THE EFFECTS OF GRAZING UPON HABITAT UTILIZATION OF THE DICKCISSEL (Spiza americana) AND BELL'S VIREO (Vireo bellii) IN NORTH CENTRAL OKLAHOMA

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PREFACE

Considerable evidence has accumulated in support of the belief that grazing is detrimental to avian populations. Dambach (1944) found that breeding birds were four times as abundant in ungrazed woodland as in grazed. Baumgartner and Lawrence (1953) found that "Large blocks of oak woods and tall grass prairie, particularly when subjected to severe over-grazing, provide exceedingly poor habitats for nesting birds." Yet, practically no evidence has been presented to show what the effects of grazing really are. The study reported herein was an attempt to answer the question.

Appreciation is expressed to my major adviser, Dr. F. M. Baumgartner, who gave freely of his counsel during the progress of the study. Appreciation is also expressed to the members of my advisory committee, Dr. L. H. Bruneau, Dr. W. A. Drew, Dr. H. I. Featherly and Dr. W. H. Irwin, for their advice and assistance. Financial support from the National Science Foundation helped to make the study possible.

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CHAPTER I

INTRODUCTION

Even the casual observer notes that grazing by cattle causes certain changes in the plant and animal populations of an area. It is not uncommon to find literature pertaining to the detrimental effects that grazing seems to have upon soil, vegetation, general range conditions, etc. However, critical data concerning the actual mechanisms by which the grazing causes the changes are much more uncommon. Malin (1953) summarized the situation when he wrote, "Overgrazing must bear justly the responsibility of a number of evils, but it has become a convenient scapegoat for a multitude of situations when the proper answer should be 'Nobody knows.'"

In this thesis is reported an analysis of the nature of the effect that grazing had upon two common species of song birds. Field studies were conducted on two 30-acre study tracts near Stillwater, Oklahoma during the spring and summer of 1960 and the summer of 1961.

CHAPTER II

REVIEW OF THE LITERATURE

Grazing produces a distinct effect upon vegetation. Larson (1940) contended that grazing is a natural part of the ecological pressures and has always been a part of plant succession. Ellison (1960) reviewed the major studies that have been made concerning the influence of grazing upon plant succession. Grazing generally has been shown to result in a decrease in the taller perennial grasses with a corresponding increase in annuals, shorter perennials and forbs (Branson, 1953; Cain, 1950; Dix, 1959; Bue, Blankenship and Marshall, 1952; Hanson, 1928; Weaver and Clements, 1938). The presence of little bluestem (Andropogon scoparius) is often used as an indicator of light or nongrazing conditions because of the rapid decrease of the grass with moderate or heavy grazing in drier years (Tomanek and Albertson, 1957). Kelting (1954) summarized the findings of investigations that have been conducted on the prairie vegetation of Oklahoma.

Grazing produces a less distinct effect upon animal populations. Grazing causes an increase in most insect populations, especially in certain species of grasshoppers (Coyner, 1938; Smith, 1940; Treherne and Buckell, 1924; Weese, 1939). Stoner (1960) suggested that the increase was due to the increased variety in host plants available because of the changes brought about through plant succession.

Berger (1961) wrote that one general effect of overgrazing was an increase in the rodent population. Phillips (1936), working in central Oklahoma, found that jackrabbits and deermice were more numerous in overgrazed areas, while cottontail rabbits, ground squirrels and pocket gophers were more numerous on ungrazed lands. Leopold (1950) suggested that overgrazing increased deer habitat since it accelerated the movement of shrubs into prairie. Buechner (1950) found that the antelope population in southern Texas increased on overgrazed pastures because of the increased availability of forbs.

Ungrazed or moderately grazed tracts tend to support higher avian populations than do grazed tracts (Baumgartner and Lawrence, 1953; Day, 1930; Monson, 1941; Smith, 1940). Baumgartner (1946) found that Bobwhite suffered from overgrazing because essential fall and winter foods (e.g. sunflowers) were eliminated.

An evaluation of the habitat chosen by animals has been attempted in a number of studies (Emlen, 1956; Getz, 1961; Judd, 1902; Lack, 1933; Williams, 1936). Miller (1942) came to the heart of the problem when he wrote:

> In making a selection, just what does the animal perceive? It seems impossible that there is a highly intelligent evaluation of the favorable factors at a given locale, but instead an automatic, instinctive reaction, even though quite delicately adjusted, to a few key aspects of the environment.

Investigations attempting to determine the factors that deliniate the habitat for a particular avian species have been numerous. Results have varied. A number of writers theorized that species of birds are dependant upon the life-form of the vegetation (Beecher, 1942; Brecher, 1943; Lack, 1933; Peterson, 1942; Pitelka, 1941). Recent studies in

Oklahoma by Stebler and Schemnitz (1955) with Scaled Quail and Jones (1960) with Prairie Chickens have supported the theory. Parmalee (1953), working with Bobwhite, found that population density depended upon the quality and quantity of available food and cover. Stokes (1950) found that availability of food was the critical factor in habitat choice of the American Goldfinch. Campbell (1955), investigating the habitat of of the Pied Flycatcher in Great Britain, found that the habitat requirements were, in chronological order, "Food supply on arrival; protective cover; nest sites; perches for song, display and feeding sallies; nest materials; and a continuing food supply for adults and young." Other habitat factors that have been suggested as being limiting in nature for other species of birds have included: the openness of the forest canopy (Breckenridge, 1956; Odum, 1941; Prescott, 1950); the availability of singing perches (Johnston, 1947; Lack, 1933; Walkinshaw, 1936); light intensity or the amount of shade (Fawver, 1950; Kendeigh, 1945; Lawrence, 1953; Peterson, 1942; Sutton, 1949); the density of the undergrowth (Bond, 1957); and the amount of "edge" available (Baumgartner and Lawrence, 1953; Hanson and Miller, 1961; Warbach, 1958).

After examining the locations of some 20,000 nests of 169 different avian species, Nickell (1958) concluded that the aspects of the vegetation in a particular habitat which are critical in the choice of a nesting site are: (1) the branching arrangement of the plants, (2) the abundance and growth stages of the plants, and (3) the availability of plants with fibers, down, etc. suitable for nest construction.

Analysis of the availability of food as a limiting factor has attracted a number of investigators. Most studies have revealed that birds choose the animal portion of their diet without selectivity in proportion to its availability (Kendiegh, 1945; McAtee, 1932; Stenger, 1958). However, enough investigations have produced conflicting results to make the question still undecided (Lack, 1954; Gibb, 1960; Dewar, 1940).

The Dickcissel has been studied in Oklahoma by Cooke (1923), Crab (1923), Nice (1931) and Overmire (1962a), but the most definitive work was by Gross (1921) who studied the species in Illinois.

Studies of Bell's Vireo in Oklahoma have been made by Nice (1929, 1931) and Overmire (1962b). Studies of the species in other states have been made by DuBois (1940), Hensley (1950), Mumford (1952) and Pitelka and Koestner (1942). The most comprehensive studies of Bell's Vireo have been by Barlow (1962) and Nolan (1960).

CHAPTER III

METHODS

Vegetation Analysis

The vegetation of the study tracts was analyzed according to the species composition, density and life-form distribution. To complete the species analysis, samples of the vegetation were made at intersections of 60-foot grid lines laid out over both study tracts. The conspicuous plant species occurring within two-foot radii of the intersections were recorded. Intersections which occurred over areas of water were excluded from the tabulation. More than 360 samples were made on each study tract. A reference collection was made to permit identification of plants that were not recognized in the field. In addition, an estimate of the density of the vegetational cover was made for each sample, following the method described by Alexander (1959). Values from one to four, depending upon the density of the vegetation, were given to each sample.

A modification of the life-form (or vegetation growth type) classification scheme developed by Du Reitz (1931) was used in the study. The vegetation on each tract was analyzed according to nine life-form types (e.g. tall trees, low trees, low forbs, etc.). In addition, a species count was made of two of the life-form types: tall trees (eight to 30 meters) and low trees (two to eight meters).

Analysis of Avian Populations

Field observations of the bird populations were made using the spot-map technique developed by Williams (1936). The locations of all singing males were plotted on field maps. Each day's results were tabulated on individual species maps. Additional information concerning nesting and courtship activities, the locations of nonsinging birds, etc. was also recorded. Gradually, grouping of the spot-locations revealed the approximate territories defended by individual males. Further observations, especially of simultaneous singing, allowed the individual territories to be defined.

The actual size of each territory was determined using the method described by Odum and Kuenzler (1955) and modified by Stenger and Falls (1959). The area of the polygon formed by connecting the outermost points of a territory was measured. Each time five additional spot-locations were added the area was redetermined. Maximum size of the defended territory was considered to be reached when the area failed to increase by more than one per cent after an addition of ten spot-locations. The one per cent level was usually reached after some 45 spot-locations for Dickcissels and 25 for Bell's Vireos.

The location of each nest was analyzed according to the height above the ground, distance from the margin of the vegetation, amount of open space above and below, etc. In addition, each nest was rated for the degree of concealment. Values from "6" for maximum concealment to "0" for total lack of concealment were used. If the nest was not visible from a distance of four feet the nest was considered to be concealed from that particular direction.

Food Studies

In order to determine the food choices of the two species, adult and nestling birds were collected at regular intervals from near both study tracts. In addition, nestlings were occasionally taken from nests within the study tracts. Since digestion is rapid in birds it was necessary to limit collecting to the time of the most active feeding (i.e. the early morning hours). Stomachs of the birds were preserved in alcohol and the contents were identified following the methods of Judd (1901) and Martin, Zim and Nelson (1951).

The insect populations on the two study tracts were estimated in order to establish an index of food availability. Weekly samples were taken on each study tract in each of three life-forms -- forbs, shrubs and grass. The areas of collecting were selected at random within the life-forms. Collecting was done between 4:00 and 6:00 PM on days following 24-hour periods without rain. Each sample consisted of six, 16-sweep trials with a 14-inch insect net. The entire contents of the net were placed in large killing jars, different jars being used for each life-form. Later, in the laboratory, the debris was removed from the samples. All insects small enough to pass through a one millimeter screen were discarded. The remaining insects were preserved in alcohol and tabulated according to order and size.

CHAPTER IV

THE STUDY TRACTS

General Description

Two 30-acre tracts were utilized in the study. Both tracts were in Payne County, Oklahoma, near Stillwater, and were less than two miles apart (Fig. 1). The study tracts were comparable in most respects, the chief difference being in the land-use treatment. Each tract consisted of a sparsely wooded ravine and intermittent stream surrounded by tall grass prairie. Each tract contained a small pond. One tract had been grazed intensely for a number of years, the other had been protected from grazing. The tracts were mapped using plane-table, alidade and steel tape. Miscellaneous data concerning the tracts are given in Table I. The climate, soils and vegetation of Payne County have been described elsewhere (Bruner, 1931; Duck and Fletcher, 1944; Parker, 1954).

