Florida Field Naturalist 43(1):12-18, 2015.

BREEDING ECOLOGY OF THE FLORIDA NIGHTHAWK (*Chordeiles minor chapmani*)

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Abstract.—I collected observational data on breeding Florida Nighthawks (*Chordeiles minor chapmani*) at two sites in Florida. The number of nests and territories varied by year and site. I found nests in a greater percent of territories in oak scrub (73%, 11 nests in 15 territories) during two seasons (1990 and 1992) than in pine flatwoods (19%, 14 in 72) throughout a seven- year period (1992 - 1997). In oak scrub, 67% of nests fledged at least one young in 1990. In pine flatwoods, 25 – 100% of nests found each year fledged at least one young. Habitat composition was different for the two sites, but configuration was similar. At a larger scale, the oak-scrub site is a protected area in a rural setting whereas the pine-flatwoods site is public and bordered by suburban development.

The Common Nighthawk (*Chordeiles minor*) is a neotropical migratory bird that breeds in North America. These aerial insectivores nest in open areas with well-drained soils, depositing two eggs directly on bare ground (Bowles 1921, Gross 1940, Tomkins 1942). They may exhibit nest area fidelity (Gross 1931; Dexter 1952, 1956, 1961), or opportunistically use a variety of breeding sites. Reported nest sites include newly cleared areas (Sutherland 1963), gravel roofs in urban areas (Gross 1940, Dexter 1952, Armstrong 1965, Walbeck 1989, but see Brigham 1989), and recently burned areas (Poulin et al. 1996). Common Nighthawks vigorously defend breeding territories (Armstrong 1965, Caccamise 1974) suggesting that appropriate breeding space may be a limiting factor in the distribution and abundance of this species; however, data on nest-site characteristics and recruitment are meager (Poulin et al. 1996, Perkins and Vickery 2007). Herein I report data on habitat and nests of Florida Nighthawks (*C. m. chapmani*) from two sites in Florida, one oak-scrub habitat and one pine-flatwoods habitat.

Methods

Study sites.—Study sites were approximately 190 km apart. Both, Archbold Biological Station in south-central Florida (ABS; 27° 11' N, 81° 21' W) and the Lower Hillsborough Flood Detention Area in west-central Florida (LHFDA; 28° 07' N, 82° 22' W), were chosen as study cites because they were known for an abundance of nighthawks. I surveyed approximately 405 ha at ABS for Nighthawk territories and nests. Most of ABS habitat is well drained oak-scrub with ephemeral grassy ponds, sand (*Pinus clausa*) and slash (*P. elliottii*) pines in upland areas, and small stands of mixed bay-tree species in lower elevation, poorly drained areas. Prescribed burn cycles are part of the ABS management program for Florida Scrub Jays (*Aphelocoma coerulescens*) and lightning strikes occasionally ignite natural fires (ABS station records). The LHFDA is a multi-use area, combining water supply pumping stations, recreational areas and cypress wetlands interspersed with upland areas of saw palmetto (*Serenoa repens*) and fetterbush (*Lyonia* sp.) Cypress wetlands render nearly one-half of the 1536 ha of LHFDA surveyed inappropriate for Florida Nighthawk breeding, leaving about 700 ha of dry soils for nesting. Recreational areas of the park were enhanced over the course of the study (1992–1997) as the area became surrounded by suburban development (Delis et al. 1996). LHFDA was on a three-year burn rotation schedule subject to change if excessively dry conditions threatened maintenance of the cypress wetlands (Anthony Richards 1992, pers. comm.).

Field methods.—Observations were made at ABS most days from 25 May to 4 August, 1990 and, for two periods, 27 April to 2 May and 26 and 27 May, during 1992. Observations were made at LHFDA one to two times each week during May through August in 1992 and April to August from 1993 to 1997. Florida Nighthawk territories were identified from observations of male displays, including "peenting" calls and "booming" dives (Miller 1925, Rust 1947), along with chases of intruding nighthawks (Bender and Brigham 1998) 30 to 60 min before sunrise. I systematically searched for nests within an elliptical area indicated by the male's dives prior to cessation of morning activity. If a nighthawk flushed, I noted sex (presence or absence of the white tail bar of the male), then carefully searched for eggs, chicks, or egg shells. I placed surveyor's tape approximately 3 m from the nest site to facilitate nest monitoring. If I did not flush a nighthawk, I returned another day to repeat observations of male behavior, and searched a wider area. I monitored nests and territories (daily at ABS and twice a week at LHFDA) until I could no longer locate eggs or young. I measured or visually estimated vegetation height and percentage of substrate with no vegetation when there was no further activity at the nest-site.

