Table 2).

The restored site included 154 individual birds seen in 2014–2015 and 149 individuals in 2015–2016. The bermudagrass site included 283 individual birds seen in 2014–2015 and

Table 1. List of avian species and the total number of individuals seen in each site and year. Study conducted in Karnes and Live Oak counties, Texas November 2014–February 2015 (Yr 1) and November 2015–February 2016 (Yr 2).

		Restored		Bermuda		Native	
Common name	Scientific name	Yr 1	Yr 2	Yr 1	Yr 2	Yr 1	Yr 2
Bewick's Wren	*Thryomanes bewickii*	0	0	0	0	10	10
Brown–headed Cowbird	*Molothrus ater*	0	0	0	0	13	1
Cactus Wren	*Campylorhynchus brunneicapillus*	0	0	0	0	11	1
Cassin's Sparrow	*Peucaea cassinii*	0	0	0	1	0	2
Common Ground-Dove	*Columbina passerine*	0	0	4	0	3	0
Eastern Phoebe	*Sayornis phoebe*	0	3	0	0	0	0
Field Sparrow	*Spizella pusilla*	0	2	0	0	0	0
Golden-fronted Woodpecker	*Melanerpes aurifrons*	0	0	0	0	6	3
Grasshopper Sparrow	*Ammodramus savannarum*	0	0	3	0	0	0
Greater Roadrunner	*Geococcyx californianus*	0	0	0	0	0	1
Green Jay	*Cyanocorax yncas*	0	0	0	0	2	2
House Finch	*Haemorhous mexicanus*	0	0	11	0	4	5
House Wren	*Troglodytes aedon*	0	0	0	0	1	0
Ladder-backed Woodpecker	*Dryobates scalaris*	1	0	1	0	2	3
Lark Bunting	*Calamospiza melanocorys*	0	2	0	0	0	0
Lincoln's Sparrow	*Melospiza lincolnii*	0	0	0	0	1	0
Loggerhead Shrike	*Lanius ludovicianus*	3	1	3	5	0	0
Long-billed Thrasher	*Toxostoma longirostre*	0	0	0	0	21	7
Meadowlark spp.	*Sturnella spp.*	30	37	61	185	1	1
Mourning Dove	*Zenaida macroura*	3	0	26	0	30	44
Northern Bobwhite	*Colinus virginianus*	36	50	0	21	0	17
Northern Cardinal	*Cardinalis cardinalis*	6	0	0	0	18	20
Northern Mockingbird	*Mimus polyglottos*	0	0	1	1	7	7
Olive Sparrow	*Arremonops rufivirgatus*	0	0	0	0	1	0
Orange-crowned Warbler	*Oreothlypis celata*	0	0	0	0	2	0
Pyrrhuloxia	*Cardinalis sinuatus*	0	0	0	0	2	7
Red–winged Blackbird	*Agelaius phoeniceus*	0	0	0	0	22	0
Ruby-crowned Kinglet	*Regalus calendula*	0	1	0	0	14	6
Savannah Sparrow	*Passerculus sandwichensis*	68	37	148	161	0	0
Say's Phoebe	*Sayornis saya*	0	1	0	0	0	0
Sprague's Pipit	*Anthus sprageuii*	1	3	9	5	0	0
Unidentified		0	3	0	1	2	6
Verdin	*Auriparus flaviceps*	0	0	0	0	6	1
Vesper Sparrow	*Pooecetes gramineus*	4	2	18	4	2	0
White-crowned Sparrow	*Zonotrichia leucophrys*	2	5	0	1	31	18
White-eyed Vireo	*Vireo griseus*	0	0	0	0	0	2
Yellow-rumped Warbler	*Setophaga coronate*	0	2	0	0	0	0
Total		**154**	**149**	**285**	**385**	**212**	**164**

385 individuals in 2015–2016, and the native site included 212 individuals in 2014–2015 and 164 individuals in 2015–2016. The number of individuals seen/day (three 350 transects) was highest in the bermudagrass site in both years (Fig. 4). Northern Bobwhites, Savannah Sparrows (*Passerculus sandwichensis*), and meadowlarks (*Sturnella spp.*) were the most commonly

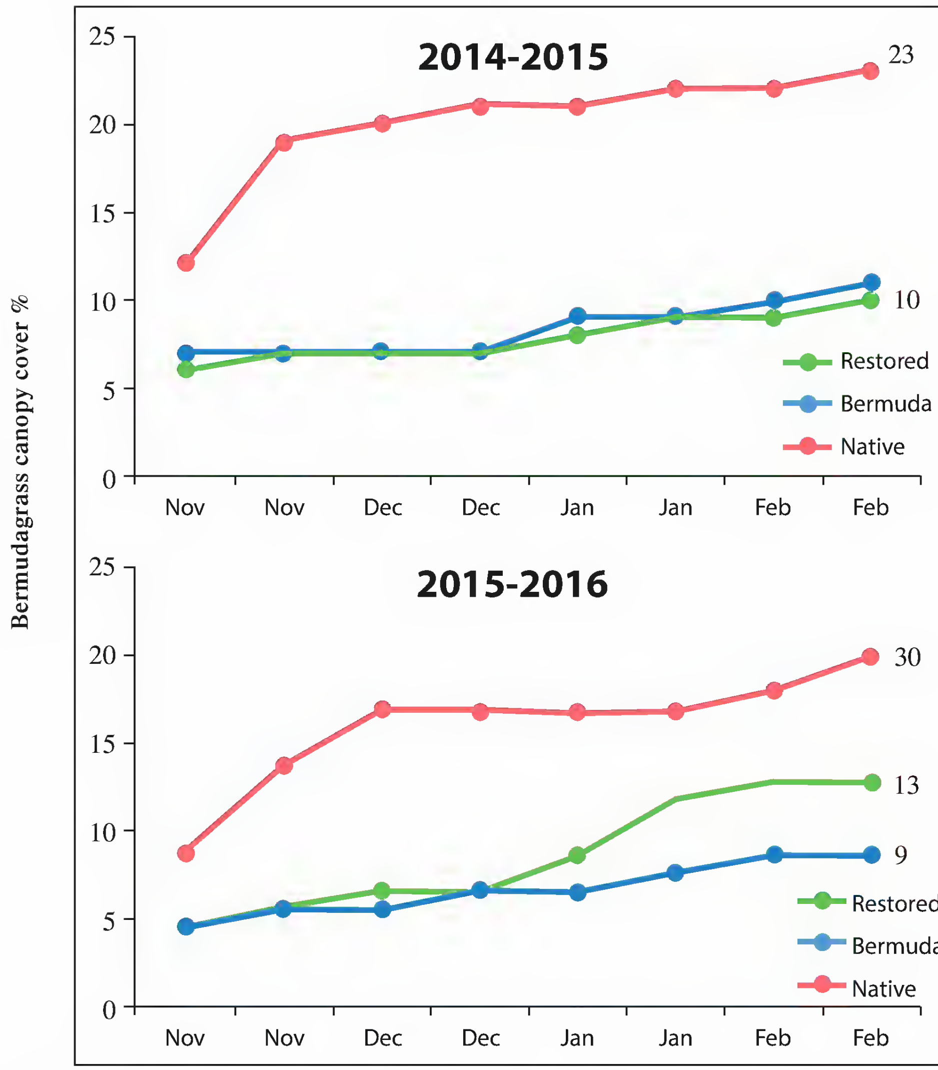

Figure 2. Species accumulation curves based on 8 sampling days (2/month from November–February). Each sampling day includes three 350 m transects. Study conducted in Karnes and Live Oak counties, Texas November 2014–February 2015 and November 2015–February 2016.

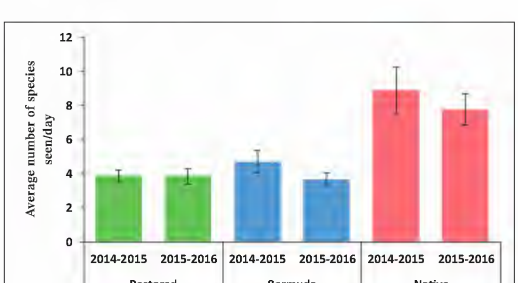

Figure 3. Average species richness observed each sampling day based on 8 sampling days (2/month from November–February). Each sampling day includes three 350 m transects. Study conducted in Karnes and Live Oak counties, Texas November 2014–February 2015 and November 2015–February 2016.

observed species in the restored site in both years, representing 87.0% of the total birds seen in the site 2014–2015 and 83.2% in 2015–2016. Savannah Sparrows and meadowlarks were the most commonly observed species in the bermudagrass site in both years, representing 73.1% of the total birds seen in the site 2014–2015 and 89.9% in 2015–2016. White-crowned Sparrows (*Zonotrichia leucophrys*), Mourning Doves (*Zenaida macroura*), Red-winged Blackbirds (*Agelaius phoeniceus*), and Long-billed Thrashers (*Toxostoma longirostre*) were the most commonly observed species in the native site in 2014–2015, representing 49.1% of the total birds seen in the site. Mourning Doves, Northern Cardinals (*Cardinalis cardinalis*), White-

Table 2. Average detection distance and SE for all detections in Karnes and Live Oak counties, Texas November 2014–February 2015 and November 2015–February 2016.

Year	Site	Mean	SE
	Restored	13.3	1.3
2014–2015	Bermuda	22.6	1.5
	Native	22.0	1.4
	Restored	18.8	2.1
2015–2016	Bermuda	17.5	1.3
	Native	21.7	1.7

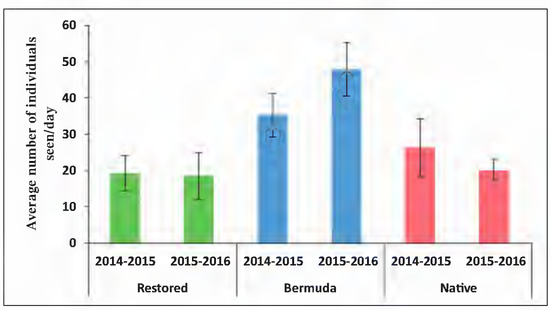

Figure 4. Average number of individuals seen each sampling day, the averages are based on 8 sampling days (2/month from November–February). Each sampling day includes three 350 m transects. Study conducted in Karnes and Live Oak counties, Texas November 2014–February 2015 and November 2015–February 2016.

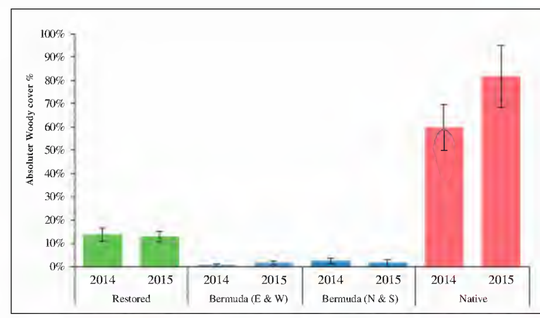

Figure 5. Absolute woody canopy cover percentage on the restored site, bermudagrass site (split into two sections), and native site. Data obtained by using the line intercept method. Woody canopy cover estimated in late August–early September, 2014 and 2015 in Karnes and Live Oak counties, Texas.

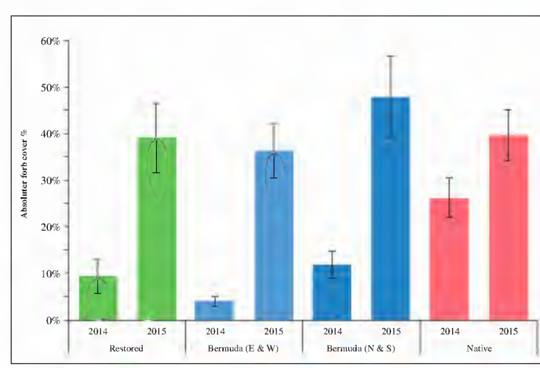

Figure 6. Absolute forb canopy cover percentage on the restored site, bermudagras site (split into two sections), and native site. Data obtained by estimates in four 20 cm by 50 cm daubenmire frames at each transect. Woody canopy cover estimated in late August–early September, 2014 and 2015 in Karnes and Live Oak counties, Texas.

crowned Sparrows, and Northern Bobwhites were the most commonly observed species in the native site in 2015–2016, representing 60.4% of the total birds seen (Table 1).

