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BIRD POPULATIONS AT ALE, PANTEX, OSAGE, AND COTTONWOOD, 1972

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ABSTRACT

This report presents the results of studies of breeding bird populations conducted at the ALE, Pantex, Osage, and Cottonwood Sites of the US/IBP Grassland Biome during 1972. Data obtained from plot censuses and roadside counts were analyzed to determine local, regional, seasonal, and annual patterns of variation in species presence and abundance, density, standing crop biomass, and avifaunal diversity and ecological differentiation. The analysis also include 1973 plot census results from ALE and 1973 roadside count results from Pantex, Osage, and Cottonwood. Morphological data from specimens collected during 1970-1972 are reviewed.

The plot censuses revealed densities ranging from 141 to 385 individuals/km^2 (both recorded at Pantex) and standing crops of 67 (ALE) to 169 (Pantex) g/ha. There were no distinct patterns in annual variations in density and biomass. Between 1970 and 1971 decreases and increases in density and biomass were equally represented among the plots, while from 1971 to 1972 density and biomass decreased at all sites except Pantex. There was no apparent correlation between grazing intensity and annual stability. Over the series of sites and plots as a whole, cumulative diversity was similar over the 3 years. As in 1971, the breeding species composition at the sites changed relatively little between years, although the abundance of individual species fluctuated at most sites. We suggest that these annual variations in plot population values may be the result of localized redistributions of individuals, with avifaunas remaining relatively stable on a regional basis.

Roadside counts were conducted on standardized routes at Pantex, Osage, and Cottonwood by the same local observers who contributed to the 1971 studies.

In general, the same seasonal trends in densities and species numbers noted in 1971 were evident in the 1972 and 1973 counts. Seasonal variation was consistentl least at Osage and greatest at Cottonwood. Interseasonal species turnover was relatively low between spring and summer at all sites, while summer-fall and winter-spring turnovers were generally high, especially when only the dominant species are considered. The ecological structure of the site avifaunas, as revealed by these counts, was generally uniform on both a yearly and a seasonal basis (with the exception of winter counts). Small ground-feeding forms appear to comprise a greater proportion of the avifauna at Pantex than at the other sites, while roadside-brush associated species seem more plentiful at Osage and Cottonwood. These results suggest that grassland sites support avian communities with an ecological structure which remains relatively stable from year to year despite changes in the abundances of individual species.

Collections of specimens provided information on body weights, wing and tail lengths, bill lengths, heights, and widths, tarsus lengths, and gonad dimensions for both sexes of the dominant breeding species at each site. These data are related to patterns of within-species variation by calculations of coefficients of variation (CV) and intraspecific character ratios (ICP, a measure of sexual dimorphism). The CV values indicate that bill features (especially height and width) are consistently more variable among individuals of a species than tail lengths, which in turn appear more variable than tarsus or wing lengths. In general, females of monogamous species appear more variable in bill dimensions than polygynous females, while dietary generalists have more variable bill measurements than dietary specialists. Sexual dimorphism is, in general, much greater in polygynous than in monogamous species.

INTRODUCTION

As information on bird populations in grassland ecosystems has accumulated during IBP studies, it has become quite clear that these populations account for an extremely small fraction of the energy and material flows in these ecosystems (e.g., Risser 1972). Yet bird communities in grasslands do evidence patterns of organization (Wiens 1973) which suggest that even if bird populations have minimal impact on system dynamics, they are responsive to its properties. Alternatively, bird populations may play a cybernetic or functional control role in the ecosystem (Turček 1969) by regulating in some way the dynamics of more "important" populations or their magnitudes or rates of energy-nutrient flux. Documentation of such a cybernetic role is difficult, however, and to date our efforts have been centered on the development of population bioenergetic models (Wiens and Innis in press) which, coupled with information on dietary composition (Wiens, Ward, and Rotenberry 1974), should at least provide some estimates of the pressure avian consumers place upon their prey populations.

The intent of this report, however, is not to assess the role of birds in grasslands, but to summarize the results of studies of the distribution and abundance of breeding bird species among several IBP Grassland Biome sites. Such information on species composition and population densities and biomasses is essential to the formulation of total ecosystem models, provides basic data inputs for the avian bioenergetic models, and contributes to the development of ecological theory (Wiens, in press). In this report we discuss the findings of studies conducted during 1972. These field studies continue and conclude research activities initiated in 1970 (Wiens 1971) and continued in 1971 (Wiens, Rotenberry, and Ward 1972). Here we will present results from plot population counts, roadside censuses, and specimen collections. Dietary relationships among these bird species during 1972 will be discussed in a separate technical report.

STUDY AREAS AND METHODS

Study Areas

During 1972 we conducted studies at ALE, Pantex, Osage, and Cottonwood (Table 1); research by our group at Pawnee, where two treatment plots had been censused annually since 1968, unfortunately had to be terminated. Population census plot locations at each site were identical to those used in 1971 (Wiens et al. 1972, Fig. 1).

Plot Censuses

Breeding bird densities were estimated on census plots of 8.4 to 10.6 ha located on grazed and/or ungrazed (or lightly grazed) treatments, using the "territory flush" procedure (Wiens 1969). The procedures followed are presented elsewhere (Wiens 1971; French 1971); they were followed without change in 1972. As in 1971 single "replicate" sample plots were censused at ALE (ungrazed), Pantex (grazed treatment), Osage (grazed), and Cottonwood (lightly grazed).

Roadside Counts

The routes and procedures for the roadside counts of birds in the general areas of the sites were the same as those followed in 1970 and 1971 (Wiens 1971; Wiens et al. 1972). Our research team did not conduct roadside

Table 1. Summarization of avian ecology research conducted on IBP Grassland Biome sites during 1972.

Site	Dates Visited 1972	Plot Census			Roadside Counts by Local Observers[b/]	Specimens Collected
		Treatments Censused[a/]	Plots per Treatment	Plot Size (ha)		
ALE	4-6 May	U	2	10.6, 10.6	None	45
Pantex	2-13 June	G U	2 1	10.6, 10.6 10.3	S, B, F, W	41
Osage	15-19 June	G	2	8.4, 10.6	S, B, F, W	35
Cottonwood	21 June-4 July	G U	1 2	9.6 10.6, 10.6	S, B, F, W	50

a/ U = ungrazed or lightly grazed; G = grazed.

b/ S = spring migration; B = breeding season; F = fall migration; W = winter.

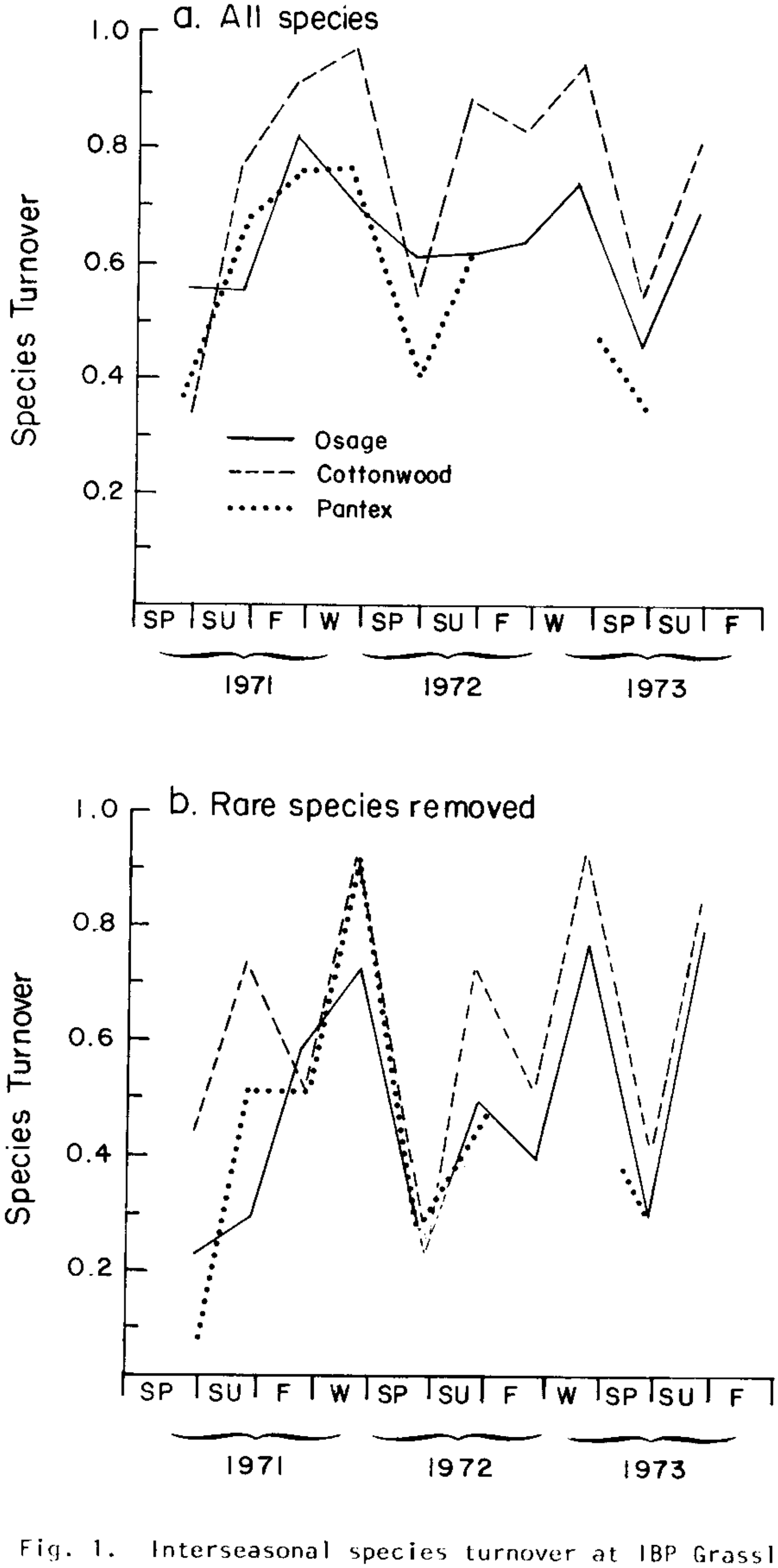

Fig. 1. Interseasonal species turnover at IBP Grassland sites, as calculated in the text. In A, all species encountered in roadside counts are included; in B, the "rare" species (frequency <0.15) have been deleted from the calculations. Sp = Spring census, Su = summer, F = fall, W = winter.

counts during 1972, but the assistance of the same resident amateurs who contributed to the 1971 studies (Mr. Kenneth Seyffert at Pantex, Mrs. Emma Messerly at Osage, and Dr. N. R. Whitney at Cottonwood) allowed the continuation of this phase of the program through 1972 and 1973.

Specimen Collections and Measurements

As in 1971 we attempted to collect 20 specimens of each of the dominant breeding species at each site, with collections evenly distributed between early morning and late afternoon feeding periods and between sexes. Weights were recorded, to tenths of a gram, with a portable Ohaus Dial-O-Gram balance soon after collection. Morphological measurements were made, to the nearest tenth of a millimeter, with Helios dial calipers. A detailed résumé of the specimen collections is given in Table 2.

RESULTS

Plot Censuses

The territory mappings of breeding individuals of each species occupying a plot were the basis for population density and standing crop biomass estimates. These mappings are presented in Appendix II; the estimations are tabulated for each species and plot in Table 3 and are summarized in Table 4. The ALE Site was also censused in April and May of 1973, under the support of Battelle-Northwest (Subcontract No. BCA-797). The results of these censuses are given in Table 5. The comments we offered about plot "replication" in 1971 (Wiens et al. 1972) were reinforced by the 1972 results.

Notes on nests discovered during the course of plot studies are summarized in Appendix III.

Table 2. Summarization of avian specimen collections at IBP sites, 1972.

Site	Dates	Species	Male AM	Male PM	Female AM	Female PM	Juvenile	Nestling	Unknown	Total
ALE	4-6 May	Horned Lark	7	6	4	4	1	0	0	22
		Western Meadowlark	2	0	1	0	0	0	0	3
		Sage Sparrow	4	6	4	2	3	0	1	20
	18-20 November	Horned Lark	7	10	1	1	0	0	0	19
		Western Meadowlark	1	0	0	0	0	0	0	1
Pantex	2-13 June	Horned Lark	4	4	4	3	4	0	0	19
		Western Meadowlark	5	2	1	1	2	0	0	11
		Grasshopper Sparrow	5	1	2	2	1	0	0	11
Osage	15-19 June	Eastern Meadowlark	1	2	1	0	1	0	0	5
		Dickcissel	1	3	0	6	0	0	0	10
		Grasshopper Sparrow	7	10	1	2	0	0	0	20
Cottonwood	21 June-4 July	Horned Lark	8	6	2	4	0	0	0	20
		Western Meadowlark	3	1	2	1	2	0	0	9
		Grasshopper Sparrow	7	2	1	2	0	0	0	12
		Chestnut-collared Longspur	4	2	2	1	0	0	0	9

Table 3. Avian species densities and standing crop biomass at IBP grassland sites, 1972.

Site	Treatment	Species	Density (Individual/km^2)		Standing Crop Biomass (g/ha)	
			Sample 1	Sample 2	Sample 1	Sample 2
ALE	Ungrazed	Horned Lark	84.3	68.8	26.8	21.8
		Western Meadowlark	24.1	36.6	25.1	38.2
		Sage Sparrow	78.6	95.6	15.3	18.6
		Brewer's Sparrow	-	4.7	-	0.6
Pantex	Grazed	Horned Lark	109.6	122.5	34.5	38.6
		Western Meadowlark	86.0	99.2	86.4	99.7
		Grasshopper Sparrow	189.2	179.4	32.2	30.5
	Ungrazed	Horned Lark	46.6	-	14.7	-
		Western Meadowlark	59.7	-	60.0	-
		Grasshopper Sparrow	35.0	-	5.6	-
Osage	Grazed	Upland Plover	7.1	18.6	9.2	24.2
		Common Nighthawk	5.9	-	4.4	-
		Eastern Meadowlark	74.4	75.1	77.4	78.2
		Dickcissel	8.6	73.5	2.2	18.7
		Grasshopper Sparrow	36.9	130.6	6.3	22.3
Cottonwood	Grazed	Killdeer	15.6	-	19.5	-
		Horned Lark	68.2	-	20.9	-
		Western Meadowlark	57.0	-	54.7	-
	Lightly grazed	Upland Plover	9.5	5.7	12.3	7.4
		Long-billed Curlew	7.6	7.6	44.6	44.6
		Western Meadowlark	52.0	43.9	49.9	42.1
		Grasshopper Sparrow	79.6	84.9	13.0	13.8
		Chestnut-collared Longspur	10.8	28.5	2.1	5.6

Table 4. Summarization of plot avifaunal features at IBP grassland sites, 1972.

Site	Treatment	Sample	Number of Species	Density (Individual/km^2)	Standing Crop Biomass (g/ha)
ALE	Ungrazed	1	3	187.0	67.2
		2	4	205.7	79.2
Pantex	Grazed	1	3	384.8	153.1
		2	3	401.1	168.8
	Ungrazed	1	3	141.3	80.3
Osage	Grazed	1	5	132.9	99.5
		2	4	297.8	143.4
Cottonwood	Grazed	1	3	140.8	95.1
	Lightly grazed	1	5	159.5	121.9
		2	5	170.6	113.5

Table 5. Species and plot densities and biomass for replicate 2 of the ALE Site in two 1973 samplings. Replicate 1 was not sampled in 1973.

Species	April 14		May 13	
	Density (Indiv./km^2)	Biomass (g/ha)	Density (Indiv./km^2)	Biomass (g/ha)
Horned Lark	154.3	48.6	111.8	34.6
Western Meadowlark	31.4	31.5	44.3	44.4
Sage Sparrow	55.1	10.7	74.1	14.4
Σ	240.8	90.8	230.2	93.4

Roadside Counts

The continued cooperation of local observers at Pantex, Osage, and Cottonwood provides a basis for assessing general trends in seasonal and annual abundances of species. The results of the 1972 counts are presented in Tables 6 to 8, while those conducted through summer 1973 are summarized in Tables 9 to 11. *Incidence* is defined as the number of individuals of a given species recorded (N_i) divided by the number of stops at which that species was recorded (S_i); *density* is the number of individuals of a species recorded (N_i) divided by the total number of stops on the count (S_t, usually = 30); and *frequency* is the number of stops at which a species was recorded (S_i) divided by the total number of stops (S_t) (see Rotenberry and Wiens, in press).

Seasonal variations. In general, the seasonal trends in total densities and species numbers observed in the 1971 censuses were evident in the 1972 and 1973 censuses as well. At Pantex the greatest total densities were recorded in the spring counts, as was the highest number of species (with the exception of 1973 when slightly more species were recorded in the summer census) (Table 12). Seasonal density and species number values have remained quite stable at Pantex during the 3 years of these censuses. At Osage summer censuses have consistently recorded the highest species numbers and total densities (with the exception of the 1972-73 winter count in which the high density was largely accounted for by two blackbird flocks). Here there has been a generally consistent tendency for the counts (both species numbers and total densities) for a given season to record successively higher values from 1971 to 1973. The 1971 Cottonwood counts recorded the highest species

Table 6. Results of seasonal roadside counts taken at the Pantex Site, 1972. Winter (W) = 1/23/72; spring (Sp) = 5/3/72; summer (Su) = 6/18/72; fall (F) = 9/17/72.

Species	Incidence[a]				Density[a]				Frequency[a]			
	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F
AGPH	300.00	3.75	1.00	1.00	10.00	0.50	0.03	0.07	0.03	0.13	0.03	0.07
AICA	-	2.50	3.03	-	-	2.00	2.93	-	-	0.80	0.97	-
AMSA	-	1.00	2.00	2.00	-	0.07	0.07	0.07	-	0.07	0.03	0.03
BUJA	1.00	1.00	1.00	1.00	0.07	0.03	0.07	0.03	0.07	0.03	0.07	0.03
BURE	1.00	-	-	-	0.03	-	-	-	0.03	-	-	-
BUSW	-	-	1.00	1.00	-	-	0.03	0.07	-	-	0.03	0.07
CAME	-	9.39	-	3.75	-	4.07	--	0.50	-	0.43	-	0.13
CASQ	-	2.00	1.00	4.67	-	0.07	0.30	0.93	-	0.03	0.30	0.20
CHGR	-	1.36	1.00	-	-	0.63	0.30	-	-	0.80	0.97	-
CHMI	-	-	1.00	-	-	-	0.13	-	-	-	0.13	-
CHVO	-	1.00	1.50	2.00	-	0.07	0.20	0.40	-	0.07	0.13	0.20
CICY	-	-	-	1.00	-	-	-	0.07	-	-	-	0.07
COVI	-	-	1.00	-	-	-	0.03	-	-	-	0.03	-
ERAL	3.60	3.10	3.22	3.20	0.60	2.07	1.93	2.13	0.17	0.67	0.60	0.67
FASP	1.33	1.00	-	1.67	0.13	0.03	-	0.17	0.10	0.03	-	0.10
GUCA	-	-	1.00	-	-	-	0.03	-	-	-	0.03	-
HIRU	-	4.50	2.60	-	-	0.30	0.43	-	-	0.07	0.17	-
ICBU	-	-	1.00	-	-	-	0.07	-	-	-	0.07	-
LALU	-	1.00	1.00	1.50	-	0.03	0.03	0.10	-	0.03	0.03	0.13
MIPO	-	1.17	1.40	-	-	0.23	0.23	-	-	0.20	0.17	-
MDAT	-	1.00		-	-	0.03	-	-	-	0.03	-	-
MUFO	-	1.80	1.00	1.00	-	0.30	0.10	0.03	-	0.17	0.10	0.03
PODO	-	1.33		-	-	0.13	-	-	-	0.10	-	-
PASA	-	1.00		2.00	-	0.03	-	0.07	-	0.03	-	0.03
PEPY	-	3.50	1.00	-	-	0.23	0.03	-	-	0.07	0.03	-

Table 6. (continued)

Species	Incidence[a]				Density[a]				Frequency[a]			
	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F
POGR	-	2.00	-	2.50	-	0.13	-	0.17	-	0.07	-	0.07
SPPA	-	1.00	-	5.29	-	0.13	-	1.23	-	0.13	-	0.23
STNE	2.00	3.67	4.24	3.93	0.20	3.30	4.10	3.53	0.10	0.90	0.97	0.90
STVU	8.00	1.00	5.00	-	0.27	0.03	0.17	-	0.03	0.03	0.03	-
TYVE	-	1.25	1.00	-	-	0.17	0.07	-	-	0.13	0.07	-
ZEMA	-	2.42	3.50	1.75	-	0.97	1.87	0.47	-	0.40	0.53	0.27
Total Density					11.30	15.55	13.15	10.04				

a/ See text.

Table 7. Results of seasonal roadside counts taken at the Osage Site, 1972. Winter (W) = 12/31/71; spring (Sp) = 4/18/72; summer (Su) = 6/9/72; fall (F) = 9/19/72.

Species	Incidence[a]				Density[a]				Frequency[a]			
	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F
AGPH	45.75	2.33	2.72	10.67	6.10	1.17	1.63	2.13	0.13	0.50	0.60	0.20
AMSA	-	2.59	1.88	3.00	-	1.47	1.00	0.10	-	0.57	0.53	0.03
ANCA	-	3.00	-	-	-	1.10	-	-	-	0.03	-	-
ANDI	-	2.00	-	-	-	0.07	-	-	-	0.03	-	-
ANPL	19.00	-	-	-	0.63	-	-	-	0.03	-	-	-
ARCO	-	-	-	3.00	-	-	-	0.20	-	-	-	0.07
ARHE	-	-	1.00	-	-	-	0.03	-	-	-	0.03	-
BALO	-	2.29	2.33	-	-	1.30	1.87	-	-	0.57	0.80	-
BUAL	-	1.00	-	-	-	0.03	-	-	-	0.03	-	-
BUJA	1.00	-	1.00	1.00	0.10	-	0.03	0.03	0.10	-	0.03	0.03
BULA	1.27	1.00	-	-	0.30	0.07	-	-	0.23	0.07	-	-
BUVI	-	-	1.00	-	-	-	0.07	-	-	-	0.07	-
CAAU	-	-	-	2.50	-	-	-	0.17	-	-	-	0.07
CAPI	9.83	-	-	-	1.97	-	-	-	0.20	-	-	-
CHMI	-	-	1.33	-	-	-	0.13	-	-	-	0.10	-
CHVO	-	1.33	1.40	1.80	-	0.27	0.23	0.30	-	0.20	0.17	0.17
CICY	1.00	1.00	1.25	1.29	0.23	0.10	0.17	0.30	0.23	0.10	0.13	0.23
COAU	-	-	-	1.00	-	-	-	0.03	-	-	-	0.03
COBR	2.00	-	1.33	1.33	0.13	-	0.13	0.13	0.07	-	0.10	0.10
COVI	-	1.00	1.57	-	-	0.07	0.73	-	-	0.07	0.47	-
CYCR	-	6.00	-	-	-	0.20	-	-	-	0.03	-	-
ERAL	4.33	1.63	1.56	13.33	1.73	0.43	0.47	4.00	0.40	0.27	0.30	0.30
EUCY	41.50	3.00	-	-	2.77	0.10	-	-	0.07	0.03	-	-
FASP	-	-	-	1.33	-	-	-	0.13	-	-	-	0.10
GETR	-	-	1.00	-	-	-	0.07	-	-	-	0.07	-

Table 7. (continued)

Species	Incidence[a]				Density[a]				Frequency[a]			
	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F
GUCA	-	-	1.00	-	-	-	0.07	-	-	-	0.07	-
HIRU	-	3.67	2.90	4.50	-	0.37	0.97	0.60	-	0.10	0.33	0.13
ICGA	-	-	1.00	-	-	-	0.03	-	-	-	0.03	-
ICSP	-	-	2.00	-	-	-	0.07	-	-	-	0.03	-
LALU	1.00	1.00	1.50	2.00	0.03	0.03	0.20	0.07	0.03	0.03	0.13	0.03
LAPI	-	4.50	-	-	-	0.30	-	-	-	0.07	-	-
MEER	-	-	-	1.33	-	-	-	0.13	-	-	-	0.10
MIPO	-	-	1.00	-	-	-	0.07	-	-	-	0.07	-
MOAT	-	2.14	2.30	13.83	-	1.00	0.77	2.77	-	0.47	0.33	0.20
MUFO	-	1.50	1.50	1.00	-	0.10	0.10	0.03	-	0.07	0.07	0.03
PADO	6.00	1.00	-	-	0.20	0.03	-	-	0.03	0.03	-	-
PASA	-	2.50	-	-	-	0.17	-	-	-	0.07	-	-
PEPY	-	-	2.50	-	-	-	0.17	-	-	-	0.07	-
PRSU	-	-	-	1.00	-	-	-	0.03	-	-	-	0.03
QUQU	2.00	2.29	2.17	-	0.07	0.53	0.43	-	0.03	0.23	0.20	-
SISI	-	-	1.00	-	-	-	0.07	-	-	-	0.07	-
SPAM	-	-	2.46	-	-	-	1.97	-	-	-	0.80	-
SPCL	-	15.00	-	-	-	0.50	-	-	-	0.03	-	-
STMA	3.92	5.73	3.69	4.48	1.57	5.73	3.57	3.73	0.40	1.00	0.97	0.83
STRU	-	-	1.00	-	-	-	0.03	-	-	-	0.03	-
STVU	-	-	3.50	4.00	-	-	0.23	0.13	-	-	0.07	0.03
TOPL	-	1.00	-	-	-	0.03	-	-	-	0.03	-	-
TUMI	1.00	-	1.00	-	0.07	-	0.07	-	0.07	-	0.07	-
TYCU	-	2.20	1.00	3.00	-	0.37	0.07	0.10	-	0.17	0.07	0.03
TYTY	-	1.00	1.00	-	-	0.03	0.30	-	-	0.03	0.30	-

Table 7. (continued)

Species	Incidence[a]				Density[a]				Frequency[a]			
	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F
TYVE	-	1.00	-	-	-	0.03	-	-	-	0.03	-	-
ZEMA	-	1.71	1.50	1.50	-	0.40	0.60	0.20	-	0.23	0.40	0.13
Total Density					15.90	16.00	16.35	15.31				

a/ See text.

Table 8. Results of seasonal roadside counts taken at the Cottonwood Site, 1972. Winter (W) = 2/6/72; spring (Sp) = 5/28/72; summer (Su) = 6/25/72; fall (F) = 10/1/72.

Species	Incidence[a]				Density[a]				Frequency[a]			
	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F
AGPH	-	3.46	3.90	1.00	-	1.50	2.29	0.07	-	0.43	0.59	0.07
AMSA	-	1.50	1.50	-	-	0.40	0.35	-	-	0.27	0.24	-
ANCA	-	1.00	-	-	-	0.03	-	-	-	0.03	-	-
ANDI	-	2.00	-	-	-	0.13	-	-	-	0.07	-	-
ANPL	-	3.17	-	-	-	0.63	-	-	-	0.20	-	-
ANSP	-	-	-	10.00	-	-	-	0.33	-	-	-	0.03
ASFL	-	1.33	1.00	-	-	0.13	0.06	-	-	0.10	0.06	-
BALO	-	1.43	1.63	-	-	0.33	0.76	-	-	0.23	0.47	-
BUJA	-	-	-	1.00	-	-	-	0.07	-	-	-	0.07
BULA	-	-	-	-	-	-	-	-	-	-	-	-
BUSW	-	-	1.00	-	-	-	0.06	-	-	-	0.06	-
CAME	-	7.75	6.00	-	-	1.03	0.71	-	-	0.13	0.12	-
CAOR	-	-	-	3.00	-	-	-	0.10	-	-	-	0.03
CHGR	-	1.00	-	-	-	0.03	-	-	-	0.03	-	-
CHNI	-	3.00	-	-	-	0.10	-	-	-	0.03	-	-
CHVO	-	2.14	3.00	-	-	0.50	0.71	-	-	0.23	0.24	-
CICY	-	1.00	-	1.17	-	0.07	-	0.23	-	0.07	-	0.20
COCA	-	-	1.00	-	-	-	0.24	-	-	-	0.24	-
DEPE	-	1.00	1.00	-	-	0.07	0.06	-	-	0.07	0.06	-
DEPU	1.00	-	-	-	0.03	-	-	-	0.03	-	-	-
ERAL	3.20	3.18	2.20	4.41	0.53	1.17	0.65	2.50	0.17	0.37	0.29	0.57
FASP	-	-	1.00	-	-	-	0.06	-	-	-	0.06	-
GETR	-	2.00	1.00	-	-	0.13	0.06	-	-	0.07	0.06	-
HIRU	-	2.00	-	-	-	0.13	-	-	-	0.07	-	-
ICSP	-	1.00	1.00	-	-	0.03	0.12	-	-	0.03	0.12	-
LALU	-	1.00	-	-	-	0.07	-	-	-	0.07	-	-
MOAT	-	1.90	1.50	-	-	0.63	0.35	-	-	0.33	0.24	-
PAAT	-	-	-	1.00	-	-	-	0.03	-	-	-	0.03

Table 8. (continued)

Species	Incidence[a]				Density[a]				Frequency[a]			
	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F
PADO	10.00	-	2.00	-	0.67	-	0.12	-	0.07	-	0.06	-
PASA	-	-	-	2.00	-	-	-	0.07	-	-	-	0.03
PEPH	6.67	-	-	1.00	0.67	-	-	0.03	0.10	-	-	0.03
PEPY	-	17.67	12.33	-	-	1.77	2.18	-	-	0.10	0.18	-
PHCO	-	1.20	1.00	-	-	0.02	0.12	-	-	0.17	0.12	-
PIPI	1.00	-	-	2.00	0.03	-	-	0.07	0.03	-	-	0.03
POGR	-	-	-	1.00	-	-	-	0.03	-	-	-	0.03
POPO	-	2.00	-	-	-	0.07	-	-	-	0.03	-	-
QUQU	-	1.33	-	8.00	-	0.13	-	0.27	-	0.10	-	0.03
SASA	-	-	1.00	-	-	-	0.06	-	-	-	0.06	-
SPAM	-	-	2.00	-	-	-	0.24	-	-	-	0.12	-
SPCL	-	4.00	-	-	-	0.13	-	-	-	0.03	-	-
SPTR	-	2.00	-	1.00	-	0.07	-	0.03	-	0.03	-	0.03
STNE	-	7.27	7.00	2.73	-	7.27	6.59	2.00	-	1.00	0.94	0.73
TORU	-	1.00	-	-	-	0.10	-	-	-	0.10	-	-
TRAE	-	1.00	-	-	-	0.07	-	-	-	0.07	-	-
TUMI	-	-	-	1.00	-	-	-	0.07	-	-	-	0.07
TYTY	-	2.00	1.50	-	-	0.60	0.18	-	-	0.30	0.12	-
TYVE	-	2.25	1.20	-	-	0.30	0.35	-	-	0.13	0.29	-
ZEMA	-	3.75	2.40	1.00	-	1.00	0.71	0.03	-	0.27	0.29	0.03
Total Density					1.93	18.64	17.03	5.93				

a/ See text.

Table 9. Results of seasonal roadside counts taken at the Pantex Site, 1973. Spring (Sp) = 5/16/73; summer (Su) = 6/16/73.

Species	Incidence[a]		Density[a]		Frequency[a]	
	Sp	Su	Sp	Su	Sp	Su
AGPH	3.00	1.40	0.40	0.23	0.13	0.17
AICA	2.54	2.56	2.03	2.30	0.80	0.90
AMSA	1.00	2.00	0.17	0.13	0.17	0.07
ANPL	2.00	1.00	0.07	0.03	0.03	0.03
BUJA	1.00	-	0.03	-	0.03	-
BURE	-	1.00	-	0.03	-	0.03
BUSW	1.00	-	0.03	-	0.03	-
CAME	3.89	2.00	2.33	0.07	0.60	0.03
CASQ	-	1.00	-	0.17	-	0.17
CHGR	1.61	1.82	0.97	1.03	0.60	0.57
CHMI	-	1.00	-	0.10	-	0.10
CHVO	1.00	1.20	0.07	0.20	0.07	0.17
DESC	-	1.00	-	0.03	-	0.03
ERAL	4.09	3.84	2.87	2.43	0.70	0.63
FASP	1.00	1.00	0.07	0.03	0.07	0.03
HIRU	2.60	2.43	0.43	0.57	0.17	0.23
ICBU	-	1.00	-	0.03	-	0.03
MIPO	1.00	1.14	0.03	0.27	0.03	0.23
MOAT	1.33	1.00	0.13	0.10	0.10	0.10
MUFO	1.00	1.00	0.03	0.07	0.03	0.07
PADO	-	2.00	-	0.07	-	0.03
PEPY	3.00	-	0.10	-	0.03	-
STNE	4.85	5.53	4.70	5.53	0.97	1.00
STVU	1.00	6.00	0.03	0.20	0.03	0.03
TYVE	1.00	1.00	0.03	0.03	0.03	0.03
ZEMA	2.37	2.40	1.27	1.20	0.53	0.50
Total Density			15.79	14.85		

[a] See text.

