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Factors Influencing Distribution and Abundance of the Loggerhead Shrike (Lanius ludovicianus migrans) in South-Central Illinois

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"Factors Influencing Distribution and Abundance of the Loggerhead Shrike (*Lanius ludovicianus migrans*) in South-Central Illinois"

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THESIS

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ABSTRACT

The loggerhead shrike (Lanius ludovicianus) is listed as a threatened species in Illinois as a result of population declines that have occurred since approximately 1900. Although Graber et al. (1973) reported that this species had been largely extirpated from the northern two-thirds of Illinois by 1965, there has been no research on shrike distribution or abundance in the state since that time. Consequently, a roadside survey was completed in 32 south-central Illinois counties to delineate the abundance of loggerhead shrikes in the study area and attempt to relate their abundance to land-use patterns among counties surveyed.

Two hundred and eleven loggerhead shrikes were observed in 22 of the 32 counties and they were most abundant in nine southeastern counties (Clay, Clinton, Hamilton, Jefferson, Lawrence, Marion, Richland, Wayne, and White). Also observed were 32 active nest sites and nest success appeared to be relatively high in the study area. Shrike abundance was positively correlated with the amount of pastureland, hay meadows, and cover crops and negatively correlated with the amount of harvested cropland and woodland in each county. Changing land-use patterns have, and will continue to, influence the distribution and abundance of the loggerhead shrike in

Illinois. Other limiting factors, including competition on the wintering grounds and nesting in marginal habitat need to be addressed in the future.

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INTRODUCTION

The loggerhead shrike (Lanius ludovicianus) once had a distribution extending from Nova Scotia well into central Mexico and from the Atlantic to the Pacific Oceans (Bent 1950). However, shrike populations have declined at various rates throughout its range over the last several decades (Morrison 1981, Robbins et al. 1986). Consequently this species was placed on the National Audubon Society's "Blue List" of declining species in 1972 (Tate 1986). The breeding bird survey indicates that from 1966 to 1987, loggerhead shrike populations have declined in the northcentral U.S. and nationally at annual rates of 5.5% and approximately 3.0%, respectively (William Harrison pers. comm.).

The loggerhead shrike is listed as an endangered species in New York, Wisconsin and Michigan and as a threatened species in many other states, including Illinois. Currently the U.S. Fish and Wildlife Service - Division of Endangered Species is conducting a status survey of the loggerhead shrike in the 48 contiguous states to decide whether any loggerhead shrike subspecies should be included in a formal listing under the Endangered Species Act (16 U.S.C. 1583) (William Harrison pers comm.).

A vast majority of information on the distribution and abundance information of the loggerhead shrike in

Illinois resulted from work completed by Graber et al. (1973). They suggested that by 1965 the loggerhead shrike had been largely extirpated from the northern two-thirds of the state. Records of isolated northerly populations exist but are 10 -20 years old making their usefulness less valuable. Very little information has been gathered in Illinois on distribution and abundance of the loggerhead shrike since that time.

Accordingly, a roadside population survey was conducted in 32 counties in the south-central portion of the state. Approximately one-third of the counties were located north of Graber et al's. (1973) "shrike extirpation line" (i.e., northern distributional boundary). The remaining counties were either located on (6 counties) or south (14 counties) of this boundary. This investigation had three primary objectives: 1) To determine if Graber et al's. (1973) extirpation line represents the northern distributional boundary of the loggerhead shrike in Illinois; 2) to determine if a north/south transition zone exists from counties where shrikes are totally absent to counties where shrike populations are relatively common; and 3) to relate shrike abundance and distribution to land-use patterns observed in the various counties.

METHODS

From 28 April through 30 July, 1990, 32 counties in south-central Illinois were surveyed for the presence of loggerhead shrikes (Fig. 1). Censusing procedures are similar to those described by Telfer (1988). In each county surveyed, two 60-mile (96.8 km) roadside routes were completed; one in the northern one-third and the other in the southern one-third of each county. Each route was driven at approximately 27-36 mph (45-60 km/h) in an east-west direction. Routes consisted of lightly traveled secondary roads selected at random so that censusing areas included representative samples of land-use patterns. Travel on each route was started at sunrise or mid-afternoon (4-5 hours 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; shrikes off censusing routes were recorded as casual observations. When a shrike was observed, the following information was recorded: a) location (Range, Tier, Section, Township, County road number); b) behavioral disposition of the individual(s) (e.g., perched on highlines, fence posts, dead trees, live trees, or in flight); c) presence or absence of barbwire in the immediate area; d) description of

predominant roadside vegetation up to 5 meters (e.g., sparse or thick vegetation, mowed or unmowed, etc.); and e) general habitat description (row crop, pastureland, hay meadows, presence of highlines, etc.) of the shrike territory (approximately 282 meter radius of observation).

Locations of shrike nests were ascertained either by observing adult shrikes visiting active nests or observing fledglings with adult birds and deducing that a nest was within close proximity since shrike territory size is relatively small (Brooks and Temple, 1990). Once a nest was located, the following variables were recorded: a) nest location (Range, Tier, Section, Township); b) vegetation type used for nesting; c) nest height; d) nest tree/vegetation height; e) general habitat description of the area; and f) presence or absence of barbwire in the immediate vicinity.

Preference Index

Using the location of each shrike as a central point, all habitat types (i.e., corn field, hedgerow, residential building, intermittent stream, etc.) in a 25 ha circular area were recorded as either present or absent. Habitat observations were based upon loggerhead shrike locations (regardless of the number of shrikes present at a particular location, each habitat was counted only once) and normally there were several

different habitat observations within each hypothetical territory. All habitat observations from separate shrike locations were summed to determine the proportion of each particular habitat utilized by shrikes.

Habitat types were combined into the following categories: a) row crops (corn field + soybean field + corn stubble); b) pastureland (grazed + ungrazed pasture); c) hay meadows/small grains (hay crop + clover + small grains, excluding winter wheat); d) woodland (pastured + unpastured woodland); and e) winter wheat. These general habitat descriptions were used to determine preference indices based on the proportion of loggerhead shrikes that utilized a particular habitat (based upon my observations) in comparison to availability of that habitat (1987 Census of Agriculture, U.S. Department of Interior) within all counties where loggerhead shrikes were observed.

The habitat preference index (PI) was calculated as follows:

$$PI = b / a$$

Where b is the proportion of shrike observations associated with a particular habitat and a is the proportion of available habitat represented by a particular habitat type in the counties where shrikes were observed. Habitats with a preference rating greater than one are considered to be preferred whereas those with a preference rating less than one are

considered to be not preferred (Petrides 1975, Gysel and Lyon 1980).

Multiple Regression Analysis

Stepwise multiple regression techniques were utilized to determine if county land-use patterns were associated with the abundance of loggerhead shrikes in south-central Illinois (using step-up procedures). The number of shrike locations observed in each county served as the dependent variable. The number of different shrike locations per county rather than the total abundance of shrikes per county was used so that counties surveyed in mid to late summer, after fledgling activity was complete, were not over represented. Independent variables (i.e., various land-use categories that intuitively might affect shrike abundance) were obtained for each county from the 1987 Census of Agriculture. These variables were converted into relative frequencies (% of county) and then arcsin transformed (Schefler, 1979) before statistical analyses.

Initially, 12 candidate independent variables were considered (See Table 1. for variable descriptors). In cases of highly correlated variables, $r > 0.75$, the less biologically relevant variable was eliminated before the multiple regression was calculated. Six independent

variables ultimately remained in the multiple regression analyses.