TABLE I

COMPARISON OF THE STUDY TRACTS

Item	Tract I	Tract II
Size	30.2 acres	30.3 acres
Shape	pentagonal	dog-legged
Elevation above sea level	930-950 feet	910-950 feet
Land use	nongrazed	grazed

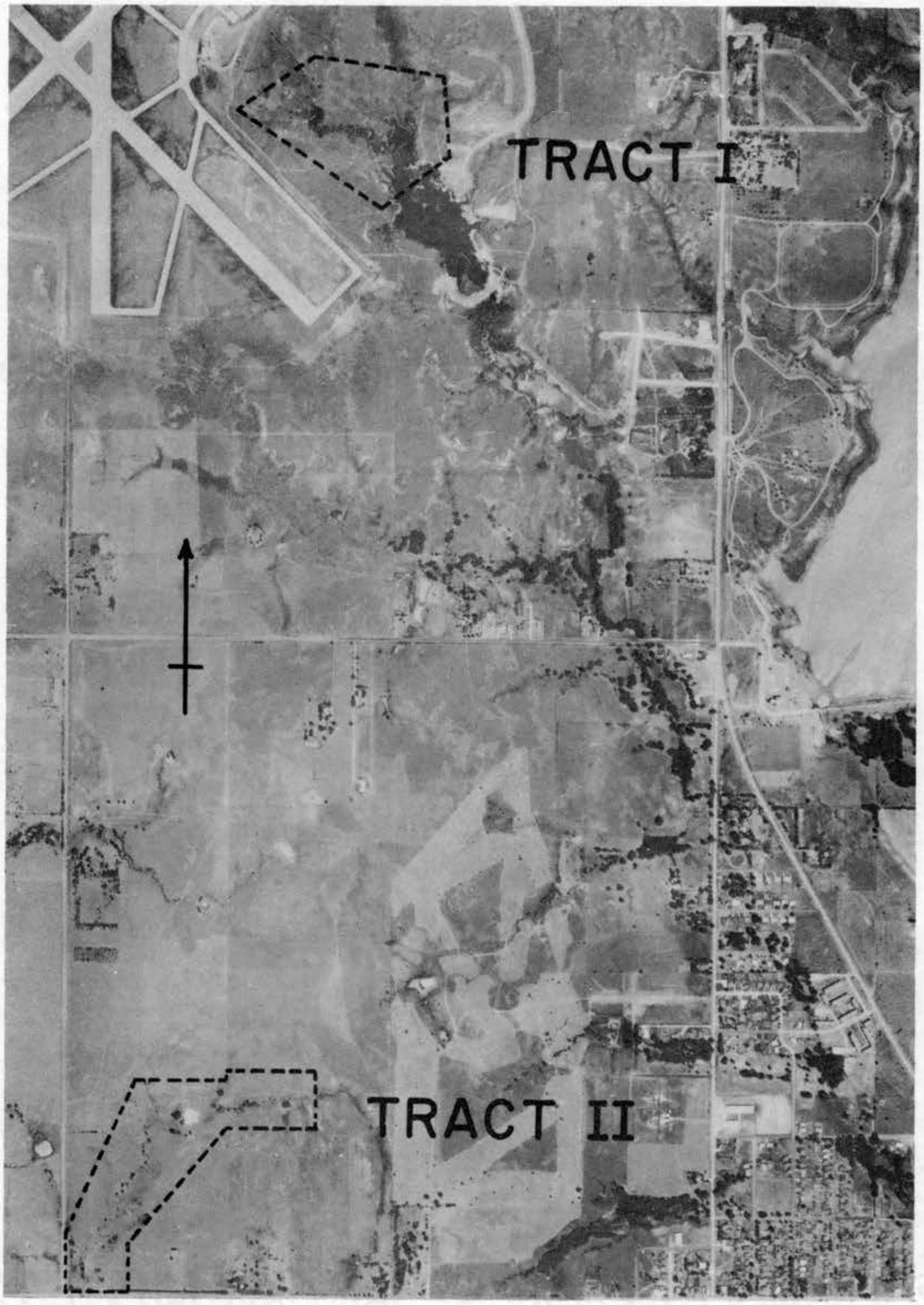

Fig. 1. Location of the study tracts. The Stillwater Municipal Airport is visible in the upper part of the photograph. Scale: 1320 feet = 1 inch

Tract I was located on part of the Izaac Walton League reserve, immediately east of the Stillwater Municipal Airport (Fig. 2). The reserve was part of the Stillwater public park system but had been leased to the Izaac Walton League since 1942. The general area had been protected from grazing for at least 40 years. A 14-acre artificial lake was on the eastern portion of the reserve for a number of years. During a flood in the spring of 1957 the dam broke and the lake drained. The dam was not rebuilt. The former lake-bed area had progressed through several early stages in vegetational succession. Occasional plantings of evergreens and osage orange (Maclura pomifera) had been made on

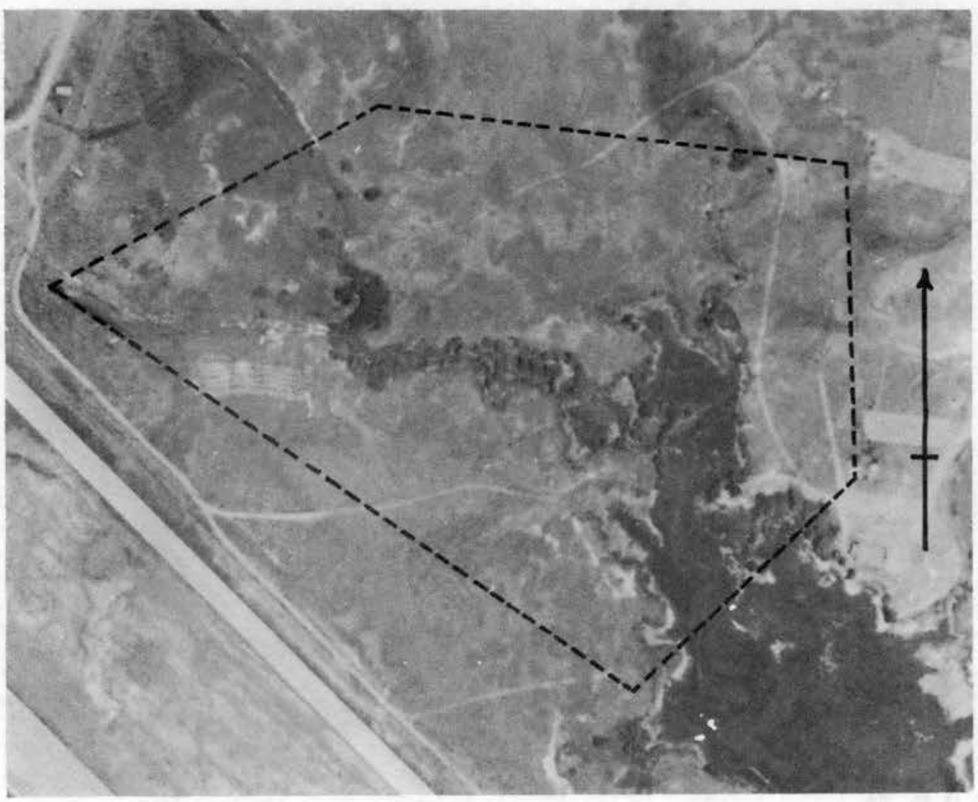

Fig. 2. Aerial photograph of Tract I. The dark mass of vegetation shows the area of the former lake-bed. The two-acre pond does not appear in the photograph since it was constructed after the photograph was taken. Scale: 400 feet = 1 inch.

portions of the reserve. A two-acre pond was constructed on part of the tract during 1960. Fig. 3 shows a typical scene from Tract I.

Fig. 3. Typical habitat on Tract I. American elms such as those in the picture were used regularily for nesting by both Dickcissels and Bell's Vireos.

Tract II was located on one of the Oklahoma State University farms, one mile west of Stillwater, at the corner of McElroy and Western Avenues (Fig. 4). The farm was used by the Oklahoma State University Animal Husbandry Department as a temporary holding pasture for cattle. The farm was acquired by the University in 1952 and had been in continuous grazing use since the time of the purchase. Fig. 5 shows a typical scene from Tract II. Occasional refinements, such as the mowing of weeds and the removal of osage orange thickets, had been made. Large patches of forbs were common over most of the tract. Areas of dense tall grasses were very limited. Conspicuous well-worn cattle trails were present over much of the tract (Fig. 6).

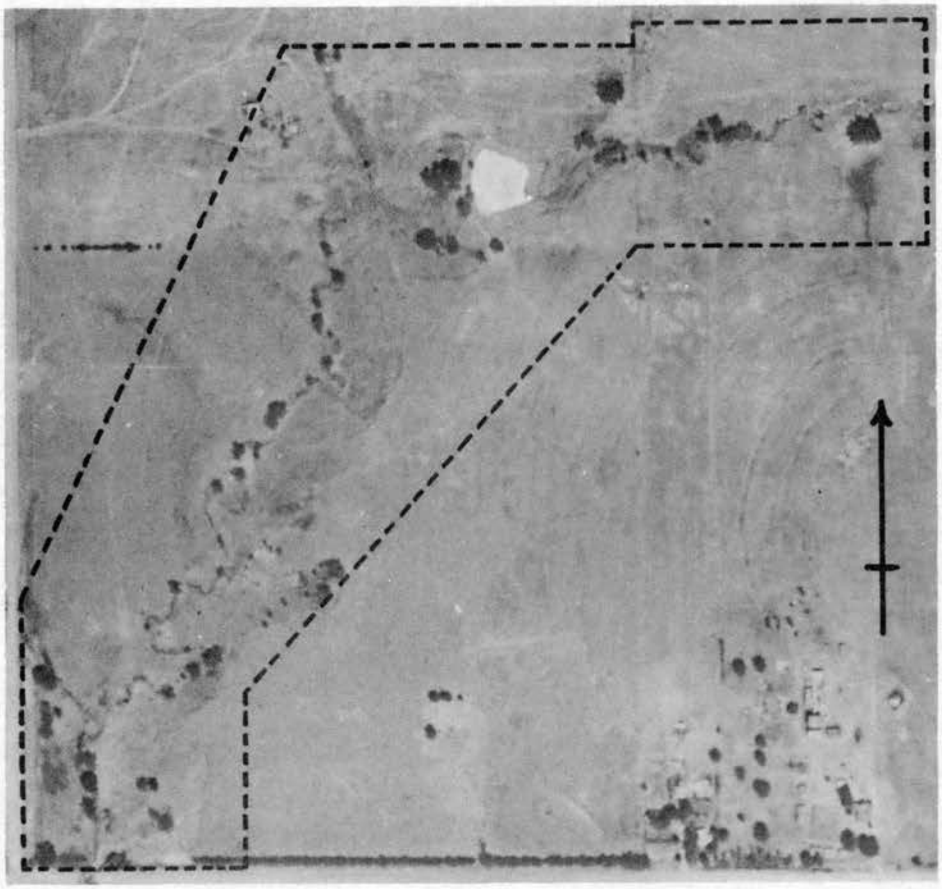

Fig. 4. Aerial photograph of Tract II. Scale: 400 feet = 1 inch.

Vegetation of the Study Tracts

The frequency of occurrence of the more common plant species is given in Fig. 7. The list of species found on both tracts was almost identical; however, the relative abundance of the species was quite different. Little bluestem was the most common grass present on both tracts. Certain species, typical of ungrazed prairie (e.g. heath aster Aster ericoides, big bluestem Andropogon Gerardi, switchgrass Panicum virgatum), had a much higher frequency on Tract I than on Tract II. Certain other species, typical of disturbed prairie (e.g. Bermuda grass Cynodon dactylon, snow-on-the-mountain Euphorbia marginata, broomweed

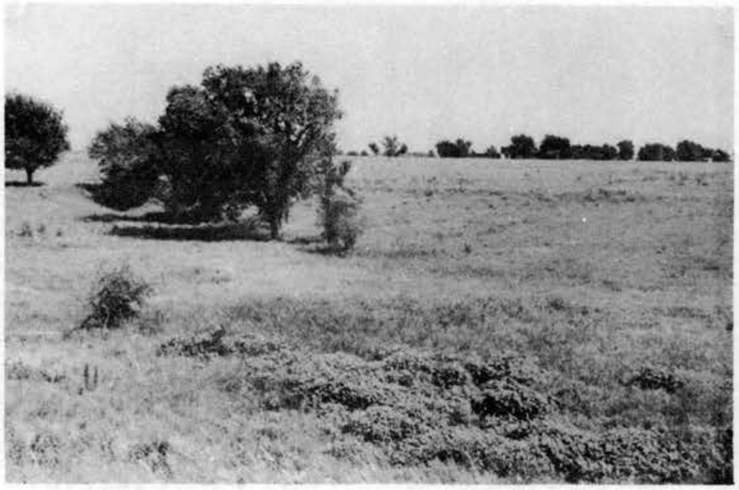

Fig. 5. Scene on Tract II looking north toward the dam. In the foreground is a patch of sunflowers, typical of many such areas of forbs on Tract II.

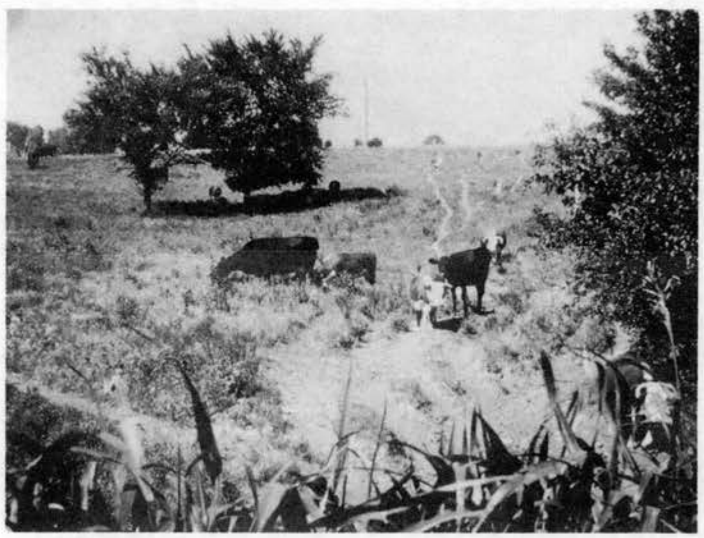

Fig. 6. Scene on Tract II showing the overgrazed condition of the area. The tall grass visible in the foreground was separated from the study tract by a fence.

