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SPECIES RICHNESS, RELATIVE ABUNDANCE, AND HABITAT ASSOCIATIONS OF NOCTURNAL BIRDS ALONG THE RIO GRANDE IN SOUTHERN TEXAS

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ABSTRACT—The segment of the Rio Grande between International Falcon Reservoir and Del Rio, Texas (distance ca. 350 km), remains largely unexplored ornithologically. We surveyed nocturnal birds monthly during February–June 1998 at 19 stations along the Rio Grande (n = 6) and at upland stock ponds (n = 13) in Webb County, Texas. We conducted 10-min point counts (n = 89) after sunset and before moonset. Four species of owls and five species of nightjars were detected. Nightjars, as a group, were nearly five times more abundant (mean number/count = 2.63) than owls (mean number = 0.55). The most common owl, the great horned owl (*Bubo virginianus*), had a mean number of 0.25/point count. The mean for elf owls (*Micrathene whitneyi*) was 0.16/point count. The most common nightjars were the common poorwill (*Phalaenoptilus nuttallii*; 1.21/point count) and lesser nighthawk (*Chordeiles acutipennis*; 1.16/point count). Survey sites on the river supported more species (mean = 2.2) than did upland stock ponds (mean = 1.4). However, only one species (common pauraque, *Nyctidromus albicollis*) showed a preference for the river sites. Our results establish this segment of the Rio Grande in southern Texas as an area of high diversity of nightjars in the United States, matched (in numbers of species) only by southeastern Arizona and southwestern New Mexico.

RESUMEN—El segmento del río Grande/río Bravo entre el embalse internacional Falcón y Del Río, Texas (aproximadamente 350 km), permanece en gran parte inexplorado ornitológicamente. Monitoreamos aves nocturnas cada mes entre febrero y junio de 1998 en 19 estaciones a lo largo del río Bravo (n = 6) y en estanques artificiales de agua (n = 13) en el condado de Webb, Texas. Condujimos conteos de puntos de 10 min (n = 89) después de la puesta del sol y antes de la puesta de la luna. Se detectaron cuatro especies de búhos y cinco especies de tapacaminos. El grupo de tapacaminos resultó cinco veces más abundante (promedio de individuos/conteo = 2.63) que los búhos (promedio de individuos/conteo = 0.55). El búho más común, el búho cornudo (*Bubo virginianus*), tuvo una media de 0.25 individuos/conteo. La media para el búho enano (*Micrathene whitneyi*) fue de 0.16 individuos/conteo. Los tapacaminos más comunes fueron el tapacamino tevíi (*Phalaenoptilus nuttallii*; 1.21 individuos/conteo) y el chotacabra (*Chordeiles acutipennis*; 1.16 individuos/conteo). Los sitios de monitoreo a lo largo del río tuvieron más especies (media = 2.2) que los estanques artificiales (media = 1.4). Sin embargo, sólo una especie (el pauraque, *Nyctidromus albicollis*) mostró una preferencia por los sitios ribereños. Nuestros resultados establecen este segmento del río Grande en el sur de Texas como un área de alta diversidad de tapacaminos en los Estados Unidos, igualada (en número de especies) solamente por el sureste de Arizona y el suroeste de Nuevo México.

Southern Texas is known for its great diversity of birds. Efforts to protect and study the avifauna have focused on federal wildlife refuges, state lands, and preserves maintained by nongovernmental conservation organizations in the lower Rio Grande Valley, a region extending from the Gulf of Mexico inland to the International Falcon Reservoir. Even prior to establishment of refuges, most early scientific expeditions in southern Texas focused on the lower Rio Grande Valley and the coast (Dresser, 1865*a*, 1865*b*; Merrill, 1878; Sennett, 1878; Singley, 1893; Pearson, 1921). Butcher (1868) is the only early investigator who published a species list for the region upriver of the International Falcon Reservoir, where nearly all lands remain in private ownership. Consequently, with few exceptions (Oring, 1964; Arnold, 1980; Woodin et

al., 1999), distributions, abundances, and basic ecology of birds occurring in the region of the Rio Grande Valley between International Falcon Reservoir and Del Rio (distance ca. 350 km) remained little studied through the end of the 20th century.

