

Technical Report No. 82  
AVIAN PRODUCTIVITY ON THE  
PAWNEE SITE IN NORTH-CENTRAL COLORADO

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## ABSTRACT

Reproductive rates, relative nesting success, and growth rates of nestlings as well as the peaks of nesting activity were determined for horned lark (*Eremophila alpestris*), McCown's longspur (*Rhynchophanes mccownii*), western meadowlark (*Sturnella neglecta*), lark bunting (*Calospiza melanocorys*), loggerhead shrike (*Lanius ludovicianus*), mourning dove (*Zenaidura macroura*), and Brewer's sparrow (*Spizella breweri*) on and adjacent to the Pawnee Site. Horned lark and McCown's longspur nests were mainly in heavily grazed shortgrass, whereas lark buntings preferred moderately to slightly grassed areas. Brewer's sparrows were confined to areas of four-wing saltbush (*Atriplex canescens*). The percent of nests successful in fledging at least one young varied from 26.2% for horned lark to 53.6% for mourning dove. All ground nesting passerines grew at essentially the same rates. A total of 766 birds representing 31 species were banded and 116 birds of 6 species collected for food habits and reproductive analyses. Homing of 6 of 15 color marked horned larks and 1 of 10 color marked lark buntings was demonstrated.

## INTRODUCTION

The reproductive biology of birds nesting on the shortgrass prairie in northcentral Colorado is being studied as part of the U.S. International Biological Program's comprehensive study of the grassland biome. This research is an attempt at gaining insight into the overall impact of avian reproduction on the shortgrass ecosystem. An estimate of the biomass contributed by avian reproduction is necessary for the mathematical model of the ecosystem under study.

Nesting data were collected on all birds found nesting in the study area, but emphasis was placed on the dominant species. These species include the horned lark (*Eremophila alpestris*), McCown's longspur (*Rhynchophanes mccownii*), western meadowlark (*Sturnella neglecta*), lark bunting (*Calospiza melanocorys*), loggerhead shrike (*Lanius ludovicianus*), mourning dove (*Zenaidura macroura*), and Brewer's sparrow (*Spizella breweri*).

## OBJECTIVES

The primary objectives of the study for 1970 were to:

- (i) Estimate the reproductive rates and relative nesting success of the dominant species nesting on the study area.
- (ii) Measure the growth rates of nesting birds of the dominant species.
- (iii) Determine the peak of nesting activity for the dominant species.

Other objectives were to:

- (i) Continue collection of crops and stomachs for future food habits analysis. These collections were discontinued in April 1970, when the food habits study was taken over by Dr. P. H. Baldwin.

- (ii) Continue banding and color marking individual birds for population studies.
- (iii) Continue updating the checklist of birds on the Pawnee Site.

#### STUDY AREA AND METHODS

The primary study area was the IBP intensive site on the Central Plains Experimental Range. The intensive site is located approximately between the IBP headquarters, 8 miles north of Nunn, and the CPER headquarter, 10 miles north and 4 miles east of Nunn, Weld County, Colorado. However, many nests were found along the roadside count route as described by Giezentanner (1970), and in the Pawnee National Grassland east of the CPER.

##### Nest Search

It had been planned to locate nests in several ways, including the technique of dragging a rope between two observers or vehicles. However, this method was proved impractical during 1969 and was not attempted.

A majority of the nests found for ground nesting species were found by flushing an incubating or brooding adult and searching the immediate vicinity. These flushings were made either coincidentally with other field work or while intentionally searching. All searching on the intensive site was done on foot, but a great deal of time was spent searching with a vehicle on areas of the national grassland outside of the CPER. Other investigators cooperated in locating many nests on the intensive site.

In addition, many ground nests were found by observing adults with a spotting scope as they returned to their nest with building material, food,

etc. The techniques of flushing and observation were the only ones successful in finding nests of the ground nesting species. Nests of other species with a limited nesting habitat requirement were found by searching the required habitat.

#### Data Collection

Data on reproductive success and nestling growth rates were recorded on North American Nest Record Cards provided by the Laboratory of Ornithology at Cornell University (Fig. 1). Nests were visited three times weekly or more often when possible; and observations were made concerning the habitat type, principal plant or structure supporting the nest, the stage of nest building or number of eggs or young, and the fate of the nest if known. In addition, eggs and nestlings were weighed to the nearest one-tenth gram on an Ohaus Dial-o-gram balance when conditions permitted.

#### Banding and Collection

All nestling birds which were followed in the nest were banded before fledging. Many adult birds were also banded when they were caught in small mammal live traps. In addition, several days in August were spent mist netting and banding around water holes and other points of concentration.

### RESULTS AND DISCUSSION

#### Reproductive Rates and Success

A total of 300 nests of 21 species were found on or near the IBP intensive site during the nesting season of 1970 (Table 2). Of the dominant nesting species, the number of nests observed varied from 10 for the western

meadowlark to 82 for the mourning dove. However, only 11 of the 82 mourning dove nests were ground nests within the intensive site. The remainder were located in trees or buildings, in farm yards, and shelterbelts in the adjacent area.

Horned lark and McCown's longspur nests found were ground nests predominantly in heavily grazed native grasslands. The nests found for lark buntings and Brewer's sparrows were in moderate to lightly grazed native grassland with the lark bunting nesting on the ground and the Brewer's sparrow confined to areas of four-wing saltbush (*Atriplex canescens*) in which it nests.

Western meadowlark and loggerhead shrike nests were found predominantly along roads and in other disturbed areas. The western meadowlark prefers tall grass as is found in ditches, but a few of the observed nests were in lightly grazed pastures. Loggerhead shrike nests were found along roads in four-wing saltbushes, or in trees or shrubs in shelterbelts or farm yards.

The nesting success of the dominant nesting species for 1969 and 1970 were as shown in Tables 1 and 2. Due to the large difference in sample sizes between the two years, statistical comparisons were not made since any significance found would be biased by sample size. However, the only explainable difference noted is that of a decreased hatching and fledging percentage for the loggerhead shrike in 1970. This can be explained by the large number of nests which were destroyed by a rain and wind storm in early June.

The percent of nests successful in fledging at least one young varied from 26.2% for the horned lark to 53.6% for the mourning dove. The lark

bunting was most successful of the ground nesters with 36.8% (Table 2). The average clutch size varied from 1.9 for the mourning dove to 6.0 for the loggerhead shrike. The percent hatched varied from 29.5% for the western meadowlark to 70.8% for the loggerhead shrike, and the percent fledged varied from 15.9% for the western meadowlark to 51.3% for the mourning dove.

The percent fledged was quite uniform for the ground nesters (from 31.1% for the lark bunting to 36.6% for the McCown's longspur) with the exception of the western meadowlark. The low fledging percentage for the western meadowlark (15.9%) can probably be explained by the fact that most of their nests are along roadways which are also travel lanes for predators.

The minimum biomass of birds believed to have been produced on the six 20-acre (8 ha) study areas is summarized in Table 3.

#### Growth Rates

The growth rate of nestlings of the dominant nesting species are as shown in Tables 4 through 9 and Fig. 2 through 7. No weight curves were obtained for the mourning dove since most successful nests were not on the intensive site, and frequent checks for weights would have required considerable time and travel. However, a representative sample will be chosen in 1971 for obtaining growth curves.

Although a comparative growth rate factor has not been computed as yet, all ground nesting species appear to grow in weight at essentially the same rate. When these growth rate factors are computed, conclusions will be possible on the comparative growth rates between years at the Pawnee Site, between species at the Pawnee Site, between the same species at the Pawnee Site and the Matador Site in Saskatchewan (Maher, 1970).



### Nesting Chronology

The peaks of nesting activity for the dominant nesting species were estimated by noting the relative number of nests initiated per week throughout the nesting season, and by backdating where necessary (Fig. 8). Future nesting activity peaks could perhaps be better estimated by the peak of gonad size in the specimens collected for future food habits study.

Horned larks were the earliest nesters, with the first nest being started during the week beginning with 24 April, and the last one during the week beginning with 19 June. Although a majority of the nests were initiated during May, there was no discernable peak. Loggerhead shrikes started nesting during the first week in May, peaked during the week beginning with 15 May, and started the last nest on 19 June.

Mourning doves had the longest nesting season of the predominant species. The first nest found was initiated during the week beginning with 8 May, and the last found was initiated during the first week in August. There were three distinct peaks of mourning dove nesting, which corresponds to their 30 day nesting cycle, since they are multibrooded (Fig. 8).

The first nests of both McCown's longspurs and western meadowlarks were initiated during the week beginning with 15 May, but the longspurs continued nesting until 17 July while the meadowlarks were finished about 19 June. Neither species showed a conclusive peak of nesting. The McCown's longspurs may possibly be double brooded.

Lark buntings and Brewer's sparrows both initiated nesting during the week of May 22 to 28. Lark buntings continued nesting until mid-July,

but did not show a definite peak. Brewer's sparrows completed nesting during the last week in June, and showed a peak just one week prior.

#### Banding and Collection

In 1970, a total of 766 birds representing 31 species were banded at the Pawnee Site (Table 10). Six of 15 adult horned larks color marked in the intensive study pastures in 1969 were retrapped in the pastures in 1970. This is believed to represent territorial birds returning to the area of nesting. Although some horned larks have been recorded in the pastures in every month of the year (Giezentanner 1970), it is not clear whether those birds nesting at the Pawnee Site also winter there. One hundred and forty-two study skins of horned larks were submitted to the U.S. National Museum for subspecific determinations. It is likely that different subspecies occur on the Pawnee Site at different times of the year.

In 1970, Phil Creighton (personal communication) recaptured one of ten lark buntings he had color marked on his study area in 1969. Thus, homing of lark buntings also occurs but perhaps to a lesser extent than with horned larks.

In 1970, 116 birds representing 6 species were collected by Giezentanner, Ryder and Strong (Table 11). Morphological measurements were taken and submitted to the data bank for future use. Visceral contents were submitted to Baldwin and his assistants for food habits studies.

#### Future Plans

Plans for the 1971 field season include several refinements for treating nests. Many nests, with both eggs and young, were destroyed by small mammal

predators believed to be primarily the thirteen-lined ground squirrel, *Citellus tridecimlineatus*. These ground squirrels are thought to follow human scent to the nests, and naphtha crystals will be spread in a circle around a representative number of nests in an attempt to determine the importance of ground squirrel predation.

A four inch high woven wire fence about 8 to 10 feet in circumference will be used around ground nests after hatching. This technique was successfully used by Phil Creighton to keep nestlings from fledging prematurely due to human disturbance (Creighton 1970). This fence will be used to keep nestlings in the nest longer for growth studies.

A cover will be designed for the balance used to weigh nestlings so that it may be carried more easily in the field. Nestlings in certain areas could not be weighed in 1970 due to lack of an adequate carrying case and wind protection for the balance. In addition, measurements of total length and first primary length will be recorded on each nestling daily for correlation with weight curves.

A special effort will be made to locate nests of the chestnut-collared longspur in 1971. This species is a relatively uncommon nester at the Pawnee Site, although it is a common nester elsewhere in the short-grass prairie.

ACKNOWLEDGMENT

The assistance of the other investigators and technicians who cooperated by locating nests is most appreciated.

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Table 1. Nesting success of the dominant nesting grassland birds, Pawnee 1969 and 1970.

	Horned + 2 Lark + 2		McCown's + 1 Longspur + 1		Western Meadowlark		Lark Bunting		Loggerhead Shrike		Mourning Dove		Brewer's Sparrow	
	1969	1970	1969	1970	1969	1970	1969	1970	1969	1970	1969	1970	1969	1970
No. nests	9	34	5	22	3	8	5	30	12	19	30	78	10	10
<hr/>														
Eggs	min.	2	3	2	4	3	2	2	5	4	1	1	2	2
Laid	mean	2.56	2.76	3.20	3.23	4.67	5.00	3.80	3.97	6.08	5.95	1.97	1.92	2.90
Per	mode	3	3	3	5	5	5	4	6	6	2	2	3	4
Nest	max.	4	4	4	5	5	6	6	7	7	2	2	4	5
<hr/>														
Eggs	min.	0	0	0	0	0	0	0	3	0	0	0	0	0
Hatched	mean	0.89	1.53	1.60	1.50	0.67	1.63	1.80	1.70	5.17	4.21	1.10	1.21	1.60
Per	max.	3	3	4	4	2	6	4	5	7	7	2	3	5
<hr/>														
Young	min.	0	0	0	0	0	0	0	0	0	0	0	0	0
Fledged	mean	0.56	0.94	1.00	1.18	0.67	0.88	1.60	1.23	3.58	2.00	1.07	0.99	1.30
Per	max.	3	3	4	4	2	3	4	5	6	7	2	3	4

Table 2. Summary of bird nesting data, Pawnee 1970.

