THE ORTHOPTERA OF THE BOULDER REGION

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Orthoptera are not the most numerous insects in numbers of species in the Boulder region, but they are certainly among the most conspicuous. The more than 90 species known from the region include a few grasshoppers whose populations are always large and may, occasionally, reach truly enormous numbers. These most abundant species are widespread in distribution and rather indiscriminate in feeding habits. In some years and under certain circumstances, therefore, they become serious economic pests. They are our best known Orthoptera.

While the behavior of such widespread species has suggested to the unscientific observer that all grasshoppers feed on all kinds of plants the ecologist knows they do not. Some species are so specialized in feeding that they are limited to a single kind of host plant, and most herbivorous Orthoptera are somewhat restricted in food habits. And some Orthoptera are actually carnivorous.

Specialized feeding habits naturally result in the limitation of certain species to particular habitats, but other factors also govern distribution. Altitude, a local environmental variable of major magnitude, is particularly important. Its effects on distribution are indirect, however, primarily because at higher altitudes temperatures are lower and the growing season is shorter. It is natural that species occurring at high altitudes are those with a northern distribution while those limited to the plains are primarily southern forms.

Orthoptera occur in all major terrestrial communities, but different families within the order characterize different general types of habitat. The "short-horned" grasshoppers, or Acrididae, are most abundant in relatively dry regions. On the other hand, katydids (Tettigoniidae) are more abundant in moist regions. Katydids, perhaps because predominantly noctural in activity, are also likely to be more abundant in warm than cold regions. This holds true for crickets (Gryllidae), too. It is not surprising, therefore, that while we have 74 species of Acrididae in the Boulder region only nine species of Tettigoniidae and only four species of Gryllidae are known.

Our most numerous observations, as well as our most interesting ones, have to do with the Acrididae. The other families will be considered only briefly. The Tetrigidae, grouse locusts, are represented by

four species, one limited to the plains and three, in the genus *Tetrix*—which is somewhat northern in distribution—present in the mountains. One species (*Tetrix brunneri*) occurs at least as high as 10,000 feet in altitude. Among the nine species of Tettigoniidae, seven are limited to the plains and foothills; one (*Steiroxys trilineatus*) is known only from altitudes of approximately 8,000 to 9,000 feet; and only one species, the Mormon cricket (*Anabrus simplex*), has a wide altitudinal range. The Mormon cricket occurs as a resident from below 7,000 to over 13,000 feet in altitude. The four species of Gryllidae are confined to the plains and foothills. The Gryllacrididae, primarily noctural but with some cold-tolerant species, occur up to 10,000 feet and higher. Our collections have included only two species, both in the genus *Ceuthophilus*, the cave crickets, but there are probably other members of this family in the Boulder region. Our collecting techniques, well adapted for members of other families, have not been appropriate for these.

Closely related to these true Orthoptera are the mantids, with two rather small, scarce, and inconspicuous species occurring on the plains and in the lower foothills. Our one walking stick has the same type of distribution. There are no native cockroaches or earwigs in this region, though we do have several species of introduced cockroaches, and our one earwig, only recently acquired, is already quite common.

The remainder of this summary will be devoted to the Acrididae, or grasshoppers. The 74 local species occur from the lowest elevations, where 61 species are resident on the plains below the foothills, to over 13,000 feet in altitude, where two species are able to complete their life cycles well up in the alpine tundra.

The most conspicuous and most abundant grasshoppers in the Boulder region belong to the group known as the "spine-breasted" Acrididae. Of the 26 species in this group 18 are in the genus *Melanoplus*. Two-thirds of these species of *Melanoplus* have fully-developed wings, and some are strong fliers, but six species in this genus have abbreviated wings and are flightless.

The most abundant grasshopper on the plains near Boulder is the long-winged, strong-flying *Melanoplus sanguinipes* (also known in recent literature as *M. bilituratus* and, somewhat earlier, as *M. mexicanus*). This is also our most widespread species as it has been taken at all altitudes in the area up to and including the summit of Mt. Evans —though it can not complete its life cycle above about 10,000 feet. It is the common pest grasshopper of medium size, distinguishable from the two other most common pest species by the absence of conspicuous, light-colored stripes on the dorsal side. *Melanoplus bivittatus* and *M. packardii* have such stripes, but the former, which is our most conspicuous garden pest, is yellow-brown while the latter is red-brown. These three species feed on a wide variety of plants, including cultivated grains, alfalfa, and the plants of mixed, natural pastures. All fly well, but only *M. sanguinipes* can be considered a persistent and regular wanderer. These three are contemporaries, seasonally, but a fourth

species, *M. confusus,* which is easily mistaken for *M. sanguinipes,* appears early in the season, mates, lays its eggs, and disappears by the time these other three species have become prevalent.

Not all local species of *Melanoplus* can be mentioned in this brief survey but a few others should be. The large *M. differentialis* of the Middle West is present but is largely replaced by its ecological counterpart, *M. bivittatus. M. femur-rubrum* is present also, as a late season form; it is never abundant, though it may appear rather common in certain moist areas. One other long-winged species should be mentioned. This is the miniature *M. infantilis,* a grass-feeder that occurs in clearings throughout the mountains from the foothills to above 10,000 feet.

