Brownspotted Grasshopper

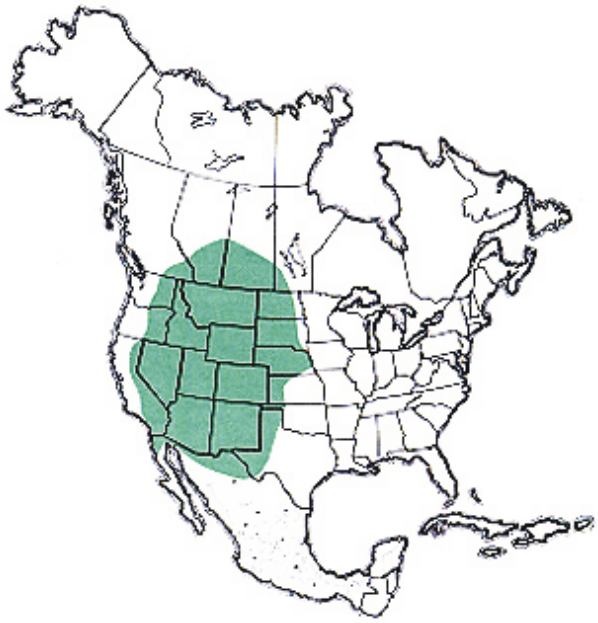
Psoloessa delicatula (Scudder)

Distribution and Habitat

The brownspotted grasshopper inhabits the grasslands of the western states and provinces. It is a common early denizen of desert shortgrass, mixedgrass, and bunchgrass prairies and extends its distribution into western desert shrub communities where grasses form a sparse understory. It does not invade mountain grasslands, but is present in foothill habitats as high as 8,076 feet.

Economic Importance

The brownspotted grasshopper feeds on grasses and sedges. When adults are abundant in spring, they cause some of the first grasshopper damage to rangeland. Populations of adults in the mixedgrass prairie may reach densities of 30 grasshoppers per square yard and maintain high densities for three or more years. Normally, populations of adults range from 0.5 to 1 grasshopper per square yard and cause no significant damage. This grasshopper is in the smallest group of the three size divisions of rangeland grasshoppers. Live weights of males average 99 mg and of females 284 mg (dry weight: males 32 mg, females 90 mg). Quantitative assessment of damage by this species has not been undertaken.



Geographic range of
Psoloessa delicatula (Scudder)

Food Habits

Host plants of the brownspotted grasshopper consist almost entirely of grasses and sedges. When the overwintered nymphs become active in early spring, they feed mainly on needleleaf and threadleaf sedges, plants that start seasonal growth very early. The nymphs feed also on cool- season grasses: western wheatgrass, downy brome, and sixweeks grass. As the season progresses and the grasshoppers become adults, they feed more on warm-season grasses, especially blue grama and sand dropseed. Examination of gut contents and direct observations have provided records of the brownspotted grasshopper feeding at various times and places on two species of sedges and 14 species of grasses. It may ingest in minute amounts forbs, lichens, moss, and arthropods.

The brownspotted grasshopper has two methods of attacking a grass or sedge. The first approach is to climb a short distance up the leaf and start cutting the leaf by eating through it. The grasshopper then holds onto the cut portion with the front tarsi and feeds on the entire leaf to the tip. The second method is for the grasshopper to raise its head and cut through a leaf, recover the fallen leaf on the ground, and then feed on it from the cut end to the tip. In the first method the grasshopper is upright, clinging to the leaf with mid- and hindlegs, and in the second method the grasshopper sits horizontally on the soil surface and litter, the mid and hind tarsi in contact with the ground, while the front tarsi handle the cut leaf. This grasshopper also feeds on ground litter, usually green or dry grass leaves, and on recumbent attached grass leaves.

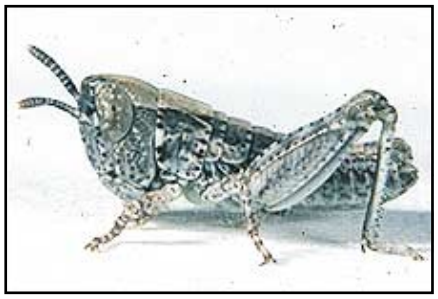
Dispersal and Migration

Adults of the brownspotted grasshopper possess long wings that extend beyond the end of the abdomen. These provide the adults with strong powers of flight for evasion of predators and for dispersal. After sunrise, three to four hours of basking are required before flight is possible. Evasive flights are silent and sinuous for distances of 5 to 9 feet at heights of 4 to 6 inches. The end of a flight often comes with a quick turn in direction and sudden drop to the ground. The grasshopper lands horizontally on the surface and may face the intruder. No records of this grasshopper migrating have been published. Collection of a solitary female on a lawn in Laramie, Wyoming, at a distance of 1 mile from the nearest rangeland habitat provides some evidence that dispersal occurs.

