Productivity of loggerhead shrikes nesting in an urban interface

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Abstract

Loggerhead shrikes (*Lanius ludovicianus*) are predatory songbirds that were once common across most of North America. A precipitous decline of loggerhead shrikes in recent years has often been associated with habitat degradation and alteration. Loggerhead shrikes are typically an open country species, and there have been no documentation or descriptions of productivity and habitat use by the species in urban environments. We monitored the productivity and characterized nesting habitat of an urban population of loggerhead shrikes in the city of Tucson, Arizona during the breeding seasons of 1997 and 1998. We documented nesting activity by 23 of 27 shrike pairs in 1997 and by 26 of 35 shrike pairs in 1998. Territory re-occupancy was high (72%) between the 2 years. Loggerhead shrikes in Tucson tended to nest earlier than reported elsewhere, with a mean estimated hatch date of April 20, and earliest hatch date of March 30. There was no difference between years in clutch size ($P = 0.313$) or brood size ($P = 0.196$). Nor was there a difference between years in fledglings per successful nest ($P = 0.439$), but the number of fledglings per nesting attempt was greater in 1997 than 1998 ($P = 0.002$). Nest success estimations using the Mayfield method indicated nest success rates of 82% in 1997 and 59% in 1998, with an average of 64%. The between year difference was probably due to nesting failures caused by several days of unseasonable heavy rain in 1998. Overall, 84% of loggerhead shrike pairs fledged young. Loggerhead shrike clutches were within, but at the lower end of, the size range reported for the species in other areas, whereas the number of fledglings produced fell midway through the range reported for the species in other studies. On average, 35% (4.5 ha) of an urban nesting shrike's territory was occupied by residential and commercial structures. Land cover consisting of low growing exotic or native vegetation and bare ground occurred in almost equal proportions among shrike territories, but areas with creosote or lawns/mowed grass were seldom present in shrike territories. The presence of buildings and human activities did not appear to prevent loggerhead shrikes from nesting if sufficient open areas were also present; we found active nests in school playgrounds, residential front yards, and parking lots. If loggerhead shrikes are left unmolested and sufficient open areas are maintained within the urban environment, the species may persist as part of the urban avian community.

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INTRODUCTION

Loggerhead shrikes (*Lanius ludovicianus*) were once common across most of North America (Yosef and Grubb 1992), but have experienced a precipitous decline in recent years (Morrison 1981, Butcher and Lowe 1990, Yosef and Lohrer 1995). Loggerhead shrike habitat is typically described as grassland, pastureland, and other open areas (Yosef 1996) and documented population declines of loggerhead shrikes have been associated with habitat degradation and alteration (Burton 1990; Smith and Kruse 1992; Telfer 1992; Yosef 1996). At the continental level, the decline of loggerhead shrikes is estimated as 2.9% annually from 1966-93 (Peterjohn and Sauer 1995).

Although loggerhead shrikes are sometimes found in areas with residential housing (Smith and Kruse 1992), localized populations have been displaced by urban development (Yosef 1996). Urbanization also may present mortality factors that shrikes do not experience under normal conditions. For example, the poor flying ability of fledglings (Morrison et al. 1995) makes them especially susceptible to cat (*Felis domesticus*) predation during the first several weeks after leaving the nest (Gawlik and Bildstein 1990; Scott and Morrison 1990).

The reproductive performance of loggerhead shrikes has been described in many regions, but there is no information available for Arizona. Further, there has been no documentation of productivity for the species in urban environments. We monitored the productivity of an urban population of loggerhead shrikes in the City of Tucson, Arizona, during the breeding seasons of 1997 and 1998, and characterized land cover types within their nesting habitat.

STUDY AREA

The study area was located in the southern section of the Tucson metropolitan area (est. population 800,000), Arizona. Specifically, the study area was bordered by Mission Road on the west, Valencia Road on the south, Kolb road on the east, and 22nd/ Golf Links Road on the north. The study area encompassed approximately 11,400 ha, and was composed of open spaces (e.g. vacant lots, undeveloped land, parks) interspersed among areas developed for industrial, commercial, and low to high-density residential uses.