Comparison With The Breeding Bird Survey

Loggerhead shrike abundance data (based on locations per county) collected in this study was compared with shrike abundance data obtained from the Breeding Bird Survey (BBS -an average of shrikes per route over the past five years) via a simple linear correlation. Censusing routes in this study and BBS routes were not identical and therefore were correlated if; 1) they intersected or ran parallel (within 10 km) to one another regardless of the particular county where the routes were completed; 2) if a BBS survey route overlapped with several of my survey routes within the same county; then all 1990 routes were compared to the BBS route; and 3) if a BBS route intersected two routes in two separate counties, the BBS route was compared with the 1990 survey routes from both counties.

RESULTS

A total of 211 loggerhead shrikes, 178 on the census route and 33 casual observations, were observed from 120 separate locations over the duration of this study (Fig. 2). Of the 120 shrike locations, 103 sitings were observed along the censusing routes. Loggerhead shrikes were observed in 22 of the 32 counties surveyed. Appendix A summarizes the locations (Range, Tier, Section, Township) of all shrikes observed. With the addition of these records to those already obtained from the Illinois Department of Conservation -Endangered Species Office, the loggerhead shrike is now known to exist in 43 Illinois counties (Fig. 3).

The abundance of loggerhead shrikes in the counties surveyed was quite variable (0 - 29 shrikes per county surveyed, Fig. 1). Seventy-seven percent (163/211) of all loggerhead shrikes were observed in nine southeastern counties (Clay, Clinton, Hamilton, Jefferson, Lawrence, Marion, Richland, Wayne and White). Similarly, the abundance of shrike locations (more than one shrike could be observed at a single location) was also quite variable, ranging from 0-17 per county surveyed. As expected, 73% (75/103) of the shrike locations were in the same nine southeastern counties. Jasper County, located north of and adjacent to this

nine southeastern county region, contained six shrike locations making the 10 county region responsible for 79% (81/103) of all locations. There were 10 counties, Coles, Cumberland, Douglas, Edgar, Macon, Montgomery, Moultrie, Sangamon, Scott, and Shelby, in which loggerhead shrikes were not observed. On a per mile basis, counties with the greatest shrike abundance (0.111 -0.147 shrikes/mile) include Clay, Clinton, Edwards/Wabash, Hamilton, Jefferson, Lawrence, Richland, Wayne, and White (Table 2).

Nesting

Thirty-two active nest sites in 14 Illinois counties were located during the course of this investigation. At least 14 of these nests sites were considered to be "successful" (i.e., fledged at least one young). Between two and six fledglings (mean = 3.2) were observed at these sites (Fig. 4). When these nesting records are combined with data from the Illinois Department of Conservation - Endangered Species Office, the loggerhead shrike has been documented to be actively nesting in 32 Illinois counties (Fig. 3).

Loggerhead shrikes used eleven different vegetation types for nesting (Table 3). Approximately 29% of the nests were located within coniferous trees and 21% were constructed within plants included in the Rosaceae. All other vegetation types were used less than 8% of the

time. Approximately 68% of the active nests were located within solitary trees; remaining nests were located within hedgerows. Of the nests located within hedgerows, 60% were located within thin hedgerows (i.e., single tree wide) with the remaining nests located within thick hedgerows (i.e., several trees wide). Although not statistically different, (t_{cal} = 0.61; df = 14; P > 0.05), nests within solitary trees were, on average, located 3.5 meters from the ground whereas nests within hedgerows were, on average, 2.2 meters from the ground.

Habitat Analysis

I recorded shrikes to be actively using 17 habitat types throughout the course of this investigation (Table 4). In sum, 272 habitat observations were observed from 103 loggerhead shrikes and their respective territories during the censusing routes. Loggerhead shrike territories most frequently contained ungrazed pasture (0.1507), hedgerows (0.1176), corn fields (0.1138), and residential houses/ buildings with well kept yards (0.1066). All other habitats had relative frequencies less than 0.10 (Table 4).

Pastureland and hay meadows habitats had positive preference indices, 6.17 and 1.94 respectively, suggesting that loggerhead shrikes prefer these areas in Illinois. The preference index for winter wheat, 1.54,

also indicates that this habitat is preferred. Row crops, such as corn and soybeans, had a preference rating of only 0.62, which indicates this habitat was not preferred. Woodlands also appear to be avoided (P.I.= 0.936) (Table 5). As suspected, a chi-square goodness of fit test (X^2_{cal} = 68.41; df = 4; P < 0.0001) indicates non-random habitat use by shrikes.

Shrike Abundance/Land Use

Results of a t-test comparing various land-use variables in 10 counties where shrikes were absent to nine counties where shrikes were relatively common within the study area shows a statistically significant difference in the percent of total cropland (t_{cal} = -4.33; P = 0.0002) and harvested cropland (t_{cal} = -4.60; P = 0.0001). The 10 counties where no shrikes were observed showed greater percentages of both total cropland and harvested than did the nine counties where shrikes were observed to be relatively common. A stepwise (up) multiple regression technique (F = 3.00) suggested that four of the six independent variables (HARVCROP, TOTWOOD, HAYALFA, and COVER) were significant predictors of the number of shrike locations per county. Shrike locations per county are negatively related to HARVCROP and TOTWOOD but positively related to the percent of each county in HAYALFA and COVER (Fig. 5).

The final equation was:

$$\text{No. of Shrike Locations} = 22.41 - 0.61(\text{HARVCROP}) - 0.48(\text{TOTWOOD}) + 0.91(\text{COVER}) + 0.72(\text{HAYALFA})$$

$$r^2 = 0.46 \qquad P < 0.01$$

Comparison with the BBS

A total of 64 Breeding Bird Survey (BBS) routes are completed yearly in Illinois by the U.S. Fish and Wildlife Service in cooperation with the Canadian Wildlife Service. Seventeen of these routes are located within the study area. As a result of the routes in this study overlapping and intersecting BBS survey routes, a total of 27 routes were available for comparison. Results suggest that the two censusing techniques used to determine abundance of shrikes were significantly correlated ($r = 0.67$, $df = 26$, $P < 0.01$).

DISCUSSION

There have been two reported declines in loggerhead shrike populations in Illinois. The first was a relatively slow decline starting around 1900, and the second, a very rapid decline in some areas of Illinois between 1957 to 1965 (Graber et al. 1973). The only information on the distribution and abundance of the loggerhead shrike since 1965 resulted from the U.S. Fish and Wildlife Service's -Breeding Bird Survey. The BBS indicates an average annual decline of 1.65% in loggerhead shrike populations from 1965 to 1989 in Illinois. Although shrike populations are declining in Illinois, this decline is not as dramatic as that in other states (Robbins et al. 1986).

Prior to the summer of 1990, loggerhead shrikes had been recorded in 31 Illinois counties. As a result of this study the shrike has now been documented in 43 counties representing an increase of approximately 28%. Although the increase in distribution seems encouraging, Graber et al. (1973) stated that because the distribution of the loggerhead shrike in Illinois was never 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) further suggested 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 located immediately north and south of the extirpation line, I determined that 10 counties did not have shrikes. Nine of these were located north of this extirpation line and only 6% (13/211) of all shrike observations were north of this line. It is important to note that the areas north and northeast of this extirpation line includes the Grand Prairie Division of Illinois that are now very intensively farmed (mainly corn and soybeans). Similarly, the greatest abundance of loggerhead shrikes in the study area occurred in a nine county region in southeastern Illinois, located south of the hypothetical extirpation line. Therefore, I conclude that the distribution of the loggerhead shrike in Illinois has not changed appreciably since 1965.