Table 10. Results of seasonal roadside counts taken at the Osage Site, 1973. Winter (W) = 2/23/72; spring (Sp) = 5/16/73; summer (Su) = 6/12/73; fall (F) = 9/14/73.

Species	Incidence[a/]				Density[a/]				Frequency[a/]			
	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F
AGPH	79.87	2.60	2.86	-	18.63	1.30	1.43	-	0.23	0.50	0.50	-
AMSA	-	1.60	1.00	-	-	0.53	0.07	-	-	0.33	0.07	-
ARHE	-	1.00	1.00	-	-	0.03	0.03	-	-	0.03	0.03	-
BALO	-	2.29	1.90	-	-	0.53	1.27	-	-	0.23	0.67	-
BUJA	1.00	1.00	-	-	0.03	0.03	-	-	0.03	0.03	-	-
BULA	1.40	-	-	-	0.70	-	-	-	0.50	-	-	-
BUSW	-	1.00	-	-	-	0.03	-	-	-	0.03	-	-
BUVI	1.00	1.00	1.00	-	0.03	0.03	0.07	-	0.03	0.03	0.07	-
CAAU	-	-	-	2.50	-	-	-	0.83	-	-	-	0.33
CHVO	2.33	1.43	2.00	3.00	0.23	0.33	0.33	0.10	0.10	0.23	0.17	0.03
CICY	1.33	-	1.00	2.57	0.27	-	0.03	0.60	0.20	-	0.03	0.23
COAM	-	-	1.00	-	-	-	0.03	-	-	-	0.03	-
COAU	-	-	1.00	-	-	-	0.03	-	-	-	0.03	-
COBR	1.75	1.50	1.33	3.50	0.23	0.10	0.13	0.47	0.13	0.07	0.10	0.13
COVI	1.00	-	1.20	-	0.03	-	0.20	-	0.03	-	0.17	-
DEPE	--	-	2.00	-	-	-	0.07	-	-	-	0.03	-
ERAL	3.58	-	3.20	-	1.43	-	1.07	-	0.40	-	0.33	-
EUCA	500.00	-	-	-	16.67	-	-	-	0.03	-	-	-
FASP	1.00	-	-	-	0.03	-	-	-	0.03	-	-	-
FLCA	-	-	1.00	-	-	-	0.03	-	-	-	0.03	-
GETR	-	1.00	-	-	-	0.07	-	-	-	0.07	-	-
HIRU	-	2.12	1.90	20.00	-	1.20	0.70	0.67	-	0.57	0.37	0.03
ICGA	-	2.00	-	-	-	0.07	-	-	-	0.03	-	-
ICSP	-	1.00	1.00	-	-	0.10	0.17	-	-	0.10	0.17	-
LALU	1.00	1.00	1.80	2.00	0.07	0.03	0.30	0.07	0.07	0.03	0.17	0.03
MEER	-	1.00	-	-	-	0.03	-	-	-	0.03	-	-
MIPO	1.00	-	1.17	-	0.03	-	0.23	-	0.03	-	0.20	-
MOAT	-	2.00	1.75	-	-	0.33	0.70	-	-	0.17	0.40	-
MUFO	-	1.33	1.67	5.00	-	0.13	0.17	0.33	-	0.10	0.10	0.07
MYCR	-	-	1.00	-	-	-	0.03	-	-	-	0.03	-
PADO	4.50	4.00	-	-	0.30	0.13	-	-	0.07	0.03	-	-
PASA	3.00	-	-	-	0.10	-	-	-	0.03	-	-	-
PEPY	-	1.00	1.50	-	-	0.03	0.10	-	-	0.03	0.07	-
QUQU	-	1.29	3.00	-	-	0.30	1.00	-	-	0.23	0.33	-
SPAM	-	1.50	3.44	-	-	0.10	3.10	-	-	0.07	0.90	-
SPAR	8.00	-	-	-	0.53	-	-	-	0.07	-	-	-

Table 10. (continued)

Species	Incidence[a]				Density[a]				Frequency[a]			
	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F
SPTR	-	1.00	1.00	-	-	0.07	0.03	-	-	0.07	0.03	-
STMA	3.53	4.18	4.57	3.39	2.23	3.90	4.57	2.60	0.63	0.93	1.00	0.77
STNE	1.60	-	-	-	0.27	-	-	-	0.17	-	-	-
STRU	-	1.00	-	9.33	-	0.10	-	0.93	-	0.10	-	0.10
STVU	3.00	2.00	3.50	20.00	0.10	0.07	0.23	0.67	0.03	0.03	0.07	0.03
TORU	-	-	1.00	-	-	-	0.03	-	-	-	0.03	-
TUMI	-	1.00	1.00	-	-	0.03	0.03	-	-	0.03	0.03	-
TYCU	7.80	4.50	1.00	5.00	0.13	0.60	0.03	0.17	0.17	0.13	0.03	0.03
TYTY	-	1.20	1.50	1.00	-	0.20	0.20	0.03	-	0.17	0.13	0.03
TYVE	-	-	1.00	-	-	-	0.03	-	-	-	0.03	-
ZEMA	-	1.60	1.70	5.40	-	0.53	0.57	0.90	-	0.33	0.33	0.17
Total Density					42.04[b]	10.93	17.01	8.37				

[a] See text.

[b] 6.74 if the large blackbird flocks are excluded.

Table 11. Results of seasonal roadside counts taken at the Cottonwood Site, 1973. Winter (W) = 2/23/73; spring (Sp) = 5/20/73; summer (S) = 7/1/73; fall (F) = 10/14/73.

Species	Incidence[a/]				Density[a/]				Frequency[a/]			
	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F
AGPH	-	2.90	6.00	1.00	-	2.93	2.12	0.03	-	0.67	0.35	0.03
AMSA	-	1.00	1.20	-	-	0.27	0.35	-	-	0.27	0.29	-
ANAC	-	4.00	-	-	-	0.13	-	-	-	0.03	-	-
ANDI	-	4.00	-	-	-	0.13	-	-	-	0.03	-	-
ANPL	-	4.50	-	-	-	0.30	-	-	-	0.07	-	-
AQCH	-	-	-	2.00	-	-	-	0.07	-	-	-	0.03
BALO	-	1.22	1.80	-	-	0.37	0.53	-	-	0.30	0.29	-
BURE	-	-	-	1.00	-	-	-	0.03	-	-	-	0.03
BUVI	-	-	-	1.00	-	-	-	0.03	-	-	-	0.03
CAME	-	32.75	5.00	-	-	8.73	0.59	-	-	0.27	0.12	-
CAOR	-	-	1.00	-	-	-	0.06	-	-	-	0.06	-
CHGR	-	5.00	-	-	-	0.33	-	-	-	0.07	-	-
CHVO	-	2.20	1.25	-	-	0.37	0.29	-	-	0.17	0.24	-
CICY	-	1.00	-	-	-	0.07	-	-	-	0.07	-	-
COCA	-	2.00	1.00	1.00	-	0.07	0.18	0.03	-	0.03	0.18	0.03
CYCR	-	1.00	-	-	-	0.03	-	-	-	0.03	-	-
DEPE	-	1.00	1.00	-	-	0.03	0.12	-	-	0.03	0.12	-
ERAL	3.78	2.23	1.00	9.00	3.40	0.96	0.12	8.10	0.90	0.43	0.12	0.90
EUCY	-	-	-	8.00	-	-	-	0.27	-	-	-	0.03
FASP	-	-	1.00	-	-	-	0.06	-	-	-	0.06	-
GETR	-	2.67	1.33	-	-	0.27	0.24	-	-	0.10	0.18	-
GRCA	-	-	-	11.00	-	-	-	0.37	-	-	-	0.03
HIRU	-	3.00	-	-	-	0.30	-	-	-	0.10	-	-
LAPI	-	1.00	-	-	-	0.03	-	-	-	0.03	-	-
MOAT	-	1.33	1.00	-	-	0.27	0.12	-	-	0.20	0.12	-
NUAM	-	1.33	-	-	-	0.13	-	-	-	0.10	-	-
PADO	15.00	2.67	-	20.00	1.00	0.27	-	1.33	0.06	0.10	-	0.07
PEPY	-	100.00	27.00	-	-	3.33	3.18	-	-	0.03	0.12	-
PHCO	-	1.33	2.00	1.00	-	0.40	0.12	0.03	-	0.30	0.06	0.03
PIER	-	1.00	-	-	-	0.03	-	-	-	0.03	-	-
POGR	-	-	1.00	-	-	-	0.12	-	-	-	0.12	-
SASA	-	1.00	-	-	-	0.03	-	-	-	0.03	-	-
SPAM	-	-	1.00	-	-	-	0.18	-	-	-	0.18	-
SPAR	2.00	-	-	-	0.07	-	-	-	0.03	-	-	-
SPPA	-	1.50	-	-	-	0.10	-	-	-	0.07	-	-

Table 11. (continued)

Species	Incidence[a/]				Density[a/]				Frequency[a/]			
	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F
SPTR	-	-	1.00	-	-	-	0.12	-	-	-	0.12	-
STNE	-	9.53	5.59	3.48	-	9.53	5.59	2.43	-	1.00	1.00	0.70
TOFL	-	6.00	-	-	-	0.20	-	-	-	0.03	-	-
TORU	-	1.50	1.00	-	-	0.10	0.06	-	-	0.07	0.06	-
TRAE	-	1.00	1.00	-	-	0.07	0.12	-	-	0.07	0.12	-
TUMI	-	-	1.00	4.00	-	-	0.06	0.13	-	-	0.06	0.03
TYTY	-	2.00	2.00	-	-	0.53	0.24	-	-	0.27	0.12	-
TYVE	-	2.00	1.00	-	-	0.47	0.12	-	-	0.23	0.12	-
ZEMA	-	2.40	2.25	-	-	0.80	0.53	-	-	0.33	0.24	-
Total Density					4.47	31.58	15.22	12.85				

a/ See text.

Table 12. Summary of seasonal and yearly variation in bird populations at IBP sites, 1971-73, as reflected by roadside counts. Data from Tables 6-11 and from Wiens et al. (1972).

Site	Season	Year	Total Density	Number of Species	Species Turnover[a/]	Species with Frequency >0.15 (%)	Species Recorded in Successive Years (%)
Pantex	Spring	1971	16.78	21		38	
					36		
	Summer	1971	11.56	20		35	
					66		
	Fall	1971	7.68	19		16	
					76		
	Winter	1971-72	11.30	7		14	1971-72: 81
					76		
	Spring	1972	15.55	24		33	
					41		
	Summer	1972	13.15	22		36	
					61		
	Fall	1972	10.04	17		35	
	Spring	1973	15.79	20		40	
					35		1972-73: 75
	Summer	1973	14.85	23		43	
Osage	Spring	1971	13.69	22		36	
					56		
	Summer	1971	15.37	27		37	
					55		
	Fall	1971	14.10	18		39	
					82		
	Winter	1971-72	15.90	14		36	1971-72: 53
					70		

Table 12. (continued)

Site	Season	Year	Total Density	Number of Species	Species Turnover a/	Species with Frequency >0.15 (%)	Species Recorded in Successive Years (%)
	Spring	1972	14.33	25	61	40	
	Summer	1972	16.32	31	61	39	
	Fall	1972	15.31	21	63	29	
	Winter	1972-73	42.03	20	74	35	1972-73: 55
	Spring	1973	10.93	29	45	48	
	Summer	1973	17.01	33	69	57	
	Fall	1973	8.37	13		31	
Cottonwood	Spring	1971	11.43	23	33	30	
	Summer	1971	16.63	25	77	44	
	Fall	1971	6.47	19	91	16	
	Winter	1971-72	1.93	5	97	20	1971-72: 63
	Spring	1972	18.64	31	54	35	
	Summer	1972	17.03	23	89	48	
	Fall	1972	5.93	16	82	19	

Table 12. (continued)

Site	Season	Year	Total Density	Number of Species	Species Turnover[a/]	Species with Frequency >0.15 (%)	Species Recorded in Successive Years (%)
	Winter	1972-73	4.47	3		33	1972-73: 55
	Spring	1973	30.58	32	94	28	
	Summer	1973	15.22	24	53	38	
	Fall	1973	12.85	12	80	17	

a/ See text.

numbers and densities in the spring count, but in both 1972 and 1973 this numerical dominance shifted to the summer. During the 3 years of censusing, summer, fall, and winter counts of species and individuals have remained basically stable while the numbers of species and total densities recorded in spring counts has steadily increased. Between-season variation in densities and species numbers has consistently been least at Osage and greatest at Cottonwood.

To what extent are these seasonal differences due to the seasonal occurrence of "rare" species or species of only sporadic distributional occurrence? To examine this we calculated the percentage of the species recorded in a count for which frequency was greater than 0.15 (i.e., at which it was seen at least 15% of the stops). The results of this analysis (Table 12) do not shed much light on the problem. At Pantex the proportion of "common" species in the censuses was relatively constant, with only fall and winter 1971-72 recording low percentages of widely-distributed species. Apparently this tendency was absent in 1972-73. At Osage there was no pattern to the seasonal variations in species commonness while at Cottonwood there was a tendency for "rare" species to account for a greater proportion of the total species count in fall. There is certainly no evidence to support the suggestion that the seasonal highs and lows in species counts are due to the movements of rare or extremely patchily-distributed species. When species counts increase or decrease, they do so in a relatively uniform manner over the entire census route.

Another way of looking at seasonal variation among these counts is through calculation of species turnovers or the percent change in species composition between successive counts. Species turnover (T) is calculated as:

$$T = \frac{S_i + S_{i+1}}{S_c + S_i + S_{i+1}}$$

where S_i = number of species unique to count i, S_{i+1} = number of species unique to the next successive count, and S_c = the number of species common to both counts. Species turnover rates for the counts are given in Table 12. Species turnovers were relatively high at all sites although a good deal of the turnover was usually associated with the disappearance and appearance of species normally recorded at low densities and/or frequencies. In nearly all cases, however, fall-winter and winter-spring turnovers were highest, especially at Cottonwood. At Osage the turnover preceding the breeding season (spring-summer) was equaled by the postbreeding (summer-fall) turnover while at Pantex and Cottonwood the postbreeding turn-over was considerably greater than the prebreeding turnover. Osage, with relatively high winter densities, showed the least variation in seasonal turnover rates while Cottonwood, with the lowest winter densities, had the greatest variation in seasonal turnover. Yearly differences in species counts were generally highest at Pantex while fairly similar at Osage and Cottonwood (Table 12). If the "rare" species (frequency <0.15) are omitted from the calculations of species turnover, the same basic inter-seasonal relationships hold (i.e., relatively low spring-summer turnover, high summer-fall and winter-spring turnovers), but the site differences largely disappear (Fig. 1). This suggests that these turnover patterns may be a rather basic attribute of the avian community dominants.

Because of the differences in species conspicuousness and their effects on total density estimates (Wiens et al. 1972), comparisons of seasonal count values for single species may be more valid than the general analyses given above. In Fig. 2 we have plotted the seasonal abundance estimates for several of the more common species. Meadowlark abundance, for example, appears to peak in spring at Osage and Cottonwood, declining into the summer and fall and decreasing markedly in winter. At Pantex the winter low is also evident, but the spring-fall decline noted in 1971 did not appear in 1972 or 1973 when spring densities increased slightly into summer or held stable through the fall census. Horned Larks generally exhibited less seasonal variation in abundance. At Pantex there is some evidence of a winter low in density while at Osage densities seem greatest in fall and/or winter. At Cottonwood Horned Lark densities remained relatively uniform through the summer of 1972 and increased that fall and winter; such an increase was not noted in the 1971 counts. Seasonal variation in abundance is, of course, most pronounced in migratory species, such as Cassin's Sparrows at Pantex, Dickcissels at Osage, or Red-winged Blackbirds at Cottonwood (Fig. 2).

Ecological structure. As in previous years we have evaluated the results of roadside counts in terms of the ecological as well as the taxonomic composition of the avifauna, assigning species to ecological categories as indicated in Appendix I. Except for the winter counts the ecological structure of the avifaunas appears relatively uniform, both on a yearly and a seasonal basis (Table 13). Given the instability in abundances of some species between seasons or years, this relative ecological stability suggests that grassland bird communities possess a fairly stable ecological

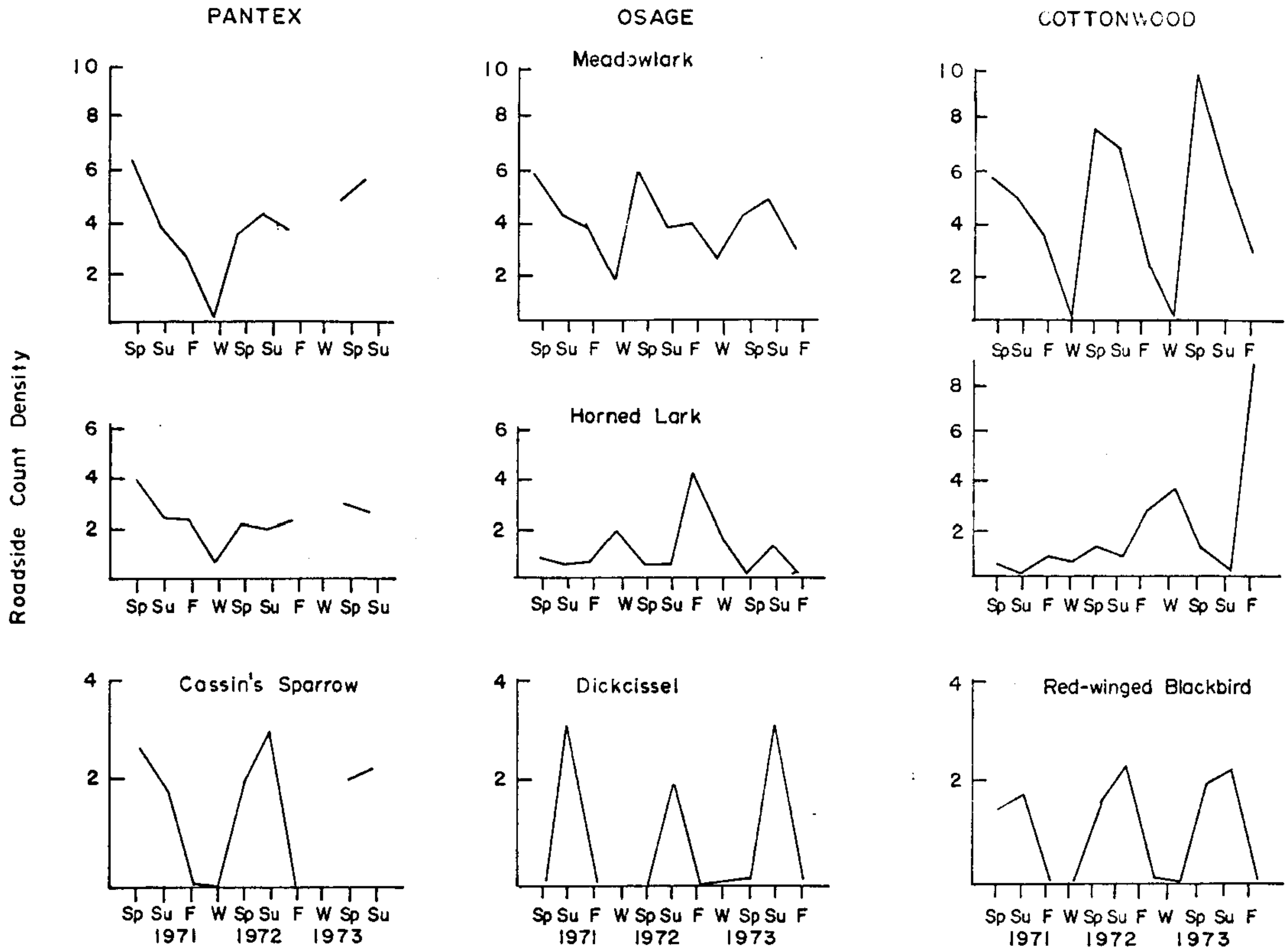

Fig. 2. Seasonal variations in the abundance of some common bird species, as recorded by roadside counts. Symbols as in Fig. 1.

Table 13. Comparisons of seasonal proportions (percent total density) of various avian ecological categories recorded in roadside counts, 1971-73. * = accounts for less than 0.005 of total density; - = category not recorded on count. Categories of species are given in Appendix I.

Site	Season and Year	Raptors	Aquatic	Roadside-Brush	Air-swoop Feeders	Air-flycatchers	Ground Shorebirds	Large Ground	Meadowlarks	Small Ground	Miscellaneous
Pantex	Spring 71	1	-	4	4	1	*	*	35	46	9
	Spring 72	*	-	6	3	3	-	*	21	59	7
	Spring 73	1	*	4	3	1	-	-	30	53	8
	Summer 71	1	-	3	4	2	-	3	33	42	12
	Summer 72	1	-	4	5	1	-	3	32	40	14
	Summer 73	*	*	7	5	1	-	1	37	40	9
	Fall 71	11	-	10	3	*	-	-	33	38	5
	Fall 72	3	-	7	-	*	-	9	35	41	5
	Winter 71-72	2	-	88	-	-	-	-	2	5	2
	Winter 72-73										
Osage	Spring 71	*	*	17	2	-	9	3	44	15	9
	Spring 72	1	4	24	2	1	9	3	37	13	6
	Spring 73	*	*	24	12	3	5	6	36	6	7
	Summer 71	1	1	18	7	1	8	1	26	32	5
	Summer 72	1	1	22	8	2	11	5	22	21	6
	Summer 73	*	1	27	5	3	7	1	27	25	5
	Fall 71	5	-	42	15	2	-	1	26	5	4
	Fall 72	4	-	34	4	*	-	1	24	27	5
	Fall 73	12	-	10	19	4	-	2	31	-	22
	Winter 71-72[a/]	7	4	55	-	-	-	-	9	23	2
	Winter 72-73	2	*	86	-	-	-	*	6	4	1
Cottonwood	Spring 71	-	3	22	3	2	-	2	49	13	6
	Spring 72	*	5	16	10	5	2	-	39	14	8

Table 13. (continued)

Site	Season and Year	Raptors	Aquatic	Roadside-Brush	Air-swoop Feeders	Air-flycatchers	Ground Shorebirds	Large Ground	Meadowlarks	Small Ground	Miscellaneous
	Spring 73	*	2	10	12	3	2	1	31	32	4
	Summer 71	1	1	18	7	1	8	1	26	32	5
	Summer 72	1	1	22	8	2	11	5	22	21	6
	Summer 73	*	-	21	21	2	4	1	37	8	5
	Fall 71	5	2	12	4	1	-	-	51	21	4
	Fall 72	5	-	7	-	-	-	1	34	51	2
	Fall 73	1	*	3	-	-	-	*	19	63	13
	Winter 71-72	-	-	-	-	-	-	34	-	28	38
	Winter 72-73	-	-	2	-	-	-	-	-	76	22

a/ Omitted from the calculations are 3000 unidentified blackbirds seen at one stop.

structure which seems largely unaffected by changes in the abundance of individual species. At Pantex this structure was remarkably stable through spring, summer, and fall of all years, while at Osage summer and fall counts generally recorded a higher proportion of small ground forms and fewer Meadowlarks than the spring censuses. Spring and summer counts at Cottonwood were generally similar although there was more yearly variation than at the other sites.

Differences in the proportional composition of the avifaunas at the different sites are evident from the data of Table 13. To some extent these may be attributed to differences among the individual observers (a bias which plagues all roadside count data). Correction of 1971 data to a standard which we did not have in 1972 seemed to have removed much of the difference. Still, while the proportional contribution of Meadowlarks to the counts appears similar in all counts, small ground forms may form a greater percentage of the avifauna at Pantex than at the other sites. Roadside-brush species seem more abundant at Osage and Cottonwood than at Pantex.

Annual Variations

While documentation of the species composition, density, and biomass of various grassland states is an important goal of this IBP research, it is also necessary to gauge the stability of these facets of avian populations through time. Annual variations in particular may indicate something of the "tightness" of organization in the avian community, the potential impacts on prey populations, or the nature of the system in a more general sense. The information collected during the course of our studies (1970-1973) is summarized in Fig. 3 and 5. Annual fluctuationas in total density and biomass are characteristic of all treatments and sites and while in all cases the *direction* of yearly change in "replicate" plots in the same treatment at the same site is identical, the *magnitude* of this change often differs considerably. There was no apparent correlation between grazing intensity and annual stability, but both treatments were sampled at only two plots (Pantex and Cottonwood) where we know that grazing produced changes of differing magnitude (Wiens 1973).

To permit closer consideration of these yearly variations, we have used a *percent annual change*, calculated as:

$$\% \text{ Change} = \frac{\text{Value of year n+1}}{\text{Value of year n}}$$

These values (Table 14) indicate the general lack of overall pattern in annual changes in density and biomass. Density and biomass decreased during the 3 years of the study at Osage, Cottonwood ungrazed, and Pantex ungrazed, and increased at Pantex grazed. Magnitudes of annual change in density were greatest at Pawnee, Osage, ALE, and Pantex and least at Cottonwood (especially the grazed treatment) while biomass variation was greatest at Pawnee, Cottonwood (grazed), and ALE and least at Pantex, Osage, and Cottonwood (ungrazed). At Pantex and Osage annual variation in biomass was generally less than variation in density while at ALE and Pawnee the reverse was true. From 1970 to 1971 decreases and increases in density and biomass were about equally mixed, while from 1971 to 1972 density and biomass decreased at all sites except Pantex.

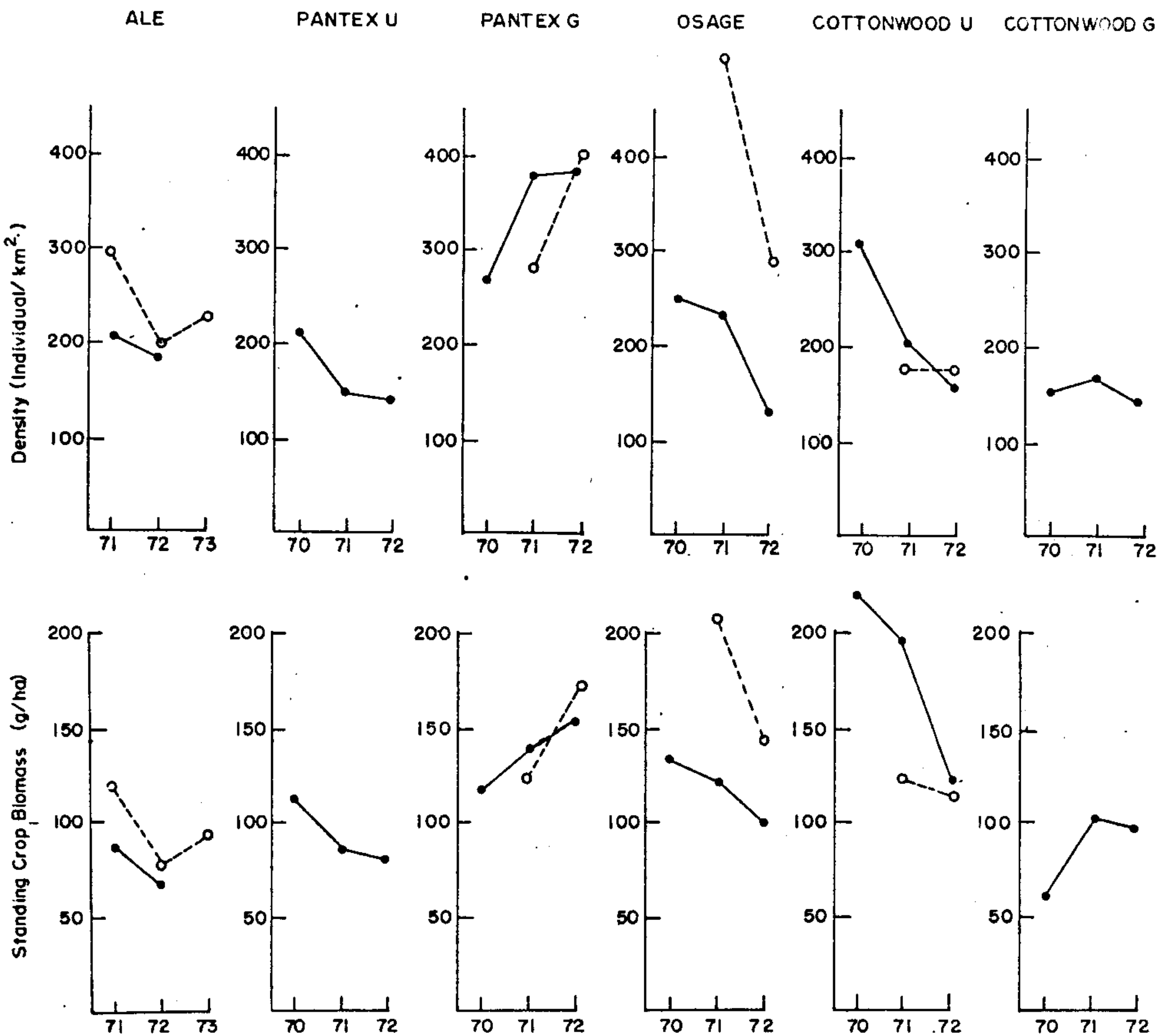

Fig. 3. Annual variations in census plot values of total density and avian standing crop biomass. Solid lines = plot 1 values; dashed lines = plot 2 ("replicate") values.

Table 14. Percent annual change in census plot density and biomass at IBP Sites, 1968-1973.

Site	Treat-ment	Repli-cate	Density					Biomass				
			1968-69	1969-70	1970-71	1971-72	1972-73	1968-69	1969-70	1970-71	1971-72	1972-73
ALE	G	1	-	-	-	-0.12	-	-	-	-	-0.25	-
		2	-	-	-	-0.29	+0.12	-	-	-	-0.34	+0.18
Pantex	G	1	-	-	+0.42	+0.02	-	-	-	+0.18	+0.11	-
		2	-	-	-	+0.40	-	-	-	-	+0.36	-
	U		-	-	-0.30	-0.05	-	-	-	-0.23	-0.07	-
Pawnee	HW		+0.44	-0.17	+0.23	-	-	+0.11	-0.12	+0.54	-	-
	HS		+0.28	+0.04	-0.16	-	-	+0.53	+0.09	-0.17	-	-
Cottonwood	G		-	-	+0.11	-0.17	-	-	-	+0.63	-0.02	-
	U	1	-	-	-0.33	-0.24	-	-	-	-0.14	-0.38	-
		2	-	-	-	-0.01	-	-	-	-	-0.08	-
Osage	G	1	-	-	-0.04	-0.45	-	-	-	-0.08	-0.19	-
		2	-	-	-	-0.43	-	-	-	-	-0.42	-
$\overline{X}$			+0.36	-0.06	-0.01	-0.13	-	+0.32	-0.01	+0.10	-0.13	
SD			0.013	0.022	0.078	0.062	-	0.088	0.022	0.125	0.058	
N (Sample Size)			2	2	7	10		2	2	7	10	

Another way of viewing annual stability of total density and standing crop biomass at these sites is through calculations of the Coefficients of Variation (CV) of mean values (Table 15). Here again the variable nature of annual variation is apparent. It was argued on theoretical grounds (Wiens, in press) that avifaunal stability should be expected to be greatest in Palouse and tallgrass prairies and least in shortgrass prairies. When the data are grouped by general grassland types (Table 16), it appears that density is most stable in shortgrass, tallgrass, and Palouse prairies and least stable in mixed-grass situations; biomass stability decreases from Palouse → shortgrass → mixed-grass → tallgrass. The sample size, however, is certainly too small to allow firm conclusions. Currently efforts are underway to examine the annual patterns of these sites in relation to associated values of precipitation, primary production, and invertebrate standing crops.

Annual variations may also be examined on a biome-wide basis, ignoring site differences. We have used the cumulative diversity method of Hurtubia (1973) in assessing the annual stability of species and ecological composition in this collection of grassland plots. In essence, this method calculates the diversity of a collection (a series of census plots) according to the information theory measure in an accumulative fashion as each additional plot is added to the collection. The results of this analysis for the plot data from 1970, 1971, and 1972 are graphed in Fig. 4 and indicate that the asymptotic cumulative diversity values are quite similar for the 3 years, whether species or ecological categories of birds are the basis for analysis. In other words, if one considers diversity

Table 15. Plot means and coefficients of variation (CV) for density and biomass, from censuses conducted during 1968-1973.