Species richness in different riparian habitats was compared by Woodin et al. (2000). More recently, Woodin et al. (2007) documented overall avifaunal diversity and conservation needs for this segment of the Rio Grande. While these two publications included nocturnal birds, their treatment was brief. In fact, there are no published quantitative data for night birds along this part of the Rio Grande. The possible occurrences in the area of species with restricted distributions in the United States and with breeding ranges extending into much of Mexico, such as elf owls (*Micrathene whitneyi*) and ferruginous pygmy-owls (*Glaucidium brasilianum*), were of particular interest. Our objectives for this study were to determine which breeding and migrating species of owls and nightjars occur in northwestern Webb County, to determine relative abundances of species of owls and nightjars, and to determine use by these species of pond and river habitats.

Materials and Methods—The 28,000-ha Galvan Ranch (ranch headquarters at 28°03′N, 99°40′W), ca. 60 km upriver of Laredo, Webb County, Texas, occurs within the Tamaulipan Biotic Province (Blair, 1950) and the Tamaulipan Brushlands Bird Conservation Region (Rich et al., 2004). Webb County has mild winters, high daily mean temperatures in summer (regularly exceeding 43°C), and low mean annual rainfall (54.4 cm; Ramos and Plocheck, 1997). Ranges of temperate and tropical birds overlap in this region (Oberholser, 1974; Woodin et al., 2007), and many species of birds and plants are typical of western deserts.

The southwestern border (5.7 km in extent) of Galvan Ranch is the Rio Grande, with a narrow riparian corridor composed mostly of giantreed (*Arundo donax*), with smaller patches of common reed (*Phragmites australis*). Reed habitat was bordered by mid-height grasses, especially buffelgrass (*Pennisetum ciliare*), interspersed with shrubs and scattered forbs. Open-canopy stands of mature trees, mostly honey mesquite (*Prosopis glandulosa*), black willow (*Salix nigra*), and sugar hackberry (*Celtis laevigata*), were present on the upland edge of the riparian corridor. Three canyons, one with flowing water during the study (Espada Creek), enter the Rio Grande in the southwestern portion of the ranch. Dominant vegetation within the canyons was mature mixed woodlands, including Mexican ash (*Fraxinus berlandieriana*), sugar hackberry, honey mesquite, and spiny hackberry (*Celtis ehrenbergiana*).

At the time of our study, there were 73 excavated stock ponds widely distributed throughout Galvan Ranch. The stock ponds were small, ca. 0.5–2.0 ha in size, depending upon rainfall. Dominant woody species at the stock ponds were honey mesquite, huisache (*Acacia farnesiana*), retama (*Parkinsonia aculeata*), and black willow. Uplands were dominated by native Tamaulipan thorn scrub composed of honey mesquite, blackbrush acacia (*Acacia rigidula*), whitebrush (*Aloysia gratissima*), purple sage (*Leucophyllum frutescens*), creosotebush (*Larrea tridentata*), guajillo (*Acacia berlandieri*), lotebush (*Ziziphus obtusifolia*), and Texas prickly pear (*Opuntia engelmannii*).

For sampling, we chose six locations along the Rio Grande and 13 stock ponds throughout the ranch. Only stock ponds associated with large trees or mature woods were selected as sampling stations, which were distributed widely across the ranch. Sampling stations (river and stock ponds) were ≥1.0 km apart. Due to small size of stock ponds, only one point-count station was located at any given pond. Stations were ≤100 m from dense woody vegetation that contained one or more trees with a diameter at breast height ≥30.5 cm. This requirement was based on known habitat associations of small, cavity-nesting owls in Texas (Mays, 1996; Proudfoot, 1996; Gamel, 1997). In 1998, we sampled at these stations for breeding or migrating owls and nightjars during 89 unlimited-distance point counts (Blondel et al., 1981): 4–5 February, 11–12 March, 8–9 April, 7–8 May, and 4–5 June. We began point counts after sunset and completed them over 1 night before the moon set (or before 0200 h). Point counts were conducted when the moon was full, or waxing between one-half and full phases (Cooper, 1981; Mills, 1986; Takats and Holroyd, 1997). The order in which stations were sampled was reversed from survey to survey so that given point counts were not always conducted at the same relative time after sunset. We conducted no point count in fog, high wind (>16 km/h), or rainfall heavier than a mist (Robbins, 1981).

