

Clearwinged Grasshopper

Camnula pellucida (Scudder)

Distribution and Habitat

The clearwinged grasshopper, *Camnula pellucida* (Scudder), is distributed widely in North America. It inhabits a variety of grasslands including the northern mixedgrass prairie, the palouse prairie, and mountain meadows. A resident population lives in a mountain meadow at 10,800 ft in Colorado, just below timberline.

Economic Importance

The clearwinged grasshopper is a severe pest of small grains and grasses. It is most destructive early in the season when it often completely destroys spring wheat. Outbreaks on rangelands may devastate grass forage in areas as large as 2,000 sq miles. A population with a density of 20 adults per sq yd will consume the entire available yield of forage grasses on rangelands of British Columbia. Cage plot tests on native grassland of interior British Columbia showed that the feeding of this grasshopper during its nymphal life reduced the yield of Kentucky bluegrass by 5.1 pounds per acre for each grasshopper per square yard. An infestation of one young adult per square yard reduced yield one pound per day over one acre. Swarms may invade vegetable crops and feed preferentially on onions, lettuce, cabbage, and peas.

Food Habits

The clearwinged grasshopper feeds mainly on grasses. It prefers succulent plants of western wheatgrass, reed canarygrass, barley, and wheat. Field observations at several locations show that it feeds heavily on many species of grasses, including fescues (Idaho fescue and red fescue), bluegrasses (Sandberg bluegrass and Kentucky bluegrass), wheatgrasses (western wheatgrass and crested wheatgrass), bromes (cheatgrass brome, smooth brome, and soft brome), and slender hairgrass. These grasses are not equally nutritious. The most favorable single species diets consist of red fescue, three species of bluegrass, wheat, crested wheatgrass, and intermediate wheatgrass. In its natural habitat, the clearwinged grasshopper consumes small amounts of forbs such as fireweed and several species of legumes.

Migration and Dispersal

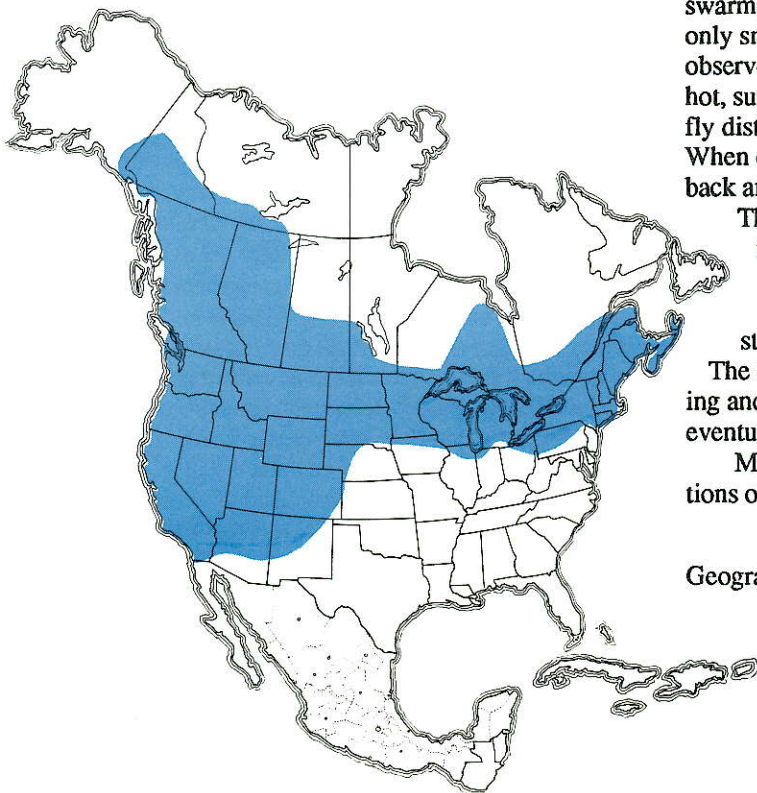
Myriads of the clearwinged grasshopper hatch in egg beds that may contain as many as 3,000 to 100,000 eggs per sq ft. Pressure of high densities and depletion of food result in movement of the young nymphs away from egg beds to the nearest green vegetation. Immature grasshoppers continue to disperse through all of the nymphal stage. The older instars march in cohesive bands.

Adults may migrate long distances in huge flying swarms at either low or high altitudes, but in recent years only small swarms in flights of short duration have been observed. These flights may occur in the afternoons of hot, sunny days. Masses take off into a gentle wind and fly distances of one hundred to several hundred yards. When egg laying begins, migration ceases but females fly back and forth between feeding grounds and egg beds.

They move to the egg beds during the heat of the day for oviposition. After a particular female deposits a clutch of eggs, she flies back to the feeding grounds in the evening or the next morning and stays there until another batch of eggs is mature.

The males appear to remain on the egg beds outnumbering and attending the females as they oviposit. Males eventually die on the egg beds.