Species	Total Nests Observed <sup>a/</sup>	Percent Nests Successful <sup>b/</sup>	Number of Nests <sup>c/</sup>	Total Eggs Laid	Mean Clutch Size	Total Eggs Hatched	Percent Hatched <sup>d/</sup>	Total Young Fledged	Percent Fledged <sup>d/</sup>
Horned Lark <sup>e/</sup>	34	26.2	34	94	2.8	52	55.3	32	34.0
McClown's Longspur <sup>e/</sup>	25	36.0	22	71	3.2	30	42.2	26	36.6
Chestnut-collared Longspur	3	66.7	3	12	4.0	11	91.7	7	58.3
Western Meadowlark <sup>e/</sup>	10	30.0	9	44	4.9	13	29.5	7	15.9
Brewer's Sparrow <sup>e/</sup>	13	30.8	10	36	3.6	16	44.4	13	36.1
Lark Bunting <sup>e/</sup>	38	36.8	30	119	4.0	54	45.4	37	31.1
Loggerhead Shrike <sup>e/</sup>	24	29.2	19	113	6.0	80	70.8	38	33.6
Mourning Dove <sup>e/</sup>	82	53.6	78	150	1.9	94	62.7	77	51.3
Barn Swallow	8	75.0	8	33	4.1	20	60.6	16	48.6
Cliff Swallow	10	30.0	5	19	3.8	13	68.4	9	47.4
Red-winged Black- bird	19	15.8	8	30	3.8	15	50.0	10	33.3
Mountain Plover	8	66.7	6	18	3.0	12	66.7	12	66.7
Say's Phoebe	10	70.0	8	34	4.2	23	67.6	17	50.0
Western Kingbird	8	75.0	7	21	3.0	16	76.2	16	76.2
Eastern Kingbird	1	100.0	1	3	3.0	2	66.7	2	66.7
Mallard	2	No Data	2	9	4.5	No Data	No Data	No Data	No Data
Brown Thrasher	1	0.0	1	5	5.0	0	0.0	0	0.0
Ring-necked Pheasant	1	100.0	1	11	11.0	7	63.6	7	63.6
Brewer's Blackbird	1	100.0	1	5	5.0	5	100.0	5	100.0
Killdeer	1	100.0	1	4	4.0	1	25.0	1	25.0
Nighthawk	1	100.0	1	2	2.0	1	50.0	1	50.0
TOTAL	300	21 Species	255						

<sup>a/</sup> Includes some nests without data on clutch size, hatching success and fledging success.<sup>b/</sup> The percent of total nests observed that successfully fledged at least one young.<sup>c/</sup> Only those nests with complete data on clutch size, hatching success and fledging success.<sup>d/</sup> The percent of total eggs laid which hatched or fledged.<sup>e/</sup> Dominant nesting species.

Table 3. Minimal avian biomass production on 120 acres at Pawnee, 1969 and 1970.

Statistic	Horned Lark	McCown's Longspur	Western Meadowlark	Lark Bunting	Brewer's Sparrow	Mountain Plover	Mourning Dove	Chestnut-collared Longspur	Totals
Breeding Pairs	1970 17.6 1969 30.6	7.0 5.7	7.8 9.3	16.6 19.6	6.2 10.4	1.5 2.0	0.0 1.0	1.5 0.0	58.2 78.6
Mean Clutch	1970 2.8 1969 2.8	3.2 3.4	4.9 4.0	4.0 4.1	3.6 3.1	3.0 3.0	0.0 2.0	4.0 0.0	0 0
Total Eggs	1970 49 1969 86	22 19	38 37	66 80	22 32	5 6	0 4	6 0	208 264
Total Wt Adults (g)	1970 1137 1969 1977	351 286	1635 1949	1248 1474	139 233	311 414	0 230	56 0	4897 6563
Total Wt Eggs (g)	1970 132 1969 231	51 44	222 216	211 256	25 36	77 92	0 23	14 0	732 898
Estimated Young	1970 17 1969 32	8 10	7 16	21 45	8 13	4 3	0 2	3 0	60 121
Total Fledgling Wt (g)	1970 315 1969 592	139 174	380 869	487 1044	79 129	400 300	0 140	52 0	1852 3248
Total Fledgling Wt $\cdot 10^{-6}$ g/m <sup>2</sup>	1970 648 1969 1218	286 358	782 1788	1002 2148	163 265	823 617	0 288	107 0	3811 6683



Table 4. Growth of horned lark nestlings, Pawnee 1970.

Day	No.	Mean Weight	Standard Deviation	Minimum Weight	Maximum Weight	Average Daily Gain
-----grams-----						
0	11	2.75	0.413	2.2	3.6	
1	11	5.35	1.090	4.0	7.6	2.6
2	10	6.88	1.330	4.9	8.5	1.5
3	8	9.81	0.742	8.8	10.9	2.9
4	7	12.74	3.234	6.1	16.5	2.9
5	5	14.42	2.232	11.3	17.3	1.7
6	7	16.24	3.196	13.0	20.9	1.8
7	9	19.11	3.537	10.8	22.7	2.9
8	6	22.18	2.968	18.5	26.8	3.1

Table 5. Growth of McCown's longspurs nestlings, Pawnee 1970.

Day	No.	Mean Weight	Standard Deviation	Minimum Weight	Maximum Weight	Average Daily Gain
0	9	2.41	0.431	1.8	3.0	
1	7	3.36	0.835	2.3	4.6	0.95
2	3	5.67	1.151	4.5	6.8	2.31
3	3	7.23	0.704	6.5	7.9	1.56
4	7	9.09	2.021	6.4	12.4	1.86
5	4	13.68	1.732	11.4	15.3	4.59
6	6	13.02	2.012	10.3	16.2	-0.66
7	3	15.70	0.656	15.1	16.4	2.68
8	7	16.56	2.942	11.6	19.7	0.86
9	3	17.40	2.173	16.0	18.0	0.84

Table 6. Growth of western meadowlark nestlings, Pawnee 1970.

Day	No.	Mean Weight	Standard Deviation	Minimum Weight	Maximum Weight	Average Daily Gain
0	1	4.90	0.0	4.9	4.9	
1	5	8.30	0.748	7.0	8.8	3.40
2	5	11.16	1.104	9.9	12.9	2.86
3	4	18.05	2.532	15.8	21.6	6.89
4	7	21.21	1.365	19.3	23.3	3.16
5	5	28.02	2.388	25.8	31.1	6.81
6	5	33.40	3.434	29.8	38.8	5.38
7	5	37.98	4.150	33.7	43.6	4.58
8	4	39.18	6.808	33.7	44.5	1.20
9	6	45.85	5.332	38.5	53.2	6.67
10	2	54.30	7.778	48.8	59.8	8.45

Table 7. Growth of lark bunting nestlings, Pawnee 1970.

Day	No.	Mean Weight	Standard Deviation	Minimum Weight	Maximum Weight	Average Daily Gain
0	7	3.27	0.292	2.9	3.6	
1	12	4.62	0.785	3.6	6.5	1.35
2	11	7.04	1.721	3.3	8.7	2.42
3	10	10.24	1.632	7.5	12.8	3.20
4	5	13.02	1.348	11.1	14.3	2.78
5	6	18.20	3.073	13.8	22.1	5.18
6	5	20.68	1.258	19.0	21.9	2.48
7	----- No Data -----					
8	1	23.21	0.0	23.2	23.2	1.26

Table 8. Growth of loggerhead shrike nestlings, Pawnee 1970.

Day	No.	Mean Weight	Standard Deviation	Minimum Weight	Maximum Weight	Average Daily Gain
0	2	4.50	0.0	4.5	4.5	
1	5	6.68	1.276	5.4	8.6	2.18
2	5	9.10	1.379	7.9	11.3	2.42
3	1	10.60	0.0	10.6	10.6	1.50
4	5	15.86	1.910	13.8	18.6	5.26
5	2	17.15	1.058	16.4	17.9	1.29
6	5	24.22	2.154	22.3	27.6	7.07
7	5	27.24	2.468	24.4	31.0	3.02
8	5	28.42	1.199	27.0	30.1	1.18
9	----- No Data -----					
10	1	34.20	0.0	34.2	34.2	5.78
11	5	36.72	5.131	27.8	40.5	2.52
12	1	36.80	0.0	36.8	36.8	0.08
13	4	40.40	1.718	38.5	42.0	3.60

Table 9. Growth of Brewer's sparrow nestlings, Pawnee 1970.

Day	No.	Mean Weight	Standard Deviation	Minimum Weight	Maximum Weight	Average Daily Gain
0	6	1.48	0.20	1.2	1.6	
1	----- No Data -----					
2	6	3.42	0.417	2.7	3.9	0.97
3	----- No Data -----					
4	----- No Data -----					
5	3	6.43	0.070	6.4	6.5	0.34
6	----- No Data -----					
7	1	7.10	0.0	7.1	7.1	0.34
8	----- No Data -----					
9	3	9.90	0.05	9.8	10.0	1.40

Table 10. Birds banded at the Pawnee Site, 1970.<sup>a/</sup>

Common Name	Scientific Name	Number Banded
Lark Bunting	<i>Calospiza melanocorys</i>	216
Mourning Dove	<i>Zenaidura macroura</i>	134
Horned Lark	<i>Eremophila alpestris</i>	91
Western Meadowlark	<i>Sturnella neglecta</i>	54
Loggerhead Shrike	<i>Lanius ludovicianus</i>	39
Prairie Falcon	<i>Falco mexicanus</i>	35
McCown's Longspur	<i>Rhynchophanes mccownii</i>	34
Mountain Plover	<i>Eupoda montana</i>	25
Brewer's Sparrow	<i>Spizella breweri</i>	17
Say's Phoebe	<i>Sayornis saya</i>	16
Golden Eagle	<i>Aquila chrysaetos</i>	15
Swainson's Hawk	<i>Buteo swainsoni</i>	13
Chestnut-collared Longspur	<i>Calcarius ornatus</i>	13
Western Kingbird	<i>Tyrannus verticalis</i>	9
Great Horned Owl	<i>Bubo virginianus</i>	8
Ferruginous Hawk	<i>Buteo regalis</i>	7
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	7
Killdeer	<i>Charadrius vociferus</i>	6
Barn Swallow	<i>Hirundo rustica</i>	6
Brewer's Blackbird	<i>Euphagus cyonophalus</i>	5
Lark Sparrow	<i>Chondestes gramineus</i>	3
House Sparrow	<i>Passer domesticus</i>	3
Cliff Swallow <sup>b/</sup>	<i>Petrochelidon pyrrhonota</i>	2
Other species <sup>b/</sup>		8
Total		766

<sup>a/</sup> Including those banded by Phil Creighton, Allegra Collister, Gerald Craig and Richard Olendorff as well as Brent Giezantanner, Mark Strong and Ronald Ryder.

<sup>b/</sup> Including single birds of the following species: Red-tailed Hawk (*Buteo jamaicensis*), Vesper Sparrow (*Poocetes gramineus*), Chipping Sparrow (*Spizella passerina*), Western Wood Pewee (*Contopus sordidulus*), Eastern Kingbird (*Tyrannus tyrannus*), Traill's Flycatcher (*Empidonax traillii*), Sage Thrasher (*Oreoscoptes montanus*) and Bullock's Oriole (*Icterus bullockii*).

Table 11. Birds collected at the Pawnee Site, 1970.<sup>a/</sup>

Common Name	Scientific Name	Number Collected
Horned Lark	<i>Eremophila alpestris</i>	89
McCown's Longspur	<i>Rhynchophanes mccownii</i>	13
Western Meadowlark	<i>Sturnella neglecta</i>	6
Mountain Plover	<i>Eupoda montana</i>	4
Lapland Longspur	<i>Calcarius lapponicus</i>	2
Pine Siskin	<i>Spinus pinus</i>	<u>2</u>
Total		116

<sup>a/</sup> Does not include those collected by Dr. Paul H. Baldwin et al.



FIGURE TITLES

- Fig. 1. Example of North American nest record card.
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- Fig. 9. Nesting chronology of dominant nesting species, Pawnee 1970.
- Fig. 10. Nesting chronology of dominant species, Pawnee 1970.

