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NESTING ECOLOGY OF RESIDENT LOGGERHEAD SHRIKES IN SOUTHCENTRAL FLORIDA

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ABSTRACT.—I studied the reproductive ecology of Loggerhead Shrikes (*Lanius ludovicianus*) in southcentral Florida from 1991 through 1993. Pairs were sedentary and defended territories year-round. Completed nests were found from late December to mid-May. Nesting peaked during mid-March with second and third nestings attempted from late March to late May. Sixty percent of all nests were built in blackberry bushes (*Rubus betulifolius*), but cabbage palm (*Sabal palmetto*) and wax myrtle (*Myrica cerifera*) also were used frequently. Mean nest height was 1.6 m and mean clutch size was 4.3 eggs. A mean of 17 days was required for incubation and the mean fledging period was 15 days. Nest failure occurred more often during the incubation than the nestling stage. The majority of nest losses were due to predation and inclement weather (49 and 20 nests, respectively). Mean hatching success was 87%, and 81% of chicks fledged successfully. Nesting success (percentage of nests that fledged at least one young) was 55%, and an analysis of other studies that used this measure detected significant clinal variation in Loggerhead Shrike nesting success, with success rate positively correlated with latitude. Unlike conspecifics in northern latitudes where second broods are considered rare, 96% of breeding pairs in Florida attempted second broods. *Received 17 Jul. 2000, accepted 20 Aug. 2001.*

The Loggerhead Shrike (*Lanius ludovicianus*) is an important indicator of environmental quality and degradation because of its exclusively predatory feeding habits and close association with agricultural areas (Hands et al. 1989). This shrike has undergone a steady decline in numbers during the past century (Hess 1910, Graber et al. 1973, Morrison 1981, Robbins et al. 1986) and has been of special concern to conservationists for at least three decades (Arbib 1972, Hands et al. 1989, Yosef 1996). Although many factors have been implicated in the decline, the common conclusion of most studies, mostly of migratory subspecies, has been that recruitment of new individuals into the breeding population is not sufficient to offset the population mortality rate (Busbee 1977; Anderson and Duzan 1978; Kridelbaugh 1982; Bystrak 1983; Brooks and Temple 1990a, 1990b; Hands et al. 1989; Lymn and Temple 1991; Cade and Woods 1997; M.D. Cadman, unpubl. data). Loss of foraging habitat and modern agricultural practices also are considered to be important factors that have contributed to the decline. In contrast, the nesting ecology of a resident population of Loggerhead Shrikes remains relatively unstudied. Here, I describe the nesting ecology of a resident Loggerhead Shrike population in southcentral Florida.

METHODS

During 1991 through 1993 I studied Loggerhead Shrike nesting behavior and ecology at the MacArthur Agro-ecology Research Center (MAERC; 27° 05′ N, 81° 10′ W; mean elevation 11 m) of the Archbold Biological Station, Highlands County, southcentral Florida. MAERC is a 4200-ha working cattle ranch, nearly equidistant from the Atlantic and Gulf of Mexico coasts, and has extensive pastures. All shrike pairs that I studied were sedentary and defended their territories year-round. Barbed wire fences enclosed the pastures. Cabbage palm (*Sabal palmetto*), live oak (*Quercus virginianus*), wax myrtle (*Myrcus cerifera*) and a few other species of trees and shrubs grew along the fencelines, creating linear habitats that were used by shrikes for nesting territories. Blackberry (*Rubus betulifolius*) shrubs also grew dispersed in the pastures.

Snelling (1968) and Nol and Brooks (1982) found that human visits to shrike nests attracted predators. Therefore, I visited all nests at equal frequencies (every third day). During each visit, the nest was checked to determine the stage of the reproductive cycle (nest building, egg laying, incubation, hatching, nestling, fledging). I also recorded the height of the nest above ground and the species of tree or shrub in which the nest was built. I calculated nesting success (percentage of pairs that fledged at least one young), hatching success (percentage of eggs laid that hatched), and fledging success (percentage of young hatched that fledged) for the three breeding seasons.

