

Packard Grasshopper

Melanoplus packardii Scudder

Distribution and Habitat

The Packard grasshopper ranges widely in western North America. It is primarily a rangeland species inhabiting the tallgrass, shortgrass, mixedgrass, bunchgrass, and desert prairies. The species also lives in ruderal habitats and has become recognized as an important cropland grasshopper. It reaches high densities in the northern part of its geographic range and lives in mountain meadows at altitudes as high as 9,000 feet.

Economic Importance

Because of its usual low densities on rangeland and its preference for poor forage plants, such as the scurfpeas, the Packard grasshopper in its natural habitat causes little damage. Nevertheless, in the northern region of the mixedgrass prairie, the Packard grasshopper is an important member of the rangeland assemblage, and it is often second in density after the dominant species, *Melanoplus infantilis*.

This grasshopper has adapted well to cropland and ruderal habitats including roadsides, fence rows, edges of cultivated fields, abandoned farm land, and Conservation Reserve Program land. In certain years it develops large populations that cause serious damage to small grains and alfalfa. Grasshopper surveys conducted in cropland areas of Saskatchewan from 1931 to 1966 reveal that the Packard grasshopper often adds substantially to the damage of cereal crops as an important member of an assemblage along with *Melanoplus sanguinipes* and *M. bivittatus*. In certain years the Packard grasshopper is the dominant species, making up 50 percent of the total population. As one moves south the Packard grasshopper becomes less important. It is mentioned as a minor pest in Kansas, although in Oklahoma it has been recorded as damaging cotton, vegetables, small grains, and legumes. The Packard grasshopper is a large species. Live weight of males and females collected from

rangeland and roadsides in eastern Wyoming averaged 571 mg and 639 mg, respectively (dry weight: males 141 mg, females 208 mg).

Food Habits

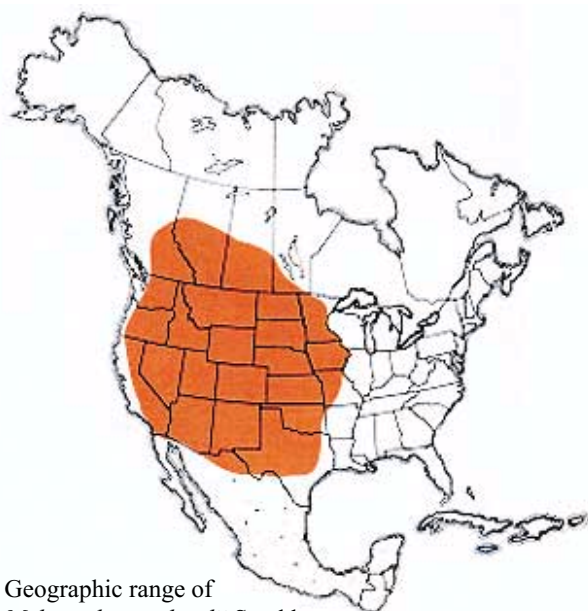
The Packard grasshopper feeds on both forbs and grasses. Examinations of crop contents of grasshoppers collected from the mixedgrass and shortgrass prairies indicate that the scurfpeas, *Psoralea tenuiflora* and *P. esculenta*, are fed upon preferentially. Although the contents of the majority of crops consist of more than one species of plant, a sizeable number consist of only fragments of scurfpea. Several other legumes that grow in the mixedgrass prairie serve as host plants including Missouri milkvetch, woolly loco, and peavine (*Lathyrus polymorphus*). When available in improved grassland, sweetclover and smooth brome serve as preferred host plants.

A total of seven grasses and 26 forbs have been recorded from crops of Packard grasshoppers collected from the shortgrass and mixedgrass prairies. The average consumption of forbs from both mixedgrass and shortgrass prairies equaled 85 percent, while grasses equaled 7 and 13 percent, respectively. Among seven grasses found in crop contents, blue grama, sand dropseed, and needleandthread were present in greatest amounts. The Packard grasshopper also fed on ground litter including dead arthropods. In ruderal habitats a variety of weeds serve as host plants including brome grasses, sweetclover, prickly lettuce, western ragweed, and sunflower. In cropland this grasshopper has fed upon winter wheat, barley, fall rye, and alfalfa.

