

Technical Report No. 28
AVIAN DISTRIBUTION AND POPULATION
FLUCTUATIONS AT THE PAWNEE SITE

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INTRODUCTION

Since July 1, 1968, two methods of censusing the avian population of the shortgrass prairie have been used regularly. These counts have the primary objective of determining the avian biomass on the Central Plains Experimental Range, International Biological Program Intensive Site, and preparing these data for incorporation into models of the ecosystem. One count was refined further to relate the effects of cattle grazing on vegetation to the distribution of the bird population.

All species of birds seen on the counts were recorded, but major emphasis has been placed on analysis of the fluctuations of only the dominant species: lark bunting (*Calamospiza melanocorys*), horned lark (*Eremophila alpestris*), western meadowlark (*Sturnella neglecta*), McCown's longspur (*Rhynchophanes mccownii*), mountain plover (*Eupoda montana*), mourning dove (*Zenaidura macroura*), loggerhead shrike (*Lanius ludovicianus*), and Brewer's sparrow (*Spizella breweri*).

Fluctuations by season and vegetative cover have been recorded and are summarized in this report.

OBJECTIVES

The primary objectives for the period July 1, 1968, to December 15, 1969, were to:

1. Determine the relative abundance of as many resident and transient species of birds as possible.
2. Determine species distribution according to different grazing intensities.
3. Derive estimates of nesting density and avian production and biomass on the Pawnee Site.
4. Describe the chronology of fluctuations in species populations.

Additional objectives achieved coincidentally with the above were:

1. Collection of crops and stomachs for future food habits analysis.
2. Banding and color marking of individuals for use in future nesting studies and migration analysis.
3. Compilation of an updated checklist of birds occurring on the Pawnee Site.

STUDY AREA AND METHODS

The major portion of the data was collected on the Central Plains Experimental Range, IBP Intensive Site, seven miles north of Nunn, Weld County, Colorado. In addition, one count extended into the northwest portion of the adjacent Pawnee National Grassland.

Plot Counts

The plot counts consisted of a total census of all birds present on six 20-acre study plots in pastures of varying grazing intensities and seasonal use as previously established by the Agricultural Research Service (Klipple and Costello, 1960). Each plot was marked by 66 flat-plate steel stakes placed in a 1,320 ft x 660 ft rectangle and staked and numbered into 132 ft squares or grids for easy location within the plot (Fig. 1).

One plot was established in each of the pastures and grazing intensities as shown in Table 1.

Each plot was censused by walking through the area and recording all birds seen within the area of the plot on a standardized map. Effort was made to avoid counting the same birds twice, at the same time striving to achieve a total census of the plot. All counts were made between 0700 and 1600 hours.

Plots 1, 2, and 4 were censused 44 times from July 1, 1968, to December 4, 1969. Plots 3, 5, and 6 were censused 40 times beginning on July 31, 1968, and continuing to December 4, 1969. From July 31, 1968, to December 4, 1969, all six plots were counted on the same day.

Counts were made weekly during the breeding season (April-August) and biweekly the remainder of the year.

Prior to March 15, 1969, most censuses were by David A. Cobb, undergraduate assistant under the direction of Dr. R. A. Ryder. Since March 15, 1969, work has been performed by the present investigator, J. Brent Giezantanner, again under the direction of Dr. Ryder. Help also was provided by undergraduate work-study assistants.

Roadside Counts

Roadside counts were made in accordance with the techniques outlined by the U. S. Fish and Wildlife Service for use in the Breeding Bird Survey (Robbins and Van Velzen, 1967). The only exception was that our counts started at sunrise through spring, summer, and fall, and shortly after sunrise in winter months. All birds within a one-quarter mile radius seen or heard during a three-minute stop along a 50-stop route were recorded on a standard form (Fig. 2). In addition, notes were made of other unusual individuals seen along the route or in the area when not actually seen during the count.

Each count began at the junction of U. S. Highway 85 and the entrance to the intensive site. The route proceeded four miles east, four miles north, nine miles east, one mile north, and six and one-half miles east through the Central Plains Experimental Range, private farmland, and the northwest portion of the Pawnee National Grassland (Fig. 3).

Fifty-one counts were made from July 2, 1968, to December 12, 1969. Each count took approximately four and one-half hours to complete.

Typical habitats represented along the roadside route are summarized in Table 2.

Collections

Five horned larks have been collected weekly to obtain weights, plumage changes, and crops for future food habits analysis. Birds were collected in habitats similar to the count routes' but not along the route itself.

RESULTS AND DISCUSSION

Objective 1. Relative abundance of all species.

