

THE RELATIONSHIP BETWEEN LAND-USE AND THE DISTRIBUTION AND ABUNDANCE OF LOGGERHEAD SHRIKES IN SOUTH-CENTRAL ILLINOIS

ERIC L. SMITH AND KIPP C. KRUSE¹

*Environmental Biology Program and the Zoology Department
Eastern Illinois University
Charleston, Illinois 61920 USA*

Abstract.—The abundance and distribution of the Loggerhead Shrike (*Lanius ludovicianus*) was estimated in 32 counties located in south-central Illinois on, or immediately adjacent to the “shrike extirpation line” of Graber et al. (1973). A total of 216 shrikes was observed in 22 of the 32 counties surveyed, of which only 13 (6%) were north of the extirpation line. Shrikes were most common near pastures, hedgerows, cornfields, and residential homes and their lawns. Regression analysis revealed that shrike abundance was positively correlated with the amount of pasture-hay meadows and covercrops, and negatively correlated with the amount of harvested cropland and woodland. Land-use practices appear to have influenced the distribution and abundance of the Loggerhead Shrike in Illinois.

LA RELACIÓN ENTRE EL USO DE TIERRAS, LA DISTRIBUCIÓN Y ABUNDANCIA DE INDIVIDUOS DE *LANIUS LUDOVICIANUS* EN LA PARTE SURCENTRAL DE ILLINOIS

Sinopsis.—La abundancia y distribución del alcudón *Lanius ludovicianus* fue estimada en 32 condados localizados en la parte surcentral de Illinois y/o en localidades inmediatas adyacentes a la “línea de extirpación” de Graber et al. (1973). Un total de 216 individuos fueron observados en 22 de los 32 condados estudiados, de los cuales 13 (6%) estaban al norte de la línea de extirpación. Las aves resultaron más comunes cerca de pastizales, setos vivos, campos de maíz y el césped de residencias. Un análisis de regresión mostró que la abundancia de estas aves estaba positivamente correlacionada con la cantidad de prados de heno y cobertura de siembras, y negativamente correlacionado con la cantidad de áreas de cultivos cosechadas y bosques. El uso de las tierras parece haber influido en la distribución y abundancia del alcudón en Illinois.

The Loggerhead Shrike (*Lanius ludovicianus*) once had a distribution extending from Nova Scotia to central Mexico and from the Atlantic to the Pacific Oceans (Bent 1950). Over the last several decades, however, shrike populations have declined at various rates throughout the species' range (Morrison 1981, Robbins et al. 1986). Consequently, in 1972 this species was placed on the National Audubon Society's “Blue List” of declining species (Tate 1986). The Loggerhead Shrike is listed as an endangered species in New York, Wisconsin and Michigan, and as a threatened species in other states, including Illinois.

Based on extensive work in Illinois, Graber et al. (1973) suggested that by 1965 the Loggerhead Shrike had been largely extirpated from the northern two-thirds of the state. Since that time, however, little information has been gathered on the distribution and abundance of this species in Illinois. Therefore, we decided to conduct a roadside survey in the south-central portion of the state. Approximately one-third of the

¹ Author to whom reprint requests should be sent.

counties that we surveyed were located immediately north of the "shrike extirpation line" (Graber et al. 1973) and the remaining counties were either located on (six counties) or immediately south (14 counties) of this line. Our investigation had two primary objectives: (1) to determine if the "extirpation line" of the early 1970s still represents the northern distributional boundary of contiguous Loggerhead Shrike populations in Illinois, and (2) to relate shrike abundance to land-use practices observed in the counties within the study area.

METHODS

We surveyed portions of 32 south-central Illinois counties (Fig. 1) for Loggerhead Shrikes between 28 Apr. and 30 Jul. 1990. We completed two 97-km roadside routes, one each in the northern and southern one-third of each county. Each route was driven at 45–60 km/h in an east-west direction. Routes consisted of lightly traveled secondary roads selected so that survey areas included a variety of land-use practices. Each route was started at sunrise or mid-afternoon (4–5 h before sunset) because these periods have been suggested to be the best time to observe shrikes in warmer climates (Telfer et al. 1989). The exact locations of all Loggerhead Shrikes were recorded on county maps. Using the location of each shrike, or the central location of several shrikes observed in the same immediate vicinity, as a central point, we recorded habitat types in a 25-ha circular area as either present or absent. Habitat types were then combined into the following land-use categories: (1) row crops (corn, soybean); (2) pasture (grazed and ungrazed); (3) hay meadows and small grains (hay crop, clover and other small grains, excluding winter wheat); (4) woodland (grazed and ungrazed); and (5) winter wheat. Habitat use by shrikes was then used to calculate preference indices based on the proportion of Loggerhead Shrikes that we observed using a particular category in comparison to availability of that category (U.S. Department of Commerce 1987). A preference index (PI) for each land-use category was calculated as $PI = b/a$, where b is the proportion of shrike observations associated with a particular category and a is the proportion of the total area represented by a particular category in the counties where shrikes were observed (Gysel and Lyon 1980).

