

Mottled Sand Grasshopper

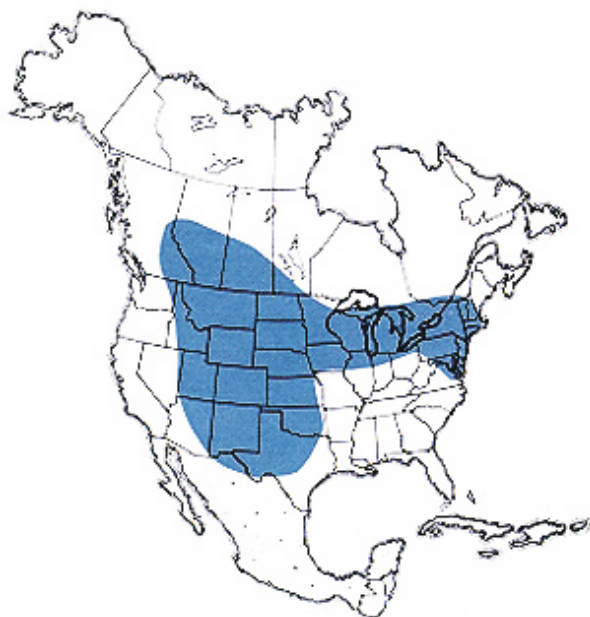
Spharagemon collare (Scudder)

Distribution and Habitat

Although locally distributed, the mottled sand grasshopper has a wide geographic range in North America. Its preferred habitat consists of sandy soil covered by sparse grasses and forbs. In the West it inhabits the sand prairie where the characteristic vegetation consists of the tall grasses, sand bluestem, and prairie sandreed, as well as several short and mid grasses and numerous species of forbs. Although the mottled sand grasshopper is prevalent in grassy areas with sandy soils, it is a rare species in grasslands with loam to clay soils such as in the mixedgrass prairie. Here, the closely related species, *Spharagemon equale*, is common. Yet, ruderal sandy loam sites (e.g., edges of wheat fields, roadsides, and other disturbed areas) provide favorable habitats for the mottled sand grasshopper where it may build up to unusually high densities.

Economic Importance

The mottled sand grasshopper is not a serious pest. Its usually low densities (less than 0.1 to 1 per square yard) cause only minor damage to forage. It may, however, increase to greater densities in disturbed areas of sandy loam soil and cause damage to wheat and other grains. In Idaho, densities of nymphs may reach 10 per square yard and present a hazard to newly seeded crested wheatgrass.



Geographic range of *Spharagemon collare* (Scudder)

Food Habits

The mottled sand grasshopper is a polyphagous species that feeds on grasses, sedges, and forbs. Examination of crop contents of grasshoppers collected in Colorado and Nebraska revealed that the species had fed upon 12 grasses, three sedges, and 13 forbs. Grasses and sedges consumed in large amounts were blue grama, needleandthread, western wheatgrass, sand dropseed, witchgrass, and threadleaf sedge. Grasses, sedges, and rushes ingested in lesser amounts included sand bluestem, little bluestem, prairie sandreed, buffalograss, hairy grama, junegrass, sun sedge, and baltic rush. Among forbs, kochia and Missouri milkvetch were heavily consumed. Other forbs eaten in greater than trace amounts were sand sagebrush, western sticktight, sunflower, redroot pigweed, bracted spiderwort, prairie spiderwort, rusty lupine, and western ragweed. In Michigan this grasshopper has been observed to feed on Kentucky bluegrass and on three forbs: type penstemon, lettuce, and an undetermined tall composite.

In an eastern Wyoming sand prairie, observations were made of adults feeding on grass and ground litter. A summary of these observations attests to the geophilous behavior of this species. Crawling on the ground, a hungry grasshopper contacted a recumbent grass leaf and began to feed. Handling the leaf with the front tarsi, it consumed the entire leaf from tip to base. If the contacted leaf was upright, the grasshopper raised up on its hindlegs and pulled the leaf down with the front tarsi. In both cases the grasshopper fed while resting horizontally on the ground. Another hungry grasshopper contacted a cut leaf and ground litter as it crawled on the ground and fed on these items while handling them with the front tarsi.

On a dirt roadside, two IV instars were observed feeding horizontally on the ground. One fed upon a fallen seed of downy brome and the other on ground litter.

Several observations of feeding adults confined in a terrarium have been made. In addition to the feeding methods described above, adults have been seen to climb grasses to a height of 1/2 inch, cut through the stem, and consume the cut piece while holding onto it with the front tarsi. During the feeding bout, the hindlegs may be extended to rest on the ground. Although cut pieces are usually held and consumed, they may occasionally fall to the ground. These are fed upon by the same individual after descending or by other individuals encountering them. Adults have been seen to feed on stubs of grasses or on short grasses, such as blue grama, from their normal horizontal position on the ground.

