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IDENTIFICATION AND ANALYSIS OF LESSER AND GREATER PRAIRIE CHICKEN HABITAT[1]

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Abstract: Essential components of the habitats of the lesser (*Tympanuchus pallidicinctus*) and the greater prairie chicken (*Tympanuchus cupido pinnata*) were analyzed comparatively on the basis of actual use by the birds. In general terms, the habitat of the lesser prairie chicken consisted of small units of shortgrass prairie intermixed with larger units of shrub or half-shrub vegetation; that of the greater prairie chicken consisted of small units of shortgrasses or midgrasses intermixed with larger units of tallgrasses. Insects were the primary food resources of the lesser prairie chickens. Major foods of the greater prairie chickens were obtained from plants. Day-resting lesser prairie chickens were found mostly in half-shrub vegetation; day-resting greaters used the edges of tallgrass and midgrass vegetation units. Both lesser and greater chickens chose units of moderately tall vegetation for night-roosting. Within these units, the actual roost sites were established where the vegetation was significantly shorter than most of the plants in the stand. Courtship areas of both species were composed of shortgrass units. Nesting areas were located less than ½ mile from courtship grounds. Nesting took place in areas of exceptionally heavy cover. When hatching was completed, greater prairie chicken females moved their broods into areas where the vegetation had been disturbed: old fields, native shortgrasses, or cultivated pastures. This enabled the young to forage for insects associated with the forbs prevailing in these vegetation types. Lesser prairie chicken broods also utilized vegetation having abundant forb cover.

During the past half century, the prairie grouse of North America have been considerably constricted in geographical distribution. Most of the range of the greater prairie chicken has been plowed or grazed out of existence (Hamerstrom and Hamerstrom 1961). The range of the lesser prairie chicken has not undergone so great an attrition, although excessive grazing has destroyed portions of it (Hamerstrom and Hamerstrom 1961).

For both these species there persists a critical shortage of information on specific habitat factors needed for maintaining these birds in numbers sufficient to provide some hunting, or to protect them against possible extinction. An approach to this problem can be made by assessing the amount of use accorded each of the components of the species' environment. Until information on habitat needs is available, effective management of any species will be hampered. It is not enough, for ex-

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ample, to recognize that prairie chickens need grasslands. Stands of grass vary in character, and those useful or attractive to prairie chickens must be identified, and the reasons for their usefulness and attraction be ascertained. This report summarizes an attempt to define prairie chicken habitat in Oklahoma on the basis of *use* by these birds. Each component of the habitat is defined, and an attempt to measure each one is recounted.

The lesser prairie chicken is found in the western portion of Oklahoma, and the greater prairie chicken in the northeastern portion of the state. Appropriately located study areas, visited bimonthly, were established for each species.

Habitat is considered here to be the place where the species population finds the resources to carry out all its life activities (Stebler 1957). There must be elements within the habitat to meet adequately the birds' need for food, shelter, and reproduction. Thus, segments of the habitat may be categorized as places used for feeding, for resting, and for reproduction. Each segment may be subdivided by (1) *time* of use (example: night-roosting and day-resting sites) or (2) *type* of use (examples: courtship grounds, nesting areas, or brood-rearing areas).

The classical approach to habitat description is either to use general terms or to analyze in detail the plant species in the community. Detailed analysis is a slow, time-consuming process, though it often clearly reveals relationships between plant and animal species. Detailed analysis without reference to actual use by an animal species often recognizes the importance of particular plant species in specific locations. However, when larger areas are considered, this importance may rapidly diminish. A faster, more generalized method of habitat evaluation is obviously needed.

Pitelka (1941) was unable to find a constant relationship between bird species and specific plant dominants or groups of dominants. He did, however, find a consistent relationship between the distribution of birds and of plant life-forms. The life-form approach, while generalized, seems specific enough to pinpoint differences in habitat, yet is not as time-consuming nor as potentially misleading as detailed analysis (Jones 1959, Schemnitz 1961). Elton and Miller (1954:481) state: "Vegetation and life form . . . provide immediately recognizable features. With this approach, a method of classification can be devised by which the ordinary observer can fairly accurately record the time and place of ecological events without an intimate knowledge of plant ecology and its associated concepts and terms."

The life-form approach has been employed in this study. An attempt has been made to develop this approach into a practical tool for identifying and evaluating habitat.

Approximately 2 years were spent in the field, gathering the data upon which this report is based. June to mid-September, 1959, was spent locating promising study sites and perfecting techniques to use in the quantitative measurement of habitat components. Intensive field work began in February, 1960, and continued until September, 1961.

This study, carried out under the direction of Dr. A. M. Stebler, was supported by the Oklahoma Cooperative Wildlife Research Unit. For helpful encouragement and assistance, the writer is indebted to: Drs. F. M. Baumgartner, H. I. Featherly, Jack Harlan, and D. E. Howell, for valuable advice and criticism; Ferrell F. Coplin, R. D. Gray, and Karl A. Jacobs, for field assistance and information; K. S. Adams, Lloyd Barby, and Mark Mayo, the land-

Table 1. Random analysis of vegetation on the Maple–Barby study area by vegetational type; 100 2-meter transects taken each year of study, Beaver County, Oklahoma. Numbers in parentheses indicate size of sample.

PLANT SPECIES	SHORTGRASS (48)		SHRUB (20)		HALF-SHRUB (56)		MIDGRASS (78)	
	Occ.	Comp.	Occ.	Comp.	Occ.	Comp.	Occ.	Comp.
Buchloë dactyloides	91.7	55.02	5	1.02	14.3	2.86	16.7	3.08
Bouteloua gracilis	52.1	16.01	–	–	7.1	2.70	3.8	0.75
Sporobolus cryptandrus	72.9	8.08	95	13.40	94.6	24.71	80.8	22.46
Aristida purpurea	25.0	4.11	5	0.38	7.1	1.55	15.4	2.68
Bouteloua curtipendula	16.7	2.34	10	0.83	19.6	5.26	56.4	18.97
Ipomoea leptophylla	10.4	2.22	5	1.15	7.1	1.92	2.6	0.74
Chloris verticillata	10.4	1.79	15	1.50	21.4	1.65	26.9	5.71
Chrysopsis villosa	8.3	1.69	–	–	–	–	5.1	1.08
Opuntia sp.	10.4	1.57	–	–	–	–	2.6	0.06
Artemisia filifolia	12.5	0.83	55	9.25	89.3	28.08	20.5	2.64
Rhus aromatica	–	–	90	40.38	8.9	0.55	2.6	0.54
Eragrostis trichodes	–	–	35	8.07	16.1	1.26	3.8	1.26
Prunus angustifolia	–	–	15	3.13	–	–	–	–
Ambrosia psilostachya	16.7	0.48	30	3.09	33.9	5.71	48.7	6.26
Bouteloua hirsuta	4.2	0.12	25	2.55	17.9	1.48	43.6	8.66
Paspalum ciliatifolium	2.1	0.15	35	1.98	16.1	1.90	9.0	1.61
Eriogonum annuum	16.7	0.35	35	1.72	35.7	2.12	23.1	1.63
Heterotheca latifolia	–	–	15	1.63	12.5	0.75	2.6	0.20
Gutierrezia sarothrae	4.2	0.44	10	1.40	5.4	2.62	23.1	5.71
Andropogon saccharoides	4.2	0.09	–	–	–	–	3.8	2.56

owners whose cooperation made this study possible; my wife, for her help in collecting data, preparing graphs, and typing the manuscript.

