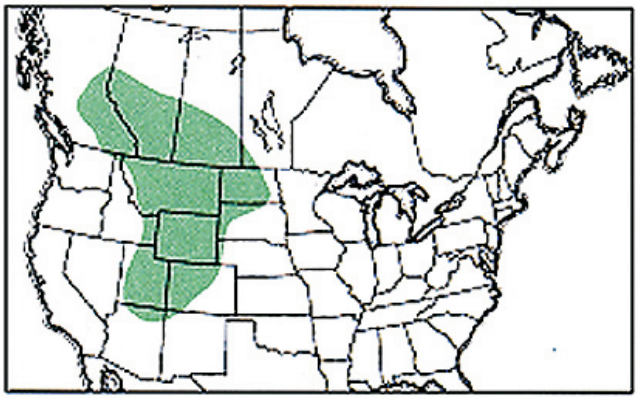
# Bruner Slantfaced Grasshopper

## *Bruneria brunnea* (Thomas)

### Distribution and Habitat

The Bruner slantfaced grasshopper (also known as *Stenobothrus brunneus*) ranges widely in the hills and mountains of the northwestern United States. It lives in the mixedgrass and bunchgrass prairies, in mountain meadows and parklands, and in alpine tundra. In the northern mixedgrass prairie its distribution extends into eastern North Dakota and southwestern Manitoba, where populations are small and local on suitable hillsides. Altitudes of its known habitats range from 1,600 to 11,100 feet.



Geographic range of *Bruneria brunnea* (Thomas)

### Economic Importance

When populations of the Bruner slantfaced grasshopper irrupt, the species becomes a serious pest of mountain and foothill grasslands. In 1920 its depradations were observed on rangelands of southeastern British Columbia. A dense infestation covering 2,000 square miles caused considerable damage to range grasses. The Bruner slantfaced grasshopper made up 50 percent of the assemblage, *Camnula pellucida* 30 percent, and *Melanoplus sanguinipes* and several other species 20 percent. In the mountains and foothills of Wyoming from 1988 to 1994, populations of the Bruner slantfaced grasshopper ranged from less than 0.1 to 15 per square yard. In the latter case, density of the assemblage was estimated to be 25 grasshoppers per square yard. The rest of the infestation was comprised of four other grass feeders and one forb feeder in approximately equal numbers.

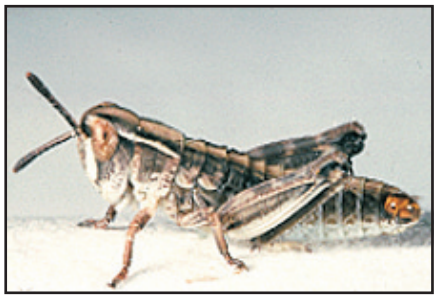
As a subdominant species, the Bruner slantfaced grasshopper may add to the damage of a dominant species. In 1989, a grassland site in the Big Horn Mountains of Wyoming was infested by an assemblage of 20 adult grasshoppers per square yard. This assemblage consisted of three grass feeders: *Camnula pellucida*, 40 percent; the Bruner slantfaced grasshopper, 10 percent; *Chorthippus curtipennis*, 10 percent; and three forb feeders: *Melanoplus bruneri*, 23 percent; *M. borealis*, 13 percent; and *M. alpinus*, 4 percent. During the period 1988-94, densities of most populations of the Bruner slantfaced grasshopper recorded in the annual grasshopper survey of Wyoming grasslands were low and economically insignificant; 118 of 148 (80 percent) sites surveyed contained less than one grasshopper per square yard. Although no experimental study of damage to forage has been made, estimates may be made from the weights of adults. Live weights of males collected from a mountain meadow in the Laramie Range averaged 223 mg and females 376 mg (dry weights: males 46 mg, females 96 mg).

### Food Habits

The Bruner slantfaced grasshopper feeds on grasses and sedges. The precise diet depends on plants available in its widespread habitats. Observations in Canada indicate that in the northern mixedgrass prairie it feeds on species of *Agropyron*, *Bouteloua*, *Carex*, *Koeleria*, and *Stipa*. In Wyoming, examination of crop contents of Bruner slantfaced grasshoppers collected from two mountain meadows, one in the southern Laramie Range and the other in the northern Big Horn Mountains, revealed that the grasshoppers had fed on mountain grasses and sedges (Table 1). The results suggest that certain grasses and sedges are selected as host plants including Idaho fescue, spikefescue, thickspike wheatgrass (*Elymus lanceolatus*), needleandthread, rock sedge, and threadleaf sedge. Differences in diet of the grasshoppers living in the two meadows appeared to be due to the presence and abundance of individual plant species in the habitat. For example, Idaho fescue was scarce in the Pole Mountain meadow but abundant in the Big Horn Mountain meadow; rock sedge was absent in the Pole Mountain meadow but common in the Big Horn Mountain meadow.

