January 1972

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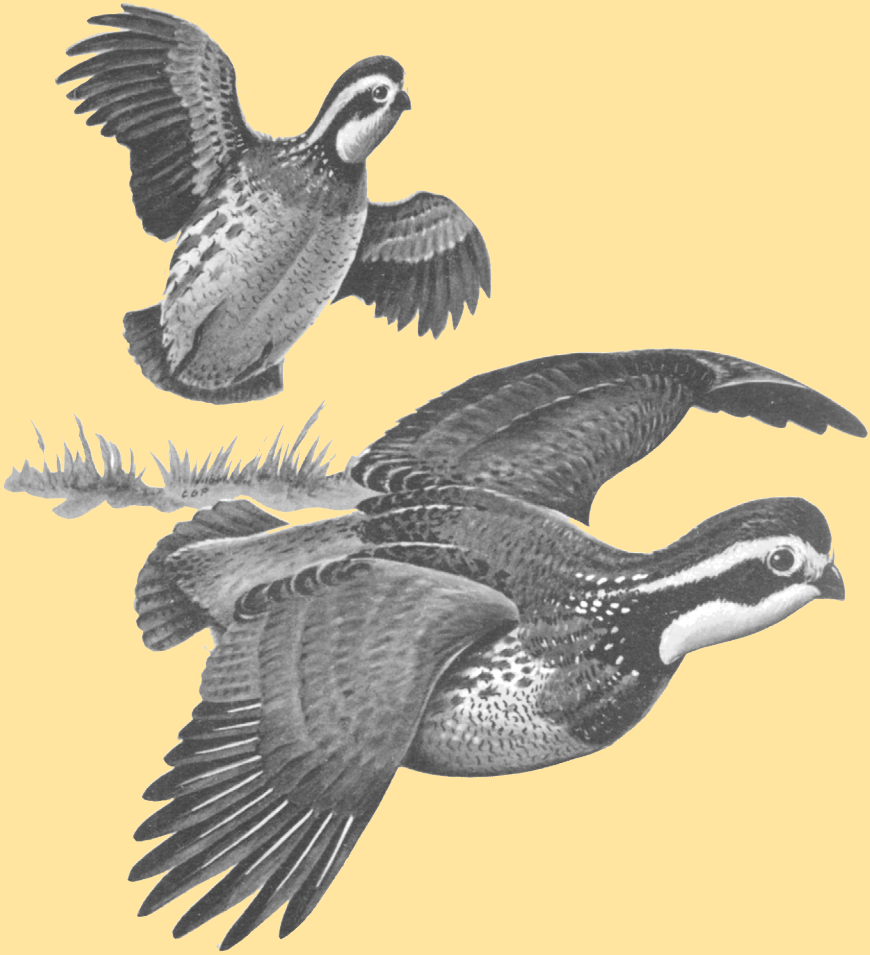

THE INTERSPERSION INDEX AS A TECHNIQUE FOR EVALUATION OF BOBWHITE QUAIL HABITAT*

by

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1972

* A contribution of Federal Aid to Fish and Wildlife Restoration Project W-15-R

Some forty years ago, the concept of habitat interspersion was advanced by Aldo Leopold (1931). Indicating then that "we are only on the threshold of an understanding of the ecology of game species," Leopold went on to postulate his law of interspersion which recognized that "game is a phenomenon of edges." Although the validity of Leopold's premises has been documented both directly and indirectly many times in the past four decades, the complexity and frustration in describing ecological diversity of game range has continued to pose a problem for wildlife managers since 1931.

On the basis of recognition and use alone, the terms interspersion and diversity were not commonly part of the wildlife jargon for many years. Even though the concepts were recognized, they were undefined from the quantitative and qualitative aspects. The Wildlife Review, for example, carried neither of these terms in its index from 1935 to 1951. Hammerstrom, Mattson and Hammerstrom (1957) were perhaps the earliest investigators to demonstrate the validity of Leopold's concepts in their work to maintain the prairie chicken in Wisconsin. They related the interspersion of habitat types to the mobility of the species as well as considering the tolerance of the species to variation in composition and interspersion of habitat. In 1964, Kelker rephrased Leopold's law stating "the abundance of resident species requiring two or more cover types appears to depend on the interspersion of numerous small blocks of such types."

More recently, Pimlott (1969) stated, "the message is clear that diversity of habitat is the life blood of the majority of species and the ramifications extend from the subsistance of an individual to the viability of a population and to the survival of the species." Assuming that most wildlife managers agree with this premise, the task in developing a method for habitat diversity evaluation becomes a very real need.