THE STUDY AREAS

The two study areas were located as close as possible to the center of the known ranges of the two species of prairie chickens in Oklahoma. These areas were about 250 miles apart, on approximately the same degree of latitude. The greater prairie chicken study area was situated in what Duck and Fletcher (1943) called "the tall-grass prairie game type"; the lesser prairie chicken study area was within the game type these authors termed "the sand–sagebrush grasslands."

The Maple Ranch and a portion of the adjoining Lloyd Barby Ranch in Beaver County were chosen as the lesser prairie chicken study area. This area lies at the edge of the sand-dune terrain just north of the Beaver River. The soils of the study area may be classified as either dominantly sand or clay soils—"sandylands" and "hardlands" in local parlance.

Plants associated with these two soil types comprise the two major plant communities. On the basis of dominant plant life-form, the sand-soil communities were separated into three associations. These were termed the *half-shrub, shrub,* and *midgrass* vegetation types. The upland community associated with the clay soils was called the *shortgrass* vegetation type.

Table 1 lists the principal plant components found in these types. Plants distinguishing the shortgrass vegetation were buffalo grass (*Buchloë dactyloides*) and blue grama (*Bouteloua gracilis*). Skunkbush sumac (*Rhus aromatica*) was the characteristic plant of the shrub association. Although little difference existed between the half-shrub and midgrass associations, the half-shrub type was distinguished by the presence of sand sagebrush (*Artemisia filifolia*), and the midgrass

Table 2. Comparison of habitat units from the greater and lesser prairie chicken study areas. Sørensen Index of Floristic Similarity was calculated for vegetational subunits as based on their predominant physiognomic characteristics.

		Greater Prairie Chicken Area Vegetation Types				All Plants of the Lesser Prairie Chicken Study Area	Lesser Prairie Chicken Area Vegetation Types		
		Midgrass	Shortgrass	Forbs	Cultivated Pasture		Half-shrub	Midgrass	Shortgrass
Greater Prairie Chicken Vegetational Types	Tallgrass	78	65.8	61.8	31.3				
	Midgrass		59.2	41.4	24.1				
	Shortgrass			36.1	46.8				
	Forbs				30.4				
	All plants of the greater prairie chicken study area					27.5			
Lesser Prairie Chicken Vegetational Types	Shrub						72.5	59.0	50.7
	Half-shrub							75.0	60.8
	Midgrass								71.3

Table 3. Random analysis of vegetation on the Adams Ranch study area by vegetational type; 100 2-meter transects taken each year of study, Osage County, Oklahoma. Numbers in parentheses indicate size of sample.

Plant Species	Tallgrass (110)		Midgrass (50)		Shortgrass* (26)		Cultivated Pastures (20)	
	Occ.	Comp.	Occ.	Comp.	Occ.	Comp.	Occ.	Comp.
Andropogon scoparius	91.8	33.36	24	4.39	15.4	3.63	–	–
Andropogon gerardi	90.0	28.68	36	3.98	11.5	0.66	–	–
Ambrosia psilostachya	72.7	11.24	86	22.34	80.8	16.00	70	9.87
Panicum virgatum	57.3	5.60	32	1.45	11.5	0.53	–	–
Panicum oligosanthes	38.2	2.75	46	3.36	34.6	4.63	–	–
Sporobolus asper	36.4	2.36	56	14.21	50.0	5.25	35	1.32
Psoralea tenuiflora	22.7	2.03	24	2.33	6.7	1.37	–	–
Sorghastrum nutans	31.8	1.50	14	0.97	–	–	–	–
Aster ericoides	23.6	1.47	30	2.65	15.4	1.18	5	0.02
Vernonia baldwinii	19.1	1.45	10	0.80	–	–	–	–
Bouteloua gracilis	–	–	42	10.52	53.8	16.34	–	–
Aristida oligantha	2.7	0.52	36	6.02	34.6	5.68	65	2.89
Gutierrezia dracunculoides	14.5	0.69	44	2.83	42.3	2.87	55	6.46
Buchloë dactyloides	7.3	0.50	24	3.35	80.8	20.65	–	–
Andropogon saccharoides	1.8	0.04	24	2.79	34.6	4.55	5	0.05
Juncus interior	27.3	0.69	34	1.98	46.2	4.16	–	–
Lespedeza stipulacea	–	–	2	0.03	–	–	100	59.20
Cynodon dactylon	–	–	–	–	3.8	1.47	65	13.61
Helianthus annuus	–	–	–	–	–	–	15	1.94
Grindelia squarrosa	–	–	–	–	–	–	5	0.85
Solidago sp.	–	–	–	–	3.8	0.05	20	0.80

* Includes small units of vegetation ordinarily classified as midgrass, when physiognomically similar (particularly patches of mowed or overgrazed vegetation).

Table 4. The Du Rietz (1931:46–47) life-form categories used to describe the physiognomy of prairie chicken habitat.

CATEGORIES	DEFINITIONS	HEIGHTS
Tree	Main trunk unbranched in lower part	Mostly above 2 m
Shrub	Stem branched from basal part	0.8–2 m
Dwarf shrub	" " " " "	0.05–0.8 m
Half-shrub	Only lower portion lignified and perennial	Above 0.8 m
Dwarf half-shrub	" " " " " "	Less than 0.8 m
Herbaceous plants*	Above-ground stems wholly herbaceous	
Tall herbs		0.8–2 m
Medium (mid) herbs		0.25–0.8 m
Low herbs		Less than 0.25 m

* Includes both forbs and grasses which have been separated in this report.

community was composed of side-oats grama (*Bouteloua curtipendula*), hairy grama (*B. hirsuta*), and windmill grass (*Chloris verticillata*).

The Sørensen Index of Floristic Similarity (Hanson and Dahl 1957) was applied to the plant species encountered in the subdivisions of the lesser prairie chickens' habitat (Table 2). Diversity and similarity of the plant communities compared are indicated by low and high index values respectively. This index does not take into account the relative quantities of the respective plant species. The greatest difference in plant composition existed between the shortgrass and shrub vegetation types, the greatest similarity between half-shrub and midgrass types (Table 2).

The greater prairie chicken study area was the K. S. Adams Ranch located near Foraker in the northwest portion of Osage County, on a part of the southern extension of the Flint Hills of Kansas. Soils of this area are mostly of two kinds: deep clay loams (covered with tallgrass vegetation) within which are intergraded, shallow clay soils with limestone fragments imbedded in or just below the surface; these shallow soils (covered with shortgrasses and midgrasses) cover part of the rolling uplands and escarpments.

Vegetation on the greater prairie chicken study area has two main divisions, excluding cultivated pastures: *tallgrass* and *shortgrass* associations. A third vegetational grouping, the *midgrass* association, is intermediate between these two, sometimes showing a greater affinity to one, and then to the other. Korean lespedeza (*Lespedeza stipulacea*) and Bermuda grass (*Cynodon dactylon*) have been planted on the cultivated pastures.

Table 3 lists the principal components of the plant communities mentioned above. Plants distinguishing the tallgrass association were big and little bluestem (*Andropogon gerardi* and *A. scoparius*). The midgrass association was dominated either by meadow grass (*Sporobolus asper*) or by blue grama. This association had the greatest measured amount of western ragweed (*Ambrosia psilostachya*). Buffalo grass and blue grama were dominant in the shortgrass vegetation.