The native site had far more brush cover than either the restored or bermudagrass site. The bermudagrass sites (section 1 and 2) had ≤ 2.8 ± 1.4% absolute woody canopy coverage, while the restored site had ≤ 13.8 ± 2.9%. The native site had an estimated 60.3 ± 9.9% woody cover in 2014–2015 and 82.2 ± 13.4% in 2015–2016 (Fig. 5). All three sites had greater forb canopy cover in 2015 compared to 2014. The bermudagrass and restored sites had comparable forb canopy cover in both years (2014: restored 9.5 ± 3.7%, bermudagrass (east and west fields) 4.15 ± 1.05%, bermudagrass (north and south fields) 12.1 ± 2.9% 2015: restored 39.3 ± 7.4%, bermudagrass (east and west fields) 36.6 ± 5.9%, bermudagrass (north and south fields) 48.3 ± 8.8%) (Fig. 6). We did not detect bermudagrass on the native site, but had 1.2 ± 0.7% on the restored site in 2014 and 5.0 ± 2.3% in 2015, and 16.4 ± 5.2% and 22.0 ± 4.7% in the bermudagrass sites in 2014 and 42.1 ± 6.8% and 42.8 ± 9.2% in 2015 (Fig. 7).

DISCUSSION

The native site had greater avian species richness than either the restored or bermudagrass site.

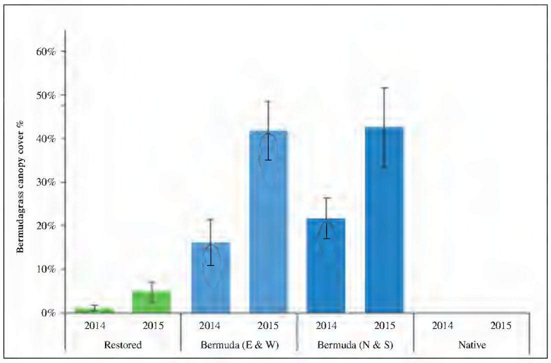

Figure 7. Bermudagrass canopy cover percentage on the restored site, bermudagrass site (split into two sections), and native site. Data obtained by estimates in four 20 cm by 50 cm daubenmire frames at each transect. Woody canopy cover estimated in late August–early September, 2014 and 2015 in Karnes and Live Oak counties, Texas.

Greater woody canopy cover provides more vertical vegetation structure than areas with low levels of woody canopy cover. Higher species richness in areas with greater woody canopy cover has been noted by Emlen (1972), Igl and Ballard (1999), Pidgeon et al. (2001), and Lozano-Cavazos et. al (2017).

Contrary to our initial hypothesis, (after removing individuals using the deer feeder), the native site did not have greater avian abundance than the restored and bermudagrass site, but fell between the two. Although two species (Savannah Sparrow and meadowlarks) made up the bulk of the abundance in the bermudagrass site.

Populations of many species of grassland birds found in this study are declining. Eastern Meadowlarks, Western Meadowlarks, and Savannah Sparrow, have undergone survey-wide declines according to the Breeding Bird Survey (BBS) data from 1966–2015 (Sauer et al. 2017). The bermudagrass site and the restored site held high number of meadowlarks in both years. We found high numbers of Savannah Sparrows in the bermudagrass site and moderate numbers in the restored site in both years. These two species made up a large percentage of the individuals seen in the grassland sites (restored and bermudagrass). These species were the most abundant grassland birds observed by Igl and Ballard (1999) and were the most abundant winter birds observed by Lozano-Cavazos et al. (2017). Savannah Sparrows and meadowlarks may be less specialized than other grassland birds in winter habitat use, as Gryzbowski (1982) observed Savannah Sparrows in sites under various types of grazing pressure in southern Texas and meadowlarks in all site types, which included various grazing pressure, cultivated fields, and fallow fields. Lozano-Cavazos et al. (2017) also observed both Savannah Sparrows and Eastern Meadowlarks in each treatment (two forms of brush management and control) and each year.

Vesper Sparrows (*Pooecetes gramineus*), Sprague's Pipits, Loggerhead Shrikes (*Lanius ludovicianus*), and Northern Bobwhites have also undergone survey-wide declines in the BBS from 1966–2015 (Sauer et al. 2017). We found Vesper Sparrows in all three sites, but the majority were in the bermudagrass site. We did not have a large sample of Sprague's Pipits, but we detected more in the bermudagrass site than the restored site. We found Loggerhead Shrikes in both the bermudagrass and restored site, but the highest number was seen in the bermudagrass site in 2015–2016. We found Northern Bobwhites in all three sites in 2015-2016, but we did not detect bobwhite in either the bermudagrass site or the native site in 2014–2015. Northern Bobwhites were most abundant in the restored site, providing some evidence that restoration activities targeted for bobwhite were successful.

The native site also had many avian species that are declining survey-wide. Bewick's Wren (*Thryomanes bewickii*), Cactus Wren (*Campylorhynchus brunneicapillus*), and Pyrrhuloxia (*Cardinalis sinuatus*) have undergone survey wide declines in the BBS from 1966–2015 (Sauer et al. 2017). We found each of these species during both years in the native site. The bird community in the native site had many similarities to another large South Texas property surveyed during the non-breeding season (Lipschutz 2016). Mourning Doves were the second and first most commonly observed species in the native site in 2014–2015 and 2015–2016. Mourning Doves were also the most common species observed by Lipschutz (2016), representing 11% of total bird observations during the non-breeding season. Northern Mockingbird (*Mimus polyglottos*), Bewick's Wren, Northern Cardinal, and Northern Bobwhite were in the top ten most common species observed by Lipschutz (2016) during the non-breeding season, and in the top ten most commonly observed species in the native site in at least one year.

Results in this study represent a metric of abundance and richness. Given considerable differences between woody cover there are likely differences in detection probabilities between sites. Although the average distance of the detection was fairly similar between sites, with the restored site in 2014–2015 the only site that stood apart. We did not incorporate detection probabilities into this study (Burnham et al. 1980) and the results should be interpreted with this limitation in mind.

Our results show that both active restoration of warm season grasses in bermudagrass sites and cessation of active management (fertilization and spraying for weeds) can produce sites usable for wintering grassland and rangeland birds. Unfortunately we were unable to include an actively managed bermudagrass site in this study. Although the bermudagrass site had greater bermudagrass canopy cover than the restored or native site, it also contained high canopy cover of forbs and should not be considered representative of an actively managed bermudagrass field that is fertilized, treated with herbicides for broad-leafed plants (forbs), and possibly hayed once or twice a year. Replication of this study with actively managed bermudagrass sites would be very beneficial.

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SHORT COMMUNICATIONS

FEMALE SHARP-SHINNED HAWK CHASES MALE WOOD DUCK THROUGH WINDOW PANE

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In early morning of 13 March 2018 ca 0830 CST, a male Wood Duck (*Aix sponsa*), pursued by a mid-sized accipiter, broke a hole through a double strength window pane (Fig. 1) at the library of Camp Tyler Outdoor School, Smith County (15143 Camp Tyler Road, Whitehouse, Texas; 32° 15' 27.48" N, 95° 10' 58.88" W). The weather was calm, cool, and clear. The window pane is northwest-facing and clearly reflected the surrounding vegetation—scattered post oaks (*Quercus stellata*), into which the duck was attempting to escape (Fig. 2). The duck was killed upon impact (Fig. 3) the cause being brain concussion and resultant hemorrhage, the primary cause of death for birds striking window panes (Klem 1990). The hawk was dazed; but, fell on the carpet and appeared to be unharmed (Fig. 4); and, it attempted to fly back through the window, but got caught in the window sash cord. It was caught, untied, examined, found to be uninjured, and released (Fig. 5).

Female Sharp-shinned Hawks (*Accipiter striatus*) and male Cooper's Hawks (*A. cooperii*) are similar (see Table 1 for comparison of identification characteristics and size measurements). Within each species there are sex size ranges greater than between a large female Sharp-shinned Hawk and a small male Cooper's Hawk; but, the Cooper's Hawk is longer tailed. I was not present before the hawk

Figure 1. Large hole through double strength window pane caused by strike of male Wood Duck being pursued by female Sharp-shinned Hawk. Notice stairway in the background.

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Figure 2. Large scattered post oak trees surrounding the Camp Tyler Outdoor School lodge building containing the library window. Tree reflection in the glass apparently attracted the male Wood Duck in its attempt to escape the pursuing female Sharp-shinned Hawk.

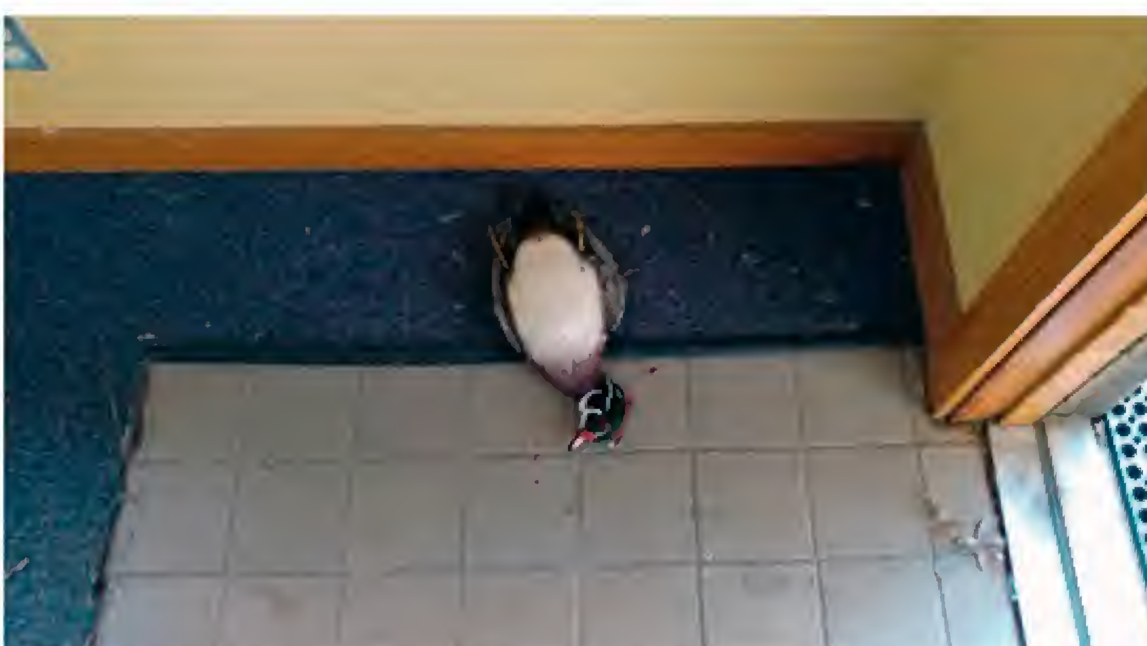

Figure 3. Dead male Wood Duck on the floor inside the library. Cause of death was brain concussion and resultant hemorrhage from window pane strike. Notice blood on floor tiles beneath the head.