Plot counts. Twenty-two species have been recorded on the plots to date. The horned lark is the most abundant year-round resident. Numbers present ranged from zero on December 23, 1968, and January 19, 1969, to a peak of 132 on September 4, 1969. During the breeding season, lark buntings arrived, and their numbers increased to peaks of 66 on July 31, 1968, and 116 on July 1, 1969. They were followed by the following species in decreasing order of abundance: McCown's longspur, western meadowlark, Brewer's sparrow, mountain plover, and other incidentals. In late fall, all species except the horned lark departed. The niche vacated by the McCown's longspurs was soon filled by the arrival in late October of the lapland longspur, a winter resident. This longspur often was observed with horned larks in mixed flocks of moderate to large size, a factor which complicated obtaining accurate counts.

Roadside counts. Eighty-one species have been recorded along the roadside route to date. This count also showed the horned lark to be the most abundant year-round resident. Numbers varied from nine on July 30, 1968, to

755 on November 15, 1969. The horned lark gathers in large flocks in fall and winter and concentrates in wheat fields and bare areas. Since these areas often are located along or near roads, large flocks are more likely to be seen than the individual camouflaged birds.

Lark buntings appeared on May 1, 1969, and reached peak numbers of 1,060 on July 24, 1969. Following in decreasing order were western meadowlarks, McCown's longspurs, Brewer's sparrow, lapland longspurs, and mourning doves. Again upon departure of the McCown's longspurs, the lapland longspur arrived to fill a similar niche.

The presence of fence posts and trees along the roadside route probably influenced the occurrence of western meadowlarks and mourning doves, placing them higher in the order of abundance along the roadside route than on the plots.

Objective 2. Species distribution by grazing intensity.

Plot counts. On heavily-grazed areas with short vegetation (Plots 1 and 3), the horned lark was the most abundant species. On these plots in summer, the McCown's longspur was next in importance and was replaced in winter by the lapland longspur.

In winter, horned larks, lapland longspurs, and an occasional raptor were virtually the only species recorded on the plots.

In summer, as vegetative cover of certain plots increased, horned larks were replaced by meadowlarks, Brewer's sparrows, and lark buntings. Table 3 summarizes total individuals seen for five key species during part of the 1969 breeding season (May to July). These figures are broken down further

in Table 4 to provide percentages for each species on a plot versus the total for the species on all six plots and in Table 5 to compare the number of individuals of a species on a plot with the total of all five species on that plot.

As seen in Tables 3, 4, and 5, horned larks comprised 66.7% of all birds seen on Plot 1 (heavily grazed) for the three-month period. In like manner, they comprised only 23-24% of the population on the lightly-grazed areas of Plots 2 and 6.

In contrast, lark buntings constituted 3.2% of the population seen on Plot 1 and 33% of all birds seen on Plot 6.

Thirty-eight percent of all horned larks observed were seen on Plot 1, 8.5% on Plot 6. Of all lark buntings seen, 2.2% were on Plot 1 and 25.8% on Plot 2.

McCown's longspurs were most abundant on Plot 1, comprising 28.7% of all species on the plot, and 75.2% of all McCown's seen were observed on Plot 1.

Western meadowlark numbers were fairly constant for all plots except Plot 1. Population percentages ranged from 5.6% to 11.4% of all species on Plots 2 to 6.

Brewer's sparrows increased in abundance as brush (mostly *Atriplex canescens*, four-winged salt bush) became more frequent and provided nesting cover (Table 1).

Objective 3. Nesting density, production, and biomass.

Intensive nest searches and observations during the breeding season used in conjunction with the weekly plot counts allowed for the computation of the estimated nesting-pair figures shown in Table 6. Horned larks and McCown's

longspurs used the heavily summer-grazed plot extensively, while meadowlarks, lark buntings, and Brewer's sparrows sought out areas of increased plant cover.

As seen in Table 7, figures obtained for the Pawnee Site are comparable with those noted at Matador in 1967 and 1968 as well as those reported in southeastern Wyoming in earlier years.

Several unsuccessful attempts were made to locate nests by dragging a rope between two observers. It was found that horned larks flushed at great distance from the observers. Often they would flush from the nest and fly low over the ground, being first observed some distance from the actual nest. In areas of greater plant cover and more brush, these factors precluded the use of a rope, as it became entangled in the vegetation.

Most nests were found by observing birds until they returned to the nest to incubate or feed young. Others were found incidental to other activities.

One hundred fifty-seven nests of 17 species were located in the overall study area (plots and roadside route) (Table 8).

Production estimates and biomass, obtained by recording periodic data from these nests and from weekly collection, are summarized in Table 9. The total avian breeding biomass was calculated to be 6.5 kg/120 acres or 0.0134 g/m^2 (wet weight) in 1969. Due to the large size of individuals, western meadowlarks provided the greatest biomass, $.0042 \text{ g/m}^2$, for adults and young, followed by the smaller but more abundant horned larks and lark buntings.

Other production and nesting ecology work has been conducted by Walter D. Gaul, graduate student from the University of Minnesota, on the mountain plover. In 1969, Gaul collected data on 80 nests and banded 157 of this species.

Objective 4. Chronology of fluctuations in species populations.