The Sørensen Index of Floristic Similarity was calculated for all distinguishing plant communities of the greater prairie chicken study area as well as for the forb association, which occurred only on severely disturbed sites (Table 4). As expected, the tallgrass and midgrass associations showed the greatest degree of similarity, the cultivated pastures the greatest degree of differentiation. Surprisingly, the shortgrass vegetation showed the greatest floristic similarity to the cultivated

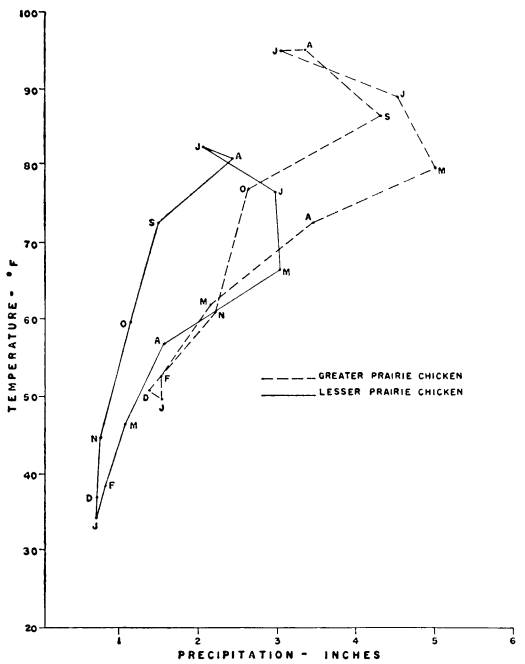

Fig. 1. Hythergraphs for Beaver City, Beaver County, and Pawhuska, Osage County, contrasting temperature—precipitation records for Weather Bureau Stations nearest the study areas (records for 22 years, data adapted from U. S. Dept. Commerce 1955).

pastures. Perhaps the similar physiognomic aspect of the two associations accounts for this.

When the plant species of the two study areas were compared, a Sørensen index value of 27.5 was obtained. This indicated there was little floristic similarity between the ranges of the lesser and the greater prairie chickens, to the extent that the study areas represented the entire ranges.

The hythergraphs in Fig. 1 depict the climate of the two study areas. As the hythergraphs show, the greater prairie chicken is exposed to higher temperatures and precipitation than is the lesser prairie chicken. Conversely, the lesser lives in an area characterized by a cooler and drier climate.

METHODS

Data on use of habitat was gathered by carefully observing the prairie chickens under field conditions, flushing them from coverts in which they were resting or feeding, and, on occasion, tracking them through sand or snow. Each observation was recorded on a specially designed Keysort marginal-punch card. The data recorded included the height of the vegetation in which the birds were seen, the life-form, the approximate coverage of the vegetation, and the dispersion of the plant components.

Table 4 shows the life-form classification used (Du Rietz 1931:46–47).

Emlen (1956) pointed out that the spatial distribution of dominant plants is an important feature of the habitat. Plants may be either evenly dispersed or aggregated. The following categories were used as a basis for classifying plant dispersion: evenly distributed, clumped, bunched, scattered, and aligned (in rows).

When birds were flushed from a precise location identifiable by the presence of droppings, another series of measurements was taken. A 2-meter-line transect was placed across the location, and the intercepted plants were measured. Specifications outlined by Anderson (1942) were followed. Height measurements of the vegetation were taken at the exact flush point and at 1-meter points on each side of the flush point, at the ends of the 2-meter transect. Similar measurements were taken at night-roost sites and nest locations.

Droppings were collected from both study areas throughout the 2 years of the study. An attempt was made to collect approximately 100 droppings every month for each species of prairie chicken. A total of 1,129 lesser prairie chicken droppings and 990 greater prairie chicken droppings

Table 5. Four-square-mile spring census counts for lesser and greater prairie chickens, 1960 and 1961.

CENSUS COUNTS	LESSER		GREATER	
	1960	1961	1960	1961
Total	65	54	74	57
Number birds per square mile	16.2	13.5	18.5	14.2

was analyzed for this report. The analysis used was essentially that of Korschgen (1952).

Identification of plant leaves, buds, and stems was aided materially by comparisons with the collections of mounted plants from the study areas. Seeds were compared for identification with those in the collection of the Oklahoma Cooperative Wildlife Research Unit. Insects collected in the field were mounted to facilitate later identification of insect residues in the droppings.

Prairie chicken populations were computed from counts on booming grounds on census areas 2 miles square (Table 5), the minimal (census) area Davison (1940) considered to be representative of a *range*. Counts of lessers were made on lands having greater numbers of birds than adjacent areas had. The greater prairie chicken was relatively evenly distributed throughout the Adams Ranch study area.

Brood counts of lesser and greater prairie chickens were obtained during all 3 years of the investigation (Table 6). The counts indicated that the lesser prairie chicken population had a slightly smaller average brood size.

The population data presented above seemed to indicate that, for the study areas selected, the numbers of birds per unit of area were approximately the same. Thus, use by the birds of various habitat features would not likely be influenced by unusually different populations of birds in either of the study areas.

PRAIRIE CHICKEN HABITAT

Grassland is vitally important to prairie chickens; it is the keystone in their ecology. Hamerstrom et al. (1957:12) stated that "such qualities as height and density of grass, and the land-use practices in which it is involved, seem clearly to be more important to the prairie chickens than species composition." It is not enough, however, to recognize that prairie chickens need grassland. We must be able to state that prairie chickens need grass of a certain density, height, and character for their vital activities. It must be realized that these vegetational features within the plant communities change during the year and that the resultant changes in use by the chickens may follow these closely.

One factor governing the use of the segments of the prairie chickens' habitat at any given period of time is the phenology of the plant species present (Jones 1962). Green leafy material, seeds, and associated insects occur in variable amounts throughout the year. These variations determine the extent to which areas are used for foraging. Plants which provide cover in the summer, when green foliage is present, may have no cover value at all during the winter.

Table 6. Summer brood counts of lesser and greater prairie chickens, 1959, 1960, and 1961.

BROOD COUNTS	LESSER				GREATER			
	1959	1960	1961	Total	1959	1960	1961	Total
Number broods	15	8	5	28	14	11	13	36
Number young	74	50	41	165	102	44	79	225
Average	4.93	6.25	8.20	5.85	7.29	4.00	6.08	6.25

Table 7. Food use expressed in percent volume and by food index rank, for lesser prairie chickens using the shrub vegetational association, 1959, 1960, and 1961.

Food Item	Percent Volume by Months												Total	Food Index Rank
	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.		
Plants														
Rhus aromatica	0.3	–	10.6	9.2	0.5	–	25.0	22.2	8.1	T	T	T	75.9	1
Evax prolifera	T	0.2	7.1	5.4	6.2	–	–	–	–	–	–	–	18.9	3
Festuca octoflora	1.1	6.6	2.0	2.4	3.1	1.0	–	–	–	T	T	1.5	17.7	5
Grass	1.1	0.2	0.6	0.3	1.1	0.7	1.3	0.4	0.6	0.7	0.4	4.0	11.4	
Eriogonum annuum	1.2	6.6	1.8	0.6	–	–	–	–	–	–	–	0.5	10.7	7
Cyperus schweinitzii	–	–	–	–	–	–	–	–	–	2.2	3.2	2.5	7.9	2
Artemisia filifolia	4.2	1.1	1.1	0.5	–	–	–	–	–	–	–	0.6	7.5	4
Viola kitaibeliana	0.8	1.6	1.5	0.9	0.4	T	–	–	–	–	–	T	5.2	8
Silene antirrhina	–	–	–	–	–	3.3	1.7	T	T	–	–	–	5.0	
Gutierrezia sarothrae	3.9	T	0.3	0.6	–	–	–	–	–	–	–	T	4.8	6
Tradescantia occidentalis	–	–	–	–	–	–	0.7	2.2	1.2	T	–	–	4.1	9
Ambrosia psilostachya	0.5	–	–	–	–	–	–	0.2	–	–	1.7	0.8	3.2	11
Sporobolus cryptandrus	0.2	0.7	–	–	0.4	0.6	–	–	–	T	0.2	0.6	2.7	10
Sorghum vulgare	–	–	1.2	1.0	T	–	–	–	–	–	–	–	2.2	
Plantago sp.	T	–	–	–	0.6	1.1	–	–	–	–	–	0.3	2.0	12
Insects														
Coleoptera	0.8	1.2	0.3	2.1	3.5	5.6	14.8	2.6	1.6	8.3	6.6	2.8	50.2	
Orthoptera	1.6	T	T	0.2	T	0.2	7.3	12.6	21.4	8.9	10.5	6.2	68.9	
Immature	0.6	1.0	2.2	4.1	0.6	0.2	0.3	–	–	T	T	–	9.0	
Hemiptera	–	–	–	–	0.5	0.7	0.2	–	T	T	3.7	0.7	5.8	