We also used stepwise multiple regression techniques to determine if county land-use patterns were associated with the abundance of Loggerhead Shrikes. The number of shrike locations observed in each county served as the dependent variable so that counties surveyed in mid-late summer, after young had fledged, were not over represented. Independent variables (i.e., various land-use categories that could potentially affect shrike abundance) were obtained for each county from the Illinois Census of Agriculture (U.S. Department of Commerce 1987). These variables were converted into relative frequencies (% of county), and arcsin transformed (Scheffler 1979) before statistical analyses. Initially, 11 candidate independent variables were considered. In cases of highly correlated variables ($r > 0.75$), the intuitively less biologically relevant variable was

eliminated before the multiple regression was calculated. Seven independent variables ultimately remained in the multiple regression analyses.

RESULTS

We observed a total of 216 Loggerhead Shrikes in 120 separate locations during the course of this investigation (Fig. 1). Loggerhead Shrikes were observed in 22 of the 32 counties surveyed; with the addition of our records to those obtained from the Illinois Department of Conservation–Endangered Species Office, the Loggerhead Shrike has been documented in 43 Illinois counties (Fig. 1).

The relative abundance of Loggerhead Shrikes in the study area was quite variable (0–29 shrikes/county surveyed, Fig. 1). Seventy-five percent (163/216) of all of the shrikes were observed in nine southeastern counties (Clay, Clinton, Hamilton, Jefferson, Lawrence, Marion, Richland, Wayne and White).

Results of a two-way ANOVA (single observation per cell) suggested that counties varied significantly ($F_{31,29} = 3.61$, $P = 0.005$) with respect to the number of shrike locations, and that routes within counties were statistically indistinguishable ($F_{1,29} = 0.91$, $P = 0.35$).

We recorded shrikes in 13 general habitat types throughout the course of this investigation (Table 1). In sum, 272 habitat observations were made at the 120 shrike locations. Loggerhead Shrike locations most frequently contained ungrazed pasture, hedgerows, cornfields, and residential houses and buildings with well kept yards. All other habitats had relative frequencies of <10% (Table 1).

When these general habitat types were combined into more general categories, pasture and hay meadows-small grains had relatively large preference indices, suggesting that Loggerhead Shrikes prefer these areas in Illinois (Table 2). The preference index for winter wheat also indicated that this habitat was preferred. Row crops (corn and soybeans) and woodlands had preference ratings indicating that these areas were not preferred (Table 2).

A stepwise multiple regression analysis indicated that four of the seven independent variables (harvested cropland, total woodland, hay and alfalfa, and cover crops) were significant predictors of the number of shrike locations per county. Shrike locations per county were negatively related to the percent of each county in harvested cropland and total woodland but positively related to the percent of each county in hay and alfalfa,

→

FIGURE 1. The abundance of Loggerhead Shrikes in 32 central Illinois counties as determined by roadside censusing procedures conducted from 28 Apr.–30 Jul. 1990. The number on the left represents locations, the number on the right is the total number of shrikes observed. Inset map shows the location of the study area in Illinois. Also shown (below) is the distribution of the Loggerhead Shrike in Illinois. A diamond denotes counties where Loggerhead Shrike nests have been documented. Graber et al.'s (1973) "shrike extirpation line" is included on all maps.

