Technical Report No. 93

1970 INSECT STUDIES AT OSAGE COMPREHENSIVE SITE

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ABSTRACT

Results of 1970 collections of insects at the Osage Site are summarized. Samples were collected at approximately two week intervals through the growing season, beginning in July, on the grazed and ungrazed treatment areas.

INTRODUCTION

The Osage Site has been described in IBP Technical Report No. 44 (Risser 1970); a summary of meteorological data collected will be found in the Osage Site 1970 Report by Paul Risser. A description of 1970 sampling is given in Table 1. Dates correspond closely to floral sampling dates. The November 23 collection, however, was taken approximately a week later and during sub-freezing weather. Earlier samples were taken by sweep net (June 2-3 and 17-19) but cannot be used except in our faunal study planned for the area.

METHODS

Collecting methods correspond closely with the suggested methods in IBP Technical Report No. 35 (French 1970). Material collected, however, was placed in Coleman ice chests and returned to Manhattan, Kansas for separation. The quick traps used were designed and fabricated at the Pantex Site using the original model described by Turnbull and Nicholls (1966). The traps for the Osage Site differed from the others in that they were twice as tall; this was to accommodate the tall grass found at this site.

After the initial successful sampling period (July 3), it was determined that the plots had to be clipped prior to using the D-vac vacuum method of collecting. Kauri, Moldung, and Solhoy (1969) describe the method that was modified for our use. After the traps were dropped, the plot was clipped using hand-powered grass clippers; the clippings were then placed in ordinary commercial brown paper sacks and were saved for extraction in Berlese funnels. The plots were then vacuumed and the D-vac collecting bags were removed and placed in ice chests for return to the laboratory and extraction.

Table 1. Insect samples taken at the Osage Site, 1970.

Date	Samples/ Replicate	Replicates/ Treatment	Number of Treatments[a/]	Data Sheets Submitted[b/]	Analyses Returned
July 3	5	2	2	Yes	Yes
July 16	5	2	2	Yes	Yes
Aug. 3	5	2	2	Yes	Yes
Aug. 17	5	2	2	Yes	Yes
Sept. 27	5	2	2	Yes	Yes
Oct. 25	5	2	2	Yes	Yes
Nov. 23	5	2	2	Yes	Yes

a/ Treatments were: Ungrazed (1) and Grazed 1969--Ungrazed 1970 (5).

b/ Dates given are dates by which data sheets will be submitted.

Extraction was done by placing the D-vac material in Berlese funnels for 48 hours. Insects were collected in 70% isopropyl alcohol; the litter was then removed from the funnel and saved for hand-sorting. The grass clippings were then placed in the Berlese funnel for 48 hours; the clippings were also saved for hand-sorting. Tables 2 through 8 give the results obtained from various stages of sorting. Only one specimen was recovered from the hand-sorted grass clippings; consequently, this method is not included in the results and has been discontinued. Biomass was determined according to the method described in IBP Technical Report No. 35 (French 1970); biomass is recorded in Table 12.

RESULTS

A total of 63 families of insects have been identified (Table 9) belonging to 10 orders. Trophic levels listed are admittedly incomplete due to the difficulty of classifying some insects and the absence of information on some groups of grassland insects. Thysanoptera, many Lepidoptera, and many immature forms were not determined to family.

Results on the numbers of insects recovered using the various techniques described above are shown in Tables 2 through 8. Hand-sorting the D-vac litter was necessary to obtain specimens of Homoptera, Hemiptera, Orthoptera, Diptera, Coleoptera, Hymenoptera, etc., which remained trapped in the Berlese funnel or were injured during collection and were therefore unable to crawl out. Berlese extraction of the grass clippings yielded many Hemiptera, Homoptera, Thysanoptera, etc.; these were primarily immatures. As an example, large numbers of immature Miridae were recovered in this manner.

Table 2. Numbers of specimens recovered by various sorting procedures for July 3, 1970 collection.[a/]

Treat.	Rep.	Family (or group)	Berlese: D-vac Material	Berlese: Grass Clippings[a/]	Hand-sort: D-vac Litter
1	1	Cicadellidae	70		18
		Formicidae	474		39
		Coccinellidae	0		1
		Fulgoridae	13		2
		Acrididae	1		1
		Tachinidae	0		2
1	2	Formicidae	722		12
		Curculionidae	2		2
		Cicadellidae	40		20
5	1	Formicidae	576		39
		Cicadellidae	116		6
		Acrididae	1		1
		Membracidae	0		1
5	2	Cicadellidae	58		13
		Fulgoridae	26		1
		Formicidae	90		4
		Acrididae	0		2
		Membracidae	0		1

[a/] Grass clippings not taken.

Table 3. Numbers of specimens recovered by various sorting procedures for July 16, 1970 collection.

Treat.	Rep.	Family (or Group)	Berlese: D-vac Material	Berlese: Grass Clippings	Hand-sort: D-vac Litter
1	1	Formicidae	360	0	9
		Cicadellidae	28	0	6
		Coccoidea	8	21	0
		Thysanoptera	94	22	0
		Lathrididae	7	0	1
		Lygaeidae	45	3	0
		Miridae	0	3	0
		Acrididae	0	0	1
		Chrysomelidae	2	0	1
1	2	Formicidae	524	0	1
		Coccoidea	2	4	0
		Cicadellidae	22	1	1
		Thysanoptera	24	12	0
		Miridae	1	7	0
		Halictidae	0	0	1
		Acrididae	1	0	3
5	1	Formicidae	455	0	6
		Coccoidea	5	13	0
		Cicadellidae	63	0	4
		Acrididae	0	0	2
		Tettigoniidae	0	0	1
		Thysanoptera	59	15	0
		Miridae	3	157	0
5	2	Coccinellidae	0	0	1
		Coccoidea	7	8	0
		Thysanoptera	24	21	2
		Acrididae	0	0	1
		Cicadellidae	43	2	3
		Cercopidae	2	0	3
		Tettigoniidae	0	0	1
		Lygaeidae	5	2	2
		Pentatomidae	0	0	1
		Miridae	2	76	0

Table 4. Numbers of specimens recovered by various sorting procedures for August 3, 1970 collection.

Treat.	Rep.	Family (or Group)	Berlese: D-vac Material	Berlese: Grass Clippings	Hand-sort: D-vac Litter
1	1	Cicadellidae	12	1	3
		Lygaeidae	67	1	0
		Coccoidea	1	6	0
		Thysanoptera	82	12	0
		Miridae	1	53	0
		Formicidae	162	0	24
		Fulgoridae	16	0	2
1	2	Formicidae	221	0	5
		Miridae	10	205	0
		Cicadellidae	8	1	1
		Thysanoptera	46	15	0
		Acrididae	0	0	2
		Membracidae	0	0	4
5	1	Fulgoridae	21	1	4
		Acrididae	0	0	4
		Tettigoniidae	0	1	6
		Miridae	0	111	0
		Cicadellidae	6	1	1
		Formicidae	289	0	5
		Coccoidea	2	2	0
		Sarcophagidae	0	0	1
		Thysanoptera	64	27	0
		Trichogrammatidae	0	2	0
5	2	Thysanoptera	52	42	0
		Acrididae	0	0	1
		Tettigoniidae	0	0	1
		Miridae	5	132	0
		Formicidae	221	0	1
		Cicadellidae	3	3	1
		Membracidae	0	0	1
		Fulgoridae	2	0	1

Table 5. Numbers of specimens recovered by various sorting procedures for August 17, 1970 collection.

