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Natural Enemies of Gypsy Moth: The GoodGuys!

Michigan State University Extension

Dr. Deborah G. McCullough
Associate Professor
Dept. of Entomology and Dept. of Forestry
Michigan State University

Dr. Kenneth A. Raffa
Professor
Dept. of Entomology
University of Wisconsin-Madison

Dr. R. Chris Williamson
Extension Entomologist
Dept. of Entomology
University of Wisconsin-Madison

"Natural enemies" refers to the predators, parasitoids and pathogens that affect pest insects such as the gypsy moth (*Lymantria dispar* L.). These natural enemies are important in helping to control gypsy moth outbreaks and in keeping populations low in the years between outbreaks. One reason why gypsy moth is a much greater problem in North America than in its native lands is that many of its important natural enemies were left behind when gypsy moth became established here.

Some natural enemies of gypsy moth will be familiar to you; others, such as insect parasitoids and pathogens, may be less well known. They all play important roles, however, in helping to limit the damage and annoyance caused by gypsy moth. Some of the natural enemies that affect gypsy moth are native to North America. Others were deliberately introduced from Europe, Asia, India and northern Africa, where gypsy moth is native, by federal agencies involved in biological control programs.

The goal of this bulletin is to help you learn to recognize some of the important natural enemies that may help control gypsy moth in your area. This bulletin will also give you suggestions on tactics to conserve or protect natural enemies of gypsy moth on your property.

Predators

Predators of gypsy moth are important in keeping gypsy moth populations low in years between outbreaks. A diverse group of bird, mammal, amphibian and insect predators will feed on gypsy moth eggs, caterpillars and pupae. Woodlots, urban forests and landscapes that include a diverse mix of forest trees, shrubs and herbaceous vegetation will provide cover and other resources for predators. Restrict use of broad-spectrum insecticides to avoid harm to populations of predatory insects. The microbial insecticide known as B.t. or B.t.k. *(Bacillus thuringiensis* var. *kurstaki)* is often used to protect tree foliage in residential areas during gypsy moth outbreaks. Unlike conventional insecticides, B.t.k. will not harm vertebrate or insect predators.

Birds

Many birds do not like to feed on large, hairy gypsy moth caterpillars, but other species seem to relish them! Yellow-billed and black-billed cuckoos, blue jays, orioles and rufous-sided towhees are among the species that feed on gypsy moth caterpillars. Some birds, such as the black-capped chickadee, will also feed on egg masses and can sometimes cause substantial egg mortality.

Mammals

Shrews, mice, voles and other small mammals often feed on gypsy moth caterpillars and pupae that they encounter on the ground and around the bases of trees. Mice (Fig. 1) seem to prefer the large female pupae to the smaller male pupae. This selective feeding can have a greater impact on the overall gypsy moth population than random feeding. Chipmunks, skunks and racoons will also feed on gypsy moth larvae and pupae, and squirrels will feed on pupae.

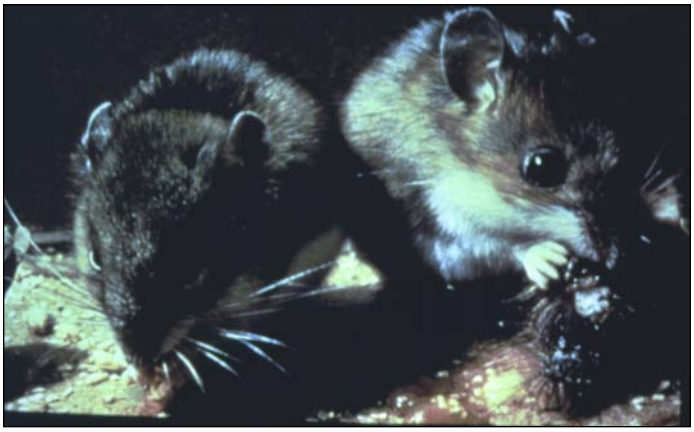

Fig. 1. Mice are important predators of gypsy moth caterpillars and pupae.

Insect predators

Fig. 2. The adult *Calosoma sycophanta* beetle is a gypsy moth predator.

Some insects are also important predators of gypsy moth. For example, the Calosoma beetle *(Calosoma sycophanta)* is a "specialist," in that it feeds almost entirely on gypsy moth (Fig. 2). It was introduced into the northeastern United States and, more recently, into Michigan in the Great Lakes region, specifically to help provide long-term control of gypsy moth populations. Adults and larval stages of this brightly colored beetle feed on gypsy moth caterpillars and pupae (Fig. 3).