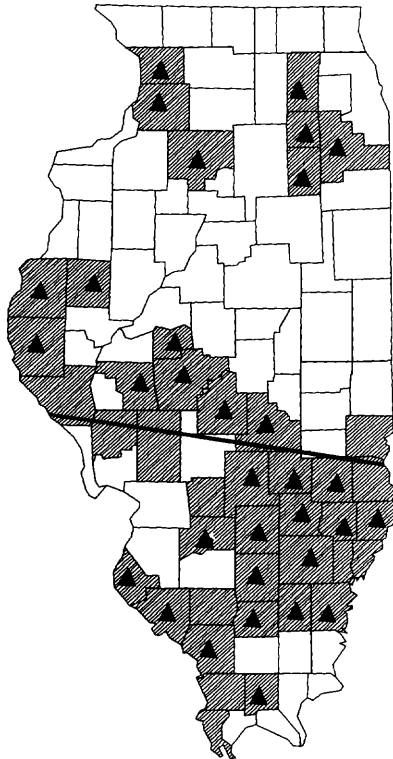
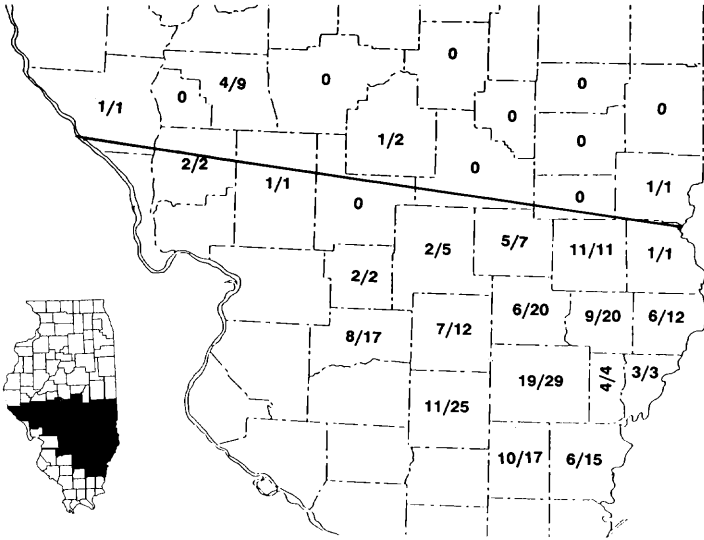


TABLE 1. Habitat types utilized by Loggerhead Shrikes observed in 32 south-central Illinois counties.¹

Habitat type	Percent utilized
Ungrazed pasture	15
Hedgerow	12
Corn field	11
Buildings-yards-lawn	11
Corn stubble	10
Winter wheat	9
Soybean field	8
Woodlot	5
Grazed pasture	4
Hay meadow	4
Prairie remnant	1
Clover field	1
Oat stubble	<1
Other	8

¹ Based on 120 shrike locations and 272 habitat observations. Generally more than one habitat type was recorded at each shrike location.

and cover crops (Fig. 2). According to the multiple regression, the Number of Shrike Locations = $22.41 - 0.61(\text{harvested cropland}) - 0.48(\text{total woodland}) + 0.91(\text{cover crops}) + 0.72(\text{hay and alfalfa})$ ($r^2 = 0.46$, $P < 0.01$).

DISCUSSION

Prior to the summer of 1990, Loggerhead Shrikes had been documented in 31 Illinois counties. As a result of our study, the shrike has now been documented in 43 counties. Although this 28% increase is encouraging, we agree with Graber et al. (1973) who stated that because the distribution of the Loggerhead Shrike in Illinois has never been accurately known, the absence of records in a number of counties may be the result of inadequate exploration rather than an actual absence of shrikes.

Graber et al. (1973) reported that Loggerhead Shrikes were all but extirpated from the northern two-thirds of Illinois by 1965. After spending approximately equal amounts of time in counties immediately north and

TABLE 2. Preference indices calculated from Loggerhead Shrike habitat observations. Indices >1.0 are preferred habitats (Gysel and Lyon 1980).

Habitat type	% of counties	% observed as shrike habitat	Preference index
Pasture	3.1	19.5	6.3
Hay meadow-small grains	2.5	4.8	1.9
Winter wheat	5.1	8.8	1.7
Woodlands	5.9	5.5	0.9
Soybeans-corn	47.6	29.8	0.6