Site	Treatment	Plot	Sample Size	Density			Biomass		
				$\overline{X}$	SD	CV	$\overline{X}$	SD	CV
ALE	U	1	2	200.2	18.67	9.32	78.2	15.49	19.81
		2	3	242.4	44.08	18.18	97.2	20.22	20.80
Pantex	G	1	3	342.8	66.36	19.36	135.7	18.48	13.62
		2	2	343.7	81.18	23.62	146.3	31.82	21.75
	U	1	3	167.5	38.78	23.15	93.1	16.95	18.21
Pawnee	HW	-	4	295.1	50.90	17.24	104.1	22.20	21.33
	HS	-	4	240.0	30.76	12.82	81.2	16.67	20.53
Cottonwood	G	1	3	154.0	14.25	9.25	84.2	20.99	24.93
	U	1	3	226.1	76.93	34.02	182.4	54.77	30.02
		2	2	171.6	1.41	0.82	118.4	6.86	5.79
Osage	G	1	3	207.5	69.82	31.23	118.4	17.16	14.49
		2	2	408.2	156.13	38.24	196.0	74.32	37.92

Table 16. Means and standard deviations of coefficients of variation of plot density and biomass (from Table 15), grouped by grassland types. Sample size is given in parentheses.

Grassland Type	Density		Biomass	
	$\overline{X}$	SD	$\overline{X}$	SD
Palouse (2)	13.74	6.26	20.31	0.70
Shortgrass (5)	19.24	4.46	19.09	3.35
Mixed-grass (3)	14.70	17.26	20.25	12.78
Tallgrass (2)	34.74	4.96	26.21	16.57

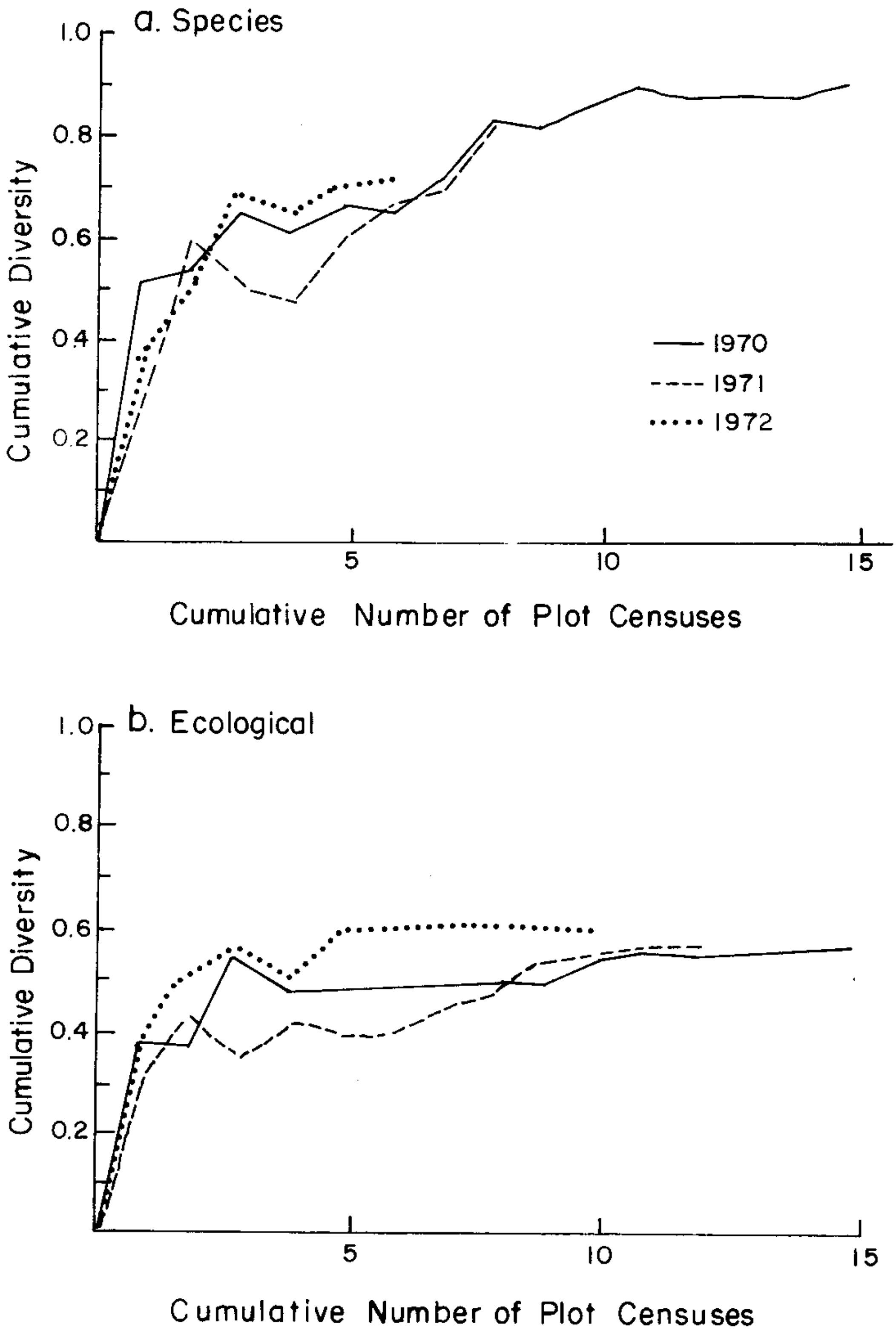

Fig. 4. Annual patterns of cumulative avian diversity in grasslands, calculated by the methods of Hurtubia (1973). In A, diversity was calculated using species as units; in B, ecological categories of bird species (from Wiens 1973) were used in the calculations.

across all sites sampled, there is little annual variation, despite the fluctuations in the abundances of individual species or in biomass or density values at given plots. In a way, this lends credence to our earlier argument (Wiens et al. 1972) that annual variations in plot counts may represent *localized* redistributions of individuals, with avifaunas maintaining a relative degree of stability on a *regional* basis.

This view is also indirectly supported by a comparison of annual changes in plot versus roadside count density estimates (Table 17). In comparisons of plot and roadside count values over successive years, only 62% of the compared pairs agreed in the *direction* of change, and of these only 25% were close in agreeing on the *magnitude* of change. This may, of course, reflect biases in either or both of the sampling methods. We think it more likely, however, that the differences stem from the different spatial scales of the two sampling methods. Thus the changes in plot values portray events on a local (10.6 ha) scale, while variations in roadside count results are perhaps more indicative of regional (a 15-mi transect) events.

Annual changes in the density of individual species are depicted in Fig. 5. While meadowlark density appeared relatively stable at most sites (except Pantex, grazed and Cottonwood, grazed), Grasshopper Sparrow and Dickcissel numbers were much less stable. Horned Lark densities decreased at all sites from 1971 to 1972, but increased again in 1973 at ALE (the only site censused). Sage Sparrow numbers have steadily declined during our studies at ALE. Again, the time frame available is too limited to establish any real trends in population densities or to support a search for possible causal factors underlying these variations.

Table 17. Comparisons of plot and roadside count density estimates for 1970-1972. Percentages of annual changes between successive years are given in parentheses.

Site	Species	Count	1970		1971[a]		1972[a]		1973
Pantex	Horned Lark	Plot	197	(+0.78)	350	(-0.69)	110		-
		Roadside	-		2.3	(-0.17)	1.9	(+0.26)	2.4
	Western Meadowlark	Plot	50	(-0.46)	27	(+2.18)	86		-
		Roadside	-		3.7	(+0.11)	4.1	(+0.34)	5.5
	Grasshopper Sparrow	Plot	17	(-1.00)	0	(+)	189		-
		Roadside	-		0.0	(+)	0.1	(0.00)	0.1
	Σ	Plot	266	(+0.42)	377	(+0.02)	385		-
		Roadside	-		11.6	(+0.14)	13.2	(+0.13)	14.9
Osage	Eastern Meadowlark	Plot	88	(-0.09)	80	(-0.07)	74		-
		Roadside	-		4.1	(-0.12)	3.6	(+0.28)	4.6
	Dickcissel	Plot	81	(+0.16)	94	(-0.90)	9		-
		Roadside	-		3.0	(-0.33)	2.0	(+0.55)	3.1
	Grasshopper Sparrow	Plot	71	(-0.18)	58	(-0.36)	37		-
		Roadside	-		1.4	(-0.29)	1.0	(-0.50)	0.5
	Σ	Plot	250	(-0.04)	240	(-0.45)	133		-
		Roadside	-		15.4	(+0.06)	16.3	(+0.04)	17.0
Cottonwood	Horned Lark	Plot	131	(-0.24)	99	(-0.31)	68		-
		Roadside	-		0.1	(+6.00)	0.7	(-0.86)	0.1
	Western Meadowlark	Plot	73	(-0.07)	68	(-0.24)	52		-
		Roadside	-		4.6	(+0.43)	6.6	(-0.15)	5.6

Table 17. (continued)

Site	Species	Count	1970		1971[a]		1972[a]		1973
	Grasshopper Sparrow	Plot	154	(-0.38)	96	(-0.17)	80		-
		Roadside	-		0.6	(-0.33)	0.4	(0.00)	0.4
	Chestnut-collared Longspur	Plot	5	(+0.20)	6	(+0.83)	11		-
		Roadside	-		0.2	(-1.00)	0.0	(+)	0.1
	Σ	Plot	310	(-0.33)	209	(-0.24)	160		-
		Roadside	-		16.6	(+0.06)	17.0	(-0.11)	15.2

[a] 1971-1972 comparisons:
- Agree in direction of change: 8/13 = 62%
- Disagree in direction of change: 5/13 = 38%
- Roadside change within ±50% of plot change: 2/8 = 25%

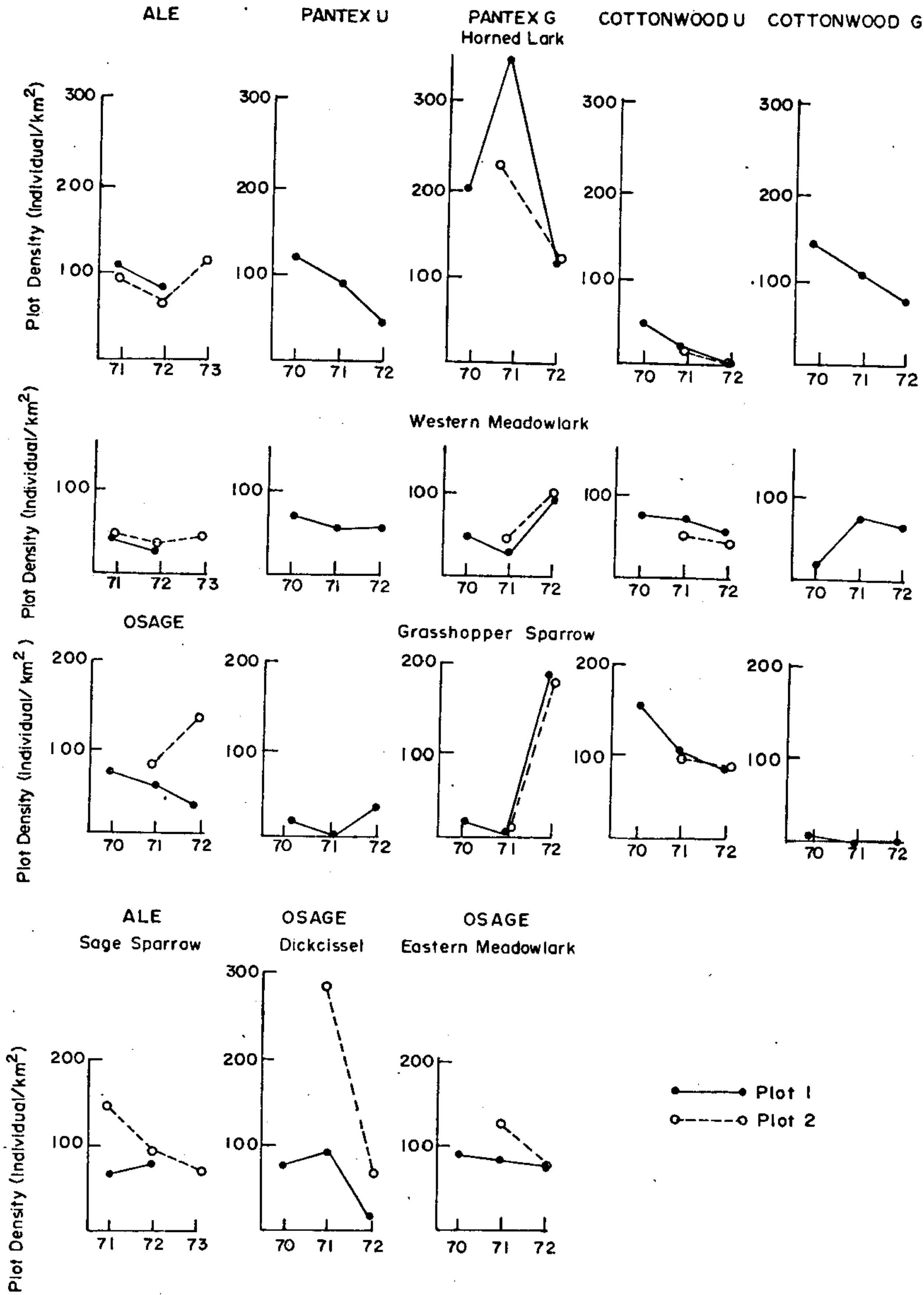

Fig. 5. Annual variations in densities of some common bird species, as determined by census plots.

Specimen Collections

The 1972 specimen collection activities are summarized in Table 2. While the primary aim of these collections is to document dietary habits through stomach analysis, the specimens also provide information on various morphological attributes of the species occupying grassland habitats.

Body weight. Wet body weights of freshly collected specimens are summarized for the 3 years of this study in Table 18. There is no evidence of any real variation in species' body weight between different years at the same site or between different sites. Female body weights are generally more variable than male weights, no doubt reflecting variations associated with gonadal development (Table 20).

External morphology. Measures of bill length and depth, tarsus length, wing length, and tail length for combined 1970-1972 collections at each site are summarized in Table 19. These morphological features may be expected to reflect adaptations of grassland birds to their habitat, their prey, and their avifaunal associates, and a detailed theoretical examination of these results is underway. For example, bill features, because of their possible relationships to prey size selection, are a favorite measure in various competition-related theories (e.g., Cody 1968, Schoener 1965). At most sites studied the species present differed in bill length-depth relationships although there was more overlap in the Cottonwood avifauna than elsewhere. When data on dietary habitats and prey sizes have been analyzed, they may permit a more detailed evaluation of the significance of these bill size patterns. Tarsus length also may be important in habitat utilization by grassland birds since it may affect their use of or movement in vegetation of varying density or depth. Again species' differences are apparent at all

Table 18. Body weights (g net weight) of adult males, adult females, and juveniles of species collected at IBP grassland sites, 1970-1972.

Species	Site	Date	Age Class	Sex	1970 $\overline{X}$	1970 SD	1970 N[a/]	1971 $\overline{X}$	1971 SD	1971 N[a/]	1972 $\overline{X}$	1972 SD	1972 N
Upland Plover	Osage	June	Adult	M	128.7	-	1	138.6	-	1			
				F				121.7	2.76	2			
Horned Lark	ALE	April	Juvenile	-				23.6	-	1			
			Adult	M				30.9	0.41	4			
				F				32.1	3.35	3			
		May	Juvenile	-				31.0	4.95	2	29.5	-	1
			Adult	M				29.7	2.00	7	30.1	1.11	13
				F				33.8	1.27	3	30.3	2.22	8
		November	Adult	M							29.0	10.80	17
				F							32.9	0.60	2
	Pantex	June	Juvenile	-				27.1	2.33	2	26.6	3.79	4
			Adult	M	32.3	1.33	16	31.3	1.30	14	31.1	1.12	8
				F	32.1	2.15	9	31.8	2.46	9	33.2	3.97	7
	Cottonwood	June	Juvenile	-				21.6	-	1			
			Adult	M	32.4	1.62	14	31.1	1.40	13	32.4	1.27	14
				F	31.3	1.60	9	30.3	2.80	7	29.3	4.98	6
Western Meadowlark	ALE	May	Adult	M				115.9	1.06	2	109.5	15.06	2
				F							91.1	-	1
		November	Adult	M							128.1	-	1
	Pantex	June	Juvenile	-	55.6	-	1				101.5	3.39	2
			Adult	M	106.7	0.50	2	112.4	5.63	4	113.6	4.12	7
				F	90.4	9.50	10	88.6	5.09	2	91.2	5.59	2

Table 18. (Continued).

Species	Site	Date	Age Class	Sex	1970 $\overline{X}$	1970 SD	1970 N[a]	1971 $\overline{X}$	1971 SD	1971 N[a]	1972 $\overline{X}$	1972 SD	1972 N
Western Meadowlark (Continued)													
	Cottonwood	June	Juvenile	-				57.1	40.40	11	75.7	0.77	2
			Adult	M	111.7	6.37	7	109.3	7.03	6	114.7	4.13	4
				F	89.9	7.81	4	82.6	4.20	5	86.4	5.98	3
Eastern Meadowlark	Osage	June	Juvenile	-				96.8	-	1	76.6	-	1
			Adult	M	111.2	6.82	7	111.4	5.66	11	115.2	5.37	3
				F	84.9	10.67	3				88.6	-	1
Dickcissel	Osage	June	Adult	M	29.5	1.80	9	28.8	0.89	5	29.3	2.09	4
				F	25.5	0.71	2	24.3	1.44	5	24.6	2.39	6
Sage Sparrow	ALE	April	Adult	M				19.0	1.02	4			
		May	Juvenile	-				16.2	-	1	18.7	0.31	3
			Adult	M				19.2	0.86	6	19.2	1.05	11
				F				19.8	1.18	4	19.8	2.22	6
Grasshopper Sparrow	Osage	June	Adult	M	16.6	0.51	3	17.2	0.57	9	17.4	0.84	17
				F	17.0	-	1	17.1	-	1	17.5	3.37	3
	Pantex	June	Juvenile	-							14.7	-	1
			Adult	M							17.5	1.12	7
				F							15.0	0.98	3
	Cottonwood	June	Adult	M	16.7	1.28	5	17.0	0.43	9	17.2	1.07	9
				F	18.2	0.57	2	15.6	-	1	17.3	0.67	3
Chestnut-collared Longspur	Cottonwood	June	Adult	M	19.4	0.78	2	19.7	0.92	2	18.6	0.83	6
				F	17.9	0.78	2	19.8	2.26	2	19.7	0.75	3

a/ Sample size.

Table 19. Morphological measurements (mm) of adult males and females collected at IBP grassland sites, 1970-1972.

Species	Sex	Site	Year	N	Wing length		Tail length		Bill length		Bill height		Bill width		Tarsus length	
					$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD
Upland Plover	♂	Osage	1970	1	170.2	-	83.8	-	21.0	-	4.0	-	4.4	-	47.6	-
			1971	1	172.0	-	86.2	-	27.7	-	5.5	-	5.0	-	49.1	-
			Σ	*2*	*171.1*	*1.27*	*85.0*	*1.70*	*24.4*	*4.74*	*4.8*	*1.06*	*4.7*	*0.42*	*48.4*	*1.06*
	♀	Osage	1971	2	165.5	1.06	80.9	0.57	22.4	0.64	5.3	0.49	5.0	0.28	51.1	0.14
Horned Lark	♂	ALE	1971	11	105.0	2.12	71.1	1.99	10.1	0.40	4.4	0.18	4.6	0.17	21.5	0.56
			1972	13	105.0	3.44	71.2	4.00	10.2	0.33	4.6	0.17	4.8	0.34	21.6	0.53
			1972(N)	14	105.3	2.16	71.2	1.87	9.2	0.38	4.4	0.31	4.4	0.26	21.1	0.77
			Σ	*24*	*105.0*	*2.85*	*71.1*	*3.17*	*10.1*	*0.36*	*4.5*	*0.21*	*4.7*	*0.29*	*21.5*	*0.54*
		Pantex	1970	16	106.5	2.07	72.3	1.99	9.6	0.37	4.2	0.29	4.2	0.27	21.4	0.73
			1971	14	104.1	2.75	70.0	3.14	9.7	0.37	4.6	0.21	4.5	0.41	21.5	0.67
			1972	8	104.6	1.63	70.2	3.71	10.2	0.52	4.6	0.31	4.0	0.17	20.8	1.00
			Σ	*38*	*105.2*	*2.48*	*71.0*	*2.97*	*9.7*	*0.47*	*4.4*	*0.33*	*4.3*	*0.36*	*21.3*	*0.80*
		Cottonwood	1970	14	103.5	2.43	69.5	2.15	10.0	0.67	3.8	0.43	3.8	0.57	21.4	1.04
			1971	13	106.2	2.80	70.4	3.12	10.02	0.30	4.6	0.16	4.5	0.20	21.1	0.62
			1972	14	105.0	2.51	70.3	2.69	9.7	0.38	4.4	0.17	4.1	0.17	20.6	0.61
			Σ	*41*	*104.8*	*2.74*	*70.1*	*2.63*	*9.9*	*0.50*	*4.3*	*0.46*	*4.1*	*0.46*	*21.0*	*0.83*
	♀	ALE	1971	6	97.4	1.28	63.8	1.54	9.8	0.55	4.4	0.15	4.5	0.23	21.3	0.67
			1972	8	97.4	1.68	63.1	2.04	9.5	0.28	4.3	0.42	4.4	0.34	21.1	0.92
			1972(N)	2	93.5	4.95	63.9	1.48	8.6	0.14	4.5	0.00	4.3	0.49	21.0	0.00
			Σ	*14*	*97.4*	*1.47*	*63.4*	*1.84*	*9.7*	*0.44*	*4.4*	*0.33*	*4.5*	*0.29*	*21.2*	*0.80*
		Pantex	1970	9	97.4	0.97	64.7	2.29	8.9	0.57	4.0	0.24	4.0	0.36	20.7	0.74
			1971	9	99.5	2.29	64.2	3.52	9.4	0.79	4.5	0.24	4.4	0.22	21.4	0.46
			1972	7	95.1	3.44	62.7	2.72	9.0	0.24	4.5	0.24	3.9	0.18	20.7	0.56
			Σ	*25*	*97.5*	*2.86*	*64.0*	*2.90*	*9.1*	*0.61*	*4.3*	*0.34*	*4.2*	*0.35*	*20.9*	*0.67*
		Cottonwood	1970	9	94.1	2.14	63.1	3.89	8.6	0.56	3.6	0.35	3.6	0.42	19.9	0.59
			1971	7	98.6	2.03	63.1	2.13	9.8	0.32	4.7	0.38	4.6	0.29	21.3	0.70
			1972	6	96.4	4.52	62.7	3.04	9.0	0.33	4.3	0.23	4.3	0.19	20.0	0.74
			Σ	*22*	*96.1*	*3.40*	*63.0*	*3.05*	*9.1*	*0.68*	*4.1*	*0.58*	*4.1*	*0.53*	*20.3*	*0.89*

able 19. (continued)

pecies	Sex	Site	Year	N	Wing length $\bar{X}$	Wing length SD	Tail length $\bar{X}$	Tail length SD	Bill length $\bar{X}$	Bill length SD	Bill height $\bar{X}$	Bill height SD	Bill width $\bar{X}$	Bill width SD	Tarsus length $\bar{X}$	Tarsus length SD
/estern Meadowlark	♂	ALE	1971	2	124.6	5.16	74.9	0.78	22.8	1.27	7.4	0.28	7.1	0.49	39.0	0.57
			1972	2	125.9	1.06	76.5	3.25	24.8	0.07	8.6	0.49	7.8	0.07	39.2	1.13
			1972 (N)	1	126.9	-	79.9	-	23.1	-	7.9	-	7.6	-	38.1	-
			Σ	*4*	*125.3*	*3.15*	*75.7*	*2.15*	*23.8*	*1.35*	*7.8*	*0.74*	*7.4*	*0.50*	*39.1*	*0.74*
		Pantex	1970	2	121.2	4.24	73.9	0.64	20.6	1.27	7.9	0.28	7.0	0.35	38.4	1.41
			1971	4	124.3	3.29	71.9	3.77	20.9	0.60	8.1	0.59	7.2	0.45	38.7	0.30
			1972	7	124.5	1.40	72.7	1.49	22.7	1.11	7.2	0.33	6.2	0.14	38.6	0.86
			Σ	*13*	*123.9*	*2.58*	*72.6*	*2.26*	*21.9*	*1.35*	*7.6*	*0.60*	*6.6*	*0.52*	*38.6*	*0.75*
		Cottonwood	1970	7	122.3	2.72	72.2	3.56	22.3	0.70	8.0	0.48	7.0	0.41	37.0	0.92
			1971	6	121.5	2.75	71.2	2.00	23.0	0.63	8.7	0.61	7.2	0.16	37.4	1.42
			1972	4	119.1	4.87	71.7	3.16	21.8	0.67	7.0	0.34	6.3	0.42	37.0	1.21
			Σ	*17*	*121.3*	*3.35*	*71.7*	*2.84*	*22.4*	*0.79*	*8.0*	*0.83*	*6.9*	*0.47*	*37.2*	*1.13*
	♀	ALE	1972	1	115.1	-	69.8	-	21.8	-	7.8	-	6.8	-	33.0	-
		Pantex	1970	10	109.7	2.46	63.7	3.14	19.8	0.81	6.6	0.39	5.9	0.29	35.6	1.15
			1971	2	110.1	4.38	65.4	1.77	20.0	1.63	7.9	0.28	6.4	0.85	33.5	1.13
			1972	2	109.4	1.63	66.0	2.97	20.5	1.41	6.7	0.07	5.7	0.21	35.1	0.42
			Σ	*14*	*109.7*	*2.43*	*64.3*	*2.93*	*19.9*	*0.93*	*6.8*	*0.57*	*5.9*	*0.41*	*35.2*	*1.26*
		Cottonwood	1970	4	109.6	1.07	63.6	4.41	21.0	0.80	7.6	0.24	6.2	0.73	35.5	0.74
			1971	5	110.7	1.07	63.7	4.41	21.2	0.94	7.6	0.35	6.8	0.18	34.8	0.99
			1972	3	109.4	0.90	63.7	3.62	20.1	0.60	6.5	0.10	5.8	0.51	33.9	0.31
			Σ	*12*	*110.0*	*1.11*	*63.7*	*3.84*	*20.9*	*0.87*	*7.3*	*0.56*	*6.4*	*0.63*	*34.8*	*0.96*
Eastern Meadowlark	♂	Osage	1970	7	117.1	3.71	73.3	1.74	22.5	1.33	7.4	0.53	6.8	0.38	38.6	1.17
			1971	11	118.5	2.52	72.2	2.60	22.0	0.97	8.5	0.37	7.3	0.47	40.0	1.63
			1972	3	119.6	4.83	75.6	1.19	22.3	0.66	7.4	0.15	6.6	0.87	40.9	0.10
			Σ	*21*	*118.2*	*3.23*	*73.0*	*2.43*	*22.2*	*1.05*	*8.0*	*0.68*	*7.1*	*0.57*	*39.6*	*1.56*
	♀	Osage	1970	3	104.7	1.47	61.7	0.44	19.9	0.78	6.7	0.42	6.2	0.49	35.6	0.82
			1972	1	108.6	-	66.4	-	19.7	-	6.7	-	5.8	-	36.4	-
			Σ	*4*	*105.7*	*2.31*	*62.9*	*2.38*	*19.9*	*0.64*	*6.7*	*0.34*	*6.1*	*0.44*	*35.8*	*0.78*
Dickcissel	♂	Osage	1970	9	80.2	2.13	57.8	1.57	9.5	0.43	7.3	0.33	5.6	0.38	21.7	0.75
			1971	5	82.0	3.84	59.1	3.79	10.9	0.16	8.1	0.36	6.3	0.26	22.7	0.78
			1972	4	80.1	1.36	58.3	2.43	10.5	0.45	7.4	0.26	5.5	0.17	22.3	0.67
			Σ	*18*	*80.7*	*2.58*	*58.3*	*2.48*	*10.1*	*0.74*	*7.6*	*0.47*	*5.8*	*0.44*	*22.1*	*0.84*

Table 19. (continued)

Species	Sex	Site	Year	N	Wing length $\overline{X}$	Wing length SD	Tail length $\overline{X}$	Tail length SD	Bill length $\overline{X}$	Bill length SD	Bill height $\overline{X}$	Bill height SD	Bill width $\overline{X}$	Bill width SD	Tarsus length $\overline{X}$	Tarsus length SD
	♀	Osage	1970	2	72.2	0.35	50.0	0.57	9.1	0.07	6.8	0.21	5.4	0.00	20.7	0.42
			1971	5	74.2	1.48	52.6	1.97	9.6	0.41	7.4	0.26	6.0	0.31	21.3	0.64
			1972	6	73.0	2.63	53.4	2.89	9.9	0.37	6.9	0.48	5.4	0.24	21.2	0.62
			Σ	*13*	*73.4*	2.05	*52.6*	*2.50*	*9.7*	*0.47*	*7.1*	*0.46*	*5.6*	*0.39*	*21.2*	*0.60*
Sage Sparrow	♂	ALE	1971	7	77.9	1.82	70.6	2.15	8.4	0.33	5.3	0.20	5.1	0.16	21.7	0.55
			1972	11	77.1	3.26	71.1	2.99	8.3	0.45	5.4	0.24	5.1	0.31	21.5	0.59
			Σ	*18*	*77.4*	*2.76*	*70.9*	*2.62*	*8.3*	*0.40*	*5.4*	*0.22*	*5.1*	*0.25*	*21.6*	*0.57*
	♀	ALE	1971	2	75.2	1.13	67.3	0.28	7.7	0.28	5.4	0.35	4.8	0.28	21.0	0.71
			1972	6	75.2	2.01	69.4	3.24	8.3	0.29	5.3	0.19	5.2	0.14	21.3	0.73
			Σ	*8*	*75.2*	*1.75*	*68.9*	*2.90*	*8.2*	*0.39*	*5.3*	*0.21*	*5.1*	*0.24*	*21.2*	*0.67*
Grasshopper Sparrow	♂	Osage	1970	3	61.5	0.57	43.9	1.33	6.9	0.06	5.3	0.50	4.5	0.52	18.5	0.66
			1971	9	63.0	1.56	44.2	2.18	8.1	0.39	5.7	0.45	5.3	0.37	19.4	0.46
			1972	17	63.0	1.45	45.0	1.53	7.8	0.40	5.5	0.20	4.5	0.29	19.3	0.70
			Σ	*29*	*62.8*	*1.45*	*44.6*	*1.73*	*7.8*	*0.49*	*5.5*	*0.34*	*4.8*	*0.50*	*19.3*	*0.66*
		Pantex	1972	7	61.6	2.53	48.6	8.24	8.0	0.39	5.5	0.35	4.4	0.20	19.1	0.47
		Cottonwood	1970	5	62.9	2.67	44.8	2.69	7.6	0.58	5.5	0.44	5.0	0.42	19.6	0.55
			1971	9	63.9	1.33	44.2	1.11	8.1	0.35	6.0	0.36	5.3	0.26	19.4	0.56
			1972	9	62.4	1.61	44.7	2.16	7.5	0.47	5.2	0.27	4.5	0.29	18.7	0.41
			Σ	*23*	*63.1*	*1.84*	*44.5*	*1.88*	*7.7*	*0.52*	*5.6*	*0.47*	*4.9*	*0.47*	*19.2*	*0.61*
	♀	Osage	1970	1	59.1	-	42.7	-	7.2	-	4.5	-	4.4		18.5	-
			1971	1	61.1	-	41.9	-	8.5	-	5.9	-	5.2	-	19.1	-
			1972	3	59.9	1.10	42.7	1.62	7.9	0.25	5.5	0.20	4.5	0.29	19.3	0.70
			Σ	*5*	*60.0*	*1.06*	*42.5*	*1.19*	*7.9*	*0.49*	*5.4*	*0.65*	*4.6*	*0.43*	*19.1*	*1.01*
		Pantex	1972	3	59.4	0.46	43.8	0.57	7.8	0.50	5.4	0.10	4.5	0.40	19.1	0.06
		Cottonwood	1970	2	58.8	2.69	43.4	-	7.4	1.06	3.7	-	4.7	0.57	19.7	1.06
			1971	1	60.0	-	42.3	-	8.2	-	5.7	-	5.4	-	19.5	-
			1972	3	58.0	2.22	42.8	0.90	7.8	0.44	5.1	0.06	4.8	0.10	18.6	0.57
			Σ	*6*	*58.6*	*2.02*	*42.8*	*0.74*	*7.7*	*0.64*	*5.0*	*0.75*	*4.9*	*0.37*	*19.1*	*0.82*
Chestnut-collared Longspur	♂	Cottonwood	1970	2	78.2	3.54	55.3	1.48	7.2	-	4.2	0.49	4.5	0.21	18.8	0.07
			1971	2	80.1	0.21	53.9	1.84	7.9	0.07	5.0	0.28	5.2	0.07	19.4	0.07
			1972	6	81.7	1.84	54.7	2.69	7.9	0.40	4.8	0.16	4.6	0.32	18.5	0.50
			Σ	*10*	*80.7*	*2.33*	*54.7*	*2.20*	*7.8*	*0.42*	*4.7*	*0.40*	*4.7*	*0.36*	*18.7*	*0.50*

Table 19. (continued)

Species	Sex	Site	Year	N	Wing length		Tail length		Bill length		Bill height		Bill width		Tarsus length	
					$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD
Chestnut-collared Longspur	♀	Cottonwood	1970	2	75.6	0.14	51.1	1.70	7.1	0.35	3.9	0.64	4.4	0.78	18.0	0.28
			1971	2	79.7	2.55	50.8	2.55	7.2	0.14	4.7	0.35	5.2	0.35	19.7	-
			1972	3	78.2	1.40	51.1	0.20	7.5	0.32	4.5	0.07	4.5	0.15	18.6	0.28
			Σ	*7*	*77.9*	*2.15*	*51.0*	*1.26*	*7.3*	*0.33*	*4.3*	*0.50*	*4.6*	*0.51*	*18.6*	*0.72*

sites, but the patterns seem a direct function of body size. It would be intriguing to determine if the body weight-tarsus length relationships differ from those in thicket or forest avifaunas.