That early wildlife investigators recognized habitat deficiencies and the management steps needed to correct them is evident. Stoddard (1931), in his monumental

classic on bobwhite quail management, listed in detail the steps needed for transforming nonproductive quail cover to that capable of producing and carrying significant bobwhite densities. Leopold, op. cit., and Errington and Hammerstrom (1936) provided the basic approach to studying food and cover requirements for effective game management. Fundamental habitat concepts were delineated by Kabat and Thompson (1963) as related to Wisconsin bobwhites. Their quail: hedgerow-mile index was a primary step in providing a useable descriptive tool for game managers. Leopold's interspersion concepts were finally "coming home."

Today's rapid change in land-use patterns coupled with ever-increasing human demand factors has placed an increasing burden on the contemporary wildlife manager. Faced with the need to optimize every environmental effect, and to defend his decisions, a definitive expression of habitat quality is a management need. This need, in recent years, has not confined itself to wildlife interests alone. Resource planners, also, have found themselves in situations where there is a pressing need for describing recreational land values and potentials for management. There is now an additional need for interfacing wildlife habitat values with highway corridors, urban and rural population shifts, and other land use changes brought about by expanding technology and economic growth.

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Because of the recognized need to define habitat quality in Nebraska's quail management program, a study was initiated to empirically measure the quality of quail habitat and to determine if this could be related to quail population indices.

The study area consisted of three counties, containing some of Nebraska's best bobwhite habitat, located in the southeast portion of the State. From

north to south, they included Cass, Otoe and Pawnee Counties.

Cass, Otoe and Pawnee Counties are part of an eroded glacial drift plain capped with Loveland and Peorian loess, both wind-deposited formations. The soils which developed under the influence of tall-grass vegetation are characterized by high organic matter, granular structure, and a comparatively uniform chemical composition.

The climate in this region is typical of an area situated near the center of a large continent in the temperate zone; it is characterized by warm summers, cold winters and moderate precipitation. The mean annual temperature is approximately 51° F; the mean annual precipitation is 30 inches; and the mean relative humidity is 70 percent. The average growing season is 156 to 167 days.

Procedures

Preliminary studies, based on preexisting 20-mile bobwhite audio-census routes, were devised to provide quantitative data regarding land use in the three counties. Aerial photographs were examined in the county ASCS offices to measure existing land use along each route. Using a polar planimeter, habitat acreage determinations were made for one-half mile transects along each side of the route based on the following classification:

1. Cropland (row crops, small grains, legumes)

2. Grassland (pastures, native prairie, grassed waterways, fence rows)

3. Woody vegetation

4. Farmsteads (parcels of land containing houses, outbuildings, etc.)

5. Miscellaneous (stock ponds, quarries, roadways)

Assuming that the audio-census used in these counties provided an accurate index of the number of whistling males within one-half mile of the census route, we elected to measure the habitat in a belt along the length of the route and extending laterally one-half mile on each side. We located the audio-census route on aerial photographs (660 ft./inch scale) and then superimposed the sample transect along the route extending the width to 1/2-mile on each side of the route.

We derived the interspersion index by drawing lines diagonally across each quarter section of land bordering the audio-census routes (Figure 1), then counting the number of times the established vegetation classifications changed along the course of each line. The number of changes in each line in each quarter section was summed (Figure 2). Each quarter section total was summed to determine the total for each route. This was our interspersion index for the county:

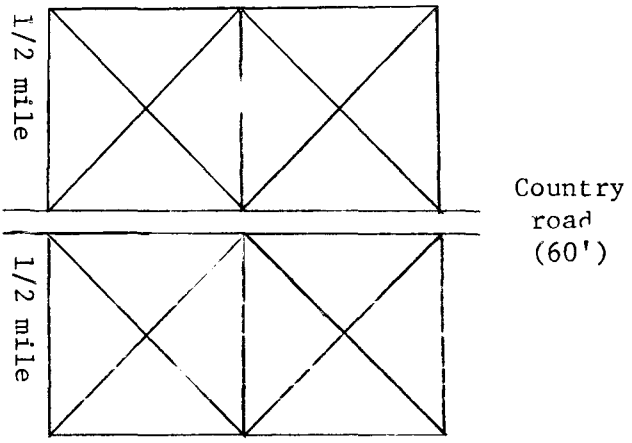
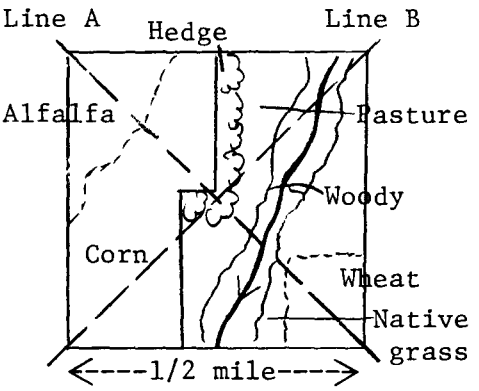


Figure 1. Diagram of diagonal lines used in calculating the interspersion index.