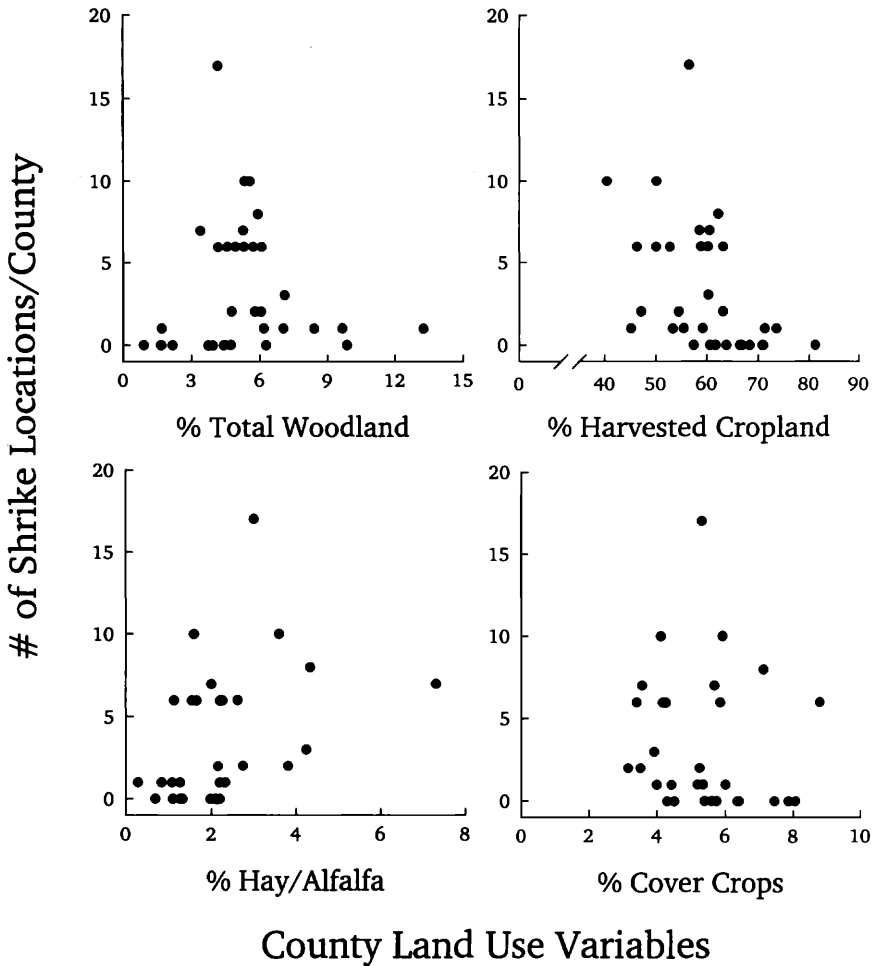


FIGURE 2. The relationship between the number of Loggerhead Shrike locations per county and county land use variables.

south of the reported line of extirpation, we found that nine of 10 counties without shrikes were located north of the extirpation line, and that only 6% (13/216) of all shrike observations were north of this line. Much of the area north and northeast of the extirpation line includes the Grand Prairie Division of Illinois, which is intensively farmed (mainly corn and soybeans). The greatest abundance of Loggerhead Shrikes in the study area occurred in a nine-county region in southeastern Illinois, south of the hypothetical extirpation line. Therefore, we conclude that the distribution of the Loggerhead Shrike in east-central Illinois has not changed appreciably since 1965.

Shrikes require open areas with short or patchy grasses for foraging, and scattered trees or hedgerows for nest substrate near suitable foraging areas (Bent 1950, Burnside and Shepherd 1985, Miller 1931). Thus, it is not surprising that shrikes in Illinois are most often observed near pasture, hedgerows and residential buildings with well kept yards. Although pasture and hay meadows comprise only a small percentage of the total land within our study area, their common occurrence in close proximity to shrike observations indicate that these habitats are preferred. Our results concur with those of Bohall-Wood (1987), who documented that Loggerhead Shrikes preferred open areas and improved pasture as suitable habitat.

Multiple regression analysis revealed that fields of hay/alfalfa/other small grains and cover crops were significant predictors of shrike abundance; the greater the acreage of these two land-use types in each county, the greater the number of shrike locations. Lawns, hay fields, and pasture habitats occupied over 80% of the shrike territories in north-central South Carolina (Gawlik and Bildstein 1990) and Novak (1986) found pasture with scattered hedgerows to be preferred habitat for shrikes in New York State. Kridelbaugh (1981) also reported that shrikes prefer short grassy areas (lawns, pastures and hay fields) because these habitats are routinely disturbed by mowing and grazing, and result in shorter vegetation than similar undisturbed grassland habitats. Although we often observed Loggerhead Shrikes near row crops, they utilize these habitats much less than one would expect by chance, suggesting that this type of habitat is not preferred. Multiple regression also indicated that the number of shrike locations was negatively related to the percentage of each county in harvested cropland and total woodland.

We did not observe shrikes in all habitats that appeared to be suitable (e.g., hedgerows or scattered trees with pasture). There are three possible explanations for not observing shrikes in what appears to be suitable habitat: (1) shrikes were present but our censusing methods were inadequate to detect them; (2) what appears to be suitable habitat really is not; and (3) shrikes were not present even though habitat was suitable. Brooks and Temple (1990a) have recently suggested that in addition to decreasing suitable habitat, there are likely to be other factors limiting shrike abundance, such as pesticides (Anderson and Duzan 1978) and winter mortality (Brooks and Temple 1990b).

