Lymantria dispar

Other scientific names: *Porthetria dispar* Linnaeus; *Ocneria dispar* Linnaeus; *Bombyx dispar* Linnaeus; *Hypogymna dispar* Linnaeus; *Liparis dispar* Linnaeus; *Phalaena dispar* Linnaeus; *Porthesia dispar* Linnaeus
Order and Family: Lepidoptera: Lymantriidae
Common names: gypsy moth; Asian gypsy moth; European gypsy moth

The gypsy moth, *Lymantria dispar* Linnaeus, 1758, is a significant defoliator of a wide range of broadleaf and even conifer trees. While low population levels can exist for many years without causing significant damage, severe outbreaks can occur resulting in severe defoliation, growth loss, dieback and sometimes tree mortality. Two strains of gypsy moth exist: the Asian strain, of which the female is capable of flight; and the European strain, of which the female is flightless. This moth is considered a significant pest in both its native and introduced ranges.


G. ALLARD


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Gypsy moth egg masses, larva and adults

DISTRIBUTION

Native: The Asian strain is native to southern Europe, northern Africa, Asia and the Pacific (central and southern, and Japan).
The European strain is found in temperate forests throughout Western Europe.
Introduced: The European strain has been introduced to North America, in Canada (1912 first detected, 1924 first infestation) and the United States (1869).
The Asian strain has been introduced into Europe (Germany, other countries in the region) where it readily hybridizes with the European strain. A breeding colony was reported in 1995 in Europe (United Kingdom) but there was no establishment. This strain has been introduced but has not established in North America (Canada, United States) (Wallner, 2000a).

IDENTIFICATION

The Asian gypsy moth is virtually identical in appearance to its European counterpart (Wallner, 2000a). Adult females are white or cream in colour and are much larger than the males with a wingspan of 55 to 70 mm (Wallner, 2000a; Kimoto and Duthie-Holt, 2006). Adult males are mottled brown in colour and have a wingspan of 35 to 40 mm (Wallner, 2000a; Kimoto and Duthie-Holt, 2006). Both sexes have a dark, crescent-shaped mark on the forewing and pectinate antennae, although the longer branches on the males give their antennae a feathered appearance (Kimoto and Duthie-Holt, 2006).

Egg masses are ovoid, 3 to 6 cm in length and 2 to 3 cm in width, and can contain 100 to 1 000 eggs (Wallner, 2000a). They are covered in tan coloured hairs from the female's abdomen and eventually become sun bleached with age (Brandt, 1994; Kimoto and Duthie-Holt, 2006). Spent egg masses have small pin-sized holes created by emerging larvae.

Newly hatched larvae are 3 mm in length and tan in colour but turn black within 24 hours (Wallner, 2000a). The first and third instars are black with long hairs while the second instar is brown with short hairs (Kimoto and Duthie-Holt, 2006). The fourth, fifth and sixth instars are quite similar to each other and may be light to dark gray with flecks of yellow. They have long dark or golden hairs and two rows of tubercles along the back which are typically arranged in five pairs of blue tubercles followed by six pairs of red, but variations are known to occur (Kimoto and Duthie-Holt, 2006). Mature larvae are approximately 50 to 90 mm in length (Wallner, 2000a).

HOSTS

Both strains have exceptionally wide host ranges, more than 250 species, although the Asian strain is even broader than the European strain. Preferred hosts of both forms include *Quercus*, *Populus*, *Salix*, *Tilia*, *Betula* and *Malus* species. *Larix*, *Ulmus* and *Diospyros* species are also highly preferred. Conifers growing in mixture with preferred hosts can also be defoliated during periods of high insect pest densities (Wallner, 2000a).

BIOLOGY

Both the Asian and European strains of the gypsy moth have one generation per year. Adults are active in July and August when mating and egg-laying occur (Wallner, 2000a). Adult females of Asian strains are capable of flight whereas females of European strains are flightless. Females lay egg masses indiscriminately on almost any surface including tree bark, branches, rock piles, lawn furniture, birdhouses, wood piles, logs, recreational vehicles and equipment.

Larvae hatch in early May and climb to the tree tops and balloon on silken threads to neighboring trees where they feed gregariously (Wallner, 2000a). Male gypsy moth larvae typically pass through five instars while females have six instars (Wallner, 2000a). Early instar larvae excavate small holes in leaves and as the larvae grow they make larger holes and consume the leaf margins; final instar larvae consume the entire leaf (Kimoto and Duthie-Holt, 2006). They are primarily nocturnal feeders and rest in protected locations such as bark flaps, holes and wounds on host trees during the day.

Pupation takes place in sheltered places; pupae may be found attached by silken thread to branches, tree trunks, rocks, forest debris, buildings or fences (Kimoto and Duthie-Holt, 2006). Adults emerge approximately two weeks later.


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G. ALLARD

Defoliation of trees by the gypsy moth in Romania (L) and Kyrgyzstan (R)

SYMPTOMS AND DAMAGE

Populations of the gypsy moth can occur at low levels in forests for many years without causing significant damage. However, at times there are significant outbreaks, frequently coinciding with periods when the trees are under stress such as in Central Europe in the 1990s. These outbreaks cause severe defoliation of host trees resulting in growth loss, dieback and sometimes tree mortality. Tree mortality often occurs when there are several sequential outbreaks. Outbreaks typically last for about three years and collapse when host trees are weakened to the point that they produce little or no foliage for the larvae to feed upon in the following spring. High levels of parasitism can also cause outbreaks to collapse.

DISPERSAL AND INTRODUCTION PATHWAYS

Adults of Asian strains are capable of flight and thus have strong dispersal ability whereas females of European strains are flightless. Young larvae can move some distance by ballooning from the tops of trees.

Pathways of introduction of the gypsy moth include movement of vehicles, camping equipment, nursery stock, ships, and equipment that has been exposed for a period to the outdoors. Ecotourism may contribute to ignorant or passive possession and dispersal and thus awareness campaigns are important.

CONTROL MEASURES

Preventative measures include thinning of forest stands to improve tree vigour and thinning to reduce the proportion of preferred host trees. Small infestations of gypsy moths particularly on ornamental trees can be controlled by collecting and destroying the egg masses before the eggs hatch (Brandt, 1994). Mass-trapping through the use of pheromones can also assist with control.

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Aerial spraying operations using Bacillus thuringiensis *var* kurstaki *(Btk) (Foray 76B) for gypsy moth control, United States*

Aerial and ground application of biological insecticides is the most common method for eradicating new isolated populations and also to suppress outbreaks of well established populations. The most common biological insecticide used against the gypsy moth is *Bacillus thuringiensis* (Bt) which disrupts the digestive system of larvae, suppressing their appetites and eventually resulting in death typically within 7 to 10 days. In the United States the gypsy moth is considered the most costly of introduced forest insect pests with annual control expenditures exceeding US$35 million since 1980 (Wallner, 2000a).

A number of natural predators have been used to control *L. dispar*. Vertebrate predators are important in maintaining low densities, parasites are often abundant during outbreaks, and diseases, especially a nucleopolyhedrosis virus, have been noted to be responsible for the collapse of outbreak populations (Wallner, 2000a). Another important natural control is the fungal pathogen, *Entomophaga maimaiga*, which is not dependent on gypsy moth density (Wallner, 2000a).

Predictive models have been used to determine risk assessment and potential damage in new areas.