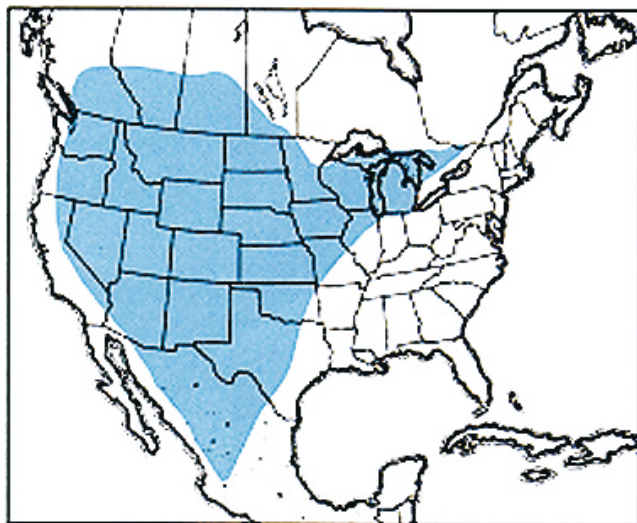


# Redwinged Grasshopper

## *Arphia pseudonietana* (Thomas)

### Distribution and Habitat

The redwinged grasshopper ranges widely in North America occupying grass and grass-shrub habitats. It reaches highest densities in the mixedgrass prairie. At the periphery of their geographic range, these grasshoppers occupy restricted habitats and are less numerous. In the tall and midgrass prairies of their eastern and northern range, they inhabit the dry, sandy, or gravelly uplands and hilltops, while in their western and southwestern range, they inhabit mesic grassland sites.



Geographic range of *Arphia pseudonietana* (Thomas)

### Economic Importance

The redwinged grasshopper is a minor pest in western grasslands. It feeds on a variety of valuable forage grasses and sedges, but because of low numbers it causes no serious losses. Populations, usually less than one young adult per square yard, are not known to reach outbreak densities. It is a large grasshopper, and during a general rangeland outbreak of grasshoppers, it adds to the overall damage. In the fall, adults invade fields of winter wheat located in the vicinity of their normal habitats and contribute to the grasshopper damage of this crop. Live weights of males collected from mixedgrass prairie of southeastern Wyoming average 309 mg and females 684 mg (dry weights: males 97 mg, females 214 mg).

### Food Habits

The redwinged grasshopper feeds on grasses and sedges. Data obtained by direct observation and from examination of crop contents show that it feeds on at least 20 species of grasses and four species of sedges. In a particular habitat, two or three species serve as the main host plants. In the shortgrass prairie of north-central Colorado, the redwinged grasshopper feeds chiefly on blue grama, western wheatgrass, and needleleaf sedge; in the mixedgrass prairie of western Nebraska on western wheatgrass and buffalograss; in the sand prairie of northeastern Colorado on needleandthread and western wheatgrass; and in the sand prairie of southeastern North Dakota on Kentucky bluegrass and Penn sedge.

Occasionally the redwinged grasshopper ingests small amounts of forbs, such as cudweed sagewort and scarlet globemallow.

Observations in a Montana habitat of the mixedgrass prairie revealed that nymphs spend much time on grass plants and consume green leaves of downy brome, western wheatgrass, blue grama, sideoats grama, needleandthread, and green needlegrass. The adults were observed to spend little time on plants and showed a preference for junegrass.

In laboratory two-choice tests, adults fed sparingly on dandelion and heavily on downy brome and western wheatgrass. In these tests the grasshoppers fed more heavily on young wheat leaves than on either downy brome or western wheatgrass.

The redwinged grasshopper's method of attacking a grass plant has been observed twice in nature and several times in the laboratory. One observation in nature involved the feeding of a female (instar V) on two felled green leaves of needleandthread. Crawling on the ground, the nymph contacted the first leaf (2.5 inches long) at 8:52 a.m., and consumed it entirely from base to tip. As it fed, the nymph handled the leaf with its front tarsi and rested horizontally on the ground. At 9 a.m. it contacted the second leaf, also 2.5 inches long, and ingested it by 9:03 a.m. Ground temperature was 76°F, air 68°F, sky was clear, and a southwest wind prevailed at 0-4 mph.