Tr.	Rep.	Family (or Group)	Berlese: D-vac Material	Berlese: Grass Clippings	Hand-sort: D-vac Litter
1	1	Formicidae	234	0	11
		Carabidae	0	2	0
		Lygaeidae	15	22	0
		Tachinidae	0	0	2
		Coccoidea	1	38	0
		Thysanoptera	13	9	0
		Miridae	8	13	0
1	2	Formicidae	71	0	8
		Coccoidea	1	70	0
		Fulgoridae	1	0	1
		Lygaeidae	41	1	0
		Thysanidae	0	6	0
		Miridae	11	6	0
		Thysanoptera	20	1	0
		Eulophidae	3	4	0
5	1	Formicidae	55	0	2
		Coccoidea	17	130	0
		Cercopidae	0	2	0
		Thysanoptera	20	27	0
		Tettigoniidae	4	0	7
		Cicadellidae	0	0	1
		Pteromalidae	0	1	0
		Sarcophagidae	0	0	1
		Trichogrammatidae	0	1	0
5	2	Thysanoptera	11	40	0
		Coccoidea	7	76	0
		Formicidae	11	0	1
		Fulgoridae	3	0	2
		Eulopidae	0	2	0
		Miridae	1	1	0
		Trichogrammatidae	1	1	0
		Cicadellidae	1	0	2
		Lygaeidae	4	2	0

Table 6. Number of specimens recovered by various sorting procedures for September 27, 1970.

Tr.	Rep.	Family (or Group)	Berlese: D-vac Material	Berlese: Grass Clippings	Hand-sort: D-vac Litter
1	1	Thysanoptera	179	24	0
		Coccoidea	14	22	0
		Trichogrammatidae	4	2	0
		Coleoptera	4	2	0
		Lygaeidae	26	2	0
1	2	Coccoidea	49	82	0
		Thysanoptera	125	35	0
		Lygaeidae	37	1	0
		Nitidulidae	7	2	0
		Collembola	210	1	0
5	1	Thysanoptera	157	41	0
		Coccoidea	19	34	0
		Cicadellidae	0	2	1
		Noctudidae	0	0	1
		Fulgoridae	0	0	1
		Trichogrammatidae	1	2	0
5	2	Coccoidea	13	89	0
		Thysanoptera	410	29	0
		Cercopidae	1	2	0
		Formicidae	21	1	1
		Coleoptera	0	4	0
		Trichogrammatidae	2	2	0
		Hymenoptera	3	2	0

Table 7. Number of specimens recovered by various sorting procedures for October 25, 1970.

Tr.	Rep.	Family (or Group)	Berlese: D-vac Material	Berlese: Grass Clippings	Hand-sort: D-vac Litter
1	1	Thysanoptera	45	78	0
		Coccoidea	6	32	0
		Collembola	179	18	0
		Nitidulidae	16	7	0
		Scaphididae	1	2	0
		Cicadellidae	3	4	0
		Psocoptera	2	7	0
		Hymenoptera	7	1	0
		Formicidae	30	1	1
		Lygaeidae	20	1	0
1	2	Thysanoptera	38	61	0
		Coccoidea	4	18	0
		Collembola	240	8	0
		Lygaeidae	7	1	0
		Cecidomyiidae	0	1	0
		Scaphididae	0	2	0
		Nitidulidae	2	1	0
		Cicadellidae	6	2	0
		Cercopidae	4	1	0
		Eulophidae	0	1	0
5	1	Thysanoptera	314	113	0
		Coccidea	0	31	0
		Collembola	1065	5	0
		Formicidae	88	0	2
		Nitidulidae	40	4	0
		Psocoptera	1	6	0
		Scaphidiidae	2	2	0
		Issidae	0	0	1
5	2	Thysanoptera	176	76	0
		Coccidea	14	21	0
		Collembola	832	5	0
		Nitidulidae	74	8	0
		Diptera	2	0	1
		Psocoptera	1	3	0
		Hymenoptera	9	1	0

Table 8. Number of specimens recovered by various sorting procedures for November 23, 1970.

Tr.	Rep.	Family (or Group)	Berlese: D-vac Material	Berlese: Grass Clippings	Hand-sort: D-vac Litter
1	1	Coccoidea	16	22	0
		Thysanoptera	10	1	0
		Carabidae	0	0	1
		Lepidoptera	0	0	1
1	2	Thysanoptera	31	6	0
		Coccoidea	7	6	0
		Trichogrammatidae	0	1	0
		Diptera	0	0	1
		Collembola	49	1	0
5	1	Coccoidea	11	5	0
		Carabidae	0	0	1
		Collembola	26	1	0
5	2	Coccoidea	34	80	0
		Thysanoptera	30	5	0
		Collembola	34	1	0
		Blattidae	0	1	0
		Diptera	5	1	0

Table 9. List of families determined from the Osage Comprehensive Site from July 3 through November 23, 1970.[a/b/]

Order	Family (or Group)	Trophic Level[c/]
Collembola*	Entomobryidae	Herbivore; Omnivore
	Poduridae	Herbivore; Omnivore
	Sminthuridae	Herbivore
Orthoptera	Acrididae*	Herbivore
	Blattidae	Omnivore
	Gryllidae	Herbivore; Omnivore
	Phasmidae	Herbivore
	Tettigoniidae*	Herbivore
Homoptera	Cicadellidae*	Herbivore
	Coccoidea*	Herbivore
	Issidae	Herbivore
	Aphididae	Herbivore
	Fulgoridae*	Herbivore
	Cercopidae*	Herbivore
	Membracidae*	Herbivore
Hemiptera	Lygaeidae*	Herbivore
	Miridae*	Herbivore
	Pentatomidae*	Herbivore
	Tingidae	Herbivore
	Neidiidae	Herbivore
	Corixidae	Herbivore; Predator
	Reduviidae	Predator
	Scutelleridae	Herbivore
Coleoptera	Nitidulidae*	Herbivore
	Lathridiidae	Unknown
	Phalacridae*	Herbivore
	Cerambycidae	Herbivore
	Curculionidae	Herbivore
	Staphylinidae	Predator
	Chrysomelidae*	Herbivore
	Pselaphidae	Unknown
	Malachiidae	Predator
	Ptilidae	Herbivore
	Cisidae	Herbivore
	Scydmaenidae	Unknown
	Scaphidiidae	Herbivore
	Elateridae	Herbivore
	Meloidae	Herbivore; Predator
	Carabidae	Predator
	Coccinellidae*	Predator
Lepidoptera	Noctuidae*	Herbivore
Diptera	Tabanidae*	Herbivore; Predator
	Tachinidae*	Parasite
	Sarcophagidae*	Scavenger
	Asilidae	Predator
	Chloropidae	Unknown

Table 9. (Continued)

Order	Family (or Group)	Trophic Level[c/]
	Cecidomyiidae	Herbivore
	Ceratoposonidae	Predator
	Sciaridae	Unknown
	Mycetophilidae	Herbivore
Hymenoptera	Formicidae*	Omnivore
	Trichogrammatidae	Parasite
	Tenthredinidae	Herbivore
	Encyrtidae*	Parasite
	Thysanidae*	Parasite
	Eulopidae	Parasite
	Dryinidae	Parasite
	Halictidae*	Unknown
	Figitidae	Parasite
	Pteromalidae	Parasite
	Ichneumonidae	Parasite
	Tiphiidae*	Parasite
	Sierolomorphidae	Unknown
Psocoptera		Scavenger
Thysanoptera*		Herbivores; Predators; Omnivores

a/ All orders were not determined to family (e.g., Thysanoptera, some Lepidoptera, etc.).

b/ All immatures were not determined to family.

c/ Admittedly incomplete; taken primarily from Borror and DeLong, 1969.