METHODS

Surveys

Loggerhead shrikes typically hunt from elevated perches such as power lines and tall shrubs (Bohall-Wood 1987; Luukkonen 1987) and may be located by visually scanning an area while walking, bicycling, or by periodically stopping and scanning during vehicle surveys (Brooks and Temple 1986, 1990). We surveyed the study area for loggerhead shrikes by walking or bicycling through open areas (e.g. fields, parks) and driving through residential areas adjacent to open spaces ^{3}0.16 ha (e.g. vacant lots, drainage canals). Once we detected a loggerhead shrike, we located nests by searching trees in the vicinity or by observing the shrikes until they approached a nest. We recorded the location of each loggerhead shrike nest that we found and plotted the location on a study area map.

Productivity

We checked nests at least twice a week during the nesting season to determine stage of the nesting cycle and timing of fledging or nesting failure. When possible, we examined nest contents to determine clutch and brood sizes and estimate ages of nestlings. Dense vegetation (e.g. mistletoe, *Phoradendron sp.*) prevented visual inspection of some nests. We did not determine clutch sizes at these nests but estimated brood sizes by counting nestlings visible during feeding episodes. We considered nestlings to have fledged once they left the nest and defined a nest as successful if ^{3}1 nestling fledged. We also used Mayfield's method to provide an estimate of nesting success based on exposure days (Mayfield 1961, 1975). Fledgling loggerhead shrikes are secretive and inconspicuous (Yosef 1996) and can be difficult to locate. Thus, our estimates of fledgling numbers should be considered as conservative. We compared reproductive parameters between first and second nesting attempts and between years with Mann-Whitney rank sum tests (Sokal and Rohlf 1995). We provide means and standard errors for all measures.

Breeding Habitat

Estimates of shrike nesting territory size ranged from 3 - 25 ha (see review in Yosef 1996). Since no information is available for Arizona or urban areas, we characterized loggerhead shrike habitat at the territory level by measuring habitat variables within a 200 m radius (12.5 ha) of the nest (Novak 1995). The boundary of each area was delineated on 1995 aerial photographs (2.5 cm = 360 m) of the study area. We pooled land cover types into the categories of residential & commercial buildings (Var. 1), open areas dominated by exotic vegetation (Var. 2), open areas dominated by native vegetation (Var. 3), bare open areas (Var. 4), grasslands (Var. 5), and creosote (*Larrea tridentata*) flats (Var. 6). We estimated the percent cover of each category at nest territories by counting grid points overlaid on the aerial photographs, and verified the photographic interpretation of cover-types with ground-truthing.

RESULTS

Surveys

In 1997, we documented nesting activity by 21 of 25 pairs of shrikes in the study area. For analysis, we also included 2 pairs found in the urban landscape but outside the study area. In 1998, we documented nesting activity by 26 of 35 pairs of shrikes in the study area. The difference between years in the number of detected pairs is probably reflective of more complete survey coverage in 1998, rather than an increase in shrike pairs. Locations where shrike pairs were seen, but for which we could not determine nesting status, were primarily in areas of restricted access (e.g. private property, military installation). Loggerhead shrikes did not appear to be evenly distributed across the study area. The majority of pairs (72%) were nesting within approximately 2,300 ha on the west side of the study area. The nearest we found shrikes nesting to each other was 251 m.

Productivity

Of 25 territories occupied in 1997, 18 (72%) were re-occupied in 1998. Further, 54% of the 1997 nests were re-used by shrikes in 1998. Heavy, unseasonable rains related to the "El Niño" weather pattern may have caused several nesting failures in 1998. Six of 8 shrike pairs were able to fledge young on second, and in 1 case a third, nesting attempts. Additionally, 1 pair of loggerhead shrikes successfully reared 2 broods. The mean estimated hatch date for first nesting attempts in 1997 and 1998 was April 20, and the earliest hatch date was March 30.

