Specklewinged Grasshopper

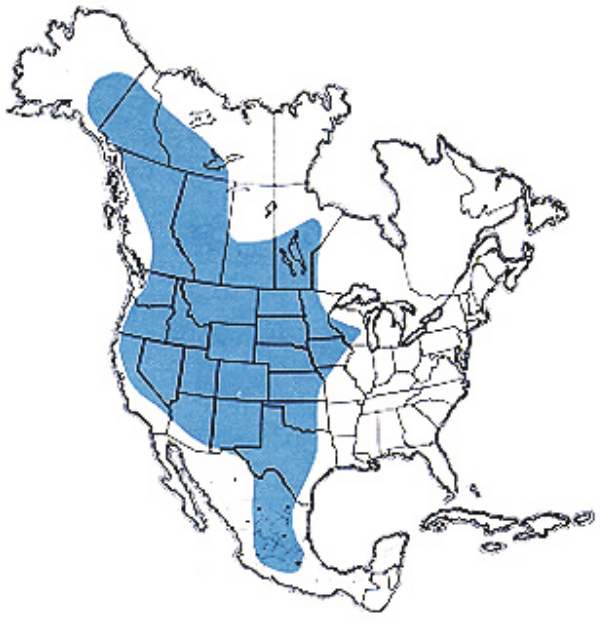
Arphia conspersa Scudder

Distribution and Habitat

The specklewinged grasshopper enjoys a wide distribution in western North America that stretches from Alaska to Mexico. It inhabits all of the grassland prairies and penetrates desert shrub communities wherever grasses make up part of the vegetation. In Colorado and Idaho, resident populations have been found in mountain meadows and other open grasslands up to 11,000 feet.

Economic Importance

Although the specklewinged grasshopper feeds on quality forage, its impact on grazing land is minimal due to low densities throughout its distribution. Populations in desert grassland and in shortgrass and mixedgrass prairie have been determined to range from 0.05 to 0.1 adults per square yard. In mountain habitats, numbers are less, ranging from approximately 40 to 120 adults per acre. In some apparently suitable habitats they appear to be absent. This species is in the largest category of the three size divisions of rangeland grasshoppers. Live weight of males from mixedgrass prairie in Platte County, Wyoming averaged 251 mg, and of females 776 mg (dry weight: males 86 mg, females 178 mg). Individuals from mountain habitats are smaller; live weights of individuals from 10,170 feet in central Colorado averaged 194 mg for males and 494 mg for females.



Geographic range of *Arphia conspersa* Scudder

Food Habits

The specklewinged grasshopper feeds primarily on grasses and sedges. Sixteen species of grasses and three species of sedges have been recorded in crop contents. Specific host plants ingested depend on both the grasshopper's preferences and the availability of plants in diverse grassland habitats. In the sand prairie of southeastern North Dakota, Kentucky bluegrass made up 50 percent of the diet; in the mixedgrass prairie of central Nebraska, prairie junegrass made up 67 percent; in the mixedgrass prairie of eastern Colorado, western wheatgrass and needleandthread in equal quantities made up 58 percent of the diet; and in the shortgrass prairie of northern Colorado, blue grama (27.6 percent), western wheatgrass (18.8 percent), and downy brome (17.6 percent) made up 64 percent of the diet. Other plants found in substantial amounts include threadleaf sedge, needleleaf sedge, sand dropseed, and sixweeks fescue. Small amounts of forbs (12 species), fungi, and arthropods are ingested by this grasshopper. No doubt, the number of grasses and sedges known to be ingested is still far short of the actual number fed upon by this grasshopper.

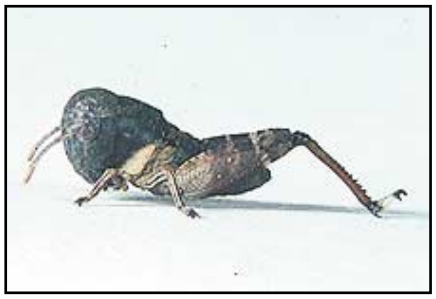
The specklewinged grasshopper feeds mainly from a horizontal position on the ground, and eats dry grass litter, recumbent attached leaves, or green leaves cut by itself. It attacks a standing leaf by raising up diagonally on its hind legs and cutting the leaf about one-half to one inch above the base. It may hold onto the cut portion with the front tarsi and feed to the tip, or it may drop the cut portion and return to the ground to eat the fallen leaf. Sometimes it will eat the remaining green stub from a horizontal position.

Dispersal and Migration

The specklewinged grasshopper has strong powers of flight, possessing long wings that extend beyond the end of the abdomen in both males and females. Appetitive flights of the males occur regularly and are accompanied by a crackling sound called crepitation. These flights are comparatively rare in females. The sound is produced by the wings, but an explanation of the exact mechanism remains in dispute. Appetitive flights last one to three seconds and describe an arc 6 to 10 feet long and 3 feet high. The flights are a part of courtship and function to bring the sexes together. Because of its behavior to aggregate, the specklewinged grasshopper has low vagility. Evidence for its dispersal is present in montane settings. It often colonizes regrown road cuts and cleared chaparral within five years, wherever nearby populations are present. No records of migration exist for this species.