Migratory behavior is not characteristic of all populations of the clearwinged grasshopper. Individuals infest-



Geographic range of *Camnula pellucida* (Scudder)

Instar 1



1. BL 4.2-5.5 mm. FL 2.4-2.7 mm. AS 11-13.

Instar 2



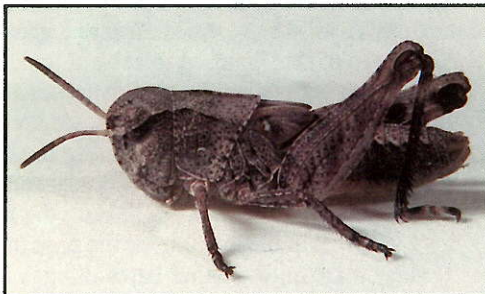
2. BL 5-7.1 mm. FL 3.4-3.8 mm. AS 14-16.

Instar 3



3. BL 7.3-8.9 mm. FL 4.7-5.2 mm. AS 18.

Instar 4



4. BL 10-14.5 mm. FL 6-7.2 mm. AS 20-22.

Instar 5



5. BL 14-20 mm. FL 8.4-9.9 mm. AS 22-25.

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

ing sodded pasture near Harney, Minnesota, exhibited little movement. Nymphs developed to maturity close to where they had hatched and the adults showed little tendency to migrate, flying only short distances. Mating and egg laying occurred in the same area where eggs had been deposited the previous year.

Identification

Adults of the clearwinged grasshopper are of medium size, yellow to brown, and possess mottled forewings and transparent hindwings (Fig. 8). The forewings have along their angles light stripes that in the resting grasshopper with closed wings converge near the middle. The male (Fig. 6) is noticeably smaller than the female (Fig. 7). First instar nymphs are strikingly colored cream, tan, and black (Fig. 1).

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

- (1) Head with lateral foveolae triangular (Fig. 9). Usually a dark bar crosses transversely across front of head under antennal sockets, across lower part of compound eyes, and onto sides of head.
- (2) Pronotum with median carina low but uniformly elevated; median carina entire (without notch) in early instars, notched once in front of middle in the older instars (Fig. 9). Pronotum with lateral carinae clearly defined (Fig. 9).
- (3) Hind tibia fuscous in first to third instar, fuscous or tan in fourth and fifth instars.

Hatching

The clearwinged grasshopper is an early hatching species. Eggs begin embryonic growth in the summer of deposition and continue until they attain 30 to 50 percent of development. To reach the advanced stage, they require 400 day-degrees of heat at which point diapause stops further summer development. Lack of soil moisture may retard this initial development.

Diapause in eggs is broken during winter. At 41 F eggs require a minimum of 70 days of chilling. The rise of soil temperatures above a threshold of 55 F the following spring starts the final stages of embryonic development. After experiencing 150 day-degrees of heat, the eggs are ready to hatch. Emergence begins when soil temperature reaches 80 F and air temperature 65 F. Hatching of all eggs in an individual pod may be completed on the same day but this process generally lasts two

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

to four days. A warm spring and favorable soil moisture shorten the hatching period of all the eggs in a bed. Because the hatching period may be completed in 12 days, the nymphs seem to appear en masse on bed grounds. Cool, dry weather, however, may delay the start of hatching by a month and may extend the hatching period for a month or longer. Hatchlings emerge in the morning when temperatures are rising rapidly, especially after a shower the previous evening. Hatching begins around 9 a.m. and reaches a maximum between 11 a.m. and 12 noon.

Nymphal Development

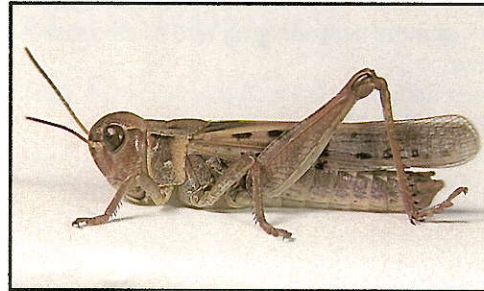
The nymphs disperse quickly in search of food when large numbers of hatchlings are present on egg beds of native sod. Movement may be in any direction and often continues through the entire nymphal stage. Invasion of young fields of wheat at this time results in extensive crop damage. Nymphs exposed to warm temperatures and nutritious food plants complete development in 26 days. Less favorable conditions may extend this period to 40 days or longer.

Adults and Reproduction

Because nymphs of the clearwinged grasshopper develop faster than those of the two-striped, adults of the clearwinged may appear first. The young adults are dark brownish gray, but as they mature, they turn lighter. When they become sexually active on the breeding grounds, they turn bright yellow. In laboratory cages under conditions simulating the natural environment, males become reproductively mature in five to seven days after fledging and females in seven to ten days.

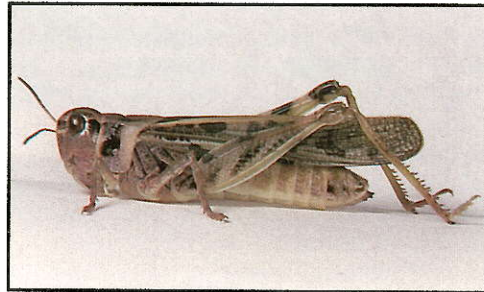
Courtship by the male involves holding the antennae upright in a V-shape and moving the hind femora rapidly up and down and against the tegmina (ordinary stridulation). The male climbs onto the back of a receptive female and quickly lowers his abdomen down to make genital contact. Perched precariously and to one side, the male often becomes dislodged and comes to rest on the ground at the side of the female or is pulled along behind her.