Internal morphology. Gonad dimensions of both males and females were measured in each year. Measurements of the diameter of the largest follicle are an indicator of female reproductive activity. However, since follicle enlargement closely precedes egg-laying, there is considerable within-population variation in this measure at any point in the breeding season due to the general lack of synchrony of egg-laying activities. Follicle measurements are summarized in Table 20. For males enlargement of the testes occurs at the onset of reproductive activities and continues through the breeding season. Variation in testes length of a species between sites or between years was slight, as expected (Table 20).

Patterns of variation. Variation in morphological attributes of birds has recently received considerable attention, especially as an indicator or correlate of niche-variation or niche breadth. These relations have especially been brought into focus by Rothstein (1973*a*, 1973*b*). Rothstein has employed two measures to assess variability in morphological features, the *coefficient of variation* (CV), given by

$$CV = \frac{100\ s}{\bar{X}}$$

and an *intraspecific character ratio* (ICR), given by

$$ICR = \frac{\bar{X}_1}{\bar{X}_s}$$

Table 20. Gonadal measurements of adult males and females collected at IBP grassland sites, 1970-1972.

Species	Site	Year	♀ Follicle Diameter			♂ Testes Length		
			$\overline{X}$	SD	N	$\overline{X}$	SD	N
Upland Plover	Osage	1970	-	-	-	10.40	-	1
		1971	1.95	0.07	2	10.50	-	1
		Σ	*1.95*	*0.07*	*2*	*10.45*	*0.07*	*2*
Horned Lark	ALE	1971 (May)	4.48	2.34	6	8.43	1.38	11
		1972 (May)	4.59	3.71	8	8.64	1.36	13
		1972 (November)	0.00	0.00	2	2.26	1.89	14
		Σ *(May)*	*4.54*	*3.08*	*14*	*8.54*	*1.34*	*24*
	Pantex	1970	2.30	1.46	9	9.37	1.26	16
		1971	3.99	2.32	9	8.86	0.83	14
		1972	4.86	3.28	7	8.82	0.75	8
		Σ	*3.62*	*2.52*	*25*	*9.09*	*1.01*	*38*
	Cottonwood	1970	1.88	1.44	9	8.70	0.91	14
		1971	2.52	0.94	5	9.15	0.86	13
		1972	2.27	0.89	6	9.54	0.98	13
		Σ	*2.24*	*1.15*	*21*	*9.12*	*0.96*	*40*
Western Meadowlark	ALE	1971 (May)	-	-	-	11.45	1.34	2
		1972 (May)	5.00	-	1	11.25	0.07	2
		1972 (November)	-	-	-	2.30	-	1
		Σ *(May)*	*5.00*	-	*1*	*11.35*	*0.79*	*4*
	Pantex	1970	5.06	4.02	10	14.20	5.80	2
		1971	7.90	3.25	2	14.87	2.13	4
		1972	-	-	-	12.32	2.02	7
		Σ	*5.49*	*3.65*	*14*	*13.28*	*2.68*	*13*
	Cottonwood	1970	2.45	2.11	4	11.43	1.58	7
		1971	2.08	0.59	5	12.70	1.40	6
		1972	2.10	0.62	3	9.72	1.53	4
		Σ	*2.21*	*1.20*	*12*	*11.48*	*1.82*	*17*
Eastern Meadowlark	Osage	1970	5.00	5.63	3	12.79	2.71	7
		1971	-	-	-	13.30	1.18	11
		1972	1.00	-	1	13.47	2.38	3
		Σ	*4.00*	*5.01*	*4*	*13.16*	*1.88*	*21*
Dickcissel	Osage	1970	1.65	0.49	2	8.33	0.42	9
		1971	3.22	2.55	5	8.12	1.24	5
		1972	3.00	2.03	6	7.60	2.27	4
		Σ	*2.88*	*2.05*	*13*	*8.11*	*1.20*	*18*
Sage Sparrow	ALE	1971 (May)	5.20	0.57	2	8.29	1.09	7
		1972 (May)	3.80	4.05	6	8.77	0.92	10
		Σ *(May)*	*4.15*	*3.49*	*8*	*8.57*	*0.99*	*17*

Table 20. (continued)

Species	Site	Year	♀ Follicle Diameter $\overline{X}$	SD	N	♂ Testes Length $\overline{X}$	SD	N
Grasshopper Sparrow	Osage	1970	1.20	-	1	8.22	0.68	2
		1971	1.90	-	1	9.51	0.74	9
		1972	3.70	4.24	3	8.87	1.38	17
		Σ	*2.84*	*3.23*	*5*	*9.01*	*1.34*	*28*
	Pantex	1972	1.73	0.15	3	8.21	0.90	7
	Cottonwood	1970	1.30	0.14	2	8.58	1.23	5
		1971	1.50	-	1	9.06	1.36	9
		1972	2.30	0.95	3	8.79	0.95	8
		Σ	*1.96*	*0.82*	*6*	*9.02*	*1.16*	*22*
Chestnut-collared Longspur	Cottonwood	1970	1.20	0.85	2	6.60	0.00	2
		1971	1.40	-	1	6.40	1.27	2
		1972	2.30	1.82	3	7.25	1.52	6
		Σ	*1.78*	*1.34*	*6*	*6.95*	*1.27*	*10*

where $\overline{X}_l$ is the mean value for a feature in the larger sex of a species and $\overline{X}_s$ is the mean value for the smaller sex. CV values calculated for the combined 1970-1972 data of Tables 18 and 19 are given in Table 21, ICR values in Table 22.

The CV values suggest that bill features, especially bill height and width, are more variable among individuals of a species than tail lengths, which in turn appear more variable than tarsus or wing lengths. These patterns are quite consistent among the species, with bill height or width being the most variable feature in all except one of the species-site entries in Table 21, and wing or tarsus length the least variable measures in all save one. These results are in agreement with the observations of many other studies (Rothstein 1973*b* and references cited therein). The high variability in bill dimensions has been suggested to reflect inter-individual feeding niche diversification, flexibility in developmental canalization, or a close tuning by selection of bill dimensions to small environmental changes (Rothstein 1973*b*). It is impossible to unravel these potential determinants of variability at this time, although future analyses of diet composition may provide an additional perspective on the problem.

The ICR values portray a specific sort of variation --- because of sexual dimorphism. In contrast to the above analysis, these calculations indicate that the species in general were no more dimorphic for bill features than for the other measures. There are substantial differences in the degree of dimorphism between species, however, suggesting that a finer analysis may be in order. In Table 23 we present these values grouped according to the mating system or dietary "specialization" of the species. It is at once

Table 21. Coefficients of variation (CV) for morphological features of male and female adult grassland birds. Values were calculated for the combined 1970-1972 data for each site.

Species	Site	Wing Length		Tail Length		Bill Length		Bill Height		Bill Width		Tarsus Length	
		♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
Upland Plover	Osage	0.74	0.64	2.00	0.70	19.47	2.86	22.31	9.33	8.93	5.60	2.19	0.27
Horned Lark	ALE	2.71	1.51	4.45	2.90	3.56	4.54	4.65	7.55	6.12	6.49	2.51	3.77
	Pantex	2.36	2.93	4.18	4.53	4.83	6.71	7.50	7.89	8.47	8.43	3.76	3.20
	Cottonwood	2.61	3.54	3.75	4.84	5.06	7.48	10.80	14.18	11.14	12.95	3.95	4.38
Western Meadowlark	ALE	2.51	-	2.84	-	5.68	-	9.28	-	6.76	-	1.89	-
	Pantex	2.08	2.21	3.11	4.56	6.18	4.67	7.92	8.36	7.85	6.89	1.94	3.58
	Cottonwood	2.76	1.01	3.96	6.03	3.53	4.17	10.36	7.65	6.82	9.89	3.04	2.76
Eastern Meadowlark	Osage	2.73	2.19	3.33	3.79	4.73	3.23	8.52	5.10	8.07	7.25	3.94	2.18
Dickcissel	Osage	3.20	2.79	4.26	4.76	7.31	4.86	6.20	6.51	7.63	6.95	3.80	2.83
Sage Sparrow	ALE	3.57	2.33	3.69	4.21	4.80	4.77	4.10	3.96	4.91	4.71	2.64	3.16
Grasshopper Sparrow	Osage	2.31	1.76	3.88	2.80	6.29	6.20	6.16	12.14	10.50	9.31	3.43	5.30
	Pantex	4.11	0.77	16.94	1.30	4.86	6.41	6.38	1.85	4.53	8.83	2.46	0.31
	Cottonwood	2.92	3.45	4.22	1.68	6.72	8.29	8.41	15.12	9.51	7.60	3.18	4.30
Chestnut-collared Longspur	Cottonwood	2.88	2.76	4.02	2.47	5.42	4.52	8.51	11.57	7.69	11.01	2.67	3.87

Table 22. Intraspecific character ratios (ICR) for morphological features of grassland bird species, calculated using combined 1970-1972 data. See text.

Species	Site	Weight	Wing	Tail	Bill Length	Bill Height	Bill Width	Tarsus
Horned Lark	ALE	1.04[a/]	1.08	1.11	1.17	1.00	1.09	1.02
	Pantex	1.02[a/]	1.07	1.09	1.07	1.02	1.02	1.02
	Cottonwood	1.05	1.09	1.11	1.09	1.05	1.00	1.03
Western Meadowlark	ALE	1.24	1.09	1.08	1.09	1.00	1.09	1.18
	Pantex	1.24	1.13	1.13	1.10	1.12	1.12	1.10
	Cottonwood	1.30	1.10	1.13	1.07	1.10	1.08	1.07
Eastern Meadowlark	Osage	1.30	1.12	1.16	1.12	1.19	1.16	1.11
Dickcissel	Osage	1.19	1.10	1.11	1.04	1.07	1.04	1.04
Sage Sparrow	ALE	1.04[a/]	1.03	1.03	1.01	1.02	1.00	1.02
Grasshopper Sparrow	Osage	1.01[a/]	1.05	1.05	1.01[a/]	1.02	1.04	1.00
	Pantex	1.17	1.04	1.11	1.03	1.02	1.02[a/]	1.00
	Cottonwood	1.02[a/]	1.08	1.04	1.00	1.12	1.00	1.01
Chestnut-collared Longspur	Cottonwood	1.01[a/]	1.04	1.07	1.07	1.09	1.02	1.01

a/ ♀ value larger than ♂ value.

Table 23. Mean ICR values (standard deviations in parentheses) for polygynous vs. monogamous species and for dietary specialists vs. dietary generalists.

	N	Weight	Wing	Tail	Bill Length	Bill Height	Bill Width	Tarsus
Polygynous	5	1.25 (0.047)	1.11 (0.016)	1.12 (0.029)	1.08 (0.030)	1.10 (0.069)	1.10 (0.045)	1.10 (0.052)
Monogamous	8	1.05 (0.053)	1.06 (0.023)	1.08 (0.033)	1.06 (0.057)	1.04 (0.042)	1.02 (0.030)	1.01 (0.011)
Specialist[a/]	3	1.08 (0.096)	1.06 (0.037)	1.07 (0.040)	1.04 (0.030)	1.06 (0.036)	1.02 (0.020)	1.02 (0.015)
Generalist[b/]	10	1.14 (0.122)	1.09 (0.030)	1.10 (0.037)	1.08 (0.052)	1.06 (0.065)	1.06 (0.054)	1.05 (0.060)
Specialist[c/]	2	1.03 (0.021)	1.03 (0.007)	1.05 (0.028)	1.04 (0.042)	1.06 (0.049)	1.01 (0.014)	1.02 (0.007)
Generalist[c/]	6	1.05 (0.060)	1.07 (0.019)	1.09 (0.032)	1.06 (0.063)	1.04 (0.043)	1.03 (0.034)	1.01 (0.012)

a/ From dietary diversity measures: Dickcissel = 1.52, Sage Sparrow = 1.48, Chestnut-collared Longspur = 1.18

b/ Diversity measures: Horned Lark = 1.74, Western Meadowlark = 1.79, Eastern Meadowlark = 1.70, Grasshopper Sparrow = 1.66

c/ Polygynous species excluded

apparent that dimorphism is in general much greater in polygynous species (meadowlarks and Dickcissels) than monogamous species. This difference is greatest with respect to body weight, and least in the bill length and tail length ICR values. These patterns are not unexpected, since the strong sexual selection on polygynous males may influence size and conspicuousness more than tropic features. Another basis for comparison stems from Rothstein's (1973*a*) suggestion that species with varied diets should be significantly more dimorphic in bill height and bill length than species with restricted diets ("specialists"). To examine this in a preliminary fashion, we have calculated the mean diversity of prey items taken by the species, as recorded in our dietary analyses for 1970-1972. The diversity values are given in Table 23; we arbitrarily (but with intuitive justification) categorized Dickcissels, Sage Sparrows, and Chestnut-collared Longspurs as dietary "specialists", at least in relation to the other "generalist" species. ICR values for generalists are higher than those of specialists for nearly all characters, although the differences are not great and are, if anything, slightly less for bill height and length than for the other characters. To avoid confusing possible sources of variation, we have also compared specialist and generalist ICR's with the polygynous species removed from the analysis (meadowlarks are considered generalists; Dickcissels specialists). Viewed in this manner, the greatest differences are in the mean ICR values for wing length and tail length, perhaps indicating a tendency for generalists to be more dimorphic in these characters than specialists. The adaptive significance of this pattern is not readily apparent.

A similar approach to the CV values is presented in Table 24. It appears that bill length, height, and width may be more variable in females of monogamous species than in polygynous forms, while polygynous males seem more variable in bill height than monogamous males. Generalists are more variable in bill height and bill width (both sexes) and bill length (females only) than specialists. Again, a fuller exploration of these morphological patterns awaits the analysis of dietary information.

Table 24. Mean CV values (standard deviations in parentheses) for males and females of polygynous vs. monogamous species and for dietary specialists vs. dietary generalists.

	N	Wing		Tail		Bill Length		Bill Height		Bill Width		Tarsus Length	
		♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
Polygynous	5	2.66 (0.407)	2.05 (0.747)	3.50 (0.593)	4.79 (0.929)	5.49 (1.436)	4.23 (0.729)	8.46 (1.556)	6.91 (1.424)	7.43 (0.601)	7.75 (1.439)	2.92 (0.981)	2.84 (0.574)
Monogamous	8	2.93 (0.616)	2.38 (0.976)	5.64 (4.572)	3.09 (1.314)	5.19 (0.976)	6.12 (1.408)	7.06 (2.202)	9.28 (4.780)	7.86 (2.498)	8.67 (2.560)	3.08 (0.588)	3.54 (1.475)
Specialist	3	3.22 (0.345)	2.63 (0.257)	3.99 (0.286)	3.81 (1.195)	5.84 (1.307)	4.72 (0.176)	6.27 (2.206)	7.35 (3.873)	6.74 (1.588)	7.56 (3.194)	3.04 (0.661)	3.29 (0.531)
Generalist	10	2.71 (0.551)	2.15 (1.000)	5.07 (4.203)	3.60 (1.556)	5.14 (1.087)	5.74 (1.676)	8.00 (1.914)	8.87 (4.270)	7.98 (2.031)	8.63 (1.980)	3.01 (0.779)	3.31 (1.456)
Specialist[a/]	2	3.23 (0.488)	2.55 (0.304)	3.86 (0.233)	3.34 (1.230)	5.11 (0.438)	4.65 (0.176)	6.31 (3.118)	7.76 (5.381)	6.30 (1.966)	7.86 (4.455)	2.66 (0.021)	3.52 (0.502)
Generalist[a/]	6	2.84 (0.663)	2.33 (1.141)	6.24 (5.250)	3.01 (1.442)	5.22 (1.136)	6.61 (1.271)	7.32 (2.130)	9.79 (4.997)	8.38 (2.582)	8.94 (2.203)	3.22 (0.624)	3.54 (1.731)

a/ Polygynous species excluded.

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APPENDIX I

LISTING OF SPECIES RECORDED IN ROADSIDE COUNTS

Listing of species recorded in roadside counts. Ecological categories are denoted by R = raptor; A = aquatic; RB = roadside-brush; ASF = air-swoop feed; AF = air-flycatching; GS = ground shorebird; LG = large ground; ML = meadowlark; SG = small ground; and M = miscellaneous.

Code	Species	Category
AGPH	Red-winged Blackbird (*Agelaius phoeniceus*)	RB
AICA	Cassin's Sparrow (*Aimophilla cassinii*)	SG
AMSA	Grasshopper Sparrow (*Ammodramus savannarum*)	SG
ANAC	Pintail (*Anas acuta*)	A
ANCA	Green-winged Teal (*Anas carolinensis*)	A
ANDI	Blue-winged Teal (*Anas discors*)	A
ANPL	Mallard (*Anas platyrhynchos*)	A
ANSP	Water Pipit (*Anthus spinoletta*)	SG
AQCH	Golden Eagle (*Aquila chrysaetos*)	R
ARCO	Ruby-throated Hummingbird (*Archilocus colubris*)	M
ARHE	Great Blue Heron (*Ardea herodias*)	A
ASFL	Short-eared Owl (*Asio flammeus*)	R
BALO	Upland Plover (*Bartramia longicauda*)	GS
BUAL	Bufflehead (*Bucephala albeola*)	A
BUJA	Red-tailed Hawk (*Buteo jamaicensis*)	R
BULA	Rough-legged Hawk (*Buteo lagopus*)	R
BURE	Ferruginous Hawk (*Buteo regalis*)	R
BUSW	Swainson's Hawk (*Buteo swainsoni*)	R
BUVI	Green Heron (*Buturoides virescens*)	A
CAAU	Turkey Vulture (*Cathartes aura*)	R
CAME	Lark Bunting (*Calamospiza melanocorys*)	SG
CAOR	Chestnut-collared Longspur (*Calcarius ornatus*)	SG
CAPI	Smith's Longspur (*Calcarius pictus*)	SG
CASQ	Scaled Quail (*Callipepla squamata*)	LG
CHGR	Lark Sparrow (*Chondestes grammacus*)	SG
CHMI	Common Nighthawk (*Chordeiles minor*)	ASF
CHNI	Black Tern (*Chlidonias niger*)	M
CHVO	Killdeer (*Charadrius vociferus*)	RB
CICY	Marsh Hawk (*Circus cyaneus*)	R
COAM	Yellow-billed Cuckoo (*Coccyzus americanus*)	RB
COAU	Yellow-shafted Flicker (*Colaptes auratus*)	M
COBR	Common Crow (*Corvus brachyrhynchos*)	M
COCA	Red-shafted Flicker (*Colaptes cafer*)	M
COVI	Bobwhite (*Colinus virginianus*)	LG
CYCR	Blue Jay (*Cyanocitta cristata*)	M
DEPE	Yellow Warbler (*Dendroica petechia*)	M

APPENDIX I (continued)

Code	Species	Category
DEPU	Downy Woodpecker (*Dendrocopos pubescens*)	M
DESC	Ladder-backed Woodpecker (*Dendrocopos scalaris*)	M
ERAL	Horned Lark (*Eremophila alpestris*)	SG
EUCA	Rusty Blackbird (*Euphagus carolinensis*)	RB
EUCY	Brewer's Blackbird (*Euphagus cyanocephalus*)	RB
FASP	Sparrow Hawk (*Falco sparverius*)	R
FLCA	Little Blue Heron (*Florida caerulea*)	A
GETR	Yellowthroat (*Geothlypis trichas*)	M
GRCA	Sandhill Crane (*Grus canadensis*)	M
GUCA	Blue Grosbeak (*Guiraca caerulea*)	RB
HIRU	Barn Swallow (*Hirundo rustica*)	ASF
ICBU	Bullock's Oriole (*Icterus bullockii*)	RB
ICGA	Baltimore Oriole (*Icterus gulbula*)	RB
ICSP	Orchard Oriole (*Icterus spurius*)	RB
LALU	Loggerhead Shrike (*Lanius ludovicianus*)	RB
LAPI	Franklin's Gull (*Larus pipixcan*)	M
MEER	Red-headed Woodpecker (*Melanerpes erythrocephalus*)	M
MIPO	Mockingbird (*Mimus polyglottis*)	RB
MOAT	Brown-headed Cowbird (*Molothrus ater*)	RB
MUFO	Scissor-tailed Flycatcher (*Muscivora forficata*)	AF
MYCR	Crested Flycatcher (*Myiarchus crinitus*)	AF
NUAM	Long-billed Curlew (*Numenius americanus*)	GS
PAAT	Black-capped Chickadee (*Parus atricapillus*)	M
PADO	House Sparrow (*Passer domesticus*)	M
PASA	Savannah Sparrow (*Passerculus sandwichensis*)	SG
PEPH	Sharp-tailed Grouse (*Pedioecetus phasianellus*)	LG
PEPY	Cliff Swallow (*Petrochelidon pyrrhonota*)	ASF
PHCO	Ring-necked Pheasant (*Phasianus colchicus*)	LG
PIER	Rufous-sided Towhee (*Pipilo erythropthalmus*)	RB
PIPI	Black-billed Magpie (*Pica pica*)	M
POGR	Vesper Sparrow (*Pooecetes gramineus*)	SG
POPO	Pied-billed Grebe (*Podilymbus podiceps*)	A
PRSU	Purple Martin (*Progne subis*)	ASF
QUQU	Common Grackle (*Quisculus quiscula*)	RB
SASA	Say's Phoebe (*Sayornis saya*)	AF
SISI	Eastern Bluebird (*Sialia sialis*)	RB
SPAM	Dickcissel (*Spiza americana*)	SG
SPAR	Tree Sparrow (*Spizella arborea*)	RB

APPENDIX I (continued)

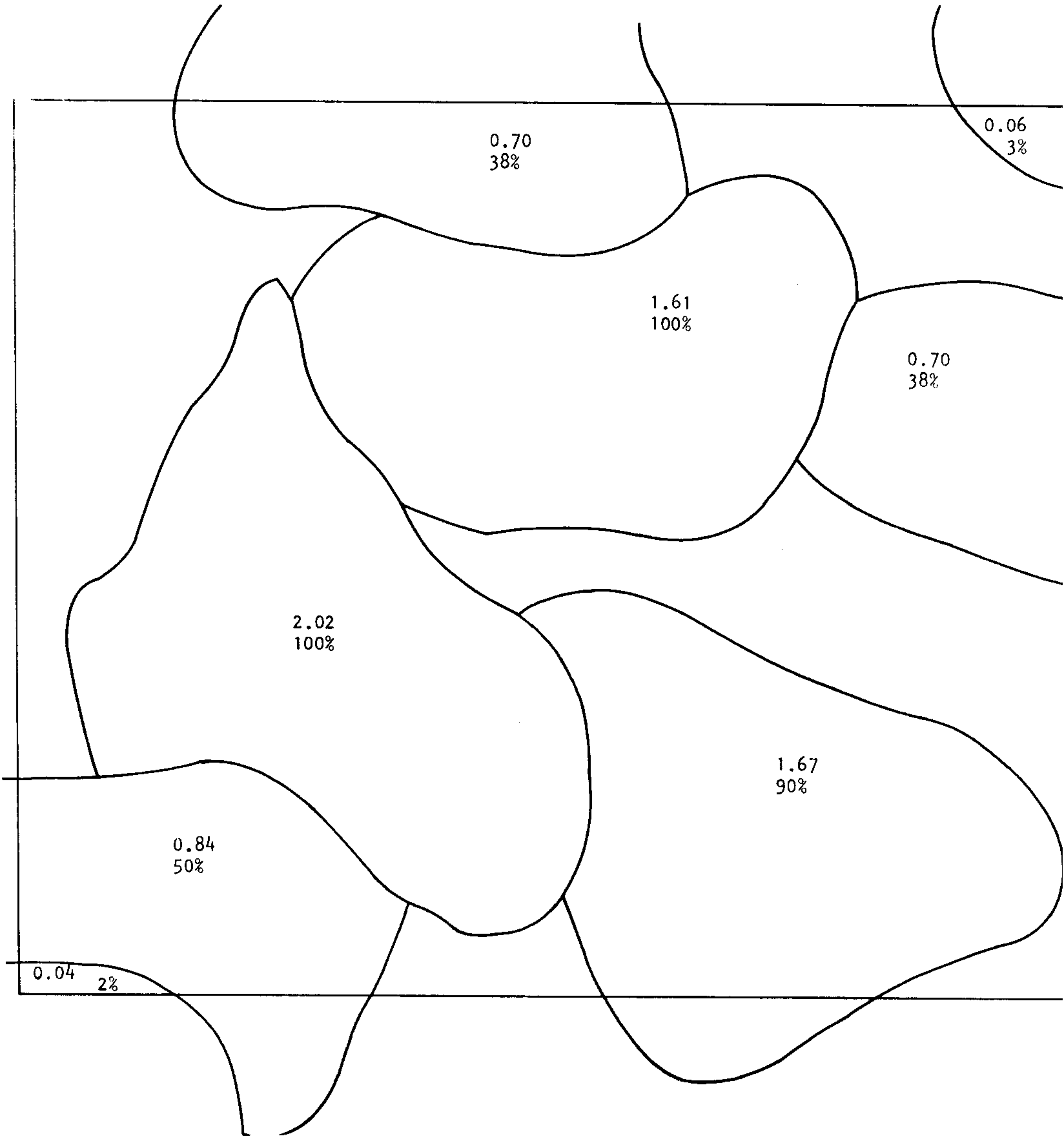
Code	Species	Category
SPCL	Shoveler (*Spatula clypeata*)	A
SPPA	Chipping Sparrow (*Spizella passerina*)	SG
SPTR	American Goldfinch (*Spinus tristis*)	RB
STMA	Eastern Meadowlark (*Sturnella magna*)	ML
STNE	Western Meadowlark (*Sturnella neglecta*)	ML
STRU	Rough-winged Swallow (*Stelgidopteryx ruficollis*)	ASF
STVU	Starling (*Sturnus vulgaris*)	RB
TOFL	Lesser Yellowlegs (*Totanus flavipes*)	GS
TORU	Brown Thrasher (*Toxostoma rufum*)	RB
TRAE	House Wren (*Troglodytes aedon*)	RB
TUMI	Robin (*Turdus migratorius*)	RB
TYCU	Greater Prairie Chicken (*Tympanuchus cupido*)	LG
TYTY	Eastern Kingbird (*Tyrannus tyrannus*)	AF
TYVE	Western Kingbird (*Tyrannus verticalis*)	AF
ZEMA	Mourning Dove (*Zenaidura macroura*)	M

APPENDIX II

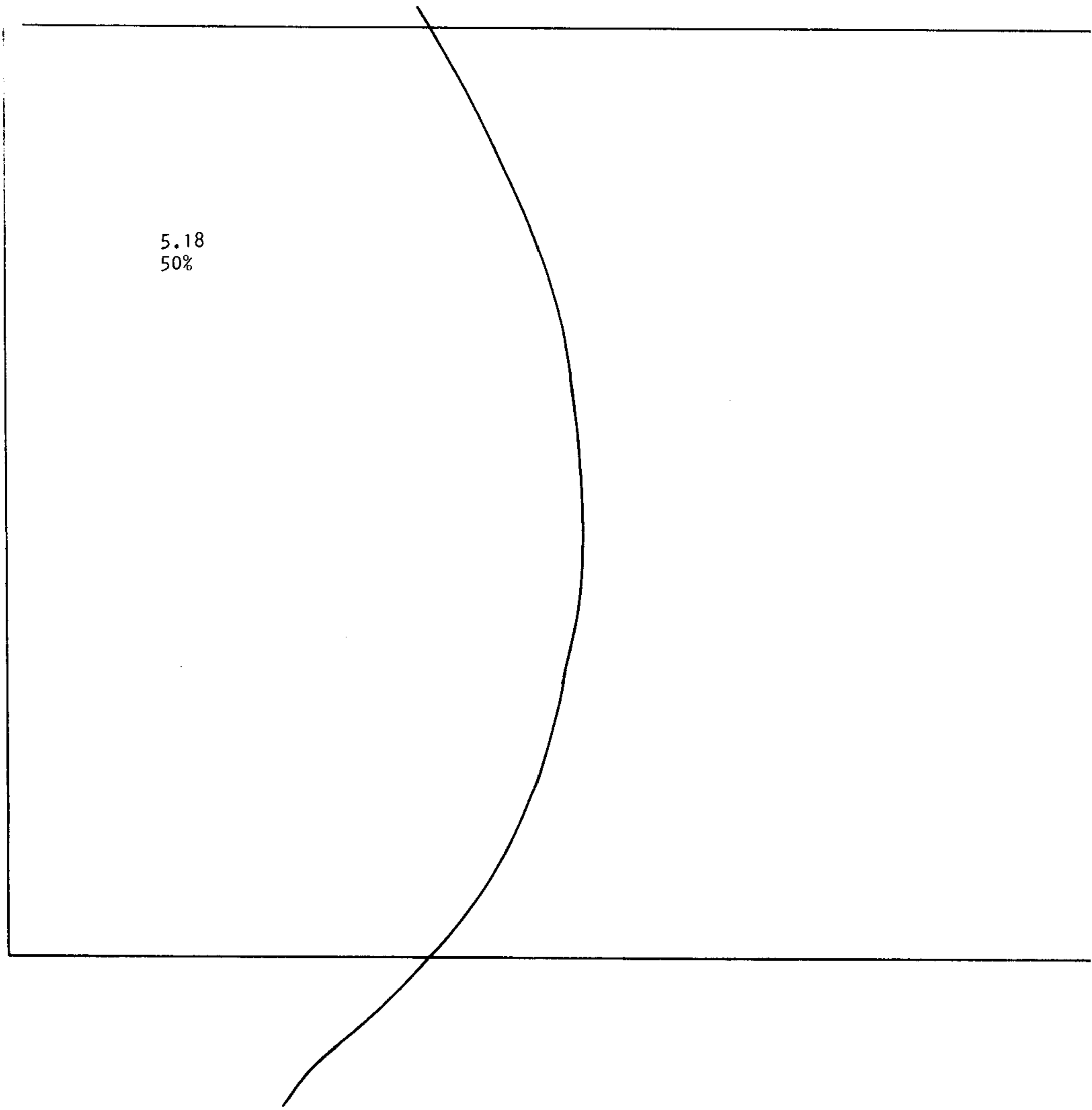
TERRITORY MAPPINGS ON IBP GRASSLAND BIOME SAMPLE PLOTS, 1972-1973

The following territory mappings summarize individual flushings (Wiens 1969) and are the data from which plot-based population density estimates were derived. Within each territory are two figures, the upper is the area of the portion of the territory within the plot (in hectares), and the lower is the proportion of the entire territory lying within the plot. The scale indicator in the upper right is equivalent to 50 m.