## NORTH AMERICAN NEST RECORD CARD PROGRAM

Y E A R

Shaded Boxes not to be completed by observer

Species	<div> <div>1</div> <div>4</div> <div>9</div> <div>5</div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> </div>									
Observer (two initials, last name)	<div> <div>15</div> <div>17</div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> </div>									
In squares in space opposite										
Locality (in relation to nearest town)										
Elevation (in feet above sea level)	<div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> </div>									
Latitude	<div> <div>29</div> <div></div> <div>31</div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> </div>									
Longitude	<div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> </div>									
State or Province	<div> <div>34</div> <div></div> <div>36</div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> </div>									
HABITAT (circle where appropriate)										
1. Woods 2. Swamp 3. Marsh 4. Field 5. Grassland 6. Desert 7. Tundra 8. Suburban 9. Urban										
0. Other (specify)										
01. Coniferous 02. Deciduous 03. Mixed 04. Orchard 05. Cultivated 06. Fallow 07. No Veget. 08. Hedgerow										
09. Shrub 10. Salt 11. Brackish 12. Fresh 13. Sandy Beach 14. Gravel Beach 15. Other (specify)										
DOMINANT PLANT(S) IN HABITAT (list one or two)										
NEST SITE (circle where appropriate)										
01 Bare ground 02 On ground in vegetation 03 Floating 04 Low vegetation 05 Shrub 06 Palm 07 Deciduous tree branch										
08 Deciduous tree cavity 09 Conifer branch 10 Conifer cavity 11 Nest box 12 Other structure 13 Cliff or bank										
14 Other (specify)										
PRINCIPAL PLANT OR STRUCTURE										
SUPPORTING NEST										
Height of Eggs Above Ground or Water in Feet (feet and tenths if under five feet)	<div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> </div>									
If parasited by Cowbird check here <input type="checkbox"/>	<div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> </div>									
If same pair had other nestings this year, indicate which this is (1, 2, 3)	<div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> </div>									
(use separate card for each nesting)										

[illegible]

Fig. 1. Example of North American nest record card.

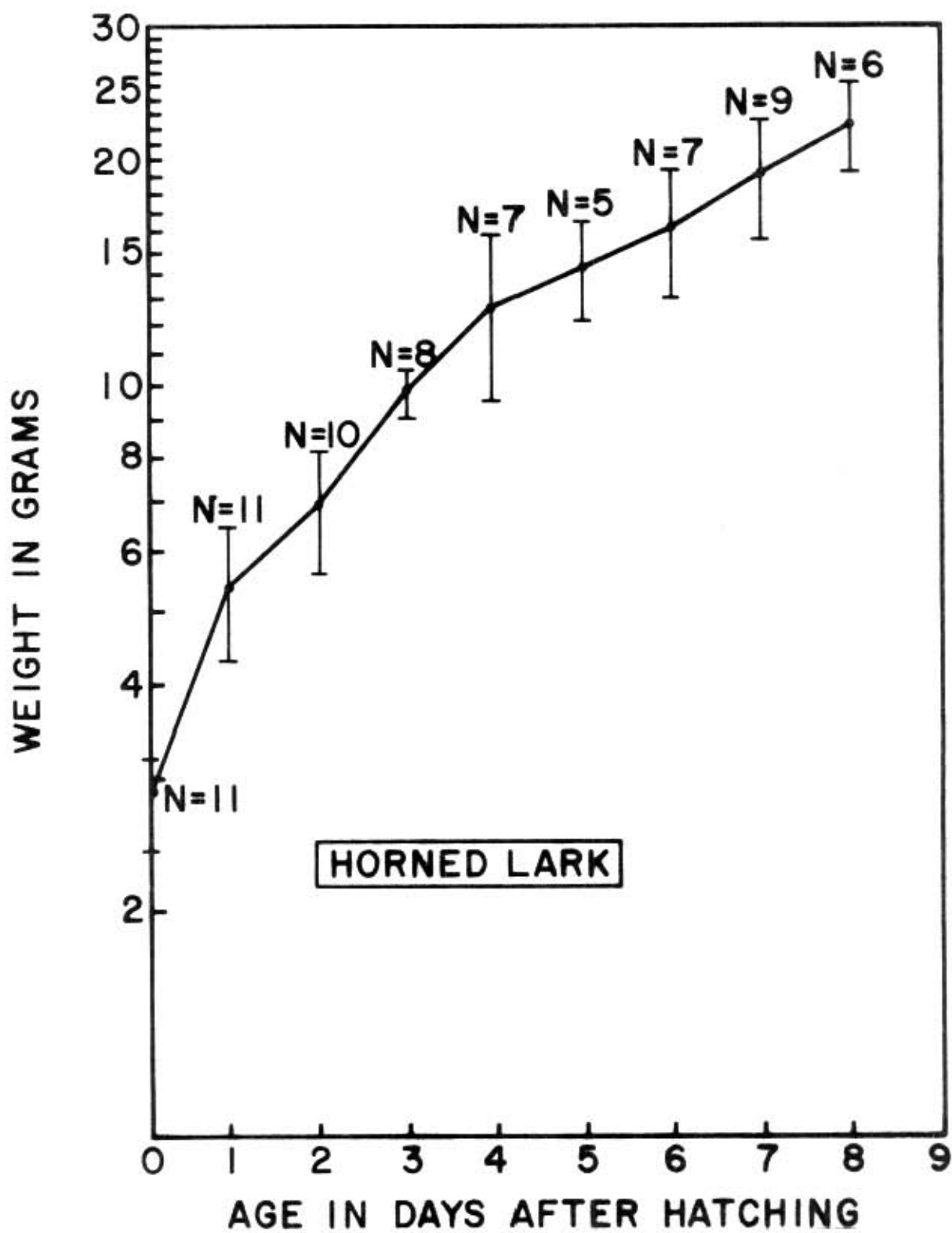


Fig. 2. Growth curve of horned lark nestlings, Pawnee 1970.

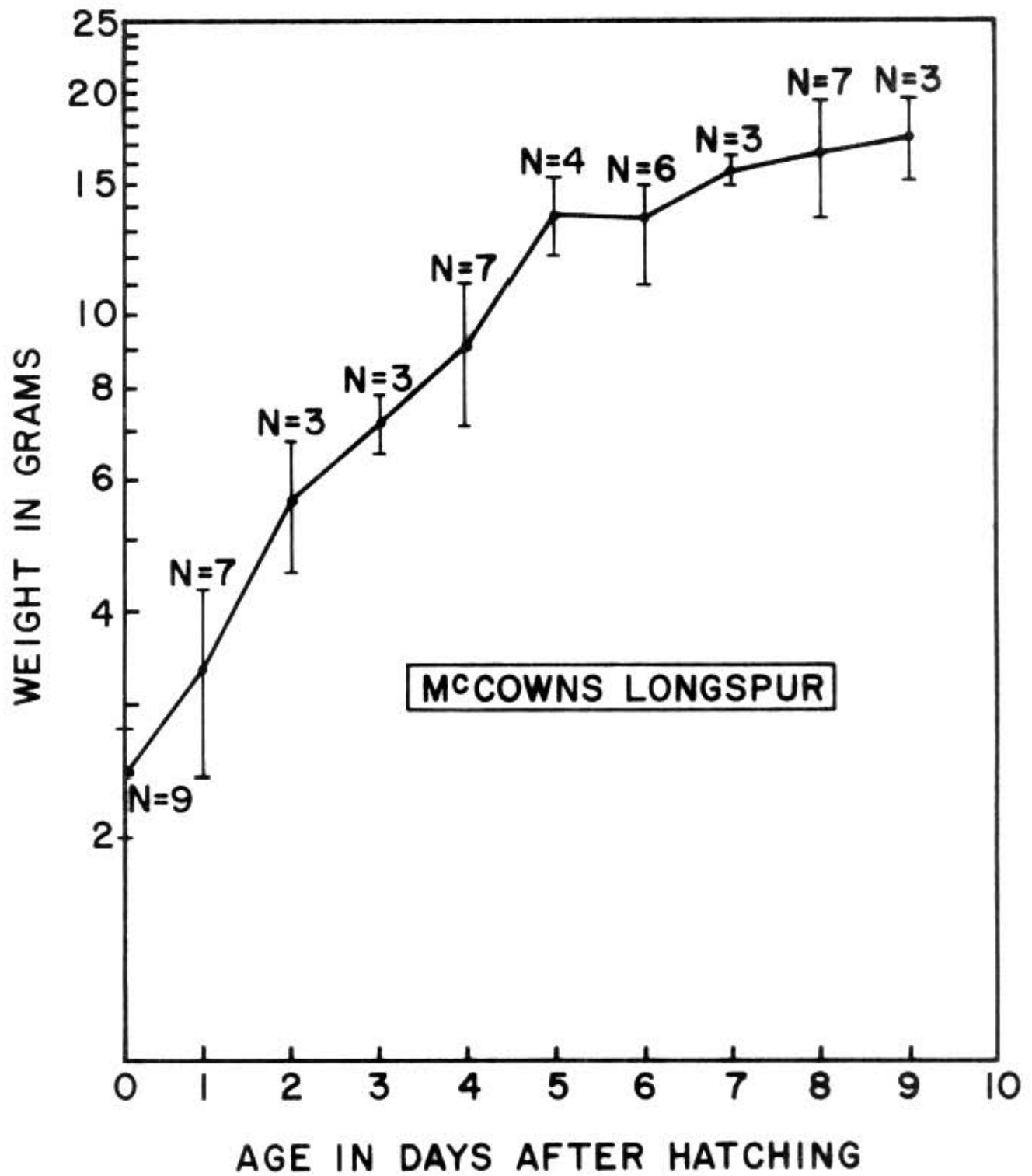


Fig. 3. Growth curve of McCown's longspur nestlings, Pawnee 1970.

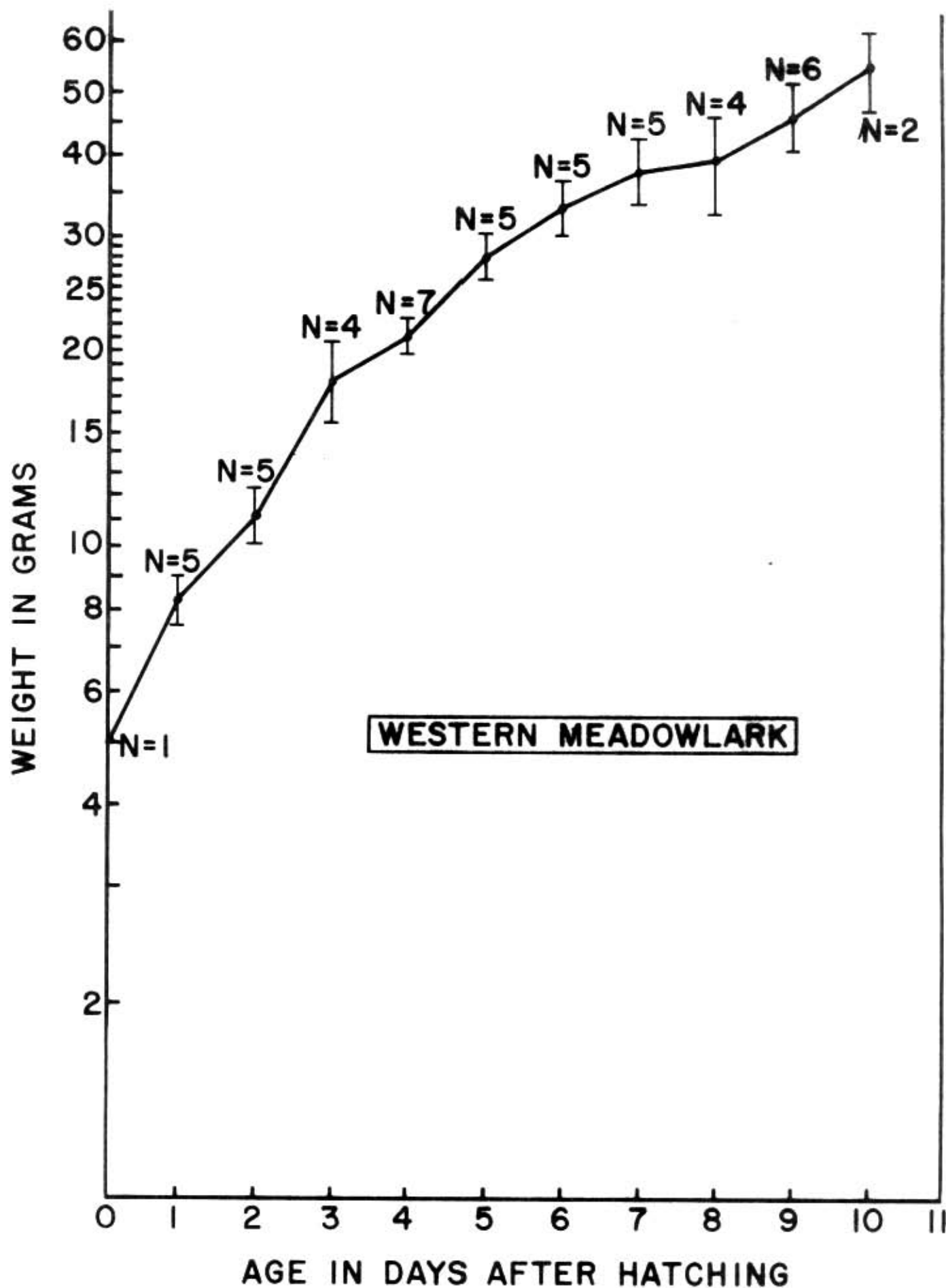


Fig. 4. Growth curve of western meadowlark nestlings, Pawnee 1970.