Summer residents. Over 40 species were observed periodically during July to September 1968. In the summer of 1969 (May to September), 65 species were recorded along the roadside route. Twenty-five species are known to breed regularly on the area. These include in addition to those previously mentioned: ferruginous hawks (*Buteo regalis*), Swainson's hawks (*Buteo swainsoni*), great horned owls (*Bubo virginianus*), burrowing owl (*Speotyto cunicularia*), golden eagles (*Aquila chrysaetos*), eastern kingbird (*Tyrannus tyrannus*), western kingbird (*Tyrannus verticalis*), Say's phoebe (*Sayornis saya*), barn swallows (*Hirundo rusticus*), chestnut-collared longspurs (*Calcarius ornatus*) and other incidentals.

Winter residents. The winter bird fauna typically consists of 9 to 12 species, primarily horned larks, lapland longspurs, rough-legged hawks (*Buteo lagopus*), golden eagles, prairie falcons (*Falco mexicanus*), ferruginous hawks, and marsh hawks (*Circus cyaneus*). In 1968, an average of 7.7 species was seen on each winter roadside count. The average for November and December 1969 is 9.6 species per count.

Spring arrival and fall departure. No spring arrival dates are available for 1968.

In 1969, lark buntings arrived on the study area on May 1, reached a peak of 1,060 on July 24 along the roadside route, and had departed from the area by September 19-25. In 1968, the last lark bunting was seen on September 10.

McCown's longspurs arrived on March 27, 1969, and remained until October 16, 1969. In 1968, McCown's were last recorded on the plot count on October 5.

Mourning doves arrived on April 24, 1969, nested through the early part of September, and departed upon the arrival of an early fall snowstorm on October 4 and 5. In 1968, mourning doves were last recorded on September 10.

Brewer's sparrows first appeared on April 24, 1969. They were present in varying numbers on the study plots and began nesting in late June through July. The last Brewer's sparrow was recorded on October 16. In 1968, the last Brewer's sparrow was recorded on September 28.

Western meadowlarks were present in small numbers in isolated habitats through the winter of 1968 and in November and December of 1969. They began arriving in significant numbers about the first of April. By the early snowstorms on October 5 and 12, most had departed for warmer climates.

Fig. 4 summarizes arrival and departure dates of these main species.

Incidental Objectives Accomplished

Dr. R. A. Ryder has compiled an updated checklist of birds of the Pawnee Site (Table 10) using a review of literature available coupled with field data acquired on the counts.

Over 1,000 birds of a total of 35 species were banded in the 1969 field season (Table 11). In addition, many of these were color-marked to aid in future nesting studies on the area.

Weights were obtained from all birds banded or collected and will be used to determine biomass for the individual species. Those weights pertaining to horned larks are summarized in Fig. 5.

Work for the coming field season will include continuation of the plot and roadside counts, intensive nest searches, and individual territory determination.

ACKNOWLEDGMENTS

Recognition should go to Thomas Rutter, Ronald Stanek, and Ralph Gutierrez for their assistance in the project lab and field work on this project.

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Table 1. Vegetation characteristics of the different plots and grazing intensities.

Plot	Pasture	Intensity	Characteristic Vegetation
1	23 E	Heavy Summer	Shortgrass, prickly pear
2	23 W	Light Summer	Short-moderate grass, prickly pear
3	22 E	Heavy Winter	Shortgrass, occasional brush
4	15 E	Moderate Summer	Short-moderate grass, little brush
5	15 W	Moderate Winter	Short-moderate grass, frequent brush
6	10 S	Light Winter	Moderate grass, much brush

Table 2. Vegetative cover - Roadside count.

Stop Number	Shortgrass	Shortgrass + Brush	Farmland	Tallgrass
1-10	D	C	-	I
11-20	-	D	I	-
21-30	D	-	-	-
31-40	D	-	-	-
41-50	D	-	C	I

D = Dominant (8 or more stops)

C = Common (4-7 stops)

I = Incidental (2-4 stops)

Table 3. Summary of birds seen on plots, 1969 breeding season.

	Plots	Horned Lark	Lark Bunting	McCown's Longspur	Western Meadowlark	Brewer's Sparrow
May (4 counts)	1	44	0	44	2	0
	2	25	32	5	11	9
	3	47	31	0	8	5
	4	74	18	0	6	8
	5	50	26	1	7	10
	6	37	31	0	9	61
June (3 counts)	1	62	8	34	1	0
	2	65	38	17	6	0
	3	20	41	0	4	13
	4	48	31	0	4	0
	5	37	25	1	6	5
	6	17	27	0	11	15
July (5 counts)	1	153	7	55	3	0
	2	27	109	19	9	0
	3	14	67	0	3	14
	4	32	73	0	16	0
	5	36	73	1	19	23
	6	15	37	0	13	15
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Total (12 counts)	1	309	15	133	6	0
	2	77	179	41	26	9
	3	81	139	0	15	32
	4	154	142	0	26	8
	5	123	124	3	32	38
	6	69	95	0	33	91
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Average/count		67.75	57.875	14.75	11.5	14.875

Table 4. Percentages of a species in one plot versus total for that species in all plots.