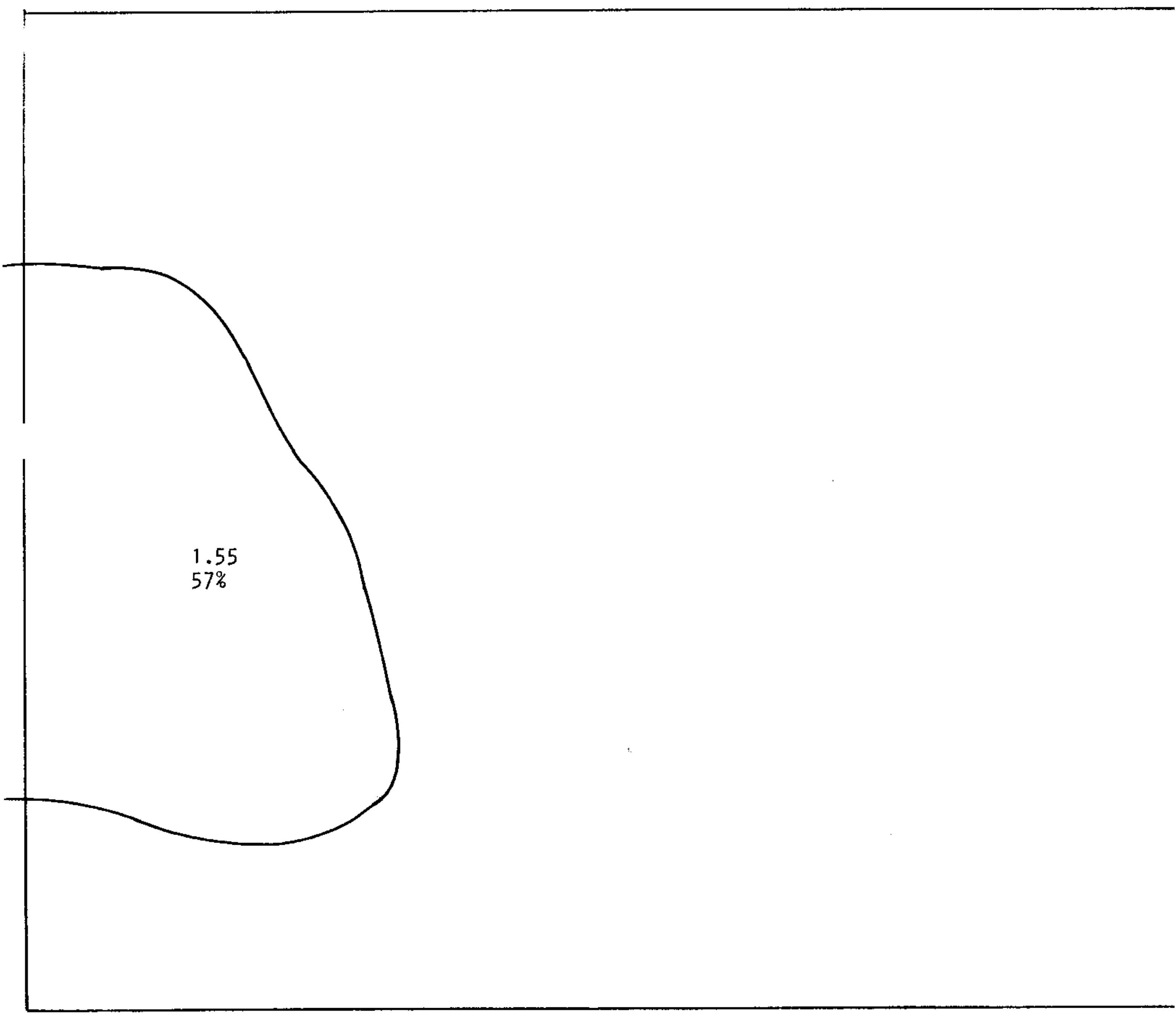
Site: COTTONWOOD Treatment: Ungrazed Sample Plot: 1 Species: AMSA
4.21 territories = 8.42 indiv. = 79.6 indiv./km^2
mean territory = 1.83 (n = 3); Percent plot occupied = 72



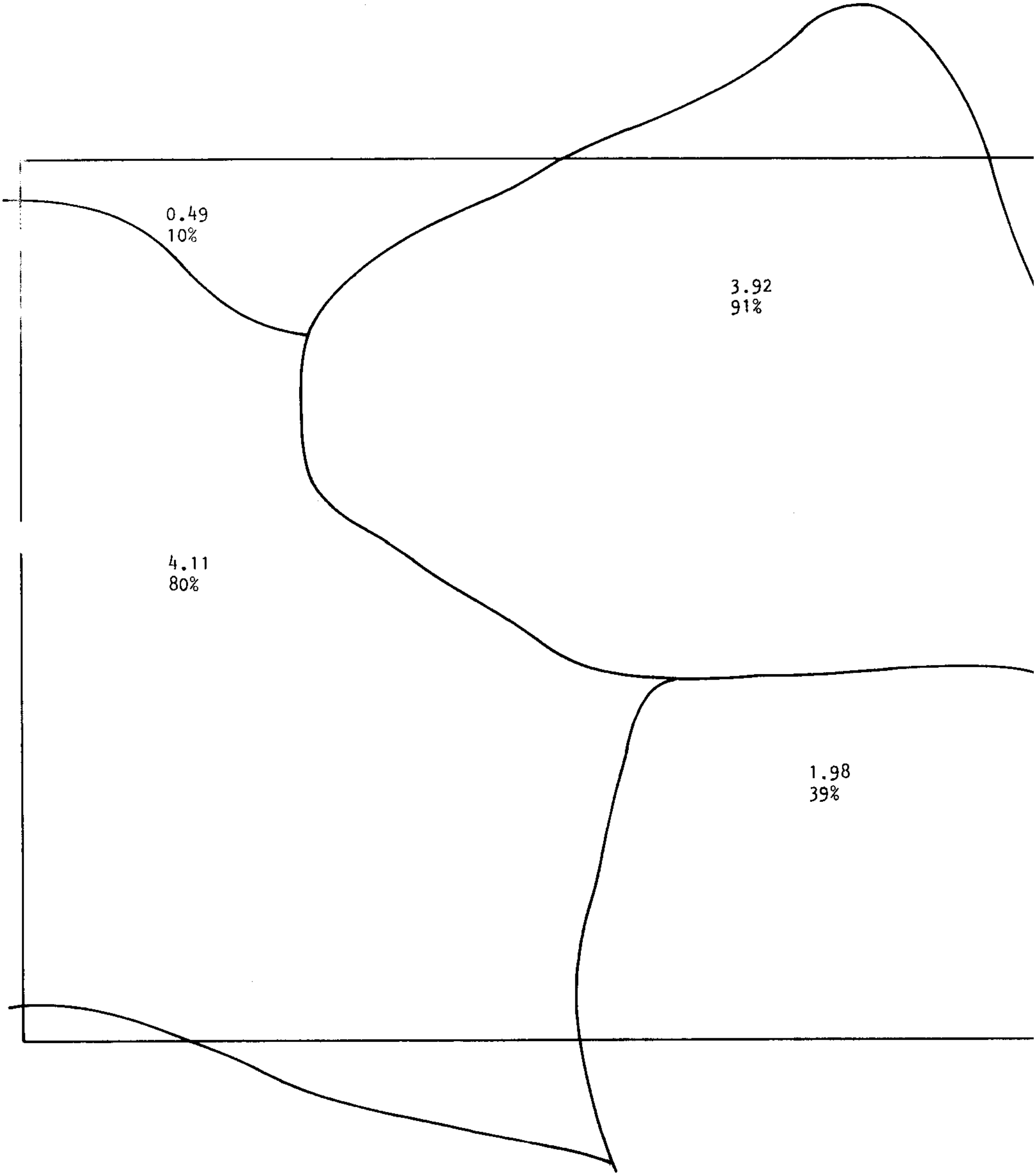
Site: COTTONWOOD Treatment: Ungrazed Sample Plot: 1 Species: BALO
0.50 territories = 1.0 indiv. = 9.5 indiv./km^2
Percent plot occupied = 49



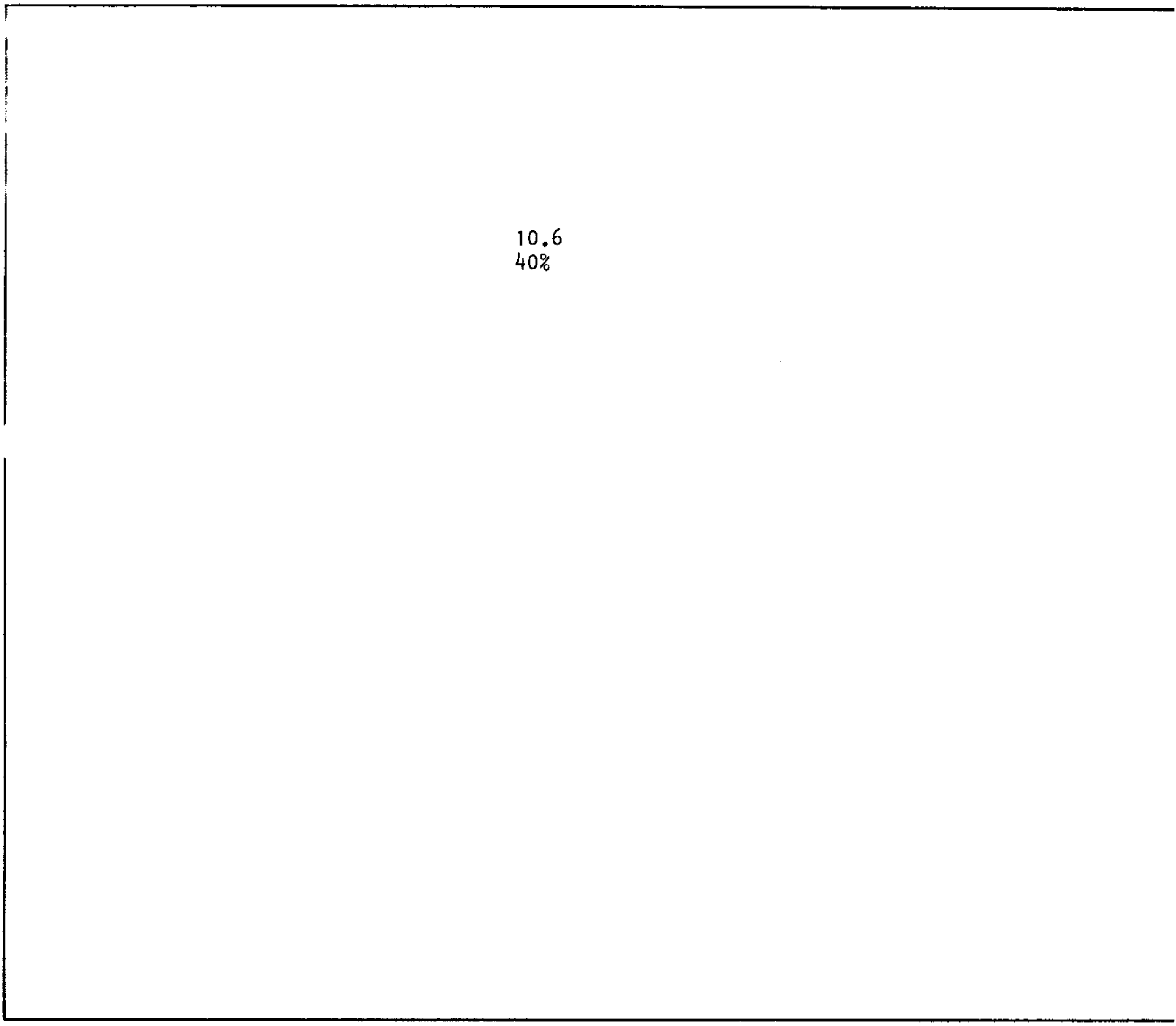
Site: COTTONWOOD Treatment: Ungrazed Sample Plot: 1 Species: CAOR
0.57 territories = 1.14 indiv. = 10.8 indiv./km^2
Percent plot occupied = 15



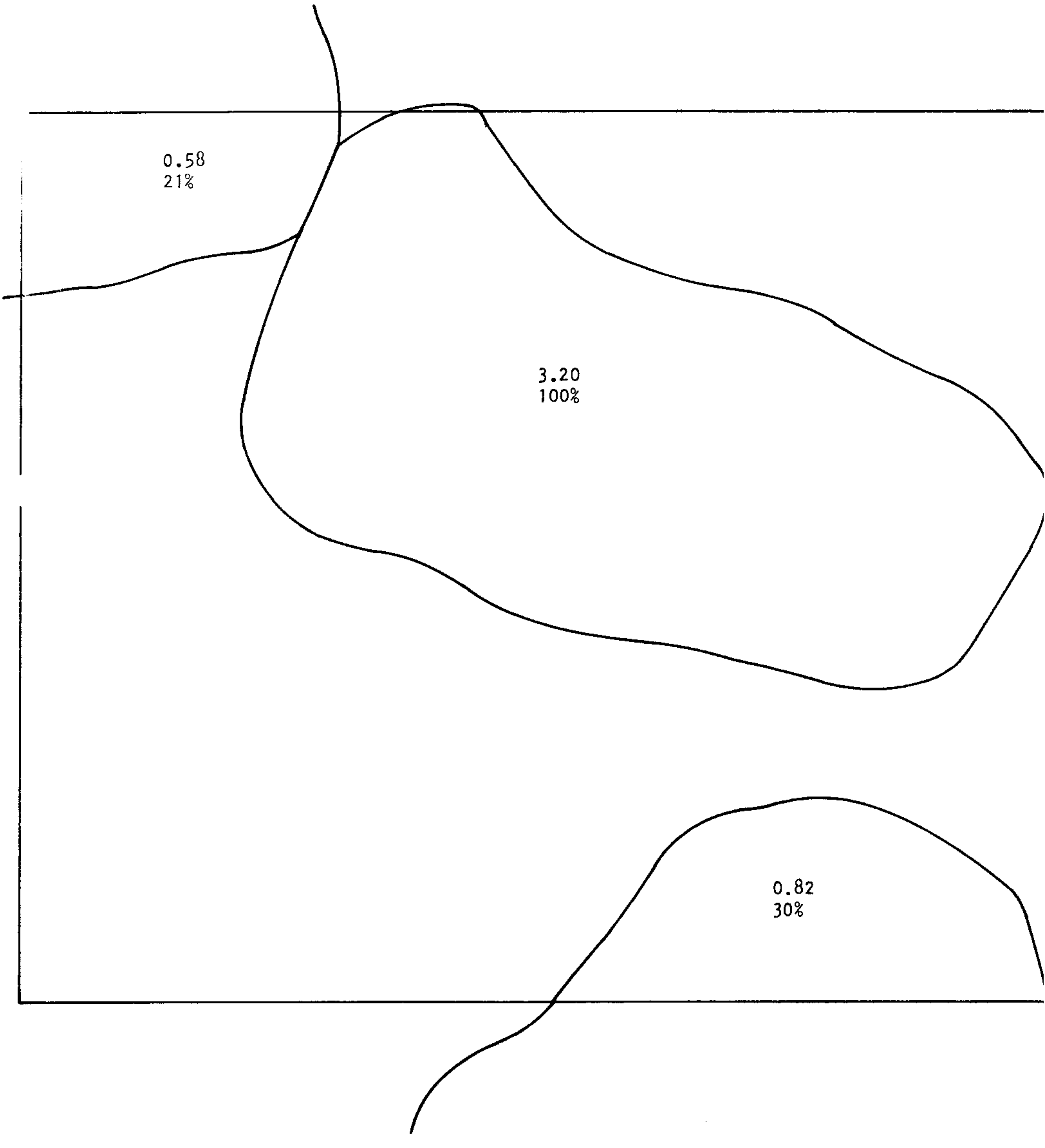
Site: COTTONWOOD Treatment: Ungrazed Sample Plot: 1 Species: STNE
2.20 territories = 5.50 indiv. = 52.0 indiv./km^2
Mean territory = 4.32 ha (n = 1); Percent plot occupied = 99



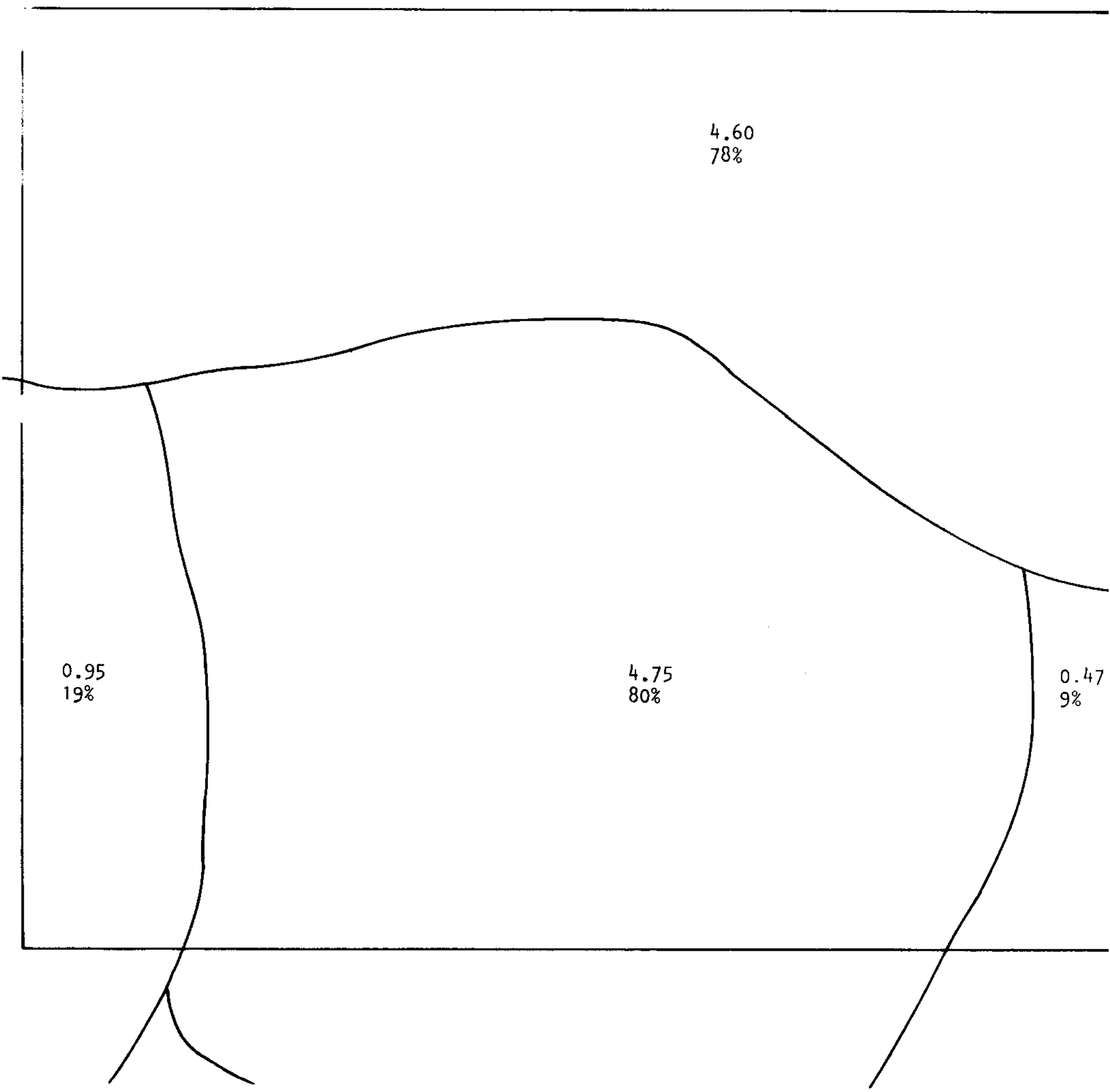
Site: COTTONWOOD Treatment: Ungrazed Sample Plot: 1 Species: NUAM
0.40 territories = 0.80 indiv. = 7.6 indiv./km^2
Percent plot occupied = 100



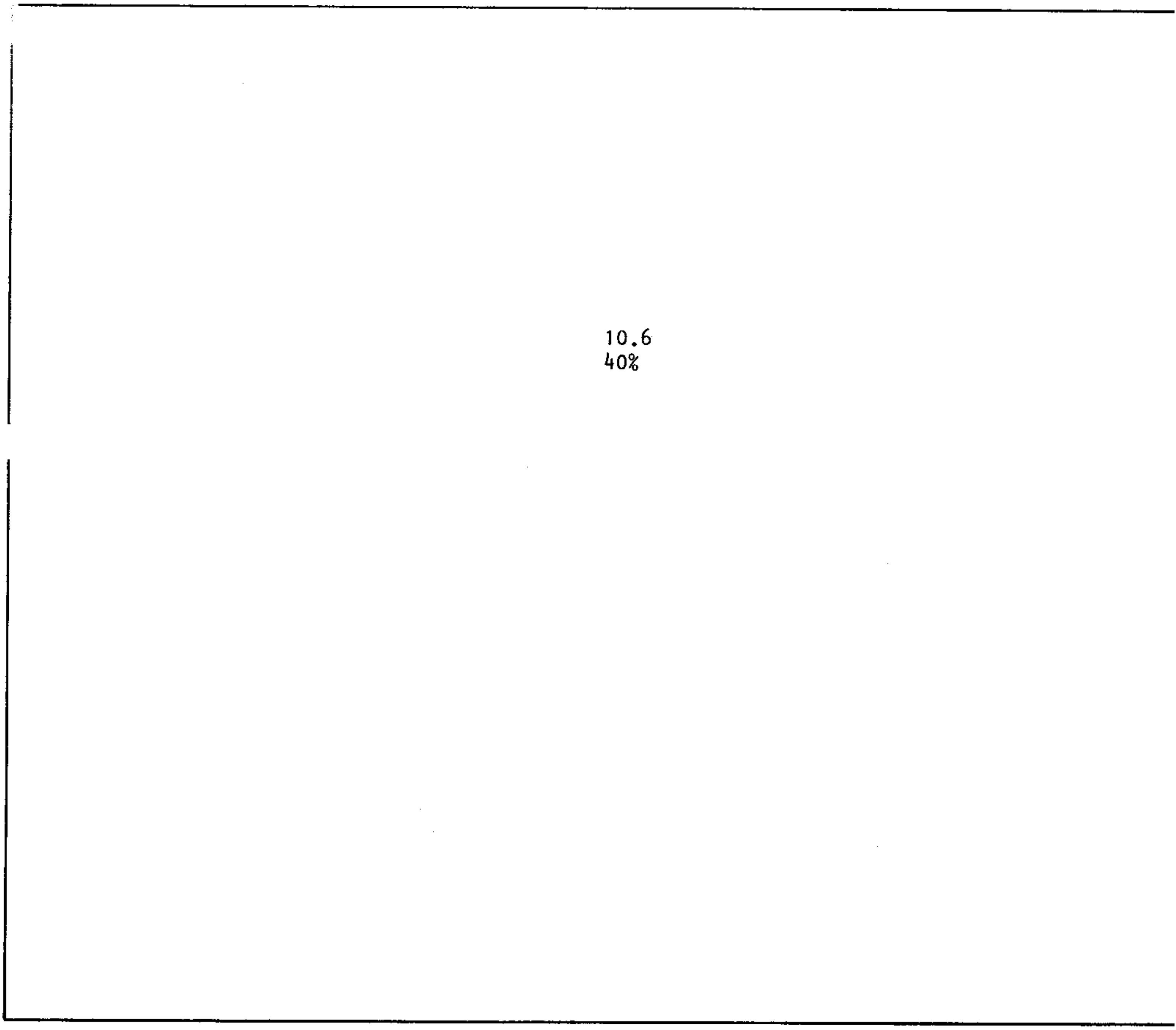
Site: COTTONWOOD Treatment: Ungrazed Sample Plot: 2 Species: CAOR
1.51 territories = 3.02 indiv. = 28.5 indiv./km^2
Mean territory = 3.20 ha (n = 1); Percent plot occupied = 43



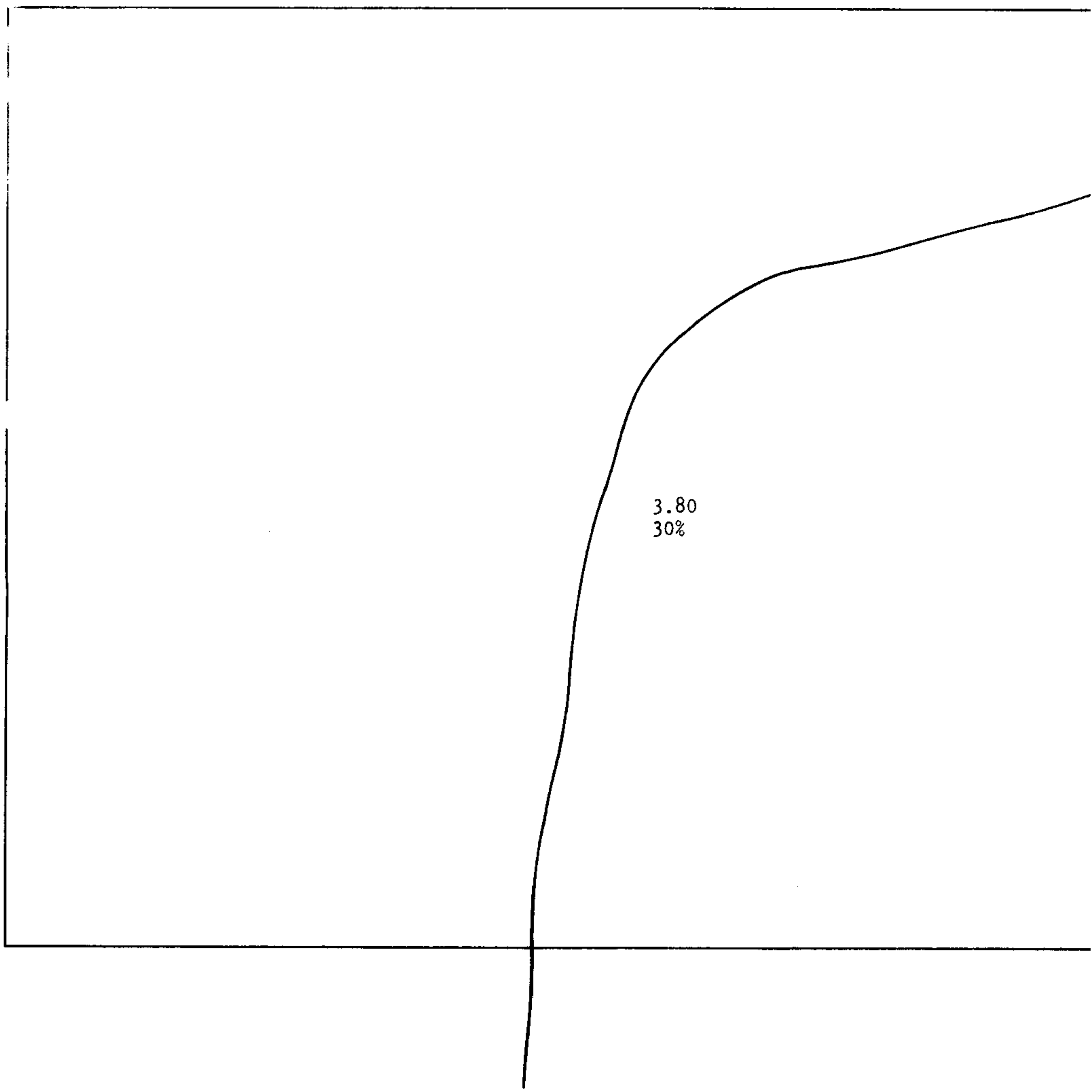
Site: COTTONWOOD Treatment: Ungrazed Sample Plot: 2 Species: STNE
1.86 territories = 4.65 indiv. = 43.9 indiv./km^2
Mean territory = 5.90 ha (n = 1); Percent plot occupied = 100



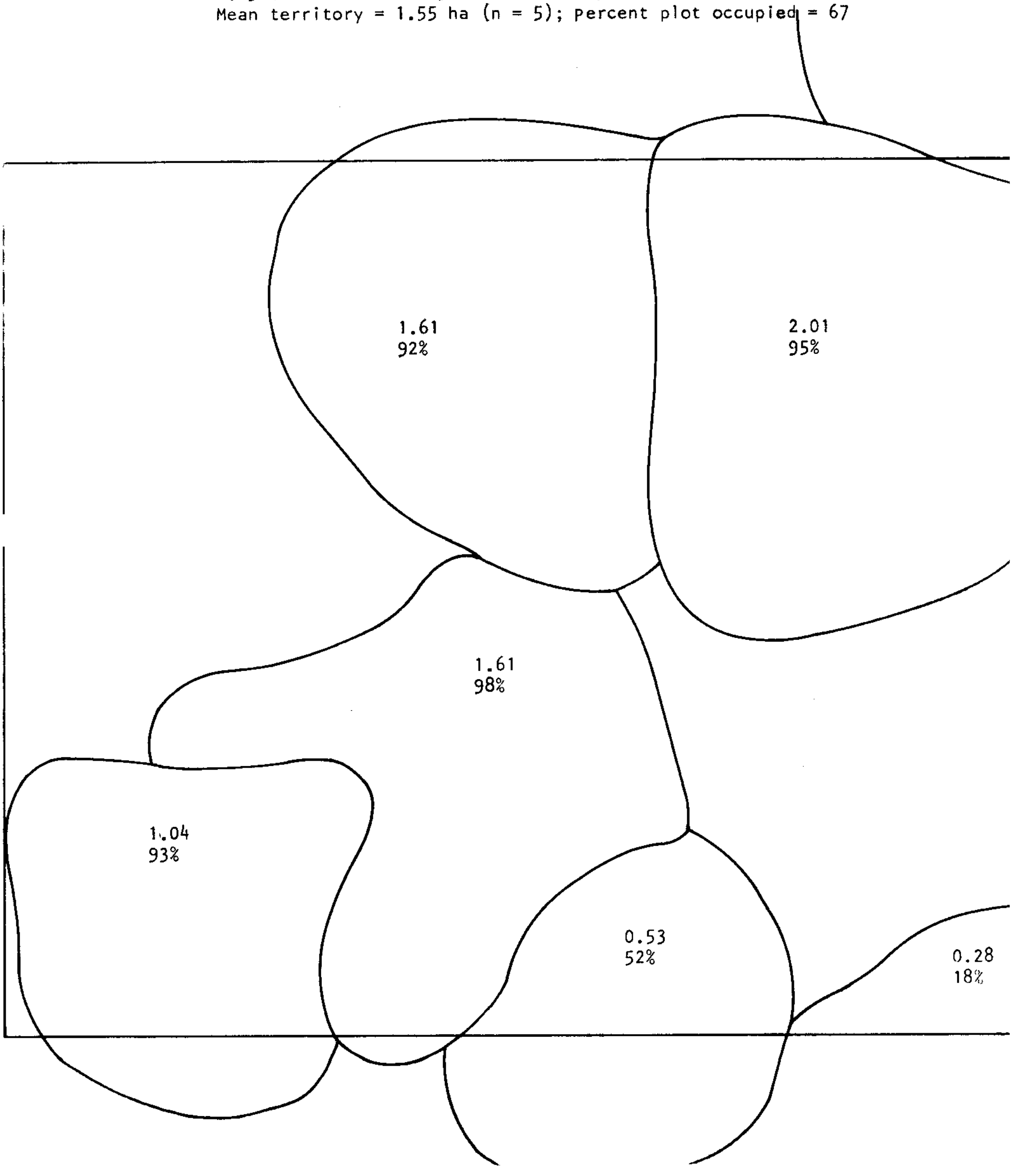
Site: COTTONWOOD Treatment: Ungrazed Sample Plot: 2 Species: NU AM
0.40 territories = 0.80 indiv. = 7.6 indiv./km^2
Percent plot occupied = 100