Evasive flights are made by both males and females beginning about three hours after sunrise when soil temperatures have risen above 60°F. The flights range from 4 to 45 feet in length and from 6 inches to 2 feet high. They

Instar 1



1. BL 4.8-6.1 mm FL 2.8-3.1 mm AS 13.

Instar 2

2. BL 6.4-8 mm FL 3.8-4.2 mm AS 15-16.

Instar 3

3. BL 9-11.5 mm FL 5.3-6.5 mm AS 17-18.

Instar 4

4. BL 12-15.5 mm FL 6.9-8.3 mm AS 20-21.

Instar 5

5. BL 15-18 mm FL 8.7-10.6 mm AS 23-24.

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

are usually sinuous and accompanied by crepitation. Silent escape flights may occur and extend from 30 feet to over several hundred feet with the wind. The fleeing grasshopper lands horizontally on the ground and often turns to face the intruder.

Identification

The specklewinged grasshopper, prevalent as adults in spring, is a wide-ranging western species. Its genus, Arphia, consists of 16 species. Of these, only the redwinged grasshopper, *Arphia pseudonietana* (Thomas), has an equally wide distribution in the West. Adults of this species, present in late summer and fall, are separated seasonally from adults of the specklewinged.

The adult specklewinged grasshopper (Fig. 6 and 7) is a large rangeland species, the female being much larger than the male. The lateral foveolae of the head are triangular or quadrilateral. The median carina of the pronotum is low but distinct, uniformly elevated, and incised once in front of the middle (Fig. 8). The body is brown except for a yellow abdomen. The tegmina are brown with dark brown speckles and, when folded, often form a pale tan or yellow median stripe. The disk of the hind wing is usually red but may be yellow (Fig. 9). The hind tibia is pale yellowish green with a fuscous annulus at each end.

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

1. Instar I. Head conspicuously large and rounded; segments of maxillary and labial palps brown with distal ends pale yellow. General body color dark brown. Pronotum with low, entire median carina; lateral lobe black with a triangular light tan patch postero-ventrally (Fig. 1). Hind tibia dark red; hind tarsus black on first segment and distal two-thirds of last segment with middle white.
2. Instars II and III. Head rounded, face nearly vertical, lateral foveolae triangular or quadrilateral. Pronotum with low, median carina (entire or weakly incised) and with disk tectate (rooflike); lateral lobes of pronotum brown with dark brown speckles and marks (without triangular light patch). Hind tibia shiny black; hind tarsus black at both ends and pale in middle.
3. Instars IV and V. Head vertically elongated, not as rounded as in earlier instars; lateral foveolae triangular or quadrilateral; segments of maxillary

Figures 6-10. Appearance of the adult male and female of *Arphia conspersa*, diagnostic characters, and the egg pod and several loose eggs.

and labial palps mainly pale. Pronotum with low, uniformly elevated median carina incised once in front of middle; disk of pronotum tectate. General body color brown with dark brown speckles and marks; venter of abdomen green with brown spots; hind tibia green and black.

Hatching

The specklewinged grasshopper is a late-hatching species. First instars begin to appear in mid-July in the mixedgrass prairie of eastern Wyoming and in the shortgrass prairie of eastern Colorado. Hatching continues for about a month. A laboratory study has revealed that females lay nondiapause eggs that hatch in 40 days at 77°F. This study suggests that the species has a one-year life cycle under favorable temperature regimes. On the other hand, field studies on the plains of central Saskatchewan and in the mountains of Colorado indicate a two-year life cycle. As with several other grasshopper species, this grasshopper appears to have a one-year or a two-year life cycle depending on the climate of its habitat.

Nymphal Development

The nymphs of this species develop relatively fast. In mixedgrass prairie at altitudes of 5,000 feet, they become third instars by late August, and fourth and fifth instars by late September. The majority are in the fifth instar, the stage that overwinters, by October. At the onset of cold winter weather they become dormant. Precisely where they seek shelter is unknown. Nymphs have been shown to survive freezing at temperatures as low as -16°C. Surface ground temperatures seldom get colder than this extreme. In winter, during periods of mild weather, some nymphs become active and may even molt to the adult stage.

The time of general metamorphosis to adulthood comes in early spring and varies as a function of weather, latitude, and altitude. In the mixedgrass prairie of eastern Wyoming, adults are present in April, but in high mountain habitats of Colorado adults may not emerge until July.

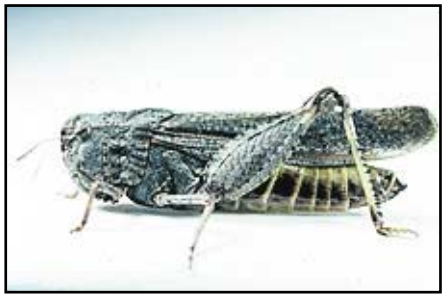
Adults and Reproduction

Adults remain in the same general area in which they developed as nymphs. Densities of the males and females are apparently high enough on the plains to present no difficulty in mate location. In the mountains, however, very low densities present a problem of mate location that is solved by the aggregation flights of males. These flights are also made

Male

6. BL 20-21 mm FL 11-12.2 mm AS 23-25.

Female



7. BL 30-37 mm FL 14-17 mm AS 24-25.

Head and pronotum

8. View of head and pronotum of adult female.

Wings

9. Forewing (tegmen) and hindwing of female.

Egg pod

10. Egg pod and several loose eggs.

in all habitats of the plains. At the peak of daily activity, males make aggregation flights every three to four minutes.