Several direct observations have been made of feeding. On July 11, 1990 at 10 a.m. DST one female was seen crawling on the ground, then stopping to feed a few seconds on plant litter. She then moved to a small peavine plant and reached up her full length to feed on a leaflet. In a roadside habitat, a male (oriented vertical head up) and a female (oriented vertical head down) were observed feeding on the petals of yellow sweetclover. A female on the ground was observed to feed on a dead darkling beetle. In a study area of the mixedgrass prairie, two females on the ground surface were observed feeding on an unidentified small lichen growing among moss.

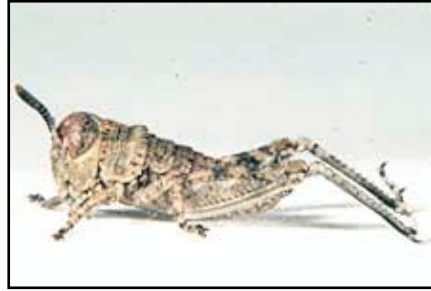
Dispersal and Migration

The Packard grasshopper is a strong flier possessing long wings. In Colorado where the species is regularly resident up to 8,500 feet, "accidentals" have been found at altitudes in excess of 11,000 feet, evidently dispersing a minimum of 10 miles in one season. Further evidence for dispersal consists of the discovery of five males and eight females on the ice of Grasshopper Glacier in the Crazy Mountains of Montana. These may have originated in a mountain meadow about one mile below the glacier where a resident population lived at an altitude of approximately 9,000 feet. But it is also possible that they originated from a distant area along with *M. sanguinipes* and *Aulocara ellioti*, which were also present on the glacier.



Geographic range of
Melanoplus packardii Scudder

Instar 1



1. BL 4.6-5.6 mm FL 2.7-3.1 mm AS 13.

Instar 2



2. BL 5.1-7.3 mm FL 3.4-4.1 mm AS 17-18.

Instar 3



3. BL 7.9-10 mm FL 5.6-6 mm AS 19-21.

Instar 4



4. BL 14-18.7 mm FL 8.2-10.2 mm AS 22-24.

Instar 5



5. BL 19-25.7 mm FL 10.8-13.5 mm AS 24-26.

Figures 1-5. Appearance of five nymphal instars of *Melanoplus packardii* - their sizes, structures, and color patterns. Notice progressive development of the wing pads. BL = body length, FL = hind femur length, AS = antennal segments number.

Identification

Of the three size divisions of grasshoppers, the Packard grasshopper is in the large category. It is, however, smaller than the two largest species of *Melanoplus*, the two-striped grasshopper and the differential grasshopper. The adults have bright color patterns of tan, brown, and yellow (Fig. 6 and 7). Two conspicuous light tan stripes run down the occiput of the head and disk of the pronotum (Fig. 8). Wings are long, reaching to at least the end of the abdomen and extending as much as 6 mm beyond. The hind tibiae are red or blue. The male possesses diagnostic characteristics of the species: the cerci are spatulate (Fig. 9) and the lobes of the aedeagus project nearly equally (Fig. 11). This species cannot be separated with certainty from *M. foedus* without exposing the aedeagus, accomplished by lifting and moving the pallium back. The supraanal plate narrows gradually to the pointed end. In a collection of grasshoppers one may identify the females by associating them with the males using size, markings, and color. The nymphs are identifiable by their structures, color patterns, and shape (Fig. 1-5).