Gutierrezia dracunculoides), had a much lower frequency on Tract I than on Tract II. The former lake-bed on Tract I contained a high percentage of forbs and many four to six-foot saplings.

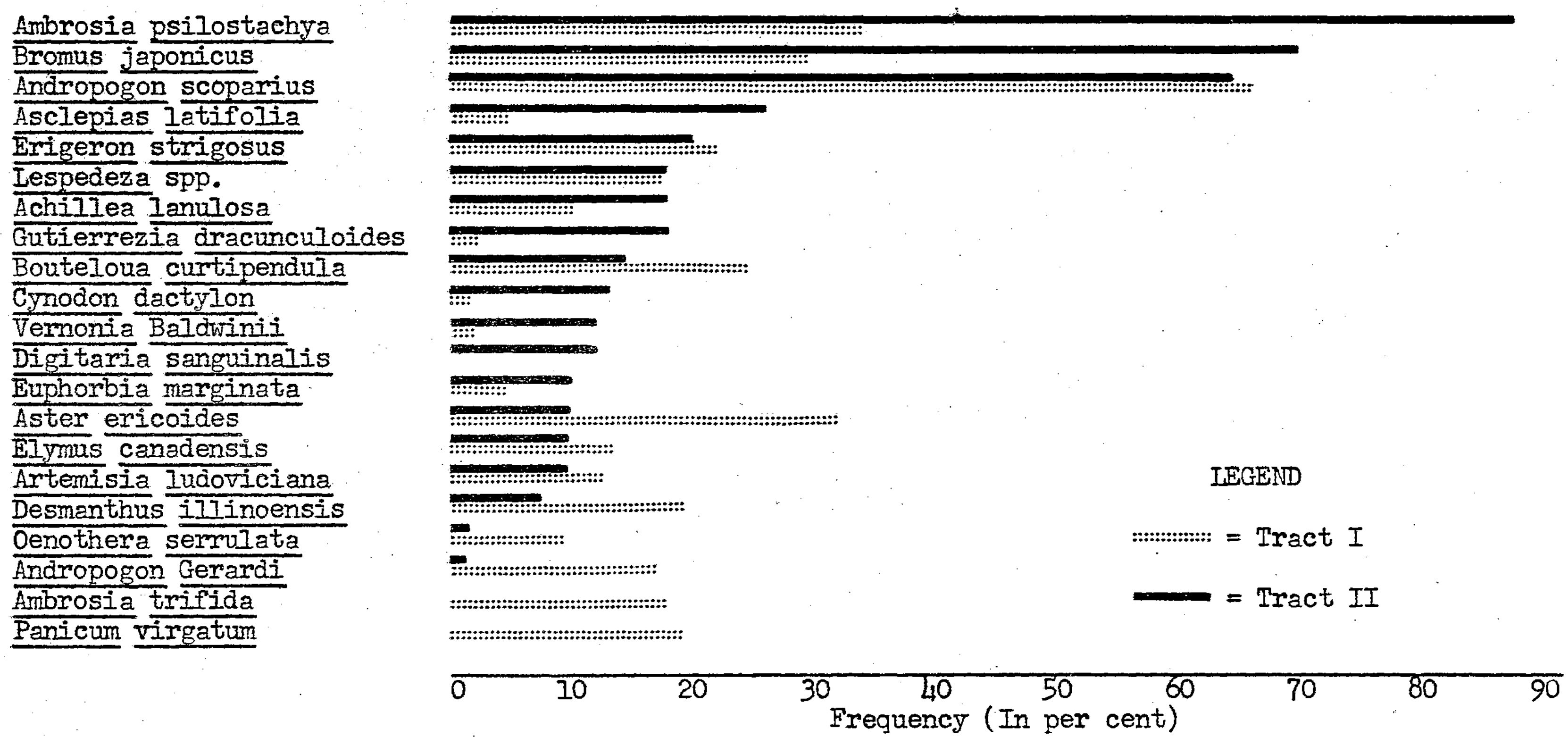

Fig. 7. Relative frequency of the more common plant species on the two study tracts.

The life-form distribution of the vegetation on the study tracts is shown in Fig. 8 and Fig. 9. Analysis of the amounts of the life-forms (Table II) shows that there was 16 per cent more area in forbs, 21 per cent more in trees, 34 per cent more in shrubs and 11 per cent less in grass on Tract I than on Tract II. Differences in the amounts of certain life-form sub-divisions were more pronounced (e.g. medium

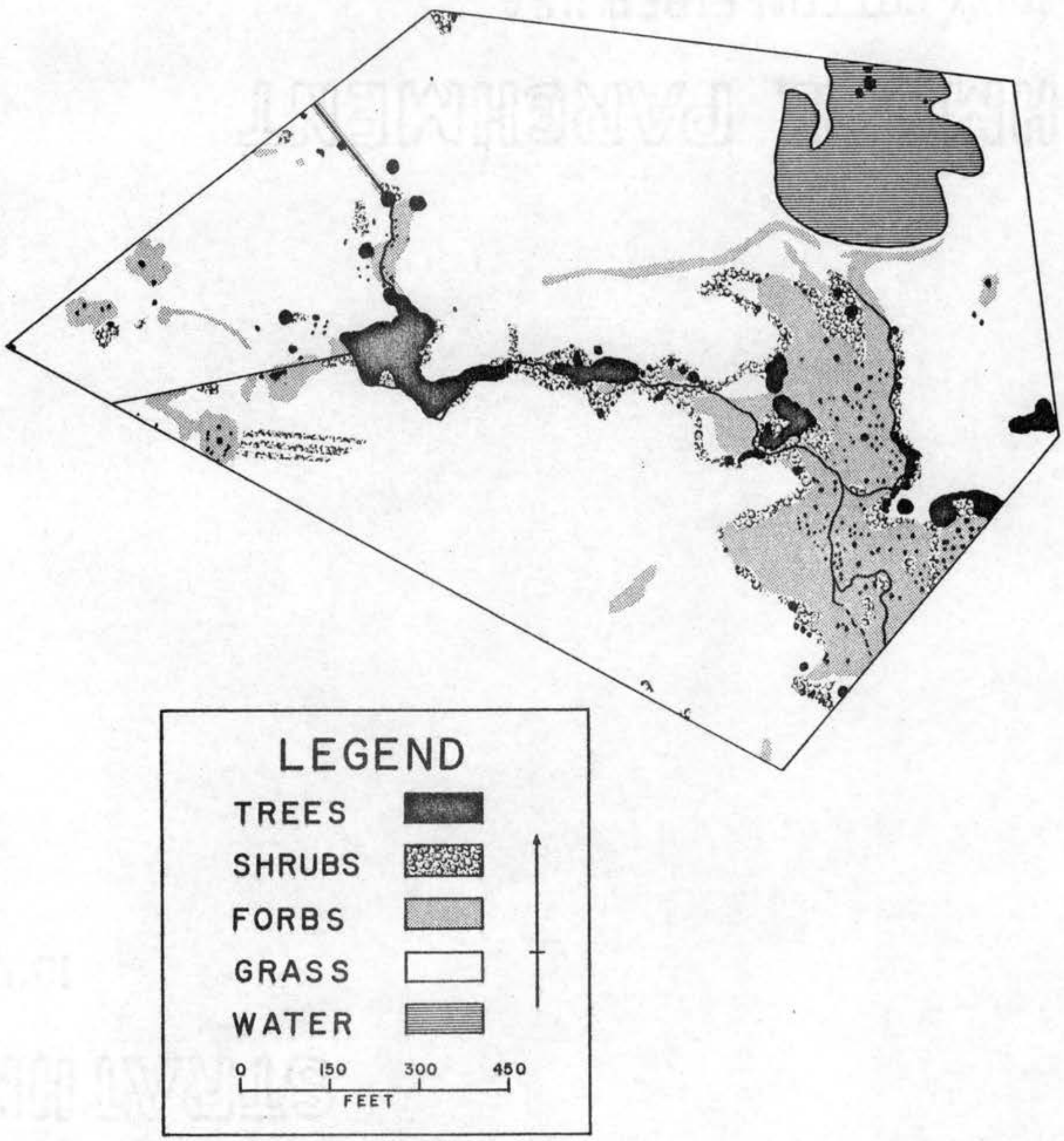

Fig. 8. Distribution of life-forms on Tract I.

shrubs were 490 per cent more abundant on Tract I, medium forbs were 290 per cent more abundant on Tract I, etc.)

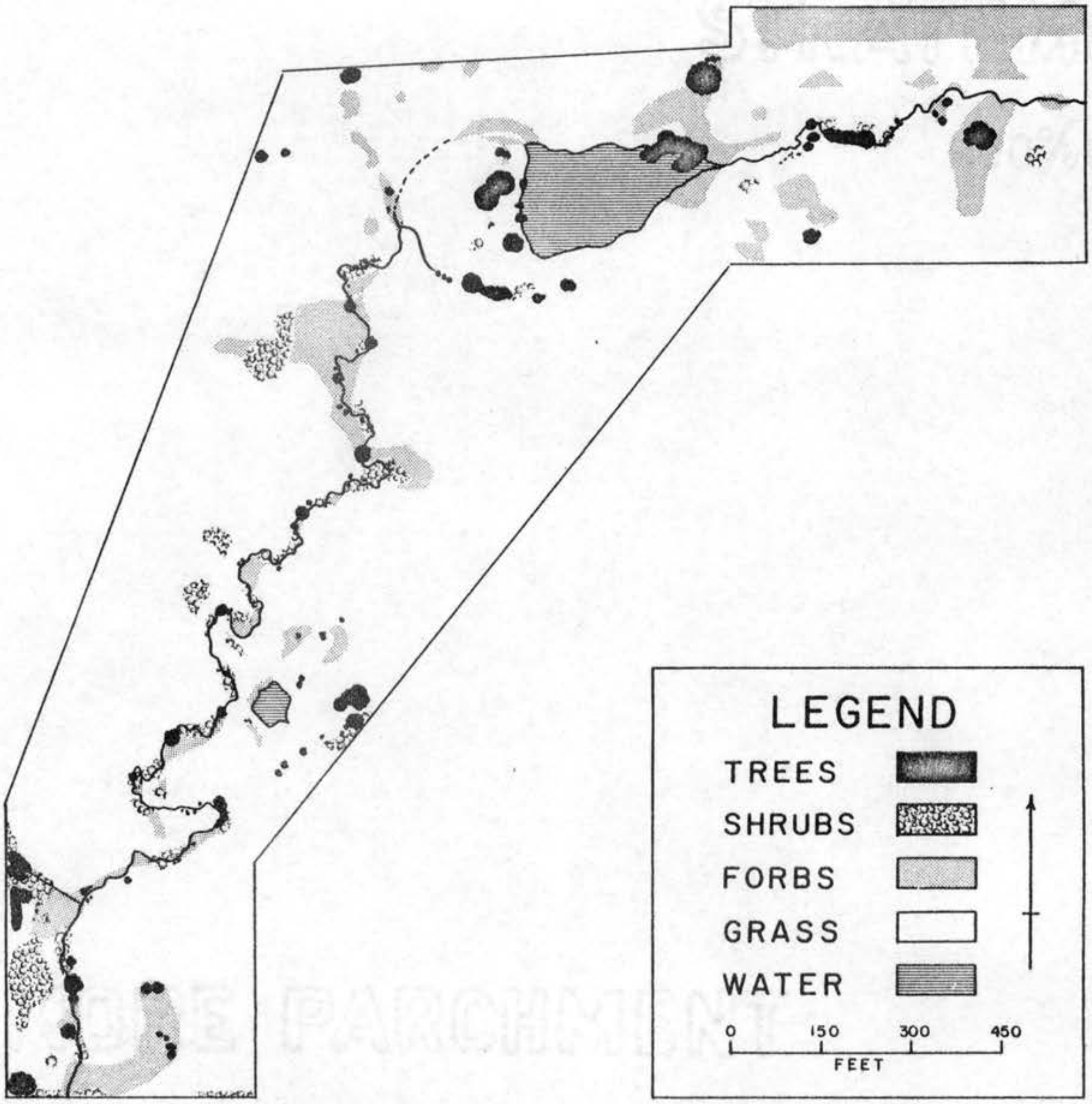

Fig. 9. Distribution of life-forms on Tract II.