In conclusion, we suggest that the distribution of the Loggerhead Shrike is largely confined to the southern one-third of Illinois and has not changed substantially since the early 1970s. Changing land-use practices (such as increasing row crops), have undoubtedly played a role in limiting the distribution and abundance of the Loggerhead Shrike in Illinois. In most of the northern two-thirds of Illinois, where land is intensively used for row crops, habitat suitability has likely decreased to the point where shrike populations can no longer exist. The southern one-third of Illinois, although heavily row cropped in some locations, still contains suitable habitat (i.e., pastures, hay meadows and other short grasses with adequate

nesting substrate) to maintain viable shrike populations. It seems logical to assume that a further increase in the percentage of harvested cropland in this area would result in a decrease in the abundance of this species.

ACKNOWLEDGMENTS

We thank the Illinois Department of Nuclear Safety and the Council for Faculty Research—Eastern Illinois University for funding this research project. We also thank the Illinois Department of Conservation—Endangered Species Office for providing Loggerhead Shrike distributional data. Eric Bollinger and Chuck Costa commented on an early draft.

LITERATURE CITED

- ANDERSON, D. W., AND R. E. DUZAN. 1978. DDE residues and eggshell thinning in Loggerhead Shrikes. *Wilson Bull.* 90:215–220.
- BENT, A. C. 1950. Life histories of North American wagtails, shrikes, vireos and their allies. Smithsonian Inst., U.S. Nat. Mus. Bull. 197. U.S. Govt. Print. Off., Washington, D.C. 411 pp.
- BOHALL-WOOD, P. 1987. Abundance, habitat use, and perch use of Loggerhead Shrikes in north-central Florida. *Wilson Bull.* 99:82–86.
- BROOKS, B. L., AND S. A. TEMPLE. 1990a. Habitat availability and suitability for loggerhead shrikes in the upper Midwest. *Am. Midl. Nat.* 123:75–83.
- , AND ———. 1990b. Dynamics of a Loggerhead Shrike population in Minnesota. *Wilson Bull.* 102:441–450.
- BURNSIDE, F. L., AND W. M. SHEPHERD. 1985. Population trends of the Loggerhead Shrike (*Lanius ludovicianus*) in Arkansas. *Ark. Acad. Sci. Proc.* 49:25–28.
- GAWLIK, D. E., AND K. L. BILDSTEIN. 1990. Reproductive success and nesting habitat of Loggerhead Shrikes in North-Central South Carolina. *Wilson Bull.* 102:37–48.
- GRABER, R. R., J. W. GRABER, AND E. L. KIRK. 1973. Illinois Birds: Laniidae. *Ill. Natur. Hist. Surv. Biol. Notes* 83.
- GYSEL, L. W., AND L. J. LYON. 1980. Habitat analysis and evaluation. Pp. 305–327, in S. D. Schemnitz, ed. *Wildlife management techniques manual*. The Wildlife Society, Bethesda, Maryland.
- KRIDELBAUGH, A. L. 1981. Population trend, breeding and wintering distribution of Loggerhead Shrikes (*Lanius ludovicianus*) in Missouri. *Trans. Missouri Acad. Sci.* 15: 111–119.
- MILLER, A. H. 1931. A systematic revision and natural history of the American shrikes (*Lanius*). *Univ. Calif. Publ. Zool.* 38:1–242.
- MORRISON, M. L. 1981. Population trends of the Loggerhead Shrike in the United States. *Am. Birds* 35:754–757.
- NOVAK, P. 1986. Possible factors influencing the distribution, status, and abundance of the Loggerhead Shrike (*Lanius ludovicianus*) in New York State. *Kingbird Fall*:176–181.
- ROBBINS, C. S., D. BYSTRAK, AND P. H. GEISSLER. 1986. The Breeding Bird Survey: its first fifteen years, 1965–1979. U.S. Dept. Interior Fish and Wildl. Serv. Resour. Publ. 157. 196 pp.
- SCHEFLE, W. C. 1979. *Statistics for the biological sciences*. Addison-Wesley Publishing Company, Reading, Massachusetts. 230 pp.
- TATE, R., JR. 1986. The blue list for 1986. *Am. Birds* 40:227–236.
- TELFER, E. S., C. ADAM, K. DE SMET, AND R. WERSHLER. 1989. Status and distribution of the Loggerhead Shrike in western Canada. *Can. Wildl. Serv. Prog. Notes*. 184:1–4.
- U.S. DEPARTMENT OF COMMERCE. 1987. *Census of agriculture: Illinois state and county data*. U.S. Government Printing Office, Washington, D.C. 478 pp.

Received 29 Aug. 1991; accepted 7 Dec. 1991.