Table 8. Food use expressed in percent volume and by food index rank, for lesser prairie chickens using the half-shrub vegetational association, 1959, 1960, and 1961.

FOOD ITEM	PERCENT VOLUME BY MONTHS												TOTAL	FOOD INDEX RANK
	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.		
Plants														
Festuca octoflora	2.9	3.8	0.6	3.4	2.7	1.0	–	–	–	T	–	5.9	20.3	1
Rhus aromatica	–	–	3.8	–	2.0	–	4.8	8.1	1.3	–	–	–	20.0	
Evax prolifera	–	0.8	2.2	3.5	9.8	–	–	–	–	–	–	–	16.3	5
Sorghum vulgare	6.8	2.6	–	–	0.7	–	–	–	–	–	–	1.3	11.4	
Silene antirrhina	–	–	–	–	–	7.5	1.9	T	–	–	–	–	9.4	
Eriogonum annuum	2.8	4.1	0.5	0.5	–	–	–	–	–	–	–	0.6	8.5	4
Grass	0.6	1.0	–	T	0.6	0.5	0.6	0.9	0.7	0.6	0.8	1.7	7.0	
Cyperus schweinitzii	–	T	–	–	–	–	–	–	–	1.3	3.5	1.5	6.3	2
Artemisia filifolia	1.6	1.0	1.0	0.5	–	–	–	–	–	–	–	0.8	4.9	3
Tradescantia occidentalis	–	–	–	–	–	–	0.7	1.4	2.3	–	–	–	4.4	12
Plantago sp.	1.6	–	0.5	–	T	0.7	–	–	–	–	–	0.5	3.3	7
Gutierrezia sarothrae	1.8	0.3	–	T	–	–	–	–	–	0.3	–	0.6	3.0	8
Viola kitaibeliana	0.5	1.7	–	0.6	–	–	–	–	–	–	–	–	2.8	6
Ambrosia psilostachya	T	–	–	T	–	–	–	–	–	–	1.4	1.1	2.5	13
Lepidium oblongum	–	–	–	–	–	1.5	–	–	–	–	–	–	1.5	
Buchloë dactyloides	–	–	–	–	0.6	0.8	–	–	–	T	–	–	1.4	
Insects														
Coleoptera	0.4	0.8	0.3	1.9	3.4	6.6	5.1	5.2	5.0	6.4	4.9	1.8	41.8	
Orthoptera	3.9	1.1	0.5	1.0	–	T	11.1	6.7	10.5	9.2	11.7	4.1	59.8	
Immature	2.7	2.7	2.4	12.7	6.3	0.6	T	–	–	T	–	0.5	27.9	
Hemiptera	–	–	–	–	1.5	0.4	1.3	1.0	0.5	–	0.7	–	5.4	

Table 9. Food use expressed in percent volume and by food index rank, for greater prairie chickens using the cultivated pasture unit, 1959, 1960, and 1961.

Food Item	Percent Volume by Months												Total	Food Index Rank
	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.		
Plants														
Lespedeza stipulacea	3.8	5.8	4.8	3.7	21.7	–	28.3	53.6	53.4	68.4	16.2	2.9	262.6	1
Sorghum vulgare	10.8	17.9	21.9	6.1	–	–	–	–	–	T	–	1.0	57.7	
Ambrosia psilostachya	0.4	–	–	–	1.7	–	–	–	–	1.5	31.5	14.2	49.3	3
Bromus japonicus	0.9	7.6	1.1	11.7	3.3	–	–	0.6	0.2	–	T	0.4	25.8	4
Grass	7.9	3.7	4.3	5.4	–	–	0.7	0.9	0.2	0.4	–	2.0	25.5	
Wheat	5.0	–	–	–	–	–	–	–	–	–	–	4.5	9.5	6
Physalis sp.	0.2	1.9	0.7	0.5	–	–	–	–	0.3	1.2	–	T	4.8	5
Helianthus annuus	–	–	–	–	–	–	–	–	–	–	0.4	3.6	4.0	
Cynodon dactylon	–	–	–	T	0.7	–	–	0.9	0.7	0.2	0.7	0.2	3.4	8
Oxalis stricta	T	0.5	–	–	–	–	0.7	–	1.1	0.2	T	0.2	2.7	2
Melilotus officinalis	0.5	0.4	0.5	0.9	–	–	–	–	T	–	–	–	2.3	7
Corn	1.8	0.3	–	–	–	–	–	–	–	–	–	–	2.1	
Polygonum sp.	–	–	–	–	–	–	1.0	0.2	0.8	–	–	–	2.0	
Solanum carolinense	0.6	–	0.8	0.2	–	–	–	–	–	–	T	T	1.6	
Hypoxis hirsuta	–	–	–	1.4	–	–	–	–	–	–	–	–	1.4	
Insects														
Coleoptera	T	–	–	1.0	1.6	–	6.7	3.2	3.3	2.6	1.5	0.5	20.4	
Orthoptera	3.1	0.9	2.6	0.3	–	–	0.3	1.2	0.4	0.8	3.7	3.3	16.6	

Table 10. Food use expressed in percent volume and by food index rank, for greater prairie chickens using the native pasture unit, 1959, 1960, and 1961.

FOOD ITEM	PERCENT VOLUME BY MONTHS												TOTAL	FOOD INDEX RANK
	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.		
Plants														
Ambrosia psilostachya	–	–	–	0.3	0.4	0.6	–	–	–	1.2	51.8	14.6	67.9	2
Sorghum vulgare	1.5	33.2	20.3	10.8	–	–	–	–	–	–	–	–	65.8	
Grass	5.0	4.0	5.5	6.7	3.7	10.7	3.0	0.9	1.3	0.9	0.2	1.6	43.5	
Solidago sp.	–	–	–	–	–	–	4.4	1.4	15.2	7.5	–	–	28.5	1
Sabatia campestris	–	–	–	–	–	–	–	15.8	2.7	8.5	–	–	27.0	
Lespedeza stipulacea	7.8	3.5	7.9	0.7	0.6	–	5.0	–	0.3	–	–	1.1	26.9	13
Bromus japonicus	–	8.6	1.2	2.4	2.6	1.1	–	T	T	–	–	–	15.9	3
Eleocharis sp.	–	–	–	–	4.4	5.9	–	–	–	–	–	–	10.3	
Carex sp.	–	–	–	–	0.6	6.8	0.8	–	–	–	–	–	8.2	8
Plantago rugelii	–	–	–	T	0.3	0.3	7.1	–	–	–	–	–	7.7	6
Corn	4.8	T	–	T	–	–	–	T	–	–	–	1.1	5.9	
Penstemon cobaea	–	–	–	–	–	–	–	–	2.4	2.5	0.4	–	5.3	
Hypoxis hirsuta	–	–	–	3.4	1.5	0.2	–	–	–	–	–	–	5.1	7
Linum sulcatum	–	–	–	–	–	–	–	1.3	0.2	2.1	–	–	3.6	9
Galium aparine	–	–	–	–	–	0.5	1.9	–	–	–	–	–	2.4	4
Physalis sp.	–	1.0	T	0.4	–	–	T	0.8	–	–	–	–	2.2	
Ratibida columnifera	–	–	–	–	–	–	–	–	–	2.1	–	–	2.1	
Oxalis stricta	–	0.6	–	T	–	T	1.1	T	T	T	–	–	1.7	5
Insects														
Coleoptera	–	–	T	0.5	1.3	3.7	6.9	6.3	3.0	3.4	0.7	1.4	27.4	
Orthoptera	0.7	0.6	2.3	1.6	T	–	–	4.3	4.4	5.4	14.1	29.8	59.8	