The second observation was of a male that flew appetitively. Upon landing it walked 2 inches, then in a diagonal orientation with hindlegs on the ground it began to feed on a leaf of grama grass, and then on the grazed end of a leaf of needleleaf sedge. The male finally turned head-down and continued to feed on the sedge. Feeding occurred from 10:33 to 10:38 a.m. DST at soil temperature of 75°F and air 67°F, clear sky, and a south wind of 2-5 mph.

Feeding on felled leaves was observed also in a laboratory terrarium provisioned with transplant of mixedgrass prairie. In addition, the adults fed on attached, recumbent leaves of needleandthread by devouring the leaf from the distal end to the base. Adults also reached with their mouthparts to feed on standing attached leaves. They attacked the leaf from 1/8 to 1 inch above its base, cut through it while feeding, then held onto the detached section, and consumed it completely. If the detached section was dropped, the grasshopper often found it and continued to feed.

### Dispersal and Migration

The redwinged grasshopper is a strong flier. Observations made in the George Reserve, Michigan, reveal that flushed males fly 10 to 30 feet. When accompanied by crepitation, the flight is uneven (zigzagging and undulating). However, when the grasshopper is suddenly disturbed, the flight is faster, silent (no crepitation), even, and smooth. Prior to alighting, males turn quickly and sharply, close the wings, and dive into the grass. The change in direction, nearly 180 degrees, brings the grasshopper around to face the direction from which it came. Flushed flight of females is longer than that of males, with females flying distances from 5 to 60 feet. In alighting, females do not turn sharply but drop straight down along the line of flight. Flushed females crepitate more softly than males and for

Instar 1



1. BL 4.8-5.5 mm FL 2.2-2.5 mm AS 11-12.

Instar 2



2. BL 5.8-7.2 mm FL 3.3-3.7 mm AS 13-14.

Instar 3



3. BL 8.3-10.1 mm FL 4.8-5.6 mm AS 16-18.

Instar 4



4. BL 10-15 mm FL 6.4-8.1 mm AS 18-20.

Instar 5



5. BL 14.5-18 mm FL 8.3-10.6 mm AS 19-22.

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

a shorter period (about 1 second) in the middle of the flight. Both sexes fly farther when greatly frightened.

On warm, sunny days, the redwinged grasshopper makes many voluntary or appetitive flights. In the mixedgrass prairie of southeastern Wyoming the grasshoppers have been observed to fly distances of 1 to 12 feet at heights of 3 to 12 inches. Interesting displays of flight by males have been observed in the grass-forb habitat of the George Reserve. Although most flights are in a straight line, some males fly nearly straight up to a height of approximately 4 feet, and then flutter down slowly with their wings flashing brilliantly red in the sunlight. When they reach the vegetation canopy, they close their wings and drop to the ground. The performance is accompanied by a loud crackling crepitation. This flight behavior as well as appetitive straight flight are exhibited only when the sun is shining brightly. The flights function to bring pairs together for courtship and mating.

Little information is available on dispersal and migration by the redwinged grasshopper. Adults have been found as accidentals at 10,000 feet in the mountains west of Boulder, Colorado, indicating dispersal of 14 miles from the closest resident population.

On 27 September 1993, a collection of seven species of rangeland grasshoppers was made along a sidewalk in downtown Cheyenne, Wyoming. Six male and three female specimens of the redwinged grasshopper were represented in the collection, which also included a total of 17 males and 23 females of *Melanoplus gladstoni*, the most abundant of the seven species. The collection suggests dispersal of these species from a heavily infested rangeland site of the mixedgrass prairie surrounding Cheyenne. Dispersal of individual adults also occurs, as indicated by the finding of a female on a sidewalk of the campus of the University of Wyoming, Laramie, on 14 September 1992 and a male on a sidewalk of the campus of Colorado State University, Fort Collins, on 9 September 1993.