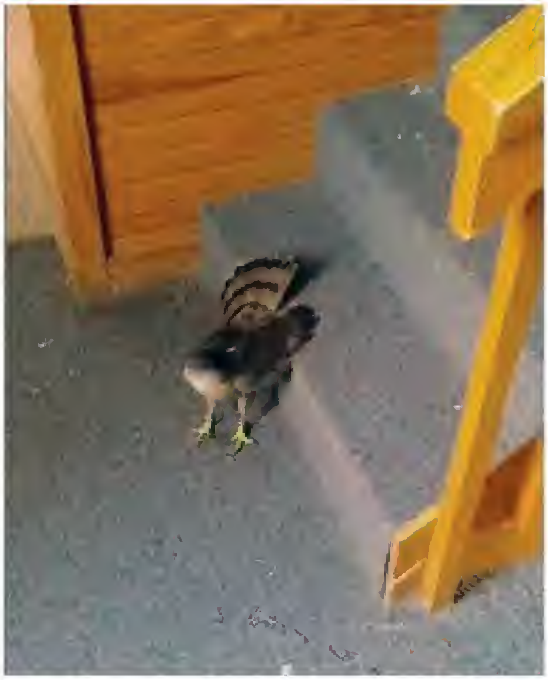

Figure 4. Dazed female Sharp-shinned Hawk standing on library carpet adjacent to stair steps.

Figure 5. Uninjured female Sharp-shinned Hawk held just before release by Jim D. Cunnigham, Executive Director of Camp Tyler Outdoor School.

was released; so, species identification was made from photographs. Relative size was determined from the photographs by comparison to objects of known length in the same geometric plane and distance from the camera (Figs. 4 and 5). Relative measurements were: total length 367 mm, wing chord 215, and tail length 178 mm). The bird was determined to be a large female Sharp-shinned Hawk; and, identification was confirmed by Keith Bildstein (pers. com). Apparently, this is the only report of a Sharp-shinned Hawk pursuing a duck (Bildstein pers. com.; Bildstein and Meyer 2000). Sharp-shinned Hawk diet is mainly small birds ca 35-77 g; the largest reported a Ruffed Grouse (*Bonasa umbellum*), 577 g. (Bildstein and Meyer 2000). Cooper's Hawks take mostly small to medium-sized birds ca 50-130 g; but, occasionally, females take larger birds including ducks (Storer 1966, Rosenfield and Bielefeldt 1993, Curtis, Rosenfield, and Bielefeldt 2006). During spring, a male Wood Duck averages 693 g (Bellrose and Holm 1994); the weight of a female Sharp-shinned Hawk is 150-218 g; and, that of a male Cooper's Hawk is 302-402 g (Wheeler and Clark 1995). Thus, capture and killing of a male Wood Duck would probably be difficult and would require an energetic cost. At Camp Tyler Outdoor School, during mid-March, there is a diversity and abundance of permanent resident, still overwintering, and early spring migrant small bird species. However, even when the prey base is sufficient, raptors perfect their hunting ability by harrying birds larger than their usual prey (Brown and Amadon 1968). So, when small prey is abundant, raptors can afford the metabolic cost of practice-capture of large non-prey. Perhaps, that was the situation during the pursuance of the Wood Duck.

ACKNOWLEGMENTS

I thank Camp Tyler Outdoor School personnel for notifying me and providing important information about this unusual observation: Jayson T. Solomon (Maintenance Assistant) discovered the broken window, Wood Duck, and Sharp-shinned Hawk and assisted in the hawk's release; Lonnie R. Dunning (Facilities Director) assisted in capture and release of the hawk and took photographs and video; Paige N. Marley (Assistant Program Director) took photographs and video; and, Jim D. Cunnigham (Executive Director) captured and released the hawk . I appreciate the expertise of Guy S. Sovia, computer consultant, who converted video images to still images.

Dr. Keith L. Bildstein (Director of Research and Education, Hawk Mountain Sanctuary, Kempton,

Table 1. Comparison of identification characteristics of adult Sharp-shinned Hawk and Cooper's Hawk (Palmer 1988; Johnsgard 1990; Rosenfield and Bielefeldt 1993; Wheeler and Clark 1995; Bildstein and Meyer 2000; Clark and Wheeler 2001; Alderfer 2006; Curtis, Rosenfield, and Bielefeldt 2006; Pyle 2008; Scott and McFarland 2010; Sibley 2010; Kaufman 2011; Wheeler 2018).

Characteristic	Sharp-shinned Hawk	Cooper's Hawk
Head	Rounded with no erect nape feathers (hackles); profile, a distinct "notch" from crown to beak. Rufous cheeks; blue-gray crown and nape; crown only slightly crown and nape; crown only slightly darker than back; no line of contrast with nape. Head relatively small.	Squarish with sharp line of contrast to nape feathers (hackles); in profile, flattish crown merges with forehead and bill in a smooth line. Grayish cheeks. Dark blue-gray crown contrasts with gray nape. Head relatively large.
Eye	Centrally located between beak and nape. Relatively large.	Closer to beak than nape. Relatively small.
Legs/Toes	Thin, stick-like. Tibiae mostly featherless. Middle toe relatively long.	Twice as thick, robust, stout. Proximal 3rd of tibiae feathered. Middle toe relatively short.
Tail	Outer feathers about same length as central pair. Tip notched (male), squarish (both sexes), rounded to wedge-shaped (some females) with narrow white terminal band. Equal width bands of black and gray-brown. Length ca 80% of wing chord and not more than 180 mm.	Outer feathers shorter and graduated outward. Tip rounded with wide white terminal band. Equal width bands of blackish- brown and blue-gray. Length ca 85% of wing chord and more than 180 mm.
Measurements (mm)		
Length	Male: 230-300	Male: 350-460
	Female: 290-370	Female: 420-500
Wing Chord	Male: 160-180	Male: 215-248
	Female: 188-217	Female: 244-283
Tail Length	Male: 124-142	Male: 171-205
	Female: 148-179	Female: 197-235
Mass (g)	Male: 87-107	Male: 329-369
	Female: 172-199	Female: 493-565

Pennsylvania) and William "Bill" Clark, Ph.D. kindly provided species identification confirmation.

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TEXAS BIRD RECORDS COMMITTEE REPORT FOR 2017

Eric Carpenter[1]

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The Texas Bird Records Committee (hereafter "TBRC" or "committee") of the Texas Ornithological Society requests and reviews documentation on any record of a TBRC Review List species (see TBRC web page at http://www.texasbirdrecordscommittee.org). Annual reports of the committee's activities have appeared in the Bulletin of the Texas Ornithological Society since 1984. For more information about the Texas Ornithological Society or the TBRC, please visit www.texasbirds.org. The committee reached a final decision on 100 records during 2017: 89 records of 39 species were accepted and 11 records of 10 species were not accepted, an acceptance rate of 89.0% for this report. The committee also added 2 species to the Supplemental List. In addition, 1 record wasn't circulated due to taxonomy change (lumped with a non-review species) and 1 additional record was withdrawn by the observers. A total of 159 observers submitted documentation (to the TBRC or to other entities) that was reviewed by the committee during 2017.

The TBRC accepted 3 first state records in 2017: White-tailed Tropicbird, Amethyst-throated Hummingbird, and Variegated Flycatcher. Thayer's Gull and Iceland Gull were lumped into Iceland Gull so Thayer's Gull was removed from the Texas State List. These 3 additions and the 1 removal bring the official Texas State List to 647 species in good standing. This total does not include the 5 species on the Presumptive Species List, nor the 2 species on the Supplemental List.

In addition to the review of previously undocumented species, any committee member may request that a record of any species be reviewed. The committee requests written descriptions as well as photographs, video, and audio recordings if available. Information concerning a Review List species may be submitted to the committee secretary, Eric Carpenter, 4710 Canyonwood Drive,

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Austin, Texas 78735 (email: ecarpe@gmail.com). Guidelines for preparing rare bird documentation can be found in Dittmann and Lasley (1992) or at http://www.greglasley.net/document.html.

The records in this report are arranged taxonomically following the AOS Check-list of North American Birds (AOU 1998) through the 58th supplement (Chesser et al. 2017). A number in parentheses after the species name represents the total number of accepted records in Texas for that species at the end of 2017. Species added to the Review List because of population declines or dwindling occurrence in recent years do not have the total number of accepted records denoted as there are many documented records that were not subjected to review (e.g. Brown Jay, Pinyon Jay, Tamaulipas Crow, and Evening Grosbeak). All observers who submitted written documentation or photographs/recordings of accepted records are acknowledged by initials. If known, the initials of those who discovered a particular bird are in boldface but only if the discoverer(s) submitted supporting documentation. The TBRC file number of each accepted record will follow the observers' initials. If photographs or video recordings are on file with the TBRC, the Texas Photo Record File (TPRF) (Texas A&M University) number is also given. If an audio recording of the bird is on file with the TBRC, the Texas Bird Sounds Library (TBSL) (Sam Houston State University) number is also given. Specimen records are denoted with an asterisk () followed by the institution where the specimen is housed and the catalog number. The information in each account is usually based on the information provided in the original submitted documentation; however, in some cases this information has been supplemented with a full range of dates the bird was present if that information was made available to the TBRC. All locations in italics are counties. Please note that the county designations of offshore records are used only as a reference to the nearest point of land.

TBRC Membership -- Members of the TBRC during 2017 who participated in decisions listed in this report were: Randy Pinkston, Chair; Keith Arnold, Academician; Eric Carpenter, (non-voting) Secretary; Greg Cook, Petra Hockey, Mark Lockwood, Dan Jones, Stephan Lorenz, Tony Frank, Chris Runk.

Contributors – Lee Adams, Tony Amos, Kenny Anderson, Keith Arnold (**KAr**), Noreen Baker, Bill Beaty, Grant Beauprez, Lea Beckworth, Bob Behrstock (**BoB**), Chris Benesh, William Benton, Kaylyn Billman, Justin Bosler, Diane Brown, Laura Brown (**LBr**), Robert Brown, Kelly Bryan (**KBr**), Frank Bumgardner, Mike Cameron, Kris Cannon, Eric Carpenter, Cameron Carver, Kendra Chock (**KCh**), Kevin Cochran (**KCo**), Scarlet Colley, Fred Collins, Greg Cook, Dennis Cooke, Mel Cooksey (**MCo**), Mary Curry (**MCu**), Maurice DeMille (**MDm**), Chris Deadman-Winston (**CDW**), Raul Delgado, Mark Dettling, Cindie Dillard, Sandy Dillard, Wyatt Egelhoff, Mark Esparza, Eric Faria, Tim Fennell, Terry Ferguson (**TFe**), Thomas Finnie (**TFi**), Joe Fischer, Mark Flippo, Harry Forbes, Phyllis Frank, Tony Frank (**TFr**), Bob Friedrichs, Maureen Gieger, Don Glasco, Donald Goodliffe (**DGo**), Rod Goodwin, Mark Gray (**MGr**), Rick Greenspun (**RGr**), Dave Grise (**DGr**), John Groves, Christian Hagenlocher, Debra Halter, David Hanson (**DaH**), Jan Hanson, Jimmy Hayes (**JHa**), Sue Heath, Mitch Heindel, Phillip Henderson, Doug Hiser (**DoH**), Petra Hockey (**PHo**), Joseph Hood (**JHo**), Jill Huebner (**JHu**), Don Jeane, Dan Jones (**DJo**), Teresa Keck, Laura Keene, John Kiseda, Jo Knopf (**JKn**), Rich Kostecke, Brian Kulvete, Michael Kuzio, Mark Lanham, Greg Lasley, Rick Laughlin, Justin LeClaire (**JuL**), Jason Leifester, Chuck Leonard, Annika Lindqvist, Michael Lindsey (**MLi**), Mark Lockwood (**MLo**), Chuck Lorenz (**CLo**), Eric Lutomski, Michael Marsden, Steve Mayes, Jan McClintock, Jon McIntyre (**JoM**), Brad McKinney, Arman Moreno, Gretchen Nareff, Bruce Neville, Diane Nunley, John O'Brien (**JOb**), Carolyn Ohl-Johnson (**COJ**), Andrew Orgill, Brent Ortego, Peter Osenton, Jane Owens, Jay Packer, John Park (**JoP**), Jim Paton (**JiP**), Kris Peterson, Barrett Pierce, Randy Pinkston, Dave Pope, Trey Redding, Martin Reid, Colton Robbins, Ross Rogers, John Rosford, Lance Runion, Chris Runk (**CRu**), Isaac Sanchez, David Sarkozi, Kim Savides, Mark Scheuerman, Willie Sekula, Chuck Sexton, Jeff Sexton, Dennis Shepler (**DSh**), Bruce Sherman, David Sikes (**DSi**), Letha Slagle, Christopher Smith (**CSm**), Gregory Smith, Laura Smith (**LSm**), Pete Sole, Cindy Sperry (**CSp**), Rex Stanford, David Stekoll (**DaS**), Denise Stephens (**DeS**), Harlen Stewart, Byron Stone (**BSt**), MaryBeth Stowe (**MBS**), Michelle Summers (**MSu**), Paul Sunby (**PSu**), Romey Swanson (**RSw**), Sandi Templeton, Carol Thompson, Barbara Tompkins, J Tribute, Gustavo Valero, Dylan Vasapolli, Tim Vasquez, Christian Walker, Dan Walker, Mathis Weatherall, Nicholas Webster, John Whittle, Shirley Wilkerson, Kimberly Williams, Adam Wood, John Yochum, Mike Zarella.