Many potential nest predators, such as Audubon's Crested Caracara (*Polyborus plancus cheriway*; Yosef and Yosef 1992), raccoon (*Procyon lotor*), indigo snake (*Drymarchon corais*), and yellow rat snake (*Elaphe obsoleta*), occurred on the study site and were either observed at nest sites or in the vicinity. I searched

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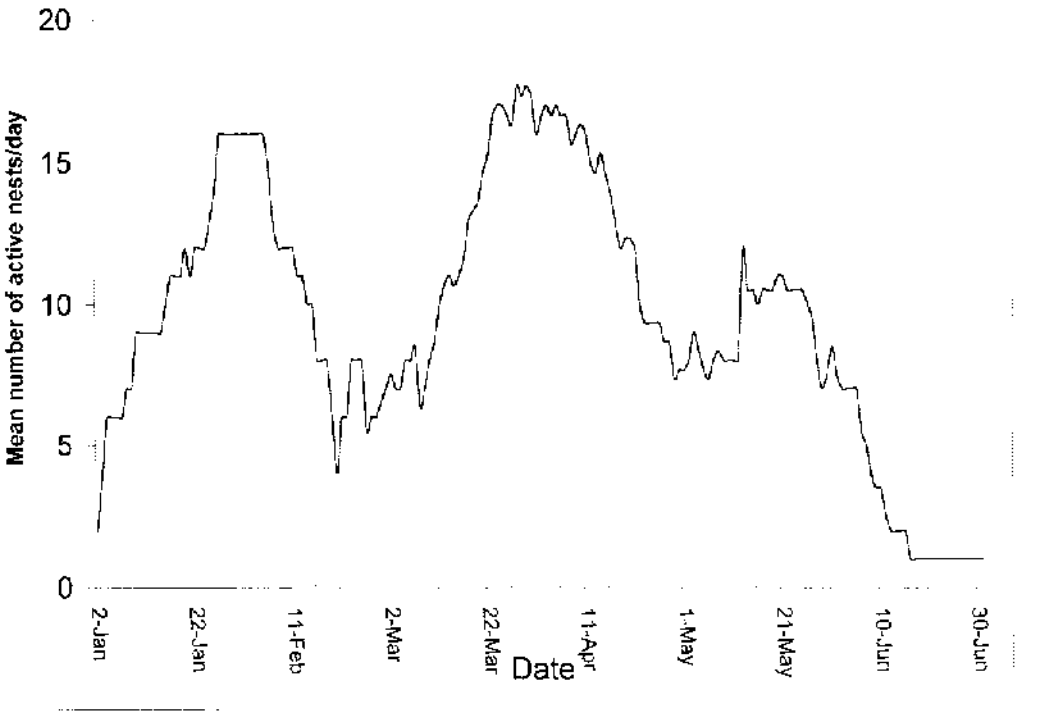

FIG. 1. Mean number of active nests per day as an index of seasonal reproductive activity of Loggerhead Shrikes in southcentral Florida for the 1991–1993 breeding seasons.

the vicinity of depredated nests for signs of the predator such as scats. Because predation was not observed directly in most cases of clutch or brood disappearance, I ascribed predation to mammals if the nest structure was damaged, and to avian or reptilian predators if the nest was intact and only the contents were missing.

RESULTS

The main breeding season was from mid-February to mid-June, although exceptional pairs were observed to initiate nesting during early January (Fig. 1). However, because some pairs nested in quick succession, or early failing pairs initiated second clutches before later pairs initiated first ones, date of clutch initiation did not consistently distinguish among first, second, or subsequent clutches in this population. Over three seasons one peak of breeding activity occurred between 27 January and 4 February and another between 20 March and 11 April. A third, smaller peak of activity was observed during the latter half of May and included mostly replacement clutches or subsequent breeding attempts. The breeding period extended over 24 weeks and usually ended before the onset of the summer rains in July. Twenty-three pairs were observed during each of the 1991 and 1993 breeding seasons, and 27 pairs during the 1992 season (Table 1). The 1992 season was cut short when most of the nests were destroyed following the spraying of the nesting bushes and the territories with the fertilizer sodium ammonium nitrate by ranchers (Yosef and Deyrup 1998). These pairs were not included in the productivity analyses.