I defined percent nest success by dividing the number of nests that fledged at least one young (left the nest area by 14 days post-hatch) by the total nests discovered. Determination of nest success may be confounded by the ability of the precocial chicks to move soon after hatching (Jackson 1985, Kramer and Chalfoun 2012), but I thoroughly searched the nest area for young that left the nest earlier than 14 days post-hatch.

Results

The male nighthawks indicated similar numbers of territories at both sites among years (Table 1). At ABS, I located nests in 75% (6 of 8, 1990) and 71% (5 of 7, 1992) of the territories I documented, whereas I found nests in 30% (4 nests each year, 13 and 12 territories, 1992, 1993) and 8% (1-2 nests each year in 12 territories, 1994-1997) of the territories at LHFDA. I found nests from pre-egg stage to fledgling stage at both sites (Fig. 1). Most nests at ABS were located in *Hypericum* dry ponds and *Quercus inopina* or *Lyonia* fields that had been burned within 5 years (N =11 nests, mean = 2.77 years post-burn). LHFDA nests were located in saw palmetto (*Serenoa repens*) or *Lyonia* fields. Vegetation height in the nest areas of both locations ranged from 1.5 m (saw palmetto or *Lyonia*),

Table 1. Density of territories in ABS and LHFDA was similar, but reproductive success per male territory-holder was greater at ABS than at LHFDA. ABS had 400 ha of usable area whereas LHFDA had 700 ha of usable area for plotting territory and nest density.

Year	Location	Territories	Territories per ha	Number of Nests	Nests per ha	% Success per Nest	% Success per Territory
1990	ABS	8	0.0198	6[a,d]	0.1500	67	50
1992	ABS	7	0.0173	5	0.1250	–[b]	–[b]
1992	LHFDA	13	0.0185	4[c]	0.0057	75	23
1993	LHFDA	12	0.0171	4[c]	0.0057	75	25
1994	LHFDA	12	0.0171	2[d]	0.0029	50	17
1995	LHFDA	12	0.0171	1	0.0014	100	8
1996	LHFDA	12	0.0171	1	0.0014	100	8
1997	LHFDA	12	0.0171	2[d]	0.0029	75	17

[a]Young or eggs missing prior to expected date
[b]Nests were not followed at ABS in 1992
[c]A predator killed the female at one nest, with eggs destroyed or abandoned
[d]Two nests were within the same nest area, a possible re-nest by the territorial pair
[d]One of two eggs broken or failed to hatch at one nest

to less than three centimeters for lichen and lower herbaceous growth. At ABS, nest-sites contained 30–90% bare sand (N = 7, mean = 67.9%, SE = 8.3); bare ground was less common at LHFDA comprising 5–70% of the nest-site area (N = 6, mean = 35.8%, SE = 12.7).

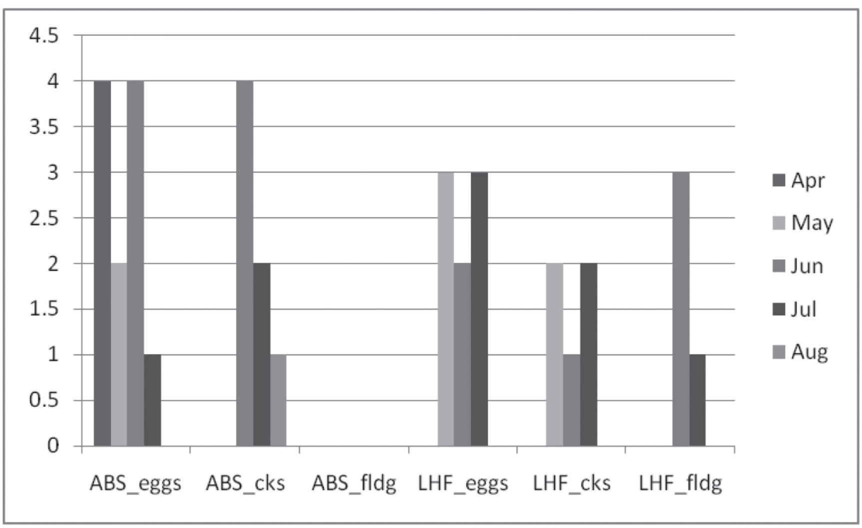

Figure 1. Frequency of eggs, chicks (cks), or fledglings (fldg) by month at Archbold Biological Station (ABS) and the Lower Hillsborough Flood Detention Area (LHF).

Nest success per nest located was similar for both locations; 67% in 1990 at ABS, and ranged from 50–75% among years at LHFDA (Table 1). At ABS, about 49% of the territories produced fledglings whereas percent of territories with successful nests at LHFDA ranged from 25% in the best years to 8% in the poorest years (Table 1). For nest success, 6 of 8 nests (67%) were successful at ABS in 1990, and 11 of 14 (79%) of nests found over all years at LHFDA were successful.