* Listed as major groups by number or biomass (Tables 10 and 11).

It is interesting to note that large numbers of adult Miridae were never found during 1970. The Berlese method for D-vac material was the best method of recovering mites, ants, and most of the insects.

Major groups of insects, according to numbers and biomass, are shown in Tables 10 and 11. Data on other invertebrates (mites and spiders) are not included here due to incorrect sorting of the July 3 samples. As a consequence, mite data for this date are useless. Mite and spider data for the subsequent collection dates are discussed below. There is reason to believe that the July 3 sample would have contained higher numbers of insects if grass clippings had been taken.

Major groups of insects according to numbers are Formicidae, Collembola, and Thysanoptera respectively. Lygaeidae, Nitidulidae, Cicadellidae, Coccoidea, Miridae, etc. are other groups found more or less consistently. Major groups according to biomass are Formicidae, Acrididae, and Tettigoniidae, respectively. Cicadellidae, Lygaeidae, Fulgoridae, Chrysomelidae, etc., are secondary contributors to the total biomass. Note that all of these groups are primarily herbivorous with the exception of Formicidae which is omnivorous.

Total numbers of insects (mean number/m^2) and biomass (g/m^2) are included in Table 12 and Fig. 1 and 2. These data include only insects for the reasons mentioned above. Data on numbers and biomass of mites (Order Acarina) are shown in Table 13 and Fig. 3. Biomass reached .01 g/m^2 on only one occasion (grazed, Oct. 25). Data on spiders (Order Araneida) are shown in Table 14 and Fig. 4. Fewer numbers were found, compared to other invertebrates, but biomass exceeded .01 g/m^2 on numerous occasions. Spiders,

Table 10. Major groups of insects by number, Osage Site, July 3 through November 23, 1970 (mean number/m^2).

Date	Treatment	Order	Family	Number
July 3	Ungrazed	Hymenoptera	Formicidae	253.4
		Thysanoptera		78.6
		Collembola		49.2
		Hemiptera	Lygaeidae	31.4
		Homoptera	Cicadellidae	29.6
		Coleoptera	Nitidulidae	25.6
		Homoptera	Fulgoridae	10.4
		Hymenoptera	Tiphiidae	5.4
		Coleoptera	Phalacridae	4.4
	Grazed	Hymenoptera	Formididae	162.6
		Collembola		67.4
		Thysanoptera		48.2
		Homoptera	Cicadellidae	35.2
		Coleoptera	Nitidulidae	24.2
		Homoptera	Fulgoridae	10.2
		Hemiptera	Miridae	5.6
		Hemiptera	Lygaeidae	4.2
July 16	Ungrazed	Hymenoptera	Formicidae	178.8
		Thysanoptera		29.6
		Collembola		24.2
		Hemiptera	Lygaeidae	19.4
		Homoptera	Cicadellidae	11.6
		Coleoptera	Nitidulidae	7.0
		Homoptera	Coccoidea	6.2
		Homoptera	Fulgoridae	5.4
		Hymenoptera	Encyrtidae	4.2
		Coleoptera	Lathridiidae	3.0
		Hymenoptera	Thysanidae	2.0
	Grazed	Hymenoptera	Formicidae	111.8
		Hemiptera	Miridae	47.4
		Collembola		33.8
		Thysanoptera		24.4
		Homoptera	Cicadellidae	23.0
		Coleoptera	Nitidulidae	13.8
		Homoptera	Fulgoridae	10.4
		Homoptera	Coccoidea	4.2
		Hemiptera	Lygaeidae	3.0

Table 10. (Continued)

Date	Treatment	Order	Family	Number
Aug. 3	Ungrazed	Hymenoptera	Formicidae	82.4
		Hemiptera	Miridae	53.8
		Collembola		46.2
		Thysanoptera		30.4
		Hemiptera	Lygaeidae	25.2
		Coleoptera	Nitidulidae	11.0
		Hymenoptera	Encyrtidae	6.0
		Homoptera	Cicadellidae	5.4
		Homoptera	Fulgoridae	5.2
	Grazed	Hymenoptera	Formicidae	108.4
		Hemiptera	Miridae	49.6
		Thysanoptera		37.0
		Collembola		35.2
		Coleoptera	Nitidulidae	21.8
		Homoptera	Fulgoridae	5.8
		Homoptera	Cicadellidae	3.0
		Hemiptera	Lygaeidae	3.0
Aug. 17	Ungrazed	Hymenoptera	Formicidae	64.8
		Homoptera	Coccoidea	22.2
		Collembola		19.2
		Hemiptera	Lygaeidae	15.8
		Thysanoptera		8.4
		Hemiptera	Miridae	7.6
		Coleoptera	Nitidulidae	3.2
	Grazed	Homoptera	Coccoidea	46.0
		Collembola		32.8
		Thysanoptera		19.6
		Hymenoptera	Formicidae	13.8
		Hemiptera	Lygaeidae	1.6
		Coleoptera	Nitidulidae	1.6
		Orthoptera	Tettigoniidae	1.6
Sept. 27	Ungrazed	Thysanoptera		72.6
		Collembola		66.2
		Hymenoptera	Formicidae	48.2
		Homoptera	Coccoidea	26.6
		Diptera		4.6
		Coleoptera	Nitidulidae	4.4
	Grazed	Thysanoptera		127.4
		Collembola		91.8
		Hymenoptera	Formicidae	42.6
		Homoptera	Coccoidae	26.0
		Coleoptera	Nitidulidae	4.6
		Diptera	Cecidomyiidae	3.6

Table 10. (Continued)

Date	Treatment	Order	Family	Number
Oct. 25	Ungrazed	Collembola		72.0
		Thysanoptera		44.4
		Hymenoptera	Formicidae	14.2
		Homoptera	Coccoidea	12.0
		Hemiptera	Lygaeidae	5.8
		Coleoptera	Lathrididae	5.6
	Grazed	Collembola		381.4
		Thysanoptera		135.8
		Hymenoptera	Formicidae	42.6
		Coleoptera	Nitidulidae	22.2
		Homoptera	Coccoidea	11.0
		Homoptera	Cicadellidae	10.2
		Coleoptera	Lathrididae	5.2
Nov. 23	Ungrazed	Collembola		11.2
		Hemiptera	Lygaeidae	10.8
		Homoptera	Coccoidea	9.0
		Thysanoptera		6.2
		Coleoptera	Nitidulidae	2.6
		Diptera		1.4
	Grazed	Homoptera	Coccoidea	25.4
		Collembola		17.0
		Thysanoptera		14.4
		Coleoptera	Nitidulidae	5.4
		Coleoptera		2.8
		Homoptera	Cicadellidae	2.0

Table 11. Major groups of insects by biomass, Osage Site, July 3 through November 23, 1970 (g/m^2).

