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NESTING HABITS OF THE LOGGERHEAD SHRIKE IN SAGEBRUSH[1]

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Abstract. The Loggerhead Shrike (*Lanius ludovicianus*) is a widely distributed member of Idaho's sagebrush (*Artemesia tridentata*) rangeland avifauna. During 1991–1993, we studied the breeding ecology and nesting locations of the species in this semi-arid habitat. Most loggerhead nests (65%) were constructed in sagebrush, although bitterbrush (*Purshia tridentata*) and greasewood (*Sarcobatus vermiculatus*) were also used frequently. Height of nest shrubs averaged 162 cm (range: 89–297 cm), and the mean height of nests was 79 cm (range: 33–160 cm). Nest variables we measured did not differentiate successful from unsuccessful nests. Significant differences, however, distinguished the three primary nest shrubs: sagebrush shrubs used for nesting tended to be smaller than bitterbrush or greasewood shrubs. Nonetheless, nest height was nearly identical regardless of shrub species, and nest success was independent of nest shrub. The low nesting heights for the loggerhead in this sagebrush-scrub habitat represent a notable departure from nesting heights in many parts of the species range, although they may be typical for the species where it occurs in the southwest. The preservation of Idaho's sagebrush rangelands will be important to the long-term survival of this species in the state.

Key words: Lanius; Artemesia; *nest success; nest height; shrub-steppe.*

INTRODUCTION

Shrikes (*Lanius* spp.) occupy a distinctive position in avian communities: they are passerines that prey upon reptiles, mammals, and other birds, as well as a wide array of invertebrates. The Loggerhead Shrike (*L. ludovicianus*), the smaller and more widespread of the two North American species, was relatively common across most of the continent early in this century (Miller 1931). In recent years, interest in the loggerhead shrike has increased as dramatic population declines have been noted in many geographic regions (Cade and Woods, unpubl.). Studies in the United States have focused on resident or migratory Loggerhead Shrike populations in the East (Siegel 1980, Milburn 1981, Luukkonen 1987, Gawlik 1988, Novak 1989), Midwest (Graber et al. 1974, Kridelbaugh 1982, Brooks 1988, Haas 1990), prairie states (Porter et al. 1975, Tyler 1992), and California (Craig 1978, Scott and Morrison 1990).

Fraser and Luukkonen (1986) speculated that, prior to European settlers, the Loggerhead Shrike may have been rare in the eastern United States and occurred in its highest numbers in brushlands and deserts of the southwest, habitats which are also found in Idaho, Oregon, and Washington. Supporting that contention, Jewett et al. (1953) and Gabrielson and Jewett (1940) found the loggerhead to be common in sagebrush habitat in eastern Oregon and Washington, respectively, early in the 1900s. Furthermore, early accounts of Idaho's avifauna indicate shrikes may also have been common here in the late 1800s and 1900s (Stearns 1930, Burleigh 1972). Southwestern loggerhead populations, however, have been largely unstudied, and the nesting habits of these shrikes are relatively unknown.

We studied ecological characteristics of Loggerhead Shrikes (*L. l. gambeli*) breeding in southwest Idaho's sagebrush (*Artemesia tridentata*) rangelands, and we report here on nesting habitats and nesting sites of the loggerhead in that semi-arid habitat during the 1991–1993 breeding seasons.

METHODS

This study was conducted primarily on three study sites on the Snake River Plain and along

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the north front of the Owyhee Mountains in southwest Idaho: Mayfield, Mudflat Road, and Wilson Creek (Woods 1994). The Mayfield site, centered 30 km southeast of Boise, included rangeland in both Ada and Elmore Counties, at 975 to 1,100 m in elevation. The Mudflat Road site, also in Owyhee County, followed Mudflat Road for 9.5 km. The site was centered 90 km south of Boise and rose from 900 to 1,225 m in elevation. Wilson Creek, in Owyhee County, is one of many intermittent streams draining the north front of the Owyhee Mountains. The Wilson Creek site, centered on the primary basin in that drainage, was 50 km southwest of Boise and at an elevation rising from 900 to 1,375 m.