The species distribution of the trees over two meters high is given in Table III. There were 230 per cent more of the trees on Tract I than on Tract II. The number of tall trees was almost identical on both tracts. The number of low trees was greater on Tract I than on Tract II, but the relative percentages of the species were almost the same on each tract.

TABLE II

AMOUNTS OF LIFE-FORMS ON THE STUDY TRACTS

Life-form	Tract I Area*	Tract I %	Tract II Area*	Tract II %
Trees				
Tall (> 8 meters)	0.32	1.02	0.44	1.45
Low (2 - 8 meters)	0.88	2.92	0.56	1.85
Dwarf (< 2 meters)	0.03	0.11	0.01	0.05
Total	1.23	4.05	1.01	3.35
Shrubs				
Medium (> 0.8 meters)	0.83	2.72	0.17	0.56
Dwarf (< 0.8 meters)	0.30	1.02	0.67	2.24
Total	1.13	3.74	0.84	2.80
Forbs				
Tall (> 0.8 meters)	0.60	1.98	0.00	0.00
Medium (0.25 - 0.8 meters)	2.93	9.66	1.02	3.36
Low (< 0.25 meters)	0.41	1.36	2.37	7.86
Total	3.94	13.00	3.38	11.22
Grass				
Medium (0.25 - 0.8 meters)	19.86	65.53	0.66	2.18
Low (< 0.25 meters)	1.37	4.54	23.31	77.25
Total	21.23	70.07	23.97	79.43
Bare ground	0.86	2.83	0.05	0.15
Water	1.90	6.31	0.92	3.05
Total	30.30	100.00	30.17	100.00

*In acres.

The amount and density of the vegetational cover is compared in Table IV. Analysis of the data show that (1) there was four per cent less overstory on Tract I, but the average density was 13 per cent greater, (2) there was 16 per cent more undergrowth on Tract I, and the average density was 14 per cent greater, (3) there was 0.6 per cent less ground cover on Tract I, but the average density was eight per cent greater.

TABLE III

NUMBER OF TREES OVER TWO METERS HIGH ON THE STUDY TRACTS

Species	Tract I						Tract II					
	Tall Trees*		Low Trees**		Total Trees		Tall Trees*		Low Trees**		Total Trees	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Ulmus americana	11	45.8	371	36.7	382	36.9	18	72.0	170	40.0	188	41.8
Salix nigra	1	4.2	201	19.9	202	19.5	2	8.0	109	25.6	111	24.7
Populus deltoides	7	29.2	161	15.8	168	16.2	0	0.0	7	1.6	7	1.6
Robinia Pseudo-Acacia	0	0.0	121	12.0	121	11.7	0	0.0	15	3.5	15	3.3
Morus rubra	0	0.0	86	8.5	86	8.3	2	8.0	23	5.4	25	5.6
Celtis reticulata	1	4.2	53	5.2	54	5.2	3	12.0	47	11.1	50	11.1
Gleditsia tricanthos	4	16.6	10	1.0	14	1.3	0	0.0	13	3.1	13	2.9
Diospyros virginiana	0	0.0	4	0.4	4	0.4	0	0.0	0	0.0	0	0.0
Tamarix gallica	0	0.0	3	0.3	3	0.3	0	0.0	0	0.0	0	0.0
Pinus spp.	0	0.0	2	0.2	2	0.2	0	0.0	0	0.0	0	0.0
Juniperus spp.	0	0.0	0	0.0	0	0.0	0	0.0	20	4.7	20	4.4
Bumelia lanuginosa	0	0.0	0	0.0	0	0.0	0	0.0	12	2.8	12	2.7
Elaeagnus angustifolia	0	0.0	0	0.0	0	0.0	0	0.0	3	0.7	3	0.7
Prunus serotina	0	0.0	0	0.0	0	0.0	0	0.0	2	0.5	2	0.4
Carya spp.	0	0.0	0	0.0	0	0.0	0	0.0	2	0.5	2	0.5
Total	24	100.0	1012	100.0	1936	100.0	25	100.0	423	100.0	448	100.0

*Over eight meters high.

**Between two and eight meters high.

TABLE IV

DENSITY OF VEGETATIONAL COVER

Density*		Tract I Frequency	Tract I Per Cent	Tract II Frequency	Tract II Per Cent
Ground cover					
4		217	60.2	145	39.8
3		126	34.8	181	49.8
2		11	3.0	32	8.8
1		11	3.0	6	1.6
	Total	362	100.0	364	100.0
Understory					
4		4	8.0	0	0.0
3		6	12.0	4	9.3
2		16	32.0	17	39.5
1		24	48.0	22	51.2
	Total	50	100.0	43	100.0
Overstory					
4		2	9.1	2	8.7
3		3	13.6	2	8.7
2		7	31.8	5	21.7
1		10	45.5	14	60.9
	Total	22	100.0	23	100.0

*4 = 75 to 100 per cent cover; 3 = 50 to 75 per cent cover; 2 = 25 to 50 per cent cover; 1 = 0 to 25 per cent cover.

Animal Populations on the Study Tracts

Various vertebrates were found on both tracts. House cats, dogs, cottontail rabbits and various species of snakes were seen occasionally. Skunks, jackrabbits, muskrats, cotton rats, opossums and raccoons were seen less frequently. Ornate box turtles (Terrapene ornata) were very numerous on Tract II. Approximately 20 species of birds nested on each tract, Dickcissels and Bell's Vireos being the most abundant species on both tracts. Results of breeding bird population studies conducted on the tracts have been reported elsewhere (Overmire, 1961a, 1961b).

Samples of the arthropod populations on the two tracts have been summarized in Table V. Analysis of the data reveals that the arthropods were nearly 70 per cent more plentiful on Tract II than on Tract I. Orthopterans were 138 per cent more plentiful, homopterans 181 per cent more plentiful and arachnids 71 per cent more plentiful on Tract II. The results are in general agreement with the findings of Coyner (1938) and Parker (1952) who conducted similar surveys in southern Oklahoma.

TABLE V

ARTHROPOD POPULATION SURVEY

Group	Tract I		Tract II	
	Number	Per Cent	Number	Per Cent
Orthoptera	963	36.4	2288	51.1
Coleoptera	454	17.1	427	9.5
Diptera	325	12.3	303	6.8
Arachnida	266	10.0	447	10.0
Homoptera	234	8.8	658	14.7
Hymenoptera	179	6.8	136	3.0
Hemiptera	154	5.8	135	3.0
Lepidoptera	65	2.4	81	1.8
All others	12	0.4	6	0.1
Total	2652	100.0	4481	100.0

Cattle were present on Tract II every day during the period of the study. The size of the herd varied, but it was not uncommon to find 60 or 70 cattle present at one time. The study tract was part of a larger, 100-acre pasture; consequently, cattle were not confined to the tract itself.

CHAPTER V

DICKCISSELS

Nesting Activities

The bulk of the Payne County population of Dickcissels arrived in late April or early May. Courtship began soon after arrival and nesting activities were under way by the latter part of May. Territories were established early in the nesting period by the males and were defended vigorously -- primarily by singing. If nesting was interrupted, pairs would frequently attempt a second nesting. As the young birds from the final broods were fledged, the territories were abandoned. During August the family units formed into loosely-organized flocks. Departure for Central and South America occurred during September.

Nest building, incubation and care of the nestlings were activites solely of the females. Males took partial responsibility in two cases for the care of first brood fledglings after the females had started construction of second nests. In a number of instances males showed concern when the safety of the fledglings was threatened. Gross (1921) found that males assumed no responsibility whatsoever for the welfare of the offspring. Five (11.4 per cent) males were found to be polygamous. Polygamy may have been more common that this since cases could easily have gone undetected.

The sequence of the nesting season is shown in Fig. 10. Both years

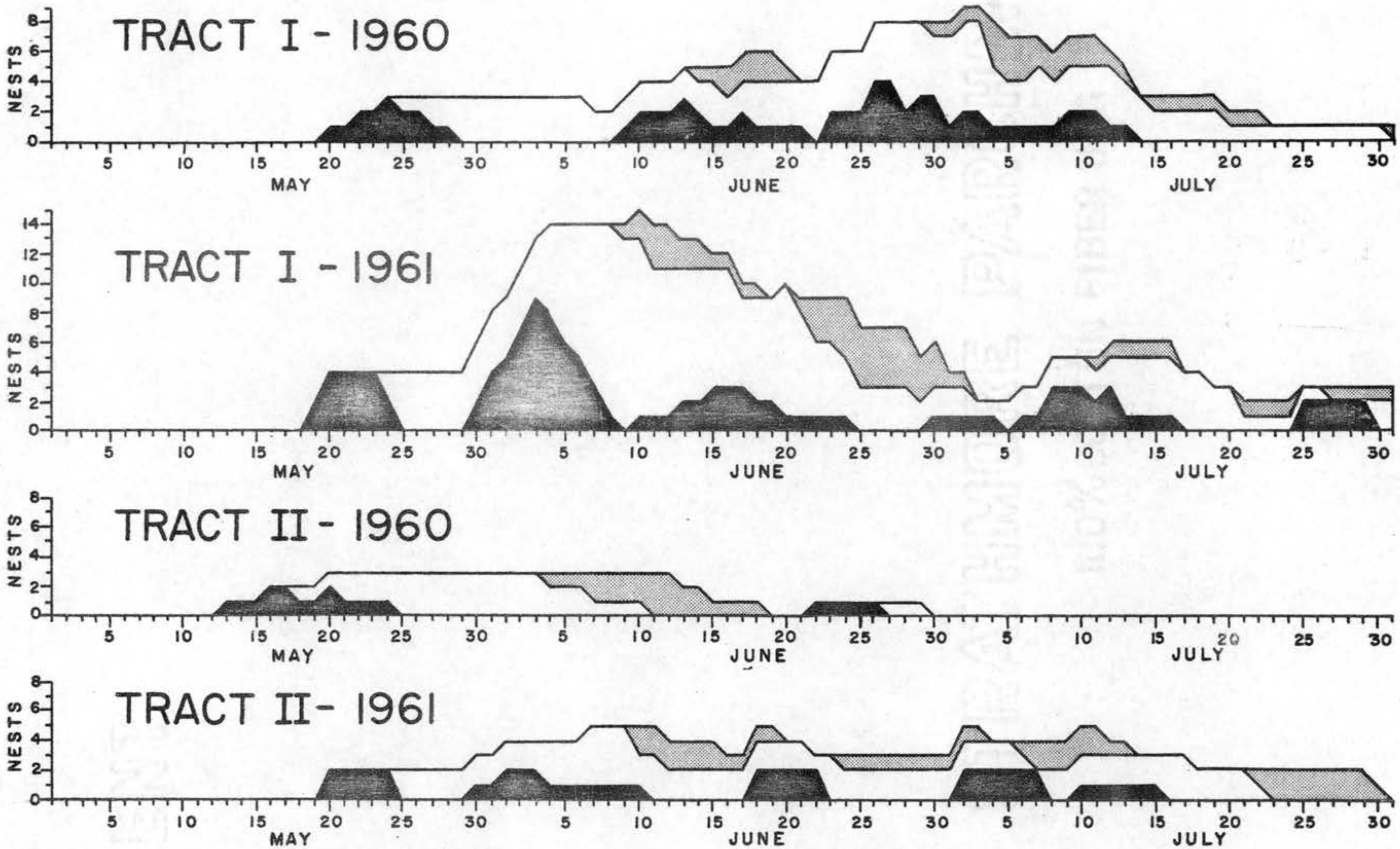

Fig. 10. Sequence of Dickcissel nesting season. Legend: ▇ = nests under construction, ▭ = nests containing eggs, ▨ = nests containing young birds.

the season started at approximately the same date on both tracts. The extent of the nesting period was shorter both years on Tract II.

Seventy-five nests were discovered on the two study tracts. Thirty-nine (52 per cent) of the nests were built in trees, with 28 (37 per cent) of the nests being in American elms. The choice of nesting site was evaluated to determine if American elms were actually sought for nest locations. Interpretation of data from Tract I (Table VI) suggests that selection did occur. American elms comprised only 45.2 per cent of the total tree community, yet they contained 77.7 per cent of the nests. However, some species of trees were virtually never used for nesting.