Date	Treatment	Order	Family	Weight
July 3	Ungrazed	Hymenoptera	Formicidae	.02050
		Orthoptera	Tettigoniidae	.01962
		Diptera	Tabanidae	.00956
		Coleoptera	Nitidulidae	.00609
		Homoptera	Cicadellidae	.00502
	Grazed	Orthoptera	Tettigoniidae	.12246
		Hymenoptera	Formicidae	.01222
		Homoptera	Cicadellidae	.00752
		Homoptera	Fulgoridae	.00346
		Orthoptera	Acrididae	.00344
		Coleoptera	Chrysomelidae	.00329
July 16	Ungrazed	Orthoptera	Acrididae	.05332
		Hymenoptera	Formicidae	.02657
		Orthoptera	Tettigoniidae	.01234
		Homoptera	Cicadellidae	.00596
		Coleoptera	Chrysomelidae	.00265
		Hemiptera	Lygaeidae	.00215
	Grazed	Hymenoptera	Formicidae	.01712
		Orthoptera	Acrididae	.01118
		Homoptera	Cercopidae	.00450
		Homoptera	Cicadellidae	.00340
		Orthoptera	Tettigoniidae	.00340
		Hemiptera	Lygaeidae	.00188
		Coleoptera	Coccinellidae	.00188
Aug. 3	Ungrazed	Hymenoptera	Formicidae	.05014
		Orthoptera	Acrididae	.00684
		Hemiptera	Lygaeidae	.00303
		Homoptera	Fulgoridae	.00201
		Homoptera	Cicadellidae	.00198
		Homoptera	Membracidae	.00112
	Grazed	Orthoptera	Acrididae	.04894
		Orthoptera	Tettigoniidae	.03969
		Hymenoptera	Formicidae	.01486
		Homoptera	Cicadellidae	.00154
		Homoptera	Fulgoridae	.00120
		Homoptera	Membracidae	.00106

Table 11. (Continued)

Date	Treatment	Order	Family	Weight
Aug. 17	Ungrazed	Orthoptera	Acrididae	.07368
		Hymenoptera	Formicidae	.02898
		Lepidoptera	Noctuidae	.00486
		Hemiptera	Lygaeidae	.00229
		Diptera	Tachinidae	.00090
		Hemiptera	Pentatomidae	.00076
	Grazed	Orthoptera	Acrididae	.03602
		Orthoptera	Tettigoniidae	.02171
		Coleoptera	Chrysomelidae	.00782
		Hymenoptera	Formicidae	.00350
		Hymenoptera	Halictidae	.00102
		Diptera	Sarcophagidae	.00062
Sept. 27	Ungrazed	Orthoptera	Gryllidae	.04750
		Lepidoptera		.01090
		Hymenoptera	Formicidae	.00672
		Hemiptera	Lygaeidae	.00388
		Hemiptera	Scutelleridae	.00266
		Collembola		.00206
	Grazed	Hymenoptera	Formicidae	.00383
		Thysanoptera		.00239
		Collembola		.00176
		Lepidoptera		.00116
		Coleoptera	Cerambycidae	.00102
		Diptera	Tachinidae	.00088
Oct. 25	Ungrazed	Hymenoptera	Formicidae	.00384
		Coleoptera	Carabidae	.00290
		Hemiptera	Lygaeidae	.00219
		Homoptera	Cercopidae	.00201
		Collembola		.00178
		Thysanoptera		.00108
	Grazed	Collembola		.00540
		Hemiptera	Lygaeidae	.00388
		Hymenoptera	Formicidae	.00267
		Thysanoptera		.00213
		Coleoptera	Lathrididae	.00103
		Homoptera	Membracidae	.00095
		Coleoptera	Nitidulidae	.00079

Table 11. (Continued)

Date	Treatment	Order	Family	Weight
Nov. 23	Ungrazed	Lepidoptera		.00536
		Hemiptera	Lygaeidae	.00360
		Coleoptera	Carabidae	.00290
		Coleoptera		.00074
		Homoptera	Cercopidae	.00070
		Coleoptera	Curculionidae	.00048
	Grazed	Collembola		.00224
		Coleoptera	Carabidae	.00200
		Coleoptera	Curculionidae	.00144
		Coleoptera		.00056
		Hemiptera	Lygaeidae	.00050
		Homoptera	Cicadellidae	.00046

Table 12. Total numbers (mean number/m^2) and biomass (g/m^2) of all groups of insects collected, Osage Site, July 3 through November 23, 1970.

Date	Treatment	Number	Biomass
July 3	Ungrazed	599.0	.11837 = .12
	Grazed	403.4	.16268 = .16
July 16	Ungrazed	331.0	.11661 = .12
	Grazed	320.4	.04876 = .05
Aug. 3	Ungrazed	291.8	.07487 = .07
	Grazed	283.8	.11331 = .11
Aug. 17	Ungrazed	155.2	.11563 = .12
	Grazed	128.6	.09125 = .09
Sept. 27	Ungrazed	258.8	.08538 = .09
	Grazed	315.2	.01572 = .02
Oct. 25	Ungrazed	180.6	.01955 = .02
	Grazed	641.8	.02430 = .02
Nov. 23	Ungrazed	50.0	.01564 = .02
	Grazed	77.4	.00972 = .01