The abundance and distribution of shrikes in Illinois appears to coincide with contiguous populations of shrikes in Indiana. Burton and Whitehead (1990) noted that the loggerhead shrike is much more common than was initially expected in Indiana and that 76% of their records came from the southwestern portion of the state (Daviess, Dubois, Pike, and Spencer Counties), in close proximity to the southeastern region (White, Hamilton, Jefferson, and Clay Counties), where I found shrikes to be common in Illinois.

Shrikes require open areas with short and/or patchy grasses for foraging and scattered trees or hedgerows for nest substrates near suitable foraging areas (Miller 1931, Bent 1950, and Burnside and Shepherd 1985). Thus, it is not surprising that locations of shrikes in Illinois are frequently associated with ungrazed pasture, hedgerows, and residential houses/buildings with well kept yards. Similarly, although pastureland and hay meadows comprise only a small percentage of the total land-use within my study area, their occurrence in close proximity to shrikes observations indicate that these habitats are preferred. My 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 HAYALFA (hay fields, alfalfa, and other small grains) and COVER (percentage of acreage in cover crops) were significant predictors of shrike abundance. The greater the acreage in these small grains and cover crops, the higher the shrike abundance. Lawns, hay fields, and pasture habitats occupied over 80% of the shrikes immediate territory in north-central South Carolina (Gawlik and Bildstein, 1990) and Novak (1986) found pastureland with scattered hedgerows to be preferred habitat for shrikes in New York State. Kridelbaugh (1982) also reported that shrikes prefer short grassy areas (lawn, pasture,

and hay fields) because these habitats are routinely disturbed by mowing and grazing, and result in shorter vegetation than similar undisturbed grassland habitats. Lastly, Burton and Whitehead (1990) documented that cover crops and pastures occurred at significantly more of the sites occupied by shrikes than at random sites without shrikes.

My observations indicate that winter wheat is a preferred habitat. This can probably best be explained by the fact that most winter wheat fields are harvested to stubble by combining that results in a suitable foraging area.

Although loggerhead shrikes are commonly found near row crops, they utilized these habitats much less than one would expect by chance suggesting that this type of habitat is not preferred. Multiple regression techniques indicate that shrike abundance was negatively related to the percentage of each county in harvested cropland and total woodland. Thus, the greater the amount of harvested cropland and total woodland within each county the lower the abundance of loggerhead shrikes. These results agree with Telfer (1988) who stated that shrikes avoid forested areas as breeding habitats.

The proportion of acreage in harvested cropland is increasing in Illinois. From 1964 to 1987 the percent of harvested cropland has increased from an average of

56.6% to 59.2% among the counties surveyed (1987 Census of Agriculture). Thus it should not be surprising that the Breeding Bird Survey indicates a 1.65% annual decline of loggerhead shrike populations in Illinois from 1965-1989 (Sam Droege, pers comm.). Luukkonen and Fraser (1987) reported that a change in land-use patterns has negatively affected loggerhead shrike populations in Virginia. Kridelbaugh (1982) attributed the loggerhead shrike decline in Missouri to a decrease in suitable habitat. In Illinois, total cropland may account for as much as 85% (Census of Agriculture, 1987) of the total land-use within a particular county. Burnside and Shepherd (1985) noted that due to social and economic conditions, subsistence farms are being replaced by large, intensively managed farms in Arkansas. These farms generally lack hedgerows and consist of monocultures of row crops which limits loggerhead shrike perch, nest, and foraging sites. A similar hypothesis was advanced to explain the declining shrike populations in Illinois early in the twentieth century (Graber et al. 1973). This study, as well as the aforementioned studies, supports the hypothesis that declines in the distribution and abundance of loggerhead shrikes are partially related to changing land-use patterns as a result of increased acreage in agricultural production.

I made no attempt to systematically search for nests in this study and only noted them when they were easily detected. Nevertheless, I was able to locate 32 active nest sites in 14 Illinois counties and 14 of these nests sites were considered to be successful (two-five fledglings observed). All active nest sites were located south of the Graber et al's. (1973) extirpation line. With the addition of my records, the loggerhead shrike has been documented to be actively nesting in 32 Illinois counties, although it seems logical to assume that this species is successfully nesting in other counties where it has been observed.

Obviously it is easier to observe successful nests with four-five fledglings and two adults than it is to observe a nesting attempt that has failed. Nevertheless, the fledglings observed indicate that nest success was not uniformly low for loggerhead shrikes in the study area. My observations are largely congruent with Lane (1986) who studied the nesting requirements of shrikes in three Illinois counties (Jasper, Wayne and Clay - all located within the study area). Twenty of the 30 nests Lane studied were considered to be "successful" with a mean brood size of 4.0. Anderson and Duzan (1978) documented a mean nesting success of 3.9 fledglings per successful nest in southern Illinois. Graber et al. (1973) documented a mean nesting success of 4.8 and 4.6 fledglings per successful nest in the

central and southern portions of the state. Relatively high nesting success for loggerhead shrikes has also been reported in other states including; Colorado (Porter et al., 1975), Minnesota (Brooks and Temple, 1990), South Carolina (Gawlik and Bildstein, 1990), Missouri (Kridelbaugh, 1983), Indiana (Burton and Whitehead, 1990) and Canada (Cadman, 1985). These results suggest that the loggerhead shrike population declines that have occurred in Illinois as well as elswhere are probably not totally attributable to low reproductive success.

Greater than two-thirds of the active nests I observed were located in solitary trees while the remaining nests were found within hedgerows. Similarly, Brooks and Temple (1990) observed 61% of nests in isolated trees. In contrast, Kridelbaugh (1983) found that 62% of the nests he examined in Missouri were located in hedgerows while Gawlik and Bildstein (1990) documented 57% of the nests they examined in rows of trees or shrubs. Lane (1986) documented that 57% of the 30 nests he examined were located within hedgerows and 43% in solitary trees. He (Lane 1986) also determined that shrikes nesting within solitary trees had a significantly higher reproductive success than nests located within hedgerows on the basis that hedgerows are major travel lanes for many potential nest predators.

I noted a wide variation in vegetation used for nesting (14 species). Of these 14 species, only Crab Apple (Pyrus malus), Colorado Blue Spruce (Picea pungens), and Eastern Red Cedar (Juniperus virginiana) were utilized more than once. Several authors, including Brooks and Temple (1990), Burton and Whitehead (1990), Graber et al. (1973), Gawlik and Bildstein (1990), Kridelbaugh (1983), have documented that shrikes have a preference for Eastern Red Cedar when it is available. Although my sample size is too small to make any definitive statement about a shrike's preference for nesting, the largest percentage (18%) of nests I observed were located within Eastern Red Cedar. Eastern Red Cedar is often associated with disturbed habitats that would provide a variety of foraging areas so I would recommend maintaining these areas as suitable habitat for loggerhead shrikes.

Loggerhead shrikes are typically one of the earliest nesting passerines (Kridelbaugh 1983). Therefore it has been suggested that row crops may not impact shrikes because vegetation will be relatively short during incubation and brooding. Burton and Whitehead (1990) recorded that the loggerhead shrikes peak nesting period in Indiana coincided closely with the greatest plowing activity, well before any vegetative growth. It has been suggested that the addition of row crops may actually be desirable for

loggerhead shrikes because they provide a mixture of habitats from which to forage (De Smet and Conrad 1989, Burton and Whitehead 1990).