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Additional Abbreviations—A.O.S. = American Ornithologists' Society; A.O.U. = American Ornithologists' Union; N.P. = National Park; N.S. = National Seashore; N.W.R. = National Wildlife Refuge; S.H.S. = State Historic Site; S.N.A. = State Natural Area; S.P. = State Park; TBSL = Texas Bird Sounds Library (Sam Houston State University); TCWC = Texas Cooperative Wildlife Collection (Texas A&M University); W.M.A. = Wildlife Management Area.

ACCEPTED RECORDS

Brant (*Branta bernicla*) (34). One south of Farwell, Parmer from 24 - 25 December 2016 (**GB**, JL; 2016-86; TPRF 3377).

Trumpeter Swan (*Cygnus buccinator*) (13). One 10 miles north of Bowie, Montague on 20 December 2016 (**PH**; 2016-88; TPRF 3378).

Eurasian Wigeon (*Mareca penelope*) (55). One at Osprey Overlook, Laguna Atascosa N.W.R., Cameron from 31 October - 29 November 2016 (**DV**, ME, RP, JKn; 2016-77; TPRF 3379).

American Black Duck (*Anas rubripes*) (9). One southeast of Dayton, Liberty on 20 December 1976 (**DC**; 2016-46; TPRF 3380). One at White Rock Lake, Dallas from 2 - 21 March 2017 (**CRu**, EC, DJo, RP, PHo; 2017-10; TPRF 3381).

Mexican Violetear (*Colibri thalassinus*) (84). One at Utopia, Uvalde from 19 May - 10 June 2016 (**CSp**, **LSm**, MH, KB; 2016-35; TPRF 3384). One at Rio Medina, Medina from 5 - 27 July 2016 (**JM**; 2016-44; TPRF 3382). One west of Fort Davis, Jeff Davis from 26 July - 31 August 2016 (**KBr**, MD, MLo, MGr; 2016-49; TPRF 3383).

Amethyst-throated Hummingbird (*Lampornis amethystinus*) (1). One west of Fort Davis, Jeff Davis from 14 - 15 October 2016 (**KBr**, COJ; 2016-73; TPRF 3385).

Costa's Hummingbird (*Calypte costae*) (39). One at El Paso, El Paso from 4 December 2016 - 14 January 2017 (**JK**, JG; 2016-82; TPRF 3386).

White-eared Hummingbird (*Hylocharis leucotis*) (40). One west of Fort Davis, Jeff Davis from 29 May - 9 August 2016 (**KBr**; 2016-75; TPRF 3387). One at Davis Mountains Preserve, Jeff Davis from 11 August - 11 September 2016 (**CRu**, DJo, RK; 2016-58; TPRF 3388).

Common Crane (*Grus grus*) (2). Up to three at Mound Lake and surrounding areas, Terry from 7 February - 8 March 2016 (**JB**, MLo, TFr, LK, CH; 2016-13; TPRF 3389).

Northern Jacana (*Jacana spinosa*) (41). One nw. of Palmview, Hidalgo on 26 March 1981 (**PO**; 2016-53; TPRF 3390). One at Calliham Unit, Choke Canyon S.P., McMullen from 25 October - 6 December 2015 (**MR**, KP, PSu; 2016-52; TPRF 3392). One at Santa Ana N.W.R., Hidalgo from 12 October - 2 November 2016 (**BK**, DG, MDm, DJo; 2016-74; TPRF 3391).

Red Phalarope (*Phalaropus fulicarius*) (47). One at White Rock Lake, Dallas from 26 - 31 August 2015 (CRu, AL, MC; 2016-67; TPRF 3394). One ~43 miles south-southeast of Matagorda Island, Calhoun on 20 November 2016 (**BM**, **AO**; 2016-81; TPRF 3393).

Black-legged Kittiwake (*Rissa tridactyla*) (104). One at Padre Island N.S., Kleberg on 15 January 2017 (**RL**, JoM; 2017-05; TPRF 3395).

Mew Gull (*Larus canus*) (40). One at El Paso, El Paso from 1 - 16 January 2017 (**JiP**, WE; 2017-11; TPRF 3396).

Great Black-backed Gull (*Larus marinus*) (59). One at Bolivar Flats, Galveston from 7 - 17 October 2016 (**LS**, BSt, DSh; 2016-70; TPRF 3398). One at JFK Causeway/Laguna Madre, Nueces from 21 - 22 December 2016 (**MCo**, DGr; 2017-01; TPRF 3397).

White-tailed Tropicbird (*Phaethon lepturus*) (1). One at Padre Island N.S., Kleberg on 3 July 2010 (**TA**; 2016-05; TPRF 3399).

Black-capped Petrel (*Pterodroma hasitata*) (3). At least one ~114 miles south-southeast of Freeport, Brazoria on 5 November 2016 (**JoM**; 2016-79; TPRF 3400).

Sooty Shearwater (*Ardenna grisea*) (20). One at Mustang Island, Nueces on 10 July 2016 (AO; 2016-47; TPRF 3401).

Great Shearwater (*Ardenna gravis*) (23). One at Port Aransas, Nueces on 18 December 2012 (KAr; 2016-51; TPRF 3403; TCWC#23867). One ~48 miles southeast of Port Aransas, Nueces on 25 August 2016 (**DP**; 2016-55; TPRF 3402).

Leach's Storm-Petrel (*Oceanodroma leucorhoa*) (35). One at San Antonio Bay, Aransas on 26 June 2014 (**JT**; 2016-45; TPRF 3404; TCWC#22794). One offshore from South Padre Island, Cameron on 4 June 2016 (**PHo**, **JOb**; 2016-42). One ~85 miles southeast of Matagorda Island, Calhoun on 23 July 2016 (**RP**, **JOb**; 2016-50; TPRF 3405).

Jabiru (*Jabiru mycteria*) (13). One south of Placedo, Victoria/Calhoun from 20 - 25 August 2016 (**JHa**, DW, DN, BS, PHo, EC; 2016-54; TPRF 3406). One near Anahuac N.W.R., Chambers from 1 - 3 August 2017 (**DaH**, **JH**, DS, TFr, JB; 2017-34; TPRF 3407).

Blue-footed Booby (*Sula nebouxii*) (2). One at Big Shell Beach, Padre Island NS, Kenedy on 28 December 1986 (**NB**; 2016-17).

Brown Booby (*Sula leucogaster*) (87). One at Port Isabel, Cameron from 4 - 5 November 2014 (PS, LA; 2017-79; TPRF 3417). One at upper Trinity Bay, Chambers on 4 December 2014 (**EF**; 2017-78; TPRF 3408). One at Corpus Christi Bay, Nueces from 10 - 29 March 2015 (**KS**, TK; 2017-82; TPRF 3409). One at Port Aransas jetty, Nueces on 11 April 2016 (AO; 2017-77; TPRF 3410). One at Brownsville Ship Channel, Cameron on 18 April 2016 (**SC**; 2016-39; TPRF 3415). One at north Dallas, Dallas on 25 May 2016 (**EL**; 2016-40; TPRF 3418). Nine at Corpus Christi Bay near Ingleside, Nueces on 27 June 2016 (**RB**; 2016-43; TPRF 3411). One to two at Benbrook Lake, Tarrant from 26 - 31 July 2016 (BT, DeS; 2017-76; TPRF 3430). One offshore from South Padre Island, Cameron on 27 August 2016 (**EC**, **RP**, **AM**; 2016-56; TPRF 3413). One at Port of Houston, Harris on 3 September 2016 (**LS**; 2016-66; TPRF 3412). One 30 miles southeast from Freeport, Brazoria on 5 September 2016 (**MW**; 2016-65; TPRF 3425). Up to 11 at Matagorda Bay, Calhoun/Matagorda from 27 September - 4 December 2016 (**PHo**, BF; 2016-63; TPRF 3432). One ~154 miles southeast of Freeport, Brazoria on 30 September 2016 (**JoM**; 2016-80; TPRF 3416). One at Lake Bridgeport, Wise from 9 October - 4 December 2016 (**MCu**, MSu, JP, DH; 2016-68; TPRF 3431). One at Corpus Christi Bay, Nueces on 10 October 2016 (**DSi**; 2016-69; TPRF 3414). One to eight at Pleasure Island, Jefferson from 21 December 2016 - 12 January 2017 (TFr, TFi, SM, ST; 2016-87; TPRF 3433). Ten at Corpus Christi Bay, Nueces on 17 March 2017 (**KCo**; 2017-68; TPRF 3419). One at Red Lake, Freestone on 3 May 2017 (**JO**; 2017-75; TPRF 3420). One at Stanmire Lake, Leon from 5 - 10 May 2017 (**CSm**, SD, CD; 2017-69; TPRF 3426). One at JFK Causeway, Nueces on 5 May 2017 (**GN**; 2017-18). Up to three at Baytown Nature Center, Harris from 2 - 4 June 2017 (**MK**, LS, KW; 2017-74; TPRF 3421). One at Lake Bob Sandlin, Camp on 11 June 2017 (**RR**; 2017-70; TPRF 3427). One to two at Port O'Connor, Calhoun from 15 June - 9 July 2017 (**PHo**; 2017-27; TPRF 3422). One at South Padre Island, Cameron on 27 June 2017 (**JuL**; 2017-73; TPRF 3428). One at Lake Mineral Wells, Parker on 9 July 2017 (**LB**; 2017-72; TPRF 3423). Two 35 miles offshore from Port Aransas, Nueces on 10 July 2017 (**TR**; 2017-71; TPRF 3424). One below Lake Livingston Dam, Polk on 10 July 2017 (**DoH**; 2017-31; TPRF 3429).

Short-tailed Hawk (*Buteo brachyurus*) (53). One at Davis Mountains Preserve, Jeff Davis on 4 June 2016 (**RK**; 2016-34; TPRF 3436). One at Utopia, Uvalde on 29 September 2016 (**MH**; 2016-61; TPRF 3434). One at Santa Ana N.W.R., Hidalgo on 29 September 2016 (**MM**, **RGr**; 2016-62; TPRF 3435). One to two at Lost Maples S.N.A., Bandera from 3 - 5 April 2017 (**MH**, DaS; 2017-14; TPRF 3437). One at Concan, Uvalde on 16 April 2017 (**BoB**; 2017-26). One at Davis Mountains Preserve, **Jeff Davis** on 24 May 2017 (**RK**, **EC**; 2017-22; TPRF 3439). One at The Bowl, Guadalupe Mountains N.P., Culberson on 6 June 2017 (**EC**,**KA**; 2017-24; TPRF 3438).