Plot Number	Horned Lark	Lark Bunting	McCown's Longspur	Western Meadowlark	Brewer's Sparrow
1	38%	2.2%	75.1%	4.4%	--
2	9.5%	25.8%	23.2%	18.8%	5.1%
3	10%	20%	--	10.9%	18%
4	18.9%	20.4%	--	18.8%	4.5%
5	15.1%	17.9%	1.7%	23.2%	21.3%
6	8.5%	13.7%	--	23.9%	51.1%

Table 5. Percentages of a species in one plot versus all five species in that plot.

Plot Number	Horned Lark	Lark Bunting	McCown's Longspur	Western Meadowlark	Brewer's Sparrow
1	66.7%	3.2%	28.7%	1.3%	--
2	23.2%	53.9%	12.3%	7.8%	2.7%
3	30.3%	52.1%	--	5.6%	12%
4	46.7%	43%	--	7.9%	2.4%
5	38.4%	38.8%	0.9%	10%	11.9%
6	24%	33%	--	11.4%	31.6%

Table 6. Breeding pairs of birds on 20-acre plots, 1969 (Densities, pairs per 100 acres in parentheses).

Species	Pastures and Use					
	23 E Heavy Summer	23 W Light Summer	22 E Heavy Winter	15 E Moderate Summer	15 W Moderate Winter	10 S Light Winter
Horned lark	10.1 (50.5)	2.6 (12.3)	3.7 (18.5)	6.5 (32.5)	4.6 (23.0)	3.1 (15.5)
McCown's longspur	3.8 (19.0)	1.1 (5.5)	0 (0)	0 (0)	0.8 (4.0)	0 (0)
Western meadowlark	0 (0)	1.4 (7.0)	1.6 (8.0)	1.9 (9.5)	1.3 (6.5)	3.1 (15.5)
Lark bunting	0 (0)	5.8 (29.0)	3.9 (19.5)	3.0 (19.5)	3.9 (19.5)	3.0 (15.0)
Brewer's sparrow	0 (0)	0 (0)	3.0 (15.0)	0 (0)	3.8 (19.0)	3.6 (18.0)
Mountain plover	2.0 (10.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Mourning dove	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.0 (5.0)

Table 7. Comparative breeding pair densities of grassland birds (Pairs per 100 acres).

Colorado	Wyoming	Saskatchewan
64.5 (Pawnee, 1969 - Ryder)	114.5 (Cheyenne, 1960)	47.4 (Matador, 1968)
41.2 (Pawnee, 1968 - Ryder)	57.5 (Laramie, 1960)	41.4 (Matador, 1967)
43.9 (Pawnee, 1968 - Wiens)	98.5 (Cheyenne, 1959)	
59.0 (Pawnee, 1951 - Cassel)	84.0 (Laramie, 1959)	
	67.5 (Laramie, 1958)	
	60.0 (Laramie, 1942)	
	72.5 (Laramie, 1941)	
	66.3 (Laramie, 1940)	
	42.5 (Laramie, 1939)	
	57.5 (Laramie, 1938)	

Sources of data (see LITERATURE CITED section).

For Colorado: (Cassel, 1952); (Wiens, 1969).

For Wyoming: (Finzel, 1962); (Mickey, 1939-1942).

For Saskatchewan: (Maher, 1969).

Table 8. Fates of nests of birds followed during 1969.

Species	Total Number of Nests	Total Eggs	Mean Clutch Size	Total Eggs Hatched	Percent Hatched	Total Fledged	Percent Fledged
Horned lark	20	39 (15) ^{1/}	2.8 (6)	23	47.8 (5)	16	76.9 (5)
Lark bunting ^{2/}	14	46 (11)	4.1 (8)	28	68.7 (8)	18	81.8 (7)
Loggerhead shrike	16	75 (13)	6.1 (12)	83	89.4 (11)	56	66.6 (13)
Mourning dove	51	76 (40)	2.0 (34)	53	63.6 (28)	38	86.1 (18)
Brewer's sparrow	15	33 (12)	3.1 (11)	27	62.8 (12)	17	62.9 (10)
Say's phoebe	8	35 (8)	5.1 (8)	21	56.5 (5)	14	84.6 (3)
Western kingbird	5	9 (2)	4.5 (2)	13	no data	13	no data
Swainson's hawk	3	1 (1)	1.0 (1)	3	no data	2	66.6 (1)
Barn swallow	7	28 (7)	5.0 (4)	9	38.4 (3)	5	100.0 (1)
Black-billed magpie	4	6 (1)	6.0 (1)	11	no data	no data	no data
Western meadowlark	4	16 (4)	4.0 (4)	3	42.8 (2)	2	100.0 (1)
McDow's longspur	7	20 (6)	3.4 (5)	11	50.0 (5)	5	100.0 (2)
Chestnut-collared longspur	2	4 (1)	4.0 (1)	1	no data	1	no data
Common nighthawk	1	2 (1)	2.0 (1)	2	100.0 (1)	1	50.0 (1)
Brown thrasher	1	5 (1)	5.0 (1)	5	100.0 (1)	no data	no data
Long-billed curlew	1	4 (1)	4.0 (1)	3	75.0 (1)	3	100.0
Mallard	1	6 (1)	6.0 (1)	-	-	-	-