Table 11. Comparison of food categories for both species of prairie chickens, Beaver and Osage Counties, 1959–61.

Month	Percent Volume Seeds	Percent Volume Green Vegetation	Percent Volume Insects	Percent Volume Seeds	Percent Volume Green Vegetation	Percent Volume Insects
	Lesser Prairie Chicken					
	Half-shrub			Shrub		
January	3.61	21.27	4.60	2.05	15.46	2.25
February	1.27	6.32	3.18	5.04	21.13	2.55
March	0.65	9.30	15.59	3.84	18.86	6.43
April	0.72	16.50	11.23	0.44	12.81	4.78
May	10.31	3.80	7.76	5.02	4.67	6.64
June	7.24	0.90	17.95	25.17	2.29	22.58
July	8.59	2.41	12.95	23.09	2.67	15.39
August	1.99	2.99	15.99	8.34	2.04	23.24
September	1.51	1.27	15.67	3.06	0.65	18.11
October	5.08	1.74	17.32	5.36	1.05	20.41
November	4.54	12.17	6.74	3.16	7.86	9.74
December	7.41	12.39	7.43	1.56	12.11	3.14
Total percent volume	18.9	32.5	48.6	26.7	31.5	41.8
	Greater Prairie Chicken					
	Native Prairie			Cultivated Pastures		
January	35.03	16.51	0.61	24.96	13.97	0.94
February	21.70	15.27	2.52	28.27	6.15	2.63
March	12.99	14.71	2.14	9.89	20.88	1.99
April	0.14	17.88	1.39	–	–	–
May	11.26	18.57	3.92	–	–	–
June	15.89	12.51	8.08	4.61	31.06	7.76
July	2.97	18.12	12.05	1.20	55.43	5.50
August	4.69	23.48	8.33	5.26	53.66	4.14
September	8.20	18.62	9.08	4.21	68.75	3.80
October	53.46	0.18	15.26	36.25	14.06	5.27
November	17.24	1.94	31.10	25.80	2.08	3.90
December	7.67	12.84	0.69	21.06	12.18	3.22
Total percent volume	41.8	37.4	20.8	33.7	58.1	8.2

Feeding Areas

Food Use.—A comparison of the two species of prairie chickens revealed striking differences in foods used and in the plant life-forms present in the area chosen for feeding. Specific foods of the lesser and of the greater prairie chickens were noticeably different (Tables 7, 8, 9, and 10).

The differences between the major categories of seeds, leaves, and insects used by the two species also was striking (Table 11). Differences in specific foods might be considered as artifacts of sampling two areas so different ecologically. Yet, when the major categories of seeds, green vegetation, and insects were examined, differences were still significant. Of particular interest was the great number of insects consumed by the lessers and, conversely, the extensive use of seeds by the greaters.

Plant life-form types used for feeding activities showed some similarity for the two species of prairie chickens (Table 12). Both species spent most of their feeding time in grass cover. Differences in feeding area were principally within the height divisions. Midgrasses were used the most by the lesser prairie chicken for feeding, with

Table 12. Summary of life-form use for feeding and resting (expressed in percent use) by both species of prairie chickens, Beaver and Osage counties, 1959–61. W = winter; Sp = spring; S = summer; F = fall; Av = average.

PLANT LIFE-FORM	LESSER PRAIRIE CHICKEN					GREATER PRAIRIE CHICKEN				
	W	Sp	S	F	Av	W	Sp	S	F	Av
FEEDING										
Trees	–	–	–	–	–	5	–	–	–	1.3
Tallgrass	59	–	–	4	15.7	50	30	2	13	23.8
Midgrass	23	21	23	55	30.5	–	13	17	2	8.0
Shortgrass	–	20	16	15	18.8	32	47	25	55	39.8
Shrub	6	3	16	–	6.3	–	–	–	–	–
Dwarf shrub	4	8	8	–	5.0	–	–	–	–	–
Half-shrub	–	–	6	15	5.3	–	–	–	–	–
Dwarf half-shrub	8	47	3	9	16.8	–	–	–	–	–
Tall forbs	–	–	–	–	–	1	–	17	–	4.5
Midforbs	–	–	27	2	7.3	1	5	22	20	12.0
Short forbs	–	1	–	–	0.3	11	11	17	10	12.3
RESTING										
Trees	–	–	–	–	–	–	–	2	–	0.5
Tallgrass	–	–	6	–	1.5	17	46	10	24	24.3
Midgrass	9	4	6	11	7.5	45	29	20	11	26.2
Shortgrass	–	2	1	–	0.8	30	17	12	35	23.5
Shrub	–	–	23	–	5.8	–	–	–	3	0.8
Dwarf shrub	–	10	19	–	7.3	–	–	–	–	–
Half-shrub	18	1	12	22	13.3	–	–	–	–	–
Dwarf half-shrub	73	83	30	67	63.3	–	–	–	–	–
Tall forbs	–	–	–	–	–	–	–	5	3	2.0
Midforbs	–	–	3	–	0.8	–	1	51	24	19.0
Short forbs	–	–	–	–	–	8	6	–	–	3.5

tallgrasses, shortgrasses, and dwarf half-shrubs approximately equal in second place. The greater prairie chicken used the shortgrass life-form the most, with tallgrasses ranking second in importance. When life-form categories were grouped without regard to height, grassy situations were the most important to both species for feeding.

Food Availability.—A determining factor of food use is the availability of preferred foods. An item highly preferred but not readily obtainable by the birds is not as important as easily available items; hence, to consider food use without regard to availability may give false impressions of the value of particular foods in overall management of a species.

The food index developed by Hungerford (1957) was used to give a relative value to a food item, based on availability and use for a given period. Values were calculated from the following formula:

$$\text{Food index} = \frac{\%\ \text{utilization} \times (100 - \%\ \text{availability})}{100}.$$

Occurrence appeared to be a more realistic measurement than volume when dealing with droppings (Jensen and Korschgen 1947, Swanson 1940), principally because of the amount of digestion which had taken place. Digestion of hard foods does not progress at the same rate as that of soft foods; however, practically all foods eaten will have recognizable remnants in the feces (Swanson 1940).

The food-index rank suggests that such foods as 6-week fescue (*Festuca octoflora*), the top-ranking food for lesser prairie

Table 13. Prairie chicken use of plant associational groupings.

