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Colorado, Distribution of Acrididae

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SOME RELATIONS BETWEEN ALTITUDE AND THE DISTRIBUTION OF ACRIDIDAE IN COLORADO.

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It is a well known fact that mountain ranges extending in a north-south direction carry boreal species far south of their latitudinal range at sea-level. That altitude is of pronounced effect in a very limited area is not so widely known. Such an effect was, however, clearly demonstrated in a series of studies undertaken during the summer of 1932 by a graduate class in Animal Ecology at this institution. The results here reported are due to the cooperation of Mr. Lawrence Jones, my assistant, and Miss Nora O'Mara and Messrs. H. B. Perrin, A. L. Oder, R. E. Rodock, and D. F. Crain, members of the class, all of whom assisted in the collection of data.

Two areas, a little less than a mile apart, were contrasted. The difference in altitude was almost exactly 900 feet. At each station two plant communities were selected as places for collections, these occurring at both elevations. These were (a) short grass, and (b) open forest (*Pinus scopulorum*). The seven collectors were divided into two groups, one of three, the other of four, the two groups collecting simultaneously at the two different altitudes. Three collecting trips were made; on the first and last trips the group of three worked at the lower area, on the second trip the larger group collected there. Each group collected for about one hour in grassland, and one hour in open forest, on each date. In other words, there were twelve, one-hour, group collections. Individual differences in collecting ability are partly eliminated by adding together the collections of all individuals in one group. Consistent total differences, especially of some magnitude, may, of course, be considered of real significance.

The results have been summarized in the accompanying three tables. Table I contrasts the Acrididae taken in short grass at the two elevations, and Table II contrasts those of the open forest. In both these tables the collections are separated according to dates. The collections made on different dates

are all combined in Table III, which summarizes all observations. For simplicity, the authorities for specific names are given only in Table III.

It is, of course, important to remember that the dates of such collections are quite significant; although workers have not always kept this fact in mind. On a given date the contrast may be very striking, but two weeks or a month later it may have disappeared. Less thorough collecting, both earlier and later

TABLE I.

ACRIDIDAE COLLECTED IN SHORT GRASS, AT TWO DIFFERENT ELEVATIONS.

SPECIES	NUMBER OF SPECIMENS[1] COLLECTED					
	June 23		June 28		July 14	
	5800′	6700′	5800′	6700′	5800′	6700′
Amphitornus coloradus	.....	.....	.....	.....	14	1
Eritettix tricarinatus	5	.....	1	1	2	.....
Chrysochraon abdominalis	.....	.....	.....	.....	2	.....
Gomphocerus clavatus	26	2	8	4	27	2
Ageneotettix deorum	.....	.....	.....	.....	9	10
Arphia conspersa	1	.....	.....	8	.....	.....
Camnula pellucida	.....	.....	1	9	1	37
Xanthippus corallipes leprosus	.....	2	.....	.....	.....	.....
Spharagemon collare	.....	.....	.....	.....	2	.....
Trachyrhachis kiowa kiowa	.....	.....	.....	4	17	3
Circotettix rabula rabula	.....	.....	.....	.....	.....	5
Hesperotettix viridis viridis	.....	.....	.....	.....	53	.....
Melanoplus dodgei incultus	.....	.....	1	1	1	.....
M. bivittatus	.....	.....	1	1	4	1
M. dawsoni	.....	.....	.....	.....	1	.....
M. confusus	.....	.....	.....	.....	3	.....
M. infantilis	.....	.....	.....	3	.....	24
M. occidentalis occidentalis	1	.....	2	1	.....	.....
M. mexicanus mexicanus	.....	.....	14	10	60	2

than that reported, emphasized the importance of this statement; for example, something over a month after the last collection here mentioned, *Hesperotettix viridis* was found not only at the 6,700-feet elevation, but also a thousand feet higher than that.

Two of the species collected, *Arphia conspersa* and *Gomphocerus clavatus*, are distributed from the base of the foothills to

[1]The numbers in the tables include adult specimens only.

elevations above timber-line, appearing later in the season at higher elevations. The dates of collections are extremely important in a consideration of the distribution of these forms. Within the limited area studied, dates are important for the same reason for *Hesperotettix viridis*, *Melanoplus bivittatus*, *M. dawsoni*,[2] and *M. mexicanus*, although none of these occurs at extremely high altitudes.

TABLE II.

ACRIDIDAE COLLECTED IN OPEN PONDEROSA PINE FOREST, AT TWO DIFFERENT ELEVATIONS.