TOTAL 157 nests of 17 species

^{1/} Numbers in parentheses represent number of nests for that particular statistic.

^{2/} Only those followed by J. Brent Giezantanner, Thomas Rutter, and Ronald Ryder. Not those followed by Phil Creighton.

Table 9. Minimal avian biomass production on 120 acres at Pawnee, 1969.

Statistic	Horned Lark	McCown's Longspur	Western Meadowlark	Lark Bunting	Brewer's Sparrow	Mountain Plover	Mourning Dove
Minimum breeding pairs	29.6	5.7	9.3	20.5	10.4	2.0	1.0
Mean clutch	2.8	3.4	4.0	4.1	3.1	3.0	2.0
Total eggs	83	20	37	84	32	6	8 ^{1/}
Egg weight (g)	2.92	2.40	6.16	3.17	1.38	15.33	6.73
Mean adult weight (g)	32.3	25.1	110	33	12	113	115
Total weight eggs (g)	242	48	228	266	44	92	54
Adult weight (g)	1920	286	2022	1353	249	451	230
Adult weight (g/m ²)	.0039	.00059	.0042	.0028	.00051	.00093	.00047
Young weight (g/m ²)	.0014	.00032	.0023	.0020	.00013	.00062	.00063
Total weight (g/m ²)	.0053	.00091	.0065	.0048	.00064	.00155	.00110
Fledgling percentage	36.8	50	42.8	56.3	39.4	50 ^{2/}	54.8
Fledgling weight (g)	20	15.5	72	21	10	100 ^{2/}	70
Estimated young	33	10	15.8	47.3	12.6	3	4.37
Total fledgling weight (g)	660	155	1130	993	126	300	306

^{1/} Assuming most doves attempted two broods.

^{2/} Estimated.

Table 10. A checklist of birds of the Pawnee Site in north central Colorado^{1/}
(Compiled by Ronald A. Ryder, December 5, 1969).

AOU Number	Species	AOU Number	Species
004	Eared Grebe	206	Sandhill Crane
001	Western Grebe	214	Sora
006	Pied-billed Grebe	221	American Coot
194	Great Blue Heron	*+273	Killdeer
202	Black-crowned Night Heron	+281	Mountain Plover
203	Yellow-crowned Night Heron	*+264	Long-billed Curlew
+172	Canada Goose	* 265	Whimbrel (one record only)
+132	Mallard	+261	Upland Plover
+135	Gadwall	263	Spotted Sandpiper
+143	Pintail	256	Solitary Sandpiper
139	Green-winged Teal	258	Willet
140	Blue-winged Teal	254	Greater Yellowlegs
141	Cinnamon Teal	255	Lesser Yellowlegs
137	American Widgeon	239	Pectoral Sandpiper
142	Shoveler	241	Baird's Sandpiper
146	Redhead	242	Least Sandpiper
147	Canvasback	232	Long-billed Dowitcher
148	Greater Scaup	249	Marbled Godwit
149	Lesser Scaup	251	Hudsonian Godwit
151	Common Goldeneye	+225	American Avocet
167	Ruddy Duck	224	Wilson's Phalarope
129	Common Merganser	223	Northern Phalarope
+325	Turkey Vulture	+053	California Gull
333	Cooper's Hawk	054	Ring-billed Gull
332	Sharp-shinned Hawk	+059	Franklin's Gull
+337	Red-tailed Hawk	069	Forster's Tern
*+342	Swainson's Hawk	077	Black Tern
+347	Rough-legged Hawk	+313.1	Rock Dove
*+348	Ferruginous Hawk	*+316	Mourning Dove
*+349	Golden Eagle	365	Barn Owl
352	Bald Eagle	+375	Great Horned Owl
*+331	Marsh Hawk	*+378	Burrowing Owl
354	Gyr Falcon	366	Long-eared Owl
+355	Prairie Falcon	+367	Short-eared Owl
+356	Peregrine Falcon	* 418	Poor-will
*+357	Pigeon Hawk	*+420	Common Nighthawk
+360	Sparrow Hawk	432	Broad-tailed Hummingbird
293	Scaled Quail	390	Belted Kingfisher
+309	Ring-necked Pheasant	+413	Red-shafted Flicker

^{1/} The Pawnee Site is considered to be that part of Weld County, Colorado, north of Colorado Highway 14 and east of U. S. 85. It is an area of intensive ecological research which is a part of the International Biological Program (IBP), Grasslands Biome Subprogram and is funded largely by the National Science Foundation (Grant GB 7824).