Fig. 3. Calosoma beetles will climb trees to prey on gypsy moth larvae.

Several native insects are also good predators and will attack gypsy moth, as well as other plant-feeding insects. For example, in Fig. 4, a predatory stinkbug is feeding on a gypsy moth caterpillar. Ants can also be important predators of young caterpillars. Many other insect predators and spiders are opportunistic feeders and will consume gypsy moth larvae or pupae when they are available.

Fig. 4. A predatory stinkbug attacks a gypsy moth caterpillar. *Photo by Lyle Buss.*

Parasitoids

The term "parasitoid" refers to certain species of wasps and flies that have a very specialized life cycle. Parasitoids lay their eggs inside, on or near the body of a host insect, such as a gypsy moth caterpillar (Fig. 5). The larval stages of most parasitoids resemble maggots. Parasitoid larvae live by feeding on tissues in the body of the host insect, killing it in the process. Once the parasitoid has completed its development, it emerges from the host insect. Several parasitoids are important natural enemies of gypsy moth. A few examples are described here.

Fig. 5. A parasitoid fly laid the white egg on this gypsy moth caterpillar. *Photo by Ron Weseloh.*

Ooencyrtus kuvanae

This little wasp is a specialist that parasitizes the eggs of gypsy moth (Fig. 6). It was introduced into the United States for biological control of gypsy moth many years ago and is now well established in most of the region infested by gypsy moth. Three generations of this wasp may occur in the summer and fall after egg masses are laid, and another generation may occur the following spring. The tiny, dark adult wasps can often be observed if you look closely at gypsy moth egg masses. You may also see the small, round holes in the egg mass where the adult wasps emerged (Fig. 7). Because the wasp is small, it can usually attack only the eggs in the upper layer of a gypsy moth egg mass. In many years, however, it is able to kill 20 to 30 percent of the eggs in an egg mass.

Fig. 6. *Ooencyrtus kuvanae* is an important egg parasitoid of gypsy moth. *Photo by Michael Higgins.*

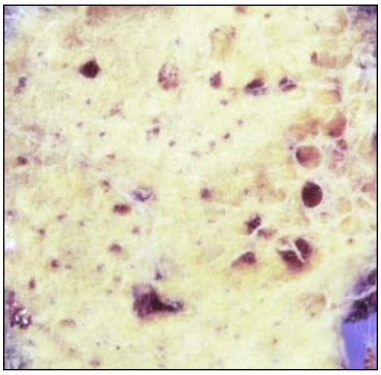

Fig. 7. Holes in a gypsy moth egg mass where *Ooencyrtus kuvanae* wasps emerged after parasitizing gypsy moth eggs. *Photo by Michael Higgins.*

Although *Ooencyrtus* wasps are rarely available from commercial suppliers, you can help to protect populations that are established in your area. For example, if you intend to scrape off and destroy egg masses as part of your gypsy moth management program, it is best to wait until winter. This will give the egg parasitoids a chance to complete their development and find overwintering sites in the litter below trees. Limit use of insecticides in mid- and late summer to avoid killing this beneficial species. The microbial insecticide B.t.k. will not harm parasitic wasps or flies.

Cotesia melanoscelus

Fig. 8. A *Cotesia melanoscelus* wasp parasitizes a young gypsy moth caterpillar.

This is another specialized wasp that was introduced specifically for biological control of gypsy moth. The first generation of the wasp will attack very young gypsy moth caterpillars (Fig. 8) and is often successful in subduing the young host caterpillar. A second generation of the wasp can attack larger gypsy moth caterpillars, those that are about halfway through their development.

Fig. 9. A white *Cotesia melanoscelus* cocoon near parasitized gypsy moth caterpillars.

This parasitoid pupates in a small, oblong yellowish cocoon (Fig. 9). These cocoons are frequently observed near a dead gypsy moth caterpillar or attached to the bark of an infested tree. In some cases, this parasitoid can be an important source of mortality. However, the small wasps sometimes have difficulty attacking larger gypsy moth caterpillars, and the wasp has its own natural enemies that may limit its effectiveness.