There was a difference in clutch size between first ('x = 4.55 ± 0.31; n = 11) and second ('x = 5.75 ± 0.51; n = 4) attempts in 1998 (T = 46.5, P = 0.053), but there was no difference in clutch size between 1997 ('x = 4.57 ± 0.20) and 1998 clutches ('x = 4.87 ± 0.29) (T= 66.5, P = 0.313) (Table 1). Nor was there a difference in mean brood size between nests hatching young in 1997 ('x = 4.31 ± 0.22) and in 1998 ('x = 4.00 ± 0.22) (T = 325.5, P = 0.196). Overall, clutch sizes ranged from 3 - 6 eggs, with a mean of 4.77 ± 0.21 eggs, and brood sizes ranged from 3 - 6 nestlings, with a mean of 4.14 ± 0.15 nestlings (Table 1).

There was no difference in the number of young fledged from successful nests in 1997 ('x = 3.58 ± 0.28) and 1998 ('x = 3.24 ± 0.37) (T = 290.5, P = 0.439), but the number of fledglings per nesting attempt was greater in 1997 ('x = 3.24 ± 0.34) than 1998 ('x = 1.67 ± 0.31) (T = 743, P = 0.003) (Table 1). Although the number of fledglings produced per nesting pair of loggerhead shrikes appeared to be greater in 1997 ('x = 3.24 ± 0.34) than 1998 ('x = 2.29 ± 0.40), the difference was not statistically significant (T = 556.5, P = 0.089) (Table 1). Based on exposure days (Mayfield 1961, 1975) for all nesting attempts, nest success was estimated at 82% in 1997 and 59% in 1998, with an average of 64%.

Breeding Habitat

We evaluated proportions of different land cover types in 36 loggerhead shrike territories in the study area (Table 2). On average, 35% (4.5 ha) of an urban nesting shrike's territory was occupied by residential and commercial structures. Land cover consisting of exotic vegetation, native vegetation, and bare ground occurred in almost equal proportions among shrike territories (Table 2). Areas with creosote or manicured grass were seldom present in shrike territories. Although we did not compare use to availability, a preliminary analysis of shrike territories and random plots suggest these land cover types are not selected in proportion to their availability (Boal et al. 1999).

DISCUSSION

Loggerhead shrikes in Tucson tended to nest earlier than reported elsewhere (see Yosef 1996 for review). Shrikes in Tucson had clutches at the lower end of the size range reported for the species in other study areas (Yosef 1996), but were similar to shrike clutch sizes in Florida (Lohrer 1974; Yosef 1992) and Ontario (Peck and James 1987). Loggerhead shrikes exhibit a latitudinal and longitudinal cline in clutch size, with clutch sizes increasing from south to north and east to west (Collister 1994). Our study is in accord with the latitudinal aspect of the cline, but we expected to observe larger clutch sizes compared to eastern study areas at the similar latitudes.

The Mayfield method of estimating nest success (Mayfield 1961, 1975) indicated nesting success was substantially lower in 1998 than in 1997. We suspect this was due to a brief but intense period of heavy rain related to the El Niño phenomenon, which appeared to cause several shrike nests to fail shortly after clutch initiation. Still, many of the shrikes that initially failed were able to successfully re-nest. The proportion of loggerhead shrike pairs that fledged young in our study (84%) was similar to that reported in Idaho (76%; Woods 1995) and Minnesota (83%; Brooks and Temple 1990). Our estimate of fledglings per nesting attempt (2.25) and per breeding pair of shrikes (2.73) is midway through the range (0.95 - 4.6 fledglings/nesting attempt) reported for other studies (Yosef 1996). We are unable to identify what influence nesting in the urban interface may have had on shrike productivity because we did not monitor the species in non-urban areas.

