

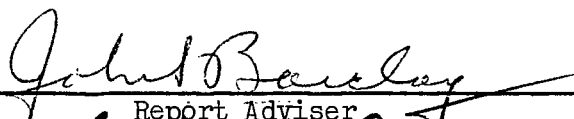
THE NESTING BIOLOGY OF THE DICKCISSEL
(SPIZA AMERICANA) IN NORTH
CENTRAL OKLAHOMA

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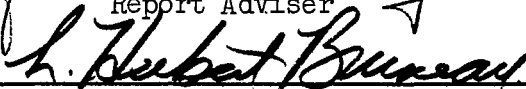
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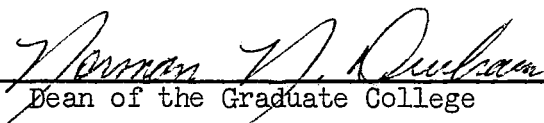
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Report Approved:



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CHAPTER I

INTRODUCTION

The Dickcissel (Spiza americana) is a midwestern, grassland bird. It is 6 to 7 inches in length. The upper parts are streaked with gray, brown and black with the lower parts white and yellow. Its bill is stout, conical, and laterally compressed. The wings are long and pointed. The tail is about $3/4$ the length of the wings and is forked.

The Dickcissel is about the size of a House Sparrow (Passer domesticus domesticus) and has similar markings, sometimes causing experienced birdwatchers to confuse the two species.

The nesting range of the Dickcissel is limited chiefly to the region of the middle west between the Alleghenies and the Rocky Mountains, and from Michigan, Wisconsin, Minnesota, and North Dakota south to Alabama, Mississippi, Louisiana, and Texas (Peterson, 1947). The species winters in South America.

In addition to being an interesting small bird of our grasslands, the Dickcissel may have an important economic status. Gross (1921) estimated that the Illinois Dickcissels saved the State about \$4,680 daily during the nesting season by the destruction of grasshoppers, in addition to consuming other harmful insects and the seeds of weeds.

There have been 2 major studies conducted on the Dickcissel in Oklahoma. The first of these was conducted by Edward Crabb in 1923

on the nesting activities of a pair of Dickcissels near Yukon, Oklahoma. His study included observations on nest construction, egg laying, incubation, and care of the prefledglings. The second and most extensive study was conducted by Thomas Overmire during the spring and summer of 1960 and the summer of 1961. His study was concerned with the effects of grazing upon the habitat utilization of the Dickcissel and Bell's Vireo (Vireo bellii) in Payne County. He found that grazing did not reduce the nesting success of either species. However, the population densities of both species were approximately 50 per cent less on grazed land.

Other than these two studies, there is little available published literature on the nesting biology of the Dickcissel in Oklahoma. Therefore, the lack of scholarly research in this area indicates a need for field research. The purpose of this paper, then, is to present data collected from 17 May to 13 June 1971 and to draw conclusions based on field research and information gathered from previous studies. The objectives of this report are: to supplement existing information on life history and resultant Dickcissel populations; to compare established and disturbed natural habitats in north central Oklahoma; to survey literature, to determine the extent of information on the Dickcissel; to develop expertise in field research.

CHAPTER II

THE STUDY TRACTS

General Description

Two tracts were utilized in this study. Both tracts were near Stillwater, Oklahoma, and together comprised an area of 68 acres. These two particular tracts were selected because of their habitat and accessible nature. The particular habitat of these areas seemed especially promising since the vegetation and physiographic features were similar to that of the study conducted by Overmire. The readily accessible nature of the tracts made more observation periods possible. The selection of two tracts, with differing physiographies and differing stages of succession (to be discussed later in this chapter) enabled this study to be comparative in nature.

Tract I was located on one of the Oklahoma State University farms, one mile west of Stillwater, near the corner of McElroy and Western Avenue. The farm was acquired by the University in 1952 and has been used for grazing. Figure 1 shows a typical view of Tract I. The exact location of this tract is section 9, T. 19N., R. 2E., Indian Meridian, Payne County, Oklahoma.

Tract II was located slightly northeast of the base of the dam at the Lake McMurtry Project in Noble County on land owned by the City of Stillwater. The land had been cleared and leveled in order to prepare a bed for the new impoundment. Figure 2 shows a typical view

of Tract II. The exact location of this tract is section 35, T. 19N., R. 1E., Indian Meridian, Noble County, Oklahoma.

