

## THE EFFECT OF OVERGRAZING ON INSECT POPULATION\*

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In the Wichita Mountains Wild Life Refuge in Comanche County, Oklahoma, a pasture of approximately 9,000 acres has been set apart, since 1907, for the grazing of a herd of bison which has never exceeded three hundred in number. The pasture is also occupied by a varying number of elk and other large herbivores.

During the first ten or fifteen years the grazing pressure within the pasture was exceedingly light and opportunity was given for the establishment over a great part of the area of an approximately normal stand of grass dominated by *Andropogon scoparius*. Since the increase of the bison herd this condition has been maintained. Outside the "buffalo pasture" where overgrazing has been extensive, the condition is quite different. In some areas the *Andropogon* has been replaced by short grasses such as *Bulbilis dactyloides* and by forbs. However, in most cases, a short period of protection from grazing suffices for the return of taller grasses. (Clements, 1934, p. 55)

During the summer of 1928, before the adoption of the present policy of progressive reduction of grazing pressure on those parts of the Reserve outside the bison enclosure, a series of quantitative collections with the insect net was made in an area in the protected pasture and in a heavily overgrazed area about a hundred yards distant. The protected area was characterized by a heavy growth of tall grasses, principally *Andropogon scoparius*, while the overgrazed area supported a rather sparse vegetation with *Bulbilis dactyloides* and an undetermined species of *Coreopsis* as the most noticeable constituents. Collections were made with fifty sweeps of a standard insect net, usually in mid-afternoon in both stations and also in early morning and after sundown in the protected "buffalo pasture" station.

Total numbers of insects and arachnids obtained per unit collection are given in Table I.

It will be noted that the numbers of insects taken by this method on the overgrazed area averaged approximately four times as great as those taken from the protected area. There may be some difference in the efficiency of the net method in the two environments. The heavier vegetation makes the sweeping process somewhat more laborious in the protected area. On the other hand the lesser depth of the vegetation in the overgrazed area reduces the volume of vegetation through which the net passes. The errors due to these two conditions would tend to cancel each other and there is little doubt that the above figures represent a real difference in population. There is also a considerable difference in the composition of the catch as to the various insect orders. The average catch of each of the principal orders of insects is given in Table II. The

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Diptera are the only group present in approximately equal numbers in both stations. Other orders are from two to nine times as abundant in the overgrazed area.

TABLE I

Total Insects per Collection Over a Period of Approximately One Month

	Overgrazed G	Normal A
June 6	60	65
7	67	33
8	159	
9	206	34
10	177	105
11	206	44
12	90	73
13	95	65
14	124	51
15		
16	262	21
17	270	30
18	135	13
19	130	26
20	143	24
21	123	28
22		66
23	111	39
24	108	58
25	227	32
26	164	24
27	143	30
28	106	29
29	207	44
30	124	20
July 1	258	33
2	218	32
3	447	30
Mean	167	40

Data on overgrazed area based on single collections; data on normal area based on averages of two or three collections each day.

TABLE II

Relative Numbers of Insects Collected by Sweeping in Overgrazed and Normal Grassland.

	Overgrazed G	Normal A	Ratio
Coleoptera	23	10	2.3
Diptera	5.6	5.5	1
Hemiptera	12	2	6
Homoptera	43	10	4.3
Hymenoptera	28	6	4.6
Orthoptera	36	4	9

Table III gives the relative numbers of the ten most abundant species or groups of species in the two series of collections.

TABLE III

Relative Numbers of Ten Most Abundant Species (or other groups) from Overgrazed and Normal Grassland.

## A

Number of collections	Normal	Over-	Normal	Over-
	A	grazed G	A	grazed G
	68	Totals 26	per collection	
O. (Acrid.) <i>Cyrtacanthacrinae</i>	77	563	1.1	22
Ho. (Memb.) <i>Campylenchia latipes</i> (Say)	3	374	0.05	14.4
O. (Acrid.) <i>Acridinae</i>	94	359	1.4	13.8
Ho. (Fulg.) <i>Scolops</i> spp	69	311	1	12
C. (Curc.) <i>Elleschus epphippiatus</i> (Say)	2	158	0.03	6
He. (Mir.) <i>Poeciloscytus basalis</i> Reut.	8	140	0.12	5.4
Ar. <i>Thomisidae</i>	47	110	0.7	4.2
Ho. (Cicad.) <i>Agallia sanguinolenta</i> (Prov.)	55	99	0.8	3.8
C. (Curc.) <i>Elleschus bipunctatus</i> (L.)	4	50	0.06	2
He. (Coriz.) <i>Harmostes reflexulus</i> (Say)	3	43	0.05	1.7

Average  
B

0.53      8.52

Number of collections	G	A	G	A
	26	Totals 68	per collection	per collection
C. (Curc.) <i>Tanymecus lacaena</i> Herbst.	30	136	1	2
O. (Acrid.) <i>Acridinae</i>	359	94	13.8	1.4
Ar. (Oxyop.) <i>Oxyopes salticus</i> Htz.	13	94	0.5	1.4
O. (Acrid.) <i>Cyrtacanthacrinae</i>	563	77	22	1.1
Ho. (Fulg.) <i>Bruchomorpha jocososa</i> Stal.	0	76	0.0	1.1
C. (Elater.) <i>Melanotus communis</i> (Gyll.)	1	76	0.04	1.1
Ho. (Fulg.) <i>Scolops</i> spp.	311	69	12	1
Ho. (Cicad.) <i>Deltocephalus sandersi</i> Osb.	9	57	0.34	0.8
Ar. (Thomis.) <i>Tibellus duttoni</i> Htz.	5	50	0.2	0.7