Table 10. (Continued)

AOU Number	Species	AOU Number	Species
+406	Red-headed Woodpecker	655	Myrtle Warbler
393	Hairy Woodpecker	656	Audubon's Warbler
+394	Downy Woodpecker	668	Townsend's Warbler
+444	Eastern Kingbird	659	Chestnut-sided Warbler
+447	Western Kingbird	661	Blackpoll Warbler
448	Cassin's Kingbird	675	Northern Water Thrush
+457	Say's Phoebe	680	MacGillivray's Warbler
464	Western Flycatcher	681	Yellowthroat
+462	Western Wood Pewee	+685	Wilson's Warbler
459	Olive-sided Flycatcher	686	Canada Warbler
*+474	Horned Lark	687	American Redstart
614	Tree Swallow	+688.2	House Sparrow
617	Rough-winged Swallow	494	Bobolink
*+613	Barn Swallow	+501.1	Western Meadowlark
*+612	Cliff Swallow	+497	Yellow-headed Blackbird
+611	Purple Martin	+498	Red-winged Blackbird
477	Bluejay	506	Orchard Oriole
+475	Black-billed Magpie	507	Baltimore Oriole
+488	Common Crow	508	Bullock's Oriole
735	Black-capped Chickadee	+510	Brewer's Blackbird
738	Mountain Chickadee	511	Common Grackle
728	Red-breasted Nuthatch	+495	Brown-headed Cowbird
721	House Wren	+596	Black-headed Grosbeak
+715	Rock Wren	597	Blue Grosbeak
+703	Mockingbird	599	Lazuli Bunting
704	Catbird	604	Dickcissel
+705	Brown Thrasher	519	House Finch
+702	Sage Thrasher	+524	Gray-crowned Rosy Finch
761	Robin	525	Black Rosy Finch
759	Hermit Thrush	+528	Common Redpoll
+758	Swainson's Thrush	+533	Pine Siskin
+768	Mountain Bluebird	+529	American Goldfinch
+754	Townsend's Solitaire	521	Red Crossbill
700	Sprague's Pipit	592.1	Green-tailed Towhee
618	Bohemian Waxwing	+587	Rufous-sided Towhee
+621	Northern Shrike	*+605	Lark Bunting
+622	Loggerhead Shrike	+542	Savannah Sparrow
+493	Starling	+546	Grasshopper Sparrow
624	Red-eyed Vireo	*+540	Vesper Sparrow
646	Orange-crowned Warbler	+545	Baird's Sparrow
644	Virginia's Warbler	+552	Lark Sparrow
652	Yellow Warbler	573	Black-throated Sparrow

Table 10. (Continued)

AOU Number	Species	AOU Number	Species
578	Cassin's Sparrow	+561	Clay-colored Sparrow
574	Sage Sparrow	*+562	Brewer's Sparrow
567	Slate-colored Junco	+554	White-crowned Sparrow
+567.9	Oregon Junco	581	Song Sparrow
570.8	Gray-headed Junco	*+539	McCown's Longspur
+559	Tree Sparrow	*+536	Lapland Longspur
*+560	Chipping Sparrow	*+538	Chestnut-collared Longspur

* Observed on the six 20-acre study plots on the Central Plains Experimental Range.

+ Observed on the 50-stop, 24 1/2 mile long roadside count.

(All others, observed off the plots and not on the roadside counts, reported in the literature or by other observers especially Paul Baldwin, David Cobb, Allegra Collister, Phil Creighton, J. Brent Giezantanner, Nancy Hurley, Carl Marti, Tom Rutter, and Lois Webster).

Table 11. Birds banded on the Pawnee Site, 1961-1969.

Species	1961-67	1968	1969 ^{1/}	Total ^{2/}
Killdeer	1	3	2	6
Mountain plover	20	15	179	214
Long-billed curlew	-	-	3	3
Mourning dove	8	10	37	55
Western kingbird	2	-	13	15
Say's phoebe	2	3	13	18
Western wood pewee	1	2	-	3
Horned lark	53	11	72	136
Barn swallow	2	1	5	8
Black-billed magpie	2	-	-	2
Mockingbird	6	-	-	6
Sage thrasher	1	2	2	5
Loggerhead shrike	17	6	64	87
Western meadowlark	20	8	15	43
Lark bunting	143	60	155	358
Brewer's sparrow	15	14	20	49
McCown's longspur	45	8	9	62
Chestnut-collared longspur	2	-	7	9