Currently, southwest Idaho desert habitat is a mix of sagebrush, sometimes in large monotypic stands, with greasewood (*Sarcobatus vermiculatus*), bitterbrush (*Purshia tridentata*), saltbush (*Atriplex* spp.), and rabbitbrush (*Chrysothamnus* spp.) also occurring at lower elevations, and juniper (*Juniperus* sp.) and mountain mahogany (*Cercocarpus ledifolius*) in higher areas. Many of the native grasses have been replaced by exotics, the most prominent being cheatgrass (*Bromus tectorum*), which sometimes occurs in vast shrubless tracts. Vegetation on our three sites was principally sagebrush, greasewood, and bitterbrush, with cheatgrass being the most common of the grasses.

During the 1991 through 1993 breeding seasons, 162 shrike nests were located on or near the three study sites. As nests were located, chronology and success of each pair was determined by regular visits to the nest site. Subsequent to nest departure, we used a 2.4 m measuring rod to measure five nest and shrub variables at all nests: maximum shrub height, maximum shrub width, height of the nest's upper rim above the ground, distance from the nest's upper rim to the top of the shrub directly above the nest, and distance from the center of the nest to the shrub's nearest outer edge. We used multiple analysis of variance (MANOVA) and Tukey's tests (level of significance is $P = 0.05$) to identify differences in shrub structure and nest placement between the three primary nest shrubs, MANOVA to compare shrub characteristics between successful and failed nests, and a chi-square test to evaluate dependence of nest success on nest shrub. Pearson's correlation was used to determine whether changes in any variable were correlated with date of clutch initiation. In doing so, we corrected for differences in chronology between the three years by adding 11 days to all 1992 clutch initiation dates and 1 day to 1993 dates—the difference in median date of clutch initiation between each year and 1991. In instances where pairs renested, usually following initial nest failure, distance between initial and subsequent nests was measured with a 2.4 m measuring rod, and we used paired *t*-tests (preceded by a Shapiro-Wilk Normalcy test to verify normal distribution of data) to evaluate differences in nest placement between first and second nests. Note that few adult shrikes in our study were banded, and records of renesting were most frequently based upon behavioral observations which indicated a renesting effort, location of the second nest within the territorial boundaries of the nesting pair, and appropriate timing of clutch initiation for the second nest. All statistical analysis was performed using the SAS statistical package (SAS Institute 1985), and descriptive statistics are presented in the form: Mean ± SD units (*n*; range).

RESULTS

Of 162 nests, 106 (65.4%) were constructed in sagebrush, 33 (20.4%) in bitterbrush, 20 (12.3%) in greasewood, two (1.2%) in four-wing saltbush (*Atriplex canescens*), and one nest (0.6%) was found in a mound of wind-blown "tumbleweeds," or Russian Thistle (*Salsola kali*; Table 1). Nests were built within abandoned Black-billed Magpie (*Pica pica*) nests on six occasions (3.7%), and two nests (1.2%) were constructed on old shrike nests. Nests were often constructed relatively low to the ground; mean height of the nest shrub was 162 ± 41 cm (162; 89–297), its width averaged 231 ± 71 cm (158; 91–481) and the mean height of the nest was 79 ± 24 cm (162; 33–160; Table 1).

No nest variable differentiated successful from unsuccessful nests (Wilk's lambda $F_{5,139} = 1.11$, $P > 0.1$). Significant differences, however, distinguished the three primary nest shrubs (Wilk's lambda $F_{10,290} = 8.36$, $P < 0.001$). Sagebrush shrubs used for nesting tended to be lower in height than those of bitterbrush, and smaller in width than either bitterbrush or greasewood shrubs (Table 1). Also, nests in bitterbrush and greasewood shrubs were constructed more deeply within the shrub's interior, being farther from both the outer edge and the top of the shrub, than nests in sagebrush (Table 1). Nest height, however, was nearly identical regardless of shrub

TABLE 1. Characteristics of nests and nest shrubs used by Loggerhead Shrikes in southwest Idaho from 1991 through 1993. All measurements are in cm, and expressed as mean ± SD.

	n	Shrub height	Shrub width	Nest height	Nest to top	Nest to edge	% Nest success
Shrub[a]							
Sagebrush	106	151 ± 36[1]	202 ± 52[1]	80 ± 24[1]	52 ± 20[1]	38 ± 14[1]	59%
Greasewood	20	173 ± 30[1,2]	268 ± 49[2]	78 ± 18[1]	65 ± 13[2]	63 ± 20[2]	53%
Bitterbrush	33	190 ± 48[2]	283 ± 76[2]	79 ± 29[1]	68 ± 24[2]	61 ± 26[2]	59%
Total[b]	162	162 ± 41	231 ± 71	79 ± 24	57 ± 21	47 ± 22	59%
Outcome[c]							
Successful	89	166 ± 45	226 ± 76	82 ± 27	59 ± 23	47 ± 20	
Failed	63	157 ± 35	237 ± 68	76 ± 20	57 ± 20	49 ± 24	
Renest Difference[d]	26	−5 ± 48	14 ± 110	−16 ± 29*	4 ± 28	9 ± 27	