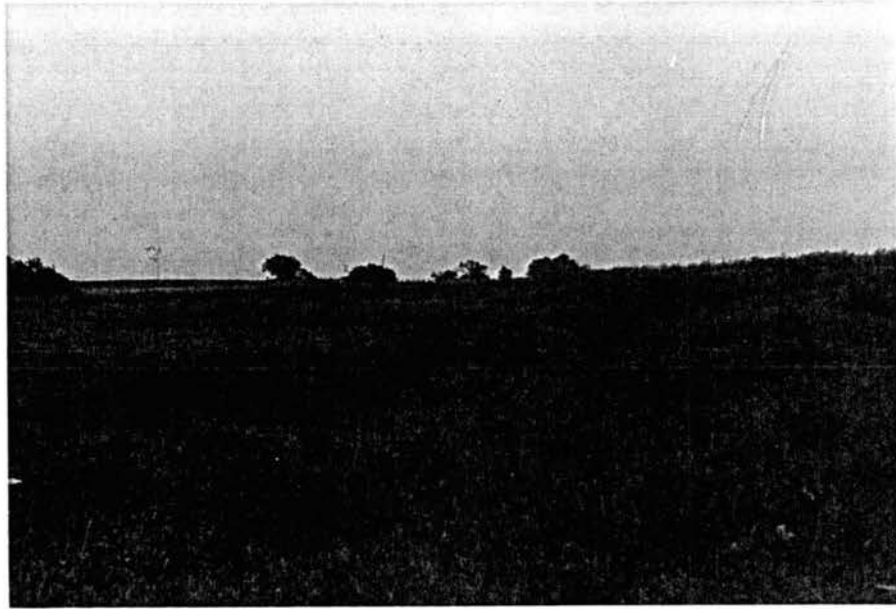


Figure 1. Typical Dickcissel nesting habitat on Tract I, looking east.

A direct comparison of Tract I and Tract II indicates the following differences in land treatment: first, Tract I was grazed land—as was evidenced by numerous cow chips in the area—whereas Tract II exhibited no evidence of recent grazing activities. Instead, Tract II showed signs of frequent human activity and disturbance indicative of recently bulldozed land. Secondly, Tract I appeared to contain relatively undisturbed native grassland vegetation whereas Tract II appeared to be in an early successional stage, probably due to the recent scraping and bulldozing activities in construction of

the McMurtry Dam. The implications of this disturbance in terms of Dickcissel population are slight and largely conjectural on the basis of the observations made in this study. Specific data which characterize the tracts are given in Table I. Maps of study tracts I and II are shown in Figures 3 and 4 respectively.



Figure 2. Typical Dickcissel nesting habitat on Tract II, looking east.