TABLE VI

CHOICE OF TREES USED FOR NESTING BY DICKCISSELS ON TRACT I*

Species	Nests		Trees	
	Number	Per Cent	Number	Per Cent
1960				
Ulmus americana	14	70.0	382	59.4
Robinia Pseudo-Acacia	1	5.0	121	18.8
Morus rubra	3	15.0	86	13.4
Celtis reticulata	2	10.0	54	8.4
Total	20	100.0	643	100.0
1961				
Ulmus americana	14	87.4	382	54.1
Salix nigra	1	6.3	202	28.6
Robinia Pseudo-Acacia	1	6.3	121	17.3
Total	16	100.0	705	100.0
1960 + 1961				
Ulmus americana	28	77.7	382	45.2
Salix nigra	1	2.8	202	23.9
Robinia Pseudo-Acacia	2	5.6	121	14.3
Morus rubra	3	8.3	86	10.2
Celtis reticulata	2	5.6	54	6.4
Total	36	100.0	845	100.0

*Data are given only for nests which were located in low (two - eight meters) or tall (over eight meters) trees. Data on the trees are from these same two life-form categories.

When the nests in black willows and black locusts (a total of three nests) were eliminated from the tabulation, the percentages of trees used for nesting vs. available trees became nearly identical. Consequently, it seems that among the acceptable trees the choice of nesting site was dependant upon the relative abundance of a species rather than upon the species per se. Data were not sufficient for a comparable analysis to be made on Tract II since only three nests were located in trees. It was impractical to attempt to count the number of individual plants in the other life-forms; consequently, no similar evaluation was made for nests located in forbs, shrubs or grass.

Territories

The locations of the territories at the time of greatest population density are given in Fig. 11. Territories were centered around the timbered ravines on both tracts. Shapes of the territories were delineated in large measure by the chance locations of trees which were used for singing perches. Most of the territories were defended for the entire nesting period, but the territories of two non-mated males were deserted after a few weeks. Both summers there were 14 territories on Tract I and eight territories on Tract II.

Analysis of the sizes of the territories is given in Fig. 12. The mean territory size was 0.62 acres on Tract I and 1.16 acres on Tract II. Variation in size was not great enough on either tract to be of statistical significance. However, when the variation between the tracts was compared, the given "t" value at the 95 per cent confidence level was exceeded.

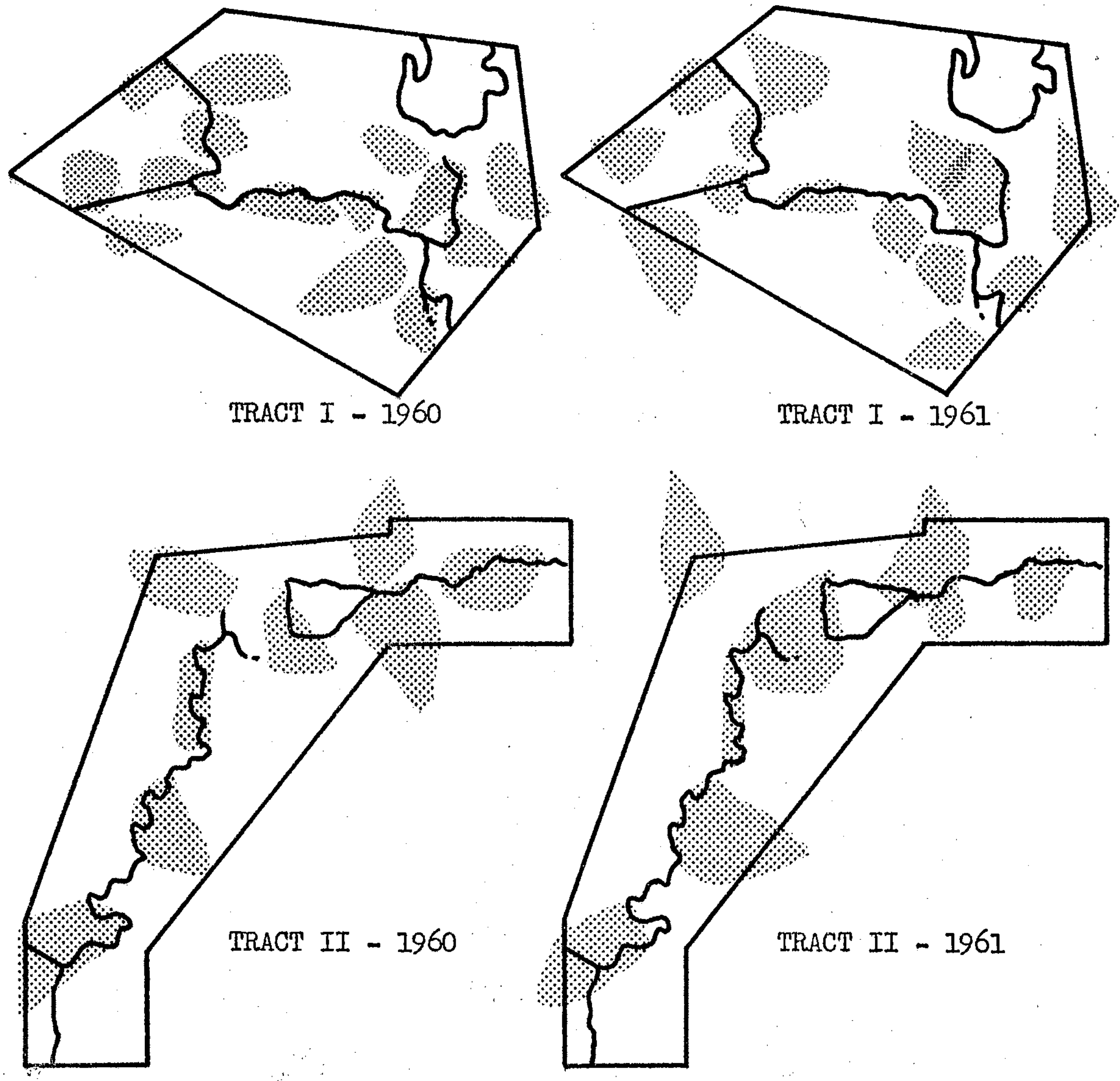

Fig. 11. Location of Dickcissel territories.

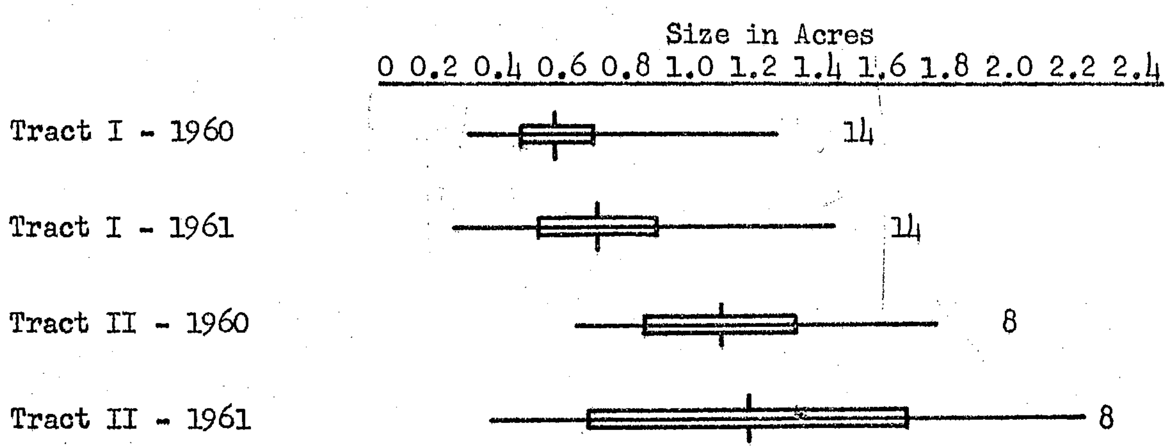

Fig. 12. Measurement of Dickcissel territories showing sample size, mean, range and twice standard error of mean.

The amounts of life-forms that were found in the combined territories on each tract are given in Table VII. Analysis of the data suggests that (1) the percentages of each life-form utilized were similar for both tracts, and (2) there was a definite selection for tree, shrub and forb life-forms.

The life-form composition of the mean territories is given in Table VIII. The amounts of trees, shrubs and forbs found in the territories was rather constant. Size of territories seemed to vary with population pressure. Territories were 87 per cent larger on Tract II, but there was only a seven per cent difference in the total amount of land utilized.

Nesting Success

An evaluation was made of factors that determined nesting success -- successful nests being defined as those which fledged at least one young bird. When nesting success was compared with nest height (Table IX), ground nests (as a group) were found to be 87 per cent more successful than were elevated nests. A comparison of nesting success with the date of start of nest construction (Table X) showed that there was no relationship between the factors. As the nesting season progressed there was a definite tendency to build nests higher above the ground (Table XI).

An analysis of nest concealment is given in Table XII. Sixty-three per cent of the nests were well concealed and had concealment ratings of "5" or "6", but analysis of the data indicates that the degree of nest concealment was not a factor in nesting success.

The causes of nest failure are given in Fig. 13. Some loss occurred because nests were blown from trees. (Nests located in trees were not

TABLE VII

AMOUNTS OF AVAILABLE LIFE-FORMS VS. AMOUNTS UTILIZED BY DICKCISSELS*

	Tract I						Tract II					
	Available		Utilized				Available		Utilized			
			1960		1961				1960		1961	
Life-form	Amt.	%	Amt.	%**	Amt.	%**	Amt.	%	Amt.	%**	Amt.	%**
Trees	1.23	4.1	0.79	64.4	0.78	63.5	1.01	3.4	0.56	55.4	0.65	64.3
Shrubs	1.13	3.7	0.71	62.9	0.63	55.7	0.84	2.7	0.54	64.4	0.27	32.2
Forbs	3.94	13.0	1.63	41.5	2.07	52.6	3.38	11.2	1.42	42.1	1.33	39.4
Grass	21.23	70.3	4.62	21.7	6.16	29.0	23.97	79.4	6.40	26.7	6.99	29.2
Bare Ground	0.86	2.6	0.01	1.2	0.01	1.2	0.05	0.2	0.02	40.0	0.01	20.0
Water	1.90	6.3	0.00	0.0	0.00	0.0	0.92	3.1	0.13	14.1	0.17	18.5
Total	30.30	100.0	7.77	25.6	9.65	31.9	30.17	100.0	9.06	30.1	9.53	31.7

*In acres.

**Per cent of available life-form utilized.

TABLE VIII

LIFE-FORM COMPOSITION OF DICKCISSEL TERRITORIES

Life-form	Amount in Mean Territory*											
	Tract I						Tract II					
	1960		1961		Mean		1960		1961		Mean	
	Amt.	%	Amt.	%	Amt.	%	Amt.	%	Amt.	%	Amt.	%
Trees	0.06	10.7	0.06	8.7	0.06	9.7	0.07	6.2	0.08	6.7	0.08	6.9
Shrubs	0.05	8.9	0.05	7.3	0.05	8.1	0.07	6.2	0.04	3.4	0.05	4.3
Forbs	0.12	21.5	0.15	21.8	0.13	21.0	0.18	15.9	0.17	14.3	0.17	14.7
Grass	0.33	58.9	0.43	62.2	0.58	61.2	0.79	69.9	0.87	73.1	0.83	71.6
Bare Ground	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.01	0.8	0.01	0.8
Water	0.00	0.0	0.00	0.0	0.00	0.0	0.02	1.8	0.02	1.7	0.02	1.7
Total	0.56	100.0	0.69	100.0	0.62	100.0	1.13	100.0	1.19	100.0	1.16	100.0

*In acres.

TABLE IX

HEIGHT OF NEST VS. NESTING SUCCESS FOR DICKCISSELS*

Location	Tract I				Tract II				Tract I + Tract II			
	Total Nests		Successful Nests		Total Nests		Successful Nests		Total Nests		Successful Nests	
	No.	%	No.	%**	No.	%	No.	%**	No.	%	No.	%**
1960												
Ground nests	1	8.3	0	0.0	1	50.0	1	100.0	2	14.3	1	50.0
Elevated nests	11	91.7	3	27.3	1	50.0	0	0.0	12	85.7	3	25.0
Total	12	100.0	3	25.0	2	100.0	1	50.0	14	100.0	4	28.6
1961												
Ground nests	9	36.0	4	44.4	3	30.0	1	33.3	12	34.4	5	41.7
Elevated nests	16	64.0	2	12.5	7	70.0	3	42.9	23	65.6	5	21.7
Total	25	100.0	6	24.0	10	100.0	4	40.0	35	100.0	10	28.6
1960 + 1961												
Ground nests	10	27.1	4	40.0	4	33.3	2	50.0	14	28.6	6	42.8
Elevated nests	27	72.9	5	18.5	8	66.7	3	37.5	35	71.4	8	22.8
Total	37	100.0	9	24.0	12	100.0	5	41.7	49	100.0	14	28.6

*Only those nests were included whose fledging results were known.