Point counts lasted for 10 min and were preceded by 1 min of observer silence. We chose 10 min for point counts (instead of 5 min) to increase accuracy of quantifying aural detections (Pardieck et al., 1996) and because of the possibility of encountering rare or tropical species (Karr, 1981). During the 10-min listening period, we noted any non-elicited, spontaneous calls. Any owls or nightjars seen during the point-count period also were noted. We counted all individuals for each species detected during a point count. We did not attempt to record distances or directions of bird calls because of limitations imposed by darkness and birds in flight; therefore, estimates of abundance in this report are not absolute measurements of densities.

After every point count, a 3-min prerecorded call of either an elf owl or ferruginous pygmy-owl was broadcast to elicit responses from these target species (Proudfoot and Beasom, 1996; Hardy and Morrison, 2000). This was done to locate these rare species in Webb County, not as a means for estimating abundances or densities of these species. We did not include calls of elf owls elicited by playback in estimates of abundance. To prevent suppression of spontaneous calls, recorded calls were never broadcast prior to a point count (Takats and Holroyd, 1997). We used a Johnny Stewart Wildlife Caller at a level of ca. 95

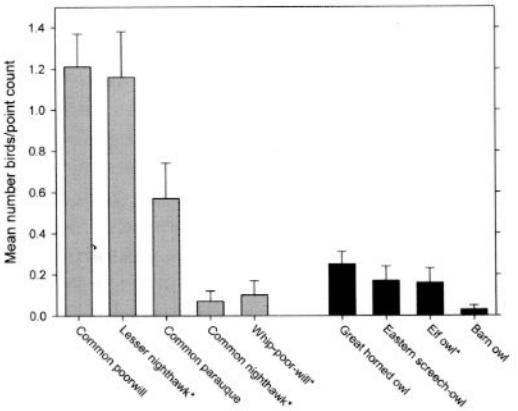

FIG. 1—Relative abundance (mean number/10-min point count; ±*SE*) of owls and nightjars on Galvan Ranch, Webb County, Texas. Means calculated from data collected February–June 1998, except for migratory species (*) for which calculations were based on 3 months.

decibels (measured at distance of 1 m). We listened for responses 3 min after broadcasting the calls. Prerecorded calls of the two species were alternated between sampling stations so that all stations received ≥2 broadcast calls of each during the study.

We calculated overall relative abundances of owls and nightjars on Galvan Ranch by averaging means of point-count results from each of the 19 sites. Estimates of relative abundance for elf owls, lesser nighthawks (*Chordeiles acutipennis*), and common nighthawks (*Chordeiles minor*) were calculated over the 3-month sampling period of April–June because these species are migratory and were present on Galvan Ranch only during that period. Estimates for whip-poor-wills (*Caprimulgus vociferus*) were based on the 3-month period March–May due to their presence as transient migrants during those months. We used *t*-tests to compare species richness of owls, species richness of nightjars, and total species richness between river and pond habitats.

We examined habitat preferences (river versus pond) of great horned owls (*Bubo virginianus*), eastern screech-owls (*Megascops asio*), elf owls, lesser nighthawks, common poorwills (*Phalaenoptilus nuttallii*), and common pauraques (*Nyctidromus albicollis*) by determining presence and absence for each species at each of the 19 sites (evaluated for each species using a two by two chi-square test). Statistical analyses were performed using version 8.2 of SAS (SAS Institute, Inc., Cary, North Carolina).

RESULTS—Four species of owls and five species of nightjars were detected on Galvan Ranch (Fig. 1). The most abundant species of night birds were common poorwills (mean = 1.21 birds/point count) and lesser nighthawks (mean = 1.16/point count). Nightjars, as a group, were almost five times more abundant (mean = 2.63/point count) than owls (mean = 0.55/point count). Among owls, the great horned owl occurred most often (mean = 0.25/point count).

Mean species richness of all night birds was 1.68 species/point count. River sites supported more species (mean = 2.24) than did upland stock ponds (mean = 1.43; $t = -4.05$, $P < 0.001$). Species richness for owls did not differ between river and pond habitats ($t = -0.43$, $P = 0.67$). Species richness of nightjars, however, was higher ($t = -3.85$, $P = 0.001$) in river habitats. Nightjars at river sites had a mean of 1.77 species/point count, and pond sites 1.03 species/point count (Table 1).

A preference for river habitats was detected for the common pauraque ($\chi^2 = 6.38$, $P = 0.012$). None of the other eight species of night birds showed differences in distribution between pond and river habitats ($P > 0.05$).