Northern Saw-whet Owl (*Aegolius acadicus*) (32). One west of Fort Davis, Jeff Davis on 30 September 2016 (**KBr**; 2016-64; TPRF 3440). One to two west of Fort Davis, Jeff Davis from 28 April - 24 May 2017 (**KBr**, DS; 2017-15; TPRF 3441).

Amazon Kingfisher (*Chloroceryle amazona*) (3). One at Zacate Creek, Laredo, Webb from 30 October 2016 - 20 January 2017 (**RD**, EC, GV, RP, BP, NW, LR; 2016-76; TPRF 3442).

Tufted Flycatcher (*Mitrephanes phaeocercus*) (5). One at Pinnacle Pass, Big Bend N.P., Chisos Mountains, Brewster on 7 May 2017 (**MF**, **LBr**; 2017-20; TPRF 3443).

Sulphur-bellied Flycatcher (*Myiodynastes luteiventris*) (30). One at Santa Ana N.W.R., Hidalgo from 29 May - 15 June 2016 (**GC**,ME, JY, EC; 2016-32; TPRF 3446). One at Lafitte's Cove, west Galveston Island, Galveston on 10 September 2016 (**CDW**; 2016-59; TPRF 3444). One at National Butterfly Center, Mission, Hidalgo on 6 May 2017 (**JR**; 2017-19; TPRF 3445).

Variegated Flycatcher (*Empidonomus varius*) (1). One at South Padre Island, Cameron from 28 September - 2 October 2016 (BB, BM, DJo, ME, RS, EC, CLo, WS, RP, TFr, PF, MCo, PHo, BP, FB, SH, GV, JHo; 2016-60; TPRF 3447).

Gray Kingbird (*Tyrannus dominicensis*) (13). One at Xeriscape Park, Quintana, Brazoria on 30 April 2017 (**SH**, **JF**; 2017-28; TPRF 3448).

Rose-throated Becard (*Pachyramphus aglaiae*) (57). One at Spring Creek Park, Lake Nasworthy, San Angelo, Tom Green from 20 - 22 October 2016 (**TV**; 2016-71; TPRF 3450). One at Estero Llano Grande S.P., Hidalgo from 9 January - 15 March 2017 (**MBS**, ME, CB; 2017-04; TPRF 3449).

Black-whiskered Vireo (*Vireo altiloquus*) (40). One at Lafitte's Cove, west Galveston Island, Galveston from 22 April - 13 May 2017 (SH, DC, WB; 2017-16; TPRF 3451). Two at Sabine Woods, Jefferson from 4 - 5 May 2017 (MS, KC, FC, KCh; 2017-21; TPRF 3452).

Black-billed Magpie (*Pica hudsonia*) (5). One ~18 miles north-northeast of Pampa, Roberts on 10 April 2017 (**RG**; 2017-13; TPRF 3453).

White-throated Thrush (*Turdus assimilis*) (19). One near Santa Ana N.W.R., Hidalgo from 17 - 20 February 2016 (DGo, BP, CR; 2016-18; TPRF 3454).

Rufous-backed Robin (*Turdus rufopalliatus*) (23). One at Crescent Bend Nature Park, Schertz, Bexar on 20 December 2016 (**DB**; 2016-84; TPRF 3455).

Varied Thrush (*Ixoreus naevius*) (47). One at Midland, Midland on 20 December 2016 (**GS**; 2017-03). One west-northwest of Canyon, Randall from 17 - 18 June 2017 (**ML**; 2017-29; TPRF 3456).

Rufous-capped Warbler (*Basileuterus rufifrons*) (34). One to two at Dolan Falls Preserve, Val Verde from 2 May - 24 October 2017 (**RSw**, RK; 2017-17; TPRF 3457).

Golden-crowned Warbler (*Basileuterus culicivorus*) (24). One at Lions/Shelly Park, Refugio, Refugio from 24 January - 24 February 2017 (RP, BO, EC; 2017-08; TPRF 3458).

Crimson-collared Grosbeak (*Rhodothraupis celaeno*) (41). One at Sheepshead lot, South Padre Island, Cameron from 3 September - 27 October 2016 (**GV**, LS, PHo, ME, BM, DJo; 2016-57; TPRF 3459).

Blue Bunting (*Cyanocompsa parellina*) (50). One at Santa Ana N.W.R., Hidalgo on 26 December 2016 (**DJo**; 2016-85).

ADDED TO SUPPLEMENTAL LIST

The TBRC maintains a Supplemental List of those species that are not on the State List but for which there is at least one record determined to be "unaccepted, natural occurrence questionable" and with respect to that record, for which a majority of members believe there is enough potential for natural occurrence for inclusion on the Supplemental List. If a record of a species not on the State List is not accepted on the grounds of questionable natural occurrence, but all members agree that the bird's identity was established, then any member may move to add the species to the Supplemental List. The species will then be added to the Supplemental List with a majority vote, either at a meeting or through other voting means. The following species were added to the Supplemental List during 2017:

Tropical Mockingbird (*Mimus gilvus*). One at Sabine Woods, Jefferson from 18 April - 28 July 2012 (**DJ**, TFe, SM, JW, JoP, MS, MLi, TFi, EC, RP, IS, BP, MR, BN, BSt, AW, HS, SW; 2012-36).

Striped Sparrow (*Oriturus superciliosus*). One east of Granger Lake, Williamson from 11 January - 7 April 2015 (**RK**, TF, CW, CT, HF, RP, AW, BN, BSt, FB, CL; 2015-04).

NOT ACCEPTED

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

Barrow's Goldeneye (*Bucephala islandica*). One at Hornsby Bend, Travis on 17 November 1979 (2017-09).

Red-billed Tropicbird (*Phaethon aethereus*). One at Rockport Harbor, Aransas on 23 April 2016 (2016-31).

Brown Booby (*Sula leucogaster*). One east of Johnson City, Blanco on 24 June 2017 (2017-30).

Northern Goshawk (*Accipiter gentilis*). One at Davis Mountains Preserve, Jeff Davis on 16 March 2016 (2016-25).

Northern Pygmy-Owl (*Glaucidium gnoma*). One at Bear Canyon, Guadalupe Mountains N.P., Culberson on 3 October 2016 (2016-72).

Buff-breasted Flycatcher (*Empidonax fulvifrons*). Two at Tobe Canyon, Davis Mountains Preserve, Jeff Davis on 16 July 2017 (2017-32).

Rose-throated Becard (*Pachyramphus aglaiae*). One at Paradise Pond, Port Aransas, Nueces on 1 April 2008 (2016-24).

Pacific Wren (*Troglodytes pacificus*). One at Palo Duro Canyon, Randall on 26 November 2014 (2015-81). One at McKittrick Canyon, Guadalupe Mountains N.P., Culberson on 23 November 2016 (2016-89).

Varied Thrush (*Ixoreus naevius*). One at Pace Bend Park, Travis on 26 January 2017 (2017-07).

Blue Mockingbird (*Melanotis caerulescens*). One near Barksdale, Real on 9 June 2016 (2016-38).

OTHER RECORDS

Iceland Gull (*Larus glaucoides*). One at Bolivar Flats, Galveston on 11 April 2017 (2017-12). This record was not circulated as Iceland Gull was lumped with Thayer's Gull by the AOS in 2017. Thayer's Gull is now considered a subspecies of Iceland Gull and the non-Thayer's Iceland Gull records in Texas to this point have all been considered "Kumlien's" Iceland Gull. "Kumlien's" is widely regarded to be an intergrade between Thayer's and the nominate subspecies.

Costa's Hummingbird (*Calypte costae*). One at El Paso, El Paso on 26 October 2017 (2017-44). Record withdrawn by observer.

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(Left to Right) Amethyst-throated Hummingbird—Video Cam still image, Variegated Flycatcher—photo by Chuck Lorenz, and White-tailed Tropicbird with Tony Amos—Staff Photo, July 3, 2010.

TOS PAPER WINS AWARD

At the 03 August meeting of the Louisiana Association of Professional Biologists the following paper won the ***publication of the year*** in conservation category! The entire TOS Bulletin staff congratulates the authors of this paper for the award and for submitting it to our publication!

"Sands, J.P., L. A. Brennan, S. J. DeMaso, and W.G. Vermilion. 2017. Population trends of high conservation priority bird species within the Gulf Coast Joint Venture Region. *Bulletin of the Texas Ornithological Society 50:19-52.*"

EVIDENCE OF CANYON WRENS NESTING IN VACATED CLIFF SWALLOW NEST IN WEST TEXAS

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The Cliff Swallow (*Petrochelidon pyrrhonota*) is well known for its colonial nesting behavior that results in aggregations of up to 6,000 individual retort-type nests made of mud, each with a small (4-5 cm) entrance opening (Emlen 1954; Brown et al. 2017). These distinct nests typically are attached to vertical and overhanging cliffs, entrances to caves, and tree limbs, as well as buildings, bridges, culverts, and other man-made structures (Brown et al. 2017). Nests from previous years often are repaired and reused during subsequent years (Meek and Barclay 1996). Nests also may be abandoned by Cliff Swallows for various reasons, and subsequently used for nesting by other species of birds, including Say's Phoebe (*Sayornis saya*), Chestnut-backed Chickadee (*Poecile rufescens*), Oak Titmouse (*Baeolophus inornatus*), House Wren (*Troglodytes aedon*), Eastern Bluebird (*Sialia sialis*), House Finch (*Haemorhous mexicanus*), and House Sparrow (*Passer domesticus*) (Sooter et al. 1954; Mayhew 1958; Weeks 1995; Brown et al. 2017).

The Canyon Wren (*Catherpes mexicanus*) is known to favor rock caverns, crevices, and cliffs as nesting sites (Bent 1948). However, because this species behaves in a secretive manner at its nest and given these nests are located in inaccessible areas, little is known about the specifics of its nesting habits (Jones and Dieni 1995). The scant data available on nesting has been generally limited to the known descriptions of Canyon Wren nests liken to cup-type nests of twigs, mosses, grasses, and dead leaves (Jones and Dieni 1995). Canyon Wrens have been documented to use Cliff Swallow nests as winter dormitories (Sooter et al. 1954), but have not been reported to use them for nesting purposes.

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We herein provide evidence of an abandoned Cliff Swallow nest being used by Canyon Wrens as a nesting structure.

On 19 April 2017, two Canyon Wrens were observed flying about a congregation of several hundred Cliff Swallow nests in the Los Alamos area of Big Bend Ranch State Park, Texas (29.55° N 103.81° W). The nests were affixed to an overhang of the vertical wall that forms one side of a rocky canyon approximately 12 m in depth. There was no sign of current use of any of the nests by Cliff Swallows although this date is early in the season for migrants (Brown et al. 2017). The habitat surrounding the canyon is Chihuahuan Desert scrub dominated by creosote-bush (*Larrea tridentata*), acacia (*Acacia* sp.), and prickly pear cactus (*Opuntia* sp.). A small, spring-fed stream is situated on the floor of the canyon, with adjacent riparian vegetation dominated by willows (*Salix* sp.), seepwillows (*Baccharis* sp.), and Fremont's Cottonwood (*Populus fremontii*).

Once initially sighted, the activity of the two wrens was observed for approximately 20 min. During this time, both individuals were observed, each intermittently flying into and away from one specific swallow nest situated approximately 5 m above the canyon floor. Upon each arrival at the Cliff Swallow nest, a Canyon Wren entered the small opening and then disappeared inside the nest. After a short period, one Canyon Wren protruded its head from the opening for a moment (Fig. 1) and then emerged from the nest and perched on its edge (Fig. 2). Following a few seconds perched at the opening, individual wrens would fly away and then return to the same swallow nest ca. 2-3 min later. Neither bird was observed entering or occupying a different swallow nest, however one was seen perching momentarily on the edge of an adjacent dilapidated nest. The two birds never were observed occupying the swallow nest simultaneously. When one of the birds was away from the nest, the distinct song of the Canyon Wren frequently was heard.

