

I.7 Insect Predators and Parasites of Grasshopper Eggs

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Introduction

The following remarks are intended to provide a brief overview of the life cycle and habits of the various insects that attack grasshopper eggs. Individually, these natural enemies may not seem significant, but collectively they determine how many grasshopper eggs will hatch and reach the nymphal stage. Also, it is important that land managers recognize the damage done to these beneficial insects when pesticides are sprayed during grasshopper control campaigns. Currently, when range-land grasshoppers are treated with pesticides, the chemical of choice is usually malathion because it is effective and inexpensive and relatively nontoxic to mammals and birds. However, malathion is not selective, killing virtually all of the exposed insects, including the beneficials.

Grasshopper Egg Laying

Grasshopper eggs are normally deposited in clusters, called egg-pods, placed just below the surface of the soil. The egg-pod is covered by a fairly durable coating of soil particles mixed with a glutinous substance excreted by the female as she lays her eggs in the soil. The female thrusts her abdomen into the soil to a depth of an inch or two (5–10 cm) and starts laying her eggs. When the cavity formed by her abdomen is filled with eggs, she commonly blocks the hole above the eggs with a glandular secretion forming a “froth plug.”

The egg-pod may contain from 2 to more than 100 eggs, depending on the species of grasshopper. The eggs are quite tough and very resistant to cold. They are able to survive the most severe winters if the ground is not disturbed. Also, there is usually enough moisture in the surrounding soil to keep the eggs from drying out even in drought conditions. After the eggs have been deposited in a suitable spot, the female grasshopper provides no maternal or defensive care and merely abandons them.

Natural Enemies of the Egg Stage

The eggs of some species hatch in a few weeks and thus escape destruction by many natural enemies. Most of the grasshoppers in the Western United States lay their eggs in summer and fall and they remain in the ground during

the winter in a state of suspended development called diapause, and they do not hatch until the following spring. These eggs are unprotected and exposed to their enemies for some 9 months of the year.

In spite of the fact that grasshopper eggs are available to natural enemies for such long periods, there are surprisingly few insect enemies of the egg stage. It must be noted that locating grasshopper egg-pods in the soil is usually a lengthy and difficult task. Because finding pods in soil and vegetation is so unpredictable, it is easy to miss egg-pods, and especially the larval stages of predators. Thus it is difficult to obtain accurate density counts per unit of area.

The insects that feed on grasshopper eggs can be divided into two groups, predators and parasites, based upon the insects' method of feeding.

Egg Predators

Predators attack the egg-pod as a whole, feeding externally on the grasshopper eggs. Predators are capable of moving from one egg or egg-pod to another as they complete their development. Most insect predators of grasshopper eggs are generalists. They pose a threat to grasshopper egg populations, but in an undirected way. Some of these predators are no more than scavengers. They locate egg-pods somewhat at random, taking advantage of targets of opportunity. The following groups of grasshopper egg predators are discussed in their approximate order of importance in the Northern Plains.

Coleoptera: Meloidae.—In North America, the larvae of blister beetles (meloids) are an important group of predators of grasshopper eggs. However, in Australia, Africa, and other parts of the world, blister beetles are of little or no importance. The adult stages are called blister beetles because their body fluids can cause blistering of the human skin. Although the larvae of this group of beetles are predaceous, the adults feed exclusively on vegetation, and certain species can become numerous enough on crops such as alfalfa to require treatment with pesticides. In this family, the beneficial aspect of the larva frequently is offset by the destructive habit of the adult.

Rees (1973) lists 26 species of meloids whose larvae are known to attack grasshopper eggs in North America. In early summer, the female blister beetle lays a group of 100–200 eggs in an earthen chamber. When the young larva hatches from the egg, it is quite mobile and begins to search through the soil for a grasshopper egg-pod. Once a pod is located, the meloid larva transforms into a fat white grub and usually eats all of the eggs within the egg-pod. In fact, if the larva still has not completed its development, it will seek out another egg-pod on which to feed. Some species require 2 years to complete their life cycle.

Diptera: Bombyliidae.—The larvae of certain bombyliid flies are also important predators of grasshopper eggs. As many as 13 genera have the habit of consuming acridid (grasshopper) eggs. The adults are called bee flies because certain species have furry bodies resembling a bumble bee. Also they hover in midair and dart swiftly from place to place, moving like bees. When the flies are at rest, the wings are held away from the body. Eggs are deposited in soil cracks and crevices in the vicinity of ovipositing grasshoppers.