Average

5.3      1.14

Of the ten species of greatest abundance in the overgrazed area, none was more abundant in the protected than in the overgrazed grassland although all were present in both communities. The average per collection of the ten species from the overgrazed area was 8.52, almost seventeen times as great as the average numbers of the same species in the normal area. Of the ten species of greatest abundance in the normal grassland four were more abundant in the overgrazed area and only one (*Bruchomorpha jocososa*) was limited to the former environment. Another species of the

same genus (*B. dorsata*) was, however, taken from the overgrazed region. The average per collection of the ten species of greatest abundance in normal grassland was 1.14, less than one seventh of the average abundance

of the species of the overgrazed area. Each species common to the two lists was much more abundant in the overgrazed area.

An examination of complete censuses shows that forty-five species were common to both stations, thirty-four of which were more abundant in the overgrazed area, and that there were forty-five additional species in the protected and twenty-seven in the overgrazed area. The total was ninety species in the protected and seventy-two in the overgrazed community. There is a possibility that these numbers might have been more nearly equal had the same number of collections been made in each station instead of only twenty-six in the overgrazed plot and sixty-eight in the protected plot. It is probable also, that the addition of early morning and late evening collections in the *Andropogon* series was responsible for the presence of several additional species.

The most abundant insects in the overgrazed area were the grasshoppers of the subfamily *Cyrtacanthacrinae*. Other investigators have reported the preference of grasshoppers for overgrazed grassland. As a result of their observations in British Columbia, Treherne and Buckell (1924) concluded that:

"Where the numbers of stock to the area available for ranging is in judicious proportion or where rotations of grazing grounds are practised, grasshoppers do not, or even cannot, permanently injure the range grasses."

The behavior of grasshoppers with respect to an area protected from grazing was reported as follows (ibid.):

"At the end of June and during July, the grass on the inside (of a fenced quadrat) was mature, while the grass on the outside, endeavoring to perform its natural function, was continually throwing up small green shoots around the roots. These tender shoots, if they escaped the attention of the cattle, afforded ideal food for the developing grasshoppers. Both nymphs and adults fed ravenously on these tender green leaves but did not make any effort to enter the fenced area. At the first severe heat wave late in July, a normal occurrence, the range moisture gave out entirely, the soil became parched and dry, and the exhausted grass plants gradually gave up the struggle and finally ceased to throw up any more shoots. The grasshoppers, deprived of their succulent feed, and at this time becoming more mature, devouring every vestige of dry grass on the range, finally descended upon the plants in the fenced area . . . . . The main injury was caused by the grasses being gnawed at a point about an inch from the ground, allowing the stems to fall over in any direction. — The seeds, however, were mature, and the longer growing season enabled the plants to extend their root systems."

It is probable that, had the observations in the Wichita area extended to the later summer, a similar increase in the grasshopper population of the protected area would have been observed. *Campylenchia* and *Scolops* feed mainly on various forbs. *Poecillocyctus* is chiefly an inhabitant of disturbed grassland areas. The data as to leafhoppers (*Cicadellidae*) indicate a considerable degree of specificity on the part of these insects. Two are listed among the most numerous species in each community, one being among the first ten in both. Although twice as many species were taken from the protected area and each species taken from the overgrazed grassland was also taken at least once from the *Andropogon* community, the total leafhopper population of the former was about three times as great.

There was little variation, during the period covered by the collections, in the species composition of either community. This indicates that all collections were made within the limits of the same seasonal society. Conclusions from the data presented, therefore, apply only to the aestival society.

#### SUMMARY

Data from quantitative collections from normal and overgrazed grassland in the Wichita Mountain Wild Life Refuge indicate that there is a striking qualitative and quantitative difference in the populations in the two areas during the aestival period. The total population in the overgrazed grassland is, on the average, approximately four times as great as in the normal prairie. Of the ten species most abundant in the normal community only one is as numerous as the least frequent of the first ten in the overgrazed community. An important factor in the distribution of grasshoppers, and perhaps of other insects, is the presence of younger and more tender plants in the area in which the vegetation is kept down by the combination of grazing pressure and insect pressure. In the closed community of the *Andropogon* grassland plants are larger and more vigorous, and better able to withstand the attacks of insects. The presence of bare areas which serve for places of oviposition of grasshoppers is also a factor in their abundance during the "hopper" stage when migration is not extensive. The net result is that excessive grazing makes possible further degradation of the plant cover of an area by favoring the presence of destructive insects.

Clements, F. E. 1934. The relict method in dynamic ecology. *Journ. Ecol.*, 22: 39-68.

Treherne, R. C. and E. R. Buckell, 1924. Grasshoppers of British Columbia, Dom. Canada, Dept. Agric. Bull. 39, N.S. 47 pp.