**Per cent of total nests at the location that were successful.

TABLE X

NESTING SUCCESS VS. DATE OF START OF NEST CONSTRUCTION FOR DICKCISSELS*

Date of Start of Nest Construction	Total Nests: Number	Total Nests: Per Cent	Successful Nests: Number	Successful Nests: Per Cent
May 4-17	1	2.1	1	7.1
May 18-31	12	25.0	5	35.8
June 1-14	12	25.0	3	21.4
June 15-28	11	22.9	2	14.3
June 29 - July 12	12	25.0	3	21.4
July 13-26	0	0.0	0	0.0
Total	48	100.0	14	100.0

*Only those nests were included whose histories were known.

TABLE XI

DATE OF START OF NEST CONSTRUCTION VS. HEIGHT OF NEST FOR DICKCISSELS*

Height of Nest Above the Ground in Feet	Date of Start of Nest Construction: May 4-17	May 18-31	June 1-14	June 15-18	June 29-July 12	July 13-26	Total Nests
13 - 14	0	0	0	1	0	0	1
12 - 13	0	0	0	0	0	0	0
11 - 12	0	0	0	0	0	0	0
10 - 11	0	0	0	0	0	0	0
9 - 10	0	0	0	0	0	0	0
8 - 9	0	0	0	0	0	0	0
7 - 8	0	0	0	0	0	0	0
6 - 7	0	1	0	0	0	0	1
5 - 6	0	0	1	1	0	0	2
4 - 5	0	0	0	0	1	0	1
3 - 4	0	0	2	0	3	0	5
2 - 3	0	0	0	4	1	0	5
1 - 2	0	0	4	4	4	0	12
0 - 1	1	11	5	1	3	0	21
Total	1	12	12	11	12	0	48

*Only those nests were included whose histories were known.

well anchored to branches or twigs.) The 53 per cent loss because of predation seems to be quite high; yet, Lack (1954) speculated that over 75 per cent of the nest failures in open-nesting song birds were from predation. Sixteen (32.7 per cent) of the nests were parasitized by the Brown-headed Cowbird (Molothrus ater), but only 8.2 per cent of the nest failures were known to be caused by cowbird interference (Fig. 14).

TABLE XII

NESTING SUCCESS VS. DEGREE OF NEST CONCEALMENT FOR DICKCISSELS*

Concealment	Total Nests		Successful Nests	
Rating**	Number	Per Cent	Number	Per Cent
6	19	38.6	6	42.8
5	12	24.6	3	21.4
4	1	2.0	0	0.0
3	4	8.2	1	7.2
2	4	8.2	2	14.3
1	8	16.4	2	14.3
0	1	2.0	0	0.0
Total	49	100.0	14	100.0

*Only those nests were included whose fledging results were known.
**6 = total concealment, 0 = total lack of concealment.

Food Choices

An analysis of the contents of 63 stomachs showed that foods of animal origin (i.e. arthropods) comprised 54.2 per cent of the diet of adult Dickcissels and 95.0 per cent of the diet of nestlings. Over 85 per cent of the arthropods were orthopterans. Judd (1901), after analyzing 163 stomachs, reported that orthopterans comprised 60 per cent of the arthropod portion of the diet. Martin et al. (1951) found that half of the arthropod food of Dickcissels consisted of orthopterans. Since orthopterans were twice as abundant on Tract II as on Tract I, the availability of food was not a limiting factor upon the size of the Dickcissel population.

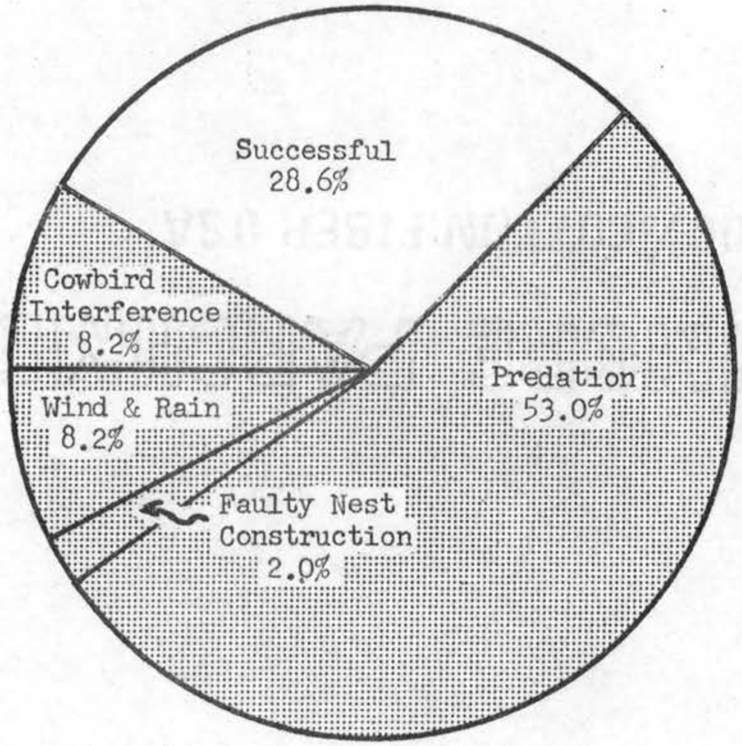

Fig. 13. Fate of Dickcissel nests.

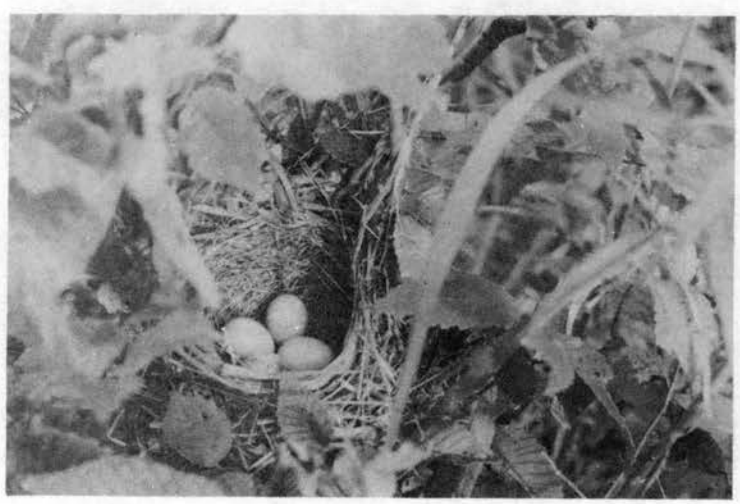

Fig. 14. Dickcissel nest containing three Dickcissel eggs and one Brown-headed Cowbird egg.

There seemed to be a selection for larger food items. The 17 arthropods from the stomachs that were still complete enough to be measured varied from 0.3 to 4.0 centimeters long, with the average length being 2.1 centimeters. Dickcissels observed catching or carrying arthropods usually had grasshoppers or caterpillars two or three centimeters long.

A comparison of the food choices with the total arthropod population would have given biased results since smaller arthropods were not usually taken. A comparison was made, therefore, between the food choices and the available arthropods over one centimeter long (Table XIII). When the data were analyzed statistically, a chi square value of 44.75 was obtained. Since the given chi square value at the 95 per cent confidence level was 16.92, it appeared that there was definite selection for food items. Errors in identification of the stomach contents, however, may have accounted for some discrepancy.

TABLE XIII

ARTHROPOD CONTENTS OF 56 DICKCISSEL STOMACHS VS. THE SAMPLED POPULATION OF ARTHROPODS OVER ONE CENTIMETER LONG.

Group	Stomach Contents		Available Arthropods	
	Number	Per Cent	Number	Per Cent
Orthoptera	275	85.7	972	85.0
Coleoptera	24	7.5	41	3.6
Diptera	2	0.6	13	1.2
Arachnida	11	3.4	14	1.3
Homoptera	3	0.9	10	1.0
Hymenoptera	1	0.3	15	1.4
Hemiptera	0	0.0	41	3.6
Lepidoptera	5	1.6	17	1.6
All others	0	0.0	14	1.3
Total	321	100.0	1143	100.0

CHAPTER VI

BELL'S VIREOS

Nesting Activities

Bell's Vireos arrived in Payne County during late April or early May. Nest building began one or two weeks after arrival. Four to five days were spent in nest construction and there was a one or two day lag between the completion of the nest and the beginning of egg-laying. Incubation took approximately 14 days. The young were fledged ten to 12 days after hatching. Both sexes shared in nest construction, incubation and raising the family. All nesting was completed by the end of July. Departure for Mexico and Central America occurred during August or September.

The sequence of the nesting season on the tracts is given in Fig. 15. Nesting began earlier and continued longer on Tract I both years.

Seventy-nine nests were located during the study. Heights of the nests above the ground varied from 20 to 144 inches, with the mean height being 37.4 inches. No significant difference was found between the heights of the nests and nesting success.

Bell's Vireos showed definite life-form preferences in the location of nests. Analysis of Table XIV reveals that nesting was concentrated in two life-forms -- low trees and medium shrubs. No nests on Tract II

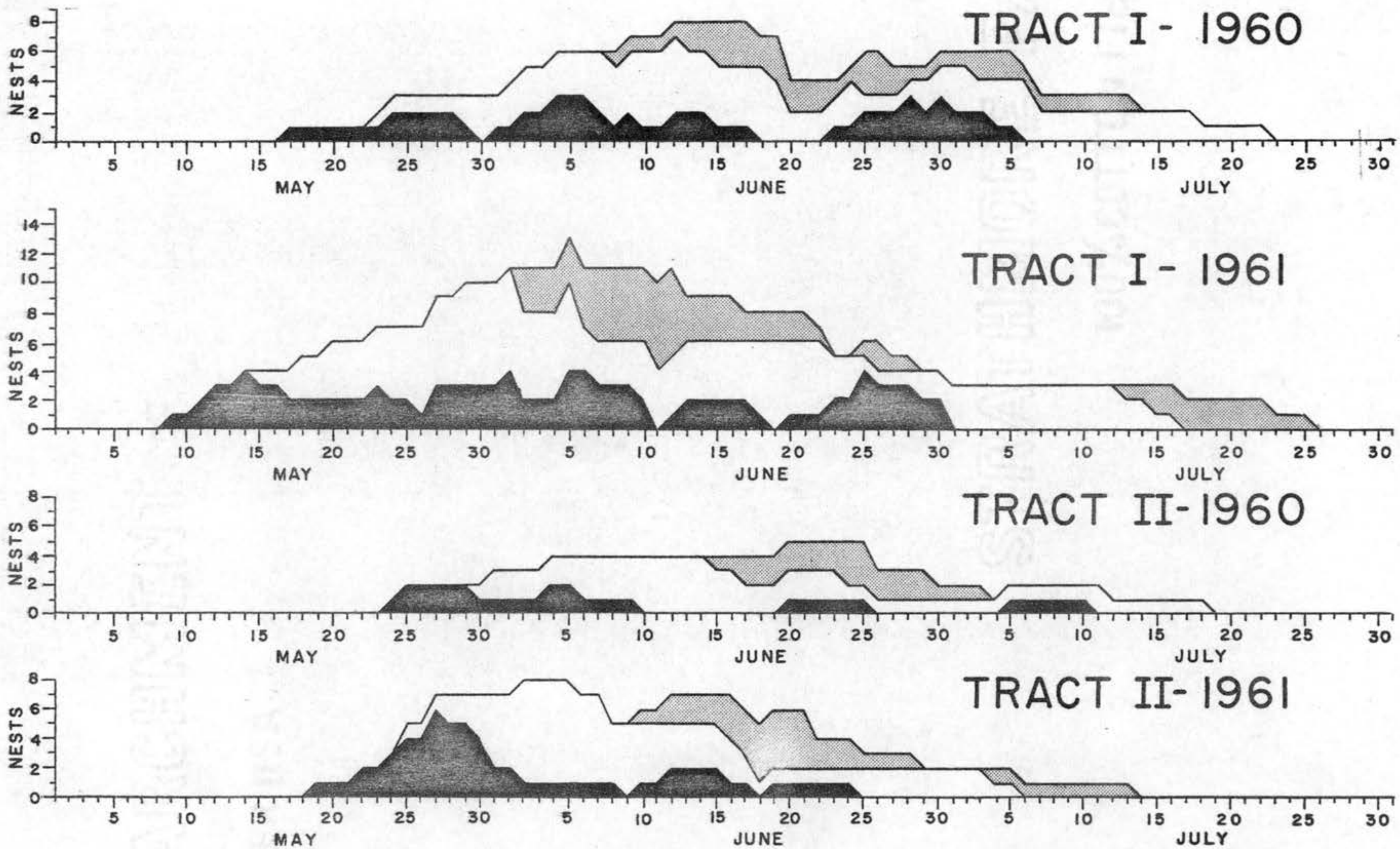

Fig. 15. Sequence of Bell's Vireo nesting season. Legend: [dark box] = nests under construction, [white box] = nests containing eggs, [shaded box] = nests containing young birds.