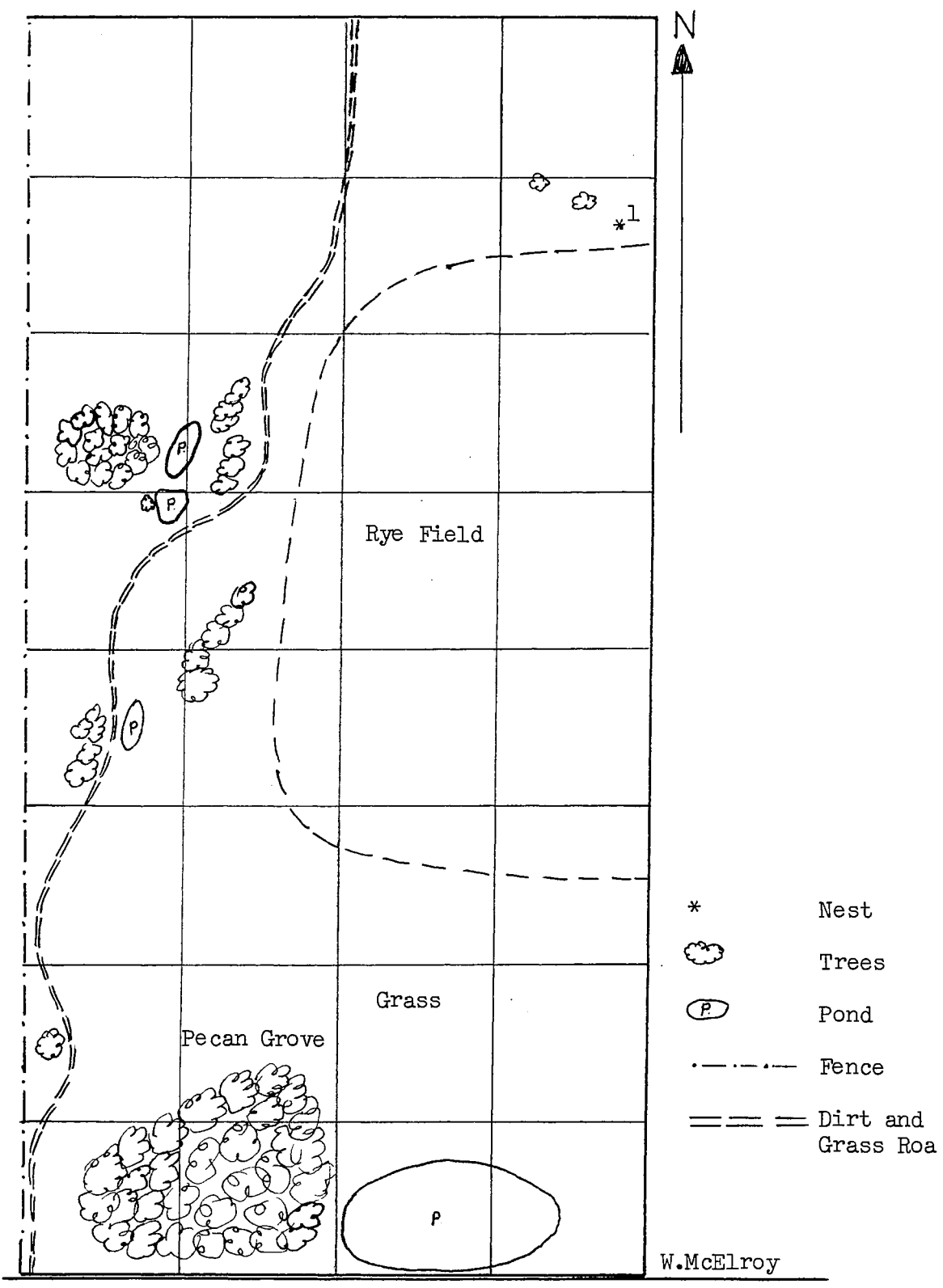


Figure 3. Map of Tract I
Scale: 1" = 250' = 1 grid

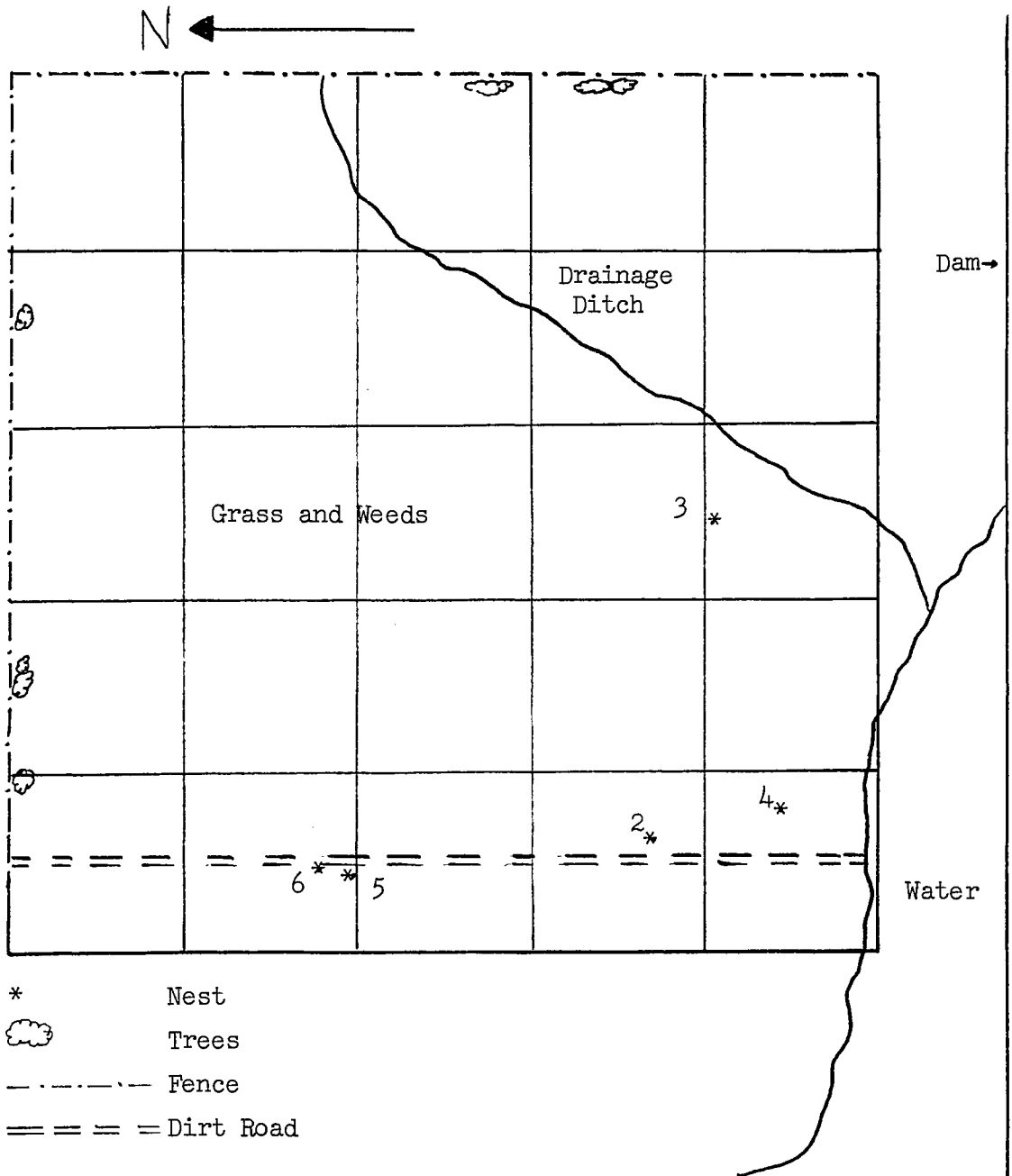


Figure 4. Map of Tract II
Scale: 1" = 200' = 1 grid

Briefly, the climate of Payne and Noble counties is temperate in nature, with a mean annual temperature range of 60.33^oF and a mean annual precipitation of 34.31 in. The soils that comprise the area are largely composed of Permian clays and shales that have weathered to form fine soils well suited to the growth of grasses which dominate the region. The area has been generally described as the "Redbeds Plains" area by Bruner (1931). The vegetation comprising the area has been described as a Stipa - Koeleria association by Bruner (1931).

TABLE I
COMPARISON OF PHYSICAL CHARACTERISTICS
OF THE STUDY TRACTS

Item	Tract I	Tract II
Size	45 acres	23 acres
Shape	square	rectangular
Elevation above sea level	923-965 feet	921 feet
Land use	grazed	cleared for impoundment
Topography	flat to gently rolling	gentle slope

Vegetation of the Study Tracts

Tables II and III present the most commonly observed plant species found on the two study tracts, their observed uses by Dickcissels, and their relative abundance. Generally, it can be noted that the species found on Tract II are characteristically plants that are "weedy" in appearance and perhaps represent species characteristic of areas in early secondary succession. Most plant species that occurred were used for song posts, but it was difficult to ascertain if these plants provided direct sustenance to the birds. Since the scope of this study was necessarily limited, feeding observations plus fecal and stomach analyses were not included.