Of particular interest are several spine-breasted grasshoppers not in the genus *Melanoplus.* These include two species of *Hesperotettix,* which are predominantly green in color and which feed chiefly on composites. Also in this group are the bizarre "barber-pole" or harlequin grasshopper, *Dactylotum pictum,* and the gray-green sage grasshopper, *Hypochlora alba.* This last named species is associated exclusively with the herbaceous sage, *Artemisia ludoviciana,* and its distribution is even more limited than that of its host plant.

The next most conspicuous group of grasshoppers is, perhaps, the band-wings, including those species that commonly display by lilting flight accompanied by crackling sounds. The most familiar on the plains is probably *Dissosteira carolina,* the road duster, but it is actually more conspicuous than common. The most abundant species in this group is a relatively small one, *Camnula pellucida,* which is a pest in Montana hay fields but with us is confined to the mountains and is of no particular economic significance. Unlike the majority of species in this group, *C. pellucida,* as its trivial name suggests, has translucent rather than colored wings.

Our noisiest "cracklers" are several species of *Trimerotropis* (which has five local species), *Circotettix rabula,* and *Aerochoreutes carlinianus.* The last named is perhaps our strongest flier among Orthoptera, indulging in extensive aerial displays but not wandering far from its home area, which is on the plains, in the Boulder region. *C. rabula,* on the other hand, is a wide-ranging mountain form, occurring from the foothills to over 11,000 feet. It is the "crackler" you hear most frequently as you drive along open, south-facing slopes at intermediate altitudes in the mountains. The species of *Trimerotropis* are usually more closely associated with forested areas, occurring primarily in small clearings in the foothills and montane zone. Only *T. suffusa* occurs as high as *C. rabula* in this region.

Several other species of band-wings are locally important, but only two other species will be mentioned. These are a pair of closely-related species in the genus *Arphia.* They are of particular interest ecologically because one, *Arphia conspersa,* matures in the spring and deposits its eggs early in the season, while the other, *A. pseudonietana,* matures late and deposits its eggs near the end of the summer. *A. conspersa*

hatches late in the season and molts only two or three times before winter. It passes through the winter in a juvenile stage and does not complete its metamorphosis until warm weather the following spring—but that means it is adult very early. *A. pseudonietana* passes through the winter in the egg stage, and its eggs do not hatch until midsummer; hence, it is not adult until near the end of the summer. This pattern thus provides a non-competitive basis for the simultaneous occurrence of two closely related species in the same region.

Among our local Acrididae are some twenty species of "slant-faced" grasshoppers, those in which the face typically "retreats" backward from the forehead. Most of these are small; in fact, our smallest grasshoppers are in this group. Members of this group are usually grass-feeders, so we find them most abundant in pastures or, in the mountains, in areas where grasses and sedges predominate.

A few of these slant-heads may be harmful, but in our region the only ones that are likely to be injurious are a few rangeland species, particularly *Ageneotettix deorum* and *Aulocara elliotti,* both relatively abundant on the plains. Other species that may be common in mixed pastures are *Amphitornus coloradus* and *Arphulella pelidna.* Two others in the same habitat, more conspicuous in size but less numerous, are *Mermiria maculipennis* and *Acrolophitus hirtipes,* the last named being a rather striking, long-legged, green grasshopper with a high crest on the thorax and with pale green wings.

To me the most interesting slant-heads are several mountain forms. One of these, *Bruneria brunnea,* seems to be established only in a few widely separated localities in the southern Rocky Mountains. Our nearest such population apparently is one in Little Horseshoe Park in Rocky Mountain National Park. Another interesting member of this group is *Chorthippus longicornis,* which occurs in patches of rushes on the plains and, in suitable wet habitats, at all altitudes up to timber line. This species is widely distributed in the northern states and in Canada.

The general tendency for members of an insect species to be smaller in the colder parts of its range is particularly well illustrated when we compare specimens of *C. longicornis* from different altitudes. Those from the plains are larger and of a more rangy build than are those from high altitudes. Their appendages are longer, too, while the legs and antennae of high altitude specimens are shorter relative to body size.

These same differences are apparent in the grasshopper that has the widest altitudinal range, *Aeropedellus clavatus,* another member of the group of slant-heads. *A. clavatus* has one population on the slope of the mesa at Chautauqua Park, here in Boulder, at a little below 5,800 feet in altitude; it also has a well established population at 13,100 feet, on Mt. Evans, and a few individuals occur up to 13,600 feet. It thus has an altitude range of nearly eight thousand feet. As in *C. longicornis,* low altitude specimens are larger and have longer append-

ages in proportion to body size than those from high altitude populations.

One other species should be mentioned, the lubber, our largest grasshopper. The lubber, *Brachystola magna,* is our only representative of a group of large forms with a predominantly southern distribution. It is not surprising, therefore, that it does not occur above the plains. It is actually never very common in our region, but because of its large size it is often seen and commented upon. It is a stout-bodied species, almost toad-like in appearance, and it has only vestigial wings. Not only is it our largest grasshopper, it is actually, in mass, the largest insect in the Boulder region.

This rapid survey has perhaps served to suggest that in an area with as diverse climatic and habitat conditions as the Boulder region such environmental variation is reflected in the complexity of the orthopteran fauna. The Orthoptera are more than merely an interesting group of insects. They provide the ecologist with valuable tools in his study of the factors governing animal distribution.

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