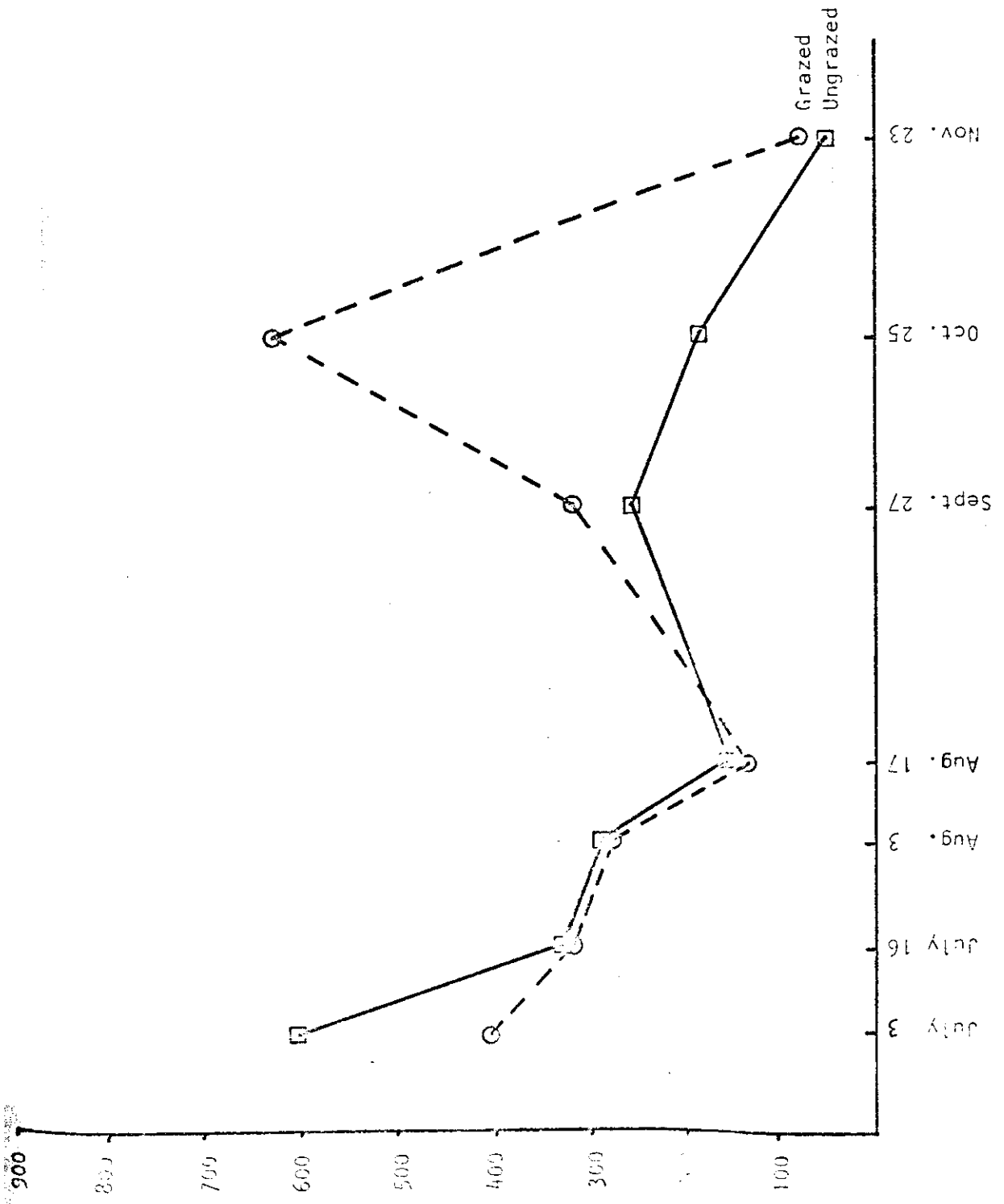

Fig. 1. Numbers of insects collected from grazed and ungrazed treatments, Osage Site, 1970.

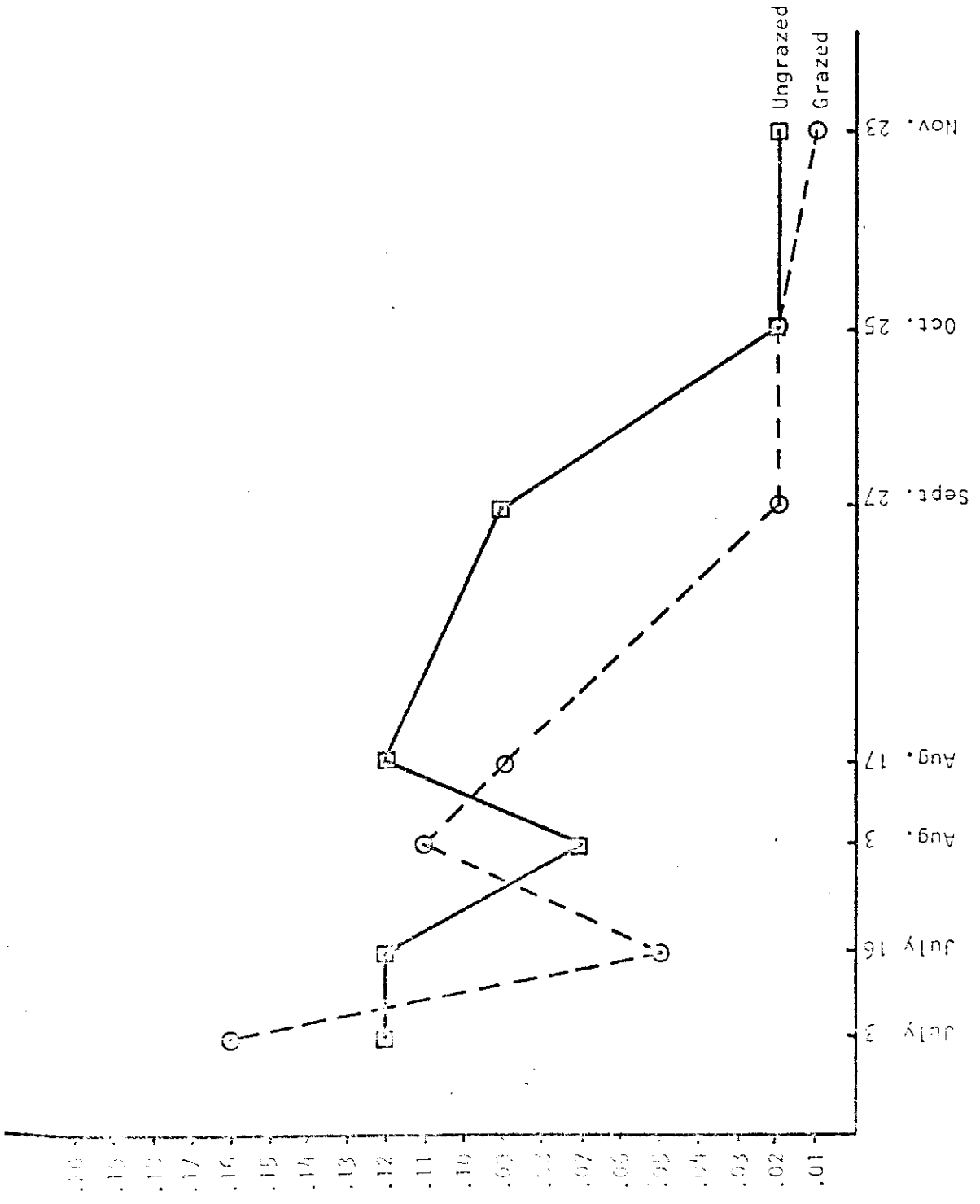

Fig. 2. Biomass of insects collected, Osage Site, 1970.

Table 13. Number (mean number/m^2) and biomass (g/m^2) of Acarina collected, Osage Site, July 3 through November 23, 1970.

Date	Treatment	Number	Dry Weight
July 16	Ungrazed	3.6	.00024
	Grazed	2.2	.00034
Aug. 3	Ungrazed	102.2	.00198
	Grazed	151.4	.00345
Aug. 17	Ungrazed	10.8	.00120
	Grazed	7.0	.00052
Sept. 27	Ungrazed	101.6	.00228
	Grazed	142.4	.00565
Oct. 25	Ungrazed	87.4	.00324
	Grazed	336.4	.01110
Nov. 23	Ungrazed	8.2	.00038
	Grazed	50.2	.00128