TABLE II
COMMONLY OCCURRING PLANT SPECIES FOUND ON TRACT I

Plant Species	Observed Use	Relative Abundance
Sand plum (<u>Prunus angustifolia</u>)	Song post	Occasional
Honey Locust (<u>Gleditsia triacanthos</u>)	Song post	Occasional
Pecan (<u>Carya illinoensis</u>)	Song post	Frequent
American Elm (<u>Ulmus americana</u>)	Song post	Frequent
Mexican Plum (<u>Prunus mexicana</u>)	Song post	Frequent
Canada Wild Rye (<u>Elymus canadensis</u>)	Food	Abundant
Japanese Brome (<u>Bromus japonicus</u>)	Food	Very Abundant
Torrey Nightshade (<u>Solanum torrey</u>)	Encircled nest	Occasional
Johnson Grass (<u>Sorghum halepense</u>)	Nesting Material	Frequent

TABLE III
COMMONLY OCCURRING PLANT SPECIES FOUND ON TRACT II

Plant Species	Observed Use	Relative Abundance
Annual Sunflower (<u>Helianthus annuus</u>)	Song post	Occasional
Sand Plum (<u>Prunus angustifolia</u>)	Song post	Rare
Cultivated Peach (<u>Prunus persica</u>)	Song post	Rare
Curlycup Gum Weed (<u>Grindelia squarrosa</u>)	Attracts insects	Very abundant
Johnson Grass (<u>Sorghum halepense</u>)	Nesting material	Frequent
White Sweet Clover (<u>Melilotus alba</u>)	Attracts insects	Frequent
Japanese Brome (<u>Bromus japonicus</u>)	Food	Abundant
Sowthistle (<u>Honchus arvensis</u>)	Support for nests 2, 4, 5, 6	Very abundant
Horse Weed (<u>Conyza canadensis</u>)	Support for nests 2, 3	Very abundant