Identification

Adults of the brownspotted grasshopper are small and colored dull gray and brown with dark brown spots and maculations (Fig. 6 and 7). Head with face slightly slanted; frontal costa grooved (Fig. 9); lateral foveolae well-defined and square to oblong. Pronotum with distinct median carina

Instar 1



1. BL 4.4-5.3 mm FL 2.4-2.7 mm AS 13-14.

Instar 2

2. BL 5.1-6.1 mm FL 3.3-4.1 mm AS 15-16.

Instar 3

3. BL 6.0-7.5 mm FL 4.1-4.9 mm AS 17-20.

Instar 4

4. BL 8.7-11.6 mm FL 5.7-7.2 mm AS 21-23.

Instar 5

5. BL 10.8-15 mm FL 7.2-9.4 mm AS 23-24.

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

cut once in front of middle; lateral carinae constricted in middle, deeply cut, and strongly depressed in region of cut; lateral lobes with rounded broad ridge that runs diagonally upward; lower on the lateral lobe, a smaller, oblique ridge is present; it runs in the opposite direction and is often conspicuously colored ivory. Hind femur with triangular marking on upper marginal area; hind tibia proximally pale gray with brown spots, distally orange.

Nymphs (Fig. 1-5) are identifiable by their shape, external structures, and color patterns:

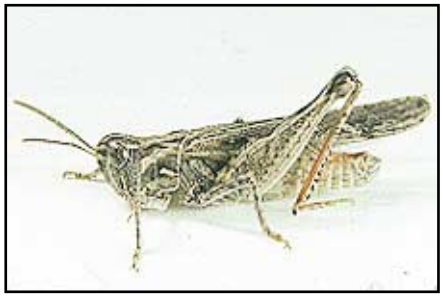
1. Head with face slightly slanted and with front of fastigium appearing rounded; frontal costa grooved; lateral foveolae square to oblong; each side of vertex with a curved brown stripe that ay extend short distance on pronotum (Fig. 8). Antennae filiform (threadlike).
2. Pronotum with definite median carina, entire (uncut) in instar I, cut in instars II to V; lateral carinae distinct and slightly constricted in instar I, strongly constricted, cut and depressed in instars II to V; lateral lobe with rounded broad oblique ridge faintly evident in instar I and becoming larger in subsequent instars; usually a distinctive pale yellow, oblique ridge present on lower rear of lobe (see Figure 4 for a clear picture).
3. Hind femur with rudimentary triangular maculation on upper marginal area. Hind tibia pale gray and brown.
4. General body color of nymphs is pale tan to brown with dark brown markings and with a light band on dorsum from head nearly to end of abdomen (Fig. 8). Older instars become darker, colored brown and gray with dark brown markings (Fig. 1-5).

Hatching

Rearing the brownspotted grasshopper in outdoor cages indicates that this species has a two-year life cycle in central Saskatchewan (Fig. 11). The eggs remain viable but unhatched during the summer in which they are laid, and hatch during the second summer at a time when most rangeland grasshoppers are mature and reproducing. The eggs are exposed to warm soil temperatures of their first summer and to low soil temperatures of winter. They perhaps break diapause during the winter cold period. The presumed timing of this event raises the question as to why

Figures 6-10. Appearance of the adult male and female of *Psoloessa delicatula*, diagnostic characters, and the egg pod and several loose eggs.

Male



6. BL 12.5-15.5 mm FL 7.9-9.3 mm AS 23-25.

Female

7. BL 17-21 mm FL 10.5-12.5 mm AS 23-27.

Dorsal view

8. Shape and color pattern of instar 2.

Head

9. Note square lateral foveolae and grooved frontal costa.

Egg pod

10. Egg pod and several loose eggs.

hatching is delayed during their second summer. In the southern range of the species, eggs appear to hatch the same summer in which they are laid. Unknown is the location of the line or zone between life cycles of one year and two years. Further study of the embryological development and life cycle of this grasshopper is desirable. For a small grasshopper, eggs lie relatively deep in the soil (three-quarters to one and one-quarter inches). The period of hatching lasts from two to six weeks.

Nymphal Development

Nymphal development is slow and extended. In the Pawnee National Grassland of northeastern Colorado, for example, eggs start to hatch in early July and nymphal development proceeds through summer and fall for about 120 days. As temperatures decrease and days become shorter in fall, greater numbers of nymphs take shelter and begin winter dormancy. Cold weather in November compels all nymphs, mainly fourth and fifth instars by this time, to seek refuge under ground litter and bury shallowly in the soil. Spells of unseasonably warm weather in winter cause some individuals to become active for brief periods. After hibernating through the winter, the nymphs resume development in April and reach adulthood during this and the next month.

Adults and Reproduction

The adults remain in the same habitat in which the eggs and nymphs develop. Even though the first group of host plants mature and dry, food resources remain plentiful. The adults feed increasingly on the vigorously growing warm-season grasses as summer progresses. A few weeks after fledging, the grasshoppers mate. Observations of mating pairs have been made during morning hours (9 to 11 a.m. DST), in June and early July. A male seeking a mate stridulates, sending two to four acoustical signals, while advancing on a female. When close, he mounts and attempts to copulate. The female may accept him or reject him by emitting a series of ticking sounds (produced by the hind tibiae kicking out and striking the ends of her tegmina).