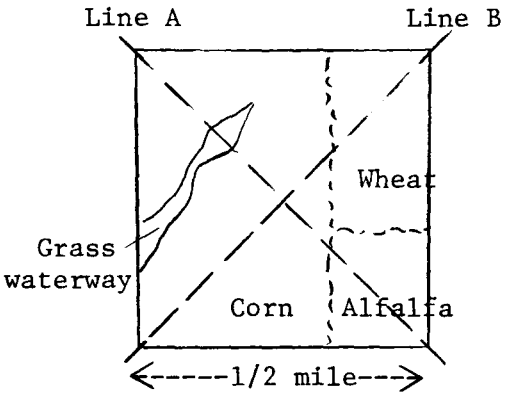
The interspersion index simply represented the number of changes from one cover type to another. The relationship of the interspersion index to the audio-census data for each route was made using linear correlation methods.

SAMPLE CALCULATION INTERSPERSION INDEX



Area 1

Line A = 6
Line B = 5
I-index = 11



Area 2

Line A = 3
Line B = 1
I-index = 4

Figure 2. Determinaton of interspersion index from simulated aerial photograph.

Findings

Land use along the three county quail census routes as determined from aerial photographs is presented in Table 1.

Table 1. Land-use patterns of Cass, Otoe and Pawnee Counties

Land-use	CASS		OTOE		PAWNEE	
	Acres	% Total Acres	Acres	% Total Acres	Acres	% Total Acres
Cropland	10,828.5	83.81	9,685.8	78.21	5,801.3	43.69
Grassland	747.2	5.78	1,590.6	12.85	5,001.5	37.66
Woodland	1,111.0	8.60	981.9	7.93	2,298.7	17.31
Farmsteads	153.7	1.19	105.6	0.85	130.7	0.98
Miscellaneous	79.8	0.62	20.1	0.16	47.8	0.36
TOTAL ACRES SAMPLED	12,920.2	100.00	12,384.0	100.00	13,280.0	100.00

The number of acres sampled along the transects ranged from 12,384 in Otoe County to a high of 13,280 in Pawnee County. These data show that very noticeable land use differences existed among the counties. The intensity of agricultural land use decreased from north to south. Approximately 84 percent of the land along the Cass County route was classified as cropland. In Pawnee County, slightly less than 44 percent of the land was in this category. Cropland comprised 78 percent of the land along the Otoe County route.

The amount of grassland in the counties was inversely related to cropland. The percentage of grassland increased from north to south. Cass, the northernmost county, had approximately one-half as much grassland as Otoe County and one-sixth as much as Pawnee County, the southernmost county.

There were approximately twice as many acres of woody vegetation along the Pawnee County route as there were along either of the other routes with the smallest acreage occurring in Otoe County. Since woody cover is considered an essential element of the bobwhite's habitat needs, we felt that a closer examination of woody cover characteristics was in order.

We examined the woody cover in the northernmost and southernmost counties with respect to acreage and cover type according to the following classification:

1. Windbreaks (multiple row tree plantings; usually associated with farm buildings)
2. Hedgerows
3. Woodland tracts less than three acres
4. Woodland tracts 3 to 5 acres
5. Woodland tracts 5 to 10 acres
6. Woodland tracts greater than 10 acres

Table 2 shows the distribution of woody cover areas by acreage and type in Cass and Pawnee Counties. Pawnee County exceeded Cass County in every category except windbreaks.

Table 2. Extent and distribution of woodland vegetation

Woodland Class	CASS		OTOE		PAWNEE	
	Acres	% Total Woody	Acres	% Total Woody	Acres	% Total Woody
Windbreak	143.1	12.88	(Data not collected)		136.9	5.96
Hedgerow	64.9	5.84			332.0	14.44
<3 Acres	150.5	13.55			428.3	18.63
3-5 Acres	121.0	10.89			159.5	6.94
5-10 Acres	174.4	15.70			320.0	13.92
>10 Acres	457.1	41.14			922.0	40.11

The differences in categories such as hedgerows and plots up to five acres in size were of particular interest. Pawnee County had five times as many acres in the hedgerow category, 2.8 times as many tracts of woody cover less than three acres in size, and 1.3 times as many acres devoted to the 3-to-5 acre class.

