

MEASUREMENTS OF THE HABITAT NICHE OF THE LEAST FLYCATCHER

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EXACT measurements of habitat niches occupied by higher animals, particularly birds, have been difficult to make and few have been reported. During a recent six-year study of the breeding birds of an upland oak habitat, opportunity arose to measure certain elements influencing the distribution of Least Flycatchers (*Empidonax minimus*). A 20-acre study plot had been chosen for the study since it appeared to be homogeneous habitat. A population of about 60 pairs of Least Flycatchers per 100 acres nested in the area. Year after year these birds were recorded as occupying one particular half of this tract almost exclusively. Obviously some rather subtle environmental differences were influencing the birds' choices of nesting sites. For this reason, an analysis of the habitat was undertaken.

The study-tract lies about 35 miles north of Minneapolis, Minnesota, and within the limits of the University of Minnesota-owned Cedar Creek Research Forest. The dominant tree of the plot was the northern pin oak (*Quercus ellipsoidalis*). A few bur oaks (*Q. macrocarpa*) and some jack pines (*Pinus banksiana*) were scattered throughout the area. A few large white pines (*Pinus strobus*) and a small number of white birch (*Betula papyrifera*) and red maple (*Acer rubrum*) trees occurred. The height of the overstory was mostly 40 to 50 feet with an occasional northern pin oak and some of the white and jack pines rising to 70 feet. Here and there one or a few of the scattered dead trees had blown down causing small openings in the forest crown. The shrub story was made up largely of young oaks, Juneberries (*Amelanchier* sp.), wild cherries (*Prunus serotina* and *P. virginiana*), red maple (*Acer rubrum*) and hazel (*Corylus americana*). This layer varied in abundance, being denser under the openings in the forest crown. The ground cover varied from sparse to moderate with two species of blueberries (*Vaccinium angustifolia* and *V. canadense*), bracken (*Pteridium aquilinum*), Solomon's seal (*Polygonatum canaliculatum*) and wild sarsaparilla (*Aralia nudicaulis*) being common along with a sparse growth of grasses and sedges.

In this study area the Least Flycatcher nested almost invariably from 10 to 30 feet above the ground in vertical forks of small trees. Its territories were small, usually less than one acre in extent, and were of the type wherein courtship, nesting, and the feeding of the nestlings all took place within these narrow limits. The feeding birds darted out from convenient lookout perches to capture prey, then alighted on another perch, and another and another in succession as they circulated throughout their territories. Singing continued throughout their feeding periods. The estimated heights in feet of

29 successive perches used by an individual flycatcher were recorded on July 9, 1954. The extremes in this particular series, 8 and 35 feet, are representative of what had been observed for other individuals over the years. This stratum used by the Least Flycatchers extended vertically from the top of the shrub stratum up to the leafy canopy of the forest overstory.

Figure 1 is a copy of the map of the area used in recording field observations. The numbers appearing in the half-acre plots represent the total recorded observations of the Least Flycatcher for each plot as recorded in the regular breeding-bird censuses of 1948 through 1954 (1953 excepted). Since these are based on over 108 hours of observation extending over six years, during which time all species were being recorded and all parts of the tract receiving similar attention, it is assumed that these figures represent an unbiased, numerical evaluation of the amount of use made by the birds

