

Threebanded Grasshopper

Hadrotettix trifasciatus (Say)

Distribution and Habitat

The threebanded grasshopper ranges widely in the grasslands of the West. It is a common species of the shortgrass, desert, and mixedgrass prairies. It is less abundant in other prairies and is rare in grass-shrub communities of the intermountain basins. In the tallgrass prairie it occupies areas of sparse vegetation on gravelly hilltops and slopes.

Economic Importance

Because of its low densities in most western grasslands, the threebanded grasshopper does not appear to be of great economic importance either as a damaging pest or as a beneficial insect. Its feeding on good forage grasses would tend to give it pest status, but research has shown that it feeds more heavily on poor forage plants and plants poisonous to livestock (death camas, milkweeds, some milkvetches, and others). The threebanded grasshopper is one of the largest rangeland species. Live weight of males and females collected from the mixedgrass prairie of eastern Wyoming averaged 540 and 1,654 mg, respectively (dry weights 152 mg and 469 mg, respectively).

Food Habits

The threebanded grasshopper is a polyphagous species feeding on grasses, forbs, sedges, dead and weakened insects, plant litter, and dry cattle dung. It feeds chiefly on forbs, with as many as 40 species recorded from analyses of crop contents and direct observations in nature. Examination of 152 specimens collected from several habitats near North Platte, Nebraska revealed that 75 percent of crop contents consisted of forbs, 21 percent grasses and sedge, and 4 percent arthropod parts. Of the 18 forbs identified in the crops, scarlet

globemallow was most abundant (8 percent). The next most abundant were a group of four species, each contributing 4 percent to crop contents: Missouri milkvetch, Virginia pepperweed, scarlet gaura, and breadroot scurfpea. Two grasses (western wheatgrass and blue grama) and one sedge (threadleaf sedge) each comprised 4 percent of the crop contents.

In multiple-choice tests, F. B. Isely, an early investigator of grasshopper biology, found that the threebanded grasshopper preferred antelopehorns, milkweed, and narrowleaf bluet. As these plants grow in the optimum habitat of the grasshopper in northeastern Texas, he concluded that they were its host plants.

Several observations have been made of the threebanded grasshopper's method of feeding. A hungry grasshopper crawling on the ground often stops to feed on ground litter. This litter may consist of green or dry grasses, forbs, or dead insects. An interesting observation was made of a female *H. trifasciatus* and a male *Aulocara elliotti* that came across a dead adult grasshopper (*Trachyrhachys kiowa*) at nearly the same time. In the scramble that followed, the larger female won out and fed for approximately eight minutes on the cadaver before it was inadvertently frightened away.

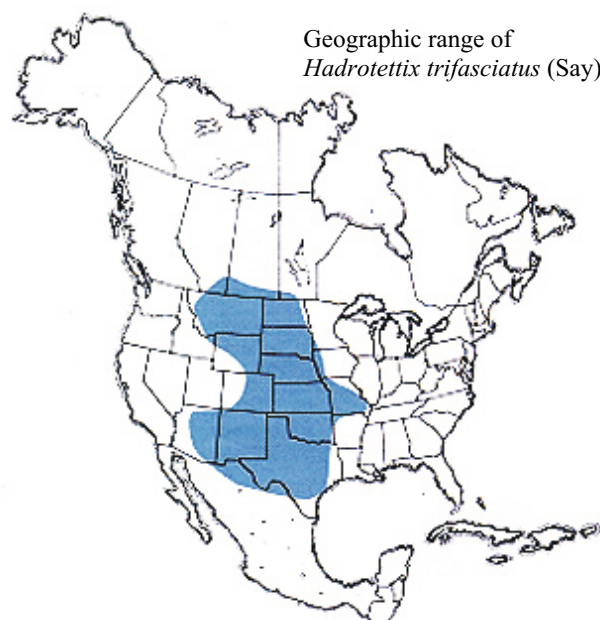
Another female climbed 2 inches up a short forb stem, cut a 1 inch section, held on to it with the front tarsi, and then consumed it completely in approximately five minutes. This grasshopper then fed briefly on the stub and finally walked away.