Dispersion of Plants	Feeding Areas		Resting Areas	
	Number of Birds	Percent Use	Number of Birds	Percent Use
Lesser prairie chicken				
Scattered	27	22.3	115	72.8
Bunched	44	36.4	13	8.2
Clumped	16	13.2	28	17.7
Continuous	28	23.1	2	1.1
Aligned	6	5.0	–	–
Greater prairie chicken				
Scattered	13	10.2	15	12.5
Bunched	5	3.9	37	30.8
Clumped	6	4.7	19	15.8
Continuous	88	69.3	48	40.0
Aligned	15	11.8	1	0.8

chickens using the half-shrub vegetation, may not be as important to those maintaining themselves in another vegetation type. For example, buds and fruits of skunkbush sumac were number one foods for the lesser prairie chickens spending most of their time in shrub vegetation (Tables 7 and 8).

Resting Areas

Day Resting.—Differences in plant life-forms used for resting by the two species of prairie chickens were exceptionally striking (Table 12 and Fig. 2). The greatest use of half-shrubs was made by the lesser prairie chickens; greater prairie chickens used grass to almost the same degree. Seasonal use of these life-forms reflects even greater dissimilarity. During the summer, shrubs and half-shrubs were used to a great degree by resting lessers, whereas midforbs were used similarly by the greaters.

More than 72 percent of the lesser prairie chickens observed selected resting areas in which plants showed a scattered associational arrangement (Table 13). The greater prairie chickens selected a large variety of vegetational arrangements for resting, although continuous covers received the highest percent of use.

Night Roosts.—Night roosts of both lesser and greater prairie chickens were located in small pockets of short vegetation within areas of taller vegetation (Table 14), with two exceptions. When snow was on the ground, lessers selected more sheltered roosts in vegetation taller than adjacent plants. In summer, the greaters selected vegetation relatively uniform in height: analysis-of-variance tests showed differences to be nonsignificant.

When snow on the study area formed into sizable drifts, lesser prairie chickens often roosted in these snowbanks. A similar phenomenon was noted for the greater prairie chicken (Ammann 1957) and for the sharp-tailed grouse (Baumgartner 1939). The Finnish scientists, Seiskari and Koskimies (1956), used snow roosting to show, in part, the ecological distinctness of two races of capercaillie (*Tetrao urogallus*). Snow roosting may reflect the close relationship of the lesser prairie chicken to the greater and suggests a more northern center of origin than the region these birds presently occupy.

Table 14. Height of vegetation (in cm) at seasonal night roosts of lesser and greater prairie chickens.

SEASON	LESSER PRAIRIE CHICKEN				GREATER PRAIRIE CHICKEN			
	At 1 m Distance	Above Roost	At 1 m Distance		At 1 m Distance	Above Roost	At 1 m Distance	
Winter	21.4	4.7	19.7	**[1]	31.9	13.2	35.4	**
(Snow)	42.6	40.2	28.3	ns				
Spring	19.5	11.9	22.5	**	13.0	3.9	21.1	**
Summer					51.6	31.8	36.9	ns
Fall	14.8	4.9	30.2	**	50.7	5.3	52.0	**

[1] ** = Highly significant (99%); ns = not significant.

Courtship Areas

The vegetation type most used by the lesser prairie chicken for courtship was the shortgrass association, although several smaller booming grounds were located in the midgrass type. The booming grounds were all on high ground, usually on ridges where short vegetation and elevation combined to give good visibility. Several grounds were at the highest point of a particular ridge, but only where the short vegetation occurred. Most booming grounds of the lesser prairie chicken also served as feeding sites in the early spring.

The greater prairie chicken's courtship areas were in shortgrass vegetation on level prairie or, by preference, on elevations with shortgrass vegetation, whenever available. Their most pronounced tendency was to select vegetation of a low physiognomy. Most booming grounds located consisted of small patches of native shortgrasses.

Booming grounds used by the two prairie chicken species could not be distinguished statistically from one another on the basis of plant cover ($t = 1.05$; 44 df). The means were 64 percent cover for grounds of the lessers and 45.3 percent cover for grounds of the greaters. This similarity in plant coverage is undoubtedly related to the similarity in life-forms and plant associations of the booming grounds of both species.

Vegetation height, as measured by 10 samples per booming ground, was significantly different for the two species of prairie chickens. Mean height of the vegetation used for booming by the greater prairie chicken was 15.1 cm and, for the lesser prairie chicken, 10.4 cm. The difference between the two is significant at the 99 percent level ($t = 2.60$**; 348 df). This indicates that the greater prairie chicken was more tolerant of tall vegetation on the booming area than was the lesser.

Nesting

A total of 272 acres of possible nesting cover for lesser prairie chickens was checked. No nests were found in this area except for an old one located when the analysis of vegetation was made in July—the eggs had evidently hatched in June. This nest was in a half-shrub, shortgrass community consisting of purple three-awn (*Aristida purpurea*) and sand sagebrush, which made up 55 and 17 percent, respectively, of the total plant cover. Height of the vegetation above the nest was 45 cm and, at distances of 1 meter on either side, was 15 and 21 cm, respectively.

Other investigators have also had difficulty finding the nests of lesser prairie chickens. Coats (1955:3) stated that the "vegetation in which nests are found, their extreme concealment and the behavior of the incubating hen make it very unlikely that nests will be discovered." Bent (1932) describes three nests: two were under bunches of sand sagebrush, and one was under a tumbleweed which had

Table 15. Food use by prairie chicken broods during their first month of life, expressed in percent volume.

Food Item	Lesser Prairie Chicken (7 droppings, 1 crop, 1 gizzard)	Greater Prairie Chicken (14 droppings)
Insects		
Coleoptera		
Chrysomelidae	T	12.8
Curculionidae	—	3.2
Scarabaeidae	7.8	2.6
Malachiidae	—	0.2
Coccinellidae	—	0.5
Carabidae	26.5	2.6
Orthoptera	41.7	6.4
Acrididae	1.4	1.0
Gryllidae	5.8	—
Hemiptera	1.9	0.7
Neuroptera	—	0.6
Homoptera	T	0.7
Hymenoptera	—	0.2
Lepidoptera	T	—
Other insects	—	66.2
Plants		
Silene antirrhina (s)*	T	—
Panicum capillare (s)	T	T
Grass	1.9	1.1
Green leaf bits	5.2	—
Lithospermum incisum (s)	2.9	—
Rhus aromatica (s)	4.8	—
Lespedeza stipulaceae (l)	—	1.2
Sabatia campestris (l)	—	T

* (s) = seed; (l) = leaf.

lodged between two tufts of grass. Coplin (1958) found three nests during his study of the lessers: "Each was situated between two or three clumps of grass, little bluestem, sand dropseed, or aristida, which remained from the previous years' growth."

On the greater prairie chicken study area, 254 acres of potential nesting cover were checked, on which nine nests were discovered. Baker (1953) found slightly fewer per acre—16 nests in 610 acres of unburned pastures and meadows. Nesting sites in this study had taller and heavier cover than was usual for the tallgrass community. All nests were located within ¼ mile of open water. Hamerstrom (1939) reported that 9 of 23 nests were located within ½ mile of a booming ground and 10 were between ½ mile and 1¼ miles from the booming ground. Nests found during the present study were all within ½ mile or, at the most, a mile of the nearest booming ground. All nests discovered were very close either to cultivated pastures or to old fields which were characterized by short vegetation and by larger numbers of forbs into which the broods were led after hatching.

Heights above the nests ranged from 25 to 70 cm, with a mean of 45 cm. An average plant cover of 62.8 percent was calculated from transect measurements made directly over the nest. Little bluestem was the principal plant cover at all but two nests. One of the two was in a clump of silver bluestem, and the other was in a clump of the three tallgrasses: switchgrass, big bluestem, and little bluestem. Schwartz (1945) indicated the various types of cover in which the greater prairie chicken will nest. Of 57 nests, 56 percent were found in ungrazed meadows, 21 percent in lightly grazed pastures, and 22 percent in sweet clover, fencerows, sumacs, old cornfields, and barnyard grass.