Although researchers are not in complete agreement concerning the frequency of double broodedness in loggerhead shrikes (Miller 1931, Porter et al. 1975), it is known that at least a small percentage of shrikes renest after nest failure (Porter et al. 1975, Brooks and Temple 1986, 1990, and Gawlik and Bildstein 1990). Loggerhead shrikes have a long nesting period (nest building + incubation + feeding of fledglings) for a passerine (45-53 days, Graber et al. 1973, Kridelbaugh 1983) and consequently, a renesting attempt may run late into the summer in the Midwest. Porter et al. (1975) documented that renesting loggerhead shrikes in Colorado began laying eggs as late as the third week in June, and De Smet and Conrad (1989) documented renesting attempts as late as late June in Ontario; young fledged from these nests in late July and early August. While initial nesting attempts may not be negatively impacted by row crops, a renesting attempt late in the season could be adversely affected because of the tall vegetation that occurs later in the summer which would reduce foraging efficiency. Adult shrikes provide approximately 165 food items per day to their nests (Gawlik, unpub. data, from Gawlik and Bildstein 1990), and it is likely that much taller vegetation would lead

to a decreased foraging efficiency. Bohall-Wood (1987) stated that loggerhead shrike prey are generally less available in crop fields. A similar situation probably exists for shrikes nesting near fields of winter wheat. These areas are often replanted into row crops during the summer months and any lower nesting success in these areas might be attributed to the inability of shrikes to provide food for their nestlings. This hypothesis needs to be addressed more closely.

I did not observe shrikes in all habitats which appeared to be suitable (i.e., hedgerows or scattered trees with pastureland, etc.). Similarly, Burton (1988) noted that shrikes he observed in Indiana were in dense clusters rather than distributed homogeneously over what appeared to be suitable habitat. There are three possible explanations for not observing shrikes in what appears to be suitable habitat; 1) shrikes were present but my 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. Although speculation at this point, I agree with Telfer (1988) and Brooks and Temple (1990), who suggest that in addition to decreasing suitable habitat, there are likely to be other factors limiting shrike abundance, such as pesticides (Anderson and Duzan 1978, Cadman 1985), winter mortality (Brooks and Temple

1990, Telfer 1988), and predation (De Smet and Conrad, 1989).

In conclusion, results from this investigation suggest that the distribution of the loggerhead shrike is largely confined to the southern one-third of the state as suggested by Graber et al. (1973). Although northerly isolated populations exist, the status of the loggerhead shrike in these areas is unclear because reports are 10-20 years old. Telfer (1988) stated that large scale habitat changes should be quantitatively evaluated as possible causes of loggerhead shrike declines. Changing land-use practices (such as increasing row crops), have undoubtedly played a significant role in limiting the distribution and abundance of the loggerhead shrike in Illinois. In most of the northern two-thirds of Illinois, where areas land is intensively used for row crops, habitat suitability has decreased to the point where shrike populations can no longer exist. The southern one-third of Illinois, although heavily cropped in some locations, still contains suitable habitat (i.e., pastureland, 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 continue to decrease the abundance of this important and interesting member of the avian community.

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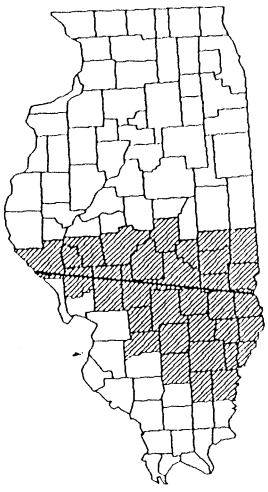
Figure 1. The abundance of loggerhead shrikes in 32 central Illinois counties as determined by roadside censusing procedures conducted from 28 April - 30 July 1990. The number on the left represents locations, the number on the right is the total number of shrikes observed. Graber et al's. (1973) "Hypothetical Extirpation Line" is included on both maps. Inset map (upper right) shows the location of the study area in Illinois.



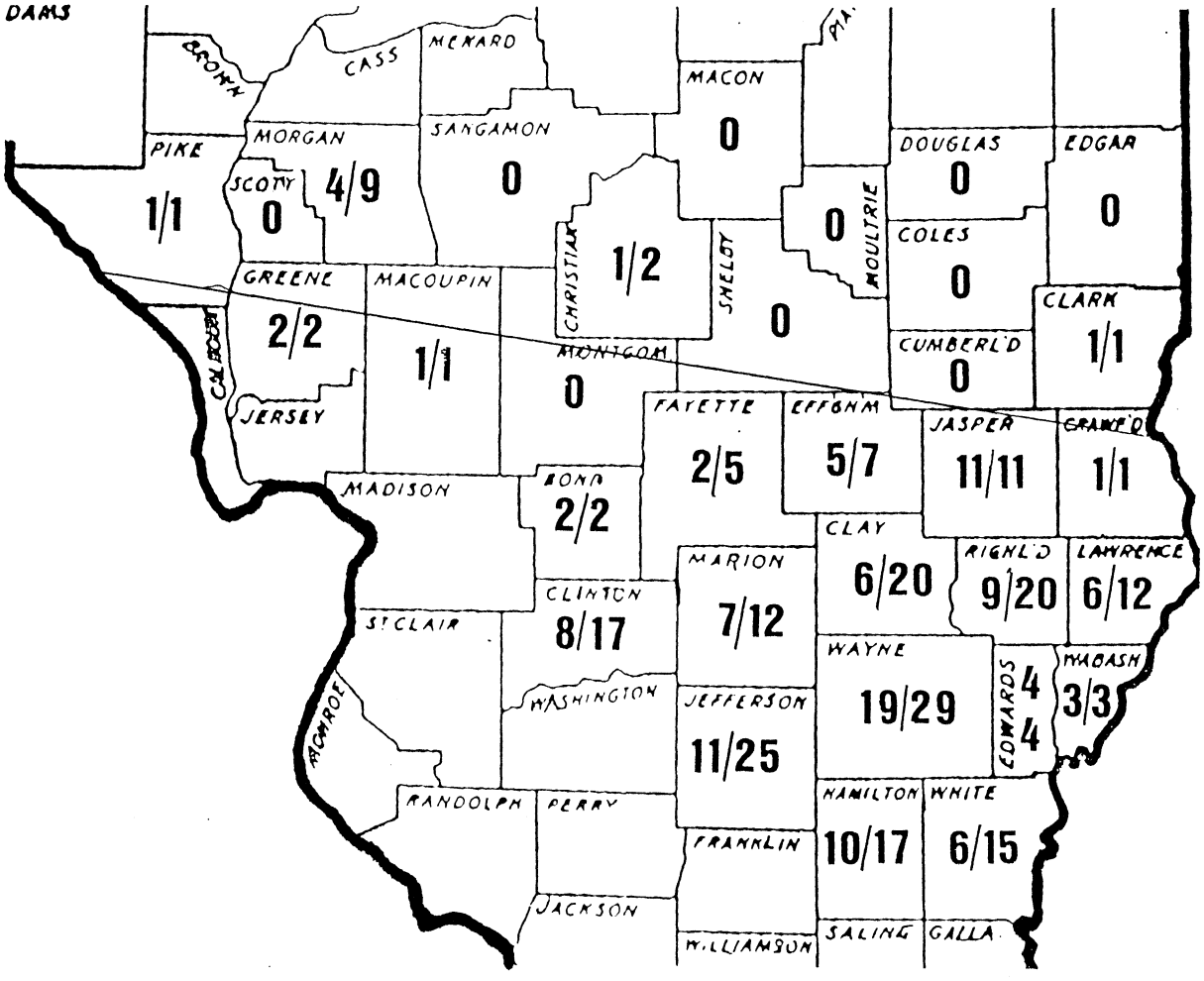
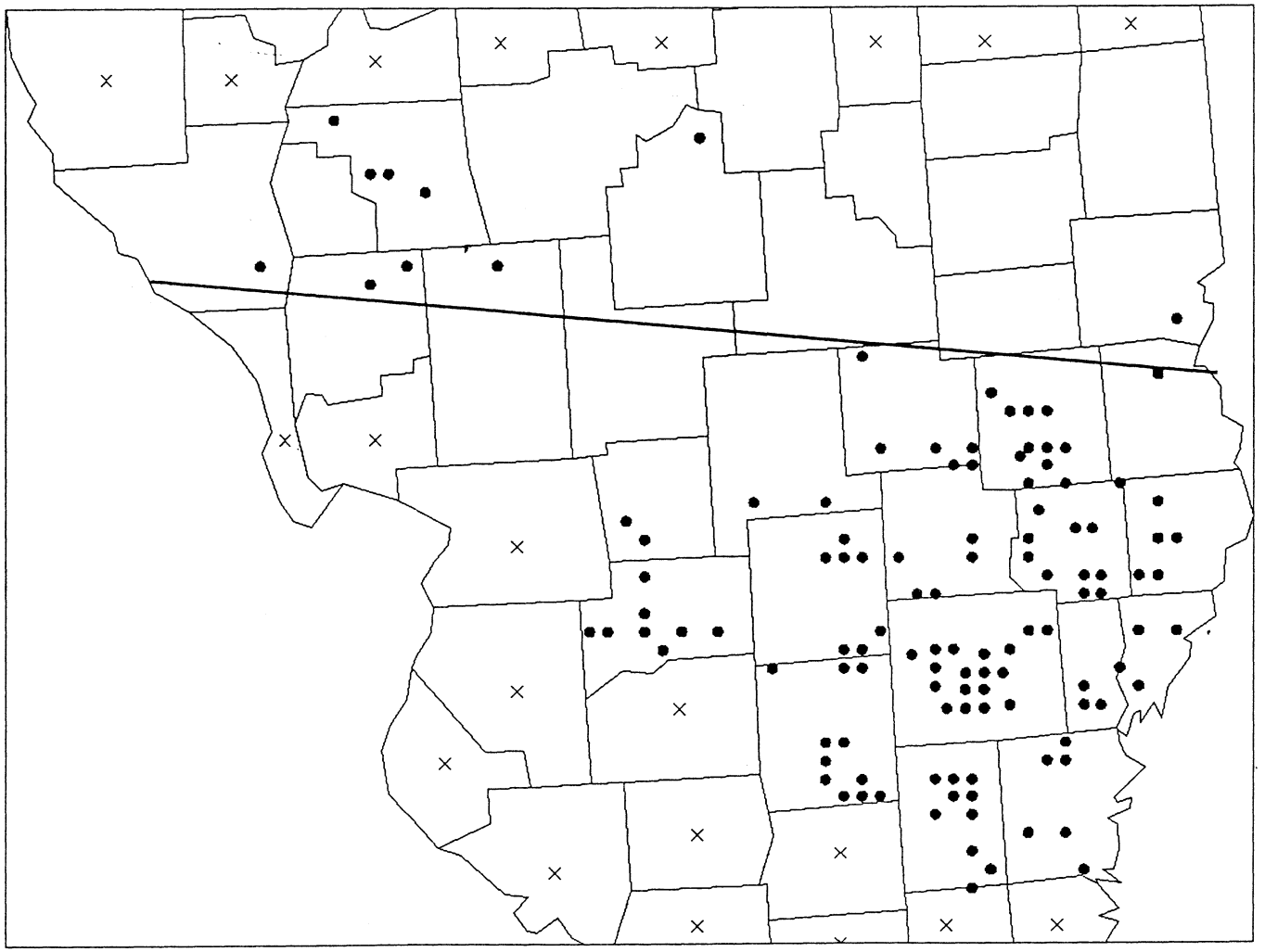

