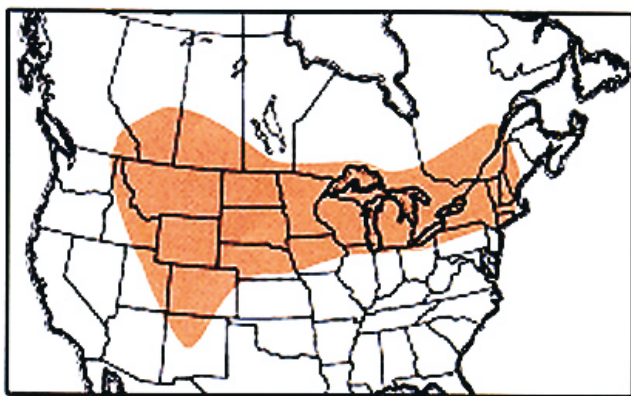


Dawson Grasshopper

Melanoplus dawsoni (Scudder)

Distribution and Habitat

The Dawson grasshopper is a small short-winged species that ranges in northern grasslands from the Atlantic coast to the Great Basin of the West. It is a common grasshopper in the mixedgrass prairie and in grass-forb parks at high altitudes (7,000 to 8,500 feet). In Colorado it is a rare resident at 10,000 feet. At lower altitudes it frequently inhabits the bottoms of ravines where grasses, forbs, and shrubs grow profusely.



Geographic range of *Melanoplus dawsoni* (Scudder)

Economic Importance

Some entomologists have concluded that the Dawson grasshopper is of little economic importance. Nevertheless, observed densities of 4 to 10 adult grasshoppers per square yard in the northern mixedgrass prairie indicate a potential for damage, especially to pastures in this region seeded to legumes.

Alfalfa fields in North Dakota are frequently infested with the Dawson grasshopper in addition to six other species of *Melanoplus*, namely, *M. bivittatus*, *M. femurrubrum*, *M. sanguinipes*, *M. packardii*, *M. gladstoni*, and *M. differentialis*. Of 12 counties surveyed in 1958 and 1959, two (Benson and Ramsey) harbored dominant numbers of the Dawson grasshopper (42 and 67 percent of the collected grasshoppers, respectively). Of 409 Dawson crops examined, 344 or 84 percent contained alfalfa fragments equalling the frequency of alfalfa in the crops of *M. femurrubrum*, a recognized serious pest of alfalfa.

Weights of the Dawson grasshopper are similar to weights of the little spurthroated grasshopper, *Melanoplus infantilis*. Live weights of males average 156 mg and females 238 mg (dry weights males 47 mg, females 73 mg). Weighed within 24 hours after molting into the adult stage, live weights of males averaged 94 mg and females 117 mg.

Food Habits

The Dawson grasshopper feeds principally on forbs. Forty species of forbs belonging to 13 plant families are known to be ingested. Two families, the bean and sunflower, appear to include the known principal host plants: western ragweed, leadplant, and milkvetches. Additionally, two introduced plants, both legumes, alfalfa and white clover, are among its host plants. White clover

has become an important host plant due to its widespread invasion of pastures, foothill rangelands, mountain meadows, and roadsides. In cage tests the Dawson grasshopper has shown a marked preference for dandelion, an introduced weed that occurs in many of its habitats.

Fragments of 10 species of grasses, usually in small amounts, have been detected in the crops of this grasshopper. In the sand prairie of southeast North Dakota, Kentucky bluegrass besides three preferred forbs (leadplant, western ragweed, and wild rose) appeared to be consumed in substantial amounts. In a small overgrazed pasture that lies in a creek bottom in Johnson County, Wyoming, crops of adults collected late in the season (20 September 1994) contained chiefly fragments of grass seeds and brome leaves. In a foothill habitat of the Big Horn Mountains lying at an altitude of 7,190 feet, Dawson grasshoppers fed upon white clover, 43 percent; *Astragalus* sp., 25 percent; golden aster, 16 percent; common yarrow, 5 percent; grass seeds, 5 percent; and arthropods, 6 percent; as measured by analyses of crop contents.

Two observations were made of the Dawson grasshopper's method of attacking a host plant. A nymph (instar V) was observed walking on the ground in a searching mode. When it came across a sprouting 1-inch forb, it consumed it from tip to base. A female sitting diagonally head-up, 11 inches high, on a secondary stem of thistle (*Cirsium* sp.) crawled 2 inches to a leaf and began to feed on the edge. She fed for one minute until she was disturbed by the observer. This meager evidence suggests that the Dawson grasshopper feeds both by searching the ground and by attacking the leaves of a host plant close to where an individual may be resting or basking.