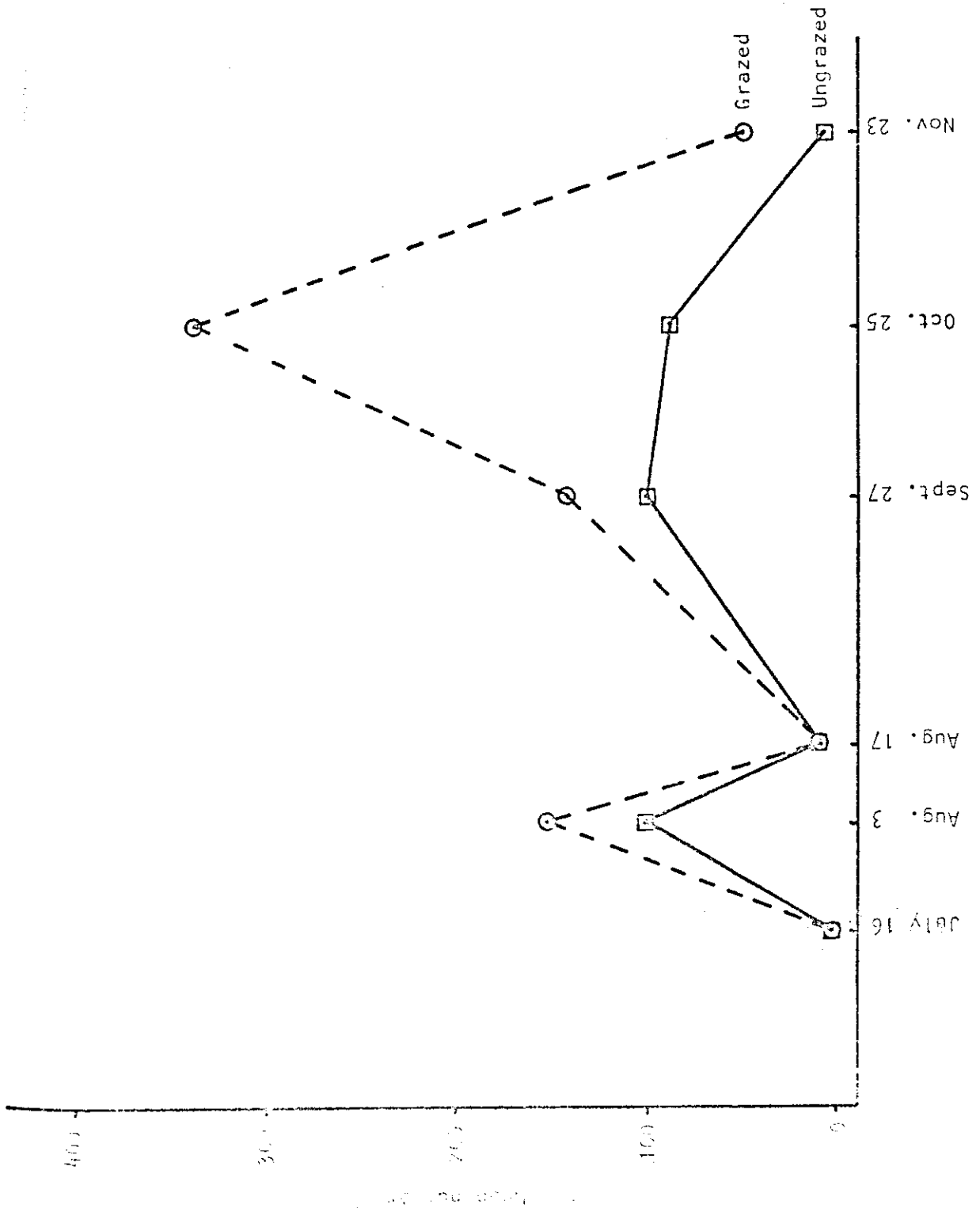

Fig. 3. Numbers of Acarina collected, Osage Site, 1970.

Table 14. Number (mean number/m^2) and biomass (g/m^2) of Araneida collected, Osage Site, July 3 through November 23, 1970.

Date	Treatment	Number	Dry Weight
July 16	Ungrazed	14.8	.01263
	Grazed	13.8	.02498
Aug. 3	Ungrazed	13.0	.00262
	Grazed	4.0	.00314
Aug. 17	Ungrazed	13.4	.00262
	Grazed	5.0	.00982
Sept. 27	Ungrazed	21.0	.04818
	Grazed	10.8	.00204
Oct. 25	Ungrazed	17.6	.01082
	Grazed	16.4	.01254
Nov. 23	Ungrazed	4.4	.00162
	Grazed	1.8	.00104

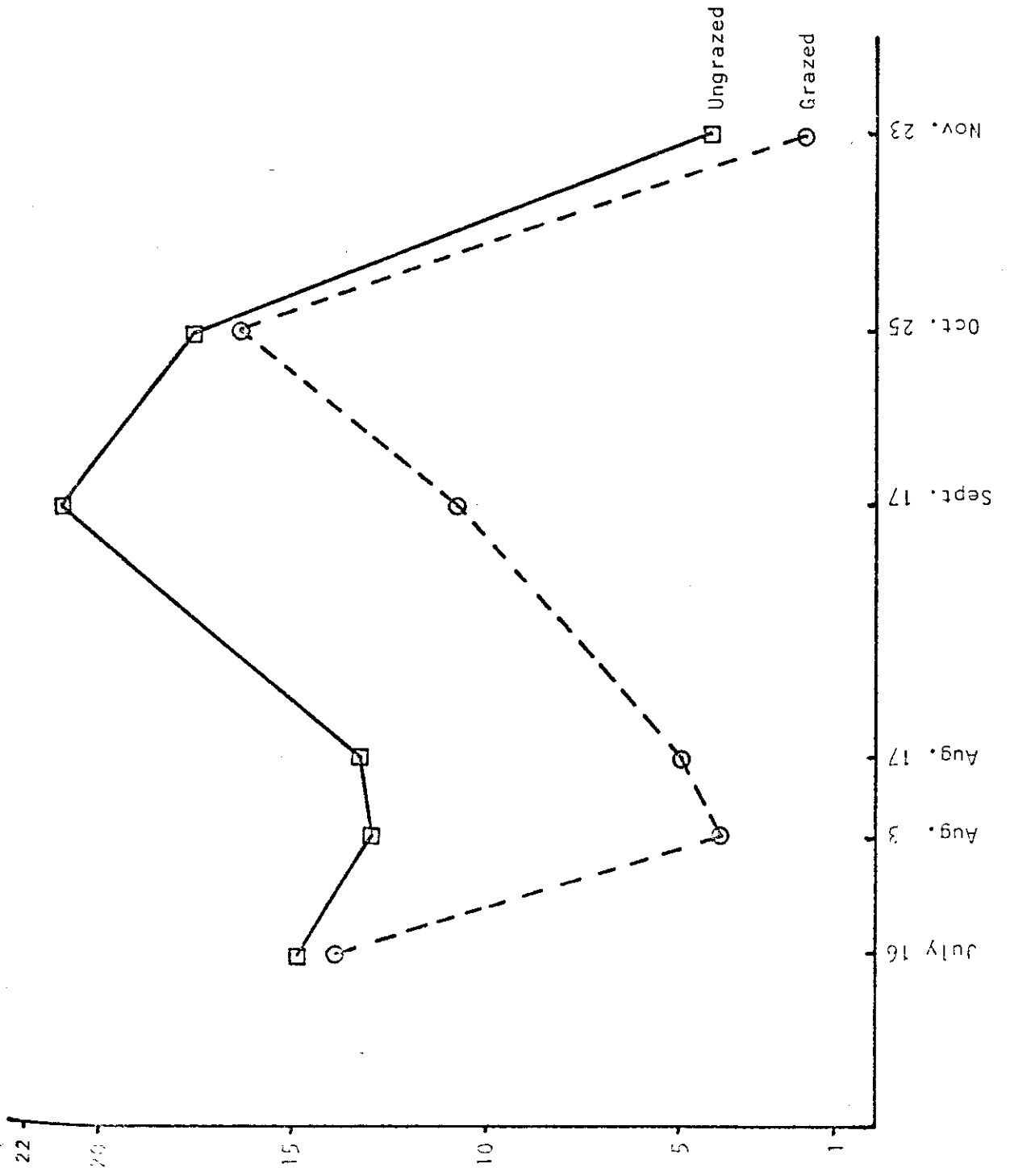

Fig. 4. Numbers of Araneida collected, Osage Site, 1970.

therefore, probably exert considerable effect as predators of other invertebrates. Biomass figures in Table 12 and Fig. 2 would be significantly higher if the mite and spider data had been included.