TABLE XIV

LIFE-FORM CHOICES IN NEST LOCATION FOR BELL'S VIREOS

Life-form	Tract I				Tract II			
	Nests		Available Life-form		Nests		Available Life-form	
	Number	Per Cent	Amount*	Per Cent	Number	Per Cent	Amount*	Per Cent
Trees								
Tall (> 8 meters)	1	1.8	0.32	13.5	0	0.0	0.44	23.8
Low (2 - 8 meters)	34	63.0	0.88	37.4	11	44.0	0.56	30.3
Dwarf (< 2 meters)	1	1.8	0.03	1.3	2	8.0	0.01	0.5
Shrubs								
Medium (> 0.8 meters)	17	31.6	0.83	35.1	12	48.0	0.17	9.2
Dwarf (< 0.8 meters)	1	1.8	0.30	12.7	0	0.0	0.67	36.2
Total	54	100.0	2.36	100.0	25	100.0	1.85	100.0

*In acres.

were located in dwarf shrubs even though dwarf shrubs comprised 36 per cent of the vegetation. The effect of grazing upon the suppression of shrub growth was on major importance because it limited the available nesting sites.

Analysis of the 48 nests located in trees indicated the the species of tree used for nesting depended upon the abundance of the species rather than upon the species *per se* (Table XV). Data were not included for the 31 nests located in shrub thickets since it was impractical to attempt to count the number of individual shrubs on the tracts. Barlow (1962), working in Kansas in somewhat similar habitat, found that Bell's Vireos seemed to show a preference for boxelder (*Acer negundo*).

Territories

Territories on the study tracts were centered along the wooded ravines (Fig. 16). Tract I had 11 territories in 1960 and 13 in 1961, Tract II had seven territories both years. Data concerning territory sizes are given in Fig. 17. The mean territory size was 0.18 acres on Tract I and 0.21 acres on Tract II. Several of the smaller territories consisted of single thickets of trees or shrubs. Previous reports have shown that territory sizes for Bell's Vireos vary considerable in different parts of the country. Barlow (1962) reported a mean size of 1.25 acres in Kansas. Nolan (1960) found that sizes ranged from two to three acres in Indiana. It is probable that population density is a factor in determining territory sizes.

Data are given in Table XVI for the life-form composition of the territories. Analysis of the data reveal that the relative percentages

TABLE XV

RELATIVE ABUNDANCE OF THE TREES VS. THE TREES USED FOR NESTING BY BELL'S VIREOS*

Species	Tract I				Tract II			
	Nests		Trees		Nests		Trees	
	Number	Per Cent	Number	Per Cent	Number	Per Cent	Number	Per Cent
1960								
Ulmus americana	5	45.4	382	59.4	3	60.0	188	85.6
Populus deltoides	0	0.0	0	0.0	1	20.0	7	3.0
Robinia Pseudo-Acacia	3	27.3	121	18.8	0	0.0	0	0.0
Morus rubra	1	9.1	86	13.4	1	20.0	25	11.4
Celtis reticulata	2	18.2	54	8.4	0	0.0	0	0.0
Total	11	100.0	643	100.0	5	100.0	220	100.0
1961								
Ulmus americana	16	66.7	382	68.5	7	87.5	188	88.4
Robinia Pseudo-Acacia	5	20.8	121	21.8	0	0.0	0	0.0
Morus rubra	0	0.0	0	0.0	1	12.5	25	11.6
Celtis reticulata	3	12.5	54	9.6	0	0.0	0	0.0
Total	24	100.0	557	100.0	8	100.0	213	100.0
1960 + 1961								
Ulmus americana	21	60.0	382	59.4	10	77.0	188	85.6
Populus deltoides	0	0.0	0	0.0	1	15.4	7	3.0
Robinia Pseudo-Acacia	8	22.8	121	18.8	0	0.0	0	0.0
Morus rubra	1	2.9	86	13.4	2	7.6	25	11.4
Celtis reticulata	5	14.3	54	8.4	0	0.0	0	0.0
Total	35	100.0	643	100.0	13	100.0	220	100.0

*Data are included only for nests which were located in low (two to eight meters) or tall (over eight meters) trees. Data on the trees are from these same two life-form categories.

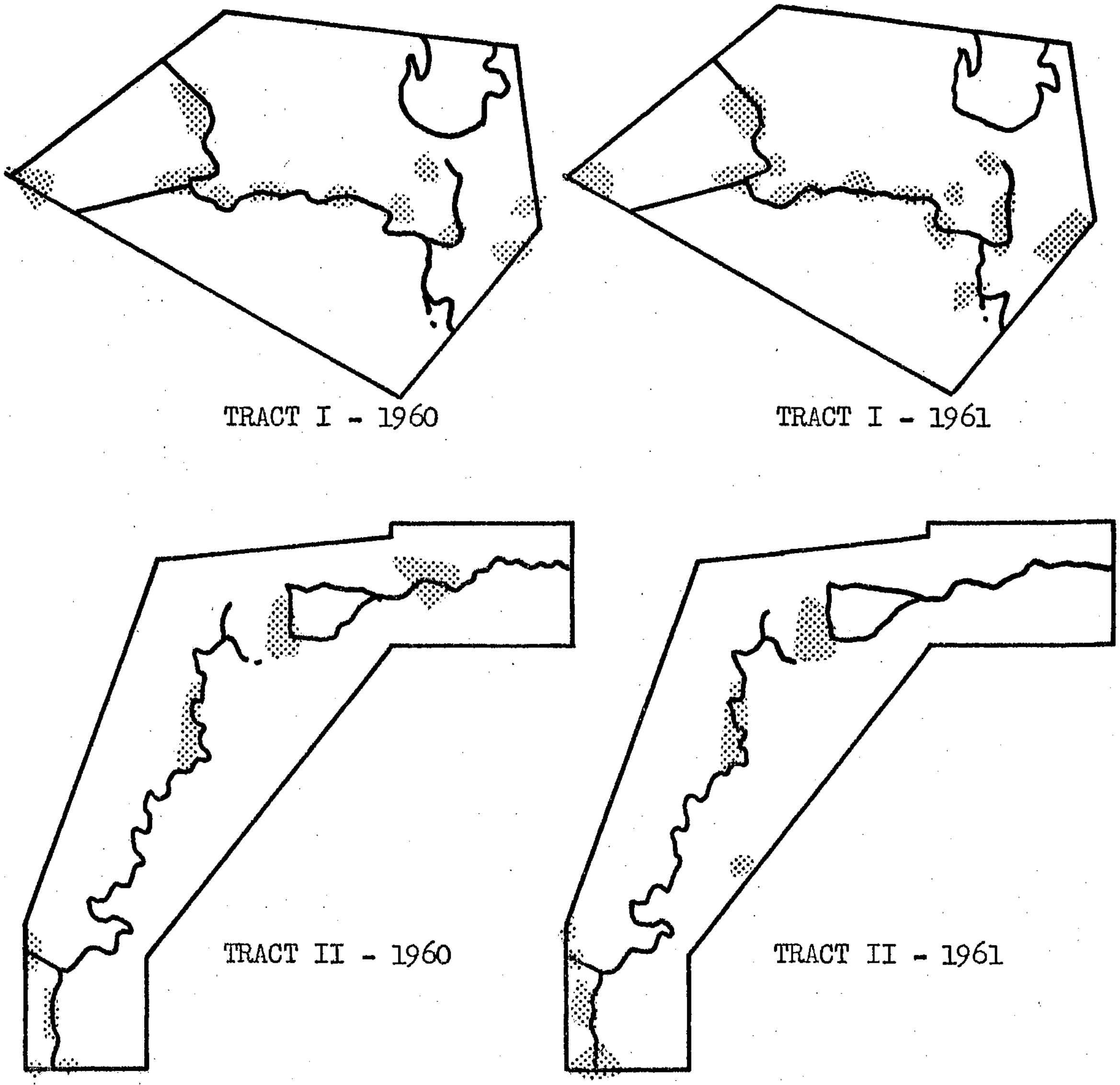

Fig. 16. Location of Bell's Vireo territories.

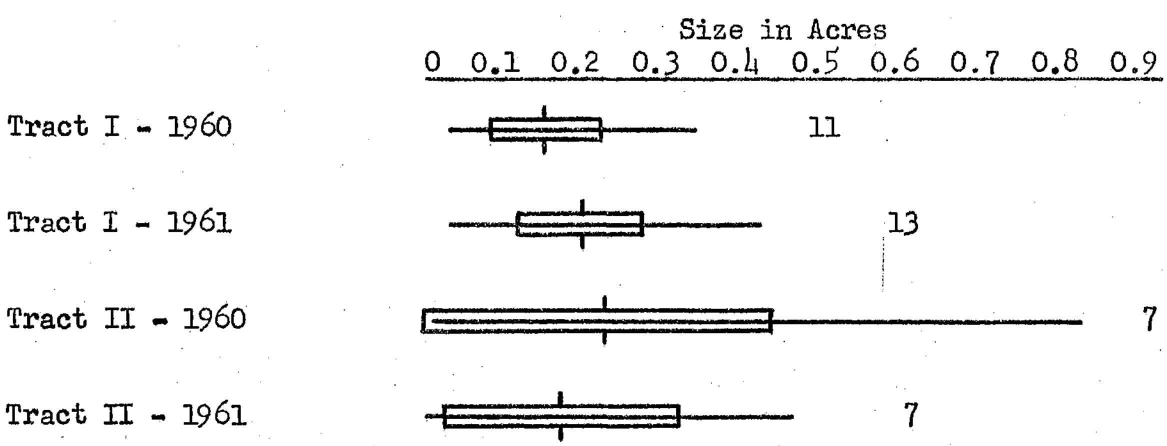

Fig. 17. Measurement of Bell's Vireo territories showing sample size, mean, range and twice standard error of mean.

TABLE XVI

LIFE-FORM COMPOSITION OF BELL'S VIREO TERRITORIES

	Amount in Mean Territory*											
	Tract I						Tract II					
	1960		1961		Mean		1960		1961		Mean	
Life-form	Amt.	%	Amt.	%	Amt.	%	Amt.	%	Amt.	%	Amt.	%
Trees	0.06	37.5	0.06	28.6	0.06	33.3	0.05	20.8	0.04	21.0	0.04	19.0
Shrubs	0.03	18.7	0.03	14.3	0.03	16.7	0.02	8.3	0.03	15.8	0.02	9.5
Forbs	0.02	12.5	0.03	14.3	0.02	11.1	0.04	16.7	0.04	21.0	0.04	19.0
Grass	0.05	31.3	0.09	42.8	0.07	38.9	0.13	54.2	0.08	42.1	0.11	52.5
Bare Ground	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
Water	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
Total	0.16	100.0	0.21	100.0	0.18	100.0	0.24	100.0	0.19	99.9	0.21	100.0

*In Acres.

of the life-forms varied considerably between the two tracts, but the amounts of trees and shrubs utilized were much more constant.

The total amounts of the life-forms utilized in the combined territories are given in Table XVII. More trees and shrubs were utilized on Tract I than on Tract II, but the percentage use of medium shrubs was 74 per cent greater on Tract II.

Nesting Success

The nesting success (31.2 per cent) was identical on both tracts. Analysis of the data in Table XVIII show that the earlier in the season a nest was started, the greater the chances were for success.

Causes for nest failure are shown in Fig. 18. Nine (28.1 per cent) nests on Tract I and four (25.0 per cent) nests on Tract II were parasitized by the Brown-headed Cowbird. Two of the parasitized nests fledged a total of three cowbirds. Only one of the parasitized nests fledged young vireos. In that nest the cowbird egg was infertile.