Two-choice cage tests showed that the Bruner slantfaced grasshopper exhibits selectivity in feeding on grasses, confirming that certain grass species in the natural habitat are preferred to others. One field observation of feeding revealed its method of attacking host plants. In a meadow of the Big Horn Mountains, an adult male was discovered walking at 10:55 a.m. DST on 4 August 1994. The temperature of soil surface was 81°F and of air at the 1-inch level 64°F, and the sky was clear. It came to a rock sedge, raised up diagonally on the plant, and cut a leaf 1/2 inch above the base. Resting horizontally on the ground surface, the grasshopper consumed the detached section, about 2 inches long, from the cut end to the tip. Adults caged on transplanted sod from a mountain meadow habitat fed in much the same way on grass. For example, a female raised up diagonally on a grass plant, cut a green leaf 1/2 inch above the base, held onto the cut section with the front tarsi, and consumed the whole 2-inch cut section. It attacked another leaf in the same manner. A male was observed to move onto a grass plant, cut a green leaf of 5 inches length at the 2-inch level, hold onto the cut section with the front tarsi, and feed on the leaf. This male also turned head-down on the plant and cut another green leaf, held onto the cut section with the front tarsi, and consumed

Instar 1



1. BL 5.5-6.9 mm FL 3.2-3.7 mm AS 13.

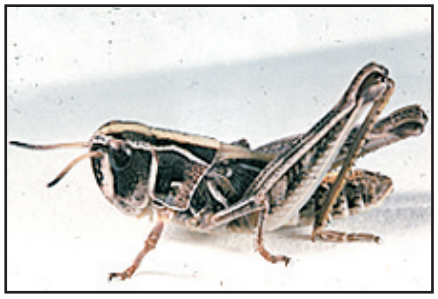
Instar 2

2. BL 6.5-10 mm FL 4.4-5 mm AS 17-19.

Instar 3

3. BL 8.9-12 mm FL 5.9-7.3 mm AS 20-22.

Instar 4



4. BL 14.5-18 mm FL 8.5-10.5 mm AS 22-24.

Figures 1-4. Appearance of the four nymphal instars of *Bruneria brunnea* - their sizes, structures, and color patterns. Notice progressive development of the wing pads. BL = body length, FL = hind femur length, AS = antennal segments number.

the entire cut section. Caged grasshoppers were also observed to feed in short bouts on ground litter.

## Dispersal and Migration

Flushed flight of the Bruner slantfaced grasshopper is straight and silent. The adults travel a distance of 2 to 8 feet at heights of 4 to 6 inches. They usually land on the ground headed away from the intruder.

Evidence for migration is meager. One long-winged female was discovered frozen along with specimens of known migratory species on a glacier in the Crazy Mountains of Montana. The wings of this female extended beyond the ends of the femora indicating exceptional powers of flight for the species. In the 1920 outbreak on rangeland of British Columbia, high numbers moved in August from areas of drought-stricken vegetation to areas of green vegetation.

## Identification

Adults of the Bruner slantfaced grasshopper are colorful, medium-sized grasshoppers (Fig. 5 and 6). The head has a slightly slanted face; antennae are filiform; a vertical ivory band runs from base of the antenna to the base of clypeus and mandible; an ivory or pale tan streak runs from rear of eye onto the lateral carina of the pronotum (See Figure 4). A common color pattern of the dorsum of head and the pronotal disk is shown in Figure 7. Pronotum with median carina incised once. Wings are long, extending approximately to end of hind femur and as much as 2 mm longer; tegmen with prominent spots and an ivory streak near front edge. Medial area of hind femur with three light spots in the dark dorsal stripe; tibia orange or red. Color patterns are variable and may differ from the common pattern described. A conspicuous pattern is an immaculate tan dorsum from head to end of abdomen in both nymphs and adults (Fig. 8).

The nymphs are identifiable by their color patterns, structures, and shape (Fig. 1-4):

1. Head with slanted face; ivory or pale tan vertical bar present on face running from base of antenna to base of clypeus and mandible; ivory or pale tan streak running from rear of eye onto lateral carina and disk of pronotum; antennae filiform; lateral foveolae oblong.
2. Pronotum with lateral lobe of instar I colored tan and spotted fuscous, lateral lobe of instars II-IV with large fuscous marking and often with ivory spot near center; median carina entire in instars I and II, incised once near middle in instars III and IV.
3. Hind femur with dorsal stripe of medial area nearly solid fuscous in instar I; three light spots in

Figures 5-9. Appearance of adult male and female, color pattern of top of head and pronotum, nymph with uncommon color pattern, and egg pods.

stripe faint in instar II, distinct in instars III and IV. Hind tibia of instars I and II fuscous, of instars III and IV straw-colored.