It is apparently uncommon for shrike species to nest in urban areas, but some species do appear to be tolerant to some levels of urbanization. For example, Guerrieri et al. (1995) examined the influence of urbanization on the presence of 3 species of shrikes in Italy. While none of the species in their study tolerated high levels of urbanization, woodchat shrikes (*L. senator*) appeared to tolerate minimal levels of urbanization and red-backed shrikes (*L. collurio*) tolerated moderate levels of urbanization, but the lesser grey shrike (*L. minor*) was intolerant of even minimal levels of urbanization (Guerrieri et al. 1995). In a more extreme example, the long-tailed shrike (*L. schach*) was the 4th or 5th most common breeding bird in the city of Kabul, Afghanistan despite active persecution of both adult birds and nests (Galushin and Polozov 1998). Some loggerhead shrikes in our study appeared to be very tolerant of human presence. For example, shrikes at 2 territories nested £ 5 m from a regularly traveled walking & bicycling path, 2 pairs nested in parking lots, 1 pair nested in a school yard, 1 pair nested in a residential front yard, and 1 pair nested on a telephone pole adjacent to a large parking lot. It appears that if loggerhead shrikes are left unmolested in areas with sufficient open space within the urban environment, the species may persist as part of the urban avian community of Tucson.

An important question regarding urban shrikes is fledgling survival. Some researchers have suggested that predation by feral and free-roaming house cats may be a significant mortality factor among juvenile shrikes (Gawlik and Bildstein 1990; Scott and Morrison 1990). This threat may be minimized in Tucson; feral cats were uncommon in the study area where shrikes were present, possibly due to the presence of coyotes (*Canis latrans*). However, other predation threats were present, including gopher snakes (*Pituophis melanoleucus*), Cooper's hawks (*Accipiter cooperii*), burrowing owls (*Speotyto cunicularia*) and roadrunners (*Geococcyx californianus*). Although roadrunners have not been noted as a predator of loggerhead shrikes (Yosef 1996), we suspect they may be a substantial threat in our study area. We witnessed 4 distinct incidents in which both members of the shrike pair aggressively mobbed roadrunners that ventured near shrike nests. The level of aggression displayed by the loggerhead shrikes suggests they perceive roadrunners to be serious threats to their nests. The interactions between these two species may warrant a closer investigation to develop a more complete understanding of the ecology of avifaunal communities in urban interfaces of the Southwest.

ACKNOWLEDGMENTS

We sincerely appreciate the financial assistance provided by Tom Wootten and T&E, Inc. of Las Cruces, NM. Bill Shaw kindly provided us with aerial photographs of the study area. Finally, we thank the many residents and property managers , Tucson Arizona.

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Table 1. Productivity at loggerhead shrike nests in Tucson, Arizona, 1997-98.

	1997		1998		Both Years	
Variable	x	SE (*n*)	x	SE (*n*)	x	SE (*n*)
Clutch Size	4.57	0.20 (7)	4.87	0.29 (15)	4.77	0.21 (22)
Brood Size	4.31	0.22 (16)	4.00	0.22 (19)	4.14	0.15 (35)
Fledglings[1]	3.58	0.28 (19)	3.24	0.37 (17)	3.41	0.23 (36)
Fledglings[2]	3.24	0.34 (21)	1.67	0.31 (33)	2.28	0.26 (54)
Fledglings[3]	3.24	0.34 (21)	2.29	0.40 (24)	2.73	0.27 (45)

[1] Fledglings per successful nest.
[2] Fledglings per nesting attempt.
[3] Fledglings per pair of breeding shrikes.

Table 2. Composition of land cover types within 12.5 ha area around urban loggerhead shrike territories ($n = 36$) in Tucson, Arizona, 1997-98.

Variable	x	SE
Var. 1 (% Residential and commercial structures and activity)	35.80	3.39
Var. 2 (% Open area with exotic vegetation as ground cover)	18.51	2.51
Var. 3 (% Open area with primarily native vegetation as ground cover)	16.21	3.30
Var. 4 (% Open area without ground cover)	17.44	2.26
Var. 5 (% Open area with mowed/maintained grass as ground cover)	6.72	3.12
Var. 6 (% Creosote)	5.68	2.25
Var. 7 (% Combined categories of Var. 2, Var. 3, and Var. 4)	53.13	4.08