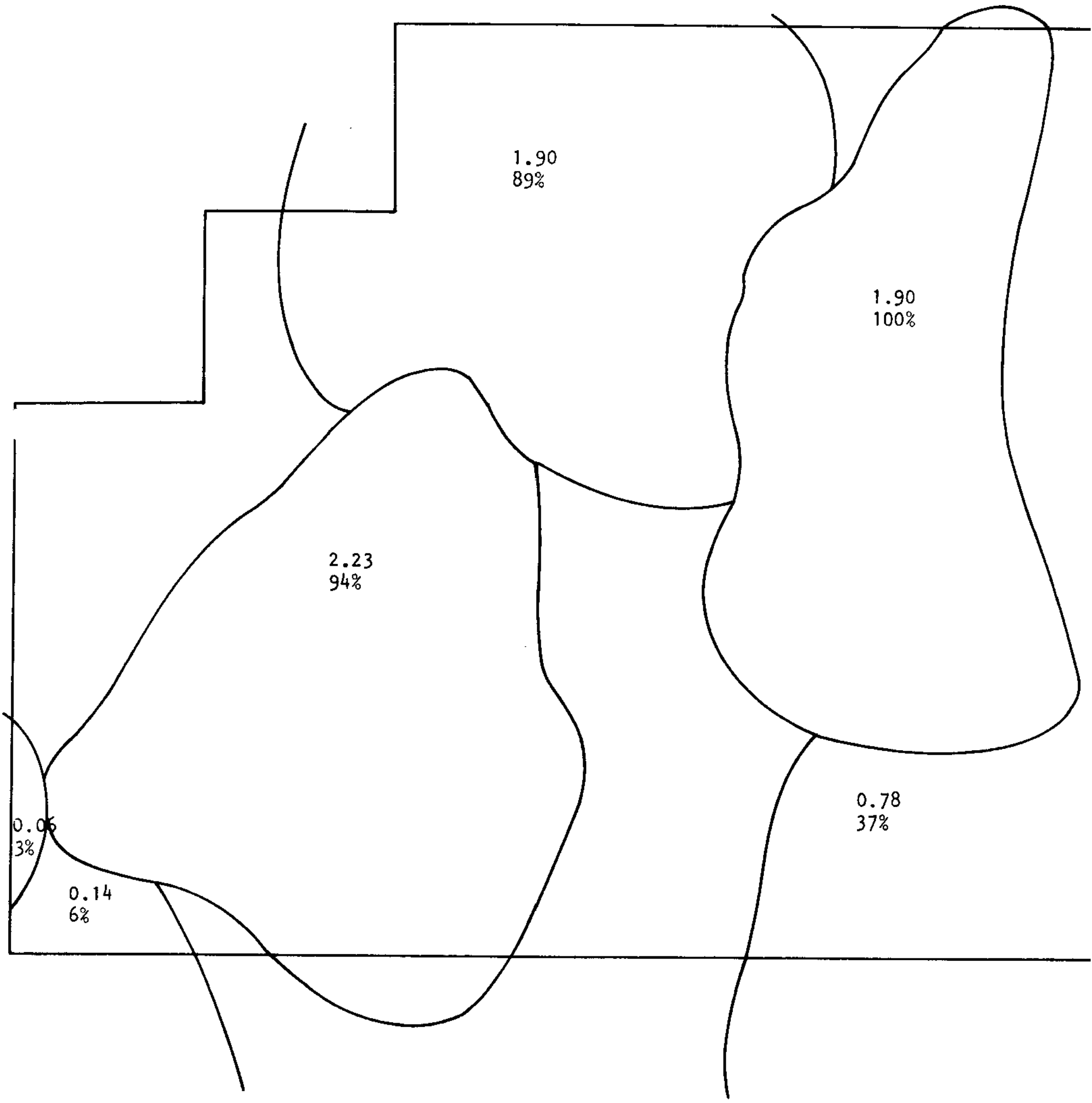
Site: COTTONWOOD Treatment: Ungrazed Sample Plot: 2 Species: BALO
0.30 territories = 0.60 indiv. = 5.7 indiv./km^2
Percent plot occupied = 36



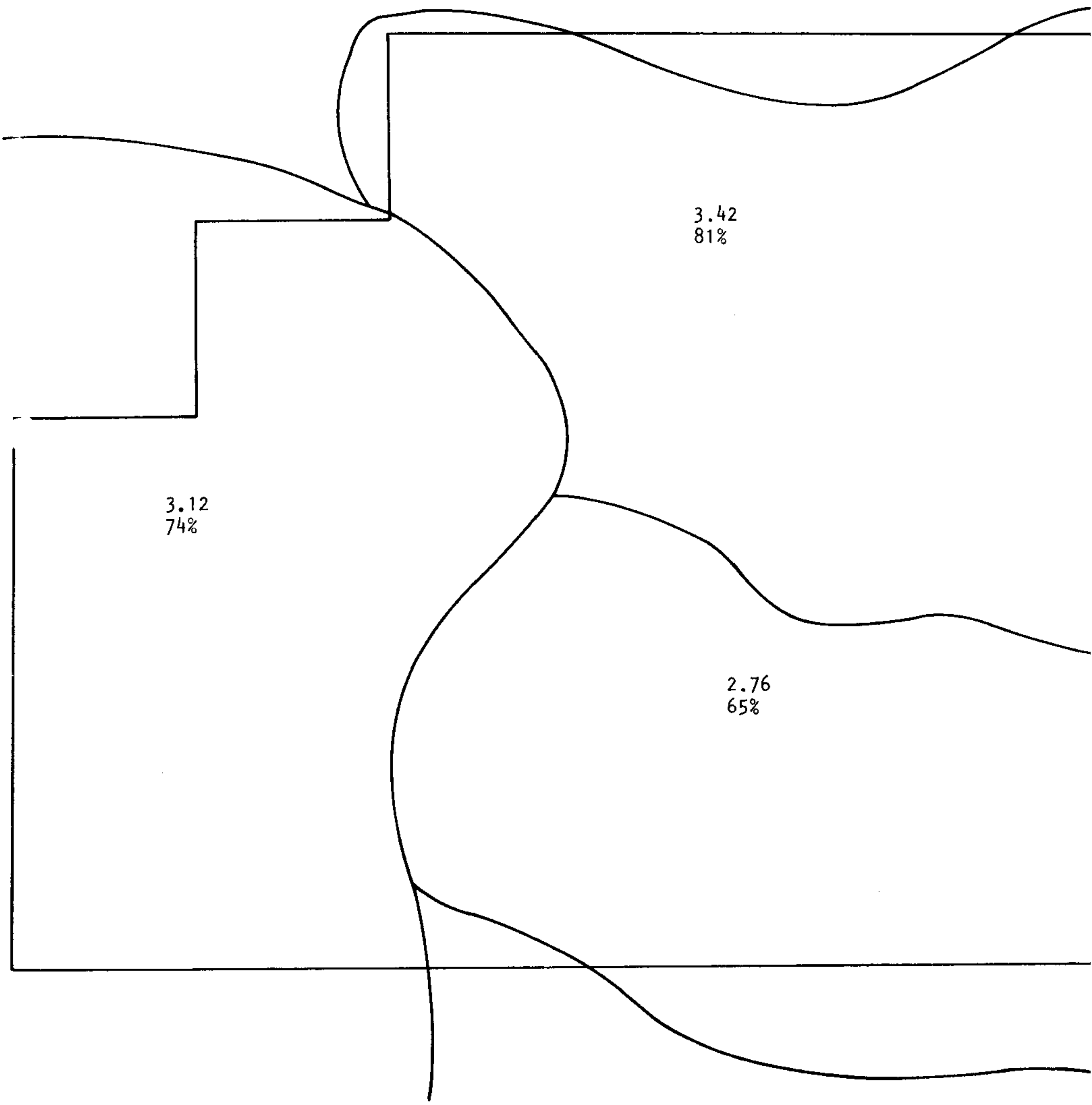
Site: COTTONWOOD Treatment: Ungrazed Sample Plot: 2 Species: AM SA
4.49 territories = 8.98 indiv. = 84.9 indiv./km^2
Mean territory = 1.55 ha (n = 5); percent plot occupied = 67



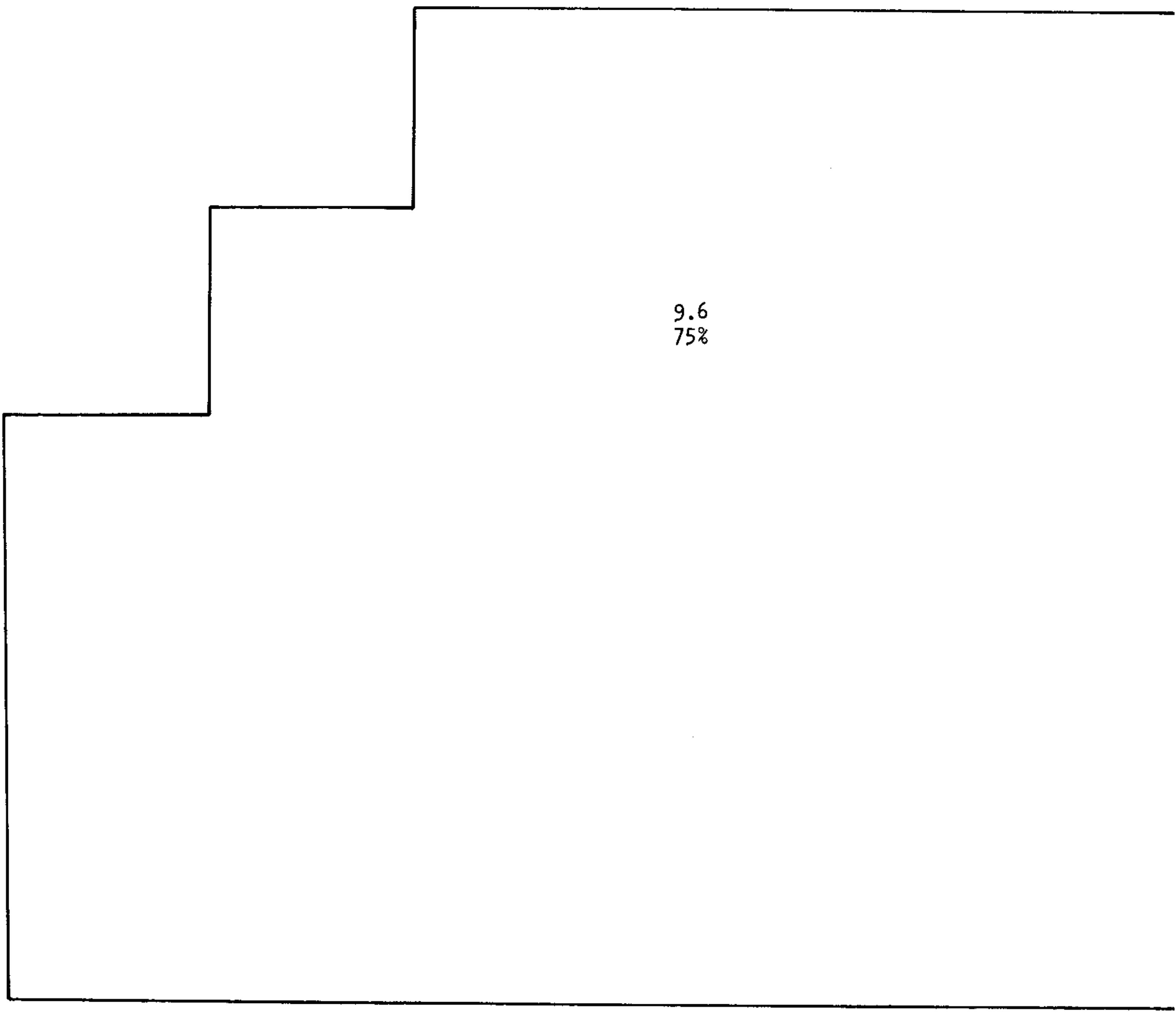
Site: COTTONWOOD Treatment: Grazed Sample Plot: 1 Species: ERAL
3.29 territories = 6.58 indiv. = 68.2 indiv./km^2
Mean territory = 2.13 ha (n = 2); Percent plot occupied = 73



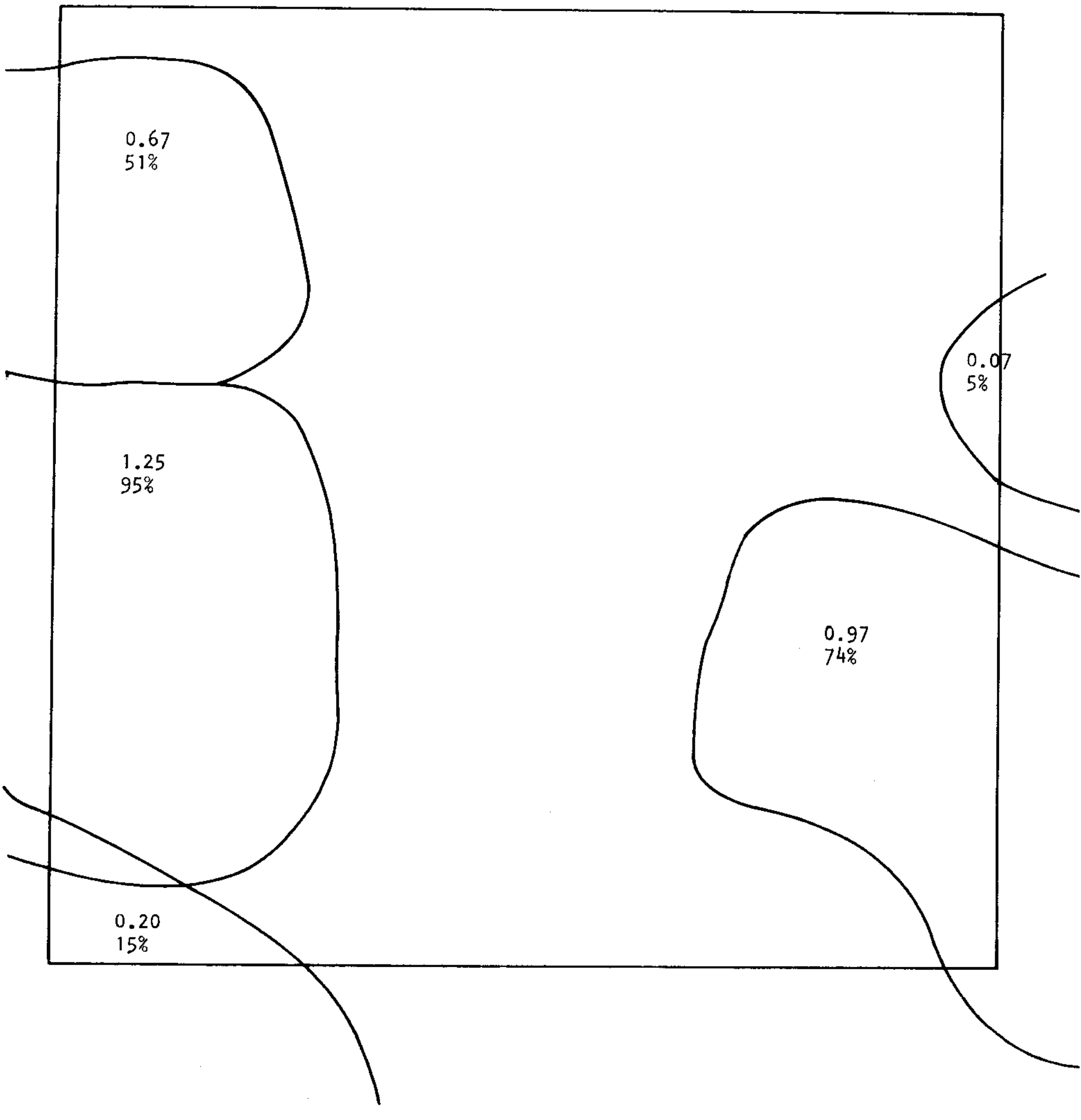
Site: COTTONWOOD Treatment: Grazed Sample Plot: 1 Species: STNE
2.20 territories = 5.50 indiv. = 57.0 indiv./km^2
Percent Plot occupied = 97



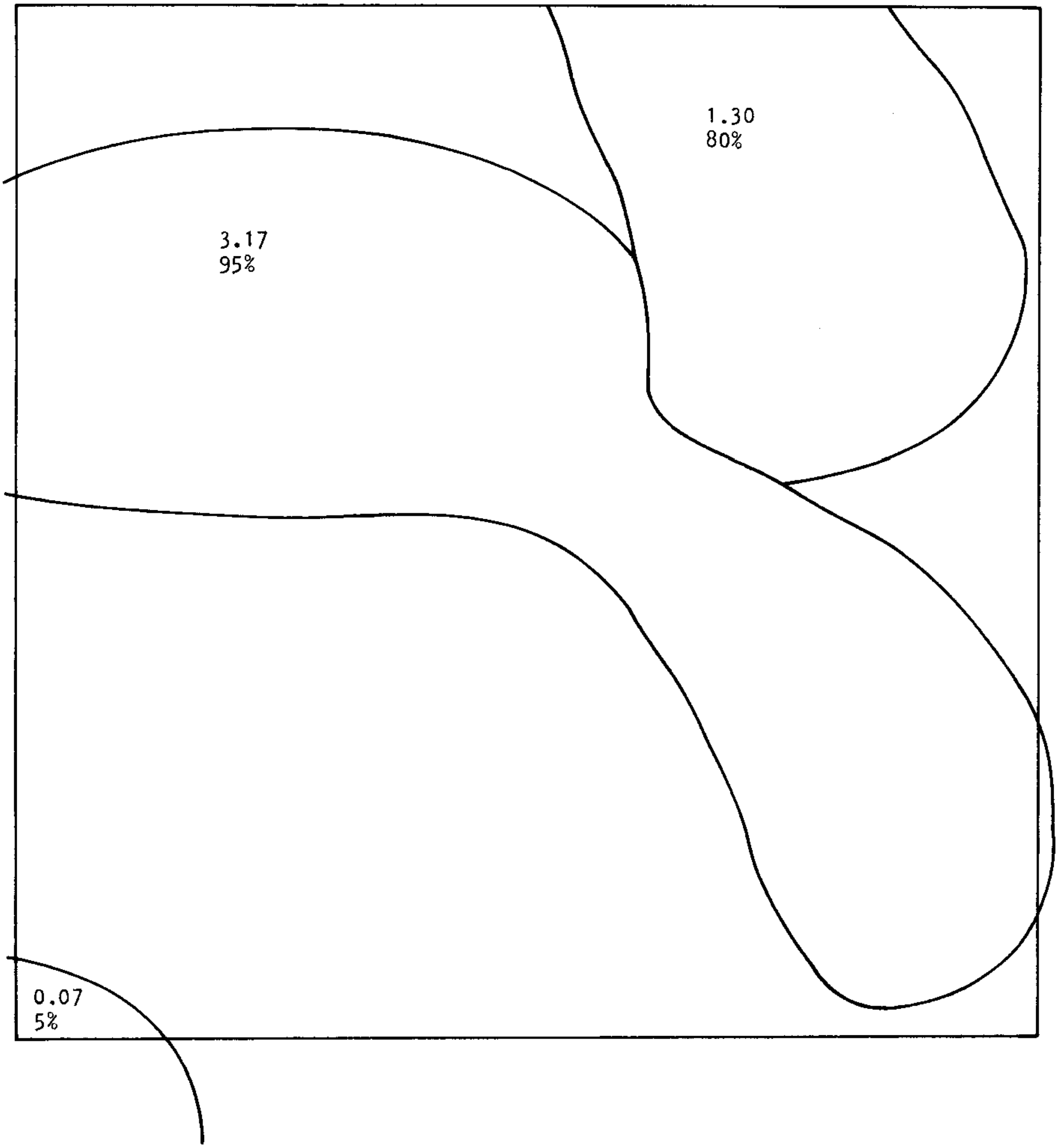
Site: COTTONWOOD Treatment: Grazed Sample Plot: 1 Species: CHVO
0.75 territories = 1.50 indiv. = 15.6 indiv./km^2
Percent plot occupied = 100



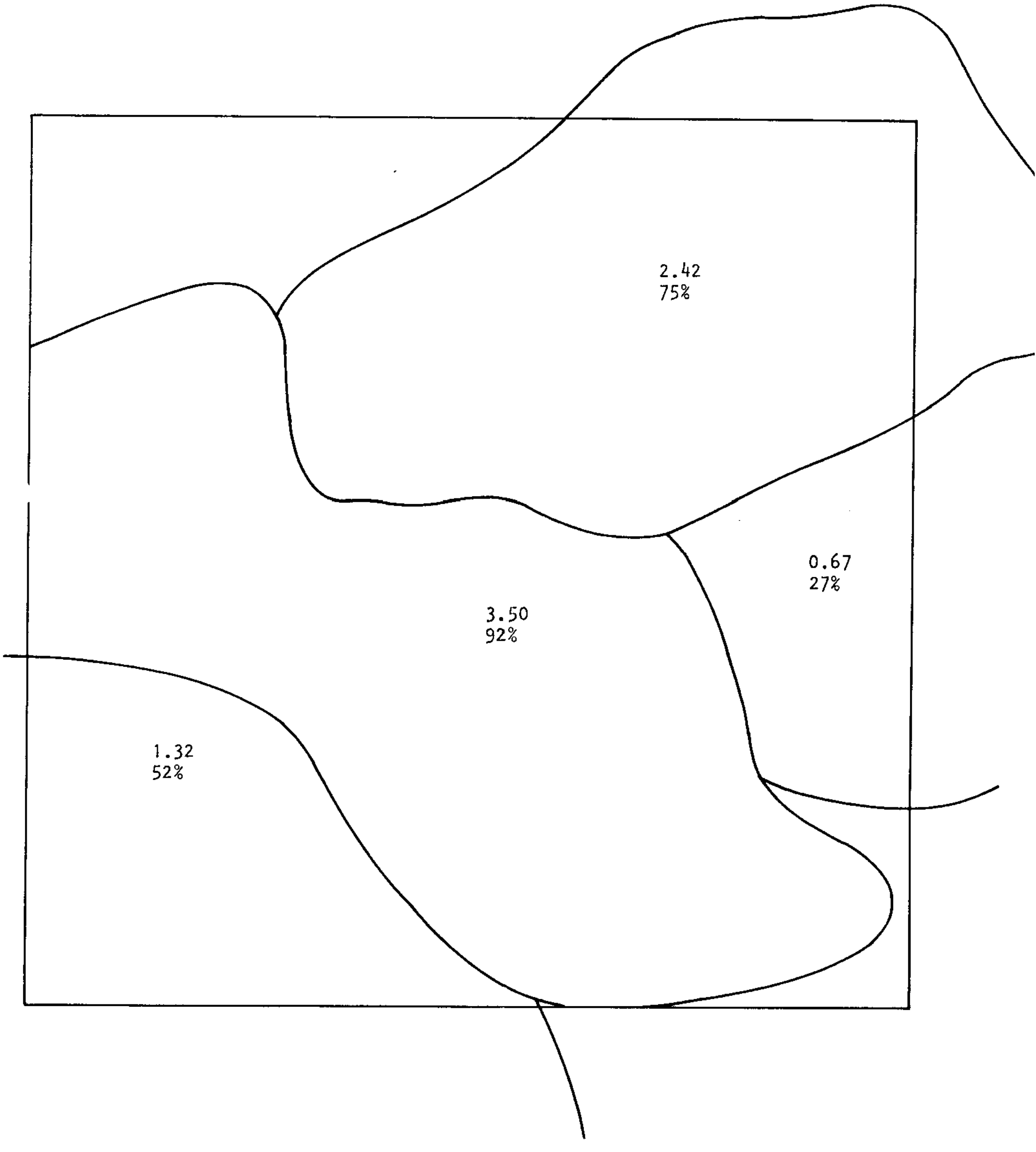
Site: PANTEX Treatment: Ungrazed Sample Plot: 1 Species: ERAL
2.40 territories = 4.80 indiv. = 46.6 indiv./km^2
Percent plot occupied = 31



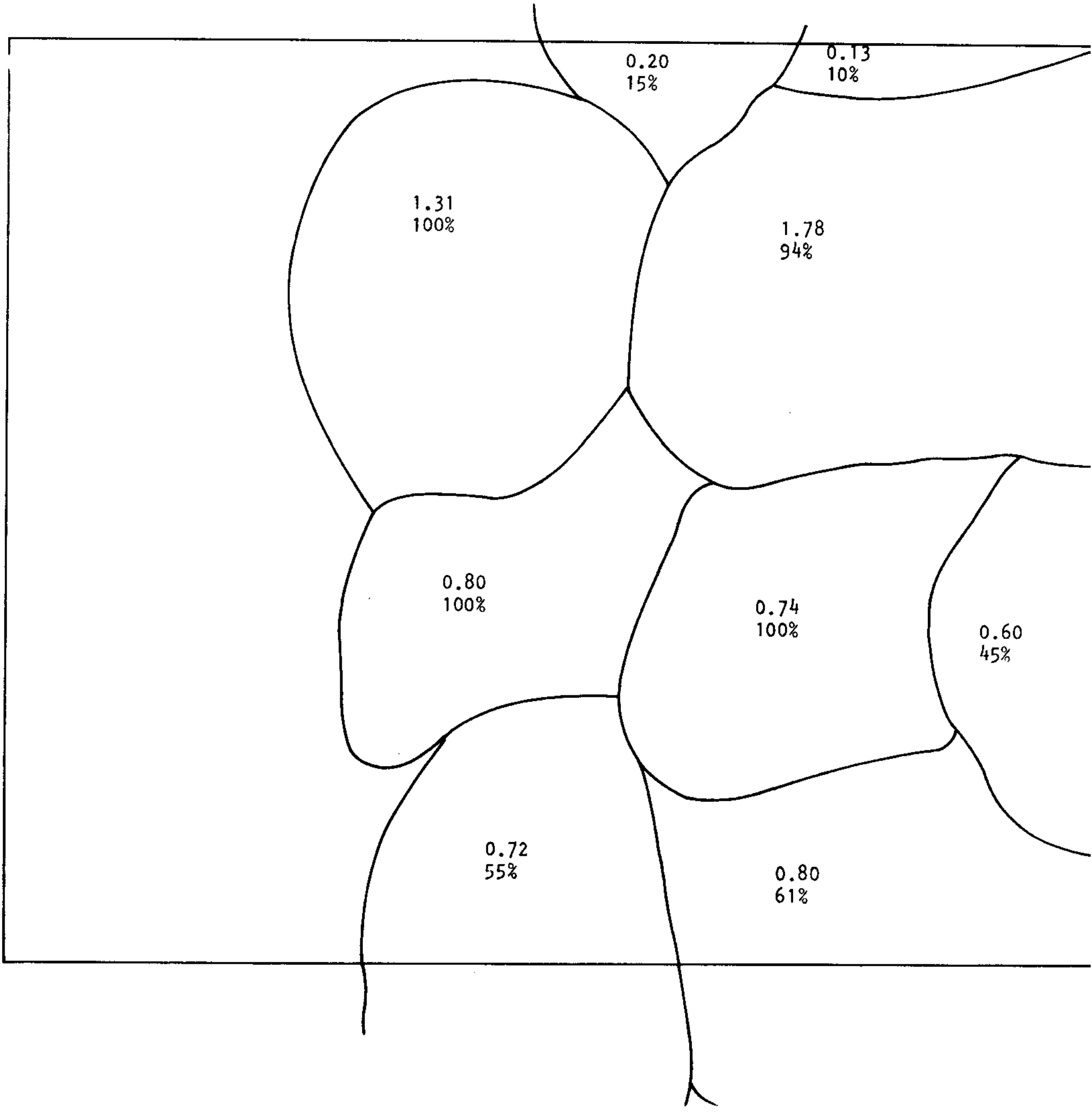
Site: PANTEX Treatment: Ungrazed Sample Plot: 1 Species: AMSA
1.80 territories = 3.60 indiv. = 35.0 indiv./km^2
Percent plot occupied = 45



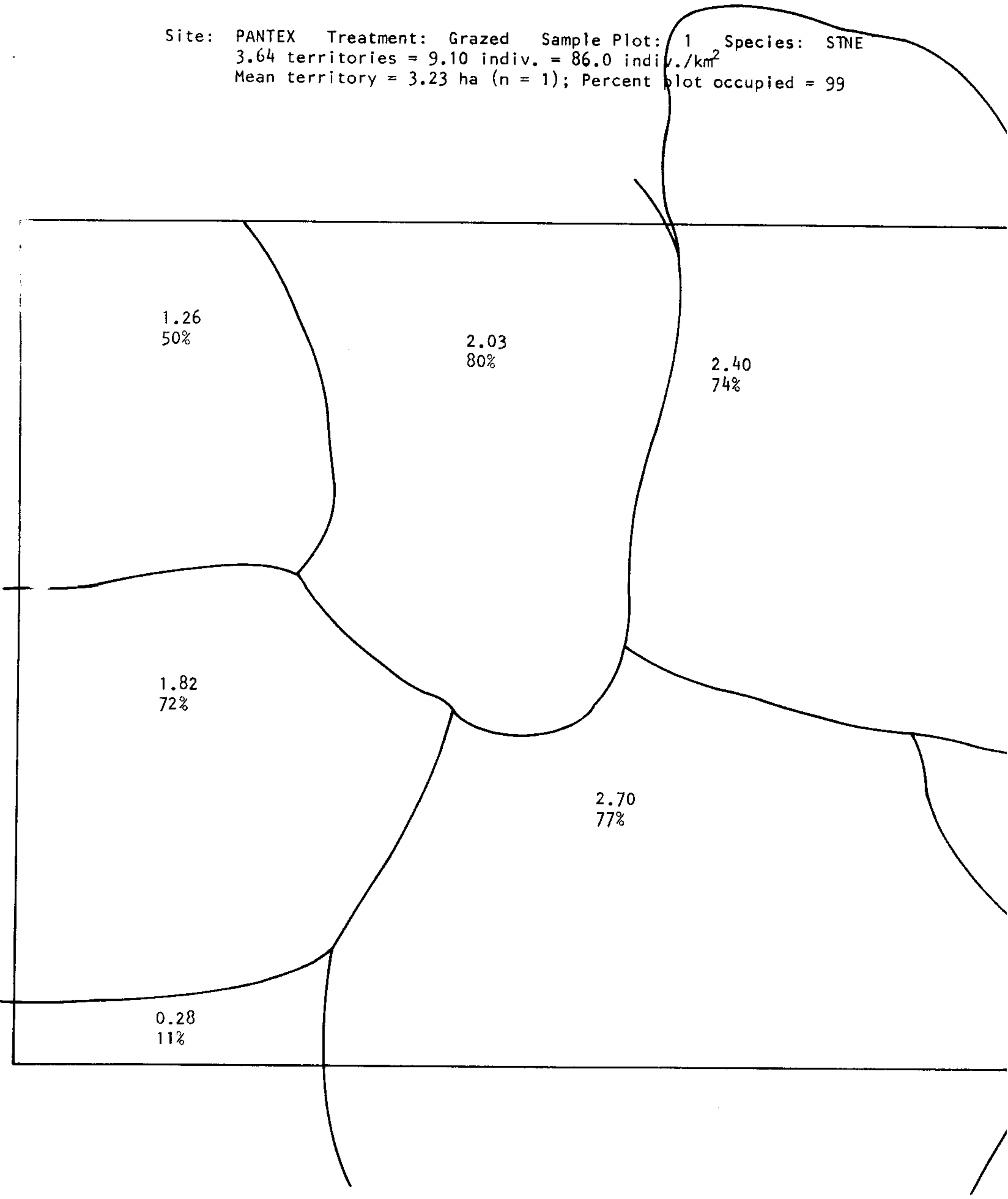
Site: PANTEX Treatment: Ungrazed Sample Plot: 1 Species: STNE
2.46 territories = 6.15 indiv. = 59.7 indiv./km^2
Mean territory = 3.21 ha (n = 1); Percent plot occupied = 77