Brood Ranges

Vegetational composition of the brood ranges showed several interesting features. The lesser prairie chickens used vegetation dominated by shrub and half-shrub lifeforms. Brood ranges usually had a greater percentage of forbs than areas used for other activities. For example, there was more western ragweed in vegetation selected by broods than in vegetation used (at the same time) by adult birds for resting or feeding. Western ragweed averaged in excess of 15 percent of the total vegetation.

Table 16. Percent use of escape cover by lesser (208 flushes) and greater prairie chickens (366 flushes). W = winter; Sp = spring; S = summer; F = fall; Av = average.

LIFE-FORM	LESSER PRAIRIE CHICKEN					GREATER PRAIRIE CHICKEN				
	W	Sp	S	F	Av	W	Sp	S	F	Av
Tallgrass	–	–	–	15	3.8	14.6	50.9	89.0	51.0	51.1
Midgrass	–	4.9	2.3	15	5.5	4.2	19.3	3.6	19.4	11.6
Shortgrass	–	24.5	2.3	–	6.7	77.1	28.1	3.1	5.1	28.3
Shrub	3.3	38.8	30.4	5	16.9	–	–	–	–	–
Half-shrub	96.6	32.6	65.3	30	56.1	–	–	–	–	–
Forbs	–	–	–	35	8.8	4.2	1.8	4.3	24.5	8.6
Average height of cover (cm)	73.7	42	57	71.2	59.3	40.3	50.6	71.8	73.8	63.5

Insects were the principal food of the young lesser prairie chickens (Table 15). More than 85 percent of the total content of the collected brood droppings consisted of insect residues, grasshoppers being the most common item. Ground beetles (Carabidae) and June beetles (Scarabaeidae) also were important foods. Plant material formed only a minor part of the total food intake.

The vegetational composition of brood ranges used by greater prairie chickens resembled that of lesser prairie chicken brood ranges with respect to the large amount of forbs. The cultivated pasture association was the cover most frequently selected by birds with broods. This cover was dominated by low weeds and annual lespedeza. Scattered about within the dominant vegetation were pockets of taller weeds, which provided resting cover for the small chicks.

Insects were the principal foods of greater prairie chicken broods, making up fully 97 percent of the total foods consumed. Beetles, the most important item, made up 23 percent of the identified food materials. Chiefly utilized were the phytophagous leaf beetles (Chrysomelidae). These are colorful and often feed on low-growing herbs, and hence were easily seen and reached by the young prairie chickens.

Vegetation on chosen feeding sites is closely correlated with food composition. Counts of insects captured in the various habitat types revealed that the vegetation with the greater percentage of forbs consistently had more insects per unit area than did the other vegetational associations in both the lesser and the greater prairie chicken ranges.

Escape Cover

For escape cover, prairie chickens of both species preferred tall coverts of either scattered or clumped vegetation. The average height (about 60 cm) of both types of vegetation was considerably higher than that used for other activities (Table 16). An interesting observation was the difference in average height of the cover chosen by the two species during the summer and winter periods. The greater prairie chickens used tall cover during the summer and short cover during the winter; the exact opposite was true of the lesser prairie chickens. This may be explained by the tendency of the greaters to form large flocks during the winter (Ammann 1957). At this time, the birds tend to rely on group reaction, rather than concealment, for predator protection. These large groups were not noted on the lesser prairie chicken study area.

DISCUSSION

The habitats of the two species of prairie chickens have been demonstrated to differ measurably from one another. For conservation of animal species, it is important to know the resources they need for all life activities. The Hamerstroms (1961:293) have pointed out that "the welfare of any species is basically determined by the condition of its habitat. Modern man is now one of the major forces, often the most important, in shaping habitats." Knowledge of the habitat of a species enables the land manager to plan for the needs of the species. Generally speaking, specific knowledge concerning habitat use is lacking. Effective care for a species population requires specific, detailed knowledge of what the species uses for food, shelter, courtship, nesting, and rearing of young.

The purpose of this discussion is to evaluate the methodology used in this report for habitat identification. These methods were developed for use in definitive identification and in comparison of the habitats of lesser and greater prairie chickens.

Actual use by the animal, rather than habitat unit or type with definitive boundaries (Emlen 1956, Elton and Miller 1954), was found to be a most effective approach to habitat evaluation of a species. Used features outside the bounded area, or unused features within the area, give a wrong impression of what makes up the habitat of a species. A more definitively helpful evaluation can be developed from a study of what the species actually uses.

The animal species may choose a different habitat component for each of its life activities. Elton and Miller (1954) have termed these components centers of activity. Obviously, nutritional resources are necessary. Another necessity is cover suitable for reproduction. Special courtship areas, if necessary, must be within easy flight distance of the nesting area. Perpetuation of the species may sometimes demand special nesting conditions. Areas supplying these facilities should be near the brood coverts. Resting places for both day and night use must be available. If these uses require different vegetal types, then the two habitat components must be present. Each activity center may be identified by plant life-form, height, cover, and dispersion, or by interaction with other animal members of the community, such as the presence or absence of insects used for food. A particular component, then, is comprised of a particular assemblage of parts or elements.

Many investigators have pointed out that higher vertebrates, particularly birds, seem to respond to features related to the physiognomy of vegetation (Elton and Miller 1954, Emlen 1956, MacArthur 1958, Miller 1942, and Svärdson 1949). A systematic classification of the physiognomy of environmental resources used by animal species should be an effective approach to habitat evaluation. A system of plant life-form classification appears to offer a helpful base upon which to develop a habitat description.

Because of its clearness and simplicity, the Du Rietz (1931) life-form system was found by this study to be the most useful. Although Du Rietz used a complicated terminology, his system is far superior, for purposes of habitat evaluation, to those of Raunkiaer (1934), Drude (1890), or Rübel (1930). The height division points of this system make it one of the most useful available for the use of animal ecologists when working with species the size of prairie chickens. Du Rietz's life-form criteria are easily understood and differentiated, in contrast to those of Raunkiaer (1934)—which are based on the height of the perrenating bud—and to the physiologically

based life-forms of Drude (1890) or the simplified perrenating bud system of Rübel (1930). The more recent systems of Küchler (1949) and of Dansereau (1951) are difficult to handle when changing from one life-form to another, because, in their systems, height relationships change from life-form to life-form; Du Rietz's system retains the same height classes throughout each category.

The Sørensen Index of Floral Similarity can be used to make floral comparisons between two habitat units. This system provides a criterion for separating the units, on a common basis, by comparing the species content of the two plant communities. Hanson and Dahl (1957) used it successfully to separate grassland communities in Colorado. Its drawback is that it does not take into account the abundance of the species within the community. In this study, the Sørensen index has been used, for the first time, to compare the habitats of two closely related animal species. With additional work, it could be employed to compare the different habitat-use features with one another.

Height of vegetation has already been used to differentiate habitats of birds (Lack 1933). Although Lack recognized that it was not the only feature of the environment which conditioned habitat selection, he considered height of vegetation to be important to most of the species he studied. This factor was also found to be important to prairie chickens. When their courtship areas were studied, for example, the average heights of the vegetation were found to be 5 cm lower for the lesser prairie chickens than for the greaters. This was, however, the only interspecific distinction observed, on the basis of height of vegetation alone. Intraspecifically, height was extremely important. Courtship grounds had very short grasses, which provided a turflike area; resting areas usually were associated with medium to tall vegetation; vegetation on night-roosting sites was similar in overall height to that on resting areas; nesting sites were associated with the tallest plants available to the birds, exclusive of trees.