Various vertebrates were encountered on both study tracts. A complete listings of animal species and their scientific names is cited in Table IV. The various vertebrate species present on Tract I are believed to be typical for tall grass prairie habitat. Difference between the two tracts may reflect the disturbed nature of Tract II. Of the birds observed on both tracts, the Eastern Meadowlark is probably the most significant numerically, especially since it may occupy the same general niche as the Dickcissel. Also, the presence of the Red-winged Blackbird on both tracts might be a reflection of the presence of wet and swampy areas.

TABLE IV
ANIMALS OBSERVED ON STUDY TRACTS

Species	Observation	Tract I	Tract II	Relative Abundance
Dogs (<u>Canis familiaris</u>)	Tracks	X	X	Occasional
Cottontail Rabbit (<u>Sylvilagus floridanus</u>)	Sighted	X	X	Occasional
Coyotes (<u>Canis latrans</u>)	Heard call		X	Occasional
Skunks (<u>Mephitis mephitis</u>)	Odor	X	X	Frequent
Raccoons (<u>Procyon lotor</u>)	Tracks		X	Frequent
White-footed Mice (<u>Peromyscus leucopus</u>)	Sighted	X	X	Frequent
Cotton Rats (<u>Sigmodon hispidus</u>)	Sighted	X		Occasional
Eastern Meadowlark (<u>Sturnella magna</u>)	Sighted	X	X	Abundant
Western Meadowlark (<u>Sturnella neglecta</u>)	Sighted	X		Abundant
Red-winged Blackbird (<u>Agelaius phoeniceus</u>)	Sighted	X	X	Frequent
Scissor-tailed Flycatcher (<u>Muscivora forfic</u>)	Sighted	X	X	Frequent
Red-tailed Hawk (<u>Buteo jamaicensis</u>)	Sighted	X	X	Occasional
Mourning Dove (<u>Zenaidura macroura</u>)	Sighted	X		Abundant
Bobwhite Quail (<u>Colinus virginianus</u>)	Heard call	X		Frequent
Common Night Hawk (<u>Chordeiles minor</u>)	Sighted	X		Frequent
Indigo Bunting (<u>Passerina cyanea</u>)	Sighted		X	Occasional
Killdeer (<u>Charadrius vociferus</u>)	Sighted		X	Frequent
Sparrow Hawk (<u>Falco sparverius</u>)	Sighted		X	Rare
White-rumped Sandpiper (<u>Erolia fuscicollis</u>)	Sighted		X	Occasional
Mallard (<u>Anas platyrhynchos</u>)	Sighted		X	Occasional
Barn Swallow (<u>Hirundo rustica</u>)	Sighted		X	Frequent

The Western Meadowlark, the Mourning Dove, and the Dickcissel all seemed to occur in the same habitat in Tract I. However, from all observations made, there seemed to be no inter-specific aggression or competition among these bird species. Possible predators were observed, but no specific predation was noted with the exception of a loss of all 5 eggs from nest 3, Tract II. No evidence of the type of predator was found.

I made no attempt to make a complete census of birds other than the Dickcissel. On the basis of 3 weekly counts, I have estimated the Dickcissel population as being 20 breeding pairs on Tract I and 15 breeding pairs on Tract II. A computation of breeding pairs on each tract indicates an average of 2.2 and 1.7 breeding pairs per acre on Tracts I and II respectively. An analysis of these figures indicates a 23 per cent difference in population density.

CHAPTER III

MATERIALS AND METHODS

The collection of nesting data was accomplished by direct personal observation aided by a pair of 7x50 binoculars. Field notes were recorded on 3"x5" index cards.

Observations were made by sitting quietly near the birds or nests. It took a few visits to each nest to determine the best vantage point from which to observe the activity in the area around the nests. Some of the birds exhibited more tolerance toward the observer than others and as a result, I found it necessary to adjust the distance of observation. I found no indication that the observations taken through such a trial and error approach altered the behavior of the birds.