1. Head with face nearly vertical; color of head in instars I and II greenish tan, instars III to V green; heads of all instars sparsely spotted brown; compound eye fuscous with many light spots; antennae filiform and fuscous, each segment ringed anteriorly pale yellow.
2. Pronotum with lateral lobes greenish tan in instar I, greenish tan or green in instar II, green in instars III to V; lateral lobes with few to many brown spots in all instars; disk of pronotum somewhat darker than the lobes and spots more dense.
3. Outer medial area of hind femur with three to four rows of spots, first row of spots (below upper carinula) separate, not coalescing into lines. Hind tibia pale gray in instar I, pale green in instar II, green in instars III to V; tibia with front edge fuscous in all instars.
4. General color: instar I greenish tan, instar II green or greenish tan, instars III to V green, occasionally tan.

Hatching

The Packard grasshopper is an early-hatching species. First instars appear in the mixedgrass prairie at the same time as those of the bigheaded grasshopper, *A. elliotti*. Although eggs of the Packard grasshopper lie deeper in the soil than eggs of the bigheaded grasshopper and receive less heat in spring, they hatch at the same time due to their advanced development in fall. In nature, diapause of eggs is broken during winter and only a few days of warm ground temperatures are required for an embryo to reach the final embryonic stage 27, which then must wait for hatching thresholds of temperature and moisture.

In the mixedgrass prairie of eastern Montana and Wyoming, eggs of the Packard grasshopper hatch from May

Figures 6-10. Appearance of the adult male and female of *Melanoplus packardii*, dorsal view of head and pronotum, end of male abdomen, and egg pod and eggs.

to early June depending on seasonal weather. In different years first instars may appear as early as May 1 or as late as May 30.

Nymphal Development

Nymphs develop at nearly the same rate as the bigheaded grasshopper. Based on dates of first appearance of nymphs and adults in the mixedgrass prairie, the nymphal period of the Packard grasshopper ranges from 47 to 63 days. Both males and females develop through five instars to become adults. Rearing nymphs in the laboratory at constant temperatures has shown that the Packard grasshopper completes the nymphal period in 47 days at 77°F and in 70 days at 70°F.

Adults and Reproduction

Although emigration of some adults may occur, the majority remain in the same habitat in which the nymphs develop. In the mixedgrass prairie of Colorado, Wyoming, and Montana, both male and female adults begin to appear in early July. Only a few observations have been made of maturation and reproduction of this species. In a study site of the mixedgrass prairie in eastern Wyoming the first adults of both sexes were seen 11 July 1990. Courting by a male was observed on 30 July 1990, approximately 20 days after adults began to emerge. The first observation of oviposition was made 16 August 1990, 36 days after adults began to emerge; however, examination of ovaries indicates a maturation period of 21 days.

Longevity of adults is relatively long, as decline of densities in summer are almost imperceptible. An average adult longevity of 50 days has been estimated from sampling populations in the mixedgrass prairie. A large part of the adult population of the Packard grasshopper lives through the months of August and September.

Females oviposit in bare ground and lay a clutch of 16 to 29 eggs. Laboratory rearing of adult Packard grasshoppers resulted in an average fecundity of 153 eggs per female at 33°C and 94 eggs at 27°C; the average numbers of pods was 7.7 and 4.8 per female, respectively.

The pod is slightly curved and 1 1/4 inches long and 3/16 inch in diameter (Fig. 10). The eggs lie in the bottom 3/4 inch; froth occupies the top part of the pod. Eggs are tan and 4.7 to 5.1 mm long.

Population Ecology

Small numbers of the Packard grasshopper commonly inhabit grasslands of the West. Densities usually range from less than 0.1 to 0.4 per square yard. Sampling in the mixedgrass prairie of eastern Wyoming indicates that although the species is one of the least abundant members of the rangeland grasshopper assemblage, it persists from year to year at low densities and does not track the fluctuations of the dominant species or that of the assemblage (Table 1).