Courtship is conducted on the ground. A male can detect a female from a distance of at least 2 feet away. He moves toward her in a series of spurt-runs; that is, he runs making several complete leg movements, then pauses and stridulates emitting one to three chirps. When he approaches within 1 inch of the female, he orients to her face-to-face. They wave their antennae at one another and the male continues to chirp. Next, the male moves to the female's side, then faces and sometimes butts her thorax. The male continues chirping and places his front tarsus on her middle femur and stomps the ground rapidly with his hind tarsi. He then produces a series of four or five chirps and mounts the female from the rear. If he is accepted, the pair copulates. A receptive female may actively solicit attention from a male by presenting her side, lowering the near hindleg, and raising both the opposite hindleg and the tegmina, which exposes the whole abdomen. One successful copulation of a pair was observed to last 23 minutes.

A gravid female selects bare ground when she is ready to oviposit. She bores more than 2 inches into the soil and deposits a clutch of 20 to 21 eggs. After extracting her abdomen, she covers the hole by pulling debris over the pod and tamps it down with her ovipositor. The eggs are light brown to brown, and range in length from 4.5 to 5.2 mm (Fig. 10). Pods are long and usually break in extracting them from the soil. One entire pod measured one and five-eighths inches long. Neither the potential nor realized fecundity of this grasshopper is known.

Population Ecology

Recorded populations of the specklewinged grasshopper have been small in all habitats. Densities have ranged from 0.05 to 0.1 adults per square yard in desert, northern mixedgrass, and shortgrass prairies. Populations on the high altitude mesa of the Gunnison River in Colorado tend to gather in clusters, occupying 200-400 feet diameter areas within an apparently suitable and much larger habitat. Twenty to 40 adults per acre is the usual density; seldom do densities reach 120 adults per acre even in the clusters. In 1970, populations residing on the mesa above 9,200 feet crashed, but populations at lower altitudes were nearly normal. It is likely that an unusually cold winter killed the nymphs but not the diapausing eggs, which hatched and allowed normal population densities of nymphs in August and September 1970. A small number of nymphs in 1971 indicated there was no recovery of the 1970 brood. Causes of population fluctuations at lower altitudes east of the Rocky Mountains have not been studied.

Of biological interest is the geographic isolation of populations with red or yellow wings. Specific color morphs are associated with particular geographic regions, and between these regions narrow zones of hybrids and mixed colors exist. Predominantly redwinged populations occupy the high plains east of the Rocky Mountains. In central Colorado, yellow morphs occupy isolated grassland habitats of pinyon-juniper and high coniferous forest.

Daily Activity

Because of the generally low densities of the specklewinged grasshopper, few observations have been made of its daily activities. Apparently the adults rest horizontally on the ground at night, their body temperatures declining to the low ambient temperatures of spring. Immobile at dawn, they begin to stir as the sun rises and then bask, orienting their sides to the warming rays. At a soil surface temperature of 57°F they are able to jump but not fly to avoid an intruder. Flight becomes possible at soil surface temperatures a few degrees above 60°F. Feeding begins around 10 a.m. and oviposition around 11 a.m. (MDT). In montane habitats the conspicuous spontaneous flights of males peak between 10 a.m. and noon.

High temperatures suppress activity. Whenever the soil surface temperature reaches 105°F, individuals either assume a stilt posture (legs extended to lift the body off the ground) or move on the ground to the shade of plants. Even without extreme heat, activity in the afternoon subsides. One female was discovered resting horizontally on the ground in a nonbasking orientation at 2:40 p.m. More observations on the behavior of this grasshopper are needed to provide a complete picture of its daily activities.

Selected References

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

Gillis, J. E. and K. W. Possai. 1983. Thermal niche partitioning in the grasshoppers *Arphia conspersa* and *Trimerotropis suffusa* from a montane habitat in central Colorado. Ecol. Entomol. 8: 155-161.

Pfadt, R. E. and R. J. Lavigne. 1982. Food habits of grasshoppers inhabiting the Pawnee site. Wyoming Agr. Exp. Stn. Sci. Monogr. 42.

Pickford, R. 1953. A two-year life-cycle in grasshoppers (Orthoptera: Acrididae) overwintering as eggs and nymphs. Can. Entomol. 85: 9-14.

Schennum, W. E. and R. B. Willey. 1979. A geographical analysis of quantitative morphological variation in the grasshopper *Arphia conspersa*. Evolution 33: 64-84.

Willey, R. B. and R. L. Willey. 1969. Visual and acoustical social displays by the grasshopper *Arphia conspersa* (Orthoptera: Acrididae). Psyche 76: 280-305.