Keeler Grasshopper

Melanoplus keeleri (Thomas)

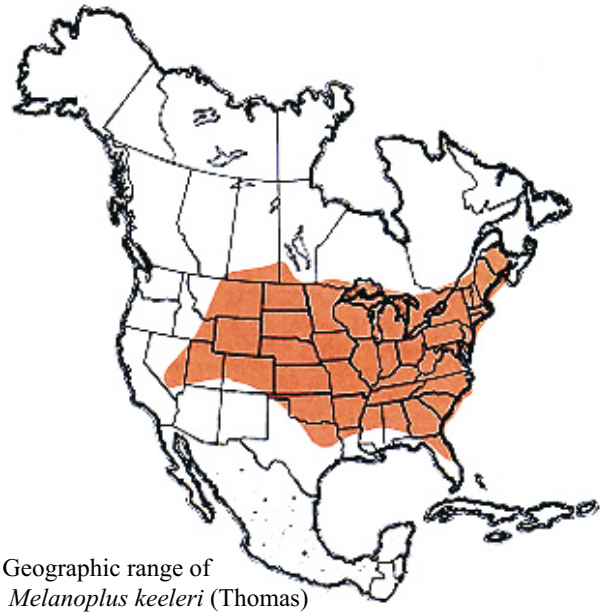
Distribution and Habitat

The Keeler grasshopper ranges widely in North America inhabiting upland grasslands from the Atlantic coast to the Great Basin and from southern Canada to southern United States. In the west it is a common inhabitant of the tallgrass prairie and the taller types of the mixedgrass prairie.

Economic Importance

The Keeler grasshopper is a minor pest of rangeland forage. When present, populations occur at low densities in the mixedgrass, tallgrass, and sand prairies. Furthermore, the nymphs and adults do not consume native grasses in significant amounts, preferring to eat forbs of low forage value. Because several forages in the bean family are among its preferred food plants, the Keeler grasshopper may become a pest in pastures seeded to mixtures that include legumes. In such situations it is usually subdominant to major pest species such as the migratory, redlegged, and twostriped grasshoppers. The Keeler grasshopper merely adds a small amount to the more serious damage of the others. Likewise, this grasshopper does not appear to be a serious pest of cultivated crops. It has been discovered in small numbers in North Dakota alfalfa fields ranking eighth in abundance after seven other melanoplines. It did feed on the alfalfa, however, as 19 out of 26 crops examined contained fragments of this legume.

The Keeler grasshopper is a medium-sized species. Live weights of males average 252 mg and of females 343 mg (dry weights: 73 mg and 100 mg, respectively).



Geographic range of *Melanoplus keeleri* (Thomas)

Food Habits

The Keeler grasshopper feeds on a wide variety of forbs. Field observations and examinations of crop contents reveal that a minimum of 52 species are consumed in variable amounts. These belong to 17 plant families. Additionally, records show that a small amount of feeding occurs on seven species of grasses and one sedge. The Keeler grasshopper has also been observed to feed on cabbage and the leaves of apple and plum. Only two plant families embrace the primary host plants: the sunflower family (Asteraceae) and the bean family (Fabaceae).

The kinds of plants present in the habitat influence greatly the diet of this grasshopper. In the tallgrass prairie of eastern Kansas, three species serve as the chief host plants: western ragweed, cudweed sagewort, and Missouri goldenrod; four species in the mixedgrass prairie of central Nebraska: breadroot scurfpea, aromatic aster, common sunflower, and prickly lettuce; four species in the sand prairie of southeast North Dakota: green sagewort (*Artemisia glauca*), western ragweed, leadplant, and cudweed sagewort; and four species in the mixedgrass prairie of northcentral Colorado: *Astragalus flexuosus*, cudweed sagewort, scarlet globemallow, and undetermined species of the sunflower family. Different host plants and dietary combinations no doubt occur in other sites. Of economic interest is the fact that several introduced forages belonging to the bean family - alfalfa, lespedeza, sweetclover, and probably others - are among this grasshopper's preferred food plants.

Although primarily a forb feeder, the Keeler grasshopper ingests small or trace amounts of grass. Examination of crop contents reveals fragments of western wheatgrass, blue grama, needleandthread, downy brome, Japanese brome, smooth brome, and Kentucky bluegrass. Cage tests show that among six species of grasses occurring in eastern Kansas, tall fescue was preferred, followed closely by smooth brome. Fragments of Penn sedge have been found in crops of Keeler grasshoppers collected in southeast North Dakota.