After a copulatory period averaging 55 minutes, the female seeks a suitable oviposition site by probing in sod. She digs her abdomen down among grass roots by opening and closing the ovipositor valves and quickly lays (average time 22 minutes) a clutch of 28 eggs (range 10-38) in the top inch of soil. She then covers the hole with a back and sideways motion of the hind legs. The females, in seeking favorable sites for oviposition, often



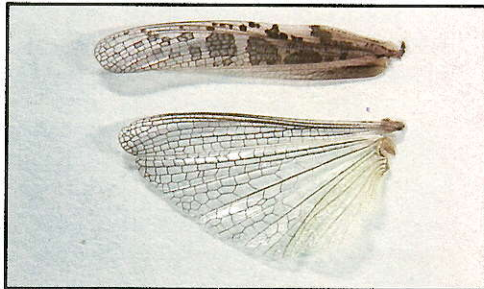
Male

6. BL 19.5-21.5 mm. FL 10.5-11.8 mm. AS 25-29.



Female

7. BL 22-25 mm. FL 12.2-13.6 mm. AS 24-26.



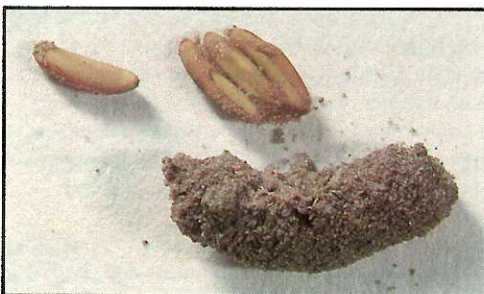
Wings

8. Forewing (tegmen) and hindwing.



Head and Pronotum

9. Note lateral foveola on head and carinae on pronotum.



Egg pod

10. Egg pod and four loose eggs.

aggregate on egg beds that may range from a few square yards to 20 acres or more depending on size of the grasshopper population.

Pods are short and stout, 5/8 inch long and 3/16 inch in diameter, and are slightly curved (Fig. 10). Eggs are light brown and 4.7 mm long. Confined in field cages on winter wheat and Kentucky bluegrass at Saskatoon, Saskatchewan, females averaged 60 days adult life and produced 8 pods or 180 eggs each. The clearwinged grasshopper has one generation annually.

Population Ecology

Populations of the clearwinged grasshopper exhibit extremes of abundance and range. The species can remain virtually unseen for five to ten years, then increase gradually over three to four years and reach peaks the following two to three years. During the period of increase, a population may spread from a few acres of rangeland to more than 2,000 square miles. These outbreaks consist almost entirely of the clearwinged grasshopper. The cause of outbreaks appears to be a combination of favorable weather, nutritious host plants, and reduced rates of predation, parasitism, and disease. Weather that supports population growth consists of above normal temperatures in spring and summer and sufficient rain to keep host plants green and succulent, par-

ticularly fescue, bluegrass, and wheat. Crashes of dense populations are caused by epizootics of the fungus, *Entomophaga grylli* (Fresenius) pathotype I; by drought resulting in starvation of nymphs or adults; by below normal spring and summer temperatures that retard development of nymphs and reproduction of adults; or by low soil temperatures in winter that may cause up to 100 percent mortality of eggs.

Daily Activity

The clearwinged grasshopper, a diurnal insect, is active during the day and inactive at night. During the night it rests in sheltered places protected from the cold. As the morning sun warms the habitat, the grasshoppers slowly crawl from their hiding places and seek sunny positions aggregating on bare soil, earth clods, and dried cattle dung. As temperatures rise further, the grasshoppers start moving about and feeding. They are active during the greater part of the day. If the ground becomes too hot, they crawl up stems of plants a distance of 2 inches. Just before sundown, they seek stones and other objects that have retained heat and orient their sides to the sun. As the habitat continues to cool, they crawl to sheltered places and become hidden. Several weather elements, particularly temperature and radiation of the sun, modify behavior (Table 1).

Table 1. Activity of nymphs and adults of the clearwinged grasshopper, *Camnula pellucida* (Scudder) correlated with air and soil temperatures (After Parker 1930).

Name of activity	Description	Average temperature °F			
		Nymphs		Adults	
		Air	Soil	Air	Soil
Beginning of activity	Basking, exposure to sun	60	76	62	78
Beginning of normal activity	Feeding	65	94	67	95
	Starting migration	67	93	75	102
	Molting	70			
	Mating			68	
	Starting oviposition			72	101
Beginning of climbing to escape heat	Climbing vegetation			80	107
Beginning of clustering in evening	Basking, exposure to sun	68	87	70	90
Ending of activity	Moving to shelter	65	77	67	80

Selected References

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