An observation was made of a caged female feeding on a dandelion leaf. It perched diagonally on the leaf and fed on the leaf's edge. In a series of progressive ingestions it moved its head forward 1/4 inch on the edge and then ate back this distance. Dandelion appeared to be a relished food plant, but it is a rare species in the habitat of this grasshopper.

Dispersal and Migration

The threebanded grasshopper is a strong flier, possessing long wings that usually extend 6 to 10 mm beyond the end of the abdomen. Finding "accidentals" of the species in three Colorado mountain sites at altitudes of 6,700 to 10,000 feet provides evidence that it makes dispersal flights. The site of the highest elevation was 10 miles from the nearest known resident population.

Flushed flight is usually straight with a 90 degree turn at the end. Landing is soft as they normally flutter to the ground. Crepitating in flight, males travel distances of 9 to 24 feet and the heavier females 6 to 15 feet, both at heights of 12 to 18 inches. Flying with the wind (2 to 8 mph), a male was observed to travel a distance of 42 feet. A case of mass emigration of adults from a desert prairie site on the San Carlos Apache Indian Reservation, Arizona occurred during June 1980. A dense infestation

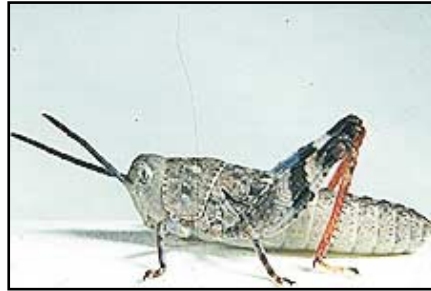


Instar 1



1. BL 5.2-10.4 mm FL 3.9-4.4 mm AS 13-14.

Instar 2



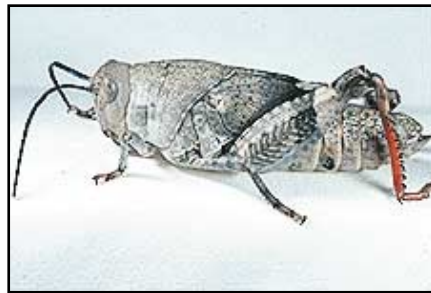
2. BL 7.9-12.5 mm FL 5.1-6.4 mm AS 17-19.

Instar 3



3. BL 12-16.7 mm FL 7.8-9.1 mm AS 20-21.

Instar 4



4. BL 19.5-22.5 mm FL 10.9-13 mm AS 23.

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

of grasshoppers, 36 per square yard, was recorded on May 30, 1980 in which the following grasshoppers (mainly ultimate instars) dominated: *Melanoplus cuneatus* (14 per square yard), *Aulocara elliotti* (13 per square yard), *Melanoplus sanguinipes* (4.4 per square yard), and *Hadrotettix trifasciatus* (3.8 per square yard). Sampling the site on June 26 revealed that the densities of adult grasshoppers were: *Aulocara elliotti* 15 per square yard and *Melanoplus cuneatus* 2.5 per square yard. No *Melanoplus sanguinipes* and no adult *Hadrotettix trifasciatus* were found. Only one ultimate instar of the latter species was found in 50 1-square-foot samples. Circumstantial evidence indicated that the forb feeders (all the adult *Melanoplus sanguinipes*, all the adult *Hadrotettix trifasciatus*, and 82 percent of the adult *Melanoplus cuneatus*) had emigrated from the site, ostensibly because of food shortage. The population of *Aulocara elliotti*, which uses grasses for food, remained high at 15 adults per square yard.

Identification

The threebanded grasshopper is a large rangeland species (Fig. 5 and 6). Antennae are long and dark, each segment often with a light anterior annulus. Pronotum has the median carina very low. Tegmen with three dark bands; hind wings with disk pale yellow or nearly white, outer dark band wide and located in the distal third (Fig. 7). Outer face of hind femur with an oblique dark band and an adjacent, distal light band; inner face mainly dark blue, adjacent distal light band, knee area dark blue; hind tibia orange or red (Fig. 8). The distal light bands of the outer and inner face meet and form a wide annulus around the hind femur.

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

1. Head with face vertical, antennae long and dark.
2. Pronotum with low median carina, uncut in instars I and II, cut near middle in instar III, cut in front of middle in instar IV.
3. Color patterns of hindlegs similar to adult, except hind tibia of instar I often gray and tan.
4. General body color brown or gray with dark brown spots.