Temperature, wind, and cloud cover were recorded at the beginning and end of each observation period and at any time that the conditions changed noticeably. Temperature was determined by means of a Fahrenheit thermometer, held two feet above the open ground in the shade. Wind condition was categorized as slight, moderate, gusty, or strong; cloud cover was recorded as clear, partly cloudy, overcast, or rain. These data were recorded with the objective that I might be able to draw conclusions concerning behavioral patterns with relation to weather fluctuations. However, I was unable to draw any correlations between weather conditions and behavior.

Measurement of linear distances of tract sizes were determined

by a steel tape. Nest dimensions were measured by a centimeter rule. All measurements were made to determine parallels between the findings of this study and previous studies cited in the literature. Measurements of nest dimensions taken in this study correspond with those examined by Overmire (1962) and Crabb (1923) in their studies.

Color photographs were taken with a Polaroid Colopack II, a Kodak World's Fair Flash camera, and a Mamiya/Sekor 35 mm. camera. Pictures were taken of the nests and the habitat around the nests for the purpose of documentation.

Field work was carried on from May 17, 1971 to June 13, 1971. Censuses were taken weekly to determine the density of breeding pairs of Dickcissels on the study tracts so that comparisons of tract densities could be made. The census technique used was that described by Pough (1947). With this technique, the assumption is made that each singing male, resident on an established territory, indicates the presence of a breeding pair. A search for nests was made in the areas where Dickcissels were repeatedly found. Notes concerning the ecology of the area and nest data (when nests were found) were recorded during each observation period. These results are recorded in Chapters I and II.

CHAPTER IV

NESTS

The bulk of the Payne County population of Dickcissels arrive in late April or early May. Baumgartner and Howell (1948) reported the Dickcissel to be an abundant summer resident, seen from April 25 until September 12. Sutton (1967) reported the Dickcissel as being seen in Oklahoma from April 18, to November 7. Since the observations made for this study began 17 May, no attempt was made to determine the earliest arrivals in the area.

Courtship begins soon after arrival and nesting is underway by the latter part of May (Sutton, 1967). May 26 is the earliest reported date for a spring nest found in Oklahoma. This nest, located near Minco, Oklahoma, contained one egg (Wetmore, 1918). I found two nests on May 27, 1971. One nest was located on Tract I and contained 1 nestling and 4 eggs. The other nest, found on Tract II, contained 5 nestlings. Crabb (1923) reported the incubation period of Dickcissel eggs to be 10 to 11 days. Considering the average incubation period to be 10 to 11 days, the nest found on May 27 on Tract II could have been completed as early as May 11. According to all available literature, this data represents the earliest recorded date for nest initiation and thus establishes a new record for the initiation of nest building in north central Oklahoma.

Nest Construction

I did not observe any nest construction activity by Dickcissels. However, Gross (1921) gives the average time for construction of the Dickcissel nest to be four days. He also provided the following description of the nest:

Dickcissel nests are bulky and somewhat crude in general appearance, but are substantial structures. They vary little in size and shape; the average measurements of ten typical nests are as follows: outside diameter 12.2 cm., inside diameter 6 cm. by 6.8 cm., outside depth 6.3 cm., inside depth 4.6 cm. The materials used seem to be those near at hand and vary according to the immediate surroundings. The exterior of the nest is usually composed of coarse weed and grass stems, or cornstalk fibers interwoven with a few leaves and grasses; the interior is lined with finer grasses, rootlets, or hair. Some nests may be made up almost entirely of one type of grass, including the lining. Though most nests are firm and well made, those built well above the ground are often so insecurely attached to their support that the least disturbance may dislodge them.

Two of the Dickcissel nests on Tract II were somewhat elevated. Nest 5 was 15" from the ground and nest 6 was 22" from ground level. Both of these nests were poorly attached to supporting vegetation. I found it necessary to adjust nest 6 as it was tipped at such an angle as to endanger the eggs. I found that this problem did not present itself with nests built close to the ground. Specific information concerning nest dimensions is given in Table V.

Included in Table VI is a list of the 6 Dickcissel nests that were found on the study tracts, the number assigned to each nest, the date the nest was found, status and location of study tract. The location of each of the nests is plotted in Figures 3 and 4.

