Gladston Grasshopper

Melanoplus gladstoni Scudder

Distribution and Habitat

The Gladston grasshopper ranges widely in the rangelands of western North America. It inhabits the mixedgrass, shortgrass, tallgrass, bunchgrass, desert, and sand prairies and also lives in grass-shrub habitats of the intermountain basins. It is a common species in the grasslands east of the Rocky Mountains and is also present in the foothills and mountain parks as high as 8,500 feet.

Economic Importance

Because of its usually low densities and its preference for poor forage plants, the Gladston grasshopper is not a serious pest of native rangeland. Under some circumstances, it may even be a beneficial insect as it voraciously attacks the developing seeds of Russian thistle and perhaps other weed species. Although this grasshopper inhabits alfalfa fields and feeds on this crop, as shown by a study in North Dakota, the species represents only 5 percent of the average infestation. In fall, adults of the Gladston grasshopper, with other late-maturing grasshoppers of the rangeland assemblage, may invade fields of winter wheat in the green seedling stage. As a group these late-maturing species can cause complete destruction of edge rows of the crop. The Gladston grasshopper is a large species. Live weight of young males and females collected from the mixedgrass prairie of southeastern Wyoming averaged 446 mg and 509 mg, respectively (dry weight 127 mg and 134 mg, respectively).

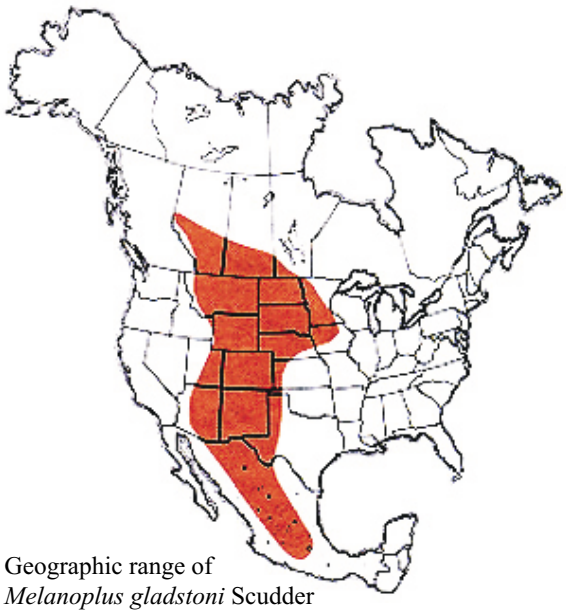
Food Habits

A polyphagous species, the Gladston grasshopper feeds on a variety of forbs, grasses, sedges, and several miscellaneous foods including seeds, moss, fungi, and dead arthropods. Forty-three species of forbs, eleven grasses, and two sedges have been detected in crops of this grasshopper collected from the mixedgrass, shortgrass, and sand prairies. The Gladston grasshopper apparently prefers forbs, as they constitute 70 to 85 percent of crop contents. In the natural grassland habitat this grasshopper has been found to feed extensively on scarlet globemallow, fringed sagebrush, Missouri goldenrod, and *Astragalus* sp. Among grasses, fragments of blue grama, Kentucky bluegrass, little bluestem, needleandthread, and sand dropseed have been found in substantial amounts in crops. Where blue grama is dominant, this grass has contributed from 9 to 25 percent of crop contents. Penn sedge made up 17 percent of crop contents of grasshoppers collected from the sand prairie of southeast North Dakota, and needleleaf sedge made up 4 percent of crop contents of grasshoppers collected from the shortgrass prairie of northern Colorado. In the desert prairie of southwest Texas, crop contents of this grasshopper consisted of 24 percent *Cryptantha* sp., 20 percent *Croton* or *Solanum* sp., 13 percent other forbs, and 23 percent grasses.

A dietary study of grasshoppers inhabiting alfalfa fields in North Dakota revealed that the Gladston grasshopper ingested plants in direct proportion to their abundance. Crop contents consisted of 75 percent alfalfa, 14 percent kochia, 10 percent smooth brome, and smaller amounts of nine less common plant species.