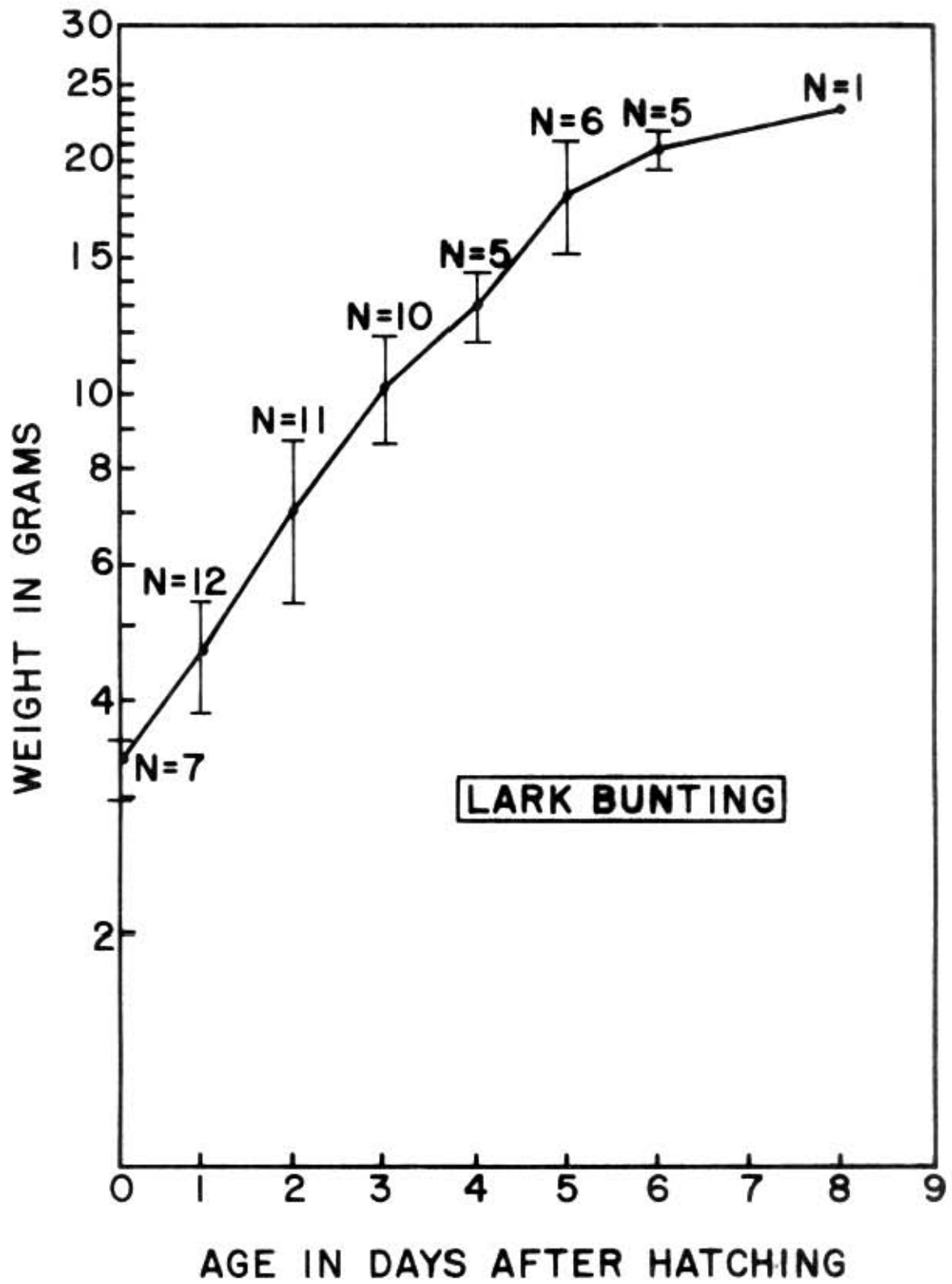


Fig. 5. Growth curve of lark bunting nestlings, Pawnee 1970.

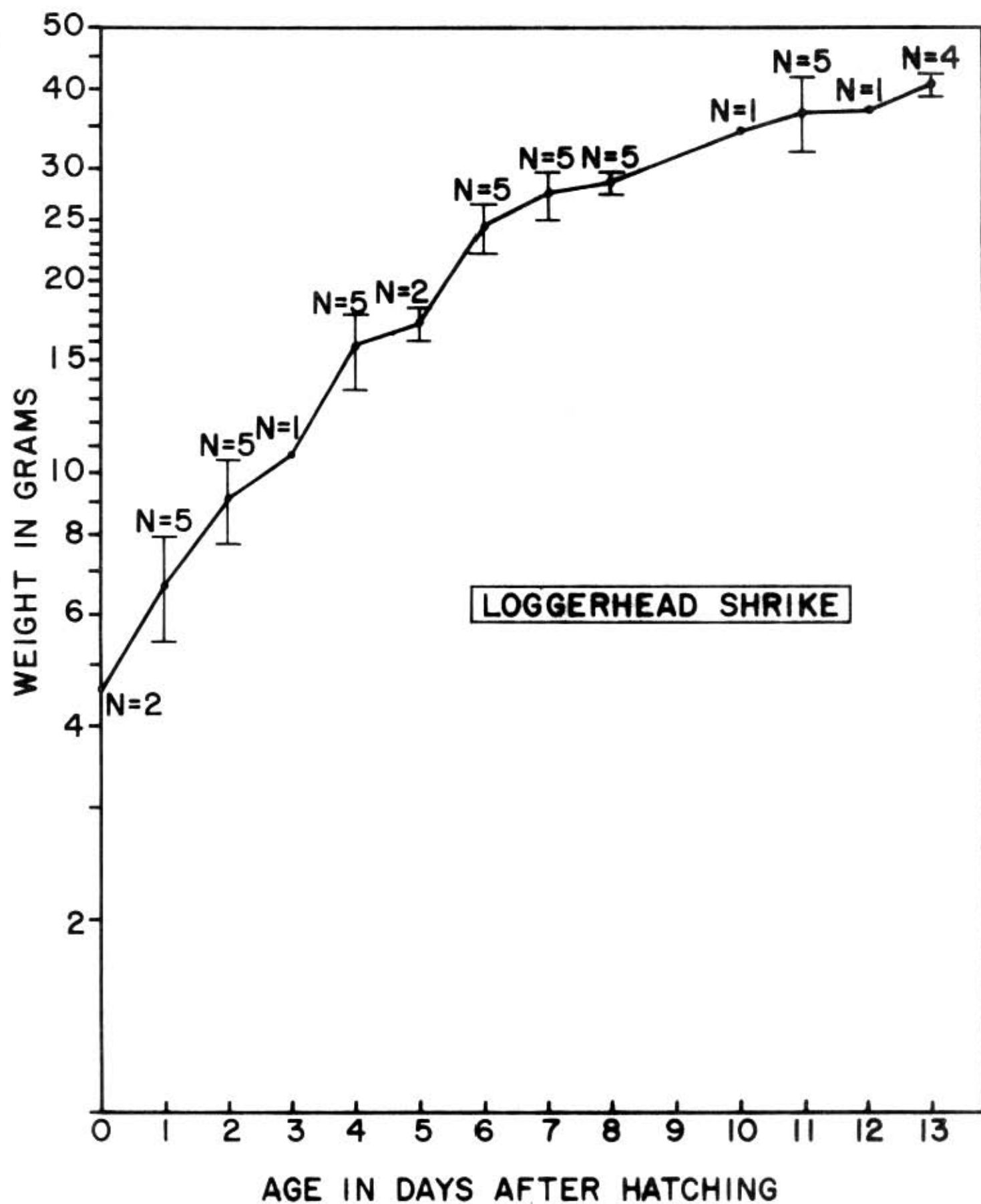


Fig. 6. Growth curve of loggerhead shrike nestlings, Pawnee 1970.

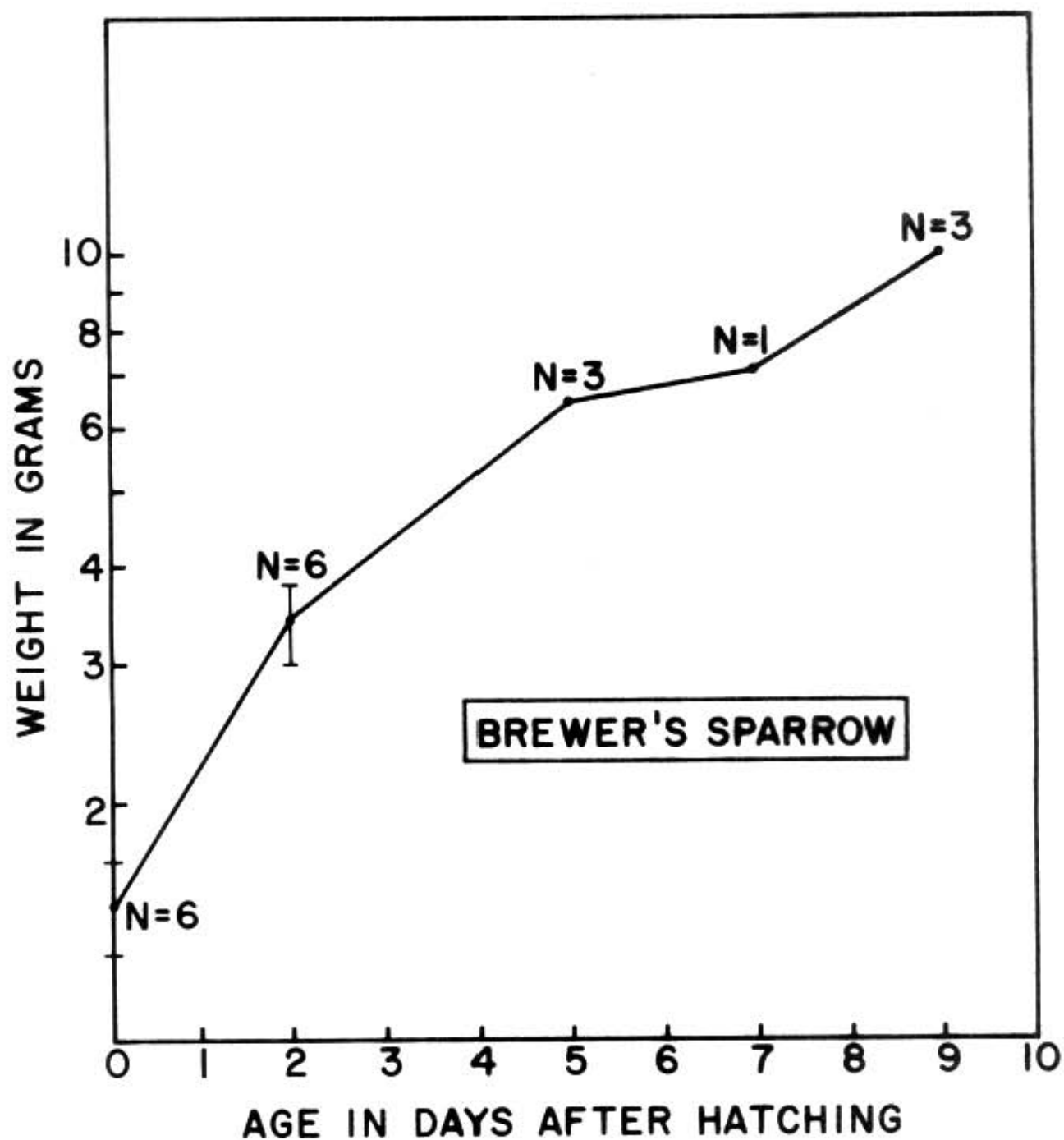


Fig. 7. Growth curve for Brewer's sparrow nestlings, Pawnee 1970.