TABLE V
 DIMENSIONS OF SIX DICKCISSEL NESTS
 FOUND ON STUDY TRACTS

Nest #	Ext. Diam. (mm)	Int. Diam. (mm)	Ext. Depth (mm)	Int. Depth (mm)
1	85	68	43	40
2	90	73	70	60
3	80	62	50	46
4	115	78	63	51
5	105	67	80	71
6	<u>110</u>	<u>61</u>	<u>83</u>	<u>52</u>
TOTAL	585	409	389	320
RANGE	80-115	78-61	83-43	71-40
MEAN	97.5	68.2	64.8	53.3

TABLE VI
 NUMBER, DATE FOUND, STATUS AND LOCATION OF SIX DICKCISSEL
 NESTS FOUND ON STUDY TRACTS

Nest #	Date Found	Status	Location
1	27 May	4 eggs, 1 nestling	Tract I
2	27 May	5 nestlings	Tract II
3	28 May	1 egg	Tract II
4	1 June	1 egg, 4 nestlings	Tract II
5	12 June	4 nestlings	Tract II
6*	12 June	5 eggs	Tract II

*Dr. Barclay found this 25 May, half completed.

Overmire (1962) located 94 Dickcissel nests near Stillwater, of which only 25 percent were on the ground. Gross (1921) and Stockard (1905) found the Dickcissel to be primarily a ground nesting species, and have further concluded that the males take no part in nest construction. Of the 6 nests found during my study, only the single nest on Tract I was built on the ground. The five nests located on Tract II ranged from 3 cm. to 59.9 cm. above the ground.

CHAPTER V

CLUTCH COMPLETION

Observations of the time of egg laying indicated that the eggs were laid at one day intervals. The exact time of egg laying was not determined. The clutch size in all nests was 5 eggs each. One nest had only 4 nestlings and one unhatched egg when found. Crabb (1923), reported a mean clutch size of 5 eggs laid at one day intervals. Stockard (1905), found that with 14 nests, 11 sets had 5 eggs and 3 sets had 4 eggs. Lack (1948), stated that average clutch-size is characteristic for each genus and each family of birds in the same region. Figure 5 shows nest number 3 with completed clutch.

Crabb (1923), observed that incubation began when the penultimate egg was laid. Nest 3 on Tract II was the only nest that I found in which the female was still completing her clutch. I did not observe the female on this nest at anytime before the clutch was completed. The clutch was completed 1 June. The eggs were gone from the nest on 10 June. I suspect that either a raccoon or a snake was responsible for robbing the nest.



Figure 5. Nest 3 with Completed Clutch

CHAPTER VI

ADULT PREFLEDGING ACTIVITY

As with the construction of the nest and incubation of the eggs, care of the nestlings was an activity solely of the female. At no time did I observe any male taking direct part in the care of the young. Gross (1921) observed a sparrow hawk capture a female Dickcissel in plain view of the male. The male continued singing on his song posts for 2 or 3 days while the nestlings slowly starved.

Of the 6 nests found, 4 had nestlings in them when discovered. The behavior of the female toward the nestlings was similar in all cases. The following is a field record of adult female prefledging activity observed at the nest site on Tract I 30 May from 12:30 p.m. until 3:30 p.m. This record typifies the observed female behavior. The nest contained 2 nestlings and 3 eggs. Table VII represents typical female food gathering behavior observed during the course of this study.

On 30 May, 1971, I flushed the female from the nest at 12:47, recording both the male's and the female's actions until I left the area at 3:30 p.m. During this time the female made 7 trips away from the nest, returning each time with what appeared to be food. On trips 1 and 3, the male accompanied her to the nest area. The rest of the time, he spent singing from song posts.

TABLE VII
TYPICAL FEEDING TIME TABLE OF DICKCISSEL

Trip #	Left Nest	Returned to Nest Area	Minutes Away From Nest	Entered Nest
1	12:47	12:50	16	1:03
2	1:12	1:19	9	1:21
3	2:15	—	3	2:18
4	2:19	2:23	6	2:25
5	2:43	—	4	2:47
6	2:48	2:51	5	2:53
7	3:03	3:07	7	3:10

I observed an identical pattern of behavior on subsequent observations of the nest on Tract I. I found, however, that I could approach more closely to the nest before the female would leave and go into her characteristic "broken wing" display. I eventually could walk to the nest and observe the female sitting on the nest for a few seconds before she performed her injured act. Her increased tolerance for my presence may be an example of habituation (Welty, 1962).

Fledging took place, with nest number 1, on 3 June. Thus the time between hatching and fledging was 8 to 10 days. Gross (1921) also reported that the Dickcissel leaves the nest 8 to 10 days after hatching. The nest at Tract I was the only nest for which I have a complete record of the time between hatching and fledging. Figure 6 shows the nest at Tract I with the first nestling in it.