Dispersal and Migration

The wide geographic range of the Dawson grasshopper suggests that the species has both a long evolutionary history in North America and effective powers of dispersal. Although the majority of adults are short-winged, a few possess long wings. In a Colorado study, three of 952 adults (0.3 percent) collected in 14 study sites were long-winged. A specially relevant observation in this study was the discovery of one long-winged female at 12,200 feet indicating a flight distance of approximately 14 miles from the closest resident population. In 1995, three of 108 (2.8 percent) adults from six survey sites in Sheridan County, Wyoming possessed long wings.

Identification

The Dawson grasshopper is a small, short-winged species. A small proportion of the population, however, may possess long wings that extend 2 to 4 mm beyond the end of the abdomen. Adults are easily recognized by their small size, short wings, black and yellow ringed abdominal terga, canary yellow venter, and red hind tibia (Fig 6 and 7). The male cercus is short, slightly concave near the end, and rounded apically (Fig. 9).

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

1. Head all black except conspicuous yellow band below compound eye and a median yellow line or

Instar 1



1. BL 4.5-5.1 mm FL 2-2.4 mm AS 13-14.

Instar 2



2. BL 5-6.9 mm FL 2.8-3.4 mm AS 17-18.

Instar 3



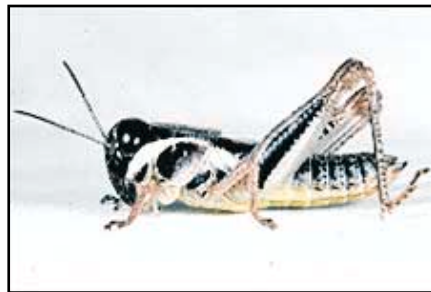
3. BL 6.9-8.8 mm FL 4.3-4.4 mm AS 19-20.

Instar 4



4. BL 8.7-12.5 mm FL 5.3-7.4 mm AS 21-23.

Instar 5



5. BL 10-13 mm FL 7.3-8 mm AS 22-24.

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

1. Pronotum mainly black; the yellow band below compound eye continues onto lateral lobe to form a conspicuous crescent; a large black band is centrally located on the lateral lobe; posteriorly below it is a yellow triangular marking; a median yellow line or band is present on the disk. The dorsal stripe of the hind femur is broad and continuous, a small dorsal yellow wedge in the middle of the stripe is sometimes present (Fig. 5). The tibia is tan.
2. Sides of abdomen are mainly fuscous or gray; in instars I and II the venter is tan; in instars III, IV, and V it is yellow; top of abdomen with median yellow band.
3. Body colors of black and yellow are shiny and appear polished.

Hatching

The Dawson grasshopper begins to hatch about one week after the migratory grasshopper, *Melanoplus sanguinipes*. Both belong to the intermediate-developing group of grasshoppers. In 1979 in northern Wyoming at an altitude of 3,700 feet, hatching of the Dawson grasshopper began the first week of June and continued until the first week of July. At higher altitudes in this region, hatching occurred later (e.g. at 4,100 feet hatching began on 19 June 1979). The effect of altitude on the life cycle of the Dawson grasshopper has been demonstrated nicely in a Colorado study. The study confirmed the applicability of Hopkin's bioclimatic law. The law, with reference to altitude in temperate North America, states that for every rise of 400 feet, events in the life cycle are delayed four days.

The start of hatching at a particular site depends on seasonal temperatures and precipitation and may vary from one year to another by as much as four weeks. The hatching period (duration) also varies, ranging from two to six weeks.

Nymphal Development

Both male and female nymphs require five instars to reach adulthood. Calculations of available data (days from first instars to first adults) indicate that at high altitudes the nymphal period is shorter than at low altitudes. For example, in northcentral Colorado nymphal development lasted 32 days at 5,750 feet, 28 days at 6,700 feet, and 20 days at 8,500 feet. In northern Wyoming, at 3,700 feet, the nymphal period lasted 45 days.