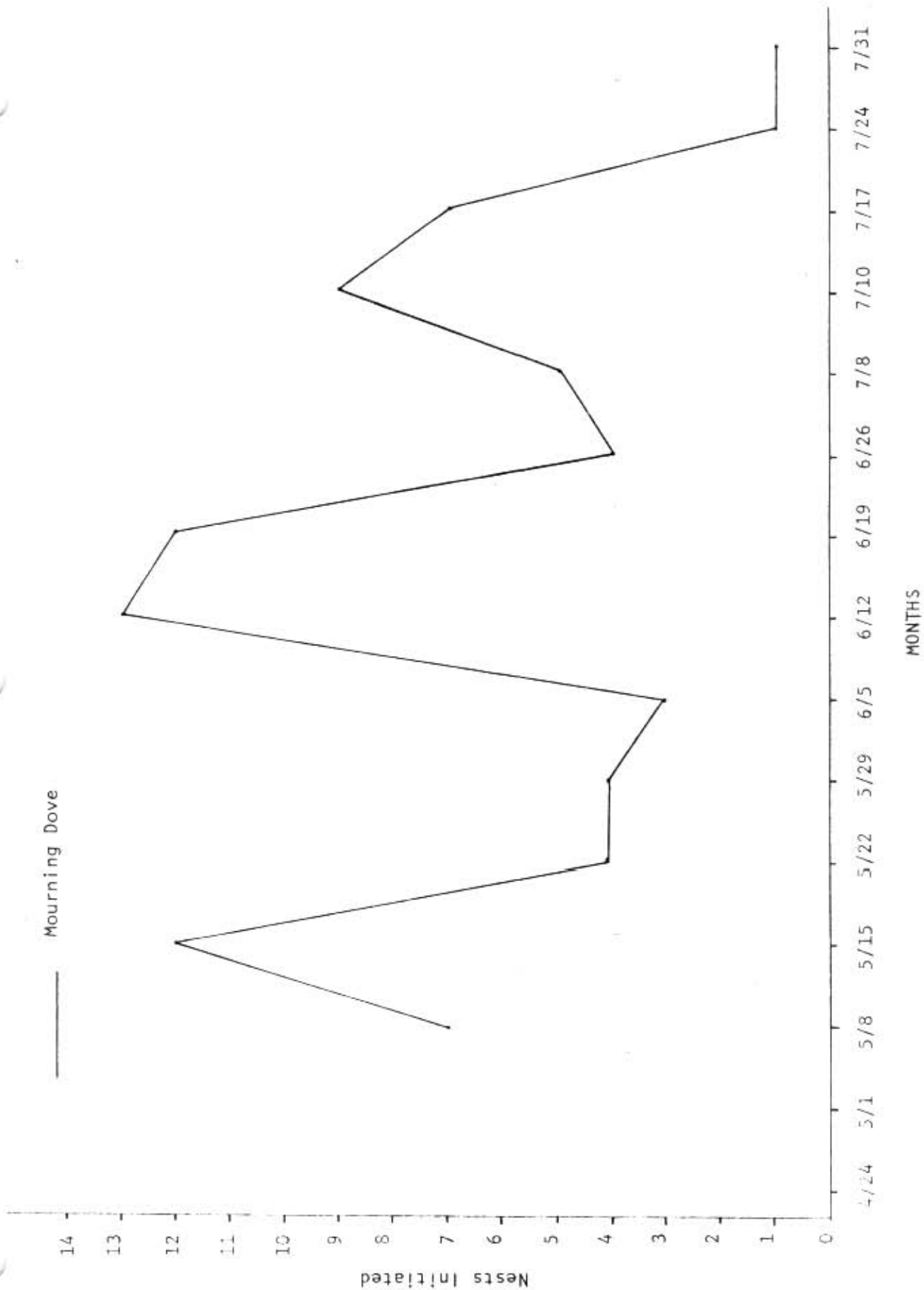


Fig. 8. Nesting chronology of the dominant nesting species, Pawnee 1970.

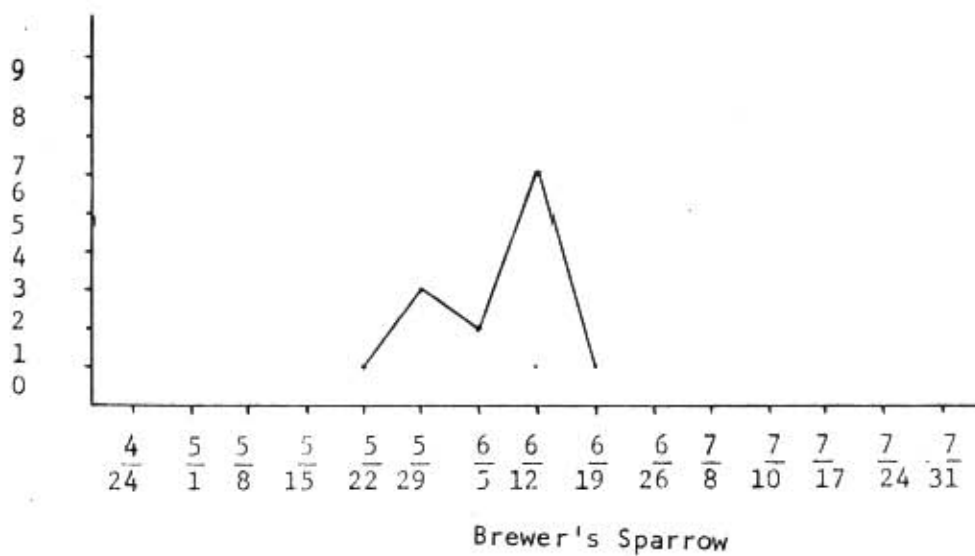
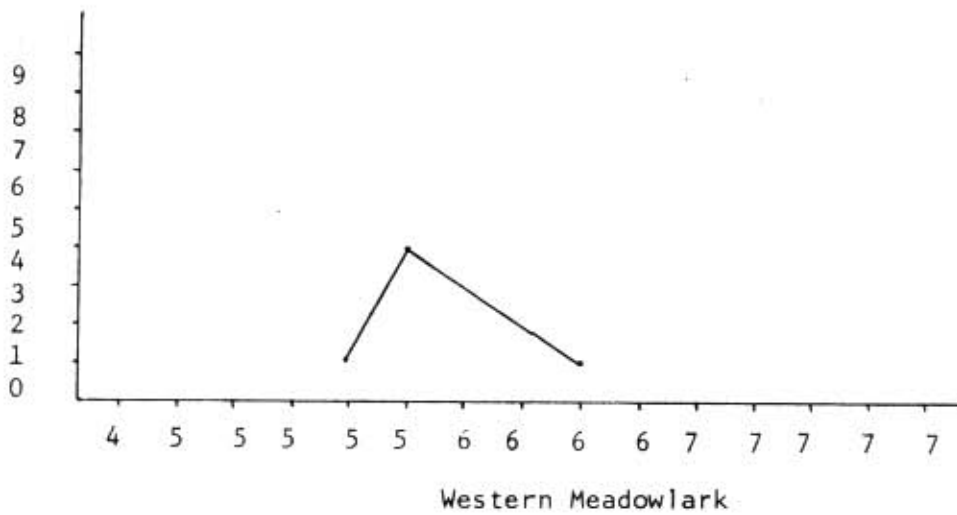
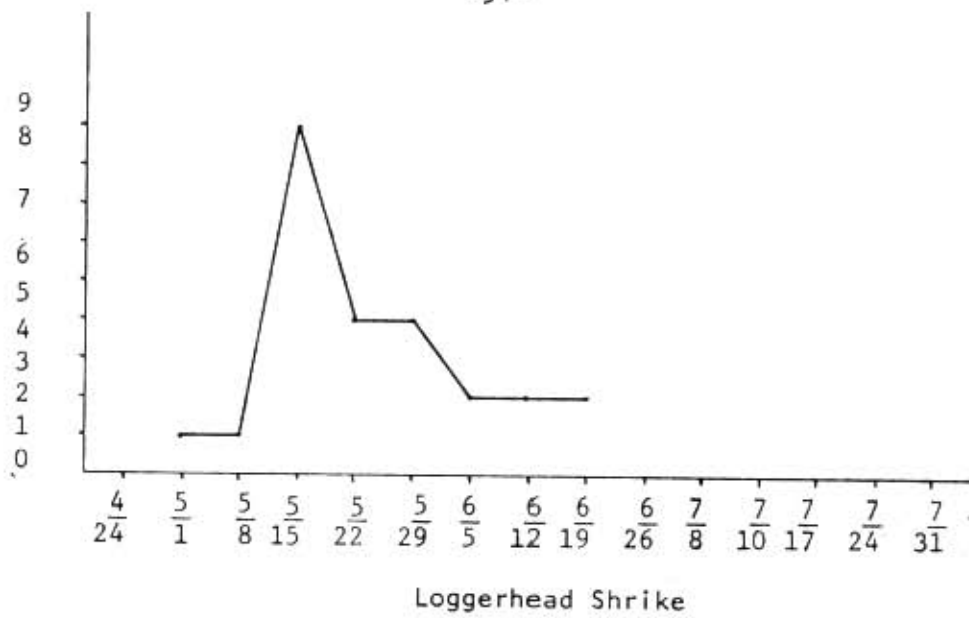
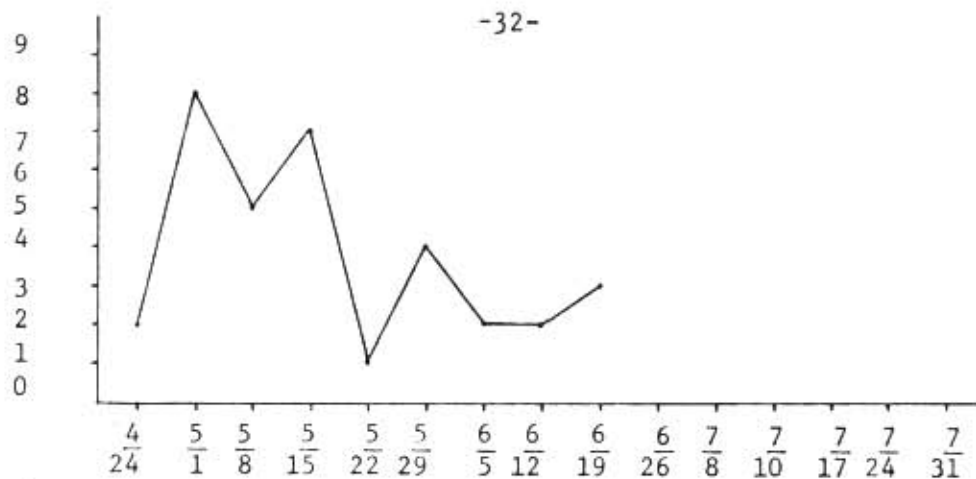
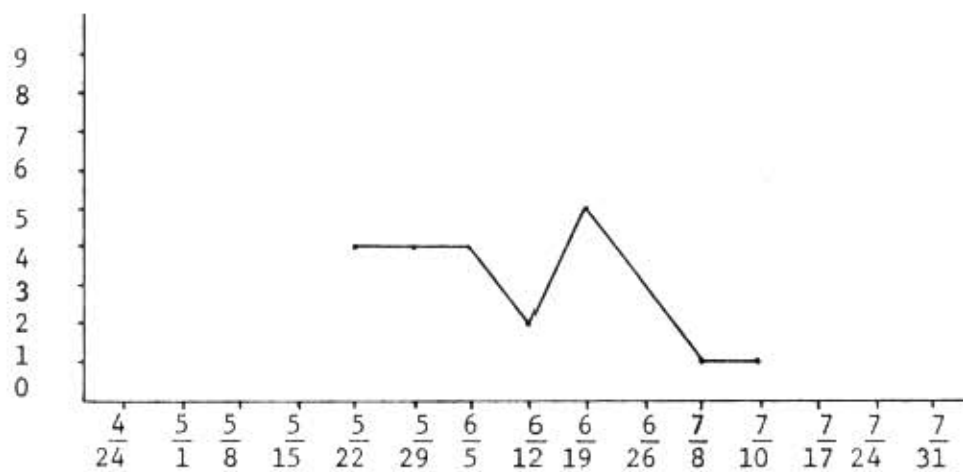


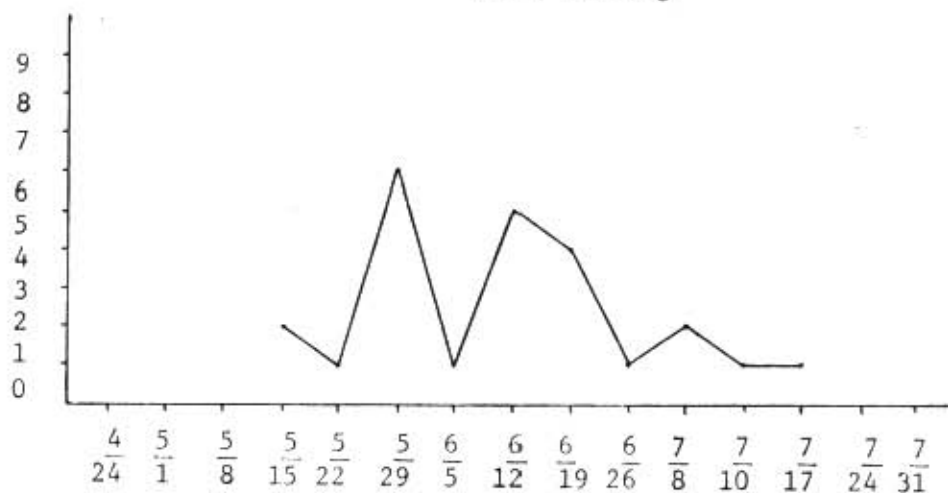
Fig. 9. Nesting chronology of dominant nesting species, Pawnee 1970.