Additional material has been collected (by sweep net, etc.), and additional studies on systematics, function, host plant relationships, etc. are being attempted in conjunction with the IBP requirements. Results are fragmentary, however, and are not reported herein.

CONCLUSIONS

Many sampling problems remain, and methods for improvement should be constantly attempted. More detailed studies on various groups should be undertaken, especially those that will shed light on the function of the various groups. R. A. Cumber, in a series of ten papers from 1958 through 1960, attempts to classify the insect complex of sown pastures in New Zealand according to economic significance. His collecting methods, however, are primarily by sweep net and cannot be considered quantitative. Only the last paper is cited herein since it contains a list of all ten papers.

It is probable that a reasonably good evaluation of relationships between populations of aboveground insects is being made under the present methods employed at the Comprehensive Sites. It is evident that high numbers of insects do not necessarily reflect the amount of biomass; consequently, both measurements are necessary. This type of study should be continued for the duration of the IBP grasslands program if trends in insect populations are to be detected. Such a survey will also provide a basis for evaluating inferences made when more detailed studies on the impact of insects on

grasslands are conducted. The following three questions (among others) can perhaps be answered: (i) Do grassland areas serve as reservoirs for large populations of insects that periodically move out into cropland and cause great economic damage? (ii) Will virus diseases of grasses become a problem under intensified management of rangeland, and will insect vectors become of great importance? (iii) Do latent populations of potential pests occur in grasslands, and will these populations increase as management practices become intensified?

The 1970 study of insects at the Osage Site was incomplete due to the fact that the first successful collection by the quick trap-suction method was not made until July 3; a full year's data for 1971 are anticipated.

The Osage Site is a working cattle ranch; range condition is very good as compared to surrounding rangeland. Visual inspection of heavily grazed pastures and poorly maintained areas in the same general vicinity suggest a higher population of certain insect groups (e.g., grasshoppers). This is consistent with some previous findings in tall grass prairie. Finally, insect populations will undoubtedly be entirely different in 1971 if normal precipitation occurs.

LITERATURE CITED

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APPENDIX I

FIELD DATA

Invertebrate Data

Invertebrate data collected in 1970 on the Osage Site is Grassland Biome data set A2U3009. Data were collected on form NREL-30. A sample data form and a sample of the data follow.

GRASSLAND BIOME

U.S. INTERNATIONAL BIOLOGICAL PROGRAM

FIELD DATA SHEET - INVERTEBRATE

SITE	INITIALS	DATE			TREATMENT	REPLICATE	PLOT SIZE	QUADRAT	TROPHIC	HOST	ORDER	FAMILY	GENUS	SPECIES	SUBSPECIES	LIFE STAGE	TOTAL NO.	DRY WT.	NO. WEIGH
		Day	Mo	Yr															
3-4	5-7	8-9	10-11	12-13	14	15	16-19	20-21	23	25-29	31-33	35-37	39-40	42-43	45	47-48	50-55	57-62	64-66

TA TYPE
- Aboveground Biomass
- Litter
- Belowground Biomass
- Vertebrate - Live Trapping
- Vertebrate - Snap Trapping
- Vertebrate - Collection
- Avian Flush Census
- Avian Road Count
- Avian Road Count Summary
- Avian Collection - Internal
- Avian Collection - External
- Avian Collection - Plumage
- Invertebrate
- Microbiology - Decomposition
- Microbiology - Nitrogen
- Microbiology - Biomass
- Microbiology - Root Decomposition
- Microbiology - Respiration

E
- Ale
- Bison
- Bridger
- Cottonwood
- Dickinson
- Hays
- Hopland
- Jornada
- Osage
- Pantex
- Pawnee

EATMENT
- Ungrazed
- Lightly grazed
- Moderately grazed
- Heavily grazed
- Grazed 1969, ungrazed 1970

TROPHIC
- 0 Unknown
- 1 Plant feeding (tissue)
- 2 Plant feeding (sap)
- 3 Plant feeding (pollen and nectar)
- 4 Plant feeding (seed)
- 5 Predator
- 6 Parasitoid
- 7 Parasite
- 8 Scavenger
- 9 Non-feeding stage

LIFE STAGE
- 00 Undetermined
- 10 Adult
- 20 Pupae
- 30 Egg
- 40 Nymph or Larva
- 41 Nymph or Larva, early
- 42 Nymph or Larva, middle
- 43 Nymph or Larva, late
- 50 Instar
- 51 Instar, 1st
- 52 Instar, 2nd
- 53 Instar, 3rd