Reared in the laboratory at six different temperatures, the Dawson grasshopper developed at six different rates with nymphal periods ranging from 21 to 66 days. Up to a point, the higher the temperature the faster the growth. The highest-rearing temperature of 104°F, however, retarded development and increased mortality. Of the temperatures

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

used in these tests, 95°F appeared most favorable, as the nymphs both developed fastest and survived in greatest numbers.

These experimental results suggest that temperatures in the habitat have a considerable influence on the rate of development and survival of this grasshopper. They do not explain, however, shorter life cycles at higher altitudes where temperatures are cooler. A hypothesis for variation in length of life cycles of the Dawson grasshopper living at different altitudes draws on one proposed to explain similar variation in populations of the migratory grasshopper, *Melanoplus sanguinipes*. Resident populations of a species may be genetically isolated, such that they adapt physiologically to the length of the growing seasons and other environmental exigencies of their habitat and pass on these adaptive characters to succeeding generations. Additionally, grasshoppers at high altitudes make behavioral adjustments that may equalize heat accumulation of individuals. They bask longer in the sun and remain longer in their thermal shelters under grass canopies, litter, and dry cow dung. Because of these responses, the most important physiological adaptations that grasshoppers at high altitudes make are to the shorter seasons.

Adults and Reproduction

First appearance of adults occurs from early to late July, with the precise time depending on seasonal temperatures and altitude. Transformation to the adult stage continues for four to five weeks; in mid to late August, only adults are present. The population then consists of adults of widely different ages. Maturation of adults has not been studied; however, courtship and copulating pairs have been observed. A male in search of a mate produces bursts of vibratory stridulation, and when close to a female he makes a sudden jump onto her back. He continues to produce bursts of vibratory stridulation as he attempts to engage her genitalia. If she is receptive, he succeeds in mating and the two remain in copulo for an undetermined period. Evidently copulation begins in the morning, as two pairs observed in a foothill habitat on 19 August 1994, were in copulo at 9:27 a.m. and at 11:41 a.m. DST.

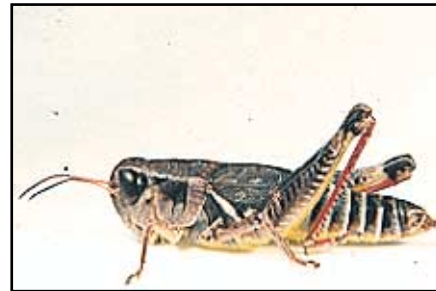
One attempt at oviposition was observed on 5 August 1994 in a weedy grass-forb habitat. The female sitting horizontally on litter began to bore into the ground at 9 a.m. but withdrew her ovipositor five minutes later. She crawled 6 inches away and began to bore again into the ground at 9:06 a.m., but again withdrew her abdomen and crawled away into thick vegetation and became lost to view. Caged females readily oviposit into bare soil, but they often bore several times before finally depositing eggs.

Adults are present in habitats at low altitudes (3,500 to 6,000 feet) from mid-July to mid-October, a period of approximately 13 weeks. As long as the supply and condition of host plants persist, this extended presence of adults gives the species considerable time to reproduce. At higher altitudes (8,500 feet), the length of the adult period is shorter, but the species apparently reproduces as well in resident populations. Rapid development of nymphs at high altitudes has been documented and accelerated rates probably include maturation and egg production as well.



Male

6. BL 14.5-18.8 mm FL 8.7-9.5 mm AS 24-25.



Female

7. BL 17-22.5 mm FL 10-10.8 mm AS 23-25.



Hindleg

8. Outer face of left hindleg of female.



Cercus

9. End of male abdomen showing the cercus



Eggs

10. Egg pod and exposed eggs.

The egg pods are 3/4 inch long and slightly curved just above the eggs. In the region of the eggs, the pod has a diameter of 1/8 inch. The eggs occupy the lower 1/4 to 3/8 inch of the pod, with pale yellow or white froth comprising the top part. Pods contain 8 to 14 (average 10.8) tannish yellow eggs that measure 3.6 to 4.5 mm long (Fig. 10).

Population Ecology

Populations of the Dawson grasshopper enjoy the greatest frequency of occurrence and the highest densities in the northern part of their geographic range and at high altitudes in the south. The species occurs commonly in the northern mixedgrass prairie of the Canadian prairie provinces where populations may increase to 10 adults per square yard. It is occasionally the dominant species in an assemblage, but more often it is subdominant to *Melanoplus infantilis*, *M. sanguinipes*, *M. packardii*, or *Encoptolophus costalis*.