Horned Lark



Lark Bunting



McCown's Longspur

Fig. 10. Nesting chronology of dominant species, Pawnee 1970.

APPENDIX I

FIELD DATA

Avian Road Count

Associated with the avian productivity work reported here are the avian road count data, Grassland Biome data set number A2U207B, and the avian permanent plot count data, Grassland Biome data set number A2U208B.

The avian road count data were recorded on form NREL-22. A sample of this form and a listing of the 1970-1971 road count data follows.

[illegible]

\*\*\* FIELD DATA \*\*\*

1 2 3 4 5 6 7 8  
123456789012345678901234567890123456789012345678901234567890

2211MAS160470

5	ER	AL	42	25	67	84	30	48
8	ST	NE	72	62	46	28	22	47
9	RH	MC	12	3	26	9	11	22
1	FA	SP	2	3	2	4		8
3	EU	MO	1			4	1	4
3	CH	MO	1	2				2
9	PO	GR		5				3
7	PA	DO		2			2	2
7	LA	LU		1		2	3	7
1	CI	CY		1	2	2	3	8
5	PI	PI		1				1
4	ZE	MA		1				1
6	OR	MO		1	2			2
9	CA	OR			37			1
7	ST	VU			2		2	2
5	SA	SA				1	1	2
3	NU	AM				1		1
4	CO	CA					1	1
8	AG	PH					1	1

11 BG21 470

5	ER	AL	51	41	84	62	39
8	ST	NE	75	63	33	27	26
9	RH	MC	16	8	37	19	8
9	CA	OR	2	9	25	6	
3	CH	VO	1	1	2	1	
8	AG	PH	1				
1	FA	SP		3	3	1	2
7	LA	LU		1			
7	ST	VU		7			2
7	OR	MO		1			
4	ZE	MA		4			
1	BU	LA		1			
1	CI	CY		1	1	1	
1	AQ	CH		1	1		1
	PI	PI		1			
3	EU	MO			8	5	
3	NU	AM			7	1	6
1	FA	ME			1		
9	PO	GR					1
4	CO	CA					1
5	SA	SA					1

21 JBG300470

5	FR	AL	31	19	68	52	33	47
8	ST	NE	70	60	30	17	13	48
9	RH	MC	8		3	8	3	11
9	CA	OR	11		12	8	25	12
4	ZE	MA	2	12			12	11
6	OR	MO	1					1
3	EU	MO	6			7	2	15
5	SA	SA	1				1	2
9	PO	GR		13	10		1	9
7	LA	LU		2	1		4	5
7	ST	VU		1			1	2
1	FA	SP		1	1	2		4
8	AG	PH		2				1
4	SP	CU		1				1
4	ZO	LE		2	4			2
1	CI	CY			1		1	2
3	AN	AC					1	1
1	BU	SW					1	1

2111JBG070570

5	ER	AL	49	23	43	38	49	44
8	ST	NE	68	78	54	28	31	49
4	ZE	MA	13	13	2	3	18	19
9	CH	ML	29	55	17	3	51	30
7	LA	LU	1	1			3	4
9	RH	MC	5		7	24	5	16
3	EU	MO	3		3	9	2	11
9	CA	OR	10		13	1		6
1	FA	SP	1	1		1		3
9	SP	BR	18	26	5	6	2	17
3	AN	PL	1	3	2			3
9	CH	GR		2			1	2
5	SA	SA		2			4	4
8	FU	CY		1				1
1	AQ	CH		1				1
5	MI	PO		1	1			2
9	PO	GR		6	7			4
7	ST	VU			2		8	4
4	SP	CU			1			1
6	OR	MO			1			1
5	HI	RU				1	4	3
5	TY	VE					2	1
1	BU	RE					1	1
1	CI	CY					1	1

2111JBG190570

5	ER	AL	23	11	49	61	48	41
8	ST	NE	53	59	47	19	23	48
9	CA	ML	253123	64	26	67	48	
4	ZE	MA	17	2	2		16	15
9	SP	BR		11	4	4		4
9	CA	OR	2		1	3		5

9	RH	MC	1		10	13	3	12
3	EU	MO	2	2	2	5	5	10
5	HI	RU	1		1	1	6	4
7	LA	LU		2			3	4
5	SA	SA		2			3	4
5	PI	PI		1				1
1	FA	SP		1				1
1	BU	SW		1			1	2
5	TY	VE		3			8	3
4	SP	CU		1			1	2
3	CH	VO			1			1
9	CH	GR			1			1
5	TY	TY			1		1	2
9	SP	PS					2	1
4	PH	NU					1	1

2111JBG260570

5	ER	AL	37	23	31	51	40	45
8	ST	NE	55	59	41	19	32	50
9	CA	ML	99	56	45	24	40	46
4	ZE	MA	14	8	3	1	7	17
9	RH	MC	3		1	21		11
3	EU	MO	2			8	4	9
9	SP	BR	7	22	4	6		13
7	LA	LU		3			2	4
1	AQ	CH	1					1
7	ST	VU		2				1
5	SA	SA		1		1	2	4
4	SP	CU		1				1
9	CA	OR			17	3		7
1	BU	SW			1		2	2
5	HI	RU			1		6	2
8	AG	PH					1	1
5	TY	TY					1	1
5	TY	VE					10	3
6	MI	PO					2	1
5	CO	BR					1	1
3	CH	VO					3	1

2111JBG020670

5	ER	AL	39	15	32	39	28	47
8	ST	NE	48	57	27	20	20	48
9	CA	ML	61	63	34	15	28	43
9	RH	MI	12		2	14	6	14
3	EU	MO				7	1	5
4	ZE	MA	7	5	3	1	6	13
7	LA	LU		3			1	3
9	CA	OR	1		10	1		6
9	SP	BR	7	11	2	5		11
8	AG	PH		1				1
5	TY	TY		5			1	3
5	SA	SA		1			1	2
7	ST	VU		4			1	3
4	SP	CU		2			1	2



2111JBG090670

3	AN	PL		3		1
5	HI	RU			1	2
5	TY	VE				6
1	AQ	CH				1
2	PH	CO				1
6	MI	PO				2
1	BU	SW				1
5	ER	AL	40	10	32	37
8	ST	NE	61	48	37	28
9	CA	ML	25	41	46	28
9	SP	BR	7	12		4
9	RH	MC	10		3	16
4	ZE	MA	4	10		4
9	CH	OR	3		13	
5	PE	PY	1			7
3	EU	MO	2		2	3
5	ST	RU	1			
1	AG	CH		1		1
5	TY	VE		2		8
5	SA	SA		3		1
7	LA	LU		2		
5	HI	RU		3		
7	ST	VU		2		
1	BU	SW		1		1
4	SP	CU		1		1
5	SA	OB			1	
1	CI	CY			2	
6	MI	PO				2

2211JBG160670

5	ER	AL	35	14	27	34	26	41
8	ST	NE	55	62	24	19	22	48
9	CA	ML	51	75	47	33	38	49
4	ZE	MA	8	13	3	1	6	18
9	RH	MC	8		6	34	6	17
9	CA	OR	5		18			10
9	SP	BR	8	22	3	4		11
7	LA	LU		1				1
5	PE	PY	1					1
8	AG	PH	1					1
1	CI	CY	1					1
7	ST	VU		3				1
5	HI	RU		1				1
5	PI	PI		1				1
7	PA	DO		1				1
6	TO	RU		1				1
5	TY	VE		2			6	2
5	SA	SA		1	1		1	3
2	PH	CO		2				2
5	ST	RU		1				1
3	EU	MO	1			7		3

4	SP	CU		2			1
1	BU	SW			1		1
1	BU	RE			1		1
1	AQ	CH		1			1
5	TY	TY				1	1
4	CH	MI				4	1
6	MI	PO				1	1

2211JBG230670

5	ER	AL	38	22	24	34	34	42
8	ST	NE		49	30	18	13	47
9	CA	ML	49	61	45	39	53	50
9	SP	BR			3	4		9
3	EU	MO				2	1	3
9	CA	DR			13			7
9	RH	MC	8		7	21		12
4	ZE	MO					6	13
7	LA	LU		4				3
3	CH	VO	1	1				2
1	AQ	CH	1					1
4	SP	CU	1				3	3
5	HI	RU	1	1			3	3
5	SA	SA		2			2	2
7	PA	DO		1			1	2
7	ST	VU					1	2
1	BU	SW		2				1
6	OR	MO						1
8	AG	PH		2				1
6	MI	PO			1			1
5	TY	VE			1		8	2

2211JBG020770

5	ER	AL	32	14	35	28	25	39
8	ST	NE	33	53	23	8	17	42
9	CA	ML	112	121	72	51	57	50
9	RH	MC	6		8	21	2	11
4	ZE	MA	15	12			7	15
9	SP	BR	9	23	2	4		9
9	CA	OR	5		1			4
9	AM	SA	1					1
4	SP	CU	1	1		1	3	4
1	AG	CH	1				1	2
1	CI	CY	1					1
3	CH	VO	4					1
5	ST	RU	1					1
7	ST	VU		3				1
7	LA	LU		2				1
6	MI	PO		2				1
4	BU	VI		1				1
5	SA	SA		1			1	2
5	HI	RU		1			2	2

7	PA	DO	6		1
5	PI	PI	2		1
5	TY	VE	1	6	2
1	FA	ME	1		1
3	EU	MO		3	1
9	CH	GR		1	1
1	BU	SW		1	1
4				1	1

2211J8G080770

5	ER	AL	21	18	20	36	17	37
8	ST	NE	23	23	13	12	18	42
9	CA	ML	1161	22	93	66	60	50
4	CA	OR	4		2			4
9	RH	MC	8		8	14	3	17
4	ZE	MA	14	11		1	6	16
9	SP	BR	9	13	3	5	2	13
4	SP	CU	1			1	1	3
1	CI	CY		2	1			3
5	SA	SA		1			1	2
7	LA	LU		2				1
5	PI	PI		4				1
3	CH	VO		1				1
1	BU	SW		2				1
6	OR	MO		1				1
4	CH	MI			1			1
3	EU	MO				4		1
5	TY	VE					6	1
6	MI	PO					1	1
5	HI	RU					3	2
7	ST	VU					1	7

2211J8G160770

5	ER	AL	15	5	14	36	43	29
8	ST	NE	40	30	14	9	18	43
9	CA	ML	96	131	81	85	57	50
9	RH	MC	6		2	15	2	11
9	CA	OR	8		1			3
9	SP	BR	9	21	9	2		12
4	ZE	MA	10	15	1		6	13
3	EU	MO	5					1
1	CI	CY	1					1
4	SP	CU	1	2				3
7	LA	LU		2				1
5	SA	SA		1			2	2
5	TY	VE					8	1
5	TY	VE					8	1
5	TY	TY					1	1
4	CH	MI				1		1
5	PE	PY	1					1
6	MI	PO					3	1
1	BU	SW				1		1
5	HI	RU				4	1	2

221JBG280770

5	ER	AL	20	7	15	20	33	30
8	ST	NE	27	20	14	9	13	35
9	CA	ML	58	166	110	88	200	49
4	ZE	MA	8	9			6	10
9	RH	MC	5		6	4		8
9	SP	BR	7	10	5	7		10
7	LA	LU		5			2	4
3	EU	MO	1					1
1	FA	ME	1				1	2
4	SP	CU		1				1
5	SA	SA		1			4	2
5	HI	RU		2			2	2
1	BU	SW		2			1	2
8	EU	CY		1				1
4	CH	MI			1		1	2
1	CI	CY			2			2
1	BU	JA				2		1
9	SP	PS				2		1
5	TY	VE					9	1
5	TY	TY					4	1
7	PA	DO					1	1
1	BU	RE					1	1