No relationship was found between the degree of nest concealment and nesting success (Table XIX), nor was nest concealment found to affect the degree of cowbird parasitism or predation.

Food Choices

In Table XX the stomach contents of 22 Bell's Vireo nestlings are compared with an index of available arthropods. Since Bell's Vireos ate almost exclusively in thickets or on forbs, the data concerning abundance of arthropods in the grass life-form were excluded from the index. Bell's Vireos seemed to show preference in selection of food items. Many more

TABLE XVII

AMOUNTS OF AVAILABLE LIFE-FORMS VS. AMOUNTS UTILIZED BY BELL'S VIREOS*

	Tract I						Tract II					
	Available		Utilized				Available		Utilized			
			1960		1961				1960		1961	
Life-form	Amt.	%	Amt.	%**	Amt.	%**	Amt.	%	Amt.	%**	Amt.	%**
Trees	1.23	4.1	0.66	53.6	0.80	65.2	1.01	3.4	0.32	31.6	0.28	27.7
Shrubs	1.13	3.7	0.30	26.6	0.41	36.3	0.84	2.7	0.11	13.1	0.23	27.4
Forbs	3.94	13.0	0.24	6.1	0.36	9.1	3.38	11.2	0.28	8.3	0.24	7.1
Grass	21.23	70.3	0.52	2.4	1.13	5.3	23.97	79.4	0.88	3.7	0.59	2.5
Bare Ground	0.86	2.6	0.00	0.0	0.00	0.0	0.05	0.2	0.02	40.0	0.01	20.0
Water	1.90	6.3	0.00	0.0	0.00	0.0	0.92	3.1	0.04	4.4	0.01	1.1
Total	30.30	100.0	1.72	5.7	2.70	8.9	30.17	100.0	1.65	5.5	1.36	4.5

*In Acres.

**Per cent of available life-form utilized.

TABLE XVIII

NESTING SUCCESS VS. DATE OF START OF NEST CONSTRUCTION FOR BELL'S VIREOS*

Date of Start of Nest Construction	Total Nests		Successful Nests	
	Number	Per Cent	Number	Per Cent
May 4-17	5	10.4	5	33.3
May 18-31	17	35.5	7	46.7
June 1-14	15	31.3	2	13.3
June 15-28	9	18.6	1	6.7
June 29 - July 12	2	4.2	0	0.0
July 13-26	0	0.0	0	0.0
Total	48	100.0	15	100.0

*Only those nests were included whose histores were known.

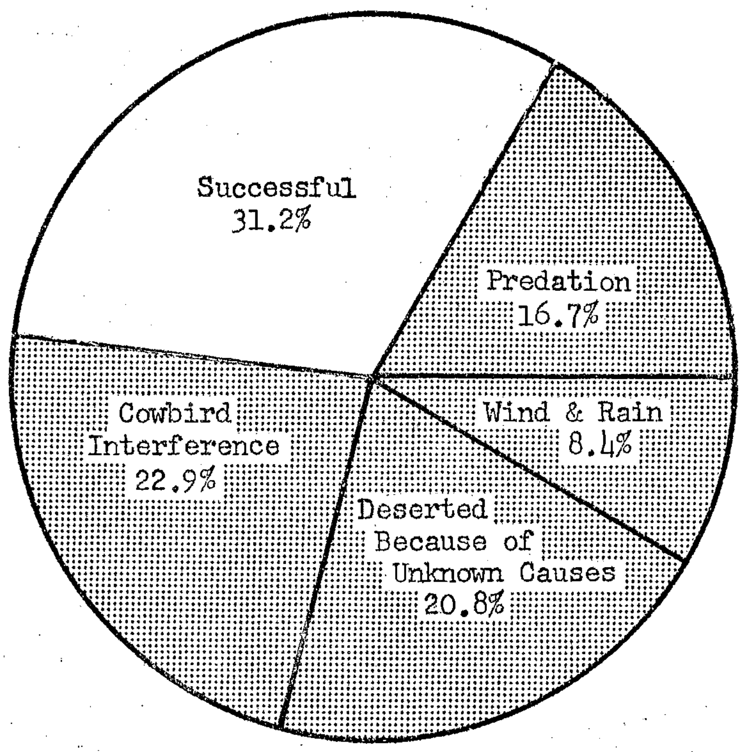

Fig. 18. Fate of Bell's Vireo nests.

orthopterans and lepidopterans (i.e. caterpillars) were eaten than would be anticipated if the selection were dependant only on the relative abundance of the food items. Chapin (1925), reporting on the contents of 52 Bell's Vireo stomachs, found that nearly 75 per cent of the summer diet consisted of grasshoppers, locusts, caterpillars and moths.

TABLE XIX

NESTING SUCCESS VS. DEGREE OF NEST CONCEALMENT FOR BELL'S VIREOS*

Concealment Rating**	Total Nests		Successful Nests	
	Number	Per Cent	Number	Per Cent
6	1	1.9	1	6.6
5	3	5.8	1	6.6
4	9	17.3	4	26.7
3	9	17.3	1	6.6
2	12	23.1	4	26.7
1	12	23.1	4	26.7
0	6	11.5	0	0.0
Total	52	100.0	15	99.9

*Only those nests were included whose fledging results were known.
**6 = total concealment, 0 = total lack of concealment.

TABLE XX

ARTHROPOD CONTENTS OF 22 BELL'S VIREO STOMACHS VS. THE SAMPLED ARTHROPOD POPULATION OF THE TREES, SHRUBS AND FORBS

Group	Stomach Contents		Available Arthropods	
	Number	Per Cent	Number	Per Cent
Orthoptera	43	50.6	1818	39.8
Coleoptera	7	8.2	582	12.6
Diptera	1	1.2	516	11.2
Arachnida	11	13.0	514	11.1
Homoptera	5	5.9	586	12.7
Hymenoptera	0	0.0	281	6.2
Hemiptera	1	1.2	171	3.7
Lepidoptera	17	19.9	113	2.5
All others	0	0.0	14	0.2
Total	85	100.0	4595	100.0

CHAPTER VII

DISCUSSION

The two study tracts seemed to be quite similar from a physiographic standpoint: elevations above sea level were nearly the same, soil types were the same, vegetation was potentially the same, etc. Yet Tract II was less desirable for Dickcissels and Bell's Vireos than was Tract I. Grazing seemed to be the reason.

Grazing caused changes in the relative abundance of the plant species and in the amounts of certain life-forms. The readjustment in life-forms seemed to be the more important change. Neither of the avian species displayed a special attachment toward any particular plant species for nesting. Within the range of acceptable vegetation, nesting site choices were random selections. The fact that the vegetation density was less on the grazed tract suggests that the acceptable vegetation may have been even more limited than was inferred from the life-form data.

Cattle commonly browse on the lower branches of trees and shrubs. If browsing has been severe, as was the case on Tract II, the lower vegetation will be quite restricted (Fig. 19). On Tract II, 48 per cent of the Bell's Vireo nests were located in medium shrubs and none were in dwarf shrubs. Yet, medium shrubs comprised only nine per cent of the available nesting vegetation while dwarf shrubs comprised 36 per cent. On Tract I, medium shrubs contained 31 per cent of the nests and dwarf shrubs, two per cent. But on Tract I, medium shrubs comprised 35 per cent of the available nesting vegetation and dwarf shrubs, 13 per cent. If grazing pressure on Tract II had been reduced, the dwarf shrubs could have grown into medium shrubs. Since 95 per cent of the Bell's Vireo nests were located in the medium shrub range, an increase in medium shrubs would undoubtedly have resulted in an increased carrying capacity for Bell's Vireos.

Fig. 19. View of part of the wooded ravine on Tract II showing the severe degree of browsing. The elimination of the undergrowth by grazing in the ravine system was one of the most significant limitations on nesting of both Dickcissels and Bell's Vireos.

Grazing also appeared to limit the nesting of Dickcissels, but the effect was not noticeable until late in the season. Dickcissels located first nests on or near the ground and later nests higher above the ground. The species apparently had an endogenous drive to do this. [The same tendancy to locate later nests at higher levels has been noted for Painted Buntings (Parmelee, 1959), Red-eyed Vireos (Lawrence, 1953) and Field Sparrows (Preston and Norris, 1947). Interpretation of Downing's data

(1959) indicates that this was also true for Mourning Doves. Bell's Vireos did not show the tendancy. The upward migration of Dickcissel nests was not just an adjustment to an increasing height of the vegetation since the later nests on Tract II were higher even though the height of the vegetation remained relatively constant throughout the summers. Grazing did not seem to limit the first nests, but if the potential nesting sites at the higher levels were browsed, later nests were excluded and the nesting season ended.

The degree of nest concealment did not seem to be a factor in nesting success for either species. Nest concealment was of a random nature and the protection afforded the better concealed nests was not reflected in greater nesting success. Nice (1937) concluded that the degree of nest concealment of the Song Sparrow "seems to be a matter of chance, rather than of consistent good or bad judgment on the parts of individuals."

Activities (e.g. feeding, courtship, etc.) of both species were mostly restricted to the early morning hours. On rainy mornings, activities were prolonged. The periods of extended activities may have affected the length of the nesting season. Several investigators (Frith, 1959; Gerstell, 1936; Marshall and de S. Disney, 1957) have shown that precipitation can play a critical role in the nesting sequence of birds. Rainfall during early July seemed to have a rejuvenating effect upon the nesting interests of Dickcissels in 1961.

The nesting success of approximately 30 per cent for both species was well below the 49 per cent average that was suggested by Nice (1957) for altricial birds in general. It was, however, in general agreement with the findings of Weins (In Press) who worked in southern Oklahoma during the summers of 1960 and 1961.

Grazing did not seem to affect the incident of predation or cowbird parasitism for either species.

So far as was known, cattle did not destroy any nests. However, many nests were located in areas that received much use by cattle. Undoubtedly, nests are occasionally destroyed by cattle activity.

Both species utilized as much land on Tract II as on Tract I, but the total for Bell's Vireo was less on both tracts. The amount of land utilized seemed to be limited by the availability of trees and shrubs.

The population density of both species was approximately 50 per cent less on Tract II. Population density affected both the sizes and shapes of the territories. Territories on Tract II were more widely spaced and tended to be larger and more irregularly shaped than territories on Tract I.

Territory boundaries were subject to continual revision. This was emphasized in the case when three male Dickcissels were collected from the same tree within a one-week period. Neighboring males had expanded their territories each time to include the recently vacated song perch.

The availability of food did not determine the size of the territories for either species. In fact, Tract II had both more plentiful food and larger territories. Stenger (1958) found that the size of Ovenbird territory was inversely proportional to the amount of food available within the territory.

Other land use practices in addition to grazing undoubtedly helped to limit the potential utilization of Tract II by Dickcissels and Bell's Vireos. Forbs had been mowed, dead snags burned, shrub thickets removed, etc. as part of a range management program. Each of the modifications decreased the potential utilization of the area for the two species of birds. The loss of forbs caused a reduction of food area; the loss of snags caused a reduction of singing perches; the removal of thickets caused a reduction in nesting sites.

The two species seemed to have little ability to increase their survival possibilities. To increase the population densities on Tract II the habitat would need to be improved so that a greater number of nesting pairs could be supported. The 30± per cent of the nests that are successful would then produce a greater total number of birds. If Tract II were protected from grazing for several years it is highly probable that the densities of the two species would increase accordingly.

CHAPTER VIII

SUMMARY AND CONCLUSIONS

The effects of grazing upon habitat utilization of the Dickcissel and Bell's Vireo were investigated in Payne County, Oklahoma. Two 30-acre tracts, one grazed and one nongrazed, were studied.

Dickcissel nests built early in the season were located on or near the ground. Later nests were placed in shrubs or low tree branches. Bell's Vireo nests were all located in shrubs or low tree branches. Grazing limited the nesting of both species since browsing eliminated many of the available nesting sites in the shrubs and trees.

Twenty-nine per cent of the Dickcissel nests and 31 per cent of the Bell's Vireo nests were successful. Nests built early in the nesting season had the greatest chance for success. Grazing did not reduce the nesting success of either species.

The population densities of both species were approximately 50 per cent less on the grazed tract. Grazing limited population densities through a reduction in the amounts of certain vegetational life-forms. The availability of food did not limit the population densities of either species.

Both species selected trees for nesting according to the abundance rather than the species of the trees. The degree of nest concealment did not affect the nesting success of either species.

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