4. Venter of abdomen and thorax ivory, yellow, or pale tan.

## Hatching

Hatching of the Bruner slantfaced grasshopper occurs in June in both the northern mixedgrass prairie and the meadows of the Big Horn Mountains and the Laramie Range. In mountain habitats time of hatching varies due to yearly variations in snow depth and spring meltdown and their effects on soil temperatures. In 1994, in a meadow of the Laramie Range, hatching began on June 11, but in 1995 a late summer delayed hatching until June 30. The hatching period is short, lasting only two weeks in both Wyoming and Montana. No research of embryonic development has been conducted, but field observations suggest that the species may have a two-year life cycle in mountain meadows and northern grasslands.

## Nymphal Development

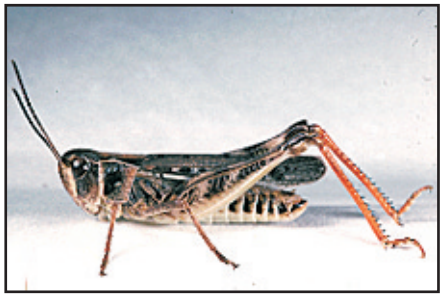
The nymphs emerge over a period of two weeks. In their mountain and foothill habitats, grasses remain green and supply an abundance of nutritious food. Cold temperatures and frequent cold rains and snow retard their development. The nymphal period, nevertheless, is relatively short, ranging from 40 to 46 days. Only four nymphal instars are required by the species to reach the adult stage.

## Adults and Reproduction

Adults normally appear in July in the northern mixedgrass prairie and in mountain meadows. Seasonal temperatures greatly influence the precise time of eclosion. In a mountain meadow of the Laramie Range, adults first appeared 14 July 1994, but in 1995, which was a seasonally late year, they did not appear until August 10. The period of eclosion lasted 21 days in 1994 and 16 days in 1995, suggesting that the grasshoppers were exposed to warmer temperatures later in the summer and were partially making up for the retardation of their earlier stages in 1995.

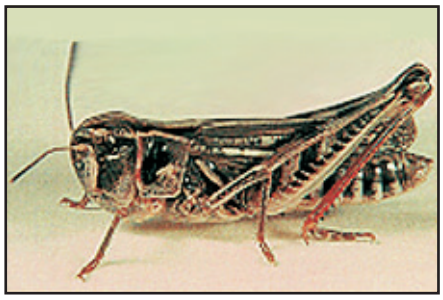
The adults remain in the same habitat in which the nymphs hatched and developed. The habitat provides green grass for food, ground litter for shelter, and interspersed bare ground for basking and oviposition. Meager information is available on mating, maturation, and oviposition. Observations are impeded by the extended duration of basking and evidently the short time they spend in other activities essential for their survival. A Montana study indicated that in the northern mixedgrass prairie, oviposition begins approximately 18 days after the first appearance of adults and continues into late September. In mountain meadows an early, heavy snowfall in August will be lethal,

Male



5. BL 14-16 mm FL 10.2-10.8 mm AS 23-24.

Female



6. BL 18.5-21 mm FL 11.5-12.4 AS 23-24.

Head Pronotum

7. Dorsal view of head and pronotum of female.

Color Form

8. Nymphs (instar III) of uncommon color form.

Egg pod

9. Two egg pods, one opened to show eggs.

Table 1. Mean percentage dry weight of food items in the diet of *Bruneria brunnea* in mountain meadow habits.

| | Laramie Range meadow | | Big Horn Mountain meadow |
|---|---|---|---|
| | 7/11/94 | 8/7/94 | 8/4/94 |
| Age | Instar V | Adult | Adult |
| *Festuca idahoensis* | 0.5 | | 37.5 |
| *Leucopa kingii* | 39.9 | 39.3 | 27.1 |
| *Elymus lanceolatus* | 35.3 | 20.8 | |
| *Carex filifolia* | 9.1 | 15.6 | |
| *Carex rupestris* | | | 29.3 |
| *Stipa comata* | 13.8 | | 1.3 |
| *Muhlenbergia filiculmis* | 0.4 | | |
| *Agropyron* sp. | | | 2.5 |
| *Oryzopsis* sp. | | 10.8 | 1.3 |
| Grass seed | 1.1 | 7.2 | 1.0 |
| Arthropod | | 6.4 | |
| No. crops examined | 11 | 15 | 13 |

but in a year with a late fall individuals persist into early October, lengthening the oviposition period.