Although the phenology of Canyon Wren nesting activity is not well understood, at latitudes consistent

Figure 1. Canyon Wren occupying a specific Cliff Swallow nest in Big Bend Ranch State Park, Texas on 19 April 2017.

Figure 2. Canyon Wren emerging from same Cliff Swallow nest in Big Bend Ranch State Park, Texas on 19 April 2017.

with or approximate to that of the observation site, nest construction is known to begin by mid-March, incubation begins as early as mid-April, and fledglings occur in May (Jones and Dieni 1995). Because of the angle of the small opening (Fig. 2) and height at which the abandoned Cliff Swallow nest was situated, it was not possible to see inside the swallow nest to confirm the presence of a Canyon Wren nest, and no nesting material was seen being carried into the nest by either individual. However, the date of the observations (19 April) falls amidst the overall reported nesting period. Moreover, both sexes are known to participate, to some degree, in all stages of nesting, from nest-building to feeding and caring for the brood and fledglings (Bailey and Niedrach 1965; Verner and Willson 1969). The observations of repeated sorties to and from a single Cliff Swallow nest by two individual Canyon Wrens, coupled with the date of the observations, provide strong evidence that the pair was using (or preparing to use) the swallow nest as a structure to support and conceal its own nest.

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TERRITORIAL PHYSICAL ATTACKS BY ASH-THROATED FLYCATCHER ON CLIFF SWALLOWS AND CONSPECIFICS

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Of the four species of flycatchers in the genus *Myiarchus* (Family Tyrannidae) that occur in Texas (Lockwood and Freeman 2014), little information has been compiled concerning non-predatory interspecific physical interactions (for reviews see Cardiff and Dittmann 2000; 2002; Miller and Lanyon 2014; Tweit and Tweit 2002). Among three sympatric species of *Myiarchus* studied in Arizona, Lanyon (1963) found that the intensity of aggression to tape playbacks was correlated to the size of the species involved with the larger Brown-crested Flycatcher (*M. tyrannulus*) most aggressive, followed by the Ash-throated Flycatcher (*M. cinerascens*) and then the smaller Dusky-capped Flycatcher (*M. tuberculifer*). The Great Crested Flycatcher (*M. crinitus*) is known to physical attack an intruding Common Grackle (*Quiscalus quiscula*) with bill blows to the back of its head (Gabrielson 1915). For the Brown-crested Flycatcher, most physical encounters are intraspecific (Cardiff and Dittmann 2000), although Lanyon (1963) was able to induce physical attacks on life-mount specimens of conspecifics, congeners, and a Hermit Thrush (*Catharus guttatus*) by producing Brown-crested Flycatcher vocalizations. No information of natural interspecific physical interactions is known for the Dusky-capped Flycatcher (Tweit and Tweit 2002) with the only record of attacks being on life-mount specimens of congeners producing Dusky-capped Flycatcher vocalizations (Lanyon 1963). Ash-throated Flycatchers from Arizona were documented to physically attack both Cassin's Sparrows (*Peucaea cassinii*) and a Cactus Wren (*Campylorhynchus brunneicapillus*) flying through their breeding territories (Austin and Russell 1972). The following describes additional intraspecific and interspecific territorial physical interactions by the Ash-throated Flycatcher with an explanation for the trigger to these specific behaviors.

While conducting a breeding bird survey from a hide on 18 June 2014 the following observations were made adjacent to pond 11 at Lake Alan Henry Wildlife Mitigation Area (33.068453° N, 101.017908° W), ca. 12 km S, 26 km W of Clairemont, Kent Co., Texas. At ca. 0740 an aerial, physically connected fight between two unknown birds was observed over the pond with the spinning pair of birds subsequently falling to the ground behind tall grasses N of the pond. After 1-2 sec, a Cliff Swallow (*Petrochelidon pyrrhonota*) flew

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from the vegetation immediately followed by an Ash-throated Flycatcher (*M. cinerascens*), which almost instantly caught the smaller Cliff Swallow and resumed the aerial tussle until again they went to the ground in a swirling mass on a dirt road E of the pond. A subsequent 2-3 sec dust producing physically attached fight, seemingly with entangled feet, ensued in the dirt with the heavier Ash-throated Flycatcher in control. The Cliff Swallow detached and flew over my position leaving the Ash-throated Flycatcher standing on the ground. After about 3 sec the Ash-throated Flycatcher flew across the pond to the top of one of the larger honey mesquites (*Prosopis glandulosa*) adjacent to the SW side of the pond and perched on a limb ca. 4 m high.

About 20 min later a second Ash-throated Flycatcher flew above the perch and was chased by the resident Ash-throated Flycatcher with some contact to its wings and back, it then promptly re-perched on the same limb. This resident Ash-throated Flycatcher then attacked another Cliff Swallow which flew above the perch resulting in another physical aerial tussle of 1-2 sec. The Cliff Swallow escaped by separating from the Ash-throated Flycatcher and closed-wing falling toward the pond water, pulling out from the drop at the last instant. The Ash-throated Flycatcher again re-perched on the same high mesquite limb and almost immediately had a near contact chase of another conspecific. After ca. 0830, the resident Ash-throated Flycatcher flew at several Cliff Swallows, a third conspecific, and a Northern Mockingbird (*Mimus polyglottos*) flying above its perch, although none were continually chased or contacted. During this period, these flights at intruders resembled short loops away from and back to the perch. For the entire time, many Cliff Swallows flying low over the pond water were ignored. And at separate times from ca. 0850 through 0930, a pair of Common Grackles (*Quiscalus quiscula*), a male Cardinal (*Cardinalis cardinalis*), and two male Brown-headed Cowbirds (*Molothrus ater*) flew high into the pond area, perched in the same tall mesquite, and all were disregarded by the resident Ash-throated Flycatcher.

The honey mesquite that the Ash-throated Flycatcher was using as a perch is one of the largest mesquites surrounding the pond. It has a woodpecker hole that can be seen by binocular through dense foliage, although no birds of any species were seen entering or exiting the nearly concealed opening. The resident Ash-throated Flycatcher was almost certainly defending a nesting territory inclusive of the perching mesquite and pond. When the flycatcher was originally observed about an hour after the 0634 sunrise it was deemed to be very aggressive and this aggressiveness was moderated over time. Early in the morning, any bird flying high over its territory was regarded as a threat and it was physically attacked or aggressively chased, however Cliff Swallows flying low over the water were ignored. Whether these territorial behaviors indicate the solo protection of a nest cavity, initiation of the nest with a mate, nest and mate protection, and/or brood protection is not directly known. However, the resident Ash-throated Flycatcher territorial behaviors were most likely related to the defense of an active nest as the date of these observations correlates with both peak egg and brood activity for the species across its range (Cardiff and Dittmann 2002). And when the pond area was sporadically checked after sunrise over the next few weeks, several Ash-throated Flycatchers were observed flying around the mesquite, often holding insect prey, though no aggressive behaviors were observed despite a frequent influx of Cliff Swallows and other bird species.

Initial attacks by the resident Ash-throated Flycatcher were reactions to any bird flying through its nesting territory and continued until the intruder left or was forced from its defined territory. Behaviorally, the flycatcher indicated an innate response (Rylander 2002) that was triggered by the perceived threat from another bird flying above its perch position, however, birds flying below its perch did not trigger an attacking response. A similar behavior was described for Ash-throated Flycatchers in Arizona by Austin and Russell (1972) where flycatchers attacked eight male Cassin's Sparrows that were performing their upward song flights and a flying Cactus Wren that made an abrupt upward flight; all nine birds were forced to the ground. These attacks were speculated to be Ash-throated Flycatcher territorial responses to the specific upward and overhead flight behaviors of the intruders (Austin and Russell 1972), responses that are consistent with the behaviors described herein.

During the ca. 2 h period when the three separate physical attacks, the near contact chase of a conspecific, and multiple aggressive chases occurred, the resident Ash-throated Flycatcher was considered to be progressively less aggressive over time. By ca. 0930 it remained on the perch and watched intermittent groups of Cliff Swallows flying both below and above its position. The resident Ash-throated Flycatcher learned to moderate its response to the non-threatening over-flights and was conditioned to not waste energy flying at each individual bird that flies above its territory. The resident flycatcher became habituated (a diminished response to a harmless stimulus) to the recurring over-flights of birds across its nesting territory. For the Cliff Swallow, non-predatory interspecific interactions are predominantly related to the use, defense, and usurping of their nests (Brown et al. 2017), although during their studies of Cliff Swallows in Nebraska, they noted that both the Eastern Kingbird (*Tyrannus tyrannus*) and Western Kingbird (*T. verticalis*) often chased Cliff Swallows without an obvious reason and occasionally would drive a swallow to the ground.

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NOTES ON INCA DOVE IRIS COLOR AND AGEING

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The Inca Dove (*Columbina inca*) presents several unique challenges in determining age. Birds average darker in the southern part of the range (Pyle 1997). For example, Lower Rio Grande Valley birds are darker than those in San Antonio (Mary Gustafson 2010), confounding the use of feather characters to estimate age. Pneumaticization patterns are possibly useful for ageing, but more study is needed (Pyle 1997). Iris coloration appears one of the most accurate means to determine juvenal birds. Adult irises becomes bright red when the bird is excited (Chiasson and Ferris 1968, Chiasson et al. 1968). Reflecting pigment cells (iridophores) in the iris govern this color change. The amount of blood flowing through the iris controls the quality of the light that is reflected by these cells (Chiasson and Ferris 1968; Chiasson et al.1968). Young go through a series of iris color changes before developing a red iris (Johnson 1960).

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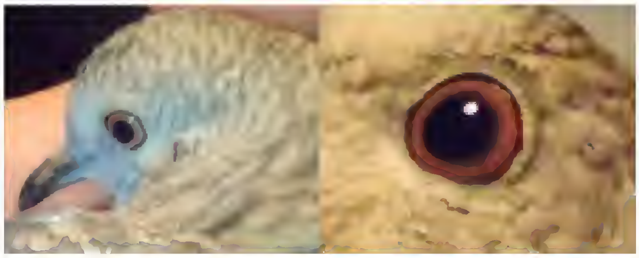

Figure 1 Brown iris of hatch year Inca dove.

Red iris of adult Inca Dove.

331 Inca Doves were banded from 2011 to 2016 in San Antonio as part of a long term study on the species' longevity and social behavior. Pyle (1997), reported young birds with gray irises, and Mueller (2004) with yellow irises. In contrast, I observed brown irises in all 21 specimens of young Inca Doves that I captured and banded.

If the Inca Dove iris changes like its relative *Columbina cruziana* recently hatched birds have a gray iris that turns to brown in 26 days (Eitniear 2006). It then progresses from brown to yellow, then orange and finally red. Brown eyed juvenile birds were captured from April until late November (Oberholser 1974 states breeding as late Feb. to late Dec.). This protracted breeding season (likely with multiple broods) means one could encounter juvenile Inca Doves 8-10 months of the year (Figure 2). Variation in the plumage coloration of Inca doves in addition to a protracted breeding season makes aging problematic. Use of various molt and plumage characters appear challenging but juvenile Inca Doves can be determined by having a brown iris. A plumbeous bill with a dark tip may also be a useful character for the youngest of birds (Oberholser 1974).

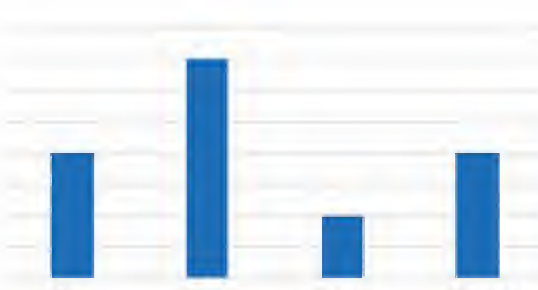

Figure 2 Months when brown eyed Inca Doves were captured (n=21).