2111MAS050870

5	ER	AL	9	9	17	13	12	25
9	CA	ML	39	165	97	27	138	43
8	ST	NE	16	17	4	6	6	26
5	HI	RU	2	1	0	0	4	3
9	CA	OR	2	0	5	0	0	4
3	EU	MO	2	0	0	4	0	2
4	ZE	MA	6	8	1	0	5	7
9	RH	MC	1	0	1	4	0	6
4	SP	CU	1	0	0	0	0	1
9	CH	GR	1	4	0	0	0	2
4	CH	MI	2	4	1	0	1	6
7	LA	LU	1	6	1	1	1	6
9	SP	BR	6	6	4	2	0	6
1	CI	CY	0	3	2	0		4
5	SA	SA	0	1	0	0		3
1	BU	SW	0	1	0	0	1	2
5	PE	PY	0	26	0	1	0	3
5	TY	VE	0	1	0	0	4	2
1	FA	ME	0	0	0	1	1	2
5	TY	TY	0	0	0	0	2	1
7	PA	DO	0	0	0	0	4	1

2211MAS130870

9	CA	ML	76	186	81	55	49	43
8	ST	NE	5	9	2	1	7	17
9	CA	OR	1	0	6	0	0	3
9	SP	BR	5	22	4	0	0	9
3	EU	MO	6	0	0	37	0	4
5	ER	AL	2	0	8	8	11	12
4	ZE	MA	7	30	0	0	10	8
1	HU	RE	1	0	0	0	0	1

6	OR	MO	1	0	0	0	0	1
9	CH	GR	0	1	0	0	0	1
4	CH	MI	0	3	0	0	0	2
7	PA	DO	0	2	0	0	0	1
7	LA	LU	0	10	1	0	1	7
5	SA	SA	0	1	0	0	3	2
5	TY	VE	0	1	0	0	4	3
1	FA	ME	0	0	2	1	0	3
1	CI	CY	0	0	1	1	0	2
5	PE	PY	0	0	0	1	0	1
1	FA	SP	0	0	0	1	0	1
9	RH	MC	0	0	0	14	0	3
1	BU	JA	0	0	0	0	1	1
5	TY	TY	0	0	0	0	4	1
5	CO	SO	0	0	0	0	1	1
1	BU	SW	0	0	0	0	1	1
5	HI	RU	0	0	0	0	5	1
8	ST	NE	6	4	15	2	12	19
9	CA	OR	5	0	17	0	0	2
5	ER	AL	10	14	33	19	5	27
4	ZE	MA	2	2	5	0	8	8
4	RH	MC	1	0	1	1	0	3
7	LA	LU	1	3	0	0	0	3
9	CA	ML	29	130	15	32	8	13
9	SP	BR	21	44	4	1	11	13
5	TY	VE	0	1	0	0	0	1
7	PA	DO	0	2	0	0	0	1
1	CI	CY	0	2	0	0	1	3
1	FA	ME	0	1	0	0	1	2
1	BU	RE	0	0	0	0	1	1
5	HI	RU	0	0	0	0	5	1
5	SA	SA	0	0	0	0	5	1
5	ER	AL	6	43	70	15	17	29
9	RH	MC	31	32	4	9	4	18
8	ST	NE	31	13	10	3	4	16
1	BU	RE	1	0	0	1	0	2
7	ST	VU	0	1	0	0	1	2
6	SI	CU	0	1	0	0	0	1
9	SP	PL	0	15	0	0	0	1
9	ZO	LE	0	5	0	0	0	1
9	PO	GR	0	0	1	0	2	2
1	AQ	CH	0	0	0	2	0	1
1	CI	CY	0	0	0	0	3	3
9	JU	OR	0	0	0	0	1	1
4	ZE	MA	0	0	0	0	2	1
1	BU	JA	0	0	0	0	1	1
5	ER	AL	29	11	83	138	216	43
8	ST	NE	2	2	1	2	0	5
9	JU	OR	1	0	0	0	0	1

2111MAS310870

2211MAS011070

2211MAS201070

2211MAS311270

2211MAS040271

1	BU	RE	1	0	0	0	0	1
1	AQ	CH	0	1	0	0	0	1
9	CA	LA	0	1	9	0	2	3
7	ST	VU	0	12	0	4	4	4
1	CI	CY	0	1	0	0	0	1
6	SI	CU	0	0	2	0	0	1
7	LA	EX	0	0	1	0	0	1
5	ER	AL	7100	4	51	85	14	
1	FA	ME	1	1	0	0	0	2
1	CI	CY	0	2	0	0	1	3
7	ST	VU	0	2	0	0	0	1
1	BU	LA	0	0	0	1	2	3
1	CA	LA	0	0	0	1	0	1
5	ER	AL	9	18	15	761	44434	
7	CA	LA	2	3	7	6	5	7
1	AQ	CH	1	0	0	0	1	2
1	FA	CO	1	0	0	0	0	1
7	ST	VU	0	1	0	0	0	1
7	PA	DO	0	3	0	0	0	1
1	BU	LA	0	0	0	2	0	2
1	BU	RE	0	0	0	0	1	1
8	ST	NE	0	0	0	0	1	1
6	LA	EX	0	0	0	0	2	2

## Permanent Plot Description and Listing

A description of the avian permanent plot count data and a listing of these data follows. The data are grouped by pasture (treatment) and by date of collection within each pasture.

Column	Contents
I Header Cards	
(1) 1-5	Identification of pasture containing the plot
6-25	Treatment description
26-33	Date (month-day-year)
35-38	Time (hours, minutes) plot count started
40-43	Time plot count ended
45-60	Observer's name
(2) 1-80	Alphameric description of weather and other information
II Bird Count Cards	
1-5	AOU code number for species
6-7	Number of birds seen
III Trailer Card	
1-5	\$\$\$\$\$ indicating the end of information for that plot on that date

\*\*\* FIELD DATA \*\*\*

1 2 3 4 5 6 7 8  
123456789012345678901234567890123456789012345678901234567890

23EHEAVY SUMMER 07-01-70 0815 0845 GIEZENTANNER  
WALKED TRANSECT CLEAR, WIND SW 0-3 MPH TEMP 65 NORTH TO LEFT  
+74 17  
539 10  
281 05  
\$\$\$\$\$

23EHEAVY SUMMER 07-07-70 0855 0925 GIEZENTANNER  
WALKED TRANSECT OVERCAST, WIND NW 10-14 MPH TEMP 78 NORTH TO LEFT  
+74 16  
539 04  
281 08  
505 01  
505 01  
\$\$\$\$\$

23EHEAVY SUMMER 07-15-70 0850 0820  
WALKED TRANSECT CLEAR, WIND ESE. 4-6 MPH TEMP 64 NORTH TO LEFT  
+74 19  
539 20  
281 03  
\$\$\$\$\$

23EHEAVY SUMMER 07-22-70 0830 0900  
WALKED TRANSECT TEMP. 75 OVERCAST NORTH TO LEFT  
+74 09  
539 09  
281 05  
\$\$\$\$\$

23EHEAVY SUMMER 07-27-70 0825 0855  
WALKED TRANSECT WIND NE 6-11 MPH NORTH TO LEFT  
+74 07  
539 07  
281 02  
\$\$\$\$\$

23EHEAVY SUMMER 08-06-70 0800 0825 STRONG  
WALKED TRANSECT CALM, TEMP 80, HIGH HUMIDITY NORTH TO LEFT  
281 16  
539 09  
+74 01  
\$\$\$\$\$



23EHEAVY SUMMER WALKED TRANSECT 281 04 539 17 474 22 \$\$\$\$\$	08-11-70 0915 0935 STRONG WIND ENE 4-6 TEMP. 74	NORTH TO LEFT
23EHEAVY SUMMER WALKED TRANSECT 474 17 539 02 \$\$\$\$\$	08-27-70 0850 0910 STRONG WIND N 0-2 MPH TEMP. 76	NORTH TO LEFT
23EHEAVY SUMMER WALKED TRANSECT 539 01 \$\$\$\$\$	09-03-70 0910 0930 STRONG CALM, TEMP 72	NORTH TO LEFT
23EHEAVY SUMMER WALKED TRANSECT 474 05 \$\$\$\$\$	10-13-70 0820 0840 STRONG WIND NE, 0-2 TEMP. 41, SKY 2	NORTH TO LEFT
23EHEAVY SUMMER WALKED TRANSECT 474 05 536 02 \$\$\$\$\$	10-30-70 0830 0850 STRONG WIND SW, 0-5 MPH. TEMP. 41, SKY 1	NORTH TO LEFT
23EHEAVY SUMMER WALKED TRANSECT 474 09 536 03 \$\$\$\$\$	11-12-70 0845 0910 STRONG CALM, TEMP. 44 SKY -2	NORTH TO LEFT
23EHEAVY SUMMER WALKED TRANSECT \$\$\$\$\$	11-24-70 0825 0855 STRONG WIND SSW 10-12 MPH TEMP. 46 SKY 1 1 IN. SNOW	NORTH TO LEFT
23EHEAVY SUMMER WALKED TRANSECT \$\$\$\$\$	12-16-70 0845 0905 STRONG CALM, TEMP 32 SNOW COVER	NORTH TO LEFT
23EHEAVY SUMMER WALKED TRANSECT \$\$\$\$\$	01-21-71 0815 0830 STRONG WIND SSE 10-14 MPH TEMP. 32 SKY 0	NORTH TO LEFT
23E WALKED TRANSECT 474 03 \$\$\$\$\$	02-02-71 1235 1250 STRONG WIND ESE 6-8 TEMP., 56 F 9 SKY 1	NORTH TO LEFT
23WLIGHT SUMMER WALKED TRANSECT 474 01 605 14 605 02 501.102 539 07 \$\$\$\$\$	07-01-70 0845 0915 GIEZENTANNER CLEAR, WIND S 2-4 MPH TEMP 68	NORTH TO LEFT

23WLIGHT SUMMER WALKED TRANSECT 474 01 605 13 605 02 601.103 639 04 316 01 \$\$\$\$\$	07-07-70 0930 1000 GIEZENTANNER OVERCAST, WIND N 10-14 MPH TEMP 82	NORTH TO LEFT
23WLIGHT SUMMER WALKED TRANSECT 474 01 605 07 605 03 639 05 \$\$\$\$\$	07-15-70 0920 0950 CLEAR, WIND ESE, 4-6 MPH TEMP 64	NORTH TO LEFT
23WLIGHT SUMMER WALKED TRANSECT 474 06 605 07 605 01 601.101 639 04 638 02 \$\$\$\$\$	07-22-70 0905 0935 WIND S, 1-2 MPH. TEMP. 72 SKY OVERCAST	NORTH TO LEFT
23WLIGHT SUMMER WALKED TRANSECT 474 03 605 03 605 02 639 05 331 01 \$\$\$\$\$	07-27-70 0900 0930 STRONG WIND NE, 2-8 TEMP. 70, CLEAR	NORTH TO LEFT
23WLIGHT SUMMER WALKED TRANSECT 605 04 605 01 474 02 639 12 \$\$\$\$\$	08-06-70 0830 0850 STRONG	NORTH TO LEFT
23WLIGHT SUMMER WALKED TRANSECT 331 01 639 05 474 01 605 01 \$\$\$\$\$	08-11-70 0940 1000 STRONG	NORTH TO LEFT
23WLIGHT SUMMER WALKED TRANSECT 639 45 601.102 \$\$\$\$\$	08-27-70 0915 0935 STRONG	NORTH TO LEFT

23WLIGHT SUMMER WALKED TRANSECT 537 21 \$\$\$\$\$	09-03-70 0930 0950 STRONG	NORTH TO LEFT
23WLIGHT SUMMER WALKED TRANSECT 536 01 474 05 \$\$\$\$\$	10-13-70 0840 0900 STRONG	NORTH TO LEFT
23WLIGHT SUMMER WALKED TRANSECT \$\$\$\$\$	10-30-70 0855 0915 STRONG	NORTH TO LEFT
23WLIGHT SUMMER WALKED TRANSECT 331 01 \$\$\$\$\$	11-12-70 0915 0935 STRONG	NORTH TO LEFT
23WLIGHT SUMMER WALKED TRANSECT \$\$\$\$\$	11-24-70 0900 0920 STRONG	NORTH TO LEFT
23WLIGHT SUMMER WALKED TRANSECT 474 04 \$\$\$\$\$	12-16-70 0910 0925 STRONG	NORTH TO LEFT
23WLIGHT SUMMER WALKED TRANSECT 474 02 \$\$\$\$\$	01-21-71 0815 0835 RYDER	NORTH TO LEFT
23W WALKED TRANSECT \$\$\$\$\$	02-02-71 1255 1310 STRONG	NORTH TO LEFT
22EHEAVY WINTER WALKED TRANSECT 474 08 605 09 605 04 313.102 540 01 \$\$\$\$\$	07-01-70 0915 0940 GIEZENTANNER CLEAR. WIND S. 2-4 MPH TEMP 70	NORTH TO LEFT
22EHEAVY WINTER WALKED TRANSECT 474 10 605 11 605 06 562 02 \$\$\$\$\$	07-07-70 1000 1030 GIEZENTANNER OVERCAST. WIND NE. 10-14 MPH TEMP 82	NORTH TO LEFT
22EHEAVY WINTER WALKED TRANSECT 474 03 605 10 605 05 562 02 501.101 \$\$\$\$\$	07-15-70 1000 1025 CLEAR. WIND ESE. 4-6 MPH TEMP 68	NORTH TO LEFT

