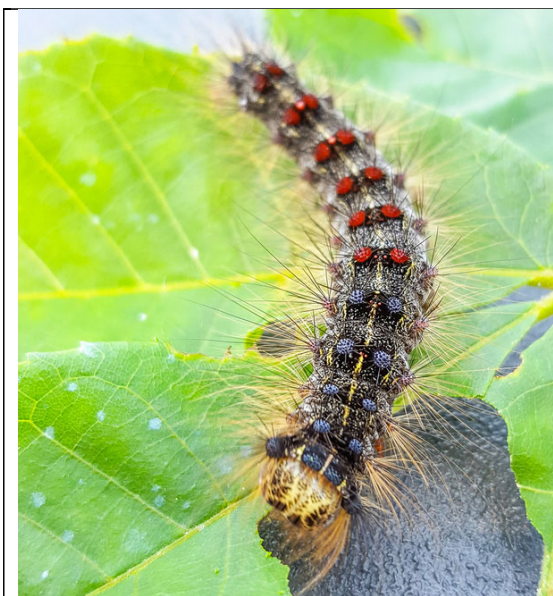


## A Virus and a Fungal Disease Cause Gypsy Moth Outbreaks to Collapse

The gypsy moth (*Lymantria dispar* L.) is an exotic pest established in Michigan since the 1980s. Caterpillars, the immature “larval” stage, feed on the leaves of oaks, aspens and many other trees in landscapes and in forested areas. During gypsy moth outbreaks, caterpillar density can be so high that some trees may be completely stripped of leaves by mid-summer. Fortunately, defoliation caused by gypsy moth caterpillars rarely kills trees. The large, hairy caterpillars, however, often annoy people living or recreating in areas where an outbreak is underway. called *Entomophaga maimaiga*.



*Healthy gypsy moth larva. Photo by Karla Salp, Washington State Department of Agriculture, Bugwood.org.*

Outbreaks of gypsy moth populations usually collapse after two to four years. This is partly because of the natural enemies that attack gypsy moth eggs, caterpillars or cocoons. Natural enemies include predators such as white-footed mice, certain birds and predatory insects or mites. Parasitoids, which are highly specialized wasps or flies, can attack gypsy moth eggs, larvae and cocoons. Two diseases that affect gypsy moth caterpillars are the most important factors causing outbreaks to collapse. One disease is a nucleopolyhedrosis virus (NPV) while the other disease is a fungus called *Entomophaga maimaiga*.

## NPV – the gypsy moth virus

Gypsy moth populations in North America have always been affected by NPV. Because the virus is present in gypsy moth populations, it does not need to be introduced. Some gypsy moths will carry a sublethal load of NPV that affects their health but doesn't cause mortality. Female moths, for example, are smaller and produce fewer eggs when they have a sublethal dose of NPV.

Generally, NPV causes high levels of caterpillar mortality when the gypsy moth population is at very high densities – e.g., an outbreak. During outbreaks, gypsy moth caterpillars must compete for food (leaves) and resting space. This stress increases their vulnerability to NPV. Often, a NPV epizootic occurs during the second or third year of an outbreak. In an epizootic, many caterpillars die over a short period of time. Caterpillars killed by NPV typically hang limply from the trunk or a branch in an upside down V-shape. The cadavers liquefy and disintegrate rapidly, and will produce a foul odor when handled.



*Gypsy moth larvae killed by NPV hang in an upside-down V. Photo by Steven Katovich, Bugwood.org.*



*Cadavers of larvae killed by NPV liquefy. Photo by Karla Salp, Washington State Department of Agriculture, Bugwood.org.*

# Entomophaga maimaiga - the gypsy moth fungus

The second disease, *Entomophaga maimaiga*, is a fungus native to Japan. In Latin, *Entomophaga* means "insect eater" and *maimaiga* is the Japanese name for gypsy moth. This fungus was originally introduced into the northeastern United States in the early 1900s as a biological control for gypsy moth. It was released in Michigan in 1991 when much of Lower Michigan experienced the first major gypsy moth outbreaks.

Thick-walled "resting spores" of *E. maimaiga* are present in the soil or on tree bark during winter. If moisture and temperatures are favorable, resting spores will germinate in May or June. Young gypsy moth caterpillars make contact with the sticky fungal spores in spring as they search for suitable leaves for feeding. The fungus digests its way into an infected caterpillar, grows inside its body and can kill the caterpillar within a week.

A second type of spores called conidia are then produced on the cadavers of the dead caterpillars. These microscopic spores are spread by the wind and can infect and kill other gypsy moth caterpillars. The cycle of conidia production and infection may occur four to nine times during summer. When the fungus kills large caterpillars, the decomposing cadavers release the overwintering resting spores back into the soil. Cadavers of large gypsy moth larvae killed by the *E. maimaiga* fungus are stiff, dry and hang head down from the tree trunk.

Weather plays an important role in determining how effective *E. maimaiga* will be in a given year. Like most fungi, the spores need moisture and high humidity to germinate. Frequent rainfall during May and June can contribute to developing *E. maimaiga* epizootics during gypsy moth outbreaks.



*Dead gypsy moth caterpillar killed by the fungal pathogen *Entomophaga maimaiga*. Photo by Steven Katovich, Bugwood.org.*

The dynamics of the two diseases differ. The gypsy moth NPV is not affected by spring rainfall or temperatures, but is seldom prevalent until gypsy moth populations reach very high levels. In contrast, *E. maimaiga* may kill gypsy moth caterpillars even when populations are low, but only if weather conditions are favorable. Both diseases may occur in the same gypsy moth population, especially during outbreaks.