During the three years, the first nest was initiated between 2 January and 9 March, and the last successful brood fledged between 8 June and 2 July (Table 1). A total of 152 nesting attempts were observed, of which 39 (26%) were renestings after a previous clutch was lost and 40 (26%) were second clutches laid after the first brood had successfully fledged; 96% of all pairs attempted second broods. Forty-nine (32%) nests were lost to predation, including 29 where raccoon scats were found, and 20 (13%) failed because of strong winds or rain storms. Clutch size ranged from 2–6 eggs. A total of 527 eggs

Florida reflect the fluctuation in reproductive success among years (Table 1). The major factors contributing to these fluctuations were mostly natural events such as predation or inclement weather. However, an anthropogenic disturbance (spraying of fertilizer) during this study demonstrated how important these effects can be on the population (Yosef and Deyrup 1998).

Nest failure occurred more often during the incubation than the nestling stage. Many more nests failed due to predation than to inclement weather (63 versus 20). Predation rates in other studies have been as high as 54% in Idaho (Woods 1995a), 79% in Illinois (Collins 1996), and 93% (Poole 1992) and 95% in Washington (Pruitt 2000). Evidence suggests that raccoons were the most common predator of shrike nests in this study area.

Shrikes nested in blackberry bushes that grew naturally in pastures even though they had access to fenceline vegetation in their territories. The placement of the majority of nests in blackberry bushes in the middle of pastures, away from fenceline vegetation, suggests that a conservation strategy for this species should include allowing volunteer shrubs and trees to grow in open pastures. Previous recommendations have been made for the enhancement of roadside grass strips and hedgerows for use by nesting birds (Joselyn et al. 1968, Leedy 1975, Warner et al. 1987, Lymn and Temple 1991, Warner 1992). Changes in agricultural practices (e.g., an increase in field size as a result of modern mechanization, and the application of pesticides) and the subsequent loss of grasslands and hedgerows (Mohlis 1974, Møller 1983) lead to greater breeding densities of species that use fencerows for nest sites; densities may be 10–30 times greater along fencerows than in more natural breeding habitat (Basore et al. 1986, Bryan 1990).

The use of such linear habitats has been documented for several passerine species (Basore et al. 1986, Bryan 1990), including Loggerhead Shrikes (DeGeus 1990, Yosef 1994). Luukkonen (1987) and Burton and Whitehead (1990) found that shrikes nested closer to roadsides than expected by chance. Further, the productivity of roadside pairs in one study was only half that of pairs breeding in other habitats, and most losses were attributed to nest predation (Ricklefs 1969). DeGeus (1990) suggested that linear habitats attracted birds to areas where predation limited production to levels below those needed for replacement, and considered this to have contributed to the decline of shrikes in the Midwest. This hypothesis is consistent with that of Yosef (1994), who found that predation resulted in a decrease in fitness levels of corridor-nesting Loggerhead Shrikes.

Renestings, following either previous success or failure, typically involved building a new nest within a few hundred meters of the previous attempt. On several occasions I observed the breeding pair dismantle an old nest and incorporate the materials into the new nest. No pair used the nest of another species, as described by Woods and Cade (1996; Black-billed Magpie, *Pica pica*) or built a new nest on top of an old nest.

Mean nest height in this study (1.6 m) was related to the choice of nesting substrate (blackberry shrubs). Similarly, Woods and Cade (1996) found that mean nest height was <1 m in Idaho where the mean height of the nest bushes in sagebrush-scrub habitat was <2 m. The wide range of nest heights reported for Loggerhead Shrikes probably reflects the heights of shrubs or trees present in those breeding areas, e.g., means of 2.2 m in Colorado (Porter et al. 1975), 3.0 m in Oklahoma (Tyler 1994), 3.2 m in Missouri (Kridelbaugh 1982), and 3.7 m in Illinois (Collins 1996).