Hatching

The threebanded grasshopper hatches early in the season along with *Ageneotettix deorum*, *Amphitornus coloradus*, and *Aulocara elliotti*. In the mixedgrass prairie of eastern Wyoming, eggs usually begin to hatch during the latter part of May. In 1992, however, first instar nymphs were collected on May 9, along with first and second instars of *Ageneotettix deorum* and *Amphitornus*

Figures 5-9. Appearance of the adult male and female of *Hadrotettix trifasciatus*, wings, hindleg, egg pod, and eggs.

coloradus. In the mixedgrass prairie of eastern Montana in 1950, hatching of the threebanded grasshopper and *A. coloradus* began on May 22. In the Southwest, hatching is earlier with first instar nymphs present in early May.

Nymphal Development

Development of the threebanded grasshopper begins with relatively large nymphs. The length of the hind femur of first instars averages 4.3 mm; by comparison, that of *Metator pardalinus*, another large bandwinged species, averages 3.6 mm.

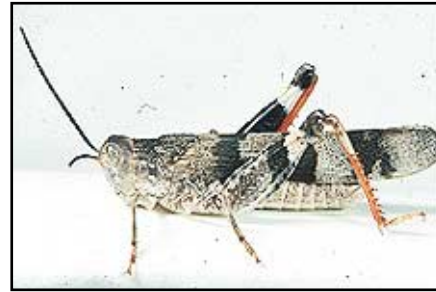
Nymphal development of the threebanded grasshopper is relatively long. Based on dates of observations of first instar nymphs and of first adults, the length of the nymphal period was 56 days in mixedgrass prairies of southeastern Montana in 1950 and southeastern Wyoming in 1991. At the same site in Wyoming in 1992, the nymphal period was 62 days. Because the nymphs appeared three weeks sooner in 1992 than in 1991, they undoubtedly were exposed to lower temperatures early in development, which extended the nymphal period six days.

Surprisingly, only four instars are needed by this large grasshopper to reach the adult stage, as revealed by a study of the morphology of field-collected nymphs (the shape and size of the ovipositor and the wing pads, the length of the hind femur, and the number of antennal segments). Although females of *M. pardalinus* weigh only half as much as females of *H. trifasciatus*, the former species requires five instars to complete development. A comparison of these two species shows that nymphal, stepwise growth (metamorphosis), as gauged by the increase in length of the hind femur, of *H. trifasciatus* is greater than that of *M. pardalinus*. Measurements of the hind femur of the first four female instars of each species yield a growth factor of 1.43 for *H. trifasciatus* and 1.31 for *M. pardalinus*. This difference and the beginning larger size of first instars of *H. trifasciatus* readily account for the heavier adults of this species despite its having only four instars. Real growth (the daily increase in weight of nymphs) of both species is probably similar, but because the nymphal period of *H. trifasciatus* is longer, the adults become significantly larger.

Adults and Reproduction

Adults of the threebanded grasshopper usually remain in the same habitat in which the eggs hatch and the nymphs develop. Their preferred host plants remain green during the summer. However, if these plants dry up or are exhausted by intensive grazing of grasshoppers, the adults respond by emigrating and thereby finding, perhaps, a more viable habitat.

The adults appear in mid June in the shortgrass prairie of southwest Texas and the desert prairie of Arizona and a month later in the mixedgrass prairie of Montana and



5. BL 24.5-27.5 mm FL 13.8-15 mm AS 23-24.

Male



6. BL 28-35.5 mm FL 14.5-18.3 mm AS 22-24.

Female



7. Spread left wings of female.

Wings



8. Inner face of female, hind femur, tibia, and tarsus.

Hindleg



9. Egg pod and four loose eggs.

Egg pod

Wyoming. Although aggregating rituals of the sexes have not been seen, courtship has been observed several times. Males approaching a female may make tipping motions of the hind femora. As they come closer, they stridulate to attract her attention. Successful courtship has not been noted, but rejection by the female has been observed. Females may reject courting males by hopping away, raising the hind femora and holding the tibiae over the back while making slight upward kicking motions, tipping the hind femora, or kicking out with the hind tibiae.