However, the Packard grasshopper's abundance in Alberta and Saskatchewan and its residency in meadows of the Rocky Mountains at relatively high altitudes indicate a center of distribution for the species in the colder regions of its geographic range. A summary of relative densities from 1928-44 in a mixedgrass prairie of southeastern Alberta shows



Male

6. BL 27-32 mm FL 13.8-15.5 mm AS 25-27.



Female

7. BL 32-35.5 mm FL 15.5-18 mm AS 25-27.



Dorsum

8. Dorsal view of head and pronotum of a female.



Cercus

9. End of male abdomen showing cercus and supraanal and subgenital plates.



Egg pod

10. Egg pod and exposed eggs in bottom of broken pod.

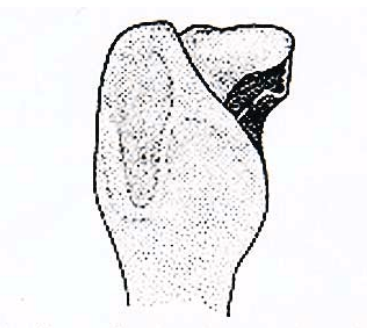


Figure 11. Shape of male aedeagus, view of left side.
Drawing by Arthur R. Brooks.

that populations fluctuate and that in certain years the species may occur in outbreak numbers, but no absolute densities are available for these populations.

A Montana study ascertained that the Packard grasshopper occupied nine of 38 sites in the mixedgrass prairie and in one site, consisting of 19 species with a density of 10 grasshoppers per square yard, it was second in abundance to *M. infantilis*. The same study found the Packard grasshopper occupied eight of 11 abandoned fields. In one of the sites the Packard grasshopper was the dominant species at approximately five per square yard.

In ruderal habitats and cropland the Packard grasshopper may be a serious pest. The ecological changes brought about by crop agriculture have created ideal habitats for no less than six species of grasshoppers including the Packard grasshopper. Crop damaging outbreaks in Alberta and Saskatchewan have often consisted of three species: the Packard grasshopper, the migratory grasshopper *M. sanguinipes*, and the twostriped grasshopper *M. bivittatus*. In certain localities the Packard grasshopper becomes the dominant species, but more often the migratory grasshopper is dominant, the twostriped is second,

and the Packard is third. Factors that appear to have made ruderal tracts more favorable for these species include the formation of better egg-laying sites of drift soil and south-facing slopes, and the introduction of succulent weeds and cereal crops that serve as reliable, abundant, and nutritious sources of food. Estimates based on relative densities indicate that the Packard grasshopper may increase to six adults per square yard in weedy roadsides.

Daily Activity

In its natural habitat in the mixedgrass prairie, the Packard grasshopper spends most of its time on the ground. Nights are passed resting horizontally on the ground surface on bare soil or litter. Early in the morning before the sun has risen, late instar nymphs and adults may sit under canopies of grasses or close to vegetation. A few individuals rest vertically, head up, on stems of slimflower scurfpea and silver sagebrush at heights of 8 to 12 inches.

As soon as the rays of the sun strike their resting places, the grasshoppers orient a side perpendicular to the rays and may tilt in the direction of the sun and lower a hindleg to expose more of the abdomen. Individuals that have spent the night on vegetation turn their back or a side to the sun. After basking for two to three hours (soil surface temperatures usually have risen to 80°F and air temperatures to 70°F), the grasshoppers become active. A few adults may become active sooner in courting and mating activities.

When temperatures become too hot, soil above 120°F and air above 90°F, grasshoppers cease activities and take evasive actions. They climb vegetation and rest vertically, head up, 2-10 inches high. They may spread their flexed hindlegs and hold onto a grass stem or leaves with their fore and midlegs. There has been one observation of basking in the evening at 4:55 p.m. DST in which an adult male and female resting on the ground turned their sides perpendicular to the rays of the sun.

Table 1. Population fluctuations of grasshoppers in a mixedgrass prairie site of eastern Wyoming (Platte County).
P = present but not found in 200 1-square foot samples.

	Number per square yard						
	1968	1969	1970	1971	1972	1973	1974
<i>Melanoplus packardii</i>	0.1	0.1	0.1	0.1	0.2	P	0.2
<i>Ageneotettix deorum</i>	3.4	2.2	0.8	1.2	0.8	1.3	3.3
Assemblage of 19 species	12.8	6.1	2.9	5.6	4.0	3.3	10.5

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