One observation was made of this grasshopper feeding on the host plant, *Penstemon glaber*. A female sitting diagonally head-up on the dry culm of Japanese brome that leaned on the host plant fed on the stub of a leaf that had been previously fed upon across its entire width. Observations of *P. glaber* plants revealed more injury to top leaves than the low, rosette leaves lying near ground level. Lateral edges of top leaves, which are about 3 inches long, exhibited uneven gouges 3/8 to 5/8

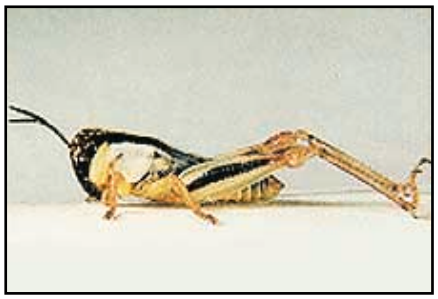
Instar 1

1. BL 4-5.4 mm FL 2.4-2.6 mm AS 12-13.

Instar 2

2. BL 6-8.3 mm FL 3.7-5.7 mm AS 16-17.

Instar 3



3. BL 8.9-10.5 mm FL 5.1-5.8 mm AS 18-19.

Instar 4

4. BL 11.8-15 mm FL 6-8.7 mm AS 20-23.

Instar 5

5. BL 13.7-22 mm FL 9.1-11.5 mm AS 23-24.

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

inch long and 1/8 inch deep. Some leaves had been attacked from the tips and only basal stubs remained. This limited evidence suggests that this grasshopper feeds close to where it perches on the plant. In the case of *Penstemon glaber*, the grasshopper fed primarily on leaves 4 to 10 inches high.

Dispersal and Migration

Western specimens of the Keeler grasshopper possess long wings that range from nearly reaching the end of the abdomen to 4 mm beyond. Despite having the structures necessary for flight, they do not appear to disperse much but remain most often in the relatively thick vegetation of midgrasses and forbs within their habitat. However, some evidence for dispersal exists. Two adult accidentals were collected in a montane site northwest of Boulder, Colorado at an altitude of 7,600 feet. In this area the species is resident up to 6,700 feet. Other evidence for dispersal comes from the collection of two fifth-instar nymphs in a mixedgrass study site (Platte County, Wyoming) on 25 July 1992 where previously the species had not been seen or collected for a period of 13 years (1968-81). Evidently, adults dispersed into the site between 1982 and 1991. Further evidence for dispersal comes from the George Reserve in Michigan, where accidentals (erratics) have been taken in nonresident habitats such as shady oak-hickory woodland and semipermanent marsh.

Adults that are flushed jump or more often fly short distances of 2 to 4 feet at heights of 8 to 12 inches. The flight is straight and silent and the landing is on vegetation or bare ground. On vegetation they land vertically head-up and on bare ground they land horizontally facing away from the intruder.

Identification

In the west, the Keeler grasshopper is a colorful long-winged, medium-sized grasshopper (Fig. 6 and 7), in contrast to many eastern specimens that are dark brown and dull. Males are recognizable by the distinctive shape of the cercus, which is bifurcate with the dorsal arm larger than the ventral (Fig. 9). Both sexes possess a distinctively shaped femoral stripe. Located on the outer face of the hind femur, the stripe is solid fuscous (not cut by any light band) and narrows

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

toward the base (Fig. 8). The hind tibiae are red and the body is brown and yellow.

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

1. Head with face nearly vertical and colored fuscous except frequently yellow around base of antenna; compound eye brown or fuscous and marked distinctively by two parallel transverse yellow stripes (See Figure 2 for clear picture); sides of head yellow, top of head yellow in instars I and II, reduced to median yellow band or all black in older instars.
2. Pronotum with disk fuscous, divided by yellow median band, lobes yellow and marked by an anterior diagonal dark stripe in instars I and II, faint or lacking in instar III, solid cream or yellow in instars IV and V.
3. Hind femur yellow with solid black femoral stripe; hind tibia gray.
4. General body color yellow and black. Venter often canary yellow.