DAMS
BROWN
CASS
MENARD
MACON
PIKE
1/1
MORGAN
SCOTT
0
4/9
SANGAMON
0
MOULTRIE
0
DOUGLAS
0
EDGAR
0
COLES
0
CHRISTIAN
1/2
SHELBY
0
GREENE
2/2
MACOUPIN
1/1
CALHOUN
MONTGOM
0
CUMBERL'D
0
CLARK
1/1
JERSEY
FAYETTE
2/5
EFFGHM
5/7
JASPER
11/11
CRAWF'D
1/1
MADISON
BOND
2/2
CLAY
6/20
RICHL'D
9/20
LAWRENCE
6/12
MARION
7/12
CLINTON
8/17
ST CLAIR
WAYNE
19/29
EDWARDS
4
4
WABASH
3/3
WASHINGTON
JEFFERSON
11/25
ALEXDR
RANDOLPH
PERRY
HAMILTON
10/17
WHITE
6/15
FRANKLIN
JACKSON
WILLIAMSON
SALINE
GALLA

Figure 2. Approximate locations of loggerhead shrikes observed from 28 April - 30 July 1990 in central Illinois. Graber et al's. (1973) "Hypothetical Extirpation Line" is included.



• Shrike Locations
× County Not Surveyed

Figure 3. The distribution of the loggerhead shrike in Illinois. A diamond denotes counties where loggerhead shrikes nests have been documented. These records result from my 1990 survey and the Illinois Department of Conservation -Endangered Species Office. Graber et al's. (1973) "Hypothetical Extirpation Line" is included.

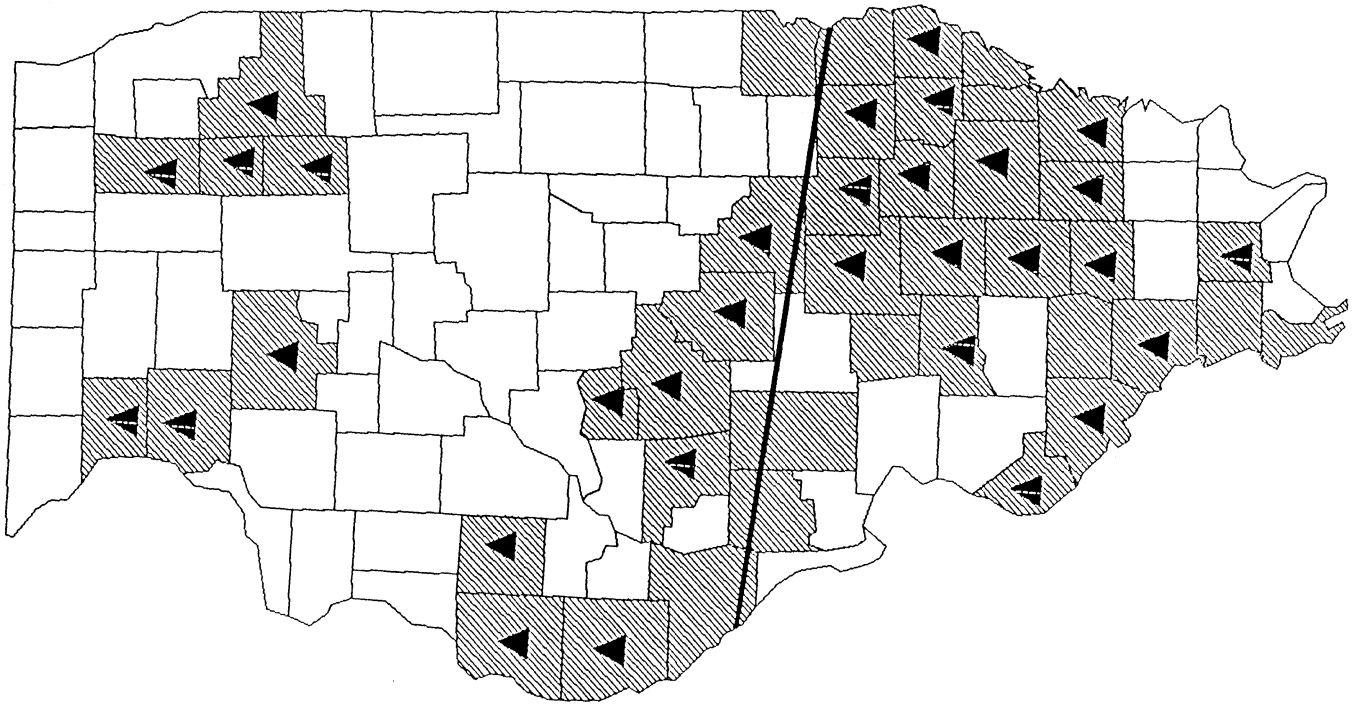


Figure 4. Loggerhead shrike fledgling group size as observed from 28 April - 30 July 1990 in Illinois.