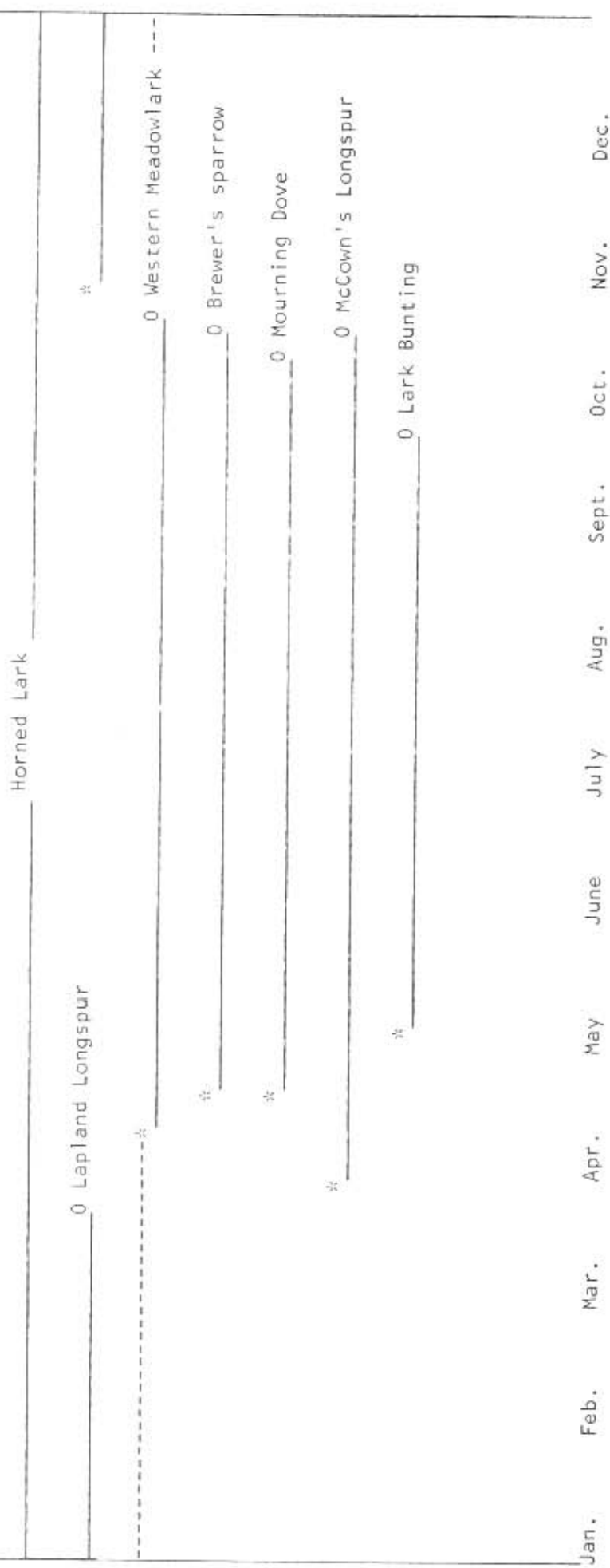
^{1/} Banded mainly by Paul Baldwin, Allegra Collister, Phil Creighton, J. Brent Giezentanner, Thomas Rutter, and Ronald Ryder.

^{2/} Plus one or two each of: Mallard, Swainson's hawk, Ferruginous hawk, Rough-legged hawk, Golden eagle, Prairie falcon, Sparrow hawk, Common nighthawk, Starling, Rough-winged swallow, Northern shrike, Red-eyed vireo, Yellow warbler, Northern water thrush, **Wilson's Warbler**, Red-winged blackbird, Baltimore oriole, Brown-headed cowbird, Black-headed grosbeak, Pine siskin, American goldfinch, Red crossbill, Savannah sparrow, Grass-hopper sparrow, Vesper sparrow, Lark sparrow, Sage sparrow, Clay-colored sparrow, Great horned owl, Barn owl, Burrowing owl.

Fig. 1. Plot bird count form and map.

Stop Number	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0
Starting Time -																				
Speedometer -																				
Ferruginous Hawk	3	4	8																	
Rough-legged Hawk	3	4	7																	
Red-tailed Hawk	3	3	7																	
Swainson's Hawk	3	4	2																	
Sparrow Hawk	3	6	0																	
Marsh Hawk	3	3	1																	
Prairie Falcon	3	5	5																	
Golden Eagle	3	4	9																	
Ring-neck Pheasant	3	0	9																	
Killdeer	2	7	3																	
Long-billed Curlew	2	6	4																	
Mountain Plover	2	8	1																	
American Avocet	2	2	5																	
Gull																				
Rock Dove	3	1	3	.	1															
Mourning Dove	3	1	6																	
Great Horned Owl	3	7	5																	
Burrowing Owl	3	7	8																	
Short-eared Owl	3	6	7																	
Common Nighthawk	4	2	0																	
Eastern Kingbird	4	4	4																	
Western Kingbird	4	4	7																	
Say's Phoebe	4	5	7																	
Horned Lark	4	7	4																	
Barn Swallow	6	1	3																	
Cliff Swallow	6	1	2																	
Loggerhead Shrike	6	2	2																	
Starling	4	9	3																	
House Sparrow	6	8	8	.	2															
Western Meadowlark	5	0	1	.	1															
Lark Bunting	6	0	5																	
Grasshopper Sparrow	5	4	6																	
Vesper Sparrow	5	4	0																	
Lark Sparrow	5	5	2																	
Chipping Sparrow	5	6	0																	
Clay-colored Sparrow	5	6	1																	
McCown's Longspur	5	3	9																	
Chestnut-collared Longspur	5	3	8																	
Brewer's Sparrow	5	6	2																	
Sage Thrasher	7	0	2																	