Instar 1



1. BL 4.5-5.8 mm FL 2.6-3mm AS 10-11.

Instar 2



2. BL 3.6-4.1 mm FL 3.6-4.1 AS 14-15.

Instar 3



3. BL 8.2-11 mm FL 5.2-6.2 mm AS 17-19.

Instar 4



4. BL 11-14.7 mm FL 6.6-7.8 mm AS 20-22.

Instar 5



5. Males: BL 15.2-15.5 mm FL 9-9.7 mm AS 22-23.
Females: BL 17.5-21.5 mm FL 11-12 mm AS 23.

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

Two-choice tests using 10 species of plants have shown that adults of the mottled sand grasshopper preferred dandelion and downy brome. Second-choice plants included: needleandthread, western wheatgrass, blue grama, kochia, and alfalfa. Least preferred but ingested in small amounts were tumble mustard and common lambsquarters. Flixweed appeared to be least preferred, as it was only nibbled upon. The tests indicate that the mottled sand grasshopper, even though a polyphagous feeder, discriminates among available food plants.

Dispersal and Migration

The mottled sand grasshopper is a strong flier, possessing long wings that extend 6 to 9 mm beyond the end of the abdomen. In the sandy grass-herbaceous habitats of the George Reserve, 25 miles northwest of Ann Arbor, Michigan, males have been seen to fly 50 to 100 feet when flushed and females even farther. Distances of flushed flights from a dirt road in eastern Wyoming were not nearly as far. Males have flown 3 to 8 feet and females 9 to 10 feet. These flights begin on the ground; reach heights of 4 to 30 inches, and end on the ground. The grasshopper flies straight or makes a right angle turn either near the start or near the end of flight. Crepitation may or may not occur during flight. Few appetitive flights have been observed and no study of their significance has been undertaken.

Evidence of dispersal comes from collection of "accidentals" at high altitudes west of Boulder, Colorado. Resident populations occur at 6,700 feet near Boulder, while "accidentals" have been collected several times up to 12,200 feet, at a distance of approximately 22 miles from the nearest resident population. Whether the distance covered is by a single flight or by a succession of short flights and whether flights in other directions and distances are taken is unknown.

Identification

The mottled sand grasshopper, a bandwinged species, occurs in the grasslands of sand dunes. Localized populations may be found in sand blowouts and sandy banks of lakes and streams. The adult is tan to gray and strongly spotted brown. It is a relatively large rangeland species (Fig. 6 and 7). The median carina of the pronotum is high and is cut once and deeply in front of the middle. The tegmina are speckled but occasionally the spots coalesce to form faint bands. The hindwings have a yellow disk and a dark broad central band (Fig. 9). The hind tibia is deep orange or red; the inner face of the hind femur is yellow and crossed by four fuscous bands (Fig. 8).

Figures 6-10. Appearance of the adult male and female of *Spharagemon collare*, hindleg of female, wings of female, egg pod, and several exposed eggs.

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

1. Head with face nearly vertical, lateral foveolae triangular.
2. General color tan profusely spotted brown.
3. Instar I
 - (a) Pronotum with median carina strongly elevated; shallow notch in carina about one-third distance from posterior end.
 - (b) Hind femur with outer face fuscous for distal three-fourths, proximal one-fourth tan with brown spots. Hind tibia fuscous. Hind tarsus with first segment white, second segment fuscous, and third segment white except fuscous at distal end.
4. Instar II
 - (a) Pronotum with median carina strongly elevated; shallow notch in carina slightly more than one-third distance from posterior end.
 - (b) Hind femur with outer face tan and spotted fuscous; outer face often with two faint brown bands, one in middle, the other distal. Hind tibia usually orange, occasionally proximal end yellow.
5. Instars III, IV, V
 - (a) Pronotum with median carina strongly elevated and arcuate; deeply incised posterior to middle in III, anterior to middle in IV and V.
 - (b) Hind femur with outer face tan or gray, heavily spotted brown on chevron ridges and on lower and upper keels, two or three dark transverse bands often present. Hind tibia usually orange.

Two other species of *Spharagemon* with elevated median carina occur in the West. The nymphs of *S. bolli* and *S. cristatum* are probably similar to those of *S. collare*, but they have not been collected or studied. Adults of *S. bolli* are normally found in sunny meadows and openings of ponderosa pines and other woodlands. Adults of *S. cristatum* are found in the grasslands of Kansas, Oklahoma, Texas, eastern New Mexico, and southeastern Colorado.