In summary, molt and plumage characters appear unreliable, as currently described in the literature, for determining age. On the other hand, it is shown here that juvenile Inca Doves can be identified as such by their brown irises.

ACKNOWLEDGMENTS

Inca Doves in this study were captured and banded under Texas permit #SPR-0893-626 and Federal Bird Banding permit #22614. The paper benefited greatly by the comments of Kent Rylander, PhD.

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BOOK REVIEWS

GULLS OF THE WORLD: A PHOTOGRAPHIC GUIDE

Klaus Malling Olsen, Princeton University Press, 2018, Amazon $30.39

Because of their enormous variability and, in some species, proclivity for hybridization, gulls are often notoriously difficult to identify. Even the most experienced gull identification experts often cannot agree on the identity of odd gulls in photos circulated in online forums. Most birders eventually figure out how to identify the easier gulls and simply ignore the more confusing individuals, especially immatures, which are more variable than adults. However, a growing number of birders relish the challenge of identifying the more bewilderingly difficult gulls. Several websites and social media accounts are dedicated to discussions of gull identification.

In recent years two impressive books provided gull aficionados in North America with a massive (and perhaps overwhelming) arsenal of information for identifying gulls. The first, Gulls of North America, Europe, and Asia by Klaus Malling Olsen and Hans Larsson, was published by Princeton University Press in 2004. The second, A Reference Guide to Gulls of the Americas by Steve N. G. Howell and Jon Dunn, was published by Houghton Mifflin Company in 2007. Both of these books are huge, the first with 608 pages and the latter with 516 pages. In a new book, Gulls of the World: a Photographic Guide, Klaus Malling Olsen provides a comprehensive yet mercifully more concise identification guide to all the gulls of the world in only 368 pages.

The Introduction of the new guide succinctly describes the age classes and molts of gulls. As with his earlier book, Malling Olsen categorizes the age classes of gulls as "juvenile," "first-winter," "first-summer," "second-winter," etc., in contrast with the terms "first cycle," "second cycle," etc., used by Howell and Dunn (and many gull aficionados). Despite the different terms, birders readily get what is meant. The chapter subsequently addresses the problems of identifying gulls that are worn, molting, diseased, abnormally plumaged, oiled, and intermediate due to hybridization. Tips are provided for perceiving the subtle effects of light on coloration, understanding variation in soft part coloration, and judging the size and jizz of gulls.

The Introduction is followed by detailed accounts for 61 species of gulls. The taxonomy does not strictly follow the American Ornithological Society's (AOS) Checklist of North and Middle American Birds or the Handbook of Birds of the World. For example, the Iceland Gull (*Larus glaucoides glaucoides*) and Thayer's Gull (*L. g. thayeri*), which were recently lumped by the AOS, are treated as separate species, and the American Herring Gull (*L. argentatus smithsonianus*), which the AOS considers conspecific with a few Palearctic taxa of the Herring Gull (*Larus argentatus*), is considered a distinct species (*L. smithsonianus*). Each species account provides an identification summary and descriptions of each age group, vocalizations, molt, geographic variation, hybridization (if known), status, habitat, and distribution. Each account is also

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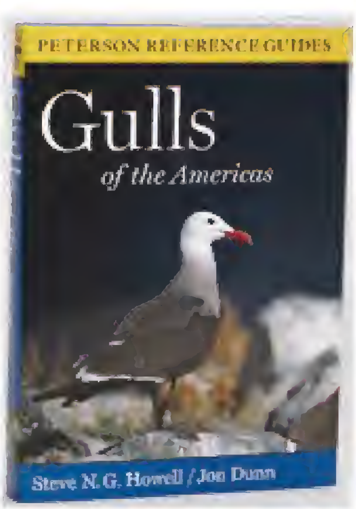
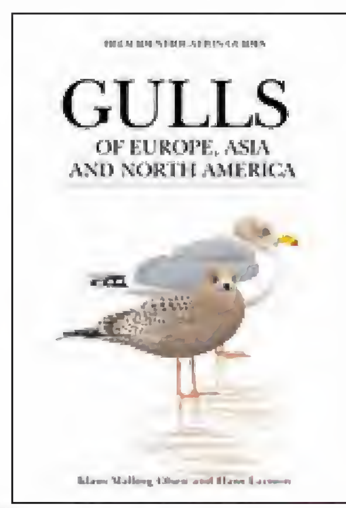
accompanied by a distributional map (or two) and many outstanding photographs illustrating different age classes. The extent of coverage varies greatly among the species, with as few as two pages and five photos of the Swallow-tailed Gull (*Creagrus furcatus*) and as many as 13 pages and 38 photos of the Herring Gull (*L. argentatus*). Justifiably more details are provided for 4-year species with more plumages and for species known to hybridize. Each species account ends with a list of author-year references, which are potentially useful for those seeking more information, but disappointingly the full references are not provided at the end of the book.

If you lack the previous two gull books and wish to know more about gull identification than what the standard field guides provide, this is just the book for you. The text is more concise and less repetitive than the earlier gull books, and the photos accurately depict the typical appearances of each species. The author deserves accolades for making gull identification easier for birders in this book. However, if you desire the most detailed information available in print for North American gulls, you will want to buy one or both of the previous two gull books.

Floyd E. Hayes,
Pacific Union College





Two impressive books providing gull aficionados in North America with a massive (and perhaps overwhelming) arsenal of information for identifying gulls.

BULLETIN OF THE TEXAS ORNITHOLOGICAL SOCIETY GUIDELINES FOR AUTHORS

SUBMISSION

For initial submission, e-mail one copy of the manuscript and photographs/illustrations[1] to jclintoneitniear@gmail.com or mail to Jack C. Eitniear, 218 Conway Drive, San Antonio, Texas 78209-1716. If you do not have access to the internet mail a DVD or CD containing a word processor version (MS WORD 2015 preferred or Apache Open Office 4.1) of the manuscript with all figures and tables, as separate documents

Submission Categories.—Manuscripts may be submitted as a Major Article or Short Communication. Major Articles generally are longer papers that are >5,000 character count including literature cited and figure captions, and excluding tables, figures, and spaces between characters. Manuscripts <5,000 characters in length including literature cited and figure captions, and excluding tables, figures, and spaces between characters will be considered Short Communications. Major articles must include an Abstract. The Editor may move a paper from one category to another at his discretion.

Multi-authored Submissions.—All authors should have contributed in a significant manner to designing and performing the research, writing the manuscript, and reading and approving the manuscript prior to submission.

Non-U.S. Submissions.—Authors whose native language is not English should ensure that colleagues fluent in English have critically reviewed their manuscript before submission.

GENERAL INSTRUCTIONS

(Carefully read and follow these instructions before submitting your manuscript. Papers that do not conform to these guidelines will be returned.)

Prepare manuscripts on 8.5 X 11 inch format with 1-inch margins. Double-space all text, including literature cited, figure captions, and tables. Insert page numbers top right beginning on the second page. Use a font size of at least 11 point. Consult a recent issue of the journal for correct format and style as you prepare your manuscript.

Write in the active voice whenever possible. Use U.S. English and spelling. Use *italics* instead of underlining (i. e., scientific names, third-level headings, and standard statistical symbols). Use Roman typeface (**not boldface**) throughout the manuscript.

Common and scientific names of bird species that occur in North and Middle America should follow the AOU *Check-list of North American Birds* (1998, 7th ed., and its supplements. Reference http://www.americanornithology.org/content/checklist-north-and-middle-american-birds. Names for other bird species should follow an appropriate standard (cite standard used). Use subspecific identification and list taxonomic authorities only when relevant. Give the scientific name at first mention of a species in the abstract and in the body of the paper. Capitalize common names of birds except when referred to as a group (i. e., Northern Cardinal, Golden-cheeked and Yellow warblers, vireos). <u>Do not</u> <u>italicize family names.</u>

The common names of other organisms are lower case except for proper names (i. e., yellow pine, Ashe juniper, Texas kangaroo rat).

Cite each figure and table in the text. Sequence tables and figures in the order cited. Use "figure" only outside of parentheses; otherwise, use "Fig." if singular, "Figs." if plural (i. e., Fig. 1, Figs. 2–3). To cite figures or tables from another work, write figure, fig., or table in lowercase (i. e., figure 2 in Jones 1980; Jones 1980:fig. 2; Jones 1987: table 5).

Use the following abbreviations: d (day), wk (week), mon (month), yr (year), sec (second), min (minute), h (hour); report temperature as °C (i. e., 15° C). In text months should be abbreviated (Jan, Feb, Mar, Apr, etc.) in figures and tables. Define and write out acronyms and abbreviations the first time they appear in text; abbreviate thereafter: "Second-year (SY) birds . . . We found SY birds in large numbers."

Present all measurements in metric units. Use continental dating (i. e., 15 August 2007), the 24-hour clock (i. e., 0500, 1230), and local standard time. Specify time as Standard Time (i. e., CST for Central

[1]Due to file restrictions by most e-mail systems we ask that you contact the editor regarding the best means to provide graphic support.

Standard Time) at first reference to time of day. **Study site location(s) should be identified by latitude and longitude.** Present latitude and longitude with one space between each element (i. e., 28° 07' N, 114° 31'W). If latitude and longitude are not available indicate the distance and direction from the nearest permanent location. Abbreviate and capitalize direction (i. e., north = N, southwest = SW, or 5 km W Abilene, Taylor County [but Taylor and Bexar counties]). Also capitalize regions such as South Texas or Southwest United States.

Numbers.—The conventions presented here revise what has often been called the "Scientific Number Style (SNS)". The SNS generally used words for 1-digit whole numbers (i.e., 9 = nine) and numerals for larger numbers (i.e., ten = 10), a distinction that may be confusing and arbitrary. The revised SNS treats numbers more consistently by extending the use of numerals to most single-digit whole numbers that were previously expressed as words. This style allows all quantities to be expressed in a single manner, and because numerals have greater visual distinctiveness than words, it increases the profile of quantities in running text. The objective of emphasizing quantity with numerals is further facilitated by the use of words for numbers appearing in a context that is only secondarily quantitative, i.e., when a number's quantitative function has been subordinated to an essentially nonquantitative meaning or the number is used idiomatically. In these cases, use words to express numbers (i.e., the sixty-four-dollar question). However, the numbers zero and one present additional challenges. For these numbers, applying consistent logic (numerals for quantities and words otherwise) often increases tedium in making decisions about correct usage and creates an inconsistent appearance, primarily because "one" has a variety of functions and readers might not quickly grasp the logic. For example, "one" can be used in ways in which quantity is irrelevant: as a personal pronoun or synonym for "you" (i.e., "one must never forget that") or as an indefinite pronoun ("this one is preferred"). The usage of the numeral in these cases would possibly be confusing to a reader. "Zero" and "one" are also used in ways that are more like figures of speech than precise quantifications (i.e., "in one or both of the ….", "in any one year", "a zero-tolerance policy"). In addition the numeral"1" can be easily confused with the letters "l" and "I", particularly in running text, and the value"0" can be confused with the letter "O" or "o" used to designate a variable. Therefore simplicity and consistent appearance have been given priority for these 2 numbers.

Cardinal Numbers.—quantitative elements in scientific writing are of paramount importance because they lead the way to the findings. Use numerals rather than words to express whole and decimal numbers in text tables and figures. This practice increases their visibility and distinctiveness and emphasizes their enumerative function.

2 hypotheses 5 birds 65 trees 0.5 mm 5 times 8 samples Also use numerals to designate mathematical relationships.

6:1 at 200X magnification 5-fold not five-fold

Use words in to represent numbers in 4 categories of exceptions:

(1) If a number begins a sentence, title, or heading, spell out the number or reword the sentence so the number appears elsewhere in the sentence.