Ferruginous pygmy-owls were not detected at any time during the study. Elf owls, however, were at both river and pond stations, including locations in the northern section of the ranch, up to 37 km away from the Rio Grande. Mean abundance of elf owls was 0.16 birds/point count. We detected eight elf owls during point counts in April (six at river stations and two at stock pond stations), and one in June at a river station. We also detected elf owls outside of point counts (i.e., by random observation or when elf owls responded to broadcast calls) at both river and pond locations. Nine detections not on

TABLE 1—Species richness of night birds by habitat and species group during 10-min point counts in 1998 for Galvan Ranch, Webb County, Texas.

Habitat	Mean (*SE*)		
	Nightjars	Owls	All species
Pond ($n = 13$)	1.03 (0.09)	0.40 (0.09)	1.43 (0.07)
River ($n = 6$)	1.77 (0.21)	0.47 (0.13)	2.24 (0.26)
All sites ($n = 19$)	1.26 (0.12)	0.42 (0.07)	1.68 (0.13)

point counts occurred in April and three in June. No elf owl was detected in May.

Discussion—The nine species of night birds we documented (including two, the common pauraque and elf owl, with restricted ranges within the USA) was greater than in most other parts of the country. Only the region of southeastern Arizona and southwestern New Mexico supports as many species of nightjars (five). We were able to document this diverse assemblage of night birds despite suboptimal conditions in the study area during late spring–early summer 1998. Smoke from persistent wildfires in Mexico caused hazy atmospheric conditions beginning in May and continued for many weeks throughout the region. At times visibility was reduced markedly, which might have suppressed activity and calling by some night birds in response to low light conditions (Cooper, 1981; Mills, 1986; Morrell et al., 1991). Rainfall also was below normal, with Laredo receiving only 29 cm of precipitation during the 12-month period prior to surveys (National Oceanic and Atmospheric Administration, http://www.srh.noaa.gov/crp/climate/lrdf-6.html). Normal annual rainfall for Laredo is 54 cm (Ramos and Plocheck, 1997).

No previous result of comprehensive night bird surveys in the semiarid Southwest has been published. Surveys of owls have been reported for the northern USA and Canada (Francis and Bradstreet, 1997; Swengel and Swengel, 1997; Takats and Holroyd, 1997; Shuford and Fitton, 1998); however, species assemblages are notably different.

Single-year auditory surveys of owls are not reliable for estimating size of population because owls have a high variability of calling behavior, which depends on breeding status, but it also is cyclical, coinciding with fluctuations in populations of prey (Francis and Bradstreet, 1997; Swengel and Swengel, 1997). However, data on relative abundance (e.g., Fig. 1) are valuable for future comparisons in this understudied region and provide new information regarding distributions of breeding birds, especially for the elf owl.

Three of the four species of owls on Galvan Ranch (great horned owl, eastern screech-owl, and elf owl) prefer woodland habitat (Gehlbach, 1995; Houston et al., 1998; Henry and Gehlbach, 1999). The barn owl (*Tyto alba*) prefers open habitats (Marti, 1992), although it also can be found in forested habitats (Foster and Johnson, 1974). The barn owl was the least common owl on Galvan Ranch, perhaps because habitats there are primarily wooded (Tamaulipan thorn scrub and riparian woodland).

Occurrence of elf owls in Webb County may represent a range extension, because no prior record exists for that county. In the past, elf owls were believed to occur in Texas only in the Big Bend region and in the lower reaches of the Rio Grande Valley (Oberholser, 1974; McKinney, 1996; Gamel, 1997). Most elf owls at Galvan Ranch were heard on the upper portion of the Rio Grande, which features deep canyons that empty into the river. Elf owls in the northern section of the ranch occurred in mesquite thorn forest, although one was observed during each of the 2 months (April and June) using a woodpecker hole in an old utility pole. During April–June, there was a marked decrease in numbers of elf owls detected (13 in April, none in May, and 3 in June), which might have been a result of less calling in response to the smoky atmospheric conditions.

Eastern screech-owls and elf owls also occur in Hidalgo County in the lower Rio Grande Valley (Gehlbach, 1987; Gamel, 1997). There, however, they used different habitats. In Hidalgo County, eastern screech-owls have been detected in tall (>4 m), closed-canopy riparian forests dominated by the evergreen anaqua (*Ehretia anacua*) and Texas ebony (*Ebenopsis ebano*), with a dense understory, while elf owls preferred mesquite grasslands or open-canopy thorn forests with only moderately dense understories (Gehlbach, 1987; Gamel, 1997; Brush, 2005).