Avoiding applications of broad-spectrum chemical insecticides in early and midsummer will help protect this species. Application of the microbial insecticide B.t.k. may slow the development of gypsy moth caterpillars. This can benefit the *Cotesia melanoscelus* wasps and may increase the rate of parasitism. If you use burlap "hiding bands" on your trees and then mechanically remove

Fig. 10. Gypsy moth caterpillars hide under burlap bands and can be removed. *Photo by Lyle Buss.*

gypsy moth caterpillars (Fig. 10), you should avoid removing any caterpillars with the yellow or white *Cotesia melanoscelus* cocoons still attached (Fig. 11).

Fig. 11. This gypsy moth cadaver with the white *Cotesia melanoscelus* cocoon should be left on the burlap band to allow the parasitoid wasp to emerge.
Photo by Lyle Buss.

Compsilura coccinnata

This fly attacks gypsy moth caterpillars, as well as the caterpillars of more than 100 other moth and butterfly species. It was introduced for gypsy moth control many years ago and is well established throughout much of the northeastern and north central United States. It has three generations a year, although only one of these generations attacks gypsy moth caterpillars. After feeding in the body of a gypsy moth caterpillar, this parasitoid pupates in a reddish brown puparium, often seen on or near the body of the dead caterpillar (Fig. 12). This parasitoid may be important in helping to keep gypsy moth populations in check and prolonging the period between outbreaks.

Fig. 12. The reddish brown puparium indicates that this gypsy moth caterpillar was killed by a parasitic fly such as *Compsilura coccinnata*. *Photo by Lyle Buss.*

Pathogens

Gypsy moth and other insects are affected by a variety of organisms that cause disease, including fungi, bacteria, viruses and protozoans. Two diseases are especially important in controlling gypsy moth outbreaks.

NPV - The Virus Disease

NPV is a nucleopolyhedrosis virus, and is a disease that affects only gypsy moth. The NPV disease is usually the most important factor in the collapse of gypsy moth outbreaks in North America. The virus is always present in a gypsy moth population and can be transmitted from the female moth to her offspring. It spreads naturally through the gypsy moth population, especially when caterpillars are abundant. During a gypsy moth outbreak, caterpillars become more susceptible to this virus disease because they are stressed from competing with one another for food and space. Typically, 1 to 2 years after an outbreak begins, the NPV disease causes a major die-off of caterpillars.

Caterpillars killed by the NPV disease hang in an upside-down V shape from trees (Fig. 13). The bodies of the dead caterpillars liquefy (Fig. 14) and rapidly disintegrate. A limited amount of the gypsy moth NPV disease is produced annually and distributed by the state and federal agencies that oversee gypsy moth suppression programs.

Fig. 13. Gypsy moth caterpillars that die from the NPV disease hang from trees in an upside-down V shape.

Fig. 14. Caterpillars killed by the NPV pathogen liquefy rapidly.

Entomophaga maimaiga - The Fungus Disease

This fungus has recently attracted much interest in the northeastern and north central states. It was introduced from Japan in 1910 but did not affect gypsy moth populations until the late 1980s. What happened to the fungus in the years between its introduction and 1988-89 is a mystery. Since 1989, the fungus has been widely released in states with gypsy moth populations.

Fungal spores that overwinter in the soil will infect young caterpillars early in the summer. When the young caterpillars die, their bodies produce windblown spores (Fig. 15) that can spread and infect older caterpillars. Large caterpillars killed by the fungus will hang head-down from the tree trunk, and the bodies of the dead caterpillars (cadavers) appear dry, stiff and brittle (Fig. 16). Within several days, the cadavers fall to the soil and disintegrate, releasing the spores that will overwinter back into the soil.

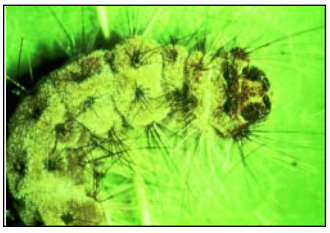

Fig. 15. Spores of the *Entomophaga maimaiga* fungus on a gypsy moth caterpillar. *Photo by Darwin Dale.*

Fig. 16. Gypsy moth caterpillars killed by the *Entomophaga maimaiga* fungus hang from the tree and are dry and brittle. *Photo by Lyle Buss.*

Like all fungi, *Entomophaga maimaiga* is strongly affected by temperature and moisture. Cool, rainy weather in the spring and early summer probably favors the fungus, but the specific conditions needed for good control are not yet known. When conditions are right, however, it can be an important source of mortality in both low and high gypsy moth populations.

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