[a] Nest shrubs with significantly different means (Tukey's test; $P < 0.05$) are indicated by different superscripts.
[b] Includes two nests in four-wing saltbush and one in Russian thistle.
[c] MANOVA did not indicate a significant difference in any category ($P > 0.1$).
[d] All measurements presented as mean of first minus second nest measurement. Asterisk indicates measurement with a significant difference ($P < 0.05$) between first and second nests.

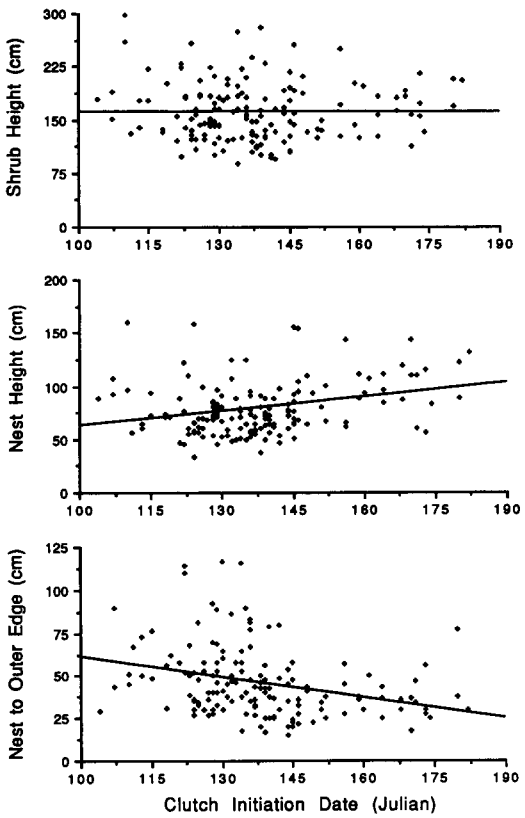

FIGURE 1. Relation between particular nest site variables and clutch initiation date in Loggerhead Shrike nests in southwest Idaho in 1991 through 1993. Date of clutch initiation was corrected by 11 days in 1992 and 1 day in 1993 so median lay dates were equal in all years.

species, and nest success, which varied from 53% to 59% among shrub species, was independent of nest shrub ($\chi^2_2 = 0.15$, $P > 0.1$). The size of the nest shrub did not vary with nesting date (shrub height: $r = -0.001$, $P > 0.1$; shrub width: $r = -0.143$, $P = 0.081$; Fig. 1). In contrast, nest height was positively correlated with clutch initiation date ($r = 0.289$, $P < 0.001$), while the distance from the nest to the top of the shrub above the nest, and the distance from the nest to the shrub's nearest outer edge, decreased as the breeding season progressed ($r = -0.187$, $P = 0.020$, and $r = -0.299$, $P < 0.001$, respectively; Fig. 1).

There were no significant differences in nest shrub height or width, distance to the top of the shrub, or minimum distance from nest to outer perimeter of shrub between first and second nest attempts ($P > 0.1$ in all cases; Table 1). Second nests were, however, significantly higher than first ones ($t_{25} = 2.78$, $P = 0.010$). Nearly all renests were found following initial failure; we found a second nesting attempt following successful breeding on only two occasions, once in 1991 and again in 1993. Shrikes constructed second nests, and initiated second clutches, more quickly than initial nest attempts. The period from initial nest construction to egg-laying in early nests was 13.1 ± 3.4 days (7; 9–18). In contrast, the mean time from first nest failure to second clutch initiation was only 8.8 ± 3.5 days (20; 3–18). Note that this time includes the selection of an alternative nest site, as well as construction

of the nest. Renests tended to be distant from previous nests, with the mean distance 149 ± 97 m (24; 43–380).