Several direct observations of the method of feeding of this grasshopper have been made at a study site of the mixedgrass prairie of eastern Wyoming. Adults attracted to isolated plants of Russian thistle climbed the plants and, from various orientations, fed upon the growing tips, small leaves, and especially the developing seeds, which were soft and juicy. A female was observed to crawl up an unidentified forb and feed, vertical, head up, on the edges of the green leaves. A female in a horizontal position on the ground was observed feeding on plant litter, and another female fed on a dead female grasshopper, *Trachyrhachys kiowa*.

An interesting observation was made of two adult Gladston grasshoppers that had moved from adjacent mixedgrass prairie into a winter wheat field during late October 1992. The wheat was 6 to 8 inches tall, but the first 16 rows had been eaten by grasshoppers that had migrated from the adjacent mixedgrass prairie, and only green stubs of wheat remained in these rows. One female Gladston grasshopper, horizontal on the ground, was observed feeding on the cut end of a green wheat stub. A male on the ground was observed feeding in the middle of a recumbent wheat leaf. This grasshopper chewed intermittently on the leaf with a peculiar up and down motion of its head. Close inspection of the leaf revealed that it was not being consumed but only chewed. Probably the grasshopper was seeking moisture but ingesting some leaf tissue.



Geographic range of *Melanoplus gladstoni* Scudder

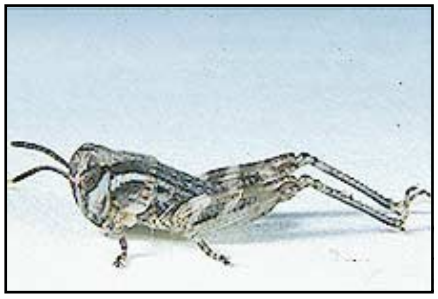
Dispersal and Migration

The Gladston grasshopper is a strong flier possessing long wings. Dispersal flights of young adults may occur soon after they fledge. A male and female were captured in the

Instar 1

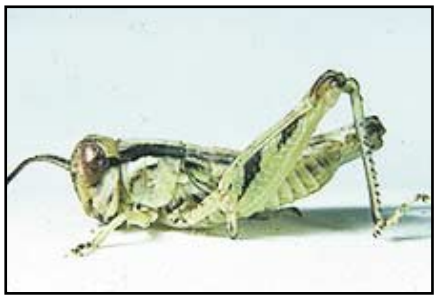
1. BL 3.7-4.5 mm FL 2.2-2.4 mm AS 13.

Instar 2



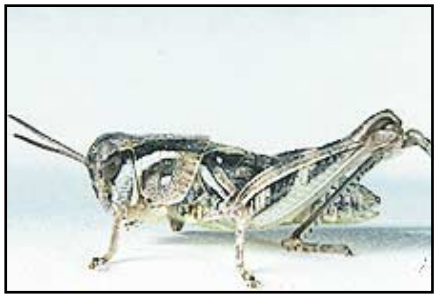
2. BL 4.3-7.8 mm FL 3-4.4 mm AS 16-18.

Instar 3



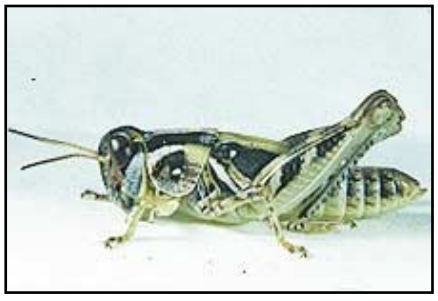
3. BL 6.4-9.6 mm FL 5.1-6 mm AS 20-21.

Instar 4



4. BL 11-13 mm FL 7.1-8.4 mm AS 21-23.

Instar 5



5. BL 13.7-15.5 mm FL 8.6-10.1 mm AS 23-24.

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

center of Laramie in early September 1991. They probably came from mixedgrass prairie that surrounds the city. Of interest is the fact that the two migrants possessed wings 2 to 3 mm longer than nonmigrant specimens in a general collection from the mixedgrass prairie.