+++ EXAMPLE OF DATA +++

```
    1         2         3         4         5         6         7         8
5678901234567890123456789012345678901234567890123456789012345678901234567890

QR 3 870110.50 1 7      HYMEFORM        10      43  .0640 143
               1 6      HYMEENCY        10       5  .0002  15
               1 0      HYME            10       1  .0032  11
               1 1      COLL            10      41  .0005 137
               1 2      COLENITI        10       7  .0024  28
               1 0      COLESCYD        10       1  .
               1 0      COLE            40       4  .0046  13
               1 2      HOMOCICA        10       2  .0055   5
               1 2      HOMOCICA        40       3  .0024  12
               1 2      HOMOFULG        40       3  .0034  15
               1 2      HEMILYGA        40      16  .0081  59
               1 0      DIPT            10       1  .0038   2
               1 8      DIPTSCIA        10       1  .
               1 5      ARAN            10       7  .0055  39
               1 0      COLEPSEL        10       1  .0003   1
               1 3      THYS            10      24  .0037  94
               2 7      HYMEFORM        10      26  .0640 143
               2 6      HYMEFULG        10       1  .0037   1
               2 6      HYMEENCY        10       7  .0002  15
               2 6      HYMETHYS        10       2  .0006   2
               2 6      HYMETRIC        10       2  .
               2 0      HYME            10       2
               2 1      COLL            10      39  .0005 137
               2 0      COLE            40       1  .0046  13
               2 2      HOMOCICA        10       2  .0055   5
               2 2      HOMOCICA        40       6  .0024  12
               2 2      HOMOFULG        10       1  .0055   2
               2 2      HOMOFULG        40       7  .0034  15
               2 2      HOMOCERC        40       1  .0008   2
               2 2      HEMILYGA        10       2  .0015  10
               2 2      HEMILYGA        40       7  .0081  59
               2 2      HEMIMIRI        40      39  .
               2 2      HEMIPENT        40       1  .0037   2
               2 3      THYS            10      24  .0037  94
               2 5      ARIIN           10       8  .0055  39
               2 0      ACUR            10      37  .0082 287
               2 2      HOMOCOCC        10       3  .0007   7
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               5 2      COLENITI        10      14  .0024  28
               5 2      COLECURC        10       1  .0008   1
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	5	2	HOMOFULG	40	3	.0034	15
	5	2	HOMOCERC	40	1	.0008	2
	5	3	THYS	10	27	.0037	94
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	5	2	HEMILYGA	40	9	.0081	59
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2	1	COLL	10	20	.0018	94
2	2	COLENITI	10	2	.0008	27
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2	0	COLE	40	9	.0004	47
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2	2	HOMOMEMB	40	1	.0016	2
2	2	HOMOFULG	40	2	.0009	8
2	2	HOMOCERC	40	1	.0003	2
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3	6	HYMEENCY	10	2	.0005	15
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3	2	COLECURC	10	2	.0008	2
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3	2	HOMOMEMB	10	1	.0024	1
3	2	HOMOMEMB	40	2	.0016	2
3	2	HOMOFULG	40	2	.0009	8
3	3	THYS	10	11	.0005	61
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3	2	HEMILYGA	10	2	.0015	10
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	1	2	HOMOFULG	40	11	.0039	26
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3 2	HOMOCICA	10	1	.0019	3
3 2	HOMOCICA	40	1	.0008	5
3 2	HOMOFULG	40	7	.0039	26
3 3	THYS	10	14	.0012	91
3 1	ORTHACRI	40	1	.0652	3
3 2	HEMIMIRI	40	27	.	
3 2	HEMILYGA	40	3	.0002	6
3 5	ARAN	10	1	.0042	11
3 0	ACAR	10	43	.0158	454
5 7	HYMEFORM	10	192	.0377	294
5 6	HYMEENCY	10	1	.0007	4
5 0	HYME	10	3	.0006	8
5 1	COLL	10	4	.0005	143
5 2	COLENITI	10	10	.0009	23
5 2	COLECURC	10	1	.0008	1
5 0	COLE	40	9	.0007	22
5 2	HOMOCICA	10	1	.0019	3
5 2	HOMOFULG	40	2	.0039	26
5 2	HOMOCOCC	10	1	.	
5 3	THYS	10	18	.0012	91
5 1	ORTHACRI	10	1	.1678	1
5 1	ORTHTETT	40	1	.1331	5
5 0	ORTHGRYL	40	1	.0006	1
5 2	HEMIMIRI	40	17	.	
5 2	HEMILYGA	40	1	.0002	6
5 8	DIPTSARC	10	1	.0015	1
5 5	ARAN	10	1	.0042	11
5 0	ACAR	10	64	.0158	454
7 7	HYMEFORM	10	26	.0377	294
7 6	HYMEEULO	10	1	.0002	2
7 6	HYMEENCY	10	1	.0007	4
7 0	HYME	10	1	.0006	8
7 1	COLL	10	13	.0005	143
7 2	COLENITI	10	5	.0009	23
7 0	COLE	40	7	.0007	22
7 2	HOMOCOCC	10	2	.	
7 2	HOMOCICA	10	1	.0019	3
7 2	HOMOFULG	40	2	.0039	26
7 3	THYS	10	10	.0012	91
7 2	HEMIMIRI	40	16	.	
7 5	ARAN	10	4	.0042	11
7 0	ACAR	10	35	.0158	454
9 7	HYMEFORM	10	42	.0377	294
9 6	HYMETRIC	10	2		
9 1	COLL	10	18	.0005	143
9 1	COLECHRY	10	5	.0026	5
9 0	COLE	40	5	.0007	27
9 2	HOMOCICA	40	1	.0008	5
9 2	HOMOFULG	40	4	.0039	26
9 2	HOMOCOCC	10	1		
9 3	THYS	10	25	.0012	91
9 1	ORTHTETT	10	3	.1331	5
9 2	HEMIMIRI	40	33	.	
9 5	ARAN	10	3	.0042	11
9 0	ACAR	10	129	.0158	454

RR 3 870520.50	1	7	HYMEFORM	10	74	.0366	222
	1	6	HYMETRIC	10	1	.	
	1	0	HYME	10	4	.0007	9
	1	1	COLL	10	12	.	
	1	2	COLENITI	10	4	.0026	85
	1	0	COLE	40	2	.0037	33
	1	2	HOMOCICA	10	2	.0024	3
	1	2	HOMOFULG	40	1	.0014	2
	1	3	THYS	10	19	.0026	94
	1	1	ORTHACRI	40	1	.0117	1
	1	1	ORTHTETT	40	1	.0121	1
	1	2	HEMIMIRI	40	52	.	
	1	2	HEMILYGA	40	1	.0012	5
	1	5	ARAN	10	1	.0115	9
	1	0	ACAR	10	148	.0034	277
	3	7	HYMEFORM	10	5	.0366	222
	3	0	HYME	10	3	.0007	9
	3	1	COLL	10	5	.	
	3	2	COLENITI	10	2	.0026	85
	3	0	COLE	40	5	.0037	33
	3	1	COLECHRY	10	1	.0019	1
	3	2	HOMOCOCC	10	1	.	
	3	3	THYS	10	47	.0026	94
	3	2	HEMIMIRI	40	12	.	
	3	2	HEMILYGA	40	3	.0012	5
	3	5	ARAN	10	1	.0115	9
	3	0	ACAR	10	21	.0034	277
	5	7	HYMEFORM	10	8	.0366	222
	5	0	HYME	10	1	.0007	9
	5	1	COLL	10	8	.	
	5	2	COLENITI	10	34	.0026	85
	5	0	COLE	40	11	.0037	33
	5	2	HOMOCOCC	10	1	.	
	5	2	HOMOCICA	10	1	.0024	3
	5	2	HOMOCICA	40	1	.0026	4
	5	2	HOMOMEMB	10	1	.0053	1
	5	3	THYS	10	9	.0026	94
	5	2	HEMIMIRI	40	26	.	
	5	2	HEMILYGA	10	1	.0015	2
	5	2	HEMILYGA	40	1	.0012	5
	5	5	ARAN	10	4	.0115	9
	5	0	ACAR	10	148	.0034	277
	7	7	HYMEFORM	10	97	.0366	222
	7	0	HYME	10	1	.0007	9
	7	1	COLL	10	3	.	
	7	2	COLENITI	10	12	.0026	85
	7	0	COLE	40	7	.0037	33
	7	2	HOMOCICA	40	1	.0026	4
	7	3	THYS	10	11	.0026	94
	7	2	HEMIMIRI	40	35	.	
	7	5	ARAN	10	1	.0115	9
	7	0	ACAR	10	44	.0034	277

9 7	HYMEFORM	10	38	.0366	222
9 0	COLL	10	5	.	
9 2	COLENITI	10	33	.0026	85
9 3	COLEPHAL	10	4	.0020	6
9 0	COLELATH	10	1	.0006	1
9 0	COLE	40	8	.0037	33
9 8	COLEFLAT	10	1	.0023	1
9 2	HOMOCICA	40	2	.0026	4
9 2	HOMOFULG	10	1	.0007	1
9 2	HOMOFULG	40	1	.0014	2
9 3	THYS	10	8	.0026	94
9 2	HEMIMIPI	10	12	.	
9 2	HEMILYGA	10	1	.0015	2
9 5	ARAN	10	2	.0115	9
9 0	ACAR	10	42	.0034	277