Reproductive success of the Loggerhead Shrikes in this study was highly variable among years. The mean reproduction rate of 4.5 young fledged per successful nest was similar to that of other studies, which ranged from 1.1 in Manitoba (De Smet 1993) and 2.0 in Alberta (Collister 1994) to 5.4 in Colorado (Porter et al. 1975). The low reproduction rates in Manitoba and Alberta probably were due to those areas being located at the northern edge of the species range, where shrikes are exposed to harsher extremes of weather (Collister 1994). However, comparison of reproduction rates among studies should be made with caution because of variation in how productivity parameters were measured (Pruitt 2000). Indeed, a comparison of success rates limited to those studies which measured success as in this study (percentage of nests that fledged at least one young) detected a trend

TABLE 1. Reproductive parameters of Loggerhead Shrikes nesting in southcentral Florida during the 1991–1993 breeding seasons.

Variable	Year		
	1991	1992	1993
Productivity			
Number of breeding pairs	23	27	23
Total nesting attempts	49	64	39
Renesting following failure	5	22	12
Renesting following success	21	15	4
Clutch size (mean ± SD)	4.8 ± 0.4	3.8 ± 0.8	4.3 ± 1.0
(range, *n*)	4–5, 49	2–5, 64	2–6, 39
Incubation period (mean days)	19.2	14.9	16.8
Brooding period (mean days)	14.5	15.7	15.2
Number of eggs laid	240	123	164
Number of eggs hatched	200	113	141
(% of laid)	83.3	91.9	85.8
Number of young fledged	161	89	119
(% of hatched)	80.5	78.8	82.6
Young fledged/successful nest (mean)	5.8	3.2	4.4
Young fledged/pair/season (mean)	7.0	3.3	5.0
First egg laid	9 Mar.	19 Feb.	2 Jan.
Last brood fledged	2 Jul.	18 Jun.	8 Jun.
Number of nests lost to			
Mammalian predators	5	21	3
Avian/reptilian predators	4	9	7
Inclement weather	12	6	2

were laid during the three seasons, of which 457 (87%) hatched and 367 (81% of those hatched) fledged. The overall probability that an egg laid would result in a fledged young was 70%. Overall nesting success (percentage of nests to fledge at least one young) was 55%. An analysis of other studies that used this measure of nesting success detected significant clinal variation, with success rate positively correlated with latitude (Table 2).

TABLE 2. Nest success (percentage of nests to fledge at least one young) in Loggerhead Shrikes is positively correlated to latitude: $r_s = 0.728$, $P = 0.026$.

Location	Latitude (°N)	Nest success	Source
Minnesota	45	74	Brooks and Temple 1990a
Idaho	43	61	Woods 1995b
Colorado	40	66	Porter et al. 1975
Missouri	39	69	Kridelbaugh 1982
Virginia	38	68	Luukkonen 1987
S. Carolina	35	65	Gawlik and Bildstein 1990
California	33	51	Scott and Morrison 1990
Alabama	33	43	Siegel 1980
Florida	27	55	Present study

Loggerhead Shrikes nested earlier in the year than most sympatric passerines and both parents cooperated in the building of the nest structure, which took about a week to build. The nest usually was well hidden just below the crown of the tree or bush, in the crotch of two branches or in the foliage on a large branch. Nests were bulky, made of rootlets, twigs, forbs, and bark strips woven together. The inside cup was lined with soft material that included annual flowers, grasses, feathers, fur of presumably road-killed mammals, or artifacts such as string or cloth.

The majority (60%) of the 152 nests were in blackberry bushes. Nests also were located in cabbage palm (22%), live oak (11%), wax myrtle (5%), and southern elderberry (*Sambucus canadensis*; 2%). Mean nest height was 1.6 m ± 0.7 SD. Sixty-three percent of the nests located in blackberry bushes that grew naturally in pastures were away from fencelines (27 m ± 6.1 SD).

DISCUSSION

The results of the 1991–1993 breeding seasons in a resident population in southcentral

toward highest, not lowest, success in the north (Table 2).

While there is general agreement that loss and degradation of breeding habitat are important factors in the decline of Loggerhead Shrike populations (Pruitt 2000), other factors also may limit shrike populations. One such area for future research is winter survivorship for both migratory and resident populations.

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