Mass migration into Cheyenne, Wyoming became apparent during the last week of August 1991, when hundreds of young adults were seen on asphalt and concrete, in downtown doorways, and in grassy lots. Further evidence of mass migration was deduced from results of sampling densities of grasshoppers in the mixedgrass prairie of eastern Wyoming (Platte County). A population of late instars and adults declined suddenly from 0.7 to 0.2 per square yard between August 13 and 26, 1969. During the same interval no decline in the migratory grasshopper, *Melanoplus sanguinipes*, occurred. This fact implied that no epizootic, intensive predation, or other severe mortality factor was present on the site. The previous year, survival of the Gladston grasshopper was high in August. Only a 2 percent per day mortality occurred in 1968, while in 1969 the decrease due to the apparent mass emigration amounted to 11 percent per day.

Flushed flights range from 2 to 9 feet at heights of 4 to 8 inches. The flight is silent and usually straight, but occasionally curved. The grasshopper lands face away from the intruder.

Identification

The adult Gladston grasshopper is a dark brown, moderately large, long-winged species (Fig. 6 and 7). A broken line, fuscous alternating with ivory, runs longitudinally down the middle of the tegmen (Fig. 9). The male cercus is uniquely shaped; it is undivided and bent inward at the apical quarter (Fig. 8). This characteristic is diagnostic of the species. A second diagnostic character, holding good for both males and females, is the curvature of the lower carina of the hind femur (Fig. 11). In profile the basal third is straight or flat. In other species of *Melanoplus* this carina is gently curved over its entire length. The hind femur is notably robust; the fuscous stripe of the medial area is broken by two light patches. The hind tibiae are usually red, but may be blue in some southern specimens (Arizona).

The nymphs are identifiable by their structures, color, and shape (Fig. 1-5).

1. Head with face nearly vertical; frontal ridge either light or fuscous; frontal view of lower mouthparts fuscous or black. Antennae filiform and fuscous dorsally, each segment ringed anteriorly in ivory. Compound eye brown with many light spots; a diagonal dark bar crosses middle.
2. A distinct yellow or ivory crescent begins on gena below compound eye and runs onto lateral lobe of pronotum. Dorsal stripe of hind femur interrupted

Figures 6-10. Appearance of the adult male and female of *Melanoplus gladstoni*, male cercus, wings, egg pod and eggs.

in middle by light patch. Hind tibia pale yellow or pale gray in instars I to IV; pale blue in instar V; front edge fuscous.

3. Body color pale gray and light brown marked with fuscous; bottom of thorax and abdomen usually bright yellow but in a few specimens pale yellow or olive.

Many of the described nymphal characters of *M. gladstoni*, *M. infantilis*, and *M. occidentalis* are similar, yet nymphs of these species can be separated easily by color and by their seasonal appearance. The venter (ventral side of both thorax and abdomen) of nymphs of the Gladston grasshopper is usually bright yellow, while the venter of nymphs of *M. infantilis* is usually white and of *M. occidentalis* pale gray. Nymphs of *M. infantilis* and *M. occidentalis* are present in the grasshopper assemblage early in the season along with nymphs of *M. sanguinipes* and *M. packardii*, while those of the Gladston grasshopper are present late when all four of the former species are adults.

Hatching

The Gladston grasshopper hatches late in the season compared with most other rangeland species. In the mixedgrass prairie of eastern Wyoming and in the shortgrass prairie of northcentral Colorado the start of hatch may begin as early as June 13 or as late as July 2. In Montana, hatching begins about one week later. The period of hatching lasts for one to two weeks. In laboratory cages females oviposit to a depth of 5/8 inch, which is not as deep as is oviposition of the migratory grasshopper, *Melanoplus sanguinipes*. Yet the latter grasshopper hatches in early June, about two to three weeks ahead of the Gladston. No studies of egg development have been made to explain the delay of hatching of the Gladston grasshopper.