Lack of tall, closed-canopy evergreen forest along the Rio Grande in Webb County might reduce competition between these two species. In Hidalgo County, Gehlbach (1987) observed an eastern screech-owl defending the tall riparian habitat from a calling elf owl. The elf owl nested 400 m from the nearest eastern screech-owl nest. In contrast, we detected eastern screech-owls in all wooded areas, including low Tamaulipan thorn scrub. In fact, both species responded at the same stock pond after a recording of an elf owl was played.

Few surveys of nightjars are in the literature. Cooper (1981) reported relative abundance of whip-poor-wills and chuck-will's-widows (*Caprimulgus carolinensis*) in Georgia. Two or three species of nightjars are typical for most areas in the USA. Of the five species of nightjars on Galvan Ranch, common poorwills and lesser

nighthawks were detected most often. These also were the only nightjars documented to occur in Laredo 140 years ago (Butcher, 1868). Common poorwills and lesser nighthawks occurred throughout Galvan Ranch in all habitat types. Their presence in Webb County was not surprising; in fact, the only confirmed breeding record for common poorwills in southern Texas was in Webb County (Arnold, 1977; Texas breeding bird atlas, http://txtbba.tamu.edu/).

In contrast to lesser nighthawks, which occurred in all but two study sites, common nighthawks were only at two sites and in low numbers. These findings support the supposition that, in areas of range overlap of these closely related species, the lesser nighthawk out-competes the common nighthawk for habitat and food resources (Caccamise, 1974). Our recording of low numbers of common nighthawks is consistent with data from Breeding Bird Surveys, which indicate only 1–3 common nighthawks detected/route in the region upriver from the International Falcon Reservoir (United States Geological Survey, http://www.pwrc.usgs.gov/bbsapps/). There also are no confirmed breeding records in Webb County (Butcher, 1868; Texas breeding bird atlas, http://txtbba.tamu.edu/).

Numbers of lesser nighthawks were twice those of the common pauraque on Galvan Ranch. In the lower Rio Grande Valley during the late 19th century, Sennett (1878) estimated that lesser nighthawks were 10 times as abundant as common pauraques.

Whip-poor-wills were detected rarely during our study in Webb County. In southern Texas, they typically have been reported in spring (March–May; Hancock, 1887; Griscom and Crosby, 1926; Rappole and Blacklock, 1994) as migrants along the coast of the Gulf of Mexico. Evidently, a few migrated at least as far inland (>250 km) as northwestern Webb County.

Although no species of owl showed a preference for the river, abundance of common pauraques and species richness of nightjars were positively related to the Rio Grande. Our detection of a preference for river habitat by common pauraques is significant, because existing information for this species indicates woodlands, dense thickets, or scrub as primary habitat (Kaufman, 1996; Cleere, 1998; Brush, 2005), with only casual mention of use of riparian habitat (Foster and Johnson, 1974; Gehlbach, 1987; Latta and Howell, 1999; Lockwood and Freeman, 2004). On Galvan Ranch, riverine habitat featured more tall reeds, dense grasses, and forbs than stock-pond habitats, probably because river areas were not over-grazed in recent past years as were lands adjacent to stock ponds.

It is not surprising that species richness of night birds at Galvan Ranch was higher at river sites than at pond sites. Data on species richness from early morning surveys in 1997 on Galvan Ranch indicated that more species occurred along the Rio Grande, or at stock ponds ≤12 km away from the Rio Grande, than at stock ponds located >12 km away from the river (Woodin et al., 2000). Results in 1997 also showed that more tropical species occurred along the river than at ponds.

The river evidently was important to nightjars in the 1860s. Dresser (1865*a*:313) witnessed nightjars at dusk flying from the prairies to the river, "literally by thousands," near Brownsville. There were few human-made stock ponds in the 1860s, so the river was undoubtedly a vital source of water and insect prey to nightjars. Despite their almost global distribution, nightjars remain a generally understudied group (Cleere, 1998), and little is known about ecology of nightjars in southern Texas.

Our detection of five species of nightjars and four species of owls emphasizes the biological importance of the Rio Grande to nocturnal birds. Although Woodin et al. (2007) documented high numbers of species along the upper reaches of the Rio Grande (above the International Falcon Reservoir), the region's biodiversity is still largely unrecognized compared to that of the lower Rio Grande Valley.

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