Hatching

The Keeler grasshopper is a late-hatching species. Depending on the year, it begins to hatch from early to late June in the mixedgrass prairie of Colorado, hatching about three weeks after the migratory grasshopper, *Melanoplus sanguinipes*, which often shares the same habitat. In Larimer County, Colorado, first instars were collected on June 4 in 1992 and on June 22 in 1993. Limited data indicate that the hatching period is short - from one to two weeks.

Nymphal Development

In their natural habitat within the mixedgrass prairie, Keeler grasshoppers develop through five instars in approximately 46 days. In Larimer County, Colorado, the first adults were observed July 31 in 1993 and July 27 in 1994. On these dates the majority of the population consisted mainly of instars IV and V.

Adults and Reproduction

Adults begin to emerge during the latter part of July and continue emerging for approximately three weeks in the mixedgrass prairie of northcentral Colorado. By mid

Male

6. BL 18.5-21.7 mm FL 11-11.5 mm AS 25-26.

Female

7. BL 19-22.5 mm FL 11-12.8 mm AS 24-26.

Hindleg

8. Outer face of left hindleg of female.

Cercus

9. End of adult male abdomen showing the cercus.

Eggs

10. Egg pod and loose eggs.

August, 85 percent of the population is fledged. At lower altitudes emergence of adults occurs earlier. In eastern North Dakota, adults are present during the first week of July; in Iowa, adults have been found as early as June 23. Although maturation of adults has not been studied, a few facts are known. Courtship in this species is brief. Without preparatory signals, the male jumps on a female. A nonresponsive female shakes her hindlegs and kicks away the unwanted suitor, but a responsive female scarcely struggles while the male produces bursts of femur shaking and attaches his genitalia. The duration of copulation is unknown. Two observations of pairs in copulo were made in the mixedgrass prairie of Colorado, one on 9 August 1994 at 11:45 a.m. DST and another three days later at 10:31 a.m. Adults peak numerically in mid August. They then gradually dwindle, but a fair number are still present and active in October. In southeast North Dakota the females have been observed to oviposit in small, bare or sparsely vegetated areas. The egg pods are 3/4 to 1 inch long, curved, and contain 20 to 22 light tan eggs 4.0 to 4.3 mm long (Fig. 10).

Population Ecology

The center of distribution of the Keeler grasshopper appears to be in the midwest where it is common in upland grass-herb habitats and at times becomes the dominant species in the grasshopper assemblage. In the western peripheral zone of its geographic range, it is rare in the normal mixedgrass and shortgrass prairies. In this zone it occupies edaphic habitats characterized by relatively tall grasses and herbs that occur on well-watered slopes and along roadsides. An edaphic site in the mixedgrass prairie of northcentral Colorado affords a favorable habitat in which populations of the Keeler grasshopper have persisted for at least eight years: 1987 to 1994. In 1994 it was the dominant species in an assemblage of nine species with a total density of eight grasshoppers per square yard. On 11 August 1994, the Keeler population measured four individuals per square yard. At this time 75 percent were adult and 25 percent were late instars. By 29 September 1994, the population had decreased to 0.2 adults per square yard, indicating a 6 percent daily mortality over the adult period.

A study site in the sand prairie of southeastern North Dakota (Sheyenne National Grasslands) harbored populations of the Keeler grasshopper for at least ten years, 1959 to 1968. Measurements of relative abundance indicated a subdominant position throughout this period. In 1960, however, it ranked second after Eritettix simplex and then decreased in density through 1962 and fluctuated in abundance to 1968.

Daily Activity

Inhabiting sites of thick, tall and mid grasses and tall forbs, the Keeler grasshopper spends most of its time perched on vegetation. At night, individuals usually rest vertically, head-up on stems of forbs at heights of 8 to 14 inches above the ground. An occasional individual may rest diagonally or horizontally on the stem of a fallen, dead forb or on the cladode of a prickly pear cactus. In the morning when rays of the sun strike them, they begin to bask. In the study site on August 9 to 12, 1994, a hill to the east hid the rising sun until 7:33 a.m. DST. Basking grasshoppers were noticed an hour later. Still on the vegetation, they turned a side perpendicular to the sun and lowered the hindleg to expose the abdomen. They basked for two hours or longer and some fed during this time on leaves of the host plant. One observation was made of a female feeding on ground litter at 11:05 a.m. Shortly before sunset, the grasshoppers settled on their host plants and presumably stayed at rest until morning.

Temperatures declined from 80°F at sunset to 60°F at sunrise, at which time the grasshoppers were quietly roosting.

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