The interspersion index values for the three counties were: Cass County - 404; Otoe County - 631; and Pawnee County - 984 (Table 3).

Preseason inventories of bobwhite quail populations are routinely conducted each year during July using a standardized audio-index or whistle count. Means from the Game Division's preseason inventories of bobwhite quail for the years 1964-1967 are shown in Table 3.

Table 3. Preseason inventories of bobwhite quail. Average number of calls per stop (4 years) and interspersion indices.

	CASS	OTOE	PAWNEE
Mean number of calls per stop (1964-1967)	1.88	2.50	5.14
Interspersion index	404	631	984

The bobwhite quail is a species characteristically associated with edge. The interspersion indices indicated that Pawnee County had more junctions of plant communities per unit area than Cass or Otoe Counties. Therefore, the higher preseason population inventories in Pawnee County were felt to be an expression of greater interspersion of habitat. The relationship between the interspersion and whistle-call indices was tested by linear correlation. The calculated r value of 0.976 indicated a significant correlation between quail numbers and the frequency of cover type change.

Modifications of this technique have been utilized by others within our agency as well as by other agencies.

Game Division technicians have applied a field modification of this technique in most quail areas of the state. After completion of the whistle-count route, the technician reverses direction and travels the route visually recording all changes from any cover type to woody cover in or immediately adjacent to the road right-of-way. The number of cover type changes recorded were used as an index to interspersion of woody cover in the counties. Correlation analysis of this data has indicated that a highly significant relationship exists between this index and the whistle-call index.

The interspersion index method was also used to assign wildlife values to each section of land in an 11-county ecological study conducted by our planning personnel (1972). The goal of this study was to assemble information needed in the decision-making process for the conservation and enhancement of the environmental resources which have significant fish and wildlife, outdoor recreation, cultural, historic, scientific or educational values. As used in that study, the term "wildlife" meant upland game species and song birds.

Van Doren, Hazard, Stallings, and Schnacke (1971), consulting engineers for the State Department of Roads, used a highly detailed modification of the Interspersion Index to assign wildlife values to a corridor study for freeway bypasses at Lincoln, Nebraska. In determining the locations having the least social cost, 10 elements including wildlife were utilized in an overlay system similar to those utilized by McHarg (1969).

Conclusions

An index based on the interspersion of vegetative types proved useful in evaluating quail habitat. Application of the technique for related studies indicated that interspersion indices may find wider application for assessing habitat deficiencies, for evaluating land areas for production of a diversity of wildlife species, and for planning purposes.

Literature Cited

Anonymous. 1972. Environmental features study of the eastern Nebraska urban region. Rept. prepared by Planning Section, Nebr. Game & Parks Commission for State of Nebraska, Office of Planning & Programming.

Errington, P. L. and F. N. Hammerstrom, Jr., 1936. The northern bobwhite's winter territory. Iowa Agr. Exp. Sta. Res. Bull. 201:301-443.

Hammerstrom, F. N., O. E. Mattson and F. Hammerstrom. 1957. A guide to prairie chicken management. Tech. Bull. No. 15, Wisc. Cons. Dept., Madison, Wisconsin.

Kabat, C. D. and D. R. Thompson. 1963. Wisconsin quail, 1834-1962, population dynamics and habitat management. Tech. Bull. No. 30. Wisc. Cons. Dept., Madison.

Kelker, G. H. 1964. Appraisal of ideas advanced by Aldo Leopold thirty years ago. J. Wildlf. Mgmt. 28(1)180-185.

Leopold, A. 1931. Game range. J. Forest. 29:932-938.

McHarg, I. L. 1969. Design with nature. Nat. History Press, N.Y. 197 pp.

Pimlott, D. H. 1969. The value of diversity. Trans. No. Am. Wildlf. Conf. 34:265-280.

Stoddard, H. L. 1931. The bobwhite quail--its habitat, preservation and increase. C. Scribner's Sons, N.Y. 559 pp.

Van Doren, L. M., S. G. Hazard, J. R. Stallings, and D. P. Schnacke. 1971. Corridor study, U.S. 77, Lincoln-South freeway. Rept. to state of Nebraska, Dept. of Roads. 127 pp.