Figure 6. Nest at Tract I with First Nestling

I found 4 nests with nestlings, one on Tract I and 3 on Tract II. In all cases, all the young birds in a given nest fledged on the same day. Once the birds had fledged, I was unable to locate any of them. Gross (1921), reports that the fledged Dickcissel acquires the ability to fly within 2 or 3 days, and at 10 to 11 days the young bird may fly up to 150 feet.

All of the nestlings found in the course of my study fledged. I have no data on the survival of the fledglings. Data on hatching and fledging success of the 6 Dickcissel nests are included in Table VIII.

TABLE VIII
HATCHING AND FLEDGING SUCCESS OF 6 DICKCISSEL NESTS

Tract	Nest #	Eggs Laid	Eggs Hatched	Percent Hatched	Number Fledged	Percent Fledged
I	1	5	2	40	2	100
II	2	5	5	100	5	100
II	3	5	0	0	0	0
II	4	5	4	80	4	100
II	5	5	4	100	4	100
II	6	<u>5</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Totals		30	15	41	15	100

In order to determine the degree of success two calculations were made:

1. Hatching success = $\frac{\text{no. of eggs hatches}}{\text{no. of eggs laid}} \times 100$
2. Fledging success = $\frac{\text{no. of eggs hatched}}{\text{no. of young fledged}} \times 100$

CHAPTER VII

CONCLUSIONS

Observations of the nesting activities of Dickcissels on two study tracts, 23 acres and 45 acres in size, in north central Oklahoma were made during the time period 17 May to 13 June, 1971. The purpose of the study was to add to the understanding of the nesting biology of the bird in the region.

The conclusions drawn from this study are as follows:

1. Sutton (1967) indicated that nesting is underway by the latter part of May. The earliest date recorded for a completed nest prior to my study was 26 May (Wetmore, 1918). I found a nest which was completed approximately 11 May, 1971. These data represent the earliest recorded date for nest initiation and thus establishes a new record for the initiation of nest building in north central Oklahoma.

2. The role of the sexes in parental care conformed with that recorded in other studies. The males observed in the present study did not participate in the care of the young.

3. The fledging success of the Dickcissels observed was 100%. Nice (1957) indicated that, among passerines, the percentage of young that are fledged is typically around 60%. The sample size in this study is insufficient to make a positive correlation.

4. An analysis of census data indicates a 23 percent difference in population density between the two tracts. However, further study

would be necessary in order to form a valid conclusion as to habitat preference in relation to the two study tracts.

5. A study by Gross (1921), Overmire (1962), and this present study indicates that the Dickcissel may have an important economic status and further work on the life history of this bird is therefore warranted.

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VITA

Gordon Alan Berry

Candidate for the Degree of

Master of Science

Report: THE NESTING BIOLOGY OF THE DICKCISSEL (SPIZA AMERICANA)
IN NORTH CENTRAL OKLAHOMA

Major Field: Natural Science

Biographical:

Personal Data: Born in Dover, New Hampshire, January 7, 1936,
the son of Mr. and Mrs. Wyatt B. Berry.

Education: Graduated from Dover High School, Dover, New Hamp-
shire; received the Bachelor of Education degree from
Keene State College at Keene, New Hampshire in 1961;
completed requirements for the Master of Science degree
in July, 1971.

Professional Experience: Science teacher, Somersworth Junior
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Biology and chemistry teacher, Berwick High School,
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Name: Gordon Alan Berry

Date of Degree: July 30, 1971

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: THE NESTING BIOLOGY OF THE DICKCISSEL (SPIZA AMERICANA) IN NORTH CENTRAL OKLAHOMA

Pages in Study: 27 Candidate for Degree of Master of Science

Major Field: Natural Science

Scope and Method of Study: The nesting biology of the Dickcissel was studied from 17 May to 13 June, 1971, on a 45 acre tract in Payne County and a 23 acre tract in Noble County. All field data were collected by personal observation of the activity associated with 6 nests. Nest construction, incubation, and prefledging activity and behavior of adult Dickcissels were included.

Findings and Conclusions: There was no evidence that Dickcissels were paired on arrival....i.e. pairing apparently occurred after arrival. Only the females were involved in nest construction, incubation, and care of the prefledglings. Eggs were laid on successive days. Although eggs of the same nest did not usually hatch on the same day, the young of the same nest did fledge on the same day.

The hatching success of 30 eggs in 6 nests was 41% and the fledging success was 100%.

The earliest recorded date for nest initiation by the Dickcissel in north central Oklahoma was established during the course of this study.

ADVISER'S APPROVAL

John Barclay