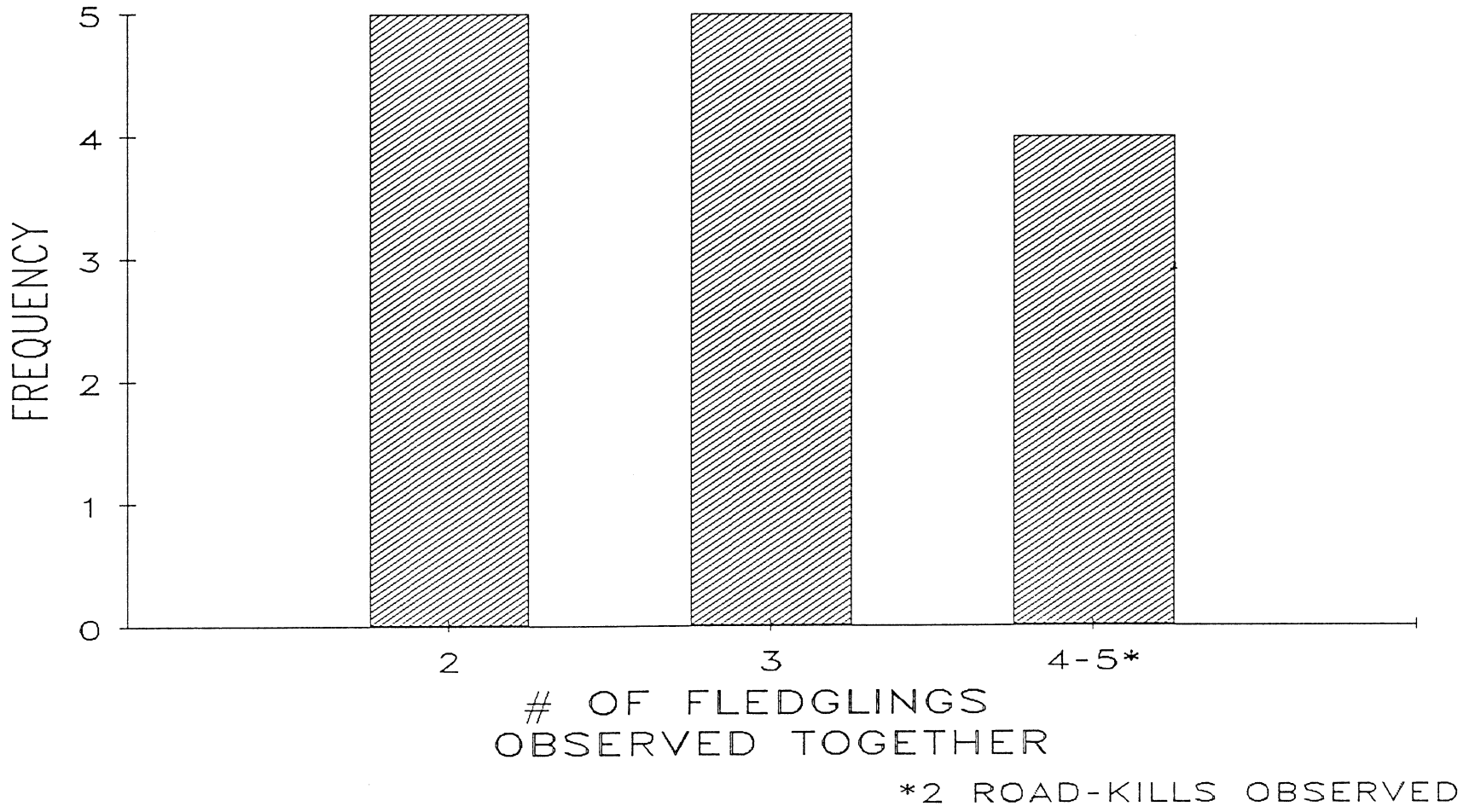
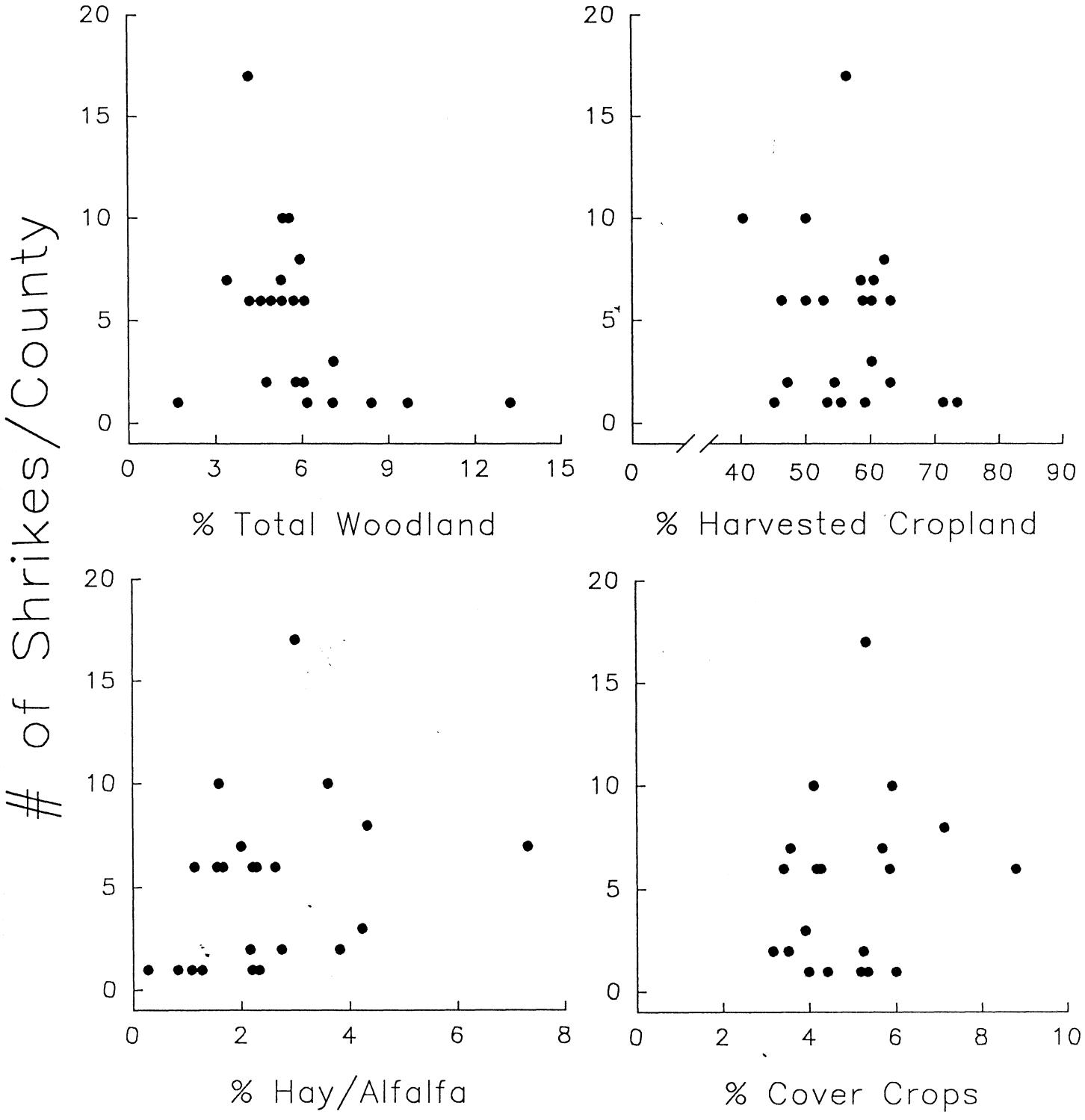