Results of grasshopper surveys in Montana and Wyoming show the influence of latitude on frequency of occurrence. The Dawson grasshopper was found in 9 of 55 sites (16 percent) in Montana, but only in 30 of 699 sites (4 percent) in Wyoming.

An important factor in fostering populations of the Dawson grasshopper appears to be quality and supply of host plants.

The species frequently inhabits abandoned fields and roadsides where dandelion, volunteer legumes, and other forbs grow abundantly. In Montana this grasshopper occupied 4 of 11 abandoned fields (36 percent).

A study of grasshopper ecology in the northern mixedgrass prairie of southwest Saskatchewan has shown that when environmental conditions become favorable for the Dawson grasshopper, populations can increase seven-fold over a period of four years. The densities during these years were low: 0.25 per square yard in 1968, 0.4 in 1969, 0.9 in 1970, and 1.7 in 1971.

In the south, favorable habitats of the Dawson grasshopper occur at high altitudes of 7,000 to 8,500 feet. An example of such a habitat was discovered in 1994 in the western foothills of the Big Horn Mountains, Washakie County, Wyoming. Located at an altitude of 7,200 feet, this grassland site was invaded by white clover that served as the grasshoppers' chief host plant. The density of all species in an assemblage of mainly young adults sampled on 19 August 1994 was estimated to be 16.5 grasshoppers per square yard. The Dawson grasshopper was the dominant species with 6.5 individuals per square yard.

The assemblage consisted of four other species: *Melanoplus sanguinipes*, 5 per square yard; *Camnula pellucida*, 3.5; *M. femurrubrum*, 1; and *M. infantilis*, 0.5. In Colorado, the Dawson grasshopper is a rare resident at 10,000 feet. Above this altitude the species is apparently unable to exist. Small populations of the Dawson grasshopper inhabit the sand prairie (altitude 1,075 feet) of southeast North Dakota. A 10-year study revealed low densities every season.

In its southern distribution, the Dawson grasshopper often inhabits the bottom of ravines from where, in outbreak years, they may disperse to surrounding mixedgrass prairie. When these large populations crash, the species disappears from the surrounding prairie but persists in the ravines.

Daily Activity

The Dawson grasshopper is a geophilus species living most of its life on the ground. In high-altitude habitats where soil and air temperatures fall below 50°F during the night, individuals rest in nocturnal shelters. One-half to one hour after the sun strikes the ground, they emerge from these shelters and begin to bask. Basking horizontally on the ground, they turn a side perpendicular to the sun's rays and lower the associated hindleg to expose the abdomen. The opposite hindleg is held in the normal position with the knee a few millimeters above the tegmen. They may also bask high on forbs, turning a side or their back to the sun. They bask for up to three hours until 10 a.m. DST. Some adults may become active before others have finished basking. Feeding has been observed as early as 9:30 a.m., courting 9:45 a.m., mating 9:27 a.m., and ovipositional probing 8:41 a.m. During the activity period many may just rest quietly occasionally stirring and preening. They sit on vegetation or horizontally on ground litter and usually face away from the sun.

All activity ceases if soil and air temperatures become too hot for the grasshoppers. Response of adults to soil surface temperature of 135°F and air 100°F was observed in a low-altitude (4,700 feet) habitat near Buffalo, Wyoming. The grasshoppers climbed forbs and grasses and rested vertically, head-up on the shady side of the plant at heights of 5 to 18 inches. The response of three adults flushed to the ground was observed. A female jumped 3 feet, landed on the ground, but almost immediately climbed up 15 inches on the stem of a wild licorice plant. A male jumped to the ground and after a few seconds crawled to a nearby grass plant and climbed up the stem. Another flushed male jumped onto a grass stem and landed 2 inches above ground and in the sun; after several seconds it moved to the stem of a slimflower scurfpea on which the grass leaned, crawled to a height of 5 inches, and came to rest vertically head-up on the shady side of the scurfpea.

When temperatures decline, a second period of activity occurs. As temperatures fall still further in late afternoon, the grasshoppers bask for a second time. Finally, just before sunset, they retreat to shelters. They have been observed to crawl into thick clumps of grasses and under dry cow dung. In the morning before sunrise, they have been discovered resting both horizontally on the ground and upside down on the underside of rocks or dry cow dung, often along with individuals of other species such as *Melanoplus sanguinipes* and *Camnula pellucida*.

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