22EHEAVY WINTER WALKED TRANSECT 474 03 605 11 605 06 562 01 \$\$\$\$\$	07-22-70 TEMP 74, OVERCAST	0950 U/I/	NORTH TO LEFT
22EHEAVY WINTER WALKED TRANSECT 474 06 562 01 501.101 605 02 605 01 \$\$\$\$\$	07-27-70 0930 1000 GIEZENTENNER WIND ENE 6-8, TEMP. 72, CLEAR		NORTH TO LEFT
22EHEAVY WINTER WALKED TRANSECT 331 01 378 01 605 10 605 09 562 08 474 06 501.105 \$\$\$\$\$	08-06-70 0900	STRONG	NORTH TO LEFT
22EHEAVY WINTER WALKED TRANSECT 378 01 552 01 605 1 605 1 562 03 \$\$\$\$\$	08-11-70 1005 1020	STRONG	NORTH TO LEFT
22EHEAVY WINTER WALKED TRANSECT 474 01 501.101 \$\$\$\$\$	08-27-70 1005 1020	STRONG	NORTH TO LEFT
22EHEAVY WINTER WALKED TRANSECT 560 01 562 02 474 10 \$\$\$\$\$	09-03-70 1000 1015	STRONG	NORTH TO LEFT
22EHEAVY WINTER WALKED TRANSECT 474 02 539 06 \$\$\$\$\$	10-13-70 0615 0930	STRONG	NORTH TO LEFT
22EHEAVY WINTER WALKED TRANSECT 474 22 536 05 \$\$\$	10-30-70 0930 0945	STRONG	NORTH TO LEFT

22E HEAVY WINTER WALKED TRANSECT 474 06 536 02 \$\$\$\$\$	11-12-70 0945 1000 STRONG	NORTH TO LEFT
22E HEAVY WINTER WALKED TRANSECT 347 01 474 04 \$\$\$\$\$	11-24-70 0930 0945 STRONG	NORTH TO LEFT
22E HEAVY WINTER WALKED TRANSECT 474 03 \$\$\$\$\$	12-16-70 0935 0950 STRONG	NORTH TO LEFT
22E HEAVY WINTER WALKED TRANSECT \$\$\$\$\$	01-21-71 0840 0900 RYDER	NORTH TO LEFT
22E WALKED TRANSECT \$\$\$\$\$	02-02-71 1320 1335 STRONG	NORTH TO LEFT
15E MODERATE SUMMER WALKED TRANSECT 474 08 605 10 605 01 501.101 378 01 \$\$\$\$\$	07-01-70 1015 1045 GIEZENTANNER CLEAR, WIND SW. 2 MPH TEMP 77	NORTH TO LEFT
15E MODERATE SUMMER WALKED TRANSECT 474 05 605 11 605 03 501.101 \$\$\$\$\$	07-07-70 1100 1130 GIEZENTANNER PARTLY CLOUDY, WIND NE. 10-14 MPH TEMP 86	NORTH TO LEFT
15E MODERATE SUMMER WALKED TRANSECT 474 09 605 03 605 02 \$\$\$\$\$	07-15-70 1100 1130 CLEAR, WIND SE. 4-6 MPH TEMP 72	NORTH TO LEFT
15E MODERATE SUMMER WALKED TRANSECT 605 01 474 06 \$\$\$\$\$	07-22-70 1100 1125 OVERCAST	NORTH TO LEFT
15E MODERATE SUMMER WALKED TRANSECT 474 03 605 01 605 02 \$\$\$\$\$	07-27-70 1100 1125 WIND ESE, 4-5 TEMP. 76, CLEAR	NORTH TO LEFT

15MODERATE SUMMER WALKED TRANSECT 474 14 605 01 \$\$\$\$\$	08-06-70 0940 1000 STRONG	NORTH TO LEFT
15MODERATE SUMMER WALKED TRANSECT 539 02 474 03 \$\$\$\$\$	08-11-70 1045 1100 STRONG	NORTH TO LEFT
15MODERATE SUMMER WALKED TRANSECT 474 24 501.102 \$\$\$\$\$	08-27-70 1045 1100 STRONG	NORTH TO LEFT
15MODERATE SUMMER WALKED TRANSECT 474 01 539 01 \$\$\$\$\$	09-03-70 1040 1055 STRONG	NORTH TO LEFT
15MODERATE SUMMER WALKED TRANSECT 474 04 \$\$\$\$\$	10-13-70 0955 1010 STRONG	NORTH TO LEFT
15MODERATE SUMMER WALKED TRANSECT 474 02 536 02 \$\$\$\$\$	10-30-70 1010 1025 STRONG	NORTH TO LEFT
15MODERATE SUMMER WALKED TRANSECT \$\$\$\$\$	11-12-70 1020 1035 STRONG	NORTH TO LEFT
15MODERATE SUMMER WALKED TRANSECT \$\$\$\$\$	11-24-70 1010 1025 STRONG	NORTH TO LEFT
15MODERATE SUMMER WALKED TRANSECT \$\$\$\$\$	12-16-70 1015 1030 STRONG	NORTH TO LEFT
15MODERATE SUMMER WALKED TRANSECT WIND, SSW 8-10 MPH TEMP. 34 SKY 0 \$\$\$\$\$	01-21-71 0910 0930 STRONG	NORTH TO LEFT
15 WALKED TRANSECT \$\$\$\$\$	02-02-71 1400 1415 STRONG	NORTH TO LEFT
15WMODERATE WINTER WALKED TRANSECT 474 04 605 08 605 04 562 02 501.102 \$\$\$\$\$	07-01-70 0945 1015 GIEZENTANNER CLEAR WIND S. 2-4 MPH TEMP 73	NORTH TO LEFT

15W	MODERATE WINTER	07-07-70 1030 1100 GIEZENTANNER	
WALKED	TRANSECT	PARTLY CLOUDY WIND NE 10-14 MPH TEMP 84	NORTH TO LEFT
474	06		
605	08		
501	01		
562	03		
702	01		
\$\$\$\$\$			
15W	MODERATE WINTER	07-15-70 1030 1100	
WALKED	TRANSECT	CLEAR, WIND SE 4-5 MPH TEMP 72	NORTH TO LEFT
474	06		
605	07		
605	01		
501	102		
562	06		
\$\$\$\$\$			
15W	MODERATE WINTER	07-22-70 1030 1100	
WALKED	TRANSECT	TEMP. 76 OVERCAST	NORTH TO LEFT
474	11		
605	17		
605	05		
501	103		
562	02		
\$\$\$\$\$			
15W	MODERATE WINTER	07-27-70 1030 1100 GIEZENTANNER	
WALKED	TRANSECT	WIND E 4 TEMP 76 CLEAR	NORTH TO LEFT
474	01		
605	07		
605	03		
501	04		
562	03		
\$\$\$\$\$			
15W	MODERATE WINTER	08-06-70 0925 0940 STRONG	
WALKED	TRANSECT		NORTH TO LEFT
562	03		
605	01		
605	02		
501	102		
\$\$\$\$\$			
15W	MODERATE WINTER	08-11-70 1025 1040 STRONG	
WALKED	TRANSECT		NORTH TO LEFT
501	102		
\$\$\$\$\$			
15W	MODERATE WINTER	08-27-70 1025 1040 STRONG	
WALKED	TRANSECT		NORTH TO LEFT
474	02		
\$\$\$\$\$			
15W	MODERATE WINTER	09-03-70 1020 1035 STRONG	
WALKED	TRANSECT		NORTH TO LEFT
331	01		
474	02		
539	01		
\$\$\$\$\$			
15W	MODERATE WINTER	10-13-70 0935 0950 STRONG	
WALKED	TRANSECT		NORTH TO LEFT
474	05		
\$\$\$\$\$			

15W MODERATE WINTER WALKED TRANSECT 474 20 536 08 347 01 \$\$\$\$\$	10-30-70 0950 1005 STRONG	NORTH TO LEFT
15W MODERATE WINTER WALKED TRANSECT 474 04 \$\$\$\$\$	11-12-70 1005 1020 STRONG	NORTH TO LEFT
15W MODERATE WINTER WALKED TRANSECT 474 10 536 05 \$\$\$\$\$	11-24-70 0950 1005 STRONG	NORTH TO LEFT
15W MODERATE WINTER WALKED TRANSECT \$\$\$\$\$	12-16-70 0955 1010 STRONG	NORTH TO LEFT
15W MODERATE WINTER WALKED TRANSECT \$\$\$\$\$	01-21-71 0910 0935 RYDER	NORTH TO LEFT
15W WALKED TRANSECT \$\$\$\$\$	02-02-71 1340 1355 STRONG	NORTH TO LEFT
10SLIGHT WINTER WALKED TRANSECT 474 09 605 03 605 02 562 02 501.101 \$\$\$\$\$	07-01-70 1055 1125 GIEZENTANNER CLEAR, WIND W. 2-3 MPH TEMP 80	NORTH UP
10SLIGHT WINTER WALKED TRANSECT 474 05 605 13 605 03 562 01 612 01 \$\$\$\$\$	07-07-70 1130 1200 GIEZENTANNER PARTLY CLOUDY WIND NE. 10-14 MPH TEMP 76	NORTH UP
10SLIGHT WINTER WALKED TRANSECT 474 01 605 03 605 02 562 02 612 01 \$\$\$\$\$	07-15-70 1120 1150 CLEAR, WIND SE 4-6 MPH TEMP 74	NORTH UP
10SLIGHT WINTER WALKED TRANSECT 474 02 605 05 605 02 562 03 331 01 \$\$\$	07-22-70 1130 1155 WIND S 2-3 TEMP 78, OVERCAST	NORTH UP



10SLIGHT WINTER WALKED TRANSECT 474 02 605 01 605 02 562 02 \$\$\$\$\$	07-27-70 1130 1200 WIND E. 2 TEMP 70 CLEAR	NORTH UP
10S WALKED TRANSECT 562 04 474 02 \$\$\$\$\$	08-06-70 1000 1020 STRONG CALM TEMP 93 HIGH HUMIDITY	NORTH UP
10S WALKED TRANSECT 562 02 \$\$\$\$\$	08-11-70 1110 1130 STRONG WIND EWE 3-5 TEMP 90	NORTH UP
10S WALKED TRANSECT 331 01 10S	08-27-70 1110 1130 STRONG WIND NNW. 0-2 TEMP 95 SKY 1	NORTH UP
WALKED TRANSECT \$\$\$\$\$	09-03-70 1110 1130 STRONG WIND NW 8-10 TEMP. 84. SKY 1	NORTH UP
10S WALKED TRANSECT 501.102 474 29 \$\$\$\$\$	10-13-70 1020 1040 STRONG WIND SSE. 2-4 TEMP 52 SKY 1	NORTH UP
10SLIGHT WINTER WALKED TRANSECT 474 26 536 05 \$\$\$\$\$	10-30-70 1045 1115 STRONG WIND WSW. 2-4 TEMP. 51 SKY 1	NORTH UP
10SLIGHT WINTER WALKED TRANSECT \$\$\$\$\$	11-12-70 1050 1110 STRONG WIND NW2-4 MPH TEMP. 51 SKY 1	NORTH UP
10SLIGHT WINTER WALKED TRANSECT \$\$\$\$\$	11-24-70 1035 1055 STRONG WIND WSW 12-15 MPH TEMP. 55 SKY 1	NORTH UP
10SLIGHT WINTER WALKED TRANSECT 474 12 536 02 \$\$\$\$\$	12-16-70 1045 1105 STRONG WIND S 5-6 MPH TEMP. 48	NORTH UP
10SLIGHT WINTER WALKED TRANSECT 474 02 \$\$\$\$\$	01-21-71 0850 0905 STRONG	NORTH UP
10S WALKED TRANSECT 474 84 \$\$\$\$\$	02-02-71 1415 1435 STRONG WIND SSE 4-5 TEMP. 54 F. SKY 1	NORTH TO LEFT