Oviposition begins about one month after the fledglings appear. Females retreat into grass cover, often blue grama or buffalograss, and oviposit through plant litter into the ground. An interesting observation was made in the mixedgrass prairie of southeastern Wyoming of a female preparing an oviposition site. She crawled into a secluded spot among blue grama, then tipped the front of her head down and began to fashion a small depression in plant litter by bobbing her head up and down into the litter. After a few seconds she turned around and began to work her ovipositor into the depression, but was soon frightened by the observer attempting a closer look.

In the saltbrush-bunchgrass community of the Big Horn Basin (Big Horn County, WY) where bare ground prevails, a single observation was made of a female ovipositing in bare ground 2 inches southeast of a saltbrush. She was discovered at 12:12 p.m. DST with her ovipositor already inserted into the soil. She completed her laying between 12:45 and 12:50 p.m. but was not observed extracting her ovipositor nor covering the hole. Temperature of the soil surface ranged from 113° to 117°F and the air at the 1 inch level from 78° to 81°F. The sky was clear, the soil dry, and an east wind ranged from 0 to 6 mph. An examination of the position of the pod in the soil revealed that the top of the pod was 1/8 inch below the soil surface, the froth occupied 5/8 inch of the pod, was vertically oriented. Because of the sharp curve in the pod, the egg portion lay horizontally in the soil so that the eggs were oriented almost vertically. The eggs were at a depth of 1/2 to 3/4 inch.

The egg pod of the threebanded grasshopper is 1 inch long and strongly curved (Fig. 9). The egg section is 5/8 inch long and contains from 18 to 26 eggs. In Figure 9 the loose eggs are recently laid and tan, and those in the intact pod are older and have turned reddish-brown. Eggs are large, their lengths ranging from 7.2 to 8.7 mm.

Population Ecology

The center of distribution of the threebanded grasshopper appears to be in the Southwest's shortgrass and

desert prairies. Although absolute densities were not determined, a study (1966-72) of grasshopper populations in the shortgrass prairie of the Texas Panhandle revealed that in two of the years (1970 and 1971) the threebanded grasshopper was the dominant species. In the other years *Mermiria picta* or *Syrbula admirabilis* was dominant. In the desert prairie of Arizona, the threebanded grasshopper occurs at densities of 1.3 to 4 per square yard and often ranks fourth in abundance after *Aulocara elliotti*, *Melanoplus cuneatus*, and *Melanoplus sanguinipes*.

In the extensive mixedgrass prairie of the West, the threebanded grasshopper is a common but not abundant species. Densities range from less than 0.1 to 0.3 grasshoppers per square yard. These low densities persist from year to year and do not appear to track the dynamic fluctuations of the dominant species or the assemblage.

Daily Activities

The threebanded grasshopper is a ground-dwelling species. At night it rests horizontally on the ground surface surrounded by a canopy of grasses. When the rays of the sun strike them, about two hours after sunrise, both nymphs and adults begin to bask. They sit horizontally on the ground and turn a side perpendicular to the sun and lower the flexed hindleg to expose the abdomen. Basking may last for two hours, until soil temperatures have risen to 80°F and air temperatures (1 inch high) to 72°F. Activities such as walking and feeding then begin. A mating pair was observed at 11:55 a.m., and attempts by two males to mate with a single female were noted at noon. Neither attempt was successful, although the female made no effort to dislodge them after they had mounted. A female was observed testing sites for oviposition in litter under a grass canopy at 12:42 p.m., when bare soil registered 130°F and air temperatures 95°F. Adults usually take evasive action from excessive heat when soil temperature reaches 120°F. Adults first stilt and then crawl away from hot bare ground. They evade the extreme heat by sitting on thick litter or by crawling atop blue grama. In either case they become elevated approximately 2 inches above ground. With further increase in temperature they may crawl into shade of vegetation or crawl up a plant to a height of 3 inches.

Few observations of the threebanded grasshopper were realized between 1 p.m. and sunset. At 5:40 p.m. a male and a female were discovered sitting horizontally and quietly on bare soil under a cloudy sky. Although still unknown, the threebanded grasshopper during clear weather probably basks before moving to its night resting locations.

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