Fig. 2. Data form on which roadside bird counts are recorded.



* - Arrival

0 - Departure

Fig. 4. Approximate arrival and departure dates - 1969.

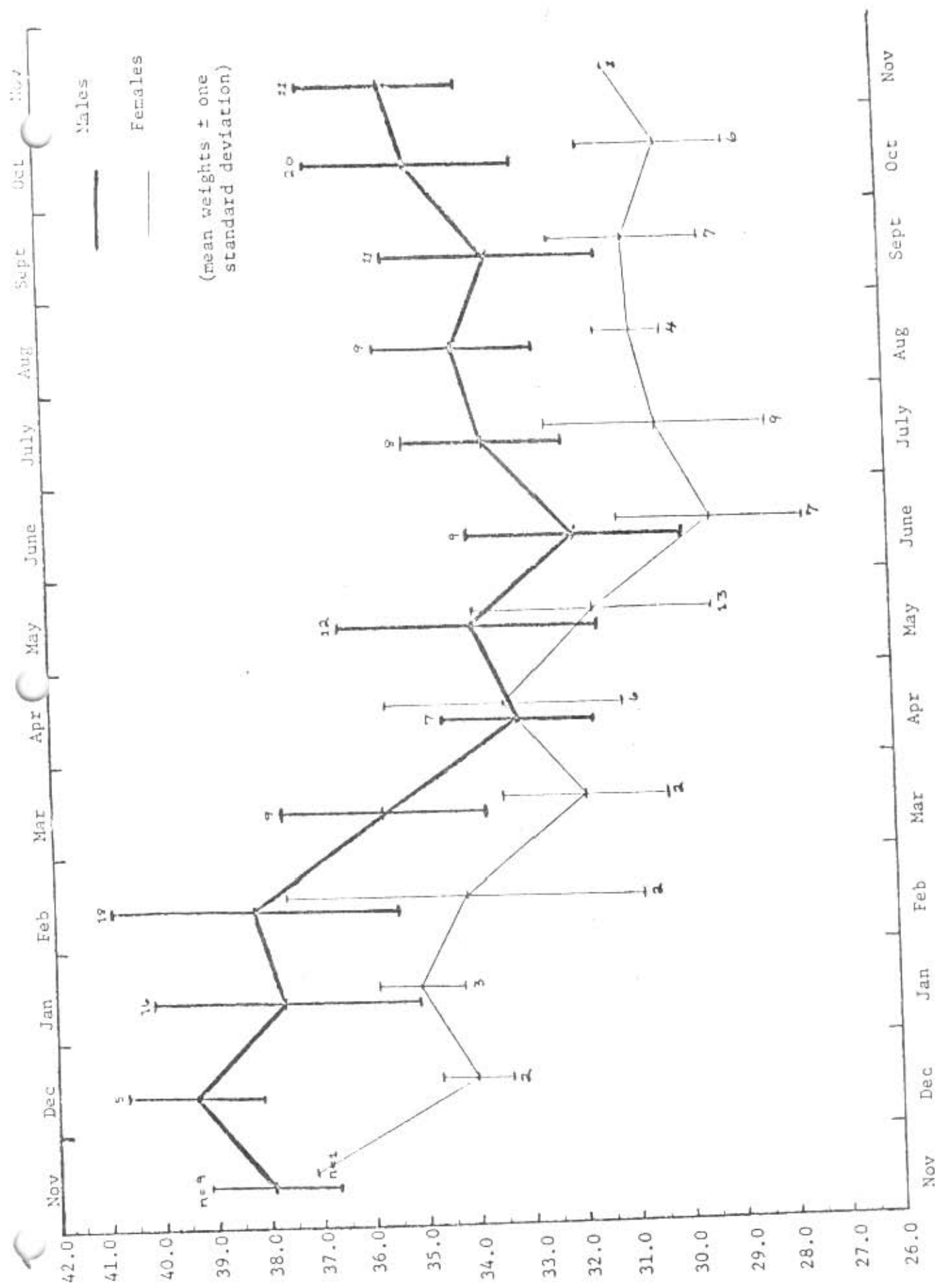


FIG. 5. Seasonal weights of horned larks collected on the Pawnee Site, November 1968 through November 1969.