FREQUENCY
5
4
3
2
1
0
2
3
4-5*
OF FLEDGLINGS
OBSERVED TOGETHER
*2 ROAD-KILLS OBSERVED

Figure 5. Land-use variables and their relationship to loggerhead shrike abundance in central Illinois. Land-use variables HARVCROP and TOTWOOD (top two figures) are negatively correlated with shrike abundance whereas HAYALFA and COVER (bottom two figures) are positively correlated.



County Land Use Variables

Table 1. Land-use variables that could potentially affect loggerhead shrike abundance recorded as the percentage of total acres in production for each of the 32 counties surveyed.

Independent Variable	Abbreviation
Total cropland	TOTCROP**
Harvested cropland: A subset of total cropland	HARVCROP*
Land used for pasture/grazing	PASTGRAZ*
Land used for other crops	OTHCROP*
Land used for cover crops	COVER*
Total woodland; grazed and ungrazed	TOTWOOD*
Land used in pastureland/rangeland	PASRANG**
Land used in pastureland/ all types	PASTALL**
Land used for hay/alfalfa/small grain green silage/green chop etc.	HAYALFA*
Acres in which commercial fertilizers were added	FERT**
Sprays/dusts added for pesticides	SPRAYS*

* = Independent variables used in step-up multiple regression.
** = Variables removed from multiple regression model due to high correlation ($r > 0.75$) with other variables.

Table 2. The number of shrikes observed in each county (by 60 mile transect). The number in parentheses is the number of shrikes/mile.

County	North Transect	South Transect	Entire County
Bond	0 (0.0)	2 (.033)	2 (.017)
Christian	2 (.033)	0 (0.0)	2 (.017)
Clark	0 (0.0)	1 (.017)	1 (.008)
Clay	8 (.133)	12 (.200)	20 (.166)
Clinton	2 (.033)	14 (.230)	16 (.133)
Coles	0 (0.0)	0 (0.0)	0 (0.0)
Crawford	1 (.017)	0 (0.0)	1 (.008)
Cumberland	0 (0.0)	0 (0.0)	0 (0.0)
Douglas	0 (0.0)	0 (0.0)	0 (0.0)
Edgar	0 (0.0)	0 (0.0)	0 (0.0)
Edwards/ ** Wabash	7 (.111)	7 (.111)	14 (.111)
Effingham	1 (.017)	1 (.017)	2 (.045)
Fayette	0 (0.0)	5 (.083)	5 (.042)
Greene	1 (.017)	0 (0.0)	1 (.008)
Hamilton	13 (.217)	4 (.067)	17 (.147)

County	North Transect	South Transect	Entire County
Jasper	0 (0.0)	6 (.100)	6 (.050)
Jefferson	6 (.100)	9 (.150)	15 (.125)
Lawrence	6 (.100)	6 (.100)	12 (.100)
Macon	0 (0.0)	0 (0.0)	0 (0.0)
Macoupin	1 (.017)	0 (0.0)	1 (.008)
Marion	5 (.083)	3 (.050)	8 (.067)
Montgomery	0 (0.0)	0 (0.0)	0 (0.0)
Moultrie	0 (0.0)	0 (0.0)	0 (0.0)
Pike	0* (0.0)	1 (0.03)	1 (0.01)
Richland	3 (.050)	10 (.167)	13 (.108)
Sangamon	0 (0.0)	0 (0.0)	0 (0.0)
Scott/ ** Morgan	3 (.050)	0 (0.0)	0 (.025)
Shelby	0 (0.0)	0 (0.0)	0 (0.0)
Wayne	9 (.150)	9 (.150)	18 (.150)
White	9 (.150)	6 (.100)	15 (.125)

* = Only a 32 mile transect.
** = Due to relatively small size, counties were combined into to two 60 mile transects.

Table 3. Vegetation used for nesting by Loggerhead Shrikes in Illinois as observed from 28 April - 30 July, 1990.

Vegetation Type Common Name (Scientific Name)	Times Used for Nesting
Pinaceae	
Colorado Blue Spruce (*Picea pungens*)	2
Cupressaceae	
Eastern Red Cedar (*Juniperus virginiana*)	2
Rosaceae	
Crab Apple (*Pyrus malus*)	2
Japanese Rose (*Rosa multiflora*)	1
Compositae	
Giant Ragweed (*Ambrosia trifida*)	1
Leguminosae	
Honey Locust (*Gleditsia triacanthos*)	1
Lauraceae	
White Sassafras (*Sassafras albidum*)	1
Fagaceae	
Shingle Oak (*Quercus imbricaria*)	1
Oleaceae	
Green Ash (*Fraxinus pennsylvanica* var. *subintegerrima*)	1
Elaeagnaceae	
Russian Olive (*Elaeagnus angustifolia*)	1
Aquifoliaceae	
American Holly (*Ilex opaca*)	1

Table 4. Habitats types utilized by loggerhead shrikes observed in 32 south-central Illinois counties.

Habitat Type	Proportion Utilized*
Winter Wheat	0.0882
Corn Field	0.1138
Clover Field	0.0073
Soybean Field	0.0845
Ungrazed Pasture	0.1507
Hedgerow	0.1176
Strawberry Field	0.0038
Corn Stubble	0.0993
Woodlot	0.0551
Hay Meadow	0.0368
Grazed Pasture	0.0441
Oat Stubble	0.0039
House/Yard/Church	0.1066
Prairie Remnant	0.0110
Furrowed Field	0.0588
Prairie Chicken Sanctuary	0.0037
Intermittent Stream	0.0147
TOTAL	1.00

* This proportion is based on 103 locations for loggerhead shrike observations. More than one habitat variable was often counted at each shrike location. A total of 272 habitat observations were recorded.

Table 5. Preference indices calculated from loggerhead shrike habitat observations.

Habitat Type	% make-up of Counties	% observed as Shrike Habitat	Preference Index
Pastureland*	3.14	19.48	6.17
Winter Wheat	5.07	8.82	1.54
Soybeans	26.86	8.46	0.31
Soybeans/ All Corn	47.59	29.78	0.63
Soybeans/All Corn/Tilled	47.59	35.66	0.75
Hay Meadow/ Small Grains	2.46	4.78	1.94
Woodlot	5.89	5.51	0.76

* = Includes both grazed and ungrazed pasture.

Appendix I. Locations of loggerhead shrikes observed from 28 April - 30 July, 1990 in 22 central Illinois counties.