A gravid female ready to oviposit selects a site of bare soil. Boring over an inch into the soil, she deposits 18 eggs and surrounds them with very little froth but forms a three-quarter inch froth plug above them. The whole pod measures around one and one-half inches (Fig. 10). The eggs are yellow and 4.9 mm long.

Population Ecology

Although densities of the brownspotted grasshopper usually remain low (0.5 to 1.0 adults per square yard), they occasionally become very high in habitats of the mixedgrass prairie (25 to 30 adults per square yard). Heavily infested sites may encompass as much as four square miles. Causes of these population outbreaks are unknown as no detailed studies of population dynamics have been made over a sufficiently long period. Limited data indicate that mortality rates of 5 to 6 percent per day of adults at both low and high densities are similar to mortality rates of other rangeland grasshoppers. Large variations in survival of overwintering nymphs have been observed, ranging from 46 to 100 percent.

Daily Activity

The brownspotted grasshopper is a ground-dwelling insect with an array of behavior patterns that allow it to cope with both cold and hot temperatures in its environment. During early spring, temperatures decline rapidly in the evening, causing the nymphs to seek cover under grass litter where they spend the night. In the morning, two to three hours after sunrise, they begin to emerge from their shelters and bask on the soil surface by exposing their sides to the warming rays of the sun. The nymphs bask for long periods, three to four hours. During the latter part of this time they may feed on ground litter, when the soil temperature has reached 70°F, even if air temperature an inch above the ground is still low (54°F). Normal activity of the nymphs begins late in the morning and ends early in the afternoon. They may begin basking by 3:30 p.m. and start taking cover by 5:30 p.m. DST.

Although the adults experience warmer weather in May and June, their body temperatures fall at night and may be no greater than 40°F at sunrise. Under these cold conditions they sit immobile on the surface of the soil or litter. When the sun strikes the habitat, they turn their sides perpendicular to the sun's rays and bask for as long as three hours. When soil temperatures reach 75°F they may begin normal morning activities of feeding, mating, and ovipositing. Air temperatures above 77°F cause them to begin moving into shade, while air temperatures above 90°F cause them to actively seek shade. They rest on the ground surface in the shade of small shrubs or clumps of grass, and assume a "straddle" position in which the hindlegs are spread away from the body. Six thermoregulatory postures assumed by adults of this grasshopper have been described under different environmental conditions. A seventh may be added, termed "squat," in which the basking grasshopper lowers its body and both flexed hindlegs onto the soil surface. Adults end their day like the nymphs, basking in the rays of the sun. Finally, they crawl under canopies of grasses in the habitat for shelter during the night.

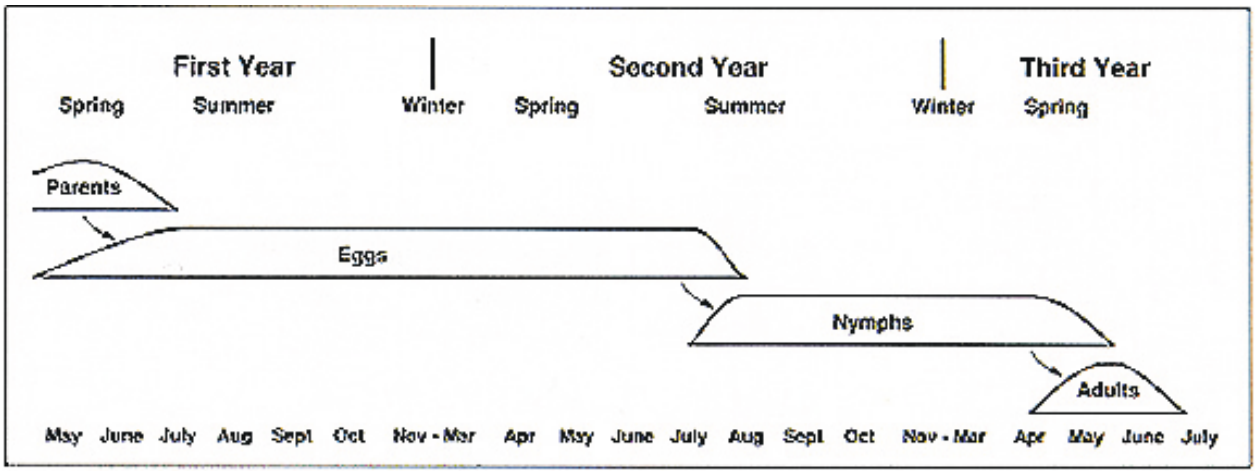


Figure 11. Diagram of the two-year life cycle of the brownspotted grasshopper, *Psoloessa delicatula* (Scudder) in central Saskatchewan. The species has a one-year life cycle in its southern range.

Selected References

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