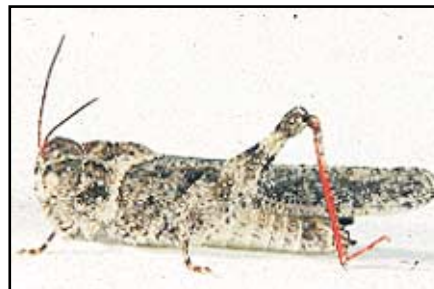
Hatching

The mottled sand grasshopper hatches two to three weeks after *Ageneotettix deorum*, a species that often lives in the same sandy soil habitats. The eggs lie about 1/2 inch deep in the soil and are probably exposed to somewhat lower temperatures and greater moisture than the eggs of *A. deorum*. The greater depth may account, at least in part, for the later hatching of the mottled sand grasshopper. In the sand hills of



Male

6. BL 21-23.5 mm FL 12.5-14.5 mm AS 24-25.



Female

7. BL 24.5-27.5 mm FL 14.7-16 mm AS 25-26.



Hindleg

8. Inner face of female hindleg showing general yellow color, four fuscous bands of femur, deep orange of tibia.



Wings

9. Spread wings of female showing speckled tegmen and colors and dark band of hind wing.



Eggs

10. Egg pod and several exposed eggs

eastern Wyoming, hatching occurs during the last week of May and first half of June, over a period of 23 days.

Nymphal Development

The nymphs develop slowly in their warm, sandy habitat, reaching adulthood in a minimum of 42 days. Males have a shorter nymphal period than females. Both males and females have five nymphal instars. Because of the extended hatching period, nymphs are often present in various stages of development.

Adults and Reproduction

Adults of the mottled sand grasshopper remain in the sandy soil habitat in which the eggs hatched and the nymphs developed. Although no information is available on maturation of the adults and the start of oviposition, pair formation and courtship have been studied. Standing on open ground for long periods, males are attracted to moving grasshoppers, including males and females of their own species and even individuals of other species. Males make one and two pulse stridulations as they approach the potential mate. In the case of a female of their own species, pair formation and mating may occur, but other relationships result in aggression or repulsion. Unresponsive females of their own species repel courting males by shaking their hind femora and striking the ground with the hind tarsi.

Females ready to oviposit select bare areas of sandy soil close to vegetation. After completing oviposition and withdrawing her ovipositor from the soil, she covers the hole by brushing sand and soil litter over it with her hind tarsi. Males have not been seen attending ovipositing females. The whole act of oviposition was timed in Manitoba by Norman Criddle, an early investigator of grasshopper biology. Observations of two females revealed that they took 34 minutes to oviposit and produce 12 eggs per pod. This number is considerably less than that found in more recent research, indicating a wide range of clutch size. Pods of the mottled sand grasshopper are 3/4 inch long and 3/16 inch in diameter and contain from 21 to 28 eggs (Fig. 10). Eggs are tan and 5 to 5.2 mm long.

Population Ecology

Observations from the late 1800s to the present reveal that populations of the mottled sand grasshopper usually remain at low densities. A study in the Nebraska Sand Hills showed that populations of this grasshopper fluctuated over four years at densities of less than 0.01 to nearly 0.2 per square yard. Although the majority of factors governing population numbers have not been investigated, the study did show that predation by birds, chiefly the grasshopper sparrow and the meadow lark, had a significant depressing effect on population size. In a sand hill habitat of eastern Wyoming, the mottled sand grasshopper had a density of one young adult per square yard in 1992. Even greater densities, up to five young adults per square yard, have been found in small (300 square feet) ruderal areas in eastern Wyoming.

Daily Activity

The mottled sand grasshopper is a geophilous species, spending its active and quiescent hours on the ground. At night it rests horizontally on ground litter, sheltered closely under a canopy of grasses. In a roadside habitat, however, it may spend the night on bare ground or it may sit horizontally on the leaf of a broadleaf weed as high as 12 inches above ground.

After sunrise, the grasshoppers gradually emerge from their shelters. They remain quiescent on bare ground or litter until the sun's rays strike them. Then they begin to bask by turning a side perpendicular to the sun's rays and by lowering the associated hindleg, which exposes the abdomen to the warming rays. During this period they often stir, preen, and turn around to expose the opposite side to the sun. The basking period may last for one to two hours before they start walking, feeding, and mating. They continue these activities for several hours until temperatures of the habitat become too hot for them, at which point they begin to stilt on bare ground (soil surface temperature 105°F). As temperatures increase further, they leave the bare ground and crawl into the shade of plants resting horizontally on ground litter.

In the afternoon when temperatures moderate, they again become active walking about, feeding, flying appetitively, and seeking mates. As temperatures in late afternoon cool further they bask again. When shadows engulf the habitat, the grasshoppers crawl into shelters under canopies of vegetation and rest horizontally on ground litter. Although temperatures are still relatively warm and within their normal activity range (70°F soil surface and 65°F 1 inch above ground), they are not easily flushed from their hide-outs. One may walk within a foot of them and they will not flush.

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