COUNTY	SHRIKES OBSERVED	TOWNSHIP	RANGE	SECTION	TOWNSHIP
Bond	1	T4N	R3W	33	Mills
Bond	1	T4N	R3W	07	Mills
Christian	2	T15N	R2W	01	Mt.Auburn
Clark	1	T9N	R12E	29	Melrose
Clay	6	T5N	R6E	01	Blair
Clay	1	T5N	R7E	06	Bible Gr.
Clay	3	T3N	R5E	17	Songer
Clay	2	T2N	R6E	04	Harter
Clay	6	T3N	R7E	05	Stanford
Clay	2	T3N	R7E	08	Stanford
Clinton	1	T2N	R4W	17	Breese
Clinton	2	T1N	R2W	03	Lake
Clinton	2	T1N	R3W	03	Santa Fe
Clinton	1	T1N	R4W	13	Germantown
Clinton	2	T1N	R4W	05	Germantown
Clinton	6	T2N	R5W	29	Sugar Creek
Clinton	1	T2N	R5W	26	Sugar Creek
Clinton	2	T3N	R4W	08	St. Rose
Crawford	1	T8N	R13W	24	Prairie
Edwards	1	T2S	R10E	06	Rd Dist. 6
Edwards	1	T2S	R10E	35	Rd Dist. 14
Edwards	1	T2S	R10E	27	Rd Dist. 7
Edwards	1	T1S	R14W	28	Rd Dist. 4

Appendix I (cont.)

COUNTY	SHRIKES OBSERVED	TOWNSHIP	RANGE	SECTION	TOWNSHIP
Effingham	1	T9N	R4E	24	Liberty
Effingham	2	T6N	R7E	33	Lucas
Effingham	1	T6N	R6E	16	Union
Effingham	1	T6N	R5E	29	Mason
Effingham	2	T6N	R6E	23	Union
Fayette	1	T5N	R1E	29	Kaskaskia
Fayette	4	T5N	R3E	30	Lone Grove
Greene	1	T12N	R11W	32	Whitehall
Greene	1	T12N	R10W	17	Athensville
Hamilton	1	T7S	R6E	11	South Twigg
Hamilton	2	T5S	R7E	31	Crook
Hamilton	1	T6S	R7E	27	Mayberry
Hamilton	2	T4S	R6E	24	Beaver Creek
Hamilton	1	T4S	R5E	27	Dahlgren
Hamilton	1	T3S	R5E	34	Dahlgren
Hamilton	5	T4S	R6E	08	South Crutch
Hamilton	1	T4S	R6E	17	Dahlgren
Hamilton	2	T4S	R6E	18	South Crutch
Hamilton	1	T3S	R5E	07	Dahlgren
Jasper	1	T5N	R9E	34	Small Wood
Jasper	1	T6N	R9E	03	Wade
Jasper	1	T6N	R9E	04	Wade
Jasper	1	T6N	R8E	11	North Muddy
Jasper	1	T5N	R9E	32	Small Wood

Appendix I (cont.)

COUNTY	SHRIKES OBSERVED	TOWNSHIP	RANGE	SECTION	TOWNSHIP
Jasper	1	T5N	R9E	32	Small Wood
Jasper	1	T6N	R9E	02	Small Wood
Jasper	1	T5N	R9E	36	Small Wood
Jasper	1	T5N	R10E	16	Fox
Jasper	1	T5N	R9E	21	Small Wood
Jasper	1	T7N	R8E	17	North Muddy
Jefferson	1	T4S	R4E	35	Moores
Jefferson	1	T4S	R4E	33	Moores
Jefferson	1	T4S	R4E	28	Moores
Jefferson	2	T4S	R4E	32	Moores
Jefferson	1	T4S	R4E	30	Moores
Jefferson	1	T4S	R4E	30	Moores
Jefferson	1	T4S	R3E	10	Spring Garden
Jefferson	1	T3S	R3E	34	Dodds
Jefferson	2	T1S	R1E	12	Grand Prairie
Jefferson	4	T1N	R3E	02	Field
Jefferson	10	T1N	R3E	04	Field
Lawrence	4	T5N	R13W	29	Petty
Lawrence	2	T4N	R12W	07	Petty
Lawrence	2	T2N	R13W	23	Lukin
Lawrence	2	T2N	R13W	30	Lukin
Lawrence	1	T3N	R13W	22	Christy
Lawrence	1	T3N	R13W	26	Christy
Macoupin	1	T12N	R7W	12	North Offer

Appendix I (cont.)

COUNTY	SHRIKES OBSERVED	TOWNSHIP	RANGE	SECTION	TOWNSHIP
Marion	4	T1N	R3E	34	Haines
Marion	1	T1N	R2E	19	Haines
Marion	2	T1N	R3E	18	Romine
Marion	1	T4N	R2E	21	Kinmundy
Marion	2	T3N	R4E	09	Omega
Marion	1	T3N	R3E	08	Alma
Marion	1	T3N	R3E	04	Alma
Morgan	1	T15N	R10W	31	Rd Dist. 7
Morgan	2	T16N	R12W	12	Rd Dist. 4
Morgan	4	T15N	R11W	06	Rd Dist. 10
Morgan	2	T15N	R11W	34	Rd Dist. 6
Pike	1	T6S	R2W	30	Montezuema
Richland	1	T3N	R9E	33	Denver
Richland	1	T4N	R9E	05	Denver
Richland	3	T4N	R10E	13	Preston
Richland	4	T3N	R8E	20	Noble
Richland	2	T2N	R10E	08	Madison
Richland	1	T2N	R10E	08	Madison
Richland	1	T2N	R10E	10	Madison
Richland	1	T2N	R11E	19	Madison
Richland	1	T3N	R9E	33	Noble
Wabash	1	T2S	R13W	01	Rd Dist. 5
Wabash	1	T1N	R12W	08	Rd Dist. 6
Wabash	1	T1N	R13W	21	Rd Dist. 2

Appendix I (cont.)

COUNTY	SHRIKES OBSERVED	TOWNSHIP	RANGE	SECTION	TOWNSHIP
Wayne	1	T1N	R6E	23	Indian Prairie
Wayne	1	T1N	R7E	30	Bedford
Wayne	1	T1N	R8E	23	Elm River
Wayne	6	T1N	R9E	17	Mt. Erie
Wayne	1	T1N	R8E	30	Elm River
Wayne	1	T1N	R8E	32	Elm River
Wayne	1	T1S	R6E	10	Berry
Wayne	2	T1S	R6E	16	Berry
Wayne	1	T1S	R6E	34	Berry
Wayne	2	T1S	R8E	36	Jasper
Wayne	1	T2S	R5E	21	Four Mile
Wayne	2	T2N	R5E	34	Garden Hill
Wayne	2	T2N	R5E	28	Garden Hill
Wayne	1	T2N	R5E	28	Garden Hill
Wayne	1	T2N	R5E	27	Garden Hill
Wayne	1	T2N	R6E	21	Keith
Wayne	2	T2N	R6E	28	Keith
Wayne	1	T2N	R7E	21	Keith
Wayne	1	T2N	R7E	28	Keith
White	3	T3S	R9E	27	Burnt Prairie
White	1	T4S	R9E	11	Burnt Prairie
White	5	T4S	R9E	09	Burnt Prairie
White	2	T6S	R8E	10	Indian
White	1	T6S	R9E	27	Heralds

Appendix I (cont.)

COUNTY	SHRIKES OBSERVED	TOWNSHIP	RANGE	SECTION	TOWNSHIP
White	3	T7S	R10E	17	New Haven