SPECIES	NUMBER OF SPECIMENS COLLECTED					
	June 23		June 28		July 14	
	5800′	6700′	5800′	6700′	5800′	6700′
Amphitornus coloradus	.....	.....	.....	.....	1	.....
Chrysochraon abdominalis	.....	1	.....	.....	3	.....
Gomphocerus clavatus	5	6	2	5	1	.....
Arphia conspersa	.....	2	.....	3	.....	.....
Camnula pellucida	.....	.....	.....	.....	.....	2
Xanthippus corallipes leprosus	.....	2	.....	1	.....	.....
Trachyrhachis kiowa kiowa	.....	.....	.....	.....	2	.....
Circotettix rabula rabula	.....	.....	.....	.....	3	12
Hesperotettix viridis viridis	.....	.....	.....	.....	8	.....
Melanoplus dodgei incultus	5	6	.....	6	3	8
M. bivittatus	.....	.....	.....	1	.....	1
M. infantilis	.....	.....	.....	.....	.....	1
M. occidentalis occidentalis	.....	1	.....	.....	.....	.....
M. fasciatus	.....	.....	.....	.....	.....	1
M. mexicanus mexicanus	1	.....	.....	3	2	4

A few species collected are at (or near) their lower altitudinal limit at 6,700 feet. Even early collecting fails to yield many at the 5,800 feet level. Species in this group are *Camnula pellucida*, *Melanoplus dodgei incultus*, *M. infantilis*, and *M. fasciatus*. (The single specimen of the latter was taken at an unusually low elevation for this species in Colorado.)

The role of biotic factors in determining this distribution remains to be determined; e. g., the plant communities in which

[2] *Melanoplus dawsoni* becomes much more common later in the summer than is indicated by the capture of but one specimen. In August it is quite characteristic of the foothills in this part of Colorado, and at that time it occurs in considerable numbers.

collections were made may not be so nearly identical as they seem. Grasshoppers in general are not monophagous, however, and it seems likely that certain climatic factors are of major importance. A final analysis will depend on controlled laboratory experiments, such as have already been conducted by several workers. A certain number of suggestions may, however, be derived from field observations by contrasting

TABLE III.

TOTAL COLLECTIONS, SUMMARIZED.

Species of Acrididae	NUMBER OF SPECIMENS COLLECTED					
	Short Grass		Open Forest		Total	
	5800′	6700′	5800′	6700′	5800′	6700
Amphitornus coloradus (Thos.)	14	1	1	.....	15	1
Eritettix tricarinatus (Thos.)	8	1	.....	.....	8	1
Chrysochraon abdominalis Thos	2	.....	3	1	5	1
Gomphocerus clavatus Thos	61	8	8	11	69	19
Ageneotettix deorum (Scudder)	9	10	.....	.....	9	10
Arphia conspersa Scudder	1	8	.....	5	1	13
Camnula pellucida Scudder	2	46	.....	2	2	48
Xanthippus corallipes leprosus Saussure[3]	.....	2	.....	3	.....	5
Spharagemon collare (Scudder)	2	.....	.....	.....	2	.....
Trachyrhachis kiowa kiowa (Thos.)	17	7	2	.....	19	7
Circotettix rabula rabula Rehn & Hebard	.....	5	3	12	3	17
Hesperotettix viridis viridis (Thos.)	53	.....	8	.....	61	.....
Melanoplus dodgei incultus Scudder	2	1	8	20	10	21
M. bivittatus (Say)	5	2	.....	2	5	4
M. dawsoni (Scudder)	1	.....	.....	.....	1	.....
M. confusus Scudder	3	.....	.....	.....	3	.....
M. infantilis Scudder	.....	27	.....	1	.....	28
M. occidentalis occidentalis (Thomas)	3	1	.....	1	3	2
M. fasciatus (F. Walker)	.....	.....	.....	1	.....	1
M. mexicanus mexicanus (Saussure)	74	12	3	7	77	19

altitudinal with latitudinal distribution. Moisture, for example, may be important in some cases, but it probably plays a relatively insignificant role in determining the distribution of *Arphia conspersa* or *Gomphocerus clavatus*. These forms have a wide vertical range, which means (in this part of Colorado) that they tolerate a wide range in moisture content of soil and

[3]This should read in all tables *Xanthippus corallipes altivolus* Scudder. I am indebted to Mr. James A. G. Rehn for this correction.

air. On the other hand, they may be very dependent on temperature, for the temperature may be the same at different elevations if measured at the season these forms appear. Length of day is another factor eliminated in these particular cases by the nature of the field observations, the length of day not being a function of the altitude.

The present report is suggestive of the probable results of intensive studies on altitudinal distribution throughout the entire season. Such studies are now being carried out, these including regular collecting at six different altitudes between 5,000 and 10,000 feet, from early spring to late autumn. It is expected that several interesting correlations between seasonal appearance and altitude will be brought to light, and that these, as interpreted in connection with facts already known, may suggest underlying causes of the observed distribution of Orthoptera in the Rocky Mountain region.