Nymphal Period

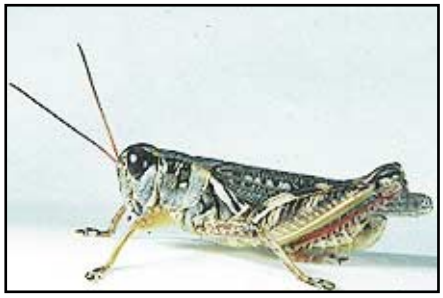
Based on the date of first appearance of instar I and the first appearance of adults, the nymphal period averages 56 days in length (range 42 to 70). Both males and females have five instars. The nymphs are present in July and August when most other species of rangeland grasshoppers are adult, some even at the end of their life cycle. Metamorphosis of the fifth instars to adults begins the middle of August and continues for three to four weeks.

Adults and Reproduction

Adults usually remain in the same habitat in which they developed as nymphs. In the mixedgrass prairie of southeast Wyoming mating pairs have been observed eight days after the first adults appear. The females begin to lay eggs about 21 days after becoming adult. Survival rate of adults is high through September and October. Freezing temperatures in November appear to bring an end to the adult stage.

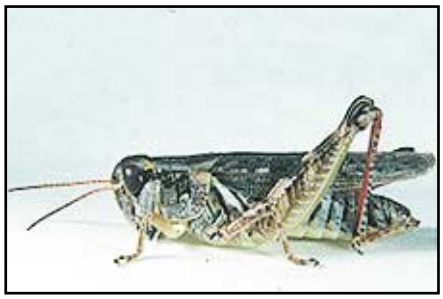
Oviposition has not been observed, but females confined in a laboratory terrarium with sandy loam soil and sod in the center laid in the bare soil, which was interspersed in the sod, and in

Male



6. BL 19-22.5 mm FL 11-12.3 mm AS 24-27.

Female



7. BL 20.1-25.2 mm FL 11.5-13.5 mm AS 25-27.

Cercus

8. End of male abdomen to show shape of cercus.

Wings

9. Spread wings of female.

Eggs

10. Two egg pods, one broken open to expose eggs.

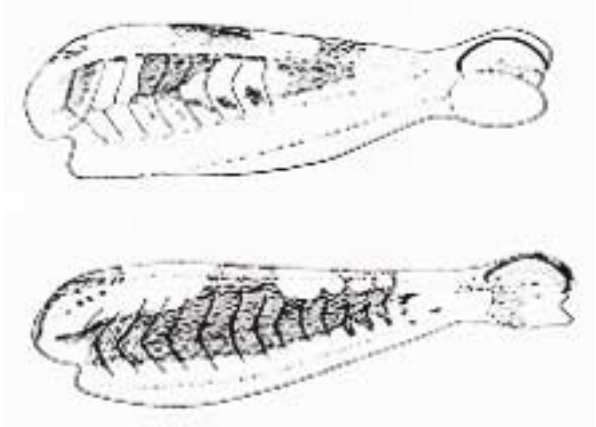


Figure 11. Left hind femur of *Melanoplus gladstoni* (above) showing the straightened lower carina of basal third and the gentle curve of the entire lower carina in *M. keeleri* (below). (From Brooks 1958).

the peripheral soil. Pods are 1 to 1 1/8 inches long and notably curved (Fig. 10) and contain 16 to 29 eggs. The eggs are tan and 4 to 4.9 mm long. Eggs are contained in the bottom section of the pod and because of its diagonal orientation, the eggs lie in the soil at a depth between 5/16 to 10/16 inch. The top section of pod consists of dry froth.

Population Ecology

The Gladston grasshopper's center of distribution appears to be in the mixedgrass prairie where it is a common inhabitant. Densities of young adults are usually low, ranging from less than 0.1 to 1.0 per square yard. It may reach a density of four per square yard during an outbreak. Even at this density the species is a subdominant; other species are more abundant and the dominant species may number 20 or more per square yard.