Plant dispersion, the associational arrangement of plant species, can be an extremely important factor in the selection of a particular plant community by an animal species (note Table 13). The greater prairie chickens consistently used continuous vegetation to a greater degree than the lesser prairie chickens did; conversely, scattered and bunched vegetation was used to a measurably greater degree by the lessers. These differences in the prairie chickens' use of plant dispersions are consistent with regional differences in the vegetation. This clearly indicates that each species of prairie chicken is adapted to the vegetal character of its region.

The graphic presentation in Fig. 2 shows the degree to which habitat definity can be determined for the various activities of a single species. In this chart, the average height of cover used for a particular activity, the life-form, and the general appearance are presented symbolically. Seasonal variations in the same activities are shown for a full calendar year. In a general way, the chart illustrates the amount of use a habitat feature (element) received from the birds. A descriptive presentation like this chart would be impossible without consideration of habitat features from the standpoint of actual use by the birds.

The method described above proved effective for describing the habitats of greater and lesser prairie chickens in Oklahoma. Much additional testing is needed to find out whether the criteria used for describing prairie chicken habitat are consistent throughout the range of these spe-

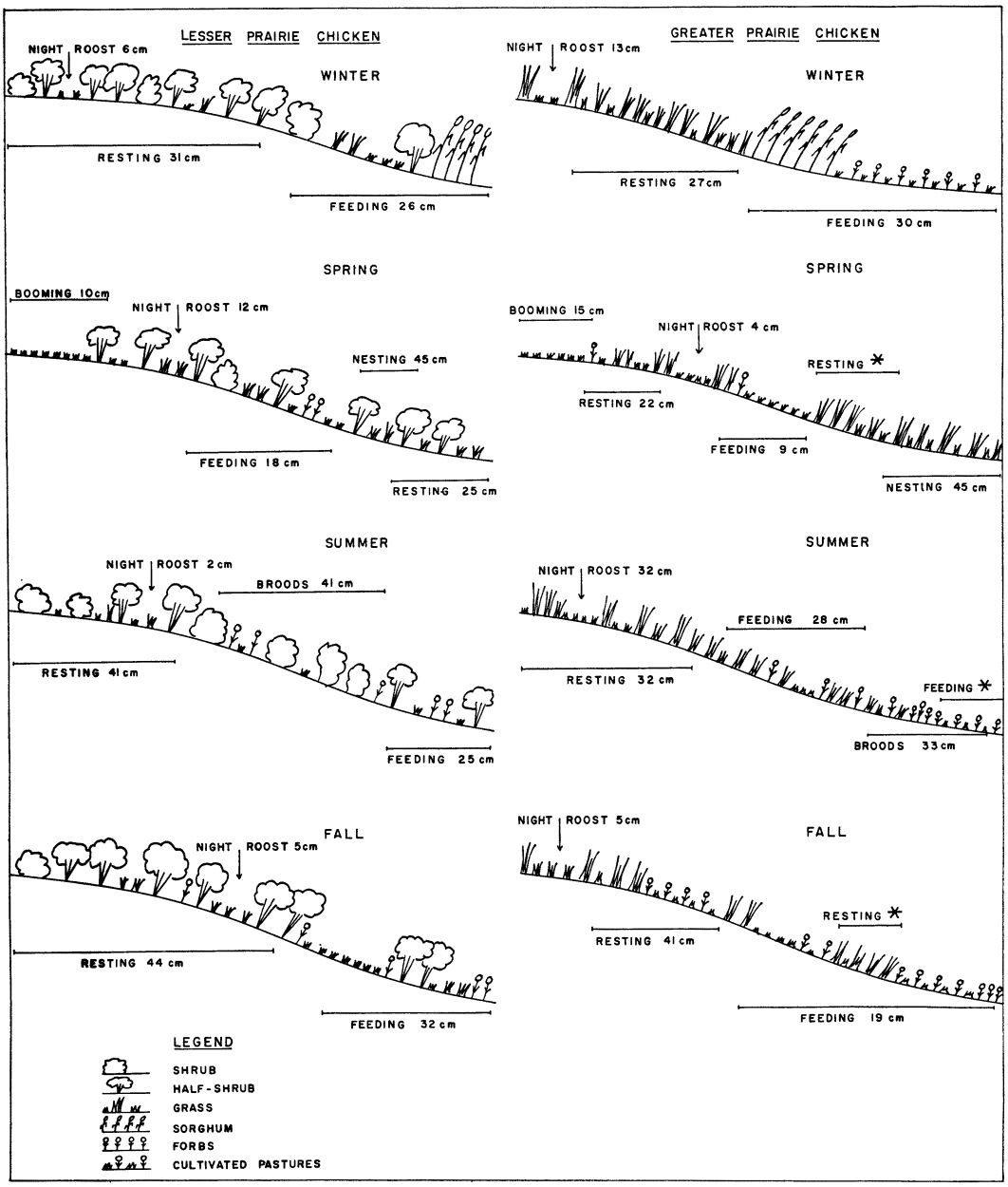

Fig. 2. Life-form as portrayed symbolically, emphasizing seasonal use for vital activities of both species of prairie chickens. Asterisks represent height measurements given for the same activity previously, in the same drawing.

cies. Plant taxa in the northern portion of their range can be expected to differ markedly from those in the southern portion. However, use of plant life-forms by the birds should be relatively constant throughout the range, forming an effective

means for overcoming the difficulties of using plant taxa for habitat identification and description.

The methodology upon which this report is based represents a compounding of the methods of the plant and the animal ecologist. The combination of plant life-form, floral comparison, plant height, and plant dispersion provides a more definitive habitat description than has heretofore been available. A better identification of an animal's habitat is obtained by considering it from the standpoint of actual use, for all vital activities, rather than by describing it in terms of a bounded habitat unit or a vegetational association based, usually, on vegetation classification schemes.

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THE EFFECT OF RAPTORS ON PRAIRIE CHICKENS ON BOOMING GROUNDS

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Abstract: With the help of several thousand cooperators, 4,745 blind-mornings have been spent in watching prairie chickens (*Tympanuchus cupido pinnatus*) on their booming grounds on two study areas in central Wisconsin during 21 springs. About 400 additional man-mornings have been spent in making counts and observations from a greater distance. A total of 1,379 encounters between prairie chickens and raptors were seen on booming grounds, in the course of which only three prairie chicken cocks were known to have been killed. Circumstantial evidence indicated the deaths of five more cocks and one bird of unknown sex, and at least three of these were probably killed by raptors. Two more cocks may have been killed in pursuits which ended out of sight of the watchers. We conclude that prairie chickens on their booming grounds are seldom taken by raptors, despite their exposed and seemingly vulnerable position. In 21 springs, we have seen no single instance in which raptor control was advisable.

Booming prairie chickens like to display in open places with short cover, and they are not easily disturbed while booming, even by cars or people. Throughout the prairie chicken's range, the peak of the hawk migration comes during the booming season. One might, therefore, assume that prairie chickens would be particularly vulnerable to raptor predation. Lehmann (1941:39), indeed, speaking of the Attwater's prairie chicken (*T. c. attwateri*), states, "Prairie chickens on the courtship grounds seemed more intent on mating than on self-preservation; consequently, losses from predation were probably heaviest at mating time." In spite of a large concentration of raptors, he found only "A freshly killed male prairie chicken [which]