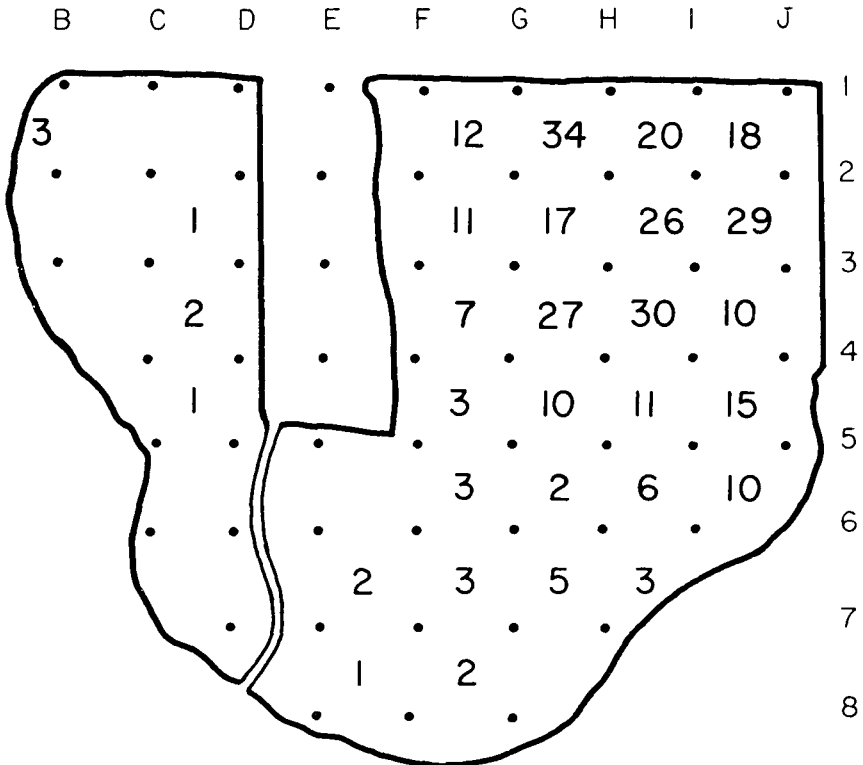


FIG. 1. Map of the Least Flycatcher census area. Numbers on the half-acre plots record the numbers of observations as indicating use of that portion of the habitat by flycatchers during six years of censusing on this 20-acre area.

TABLE 1
NUMBERS OF TREES AND HAZEL SHRUBS ON STUDY PLOTS

Plot Number Use by Birds ¹	Heavy Use		Moderate Use		Little or No Use	
	G34 H34	H23 I23	F23 G23	G45 H45	C34 D34	E56 F56
	27	26	11	10	2	0
N. Pin Oak	129	115	109	168	230	272
Bur Oak	32	19	34	18	6	3
Jack Pine	15	44	66	2	0	18
White Pine	1	1	1	0	3	2
White Birch	2	7	0	0	12	0
Total Trees	179	186	210	188	251	295
	356		398		546	
Hazel 3 ft. 6 in. or larger	477	1982	858	198	45	31

¹Values refer to numbers of observations plotted in Figure 1.

of the various half-acre plots. This pattern of use was essentially the same during each of the six seasons of the study.

Several possible elements of the environment were studied in sample plots to ascertain which might be correlated with flycatcher use. First, it seemed reasonable to suspect that the abundance of certain species of trees (1-inch DBH and larger) or shrubs was influencing the birds. Accordingly, a census was made of the trees and shrubs in six half-acre plots, two each in the little-used, moderately-used, and heavily-used areas (Table 1). Of the forest tree species present, only the northern pin oak, bur oak, and jack pine were sufficiently abundant to influence habitat selection. The least-used plots definitely had the least number of bur oaks but no difference existed between the numbers of these oaks in the moderately- and heavily-used areas. Variation existed in the numbers of jack pines present but in no way were these correlated with flycatcher use. The numbers of the dominant northern pin oaks varied inversely with the use by the flycatchers when total numbers for each pair of the three areas classified according to use were considered: 244 in the two heavy-use plots, 277 in the two moderate-use plots, and 502 in the two little-use plots. However, marked discrepancies in this relationship between individual plots indicated that this probably was not the critical element influencing flycatcher behavior.

A census of trees in different size classes was then undertaken (Table 2). The numbers in the two larger size classes showed no variation which correlated with flycatcher use. In the two smaller classes, the plots with the most trees had the least use by the birds, but these figures do not differentiate between moderate- and heavy-use areas.

