unusual for the chick to leave the egg-nest when it did. No other chick had been observed outside the egg-nest before the majority of eggs (at least 3) had hatched. Nothing in the parents' behavior appeared to have forced the chick from the nest. Perhaps the male's physiological state at the time the chick left the nest was not conducive to responding appropriately (i.e., brooding) to the presence of chicks (Beer, Behaviour 26:190–214, 1966). He may have had conflicting tendencies to incubate the eggs and to brood the chick, or simply was not motivated to brood. Why he ate the chick is not known.

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Influence of various land uses on windbreak selection by nesting Mississippi Kites.— Contemporary land-use practices have dramatically altered breeding habitats of birds of prey (Cramp, pp. 9–11 *in* World Conf. Birds of Prey, R. D. Chancellor, ed., ICPB, London, England, 1977). Some land uses appear to influence strongly both the nesting activity (White, Trans. North Am. Wildl. Nat. Resour. Conf. 39:301–312, 1974) and abundance (Olendorff and Stoddart, pp. 44–48 *in* Management of Raptors, F. N. Hamerstrom, B. E. Harrel, and R. R. Olendorff, eds., Proc. Conf. Raptor Conserv. Tech., Raptor Rep. 2, Fort Collins, Colorado, 1974) of raptors.

The Mississippi Kite (*Ictinia mississippiensis*) is a locally common raptor of the south-central plains of North America. In the prairie grasslands of western Oklahoma and south-western Kansas, kites commonly nest in tree plantings designed as windbreaks, irrespective of windbreak width, age, or tree species composition (Parker, Ph.D. Diss., Univ. Kansas, Lawrence, Kansas, 1974; Love and Knopf, Proc. Ann. Meet. For. Comm. Great Plains Agric. Counc. 30:69–77, 1978). Much of the potential nesting habitat within this region, however, is not used by kites (Parker and Ogden, Am. Birds 33:119–129, 1979). In this paper, we assess the potential influence of various land-use practices on windbreak selection by nesting Mississippi Kites.

Study area and methods.—The study areas were located in Clark and Meade counties, southwestern Kansas; and Ellis, Harper, and Roger Mills counties, northwestern Oklahoma. The region is classified as bluestem–grama prairie (*Andropogon–Bouteloua*) and grama–buffalo grass plains (*Bouteloua–Buchloe*) by Kuchler (Potential Vegetation of the Conterminous United States, Am. Geogr. Soc., New York, New York, 1964). Agricultural lands frequently contained plantings of wheat, sorghum, and, occasionally, alfalfa. Native deciduous vegetation generally was limited to narrow belts of riparian woodland dominated by cottonwood (*Populus deltoides*), and aggregations of shinnery oak (*Quercus havardii*). Tree species commonly present in planted windbreaks were black locust (*Robinia pseudoacacia*), eastern red cedar (*Juniperus virginiana*), elm (*Ulmus* spp.), green ash (*Fraxinus pennsylvanica*), osage orange (*Maclura pomifera*), and Russian mulberry (*Morus alba*). Conifers usually comprised the sides of tree plantings that received the prevailing winds.

Systematic searches for kite nests were conducted at 89 windbreaks during June and July of 1977 and 1978. Windbreaks were classified as unused, with 1–2 kite nests, or with >2 nests.

TABLE 1

DESCRIPTIONS OF LAND-USE CATEGORIES USED IN THE STUDY

Land-use category	Description
Wheat fields	Green harvestable stubble or mulch.
Cropland	Sorghum and small grains other than wheat.
Irrigated cropland	Fields of alfalfa; rarely wheat or cotton.
Sage	Dominated by sand-sagebrush, including shinnery.
Degenerating grassland	Overgrazed and eroded sand-sagebrush and shortgrass plains.
Grassland	Prairie and pasture not degenerating.
Bottomland forest	Riparian woodland.
Upland forest	Including other windbreaks.
Windbreak measured	
Water	Permanent bodies of water.
Homesteads	
Roads and rights-of-way	
Other land uses	Includes petroleum drilling operations, golf courses, etc.

Land-use practices were quantified from aerial photographs (scale 1:20,000) for circular areas 2 km from the middle of a given windbreak. The centers were established arbitrarily to standardize the analysis for unused windbreaks and those used by >1 pair of kites. Land was classified in 13 categories according to vegetation cover (Table 1). Kites may feed at a distance from their nests (Skinner, Auk 79:273–274, 1962); to accomodate the potential influence of distance from the windbreak, the amount of each cover-type was measured for two concentric zones from 0 to 1 km (zone 1) and 1 to 2 km (zone 2).

The area of windbreak in zone 2 was invariate; this variable was eliminated. Thus, 25 variables were generated from the 13 cover-types and two zones. In addition, six variables identifying characteristics of the windbreak itself were measured. These included the length of the windbreak, its width, the number of tree rows, the number of snags, and two variables measuring the distance to a road from the closest point to the road and from the center of the windbreak.