In the shortgrass prairie of northeastern Colorado, the Gladston grasshopper is a principal member of the assemblage. It may range from less than 0.1 to 1.1 per square yard. The latter number is reached during a peak in density of the assemblage (Table 1). From 1980 to 1985 populations of the Gladston grasshopper at this site fluctuated between 0.1 and 1.1 individuals per square yard, making it the primary or secondary species in five of the six years.

Daily Activities

The Gladston grasshopper dwells chiefly on the ground. During the night it rests horizontally on bare soil or litter under canopies of short grasses such as blue grama. Occasionally adults rest overnight vertically, head up on forbs. On plants of Russian thistle, 20 to 23 inches tall, the grasshoppers cling to stems at heights of 15 to 21 inches.

Early in the morning before the rays of the sun strike them, the grasshoppers emerge from their nighttime shelters. They rest horizontally on the ground facing in various directions. When the rays eventually reach them, about one hour after sunrise, they begin to bask by turning a side perpendicular to the rays and by lowering the hindleg to maximize exposure of the abdomen. They bask from one to two hours at soil temperatures that range from 59° to 103°F and air temperatures (1 inch high) from 59° to 76°F. Some individuals, however, become active at a soil temperature of 85° and an air temperature of 65°F. The peak of activity comes between 10 a.m. and noon, at which time they feed, mate, and walk about on the ground. When temperatures rise above their tolerance level, they cease activity and take evasive actions. First they may face the sun or face directly away and stilt; as temperatures increase they climb vegetation to heights of 4 inches or more.

They again bask in the afternoon from 4 to 7 p.m. on bare soil. When shadows engulf these spots, they crawl into their nighttime shelters under canopies of grasses, usually blue grama.

Table 1. Population fluctuations of grasshoppers in a shortgrass prairie site, northeastern Colorado. (Adapted from Capinera and Thompson)

	Number per square yard					
	1980	1981	1982	1983	1984	1985
Melanoplus gladstoni	0.2	0.3	0.9	1.1	0.7	0.1
Assemblage of 5 common species	0.4	0.9	2.4	4.0	3.1	1.6

Selected References

Brooks, A. R. 1958. Acridoidea of southern Alberta, Saskatchewan, and Manitoba (Orthoptera). Can. Entomol. Supplement 9.

Capinera, J. L. and D. C. Thompson. 1987. Dynamics and structure of grasshopper assemblages in shortgrass prairie. Can. Entomol. 119: 567-575.

Fry, B., A Joern, and P.L. Parker. 1978. Grasshopper food web analysis: use of carbon isotope ratios to examine feeding relationships among terrestrial herbivores. Ecology 59: 498-506.

Joern, A. 1982. Distributions, densities, and relative abundances of grasshoppers (Orthoptera: Acrididae) in a Nebraska sandhills prairie. Prairie Naturalist 14: 37-45.

Mulkern, G. B., J. F. Anderson, and M. A. Brusven. 1962. Biology and ecology of North Dakota Grasshoppers, I. Food habits and preferences of grasshoppers associated with alfalfa fields. North Dakota Agr. Exp. Stn. Research Report No. 7.

Mulkern, G. B., K. P. Pruess, H. Knutson, A. F. Hagen, J. B. Campbell, and J. D. Lambley. 1969. Food habits and preferences of grassland grasshoppers of the North Central Great Plains. North Dakota Agr. Exp. Stn. Bull. 481.

Newton, R. C., C. O. Esselbaugh, G. T. York, and H. W. Prescott. 1954. Seasonal development of range grasshoppers as related to control. USDA Bureau Entomol. Plant Quarantine E-873.

Pfadt, R. E. and R. J. Lavigne. 1982. Food habits of grasshoppers inhabiting the Pawnee site. Wyoming Agr. Exp. Stn. Science Monograph 42.