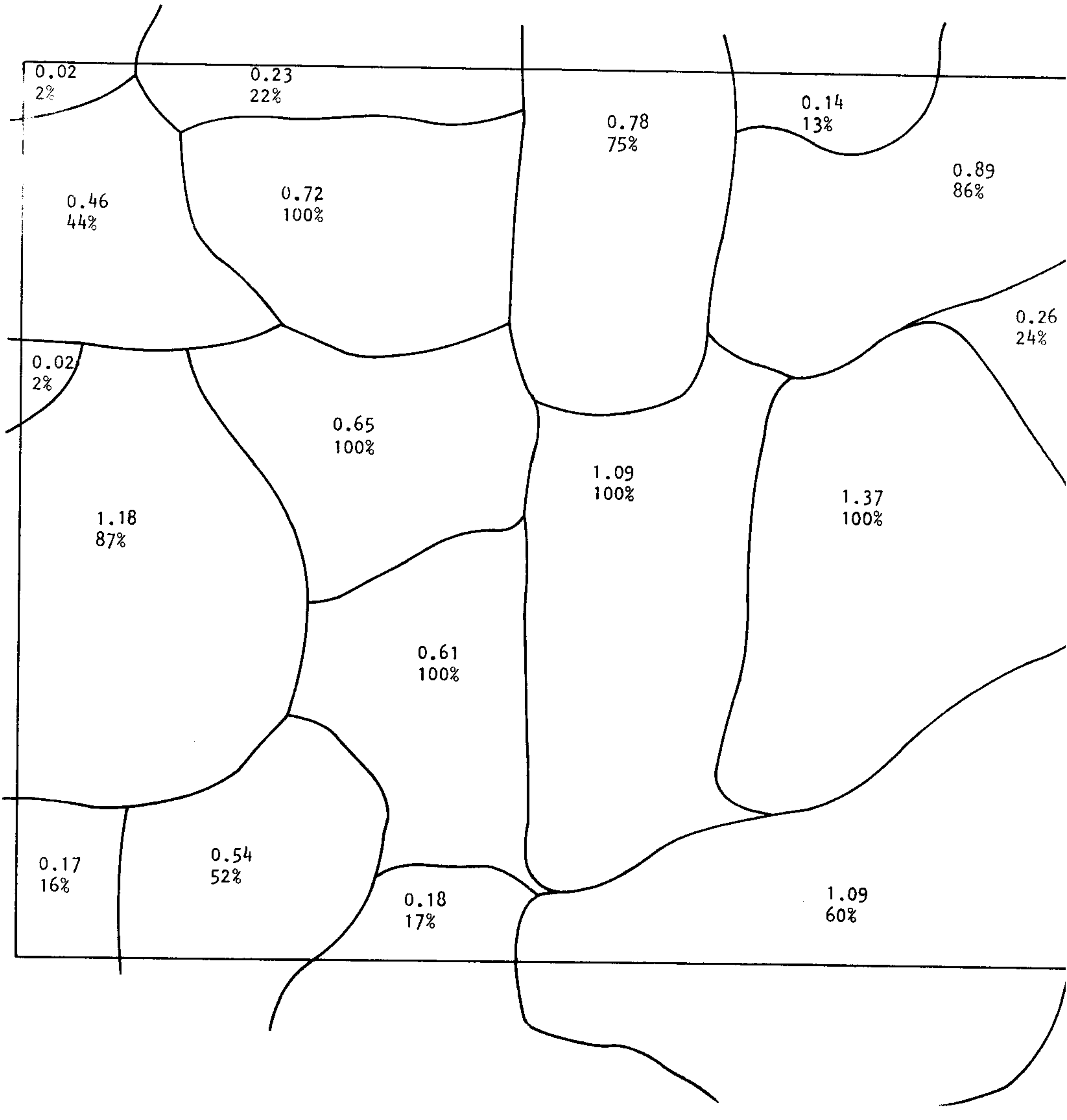
Site: PANTEX Treatment: Grazed Sample Plot: 1 Species: ERAL
5.80 territories = 11.60 indiv. = 109.6 indiv./km^2
Mean territory = 0.95 ha (n = 3); Percent plot occupied = 67



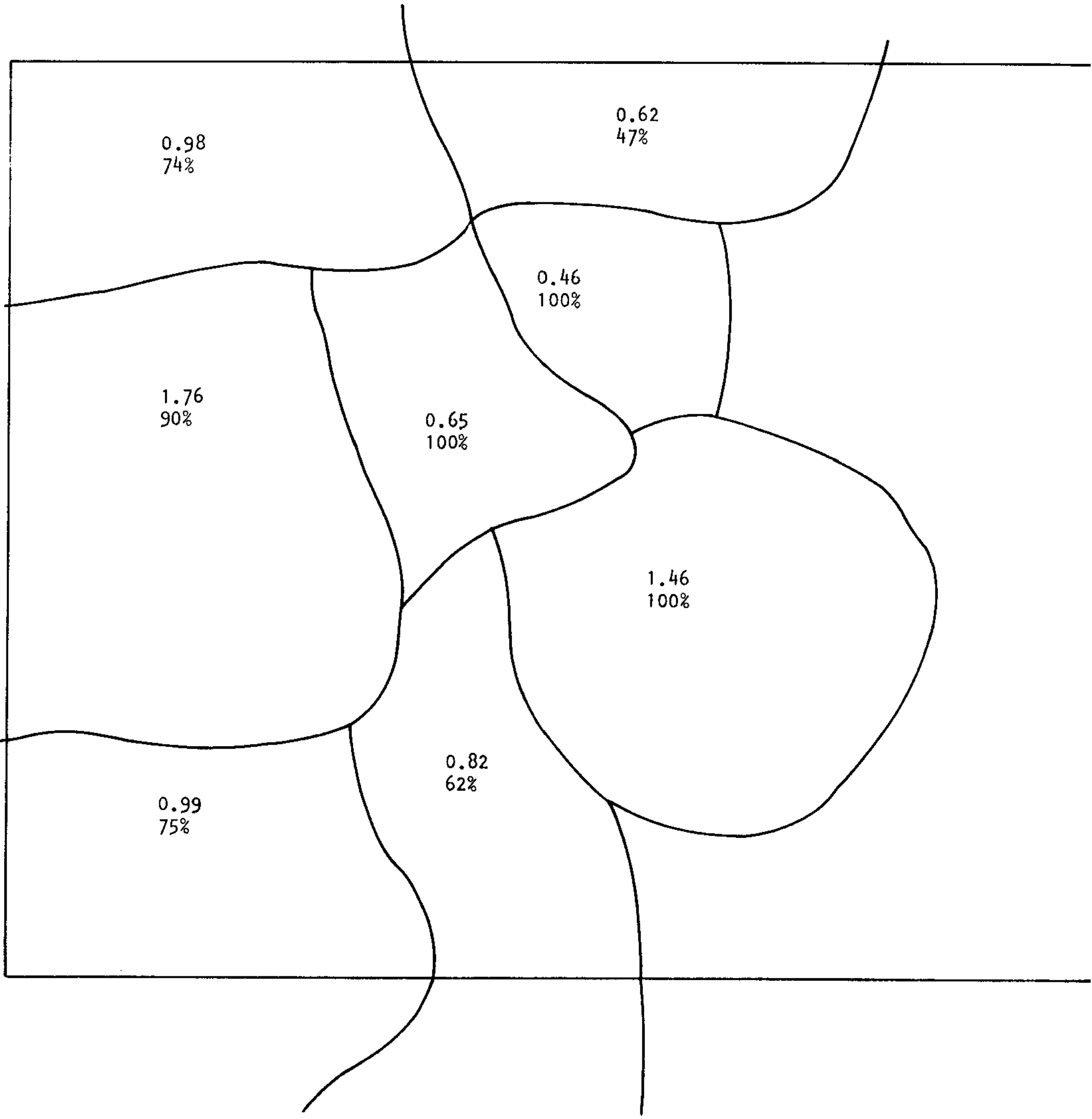
Site: PANTEX Treatment: Grazed Sample Plot: 1 Species: STNE
3.64 territories = 9.10 indiv. = 86.0 indiv./km^2
Mean territory = 3.23 ha (n = 1); Percent plot occupied = 99



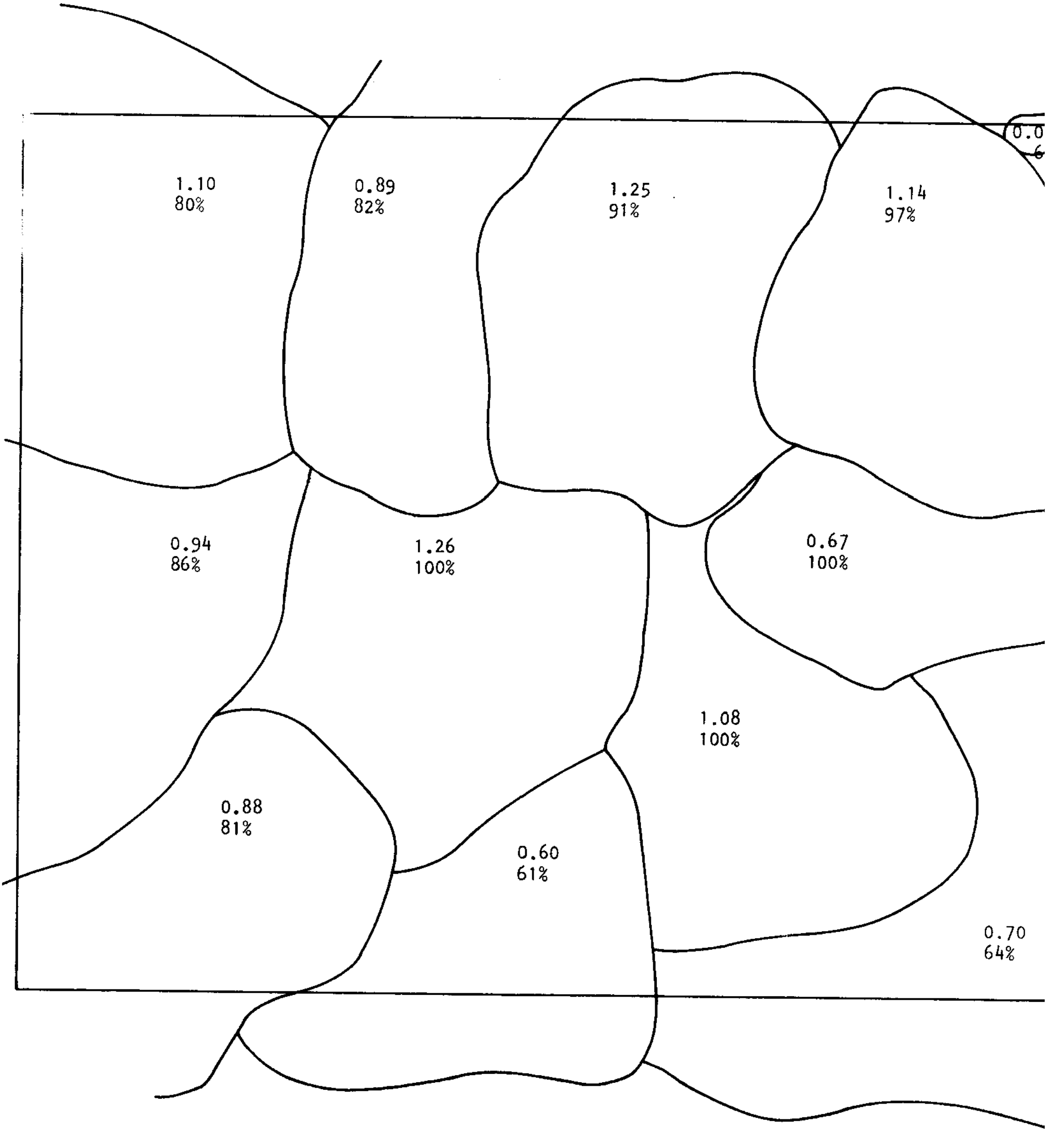
Site: PANTEX Treatment: Grazed Sample Plot: 1 Species: AMSA
10.01 territories = 20.02 indiv. = 189.2 indiv./km^2
Mean territory = 1.04 ha (n = 6); Percent plot occupied = 98



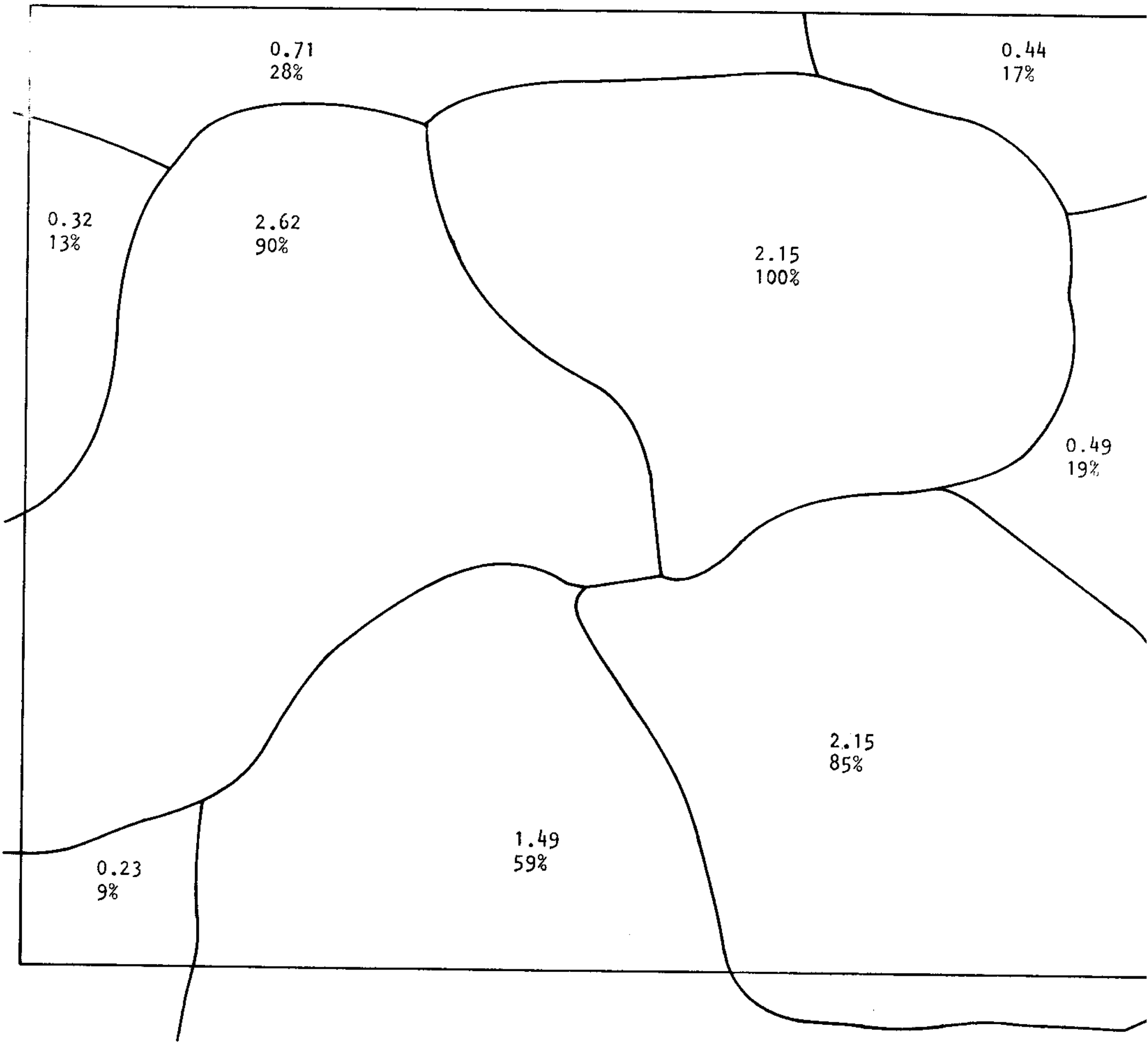
Site: PANTEX Treatment: Grazed Sample Plot: 2 Species: ERAL
6.48 territories = 12.96 indiv. = 122.5 indiv./km^2
Mean territory = 0.86 ha (n = 3); Percent plot occupied = 73



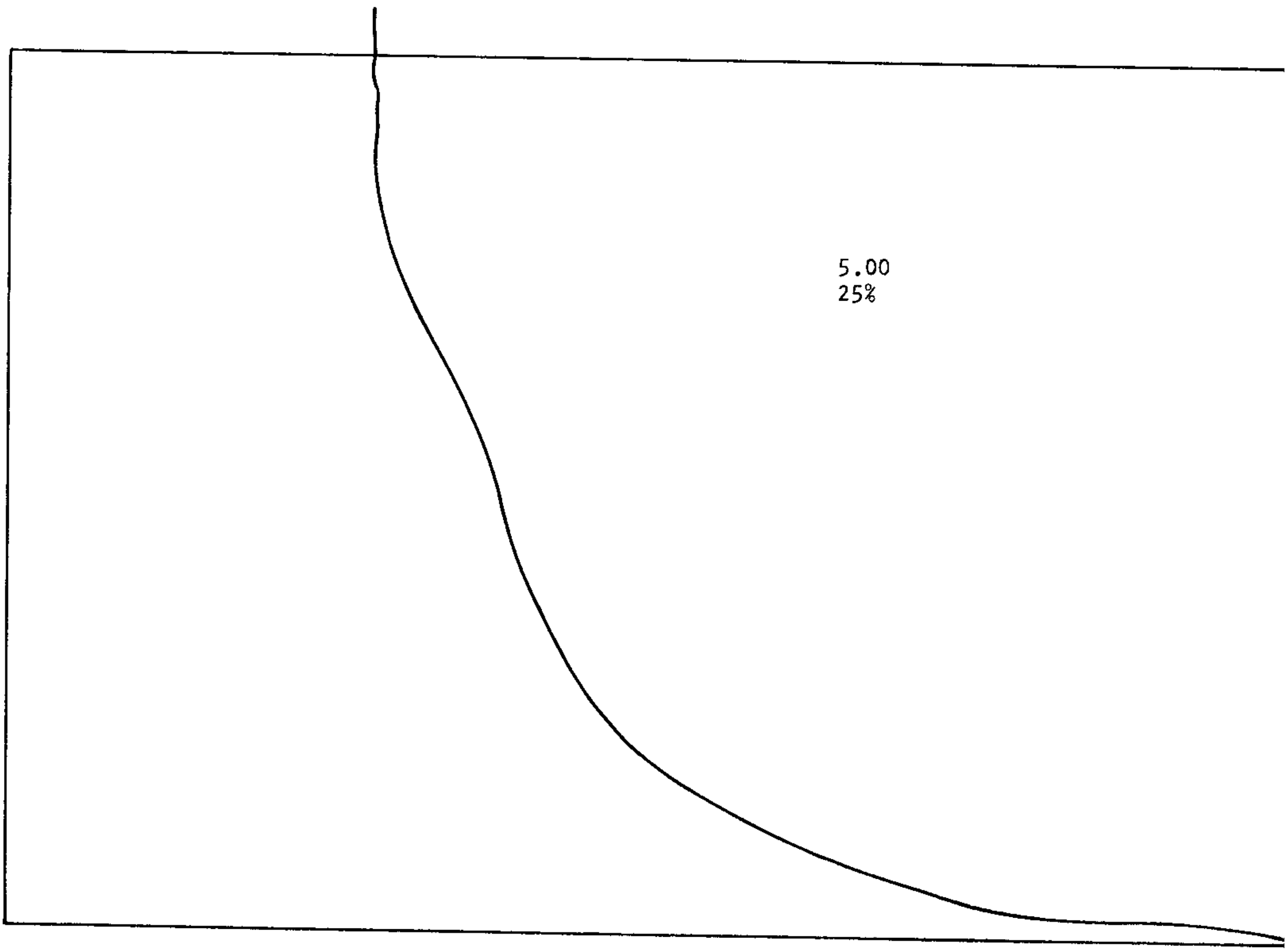
Site: PANTEX Treatment: Grazed Sample Plot: 2 Species: AMSA
9.49 territories = 18.98 indiv. = 179.4 indiv./km^2
Mean territory = 1.09 ha (n = 6); Percent plot occupied = 100



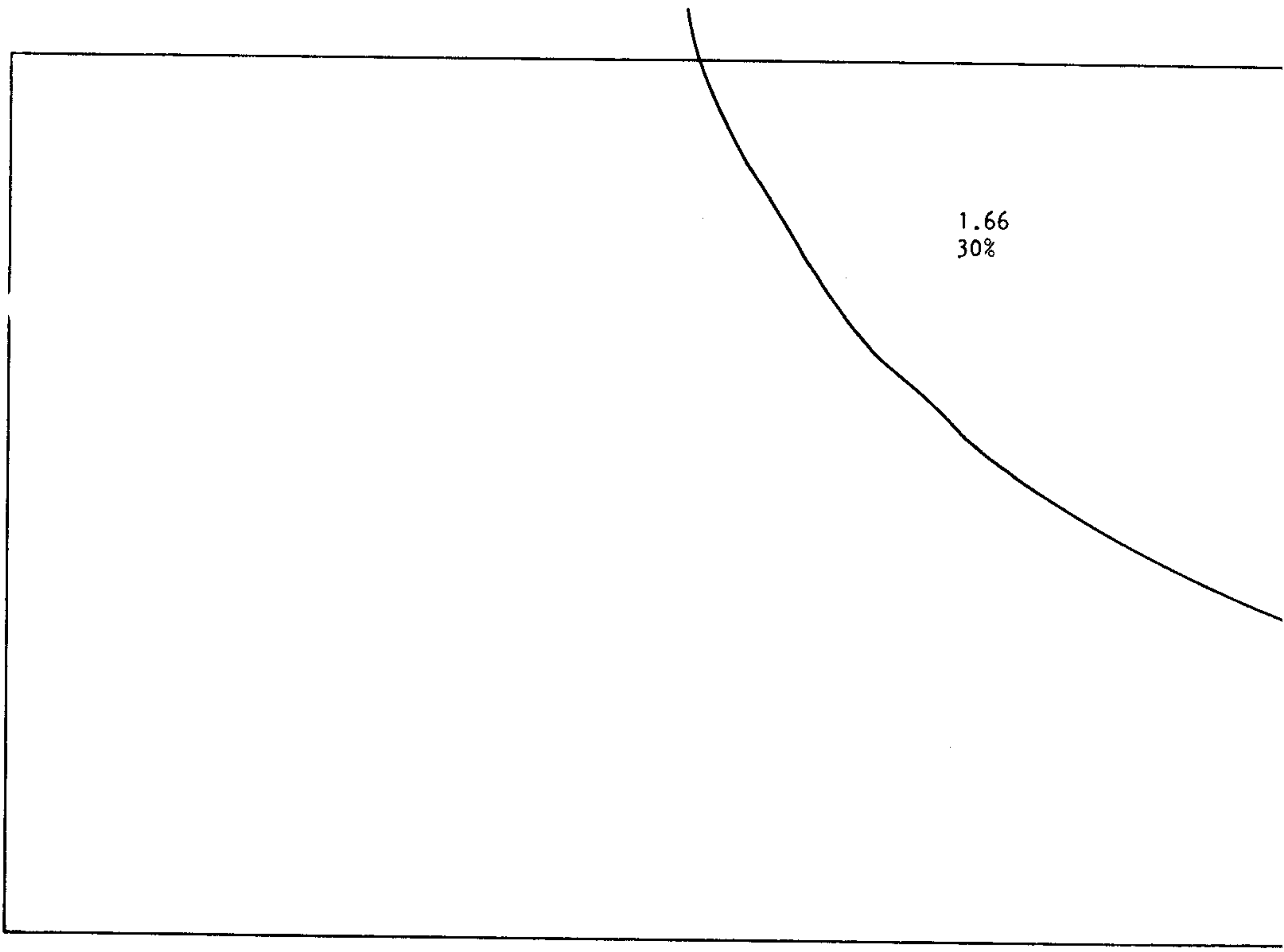
Site: PANTEX Treatment: Grazed Sample Plot: 2 Species: ST NE
4.20 territories = 10.50 indiv. = 99.2 indiv./km^2
Mean territory = 2.15 ha (n = 1); Percent Plot occupied = 100



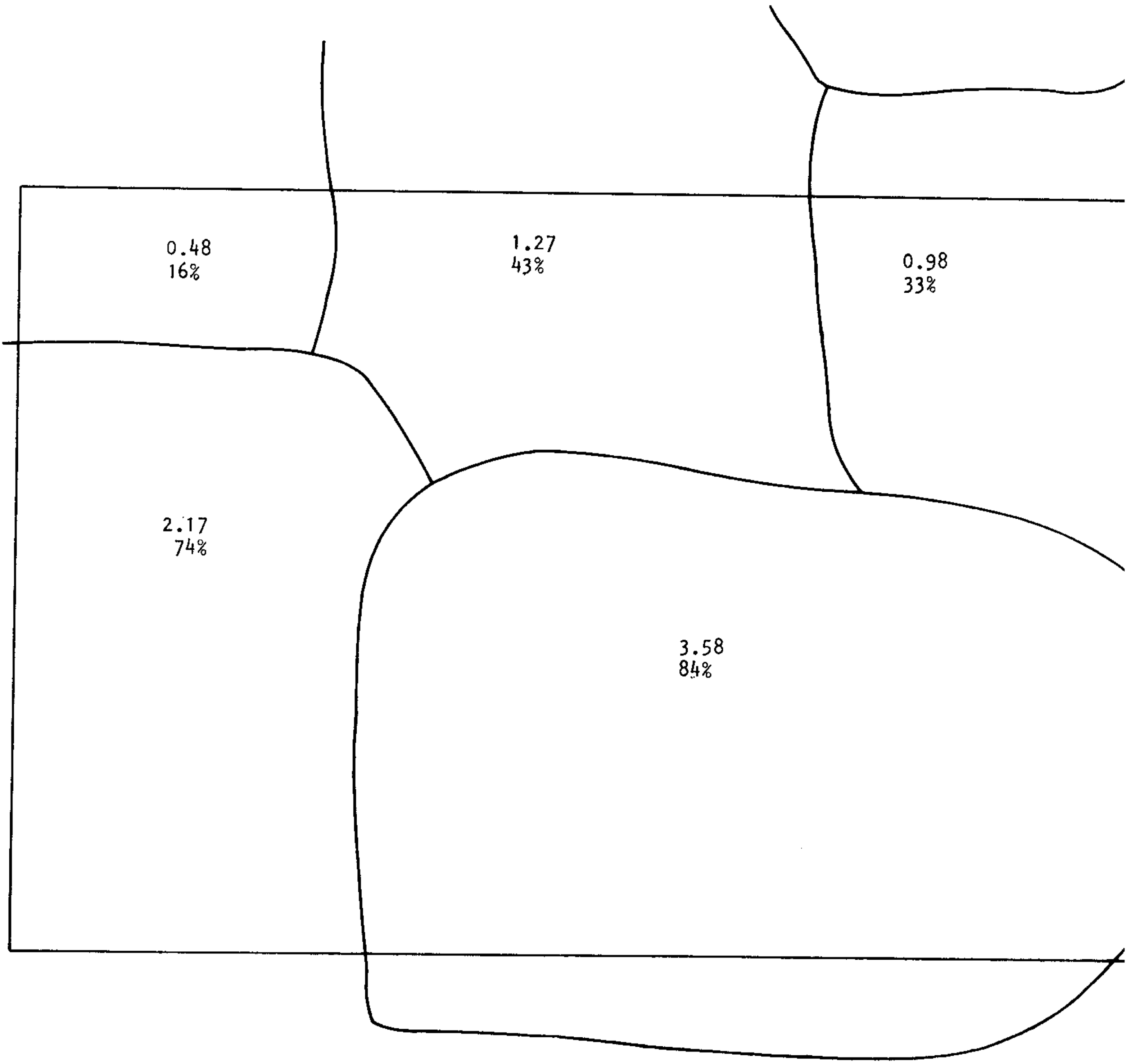
Site: OSAGE Treatment: Grazed Sample Plot: 1 Species: CHMI
0.25 territories = 0.50 indiv. = 5.9 indiv./km^2
Percent plot occupied = 60



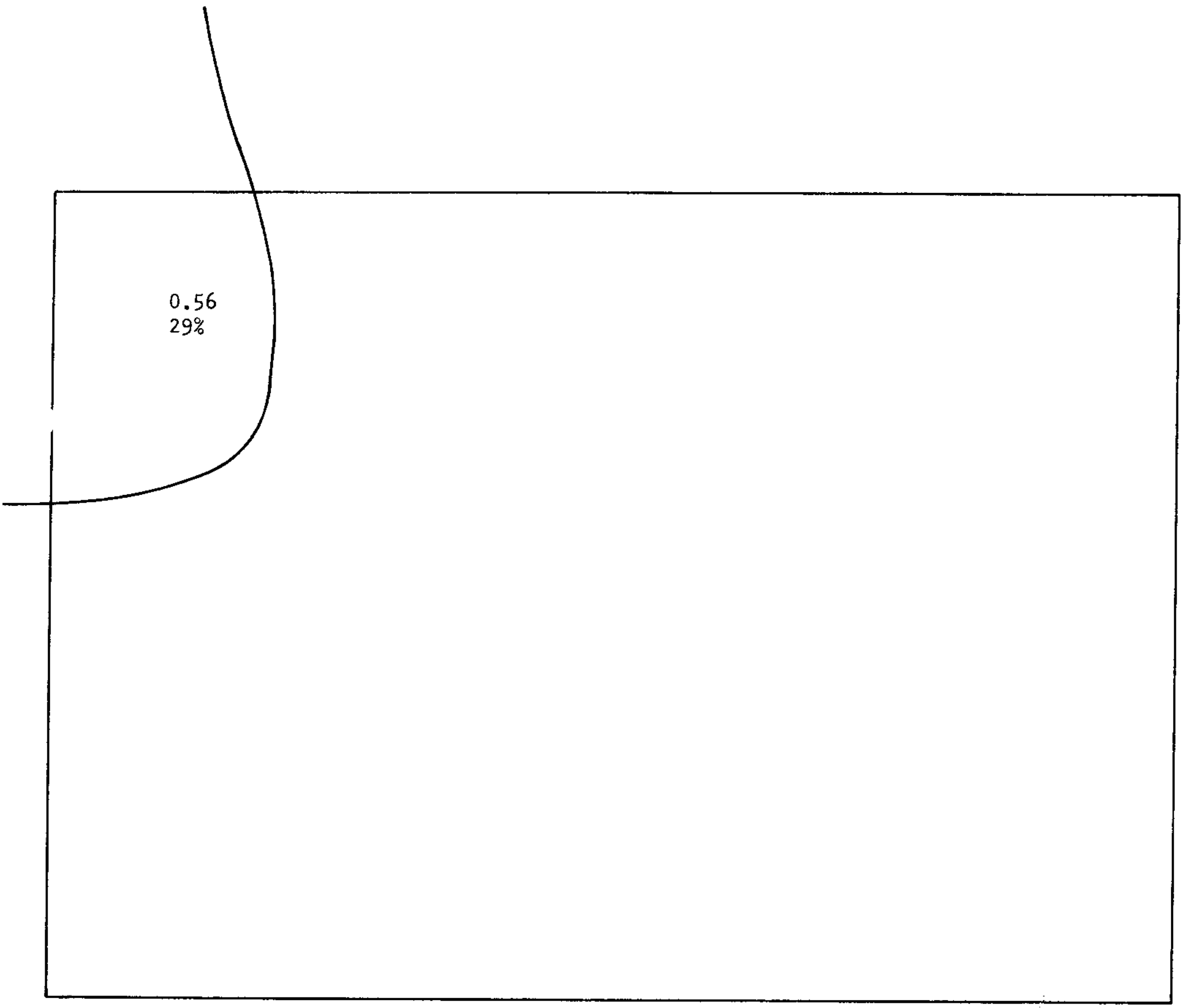
Site: OSAGE Treatment: Grazed Sample Plot: 1 Species: BALO
0.30 territories = 0.60 indiv. = 7.1 indiv./km^2
Percent plot occupied = 19



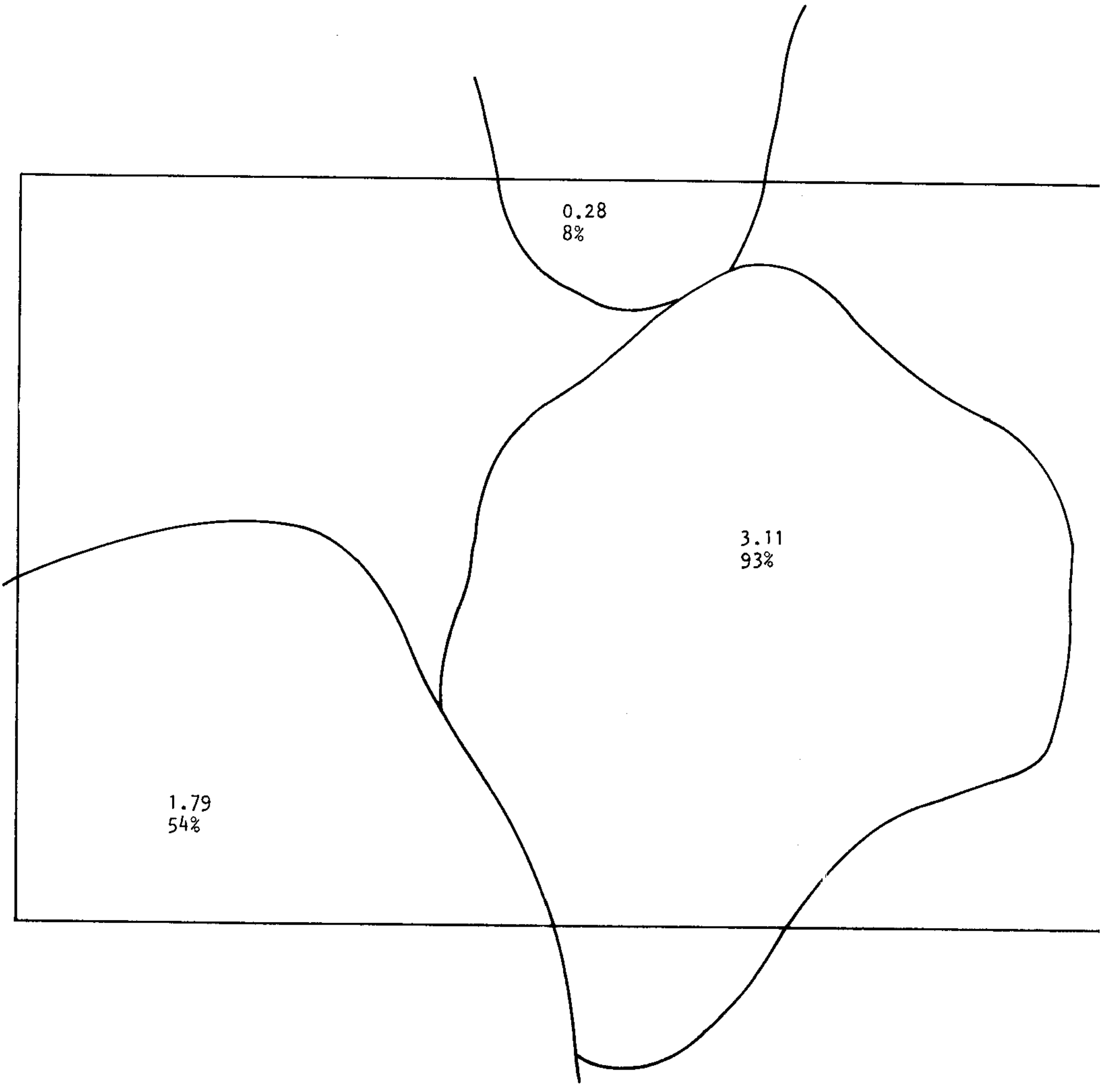
Site: OSAGE Treatment: Grazed Sample Plot: 1 Species: STMA
2.50 territories = 6.25 indiv. = 74.4 indiv./km²
Mean territory = 4.27 ha (n = 1); Percent plot occupied = 100