Thirty-six windbreaks were used in the analysis. We chose windbreaks of different classes (i.e., unused, with 1–2 nests, and with >2 nests) that were at least 4 km apart in any year to avoid overlaps in land area.

The 31 variables were standardized (Y = 0.0, SD = 1.0) and the matrix of variables and windbreaks subjected to principal components analysis (PCA) using NT-SYS (Numerical Taxonomy System; Rohlf et al., NT-SYS. Numerical Taxonomy System of Multivariate Statistical Programs, State Univ. New York, Stony Brook, New York, 1979). PCA draws new axes through the data orthogonal (and thus uncorrelated) to each other and ordered on the basis of the amount of total variation explained (Morrison, Multivariate Statistical Methods, McGraw-Hill Book Co., New York, New York, 1976; Neff and Marcus, A Survey of Multivariate Methods for Systematics, Am. Mus. Nat. Hist., New York, New York, 1980); the first principal components axis would account for the most variation, etc. Components axes were then used as new variables, each component representing a gradient formed by the combination of original variables with high loadings (i.e., correlations) onto it.

The values of the windbreaks on the PCA axes were subjected to analysis of variance

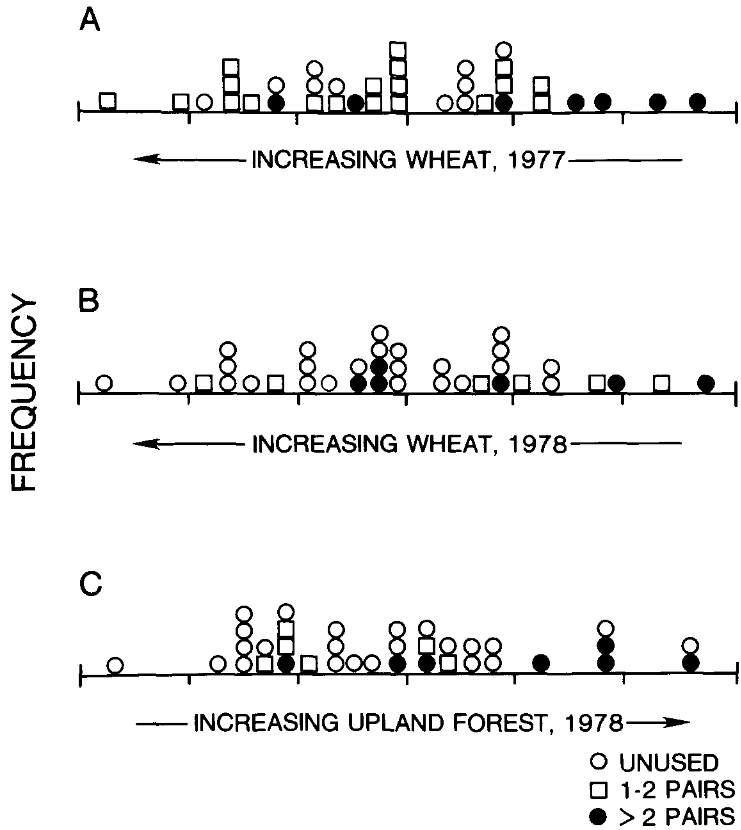

FIG. 1. Projections of windbreaks onto principal component 1 for 1977 (A) and 1978 (B), and component 3 for 1978 (C). See Table 2 for more complete descriptions of these axes. Use is for pairs of nesting Mississippi Kites.

(ANOVA) and Duncan's multiple range test using SAS package programs (Helwig and Council, eds., SAS User's Guide, SAS Institute, Cary, North Carolina, 1979), where the treatments or groups are the kite occupancy classes. Bartlett's Test (Sokal and Rohlf, Biometry, W. H. Freeman and Co., San Francisco, California, 1969) was used to determine if the homogeneity of variance assumption was met for the groups on each components axis.

The new variables were derived independently of the kite occupancy classes; however, if the presence of these groups increases the variation, these groups should contribute most to the first principal component. These groups would then contribute least to the variation of the second component, because it is orthogonal and uncorrelated with the first. Thus, the analysis presented here should extract the gradient from the data on which kites occur nonrandomly, and verify if such a result is likely to be significant biologically.