It was noticed that the growth of hazel varied between different plots. William Hsuing's ecological study of an allied species, the beaked hazel, *Corylus cornuta*, (1951. Unpubl. thesis, Univ. Minnesota Library) showed

TABLE 2
NUMBERS OF TREES ON STUDY PLOTS
ENUMERATED BY SIZE GROUPS (DIAMETER BREAST HIGH)

Plot	Trees 1 to 2 $\frac{7}{8}$ in.	Trees 3 to 6 $\frac{7}{8}$ in.	Trees 7 to 9 $\frac{7}{8}$ in.	Trees Over 10 in.	Totals
G3/4 H3/4 Heavy Use	44	81	40	14	179
H2/3 I2/3	42	71	57	16	186
F2/3 G2/3 Mod. Use	48	80	66	16	210
G4/5 H4/5	54	68	41	25	188
E5/6 F5/6 Little Use	130	106	44	15	295
C3/4 D3/4	74	120	47	10	251

that the growth usually increases with the increased light resulting from openings in the forest crown. Accordingly, counts were made of the hazel stalks 3 $\frac{1}{2}$ feet high or higher in six representative half-acre plots (Table 1). The total numbers of hazel plants in the three use classes varied directly with flycatcher use.

However, one plot used moderately had nearly twice as much hazel (858) as did one of the plots having heavy use (477). This result suggested that the degree of closure of the forest crown was related to flycatcher use but again this measurement did not differentiate between medium- and heavy-use areas.

Examination of the varying conditions in this habitat finally suggested that the real limiting factor was the degree of openness just beneath the forest crown; in other words, the abundance and distribution of limbs intersecting the zone of use of the flycatchers (8 to 30 feet in height) beneath the leafy forest canopy. The technique devised to measure this condition was to elevate to various heights a closed umbrella frame which was then opened to 42 inches in diameter and a record made of whether it did (+) or did not (—) touch a branch in opening. This was accomplished with the use of a sectional bamboo pole with control strings for opening the umbrella frame. Readings were made at four different levels (8, 15, 20, and 25 feet) and these measurements were repeated at five-step intervals along six or seven string-marked lines intersecting each half-acre plot, making 264 or 308 readings on each plot. Six plots were so measured (Table 3), two plots each representing the little-used, moderately-used and heavily-used areas. In this table the percentage of openings of the testing frame in which no obstructions were encountered is designated as the percentage of openness.

In this series the percentage of openness is correlated directly with flycatcher use to a surprising degree.

TABLE 3
MEASUREMENTS OF THE FREQUENCY OF OPEN SPACES IN THE
BRANCHES BENEATH THE FOREST CANOPY

Plot Number	Little used		Moderately used		Heavily used	
	E56 F56	C34 D34	G45 H45	F23 G23	G34 H34	G12 H12
No. Flycatcher Observations	0	2	10	11	27	34
No. Readings	264	308	264	308	308	308
Percent of Openness	26.5	23.4	36.4	37.0	45.1	48.7

It thus appears that limb density in a forest habitat is a critical factor in limiting its use by Least Flycatchers and that the density threshold beyond which the habitat became unsuited to their use was reached within the narrow limits existing in this study tract.

Pertinent to this study of the nesting territory of the Least Flycatcher is the observation that far higher populations of 200 and 271 pairs per 100 acres were recorded by MacQueen (1950. *Wilson Bull.*, 62:194-205) in two seasons' study at the Michigan Biological Station at Douglas Lake, Michigan. Her description of the environment is similar to that of this study but involved different species of trees, and included more small openings. This Douglas Lake habitat probably represents more nearly the optimum for this flycatcher, since no denser populations have been reported. Habitats more open than that at Douglas Lake would doubtless support smaller populations and would represent the approach toward the opposite (more open) limb density threshold from the one dealt with in the present study. MacQueen states that in a more closed type of forest near the station 60 pairs per 100 acres were found. This latter habitat (presumably with denser branching beneath the canopy) probably more nearly resembled the habitat in this study and correspondingly it had a comparable Least Flycatcher population.

Furthermore, it is probable that the territories of birds such as these can be measured better in three dimensions rather than in two. In this connection, the observation of Saunders (1936. *New York State Mus. Handb.* No. 16) that orchards commonly attracted small populations of these flycatchers (12 pairs per 100 acres) appears to bear out this suggestion. The low growth form of orchard trees reduces the vertical dimension of the canopied habitat, forcing the birds to extend their territories horizontally to secure the same cubic content of favorable habitat.