After a brief incubation period, the eggs hatch and the larvae wander through the soil in a random search for food. Encounters with grasshopper egg-pods appear to be more or less accidental. A bee-fly larva can completely consume the contents of a pod, but at times only a few eggs are eaten in each of several pods. In this way, many egg-pods can be damaged, allowing the entry of other scavengers. The bee-fly larval stage can last for several years. The number of egg-pods destroyed per individual often exceeds three (Rees 1973). When the bee-fly larva is fully developed, it leaves the egg-pod and pupates near the surface of the soil.

Coleoptera: Carabidae.—Both the adult and larval stages of this family are predaceous on other insects, but members of the family are known as generalists in their choice of hosts. The adults are commonly called ground beetles. The larvae of carabid beetles are predaceous on grasshopper eggs, and in some local situations, they seem to be of importance (Greathead 1963).

Miscellaneous Groups.—On occasion, the larvae of certain members of the following families of beetles and flies have been noted as soil-inhabiting predators of acridid egg-pods, but none seem to be dependent on grasshopper eggs for their survival. These include three Coleoptera families (Cleridae, Tenebrionidae, and Trogidae) and three Diptera families (Asilidae, Calliphoridae, and Chloropidae) (Greathead 1992). Note: during the Grasshopper Integrated Pest Management Project study, larvae of two new chloropid flies were found to be predators of grasshopper eggs in the Northern Plains (Dysart 1991, Sabrosky 1991).

Egg Parasites

Parasites feed internally and complete their development within a single egg. In general, parasites of the eggs of insects usually are tiny hymenopterous wasps that come from one of several different families. However, the eggs of grasshoppers are attacked by wasps of the family Scelionidae only.

Hymenoptera: Scelionidae.—Members of this group are the only true parasites of grasshopper eggs. The North American species of Scelionidae that develop as parasites in the eggs of grasshoppers belong to two genera: the genus *Scelio*, which contains about 19 species, and the genus *Synoditella*, represented by 2 species (Muesebeck 1972). *Scelio* species occur throughout the world wherever grasshoppers are found. Only a single wasp develops within a grasshopper egg. *Scelio* adults live only a very short time, usually no more than 3 weeks under the best conditions. The sex ratio varies among species, but there are usually more females than males by a considerable margin.

The factors involved in host selection are not entirely clear, but it seems certain that the adult female is attracted by some chemical in the egg-pod froth. After locating a suitable egg-pod, the female wasp chews a passageway through the froth until she encounters the grasshopper eggs. Then the wasp backs out, reenters the passageway tail first, and, using her long ovipositor, lays eggs in as many host eggs as she can reach. After the *Scelio* larva hatches, it feeds internally on the contents of the host egg.

When mature, the larva pupates within the host egg shell, and the adult wasp emerges during the summer months. In the Northern Plains, *Scelio* species are thought to have only one generation per year. The most abundant and most widespread of the North American species is *Scelio opacus*. Host records from the literature and my own studies (Dysart 1995) show that it has been reared from eggs of nine different grasshopper species.

Discussion

Many articles in the literature describe the habits and life history of grasshopper parasites and predators, but few good ecological studies describe the impact of these natural enemies on grasshopper populations.

In his general review of predators and parasites of North American grasshoppers, Rees (1973) speculated that grasshopper egg predators probably have more effect on grasshopper populations than do predators of nymphs and adults. Based on a 10-year study in North Dakota and Montana, Parker (1952) estimated that predators destroyed 20 percent of the eggs laid by grasshoppers. Parker and Wakeland (1957) cite results from a studies made at 16 sites in 7 States. Average annual destruction of egg-pods by predators was about 18 percent (9 percent by blister beetles, 6 percent by bee flies, and 3 percent by ground beetles).

Prior and Greathead (1989) estimated that, in Africa, scelionid egg parasites (*Scelio* spp.) were the predominant cause of egg mortality in solitary locust populations. However, scelionids were rather ineffective mortality factors in the egg beds of gregarious species, such as the desert locust. In Australia, parasitism by *Scelio* species at certain sites has been found in up to 90 percent of the egg-pods. In my study areas in Montana and North Dakota, *Scelio* parasitism never reached such high levels. I found that a complex of four species of *Scelio* parasitized about 11 percent of the egg-pods (Dysart 1995). Parasitism figures from the literature indicate that a range of 5 to 15 percent of pods are attacked by *Scelio* spp. in the Northern United States and the Prairie Provinces of Canada.

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