DISCUSSION

Many passerines may be rigid in their nest-construction behavior, but the willingness to nest on a variety of substrates is essential to take advantage of a wide range of potential breeding sites (Nickell 1958, Woods 1993). In general, shrikes in southwest Idaho tend to nest in shrubs 1 to 2 m in height, typically constructing the nest well within the shrub's interior. Nests in sagebrush were less well protected (i.e., closer to the outer edges of the shrub) than those in bitterbrush or greasewood, possibly owing to the larger size of the latter two shrubs, yet nesting success was independent of shrub species (Table 1). Furthermore, marked variation occurred in selection of the nest site. Shrike nests were built within the domed interior of abandoned Black-billed Magpie nests on six occasions, a habit which has been reported for the Loggerhead elsewhere (Porter et al. 1975). In addition, one shrike pair nested in a mound of wind-blown tumbleweeds which had become lodged against the base of a tree. Similarly, Siegel (1980) found a nest constructed in hardwood debris, and Bancroft (in Miller 1931) found shrikes nesting in tangled bailing wire. We also found two nests constructed on old shrike nests, as has been observed in other areas (Miller 1931, Siegel 1980).

Shrikes did not nest in trees on our sites during the 1991–1993 breeding seasons, although trees occurred sporadically in all three areas, and shrikes typically nest in trees elsewhere in their range. One shrike pair on the Mayfield site, however, constructed a nest 4.5 m above the ground in a 7.9 m tall Black Locust tree (*Robinia pseudoacacia*) in 1994, the year following the conclusion of this study. Furthermore, in the Raft River and Curlew Valleys in southeast Idaho, 350 km east of our study sites, we observed shrikes breeding in large windbreaks of Russian Olive (*Elaeagnus angustifolia*); two shrike nests we located there were 2.6 m above the ground in a 6.7 m tall Russian Olive and 1.3 m high in a 3.3 m tall tree (Woods 1994).

What factors influence a shrike to select a particular shrub, or location within a shrub, for nesting? The degree of cover provided by a nest tree or shrub has been identified as an important component of shrike nest site selection (Porter et al. 1975, Luukkonen 1987), but factors in addition to cover must determine the nest shrub selected by shrikes in Idaho. Greasewood shrubs provided superior cover to sagebrush owing to their densely interwoven and thorn-lined branches, yet only 8/13 nests occurring in stands of mixed sagebrush and greasewood were constructed in the greasewood. In addition, some nests were found in shrubs which outwardly appeared to be poorly suited for nesting, since the nests were very low to the ground or plainly visible 15 m or more from the shrub, and larger shrubs with greater cover were often available (see also Siegel 1980). Moreover, the general exclusion of trees from nesting suggests that these shrikes prefer nesting situations in which the substrate is unexceptional in comparison to nearby vegetation, rather than being emergent and somewhat isolated as are many of the trees in the vicinity of our study sites.

Shrikes sometimes construct second nests higher off the ground than first ones (Kridelbaugh 1982, Luukkonen 1987, but see Scott and Morrison 1990). In Idaho, shrikes which renested following failure constructed second nests significantly higher than first ones, though no other variables differed between first and second nests (Table 1). Yet, as breeding seasons progressed, shrikes generally tended to nest both higher off the ground and closer to the edge and top of nest shrubs (Fig. 1). Shrikes in other areas have shown similar seasonal shifts in nest placement. Nests in South Carolina were constructed higher from the ground, and farther from tree trunks, as the breeding season progressed (Gawlik and Bildstein 1990), and Scott and Morrison (1990) also found second nests to be shifted toward the outer edge of shrubs on San Clemente Island, California. Gawlik and Bildstein (1990) suggested shrikes may nest higher late in a breeding season in response to increased pressure from nest predators as breeding seasons progress and, were that the case, the outward shift in nest placement in our study could be an indirect result of greater nest height alone (because shrubs tended to be narrower near the top than in their middle). Alternatively, because temperatures increase as summer progresses, adult and/or nestling birds in hot climates may benefit from heat dissipation brought about by increased air circulation at nests which are higher and closer to the outer edges of nest shrubs. Rich (1980) suggested that Brewer's Sparrows (*Spizella breweri*) and Sage Thrashers

TABLE 2. Mean height of nests and nest trees/shrubs for the Loggerhead Shrike in Idaho and other states.

Location	Nest height (m)	Tree/ shrub height (m)	Reference
New York	1.8	4.3	Novak 1989
Virginia	3.7	6.8	Luukkonen 1987
S. Carolina	4.4	7.7	Gawlik 1988
Florida	3.4	—	Yosef, unpubl.
Alabama	3.0	—	Siegel 1980
Missouri	3.2	—	Kridelbaugh 1982
Colorado	2.0	—	Porter et al. 1975
Oklahoma	3.0	—	Tyler 1992
Idaho	0.8	1.6	This study
California[a]	2.1	3.8	Scott & Morrison 1990

[a] San Clemente Island.