### Identification

The redwinged grasshopper is a large, dark brown to black grasshopper (Fig. 6 and 7). The tegmina are colored like the body and are darkly speckled. The hind wings possess a red disk and a black marginal band (Fig. 8). The apex of the hind wing may be transparent or black. The outer face of the hind femur is dark gray, dark brown, or black and often marked by three tan transverse bands. The hind tibia is dark brown or black with a yellow annulus in the proximal quarter (Fig. 9).

In Michigan, Wisconsin, and Minnesota some demes (local populations) consist entirely of yellow-winged individuals. West of these states all individuals possess bright red wings.

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 fuscous, only tip of terminal segment yellow. General body color

Figures 6-10. Appearance of the adult male and female of *Arphia pseudonietana*, the spread wings, inner face of the hindleg, and the egg pod and exposed eggs.

black. Pronotum with low, entire median carina; lateral lobe black with a few scattered gray or brown spots. Hind tibia dark red; hind tarsus black on first segment and distal two-thirds of last segment with middle yellow or pale green.

2. Instar II and III. Head rounded, face nearly vertical, lateral foveolae triangular or quadrilateral; segments of maxillary and labial palps fuscous, each segment with tan or brown annulus apically. Pronotum with low median carina, weakly incised and with disk tectate (rooflike); lateral lobes of pronotum brown and fuscous. Venter of thorax and abdomen usually shiny black. Hind tibia dark orange, fuscous at both ends; hind tarsus black at both ends and yellow in the middle.
3. Instar IV and V. Head elongated vertically, not as rounded as in earlier instars; lateral foveolae triangular or quadrilateral; segments of maxillary and labial palps fuscous, each segment with yellow annulus apically. Pronotum with low, uniformly elevated median carina incised once in front of middle; disk of pronotum tectate. Color of body dull brown and black; venter of thorax and abdomen solid, shiny black; hind tibia multicolored (fuscous, dark orange, and tan).

### Hatching

The redwinged grasshopper is a late-hatching species. In the bunchgrass prairie of southern Idaho, however, eggs may begin to hatch in late May. In the mixedgrass prairie of western South Dakota (elevation 3,000 feet) eggs begin to hatch by June 11, while in the mixedgrass prairie of eastern Wyoming (elevation 5,050 feet) and the shortgrass prairie of north central-Colorado (elevation 5,420) eggs begin to hatch a few days later, June 13 to 19.

Although this species and the specklewinged grasshopper, *Arphia conspersa*, are considered late-hatching grasshoppers, the redwinged grasshopper hatches a month earlier than the specklewinged. Hatching of the redwinged continues for two weeks. A laboratory study has shown that after deposition, eggs develop to stage 19 (50 percent of embryonic development) and then enter diapause. Held at 77°F the eggs reached this stage in 30 days. Available data suggest that eggs of the redwinged grasshopper pass the winter in stage 19 and then complete the remaining 50 percent of their development the following spring.

### Nymphal Development

Nymphs emerge in the mixedgrass prairie of eastern Wyoming during the last two weeks of June. Their development proceeds through five instars and coincides with the warm temperatures and green food of early summer. Depending on environmental factors, the nymphal period takes a minimum of 42 to 56 days. Nymphs of different instars occur in the habitat from mid June to mid August.

### Adults and Reproduction

Adults start to emerge in mid July in the bunchgrass prairie of Idaho and during the last week of July in the mixedgrass



6. BL 20-23 mm FL 11.5-14.3 mm AS 23-24.

Male



7. BL 25.5-31 mm FL 14-16.5 mm AS 21-24.

Female



8. Forewing and spread hindwing of female.

Wings



9. Inner surface left hindleg of male.

Hindleg



10. Egg pod and exposed eggs.

Egg pod



prairie of eastern Wyoming. Most adults appear to remain in the same general area in which they developed. Flight displays often bring the sexes together. Pair formation also occurs when males, by walking or hopping, approach moving females. Reproductive maturation of the females is slow. Caged females held at an average temperature of 76°F and fed green western wheatgrass begin to oviposit when four to five weeks old. Because adults have an extended longevity, they may be present in a habitat of the mixedgrass prairie from early August until late in October, a period of 80 days. This longevity is approximately 30 days greater than that for the bigheaded grasshopper, *Aulocara elliotti*.