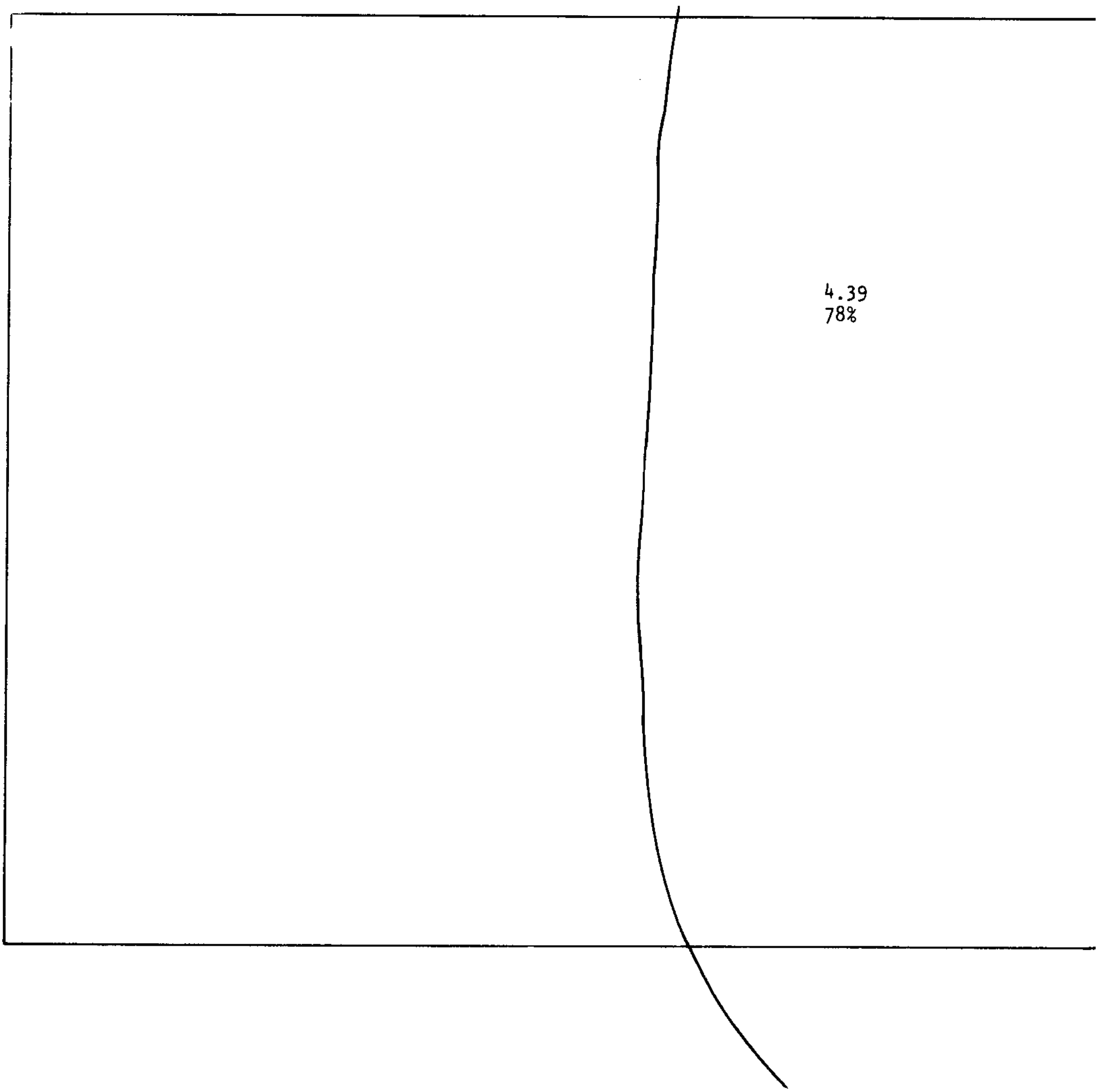
Site: OSAGE Treatment: Grazed Sample Plot: 1 Species: SPAM
0.29 territories = 0.73 indiv. = 8.6 indiv./km^2
Percent plot occupied = 7



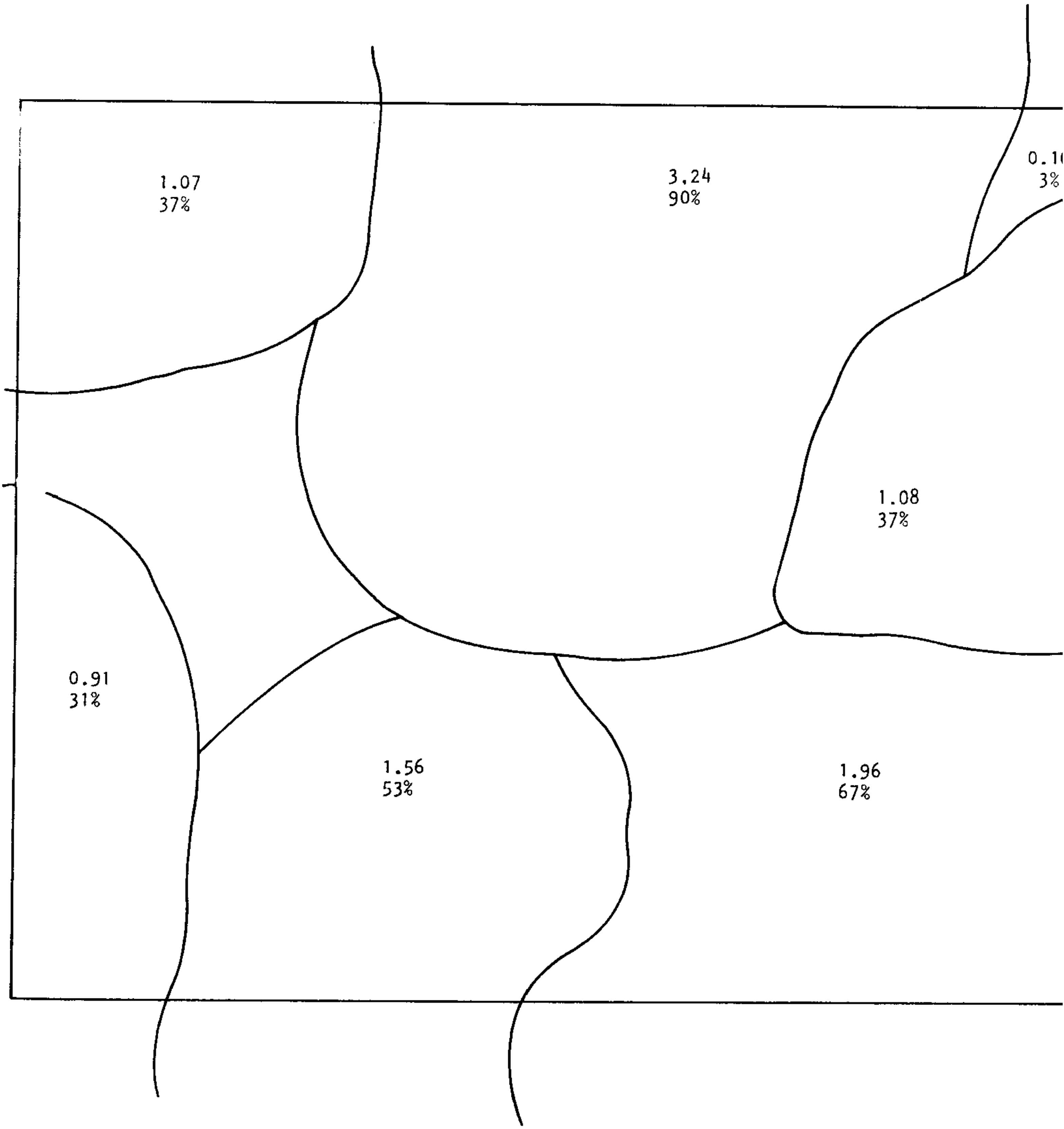
Site: OSAGE Treatment: Grazed Sample Plot: 1 Species: AMSA
1.55 territories = 3.10 indiv. = 36.9 indiv./km^2
Mean territory = 3.34 ha (n = 1); Percent plot occupied = 62



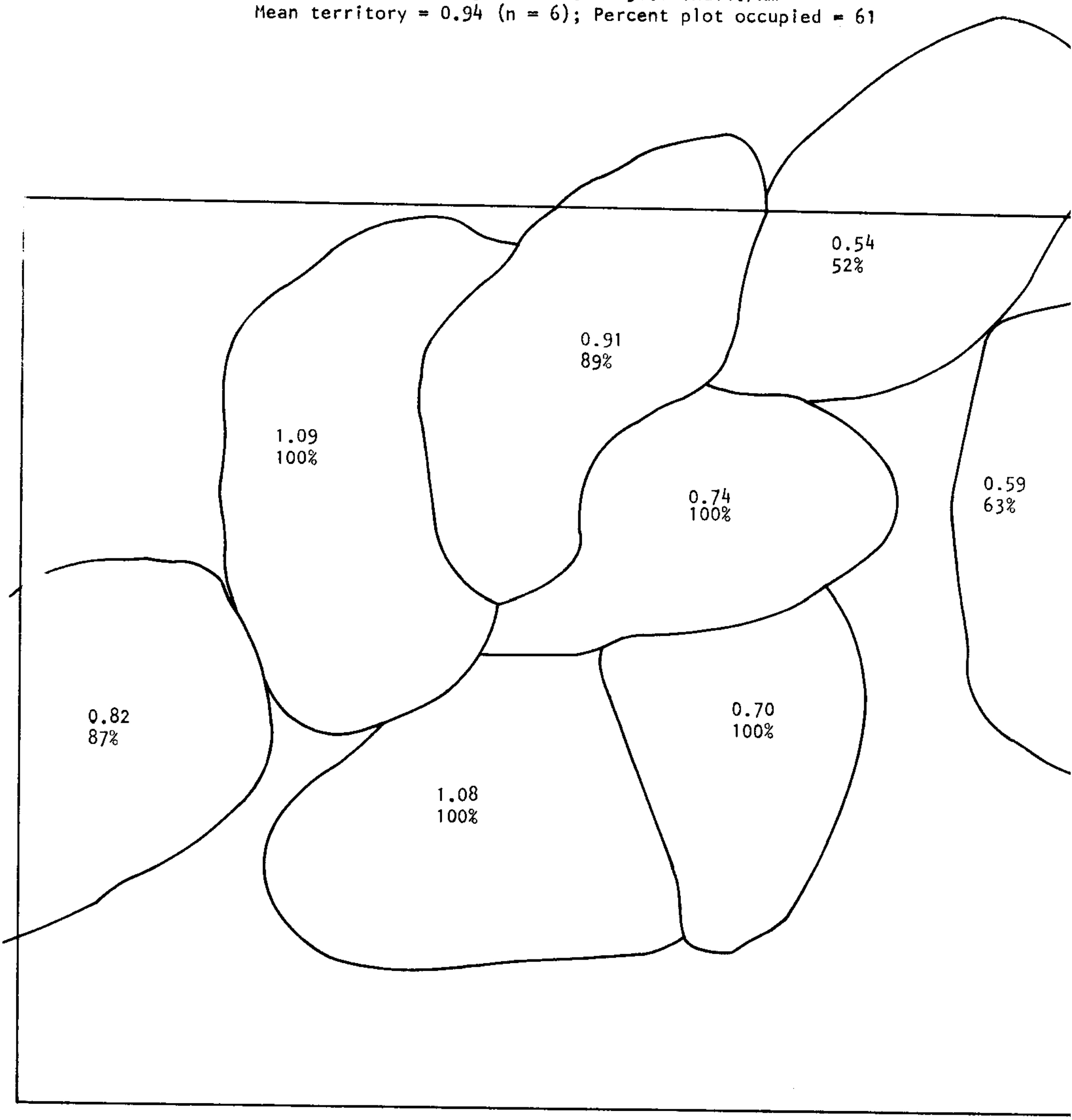
Site: OSAGE Treatment: Grazed Sample Plot: 2 Species: BALO
0.78 territories = 1.56 indiv. = 18.6 indiv./km^2
Percent plot occupied = 41



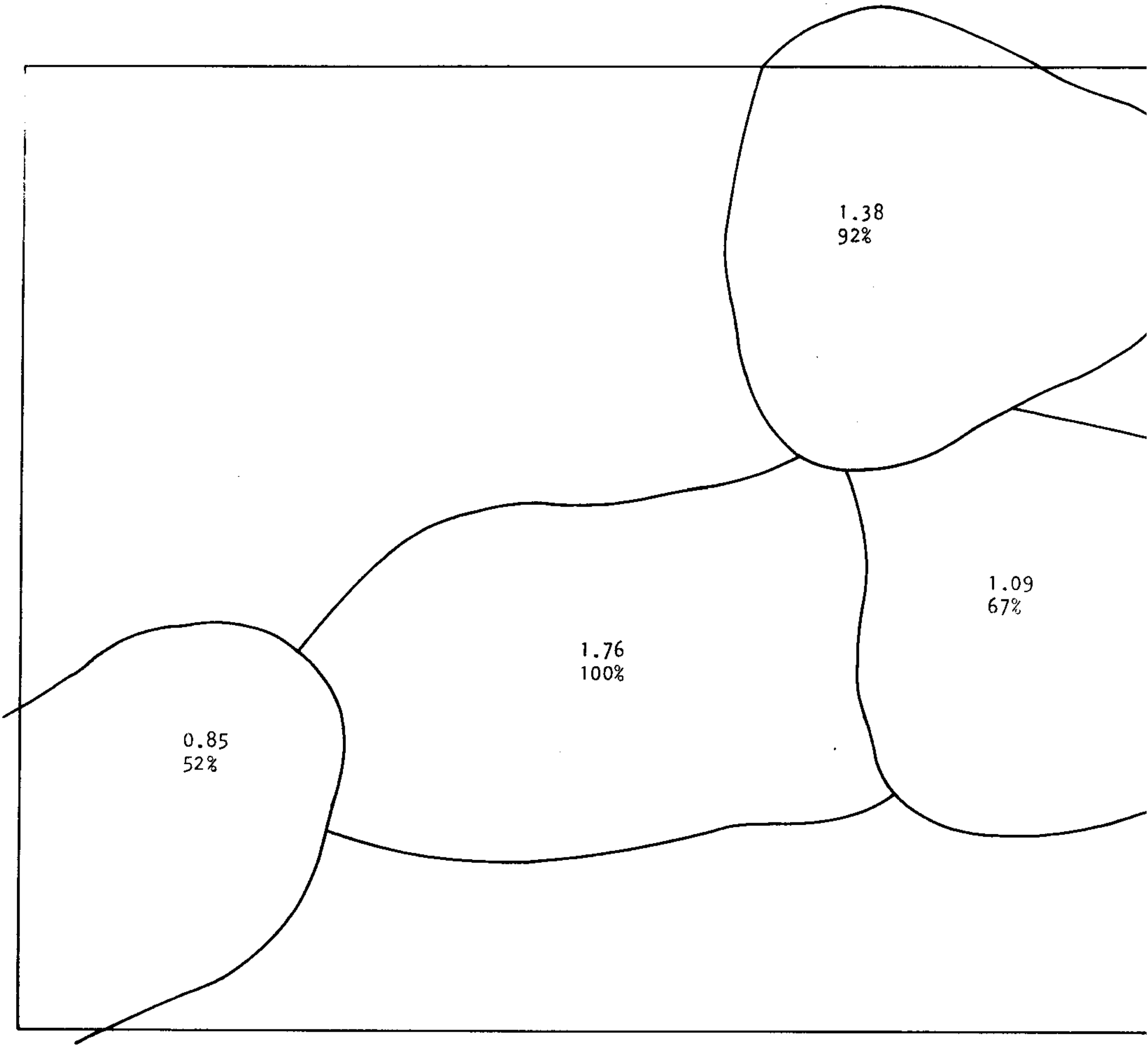
Site: OSAGE Treatment: Grazed Sample Plot: 2 Species: STMA
3.18 territories = 7.95 indiv. = 75.1 indiv./km^2
Percent plot occupied = 94



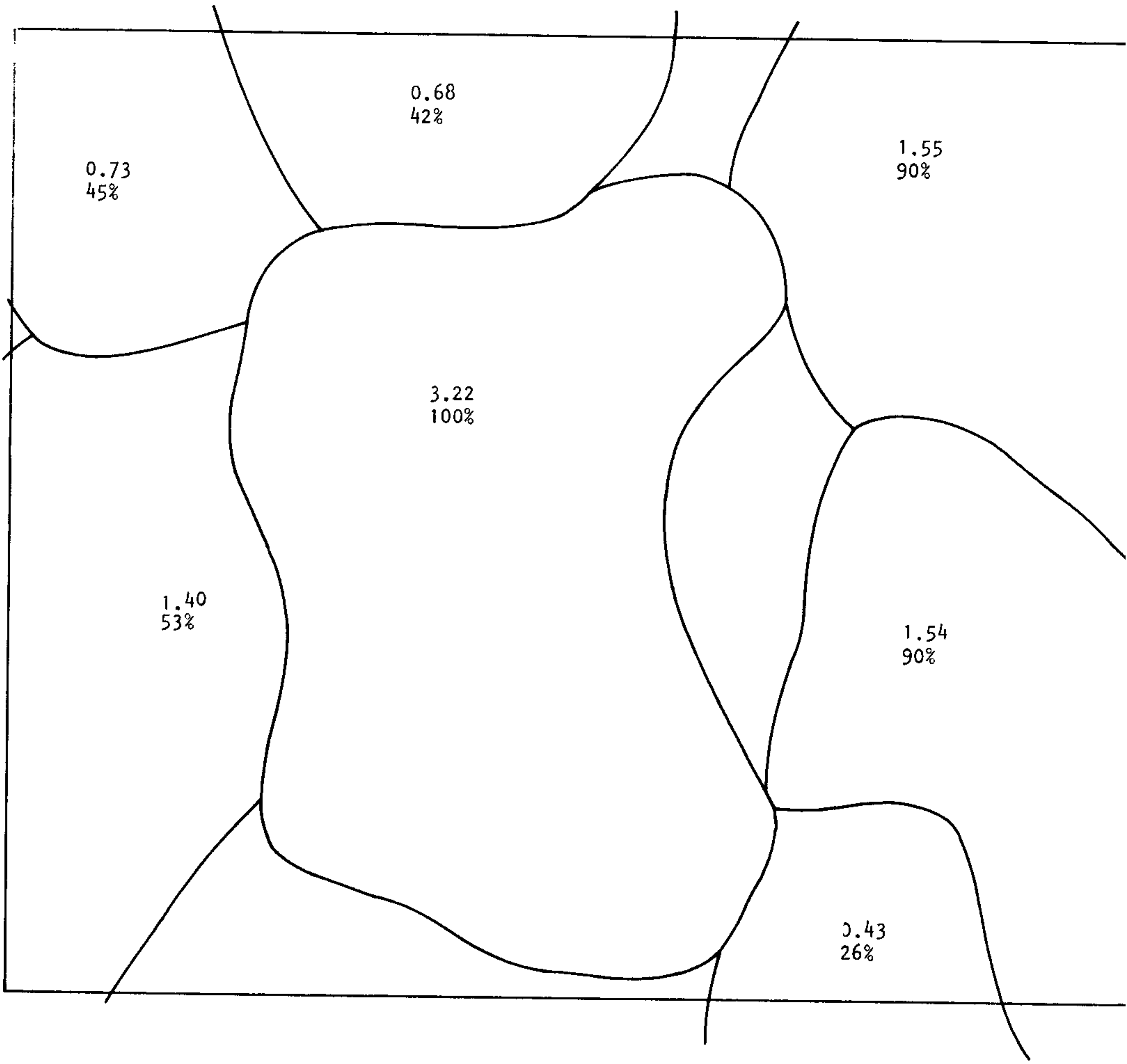
Site: OSAGE Treatment: Grazed Sample Plot: 2 Species: AMSA
6.91 territories = 13.8 indiv. = 130.6 indiv./km^2
Mean territory = 0.94 (n = 6); Percent plot occupied = 61



Site: OSAGE Treatment: Grazed Sample Plot: 2 Species: SPAM
3.11 territories = 7.78 indiv. = 73.5 indiv./km^2
Mean territory = 1.63 (n = 2); Percent plot occupied = 48



Site: ALE Treatment: Ungrazed Sample Plot: 1 Species: ERAL
4.46 territories = 8.92 indiv. = 84.3 indiv./km^2
Mean territory = 3.22 ha (n = 1); Percent plot occupied = 90



APPENDIX III

SUMMARY OF 1972 NESTING RECORDS FOR IBP GRASSLAND BIOME SITES

Site	Species	Nest No.	Comments
ALE	Horned Lark	1	3 near-fledglings, May 4; ran from nest
		-	Juvenile collected May 6
	Sage Sparrow	1	2 fledglings, May 5
		2	3 eggs, May 6
		3	3 eggs, May 7
		-	1 juvenile collected, May 5; 2 collected, May 6
	Western Meadowlark	1	1 large nestling, May 6
Pantex	Horned Lark	1	3 fledglings, June 9
		2	4 2- to 3-day chicks, June 9; eyes open, June 11; nest empty, June 12
		3	1 large nestling, June 10; foraging with ♀, June 12
		4	4 nestlings, June 12; nest empty, June 13
		-	1 juvenile collected, June 3; 3 juveniles collected, June 8
	Western Meadowlark	1	2 eggs, June 2; 6 eggs, June 3
		-	1 juvenile collected, June 3; 1 juvenile collected, June 10
	Grasshopper Sparrow	1	3 freshly-hatched chicks + 1 cracked egg, June 11; 3 chicks, June 12
		-	1 juvenile collected, June 9
Osage	Common Nighthawk	1	2 eggs, June 18; same, June 19; near grazed plot 1
	Eastern Meadowlark	1	1 egg, June 16; 2 eggs, June 17; 3 eggs, June 18; empty, June 19, severe thunderstorm previous evening

APPENDIX III (continued)

Site	Species	Nest No.	Comments
		-	1 juvenile collected, June 18
Cottonwood	Killdeer	1	3 eggs, June 21; 3 eggs, July 3; near grazed plot
	Horned Lark	1	4 eggs, June 22; 3 nestlings + 1 egg, June 29; 4 nestlings, June 30; nest empty, July 1
		2	3 eggs, June 28; unchanged, July 3
	Western Meadowlark	1	4 new nestlings + 2 eggs, June 27; 5 nestlings + 1 egg, June 28
		-	1 juvenile collected, June 23; 1 juvenile collected, June 29

APPENDIX IV

DATA APPENDIX FOR AVIAN ROAD COUNT SUMMARY

The Avian Road Count Summary data were recorded on form NREL-22. These are summaries of previously recorded data. The IBP designations for these data are listed below by the site. Examples of the data form and data follow.

ALE	A2U2001
COTTONWOOD	A2U2004
OSAGE	A2U2009
PANTEX	A2U200B

IBP

GRASSLAND BIOME

U.S. INTERNATIONAL BIOLOGICAL PROGRAM

FIELD DATA SHEET - AVIAN ROAD COUNT SUMMARY

DATA TYPE	SITE	INITIALS	DATE			TREATMENT	REPLICATE	PLOT SIZE	GROUP	GENUS	SPECIES	SEX	PAGE TOTALS					NO. STOPS
			Day	Mo	Yr								1	2	3	4	5	
1-2	3-4	5-7	8-9	10-11	12-13	14	15	16-19	21	23-24	26-27	29	31-32	34-35	37-38	40-41	43-44	46-48

DATA TYPE
01 Aboveground Biomass
02 Litter
03 Belowground Biomass
10 Vertebrate - Live Trapping
11 Vertebrate - Snap Trapping
12 Vertebrate - Collection
20 Avian Flush Census
21 Avian Road Count
22 Avian Road Count Summary
23 Avian Collection - Internal
24 Avian Collection - External
25 Avian Collection - Plumage
30 Invertebrate
40 Microbiology - Decomposition
41 Microbiology - Nitrogen
42 Microbiology - Biomass
43 Microbiology - Root Decomposition
44 Microbiology - Respiration

SITE
01 Ale
02 Bison
03 Bridger
04 Cottonwood
05 Dickinson
06 Hays
07 Hopland
08 Jornada
09 Osage
10 Pantex
11 Pawnee

TREATMENT
1 Ungrazed
2 Lightly grazed
3 Moderately grazed
4 Heavily grazed
5 Grazed 1969, ungrazed 1970
6
7
8
9

FIELD DATA

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2201JAW070572          8 ST NE   86 20            12 12
2201JAW070572          9 AM BE   28 00            07 12
2201JAW070572          9 SP BR   04 04            03 12
2201JAW070572          9 PA SA   13 04            07 12
2201JAW070572          9 PO GR   20 07            06 12
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FIELD DATA

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2204NRW280572          3 CH VO   14 01           007 30
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2204NRW280572          5 TY VE   09 00           004 30
2204NRW280572          5 ER AL   26 09           011 30
2204NRW280572          5 HI RU   04 00           002 30
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2204NRW280572          4 ZE MA   24 06           008 30
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2204NRW280572          8 QU QU   04 00           003 30
2204NRW280572          8 IC SP   01 00           001 30
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2204NRW280572	0	PO	PO	02	00	001	30
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FIELD DATA

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2209EHM090672	7	ST	VU	07	00	002	30
2209EHM090672	2	AR	HE	00	01	001	30
2209EHM090672	6	TU	MI	00	02	002	30
2209EHM090672	2	BU	VI	00	02	002	30
2209FHM090672	8	IC	GA	00	01	001	30
2209FHM090672	7	GE	TR	00	02	002	30
2209EHM090672	9	GU	CA	00	02	002	30
2209EHM190972	8	ST	NE	98	14	25	30
2209FHM190972	5	CO	BR	4	0	3	30
2209FHM190972	5	HI	RU	5	13	4	30
2209FHM190972	7	LA	LU	2	0	1	30
2209EHM190972	1	FA	SP	2	2	3	30
2209EHM190972	5	ER	AL	80	40	9	30
2209FHM190972	3	CH	VO	6	3	5	30
2209EHM190972	1	CY	CY	5	4	7	30
2209FHM190972	8	AG	PH	63	1	6	30
2209EHM190972	2	TY	CU	3	0	1	30
2209FHM190972	4	ZE	MA	1	5	4	30
2209EHM190972	8	MO	AT	79	4	6	30
2209EHM190972	5	MU	FO	1	0	1	30
2209EHM190972	5	PR	SU	1	0	1	30
2209EHM190972	7	ST	VU	4	0	1	30
2209EHM190972	4	ME	ER	0	4	3	30
2209EHM190972	4	CO	AU	0	1	1	30
2209EHM190972	1	BU	JA	0	1	1	30
2209EHM190972	4	AR	CO	0	6	2	30
2209EHM190972	9	AM	SA	0	3	1	30
2209FHM190972	1	CA	AU	0	5	2	30

FIELD DATA

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123456789012345678901234567890123456789012345678901234567890123456789

2210KDS230172	1	FA	SP	00	01	03		03	30
2210KDS230172	1	BU	RE	00	00	01		01	30
2210KDS230172	1	BU	JA	01	00	01		02	30
2210KDS230172	8	ST	NE	06	00	00		03	30
2210KDS230172	5	ER	AL	15	03	00		05	30
2210KDS230172	8	AG	PH	300	00	00		01	30
2210KDS230172	7	ST	VU	00	08	00		01	30
2210KDS030572	5	ER	AL	35	10	17		20	30
2210KDS030572	8	ST	NE	51	30	18		27	30
2210KDS030572	7	ST	VU	01	00	00		01	30
2210KDS030572	9	AI	CA	10	35	15		24	30
2210KDS030572	9	AM	SA	01	01	00		02	30
2210KDS030572	9	CH	GR	08	05	06		14	30
2210KDS030572	9	CA	ME	39	09	74		13	30
2210KDS030572	8	AG	PH	13	02	00		04	30
2210KDS030572	8	PA	DO	03	00	01		03	30

2210KDS030572	4	ZE MA	09	07	13	12	30
2210KDS030572	1	FA SP	01	00	00	01	30
2210KDS030572	2	CA SQ	02	00	00	01	30
2210KDS030572	9	SP PA	01	03	00	04	30
2210KDS030572	5	TY VE	01	02	02	04	30
2210KDS030572	6	MI PO	03	01	03	06	30
2210KDS030572	3	CH VO	01	01	00	02	30
2210KDS030572	9	PO GR	02	02	00	02	30
2210KDS030572	9	PA SA	01	00	00	01	30
2210KDS030572	9	SP PL	01	00	00	01	30
2210KDS030572	5	PE PY	06	01	00	02	30
2210KDS030572	7	LA LU	00	01	00	01	30
2210KDS030572	8	MU AT	00	01	00	01	30
2210KDS030572	5	HI RU	00	09	00	02	30
2210KDS030572	1	BU JA	00	01	00	01	30
2210KDS030572	8	ST MA	00	00	01	01	30
2210KDS030572	5	MU FO	00	00	09	05	30
2210KDS180672	8	ST NE	99	24		029	30
2210KDS180672	5	ER AL	47	11		018	30
2210KDS180672	9	AI CA	63	25		029	30
2210KDS180672	9	AM SA	02	00		001	30
2210KDS180672	5	TY VE	01	01		002	30
2210KDS180672	4	ZE MA	53	03		016	30
2210KDS180672	8	AG PH	01	00		001	30
2210KDS180672	4	CH MI	04	00		004	30
2210KDS180672	3	CH VO	03	03		004	30
2210KDS180672	2	CA SQ	07	02		009	30
2210KDS180672	9	CH GR	04	05		009	30
2210KDS180672	6	MI PO	02	05		005	30
2210KDS180672	2	CO VI	01	00		001	30
2210KDS180672	1	BU SW	01	00		001	30
2210KDS180672	5	MU FO	01	02		003	30
2210KDS180672	5	HI RU	12	01		005	30
2210KDS180672	9	GU CA	01	00		001	30
2210KDS180672	1	BU JA	02	00		002	30
2210KDS180672	5	PE PY	01	00		001	30
2210KDS180672	8	IC BU	00	02		002	30
2210KDS180672	7	LA LU	00	01		001	30
2210KDS180672	7	ST VU	00	05		001	30
2210KDS170972	1	CY CY	02	00		002	30
2210KDS170972	5	ER AL	59	05		020	30
2210KDS170972	8	ST NE	90	16		027	30
2210KDS170972	3	CH VO	10	02		006	30
2210KDS170972	1	FA SP	03	02		003	30
2210KDS170972	9	AM SA	02	00		001	30
2210KDS170972	8	AG PH	02	00		002	30
2210KDS170972	9	CA ME	14	01		004	30
2210KDS170972	1	BU SW	01	01		002	30
2210KDS170972	5	ZE MA	06	08		008	30
2210KDS170972	7	LA LU	05	01		004	30
2210KDS170972	2	CA SQ	25	03		006	30
2210KDS170972	1	BU JA	00	01		001	30
2210KDS170972	5	MU FO	00	01		001	30
2210KDS170972	9	PO GR	01	04		002	30
2210KDS170972	9	PA SA		02		1	30
2210KDS170972	9	SP PA	30	07		007	30