Five eggs were in the nest, but the typical clutch size is 12. The nest contained 5 eggs, but the typical clutch size is 12.

(2) When 2 numbers are adjacent, spell out the first number and leave the second as a numeral or reword the sentence.

The sample area was divided into four 5 ha plots.

I divided my sample area into 4 plots containing 5 ha.

(3) For most general uses, spell out zero and one.

one of the species was one of the most important on the one hand values approaching zero one peak at 12-14 m, the other at 25-28 m.

However, express the whole numbers zero and one as numerals when they are directly connected to a unit of measure or a calculated value.

1 week 1 m a mean of 0 1-digit numbers when $z = 0$

Similarly, express zero and one as numerals when part of a series or closely linked to other numbers.

1 of 4 species between 0 and 5 of these, 4 samples were…1 sample was… and 8 samples

(4) When a number is used idiomatically or within a figure of speech.

the one and only reason a thousand and one possibilities comparing one to the other the two of them one or two of these an extra week or two of growth.

Ordinal Numbers

Ordinal numbers usually convey rank order, not quantity. Rather than expressing how many, ordinals often describe what, which, or sequence. Ordinals are more prose oriented than quantitative within the text and it is less important to express ordinal numbers as numerals.

(1) Spell out single-digit ordinals used as adjectives or adverbs.
the third chick hatched   first discovered   a third washings   for the seventh time

(2) The numeric form of 2-digit ordinals is less confusing, so express larger ordinals as numerals.
the 20th century   for a 15th time   the 10th replication   the 50th flock

(3) Express single digit ordinals numerically if in a series linked with double-digit ordinals.
The 5th, 6th, 10th, and 20th hypotheses were tested or We tested hypotheses 5, 6, 10, and 20

Zeros before Decimals.

For numbers less than 1.0, always use an initial zero before the decimal point.
0.05 not .05   P = 0.05 not P = .05

Numbers Combined with Units of Measure

(1) Use a single space to separate a number and a subsequent alphabetic symbol
235 g   1240 h   8 mm

(2) Generally close up a number and a non alphabetic symbol whether it precedes or follows the number. 45° for angles   45 °C for temperature   ±9   35±   <5 but P < 0.001

(3) Geographic coordinate designation for latitude and longitude have a space between each unit. 35º 44' 77" N

(4) If the number and associated symbol or unit start a sentence, spell out the number and associated factor. Twenty-five percent of nests

Numeric Ranges, Dimensions, Series, and Placement of Units

(1) When expressing a range of numbers in text, use the word to or through to connect the numbers. Alternatively, an en dash, which means to may be us3ed but only between 2 numbers that are not interrupted by words, mathematical operators, or symbols.
Yielded −0.3 to +1.2 differences not −0.3−+1.2 differences 5 July to 20 July or 5-20 July not 5 July-20 July 1-12 m not 1 m—12 m

(2) When the word from precedes a range, do not substitute the en dash for to. From 3 to 4 nests not from 3-4 nests

(3) The en dash represents only the word "to", when between precedes a range, use "and" between the numbers.
between 5 and 18 March not between 5-18 March

(4) When the range includes numbers of several digits, do not omit the leading digits from the second number in the range.
between 2001 and 2012 not between 2001 and 12 nor 2001-12   1587-1612 m not 1587-12 m

(5) A range of numbers and the accompanying unit can be expressed with a single unit symbol after the second number of the range, except when the symbol must be closed up to the number (i.e., percent symbol) or the unit symbol may be presented with both numbers of the range.
5 to 12 cm or 5 cm to 12 cm   5 to 10 °C or 5 °C to 10 °C   20% to 30% or 20-30% not 20 to 30%

(6) If a range begins a sentence, spell out the first number and present the second as a numeral; however if a nonalphabetic symbol (%), write out both units.
Twelve to 15 ha not twelve to fifteen ha   Ten percent to 20 percent of samples not Ten percent to 20% of samples

(7) To prevent misunderstanding, avoid using "by" before a range; this may imply an amount change from an original value, rather than a range of values. growth increased 0.5 to 0.8 g/d (a range) or growth increased 0.5-0.8 g/d not growth increased by 0.5-0.8 g/d

(8) To prevent a wrong conclusion by a reader, do not express 2 numbers preceded by words like "increase", "decrease", or "change". A range may be intended but the reader may conclude the first value as an initial value and the second as a new value.

increased from 2 cm/wk to 5 cm/ wk (Was the increase 2-5 cm or was the increase 3 cm?)
When changes are from one range to a new range, en dashes within each range is a better statement.
increased from 10-20 m to 15-30 m

(9) For dimensions, use a mathematical symbol (not a lower case "x") or the word "by" to separate the measurements.
5 X 10 X 20 cm   5 cm X 10 cm X 20 cm   5 by 10 by 20 cm

(10) For a series of numbers, present the unit after the last numeral only, except if the unit symbol must be set close to the number.
5, 8, 12, and 20 m   diameters of 6 and 8 mm   12%, 15%, and 25%   categories of <2, 2-4, and > 6 km

Descriptive Statistics

Variables are often reported in the text: the units and variability term should be unambiguous.
mean (SD) = 20% (2) or Mean of 20% (SD 2)   mean of 32 m (SD 5.3) not mean of 32 ± 5.3 m
mean of 5 g (SD ± 0.33)   mean (SE) = 25 m (0.24)

MANUSCRIPT

Assemble a manuscript for Major Articles in this sequence: title page, abstract, text (introduction, methods, results, and discussion), acknowledgments, literature cited, tables, figure captions, and figures. Short Communications need not be subdivided into sections (optional).

Title Page.—Put title in all caps for a Major Article and a Short Communication. Follow with author name(s) with the first letter of the first name, middle initial and last name as a cap and all other letters in lower case.

Addresses of author(s) should be in italics and arranged from first to last at the time of the study. The current address (if different from above) of each author (first to last), any special essential information (i. e., deceased), and the corresponding author and e-mail address should be in a footnote. Use two-letter postal codes (i. e., TX) for U.S. states and Canadian provinces. Spell out countries except USA. Consult a recent issue if in doubt.

Abstract.—Heading should be caps, indented, and followed by a period, three dashes, and the first sentence of the abstract (ABSTRACT.—Text . . .). Only Major Articles have an abstract.

Text.—Text, except for headings, should be left justified. Indent each paragraph with a 0.5-inch tab. Text should began immediately after the abstract.

Up to three levels of headings may be used. First level: centered, all caps (includes METHODS, RESULTS, DISCUSSION, ACKNOWLEDGMENTS, and LITERATURE CITED). There is no heading for the Introduction. Second level: flush left, indent, capitalize initial letter of significant words and italicize all words. Third level: flush left, indent, capitalize the initial letter of each word, followed by a period, three dashes, and then the text. *Keep headings to a minimum.* Major Articles typically contain all first-level headings. Short Communications may or may not have these headings, depending on the topic and length of paper. Typical headings under Methods may include "Study Area" and "Statistical Analyses." Consult a recent issue for examples.

METHOD—First level

Study Species, Locations, and Recordings—Second level

Study Species, Locations, and Recordings—Third level

Each reference cited in text must be listed in Literature Cited section and vice versa. The exception is unpublished materials, which occur only in the text. Cite literature in text as follows:

- One author: Jones (1989) or (Smith 1989).
- Two authors: Jones and Smith (1989) or (Jones and Smith 1989)
- Three or more authors: Smith et al. (1989) or (Smith et al. 1989)

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• Unpublished materials, including those in preparation, submitted, and in review:
  (1) By submitting author(s) use initials: (JTB unpubl. data), JTB (pers. obs.),
  (2) By non-submitting author(s): (J. T. Jones unpubl. data), (J. T. Jones and J. C. Smith pers. obs.), or J. T. Jones (pers. comm.). Do not use (J. T. Jones et al. unpubl. data); cite as (J. T. Jones unpubl. data).

• Within parentheses, order citations by date: (Jones 1989, Smith 1992, Franklin et al. 1996), (Franklin 1980; Jones 1983, 1990; Smith and Black 1984), (Delgado 1988a, b, c; Smith 2000).

• When citing a direct quote, insert the page number of the quote after the year: (Beck 1983:77).

Acknowledgments.—For individuals, use first, middle (initial) and last name (i. e., John T. Smith); abbreviate professional titles and institutions from individuals. Accepted manuscripts should acknowledge peer reviewers, if known. PLEASE INCLUDE COMPLETE FIRST NAME. THIS IS DIFFERENT THAN MOST JOURNALS

Literature Cited.—**Verify all entries against original sources,** especially journal titles, volume and page numbers, accents, diacritical marks, and spelling in languages other than English.

Cite references in alphabetical order by first, second, third, etc., authors' surnames and then by date. References by a single author precede multi-authored works by the same first author, regardless of date. List works by the same author(s) in chronological order, beginning with earliest date of publication. If a cited author has two works in same year, place in alphabetical order by first significant word in title; these works should be lettered consecutively (i. e., 2006a, 2006b). Write author names in upper case (i. e., SMITH, J. T. AND D. L. JONES, ...FRANKLIN, B. J., T. S. JEFFERSON, AND H. H. SMITH). Insert a period and space after each initial of an author's name.

Journal titles and place names should be written out in full and not abbreviated; do not use abbreviations for state, Editor, edition, number, Technical Coordinator, volume, version, but do abbreviate Incorporated (Inc.). Do not indicate the state in literature cited for books or technical papers or reports when the state is obvious (i. e., Texas A&M Press, College Station.). Do not add USA after states of the United States but indicate country for publications outside the United States. Cite papers from Current Ornithology, Studies in Avian Biology, and International Ornithological Congresses as journal articles. The following are examples of how article should be referenced in the Literature Cited section of a manuscript.

BIRDS OF NORTH AMERICA

(Hard copy version) GrzyBowski, J. a. 1995. Black-capped Vireo (*Vireo atricapillus*). The Birds of North America, No. 181.
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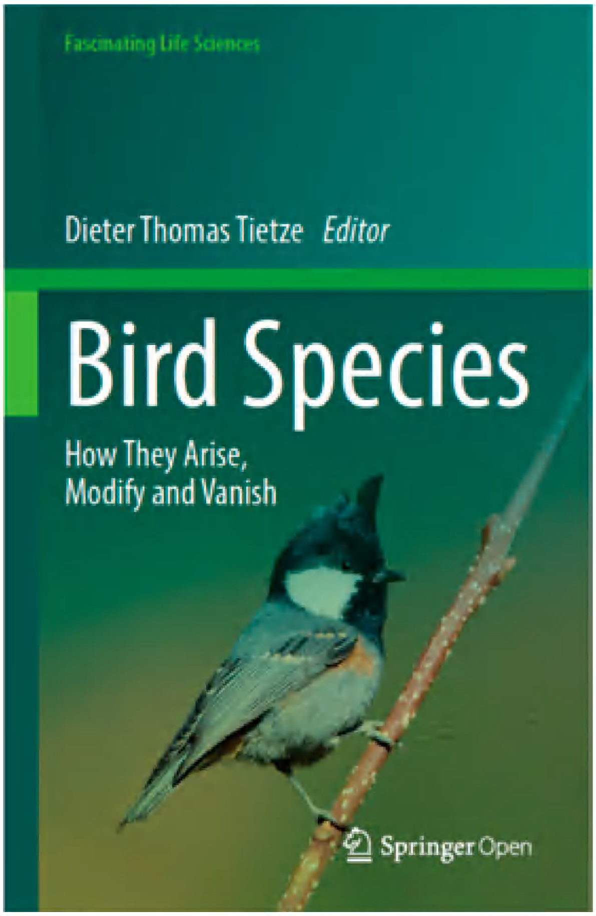

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Jill Morrow holding the pair of kestrels. Photo by Lance Morrow

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