Results.—The number of active kite nests differed greatly between years. Five of 36

TABLE 2

DESCRIPTION OF THE FIRST THREE PRINCIPAL COMPONENTS AXES FOR 1977 AND 1978[a]

Principal component	1977	1978	% Variation explained 1977	% Variation explained 1978
1	D[b] Wheat	D Wheat	17.7	17.5
	D Rights-of-way	I Windbreak		
	I Sage	D Rights-of-way		
	I Windbreak	D Cropland (zone 1)		
	D Homesteads	I Sage		
	I Grassland (zone 1)	D Homesteads		
	D Cropland (zone 2)			
2	I Water (zone 2)	I Water (zone 2)	13.1	13.0
	D Distance to roads	D Degenerating grassland		
	D Degenerating grassland	I Bottomland forest		
	I Bottomland forest	I Grassland (zone 2)		
	I Grassland (zone 2)	D Distance to roads		
3	I Upland forest	I Upland forest	9.3	7.8
	I Water (zone 1)	I Water (zone 1)		
	I Windbreak	D Other land-uses		

[a] Tables giving the loadings of vegetation cover variables are available from the authors.
[b] Variables are listed in decreasing order of importance for each component. See Table 1 and text for descriptions of variables. D = Decreasing; I = Increasing.

windbreaks (14%) had more kite nests in 1978 than in 1977, and 21 (55%) had fewer; 27 of 36 windbreaks (75%) were used by at least one pair of kites in 1977, but only 13 (36%) were used in 1978. Six windbreaks (17%) were not used in either year; two (6%) were used by 1–2 nesting kite pairs both years; and five (14%) were used by >2 kite pairs both years.

A summary of the most important variables for the first three components in each year is given in Table 2. The results of the ANOVA's for the 1977 data indicate a highly significant relationship for component 1 ($F = 4.99$, $P < 0.01$), but not for component 2 ($F = 0.57$, $P > 0.57$). Land surrounding windbreaks with high values for component 1 is characterized most strongly by less wheat, and also by more grassland in zone 1, more sage, and fewer homesteads, roads, and rights-of-way (Table 2). Windbreaks with the highest values on component 1 were used heavily by kites (Fig. 1A) with 7, 8, and 9 nests per windbreak. Windbreaks used by three or more pairs of nesting kites were significantly different from the other windbreaks on component 1 (Multiple range test, $P < 0.05$), but windbreaks used by 1–2 nesting kite pairs and unused windbreaks did not differ from each other significantly ($P > 0.05$).

Whereas six of the seven windbreaks with the lowest values on component 1 were used for nesting by at least one pair of kites, only one of these seven was used in 1978 (Fig. 1B). Thus, kites generally did not use the areas with the highest wheat values in 1978. The three windbreaks with high values on component 1 had 2, 4, and 10 kite nests. Component 1 for the 1978 data was similar to that in 1977 (Table 2); however, the ANOVA for the first component was not significant ($F = 2.05$, $P > 0.14$), nor was the ANOVA for the second component ($F = 0.41$, $P > 0.67$). The ANOVA for the third component in the 1978 data was significant ($F = 3.76$, $P < 0.05$); a multiple range test again separated the heavily used windbreaks from the other windbreaks on this component ($P > 0.05$). Heavily used windbreaks were at the upper values of component 3 (Fig. 1C); the lands surrounding these windbreaks were characterized by more upland forest (including windbreaks), more surface area of water, and less of the other land-use category (Table 1).

Discussion.—Kites tended to use the larger windbreaks that were surrounded by more native vegetation with less agricultural land, and with fewer nearby homesteads and roads than the overall sample. Kalla and Alsop (Am. Birds 37:146–149, 1983) also noted an avoidance of "farmland" (much of which was in soybean production) by kites in Tennessee. Kites, however, are frequently found in towns with much human activity, and appear to be very tolerant of human disturbance (Parker 1974, Parker and Ogden 1979).

Parker and Ogden (1979) argued that kite populations in the Great Plains have benefited from an increase in prey populations, primarily Orthopterans, caused by irrigation and overgrazing. Wheat, however, is a dryland crop which would not enhance prey populations, making lands with substantial wheat marginally suitable for kites. Kites foraging on large insects can be opportunistic (Skinner 1962, Parker 1974), and could depend on ephemerally abundant prey from a variety of habitats; however, wheat cropland would have limited capacity for such foraging opportunities.

High occupancy rate of windbreaks in preferred areas may induce some kites to use windbreaks surrounded by marginal or deficient habitat. Lands surrounding most windbreaks were planted primarily in wheat. This may explain the general scatter of points for the unused windbreaks and windbreaks used by 1–2 pairs of nesting kites, and the lack of significant differences between classes on component 1 in the 1978 data (Fig. 1B).

The mosaic distribution of land-use types also may influence windbreak use by nesting kites. Glinski and Ohmart (Condor 85:200–207, 1983) argued that vegetation patchiness enhanced foraging success, and thus reproduction, in kites. The birds they studied in Arizona foraged in a patchy arrangement of cottonwood and salt cedar (*Tamarix chinensis*). Kites were common in many towns in our study area (Parker 1974) and in the cross-timbers scrubland of west-central Oklahoma (pers. obs.); both present a mosaic patchwork of open and treed areas. Windbreaks themselves can create a patchy mosaic. In addition to providing nesting sites and potential habitat for prey, their arrangement in patches with other nonwheat habitat types may enhance foraging opportunities for kites by creating "edge," and by locally reducing wind speeds.

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