(*Oreoscoptes montanus*) in eastern Idaho increase nest height during the breeding season to facilitate wind-cooled heat dissipation. Similarly, the Verdin (*Auriparus flaviceps*) shifts orientation of nest cavities during the breeding season, apparently to take advantage of western winds during the hottest portion of the summer, and Cactus Wrens (*Campylorhynchus brunneicapillus*) that oriented nests to permit cooling winds late in the breeding season were more successful than others (Austin 1974, 1976).

Overall, loggerheads in Idaho tend to be somewhat general in their selection of the nesting site itself; they nest in relatively nondescript shrubs encompassing a wide range of sizes, although nest height is less variable. Furthermore, owing to this wide range in shrub sizes, breeding territories usually contain many shrubs suitable for nesting. It would appear that variables other than nesting site, such as foraging perches (Yosef 1993, Woods, unpubl.), may be more important in defining appropriate shrike habitat in southwest Idaho's sagebrush-scrub. Additionally, we were unsuccessful in identifying any particular nest site attribute which distinguished successful from unsuccessful nests. Factors other than those measured may determine whether a breeding attempt is successful, but the choice of nest shrub, and location of the nest in the shrub, were unrelated to outcome of the nesting effort in our study. Our results are not unique (e.g., Luukkonen 1987), and the influence of stochastic factors, principally nest failure caused by predation or inclement weather, may reduce the importance of specific nest site characteristics in determining outcome of a nesting effort for shrikes in some areas.

The low nesting height of shrikes in southwest Idaho sagebrush-scrub habitat represents a notable departure from nesting heights for the species where it has been studied in other parts of its range (Table 2). In fact, the lowest nest we found, 33 cm high at its rim, is the lowest Loggerhead nest reported in any literature we are aware of (note that four young fledged from the nest). Additionally, shrubs used for nesting by shrikes in southwest Idaho are smaller than those usually considered the minimum suitable for nesting elsewhere (e.g., Scott and Morrison 1990, Prescott and Collister 1993). Importantly, however, Porter et al. (1975) reported shrikes in Colorado sometimes nest in saltbushes, and average nest height in those shrubs, 76 cm, is almost identical to that in Idaho. Thus, the low nesting heights which we observed may be generally representative of shrike nesting heights where they breed in the arid shrubland and desert regions of the West. Further research in these areas is necessary to clarify shrike nesting habits throughout the western states. Moreover, our results underscore the variation in nesting habits which can occur when a species occupies a variety of different habitats across its range.

It is appropriate to conclude with a brief assessment of the condition of the sagebrush rangelands on the Snake River Plain in southern Idaho. Currently, the loggerhead appears to be widely distributed throughout the southern portion of the state and often locally abundant where it occurs (Woods 1994). Prior to human settlement, vegetation on the Snake River Plain was probably dominated by plant communities characterized by a variety of sagebrushes and native bunchgrasses and forbs (Yenson 1980, Soil Conservation Service 1986). Indeed, one early traveler (Fremont 1843, in Vale 1975) wrote that the Snake River Plain was "... covered as far as could be seen with *Artemesia,* the dark and ugly appearance of this plain obtained for it the name of the 'Sage Desert.'"

Unfortunately, sagebrush habitat in southern Idaho is markedly less abundant now than in earlier times, owing to a long history of livestock grazing, man-caused fires, and more recent sagebrush eradication programs to convert rangelands to farmland or improve range quality for cattle (Braun et al. 1976, Yensen 1980, Woods 1994). Since a clear tie exists between shrike occurrence and the scrub rangelands which the species occupies, it is therefore reasonable to spec-

ulate that the loggerhead bred in the state prior to man's alteration of the plain, and that a contraction in both range and numbers has occurred as appropriate habitat has been lost. Furthermore, as Idaho's human population continues to grow, additional loss of sagebrush is likely. Habitat loss has been correlated with shrike declines elsewhere (Lymn and Temple 1991, Gawlik and Bildstein 1993, Prescott and Collister 1993), and an emphasis should be placed on preservation of Idaho's existing sagebrush-scrub desert to help maintain this shrike population in the future, especially as these shrikes appear to have a limited ability to occupy human-modified landscapes.

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