Caged females oviposit freely into containers of bare soil collected from their habitat. Examination of five pods revealed 2 to 10 eggs per pod with an average of six. The unusual variation in number of eggs per pod may have been caused by the change in temperature from the mountain environment to the laboratory cage. Average temperatures in the cage were 72°F at night and 82°F during the day. Pods are 1/2 to 5/8 inch long and are inserted diagonally into the soil. The top of the pod lies 1/4 to 3/8 inch below the soil surface. The pod wall is thick and strong (Fig. 9). Eggs are yellow and 5.5 to 6.4 mm long. They are surrounded by pale tan froth and topped with 1/16 to 1/8 inch of offwhite froth.

## Population Ecology

No specific research of the population ecology of the Bruner slantfaced grasshopper has been conducted. A few facts, however, can be gleaned from general studies of grasshoppers. During irruptions this species may be the dominant member of an assemblage. In the 1920 outbreak on more than 2,000 square miles of rangeland in British Columbia, the Bruner slantfaced grasshopper contributed 50 percent of the assemblage, *Camnula pellucida* 30 percent, and several species the remaining 20 percent. No measurements of density were taken early in the year, but in August during a drought, the grasshoppers moved to areas with green vegetation in which the concentration of the Bruner slantfaced grasshopper measured 720 to 900 individuals per square yard. In meadows of the Big Horn Mountains this species may also rise to dominance. In one meadow in 1991, it was the dominant member in an assemblage of four species. Densities of young adults per square yard were estimated to be: *Bruneria brunnea*, 8.9; *Melanoplus bruneri*, 3.7; *Camnula pellucida*, 3.1; and *Chorthippus curtipennis*, 0.3. Of the 21 meadow sites surveyed for grasshoppers in 1991 in the Big Horn Mountains, the Bruner slantfaced grasshopper was dominant in one, co-dominant in three, and subdominant in 17. In the latter 17 sites, densities of this species ranged from 0.05 to 0.8 and averaged 0.3 young adults per square yard. Apparently in the many disjunct meadows of the Big Horn Mountains, the population ecologies of this grasshopper are separate and may differ substantially.

## Daily Activity

The Bruner slantfaced grasshopper is a geophilous species spending its time on the ground surface during the day and hidden in ground litter at night. None can be found in early morning on either the vegetation or on the ground surface. One successful observation of the location of their shelter was made. A male nymph (instar IV) was discovered 1/2 inch deep in ground litter of a meadow in the Big Horn Mountains on 21 July 1994 at 6:12 a.m. DST; the soil surface temperature was 35°F and air temperature 34°F. The nymph was immobile and sitting horizontally on a layer of grass litter and was completely covered by litter. Two hours after sunrise, individuals begin to appear on the ground surface. They rest horizontally on bare ground or on ground litter and bask. During basking they present a side perpendicular to the sun and lower the associated hindleg to expose the abdomen more fully. Basking continues for approximately three hours before they become active. The feeding of a male was noted at 10:55 a.m. on 4 August 1994. Other activities probably commence at this time but were not observed. A second period of basking occurs in the afternoon. Shortly before sunset, when soil temperatures have not yet cooled much (65°F to 70°F), the grasshoppers seek shelter for the night.

## Selected References

Alexander, G. and J.R. Hilliard, Jr. 1969. Latitudinal and seasonal distribution of Orthoptera in the Rocky Mountains of northern Colorado. Ecol. Monogr. 39: 385-431.

Brooks, A.R. 1958. Acridoidea of southern Alberta, Saskatchewan, and Manitoba (Orthoptera). Can. Entomol. Supp. 9: 1-92.

Larsen, J.C., J. A. Hutchason, T. McNary, and K. Zimmerman. 1988-94. The Wyoming Grasshopper Information System. Cooperative Agricultural Pest Survey. University of Wyoming, Laramie.

Lockwood, J.A., J.C. Burne, L.D. Debrey, R.A. Nunamaker, and R.E. Pfadt. 1990. The preserved fauna of grasshopper glacier (Crazy Mountains, Montana): Unique insights to acridid biology. Bol. San. Veg. Plagas (Fuera de serie) 20: 223-236.

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

Treherne, R.C. and E.R. Buckell. 1924. The grasshoppers of British Columbia with particular reference to the influence of injurious species on the range lands of the province. Bull. Can. Dept. Agric. n.s. 39: 1-47.

Vickery, V.R. and D.K. McE. Kevan. 1983. A monograph of the Orthopteroid insects of Canada and adjacent regions. Lyman Entomol. Mus. Res. Lab. Mem. 13 Vol. 2.