Documented nest failure included depredation of two incubating females at LHFDA with loss of nest contents; feathers of the females were still at the nest sites with the two eggs untouched in one case and crushed in the other. Feather placement and condition suggested predation by a mammal (G. E. Woolfenden, pers. comm.). There was also one case of egg abandonment. Most apparent failures stemmed from my inability to relocate young within the 14 day time span for expected fledging.

Discussion

Florida Nighthawks nested in open habitats with well drained soils at both locations. Territory density was similar for ABS and LHFDA (Table 1), but nests were found in a greater proportion of territories in oak-scrub than in pine-flatwoods habitats. Perkins and Vickery (2007) found that 6 of 14 nests (43%) of nighthawks fledged at least one nestling in dry prairie habitat in Florida, a percentage lower than the oak scrub (67%) or pine flatwoods (79% over all years) in my study. Although Perkins and Vickery (2007) had a large sample of nests (14), they did not report information on territories. Documentation of the number of territories in their study would have provided a base line with which to compare the apparent differences in territorial reproductive success I found between ABS and LHFDA.

Male Florida Nighthawks possibly prefer territories close to other males by social attraction (Fletcher 2007, Betts et al. 2008), but I could not determine if all males had mates (Gibbs and Faaborg 1990, Vickery et al. 1992, Larison et al. 2001). The observed difference in numbers of nests between the sites may be a function of detection probability (Vickery et al. 1992); territories are easily detected by male behavior, whereas females are cryptic and quiet (pers. obs.). Nest detection requires extensive searching (Martin and Geupel 1993) and is confounded by the mobility of newly hatched chicks (Bowles 1921, Sutherland 1963, Kramer and Chalfoun 2012) or possible movement of eggs by the female (Weller 1958, but see Jackson 1985). Flushing the female (Perkins and Vickery 2007) is common in locating nighthawk nests. Studies of grassland birds often describe several surveyors walking parallel to each other and dragging a line over the habitat (Kantrud and Higgins 1992, Ribic et al. 2012). These methods are likely better for nest detection than a single observer working alone. I followed a procedure similar to Rust (1947) in watching male dives, then searching for a nest. During the 36 years of his study, he reported 24 sets of 2 eggs and 3 sets with only 1 egg. It was unclear if 27 was the total number of nests located over the years. There can be numerous causes for avian nest failure. Parks (1946) mentions non-viable eggs as a source of nest failure, but I noted only two occurrences of hatching failure (ABS 1990, LHFDA 1997; Table 1). Exposure to extreme environmental conditions can affect both eggs (Ingels et al. 1984) and chicks (Gross 1931, Dexter 1952, Berry and Bibby 1981); there was no evidence of weather-induced loss in this study.

The loss of adult females at LHFDA, along with the contents of their nests, may be a concern (Gibbs and Faaborg 1990, Reidy et al. 2009). Ground nesting birds are vulnerable to predators (Kantrud and Higgins 1992). For instance, Webb et al. (2012) found that direct predation of female Greater Sage-grouse (*Centrocercus urophasianus*) accounted for 13.6% of nest loss and Devries et al. (2003) reported 50% of female Mallards (*Anas platyrhynchos*) were depredated during nesting. Wang et al. (1995) documented loss of 3 adult Common Poorwills (*Phalaenoptilus nuttallii*), a female and 2 males, by apparent predation. Rust (1947) found the carcass of a dead female Common Nighthawk indicated by dives of the male over the area. The female had apparently been dead for several days. In my study, I discovered the nests with eggs prior to the depredation events; one 7 days earlier, and the other 13 days earlier. No male attended the dead females, but in 1992 the male had indicated the nest, and in 1993, the male and female were flushed from the ground the week prior to discovery of the nest.

Micro-habitat and vegetation configuration were similar at the two sites even though vegetation composition was different. There were also differences on a landscape scale. Florida Nighthawks used areas of palmetto or *Lyonia* fields that were interspersed among the cypress domes and slash pine forests at LHFDA whereas ABS had a greater diversity of open habitat types. ABS is a protected area in a rural setting; in contrast, LHFDA is bordered by suburban development on the north, south, and west sides (Delis et al 1996).

More information on recruitment and habitat use by Common Nighthawks is needed. Of the studies of Common Nighthawks (e.g., Rust 1947, Selander 1951, Sutherland 1963, Fisher et al. 2004), to my knowledge only one study (Perkins and Vickery 2007) reported reproductive success on a relatively large scale. Basic biology of this widely distributed species warrants further understanding for management options as habitat is increasingly altered for human needs.

ACKNOWLEDGMENTS

I thank R. L. Curry, J. W. Fitzpatrick, and the late G. E. Woolfenden for providing access to ABS, the Southwest Florida Water Management District Land Resources Department for access to LHFDA, and Aaron Roth for constructive suggestions that improved the manuscript.

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