The act of oviposition was observed by Norman Criddle (1875-1933), an early student of North American grasshoppers, on 21 September and 1 October 1917 in Manitoba. Females rested on their front and midlegs and held the hind ones in the air, as egg laying took place. Two females were found ovipositing at the edge of an old trail. Because oviposition was underway when discovered, the total time of egg laying was not determined, but the females withdrew their abdomens after 26 and 33 minutes. They then brushed soil and litter over the aperture of the holes using the hindlegs both alternately and in unison. The recovered pods contained 24 and 25 eggs.

Caged females readily oviposit into bare soil. Two pods laid by females from the mixedgrass prairie of southeastern Wyoming contained 31 and 36 eggs. The pods are nearly straight and 1 5/8 inches long. The top 5/8 inch is occupied by froth, the bottom inch by eggs. Eggs are tan to brown and 4.2 to 5.2 mm long (Fig. 10).

### Population Ecology

The redwinged grasshopper is not abundant in any of the many grasslands it inhabits. A relatively large population inhabited a mixedgrass prairie site in southeastern Wyoming in 1993. The density of this population was sampled and found to be one young adult per square yard. In different years three other sampled populations inhabiting mixedgrass prairie in Wyoming and Colorado consisted of densities ranging from 0.1 to 0.2 young adults per square yard.

In the shortgrass prairie of north-central Colorado (Central Plains Experimental Range), densities of young adults have ranged from 0.02 to 0.05 per square yard. In spite of low densities, populations persist from year to year. Whenever investigated on this experimental rangeland, the redwinged grasshopper has been a prominent member of the assemblage. Dates of confirmed occurrence include consecutive years from 1968-75 and from 1981-86. Research during the latter period showed that populations fluctuated annually and tracked the density of the entire grasshopper assemblage (Table 1).

In the Davis Range of Texas, Ernest Tinkham reported that the redwinged grasshopper was very abundant in the fall of 1928 and that large swarms flew up from tall grasses. Regrettably, he did not determine the absolute density.

Table 1. Population fluctuation of the redwinged grasshopper and the grasshopper assemblage in a shortgrass prairie site, north central Colorado (Adapted from Capinera and Thompson).

	Number per square yard				
	1981	1982	1983	1984	1985
<i>Arphia pseudonietana</i>	0.05	0.08	0.20	0.23	0.13
Assemblage 5 common species	0.9	2.4	4.0	3.1	1.6

### Daily Activities

The redwinged grasshopper is a ground-dwelling insect. Adults spend the night on the surface of small bare areas (3 to 54 square inches) prevalent in the mixedgrass prairie, often surrounded closely by grasses or underneath a canopy of grasses. One to two hours after sunrise they begin to bask by turning a side perpendicular to the rays of the sun and lowering the associated hindleg to expose the abdomen. In August, when temperatures are still warm, they bask for about two hours but as temperatures become cooler they bask longer spending as much as four hours basking in the morning during October. After basking they become active, feeding, walking, and mating. During midday the males fly short distances or rise vertically in display. Aggregations of adults often form, bringing the sexes together. Eight aggregations were observed 20 October 1992 at 2:30 p.m. along a ranch road for a distance of one-half mile. When temperatures in summer become very hot on bare ground (125°F), the grasshoppers crawl on top of blue grama and face the sun directly. This orientation raises the body above the soil surface and exposes only the front of the head to the sun's rays, while the rest of the body is shaded. Late in the afternoon the grasshoppers bask for a second time. Shortly before sunset they retreat to their nighttime shelters.

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