



Asian Gypsy Moth

Lymantria dispar asiatica Wnukowsky (Lepidoptera: Lymantriidae)

INTRODUCTION:

The Asian Gypsy Moth (AGM) is an exotic invasive pest native to East Asia that attacks over 500 species of trees and shrubs. Closely related to the Gypsy Moth (GM), a serious exotic pest from Europe long established in the eastern U.S., AGM is not known to be established in North America, but instead has been introduced repeatedly from infested international ships and shipping containers. AGM is considered a major threat to North American trees and forests, and upon detection a cooperative eradication program between federal and state agencies is immediately initiated.

DISTRIBUTION/SPREAD:

AGM is native to Far East Asia and East Russia. In North America, AGM was first detected near the Port of Vancouver in British Columbia, Canada (1991), when eggs on infested ships from eastern Russia hatched and the larvae were blown ashore. AGM has since been detected in the U.S. states of Oregon (1991), Washington (1991), North Carolina (1993), California (2003), Idaho (2004), and Texas (2006). In each case, rapid initiation of emergency control programs eradicated the pest, although Oregon, Washington and California have had multiple new introductions. AGM was not known to occur in Europe until tracebacks from U.S. detections led the USDA there, seeking the origin of introductions into the U.S. It is now found in a number of European port cities and every major Asian port, including Japan.

AGM are typically brought into North America as egg masses or moths on infested ships and cargo from either the Far East or infested European ports. Reintroduction is a continual risk as trade with these areas expands. In addition to international shipping, humans can inadvertently spread AGM by transporting egg masses and pupae attached to vehicles, camping equipment, lawn furniture and other outdoor articles, nursery stock, logs, pallets, and many other surfaces. Natural spread is by moth flight of both sexes (unlike GM, whose females can not fly), and through “ballooning” of first instar larvae. The larvae drop down on silken threads, are caught by the wind and blown to new locations, averaging < ½ mile (0.80 km), but as great as 12 miles (19.3 km) or more at times.

Several factors favor the spread and establishment of AGM in North America, including the female’s ability to fly (thus accelerating spread), a larger host range than the GM, better adaptation to colder climates, and the ability of AGM egg masses to tolerate extremes in temperature and moisture. AGM prefers forest habitats and a pest–risk assessment prepared by the USDA APHIS and Forest Service concluded that, because of similarities between Asian and North American ecosystems, AGM has great potential to rapidly become widely established in North American forests should eradication efforts fail. In the Eastern U.S., GM defoliate about 4 million acres annually, causing millions of dollars in damage. If AGM were to become established in the U.S., the damage could be even more extensive and costly.

HOST PLANTS:

AGM larvae are polyphagous, and are known to feed on the foliage of more than 500 species of trees and shrubs, about twice as many as GM. AGM feed not only on hardwoods and conifers, but also on trees such as larch (*Larix*) that are not favored by GM. Younger AGM larvae prefer oak, although they will feed on hundreds of other plant species as well. As larvae age, they will add conifers such as hemlock, pine, spruce, Douglas fir, and southern white cedar to their diet. AGM’s larger host plant range makes it a much greater threat than GM to forests, landscape plants, commercial softwood operations like Christmas tree farms, and tree nurseries.



Adult female AGM. John H. Ghent, USDA Forest Service, Bugwood.org



Comparison of adult AGM female (left) and adult GM female (right). USDA APHIS PPQ Archive, Bugwood.org



Adult AGM male moths; note variation in size and coloration. USDA APHIS PPQ Archive, Bugwood.org



There may be great variation in body color of AGM larvae. USDA APHIS PPQ Archive, Bugwood.org

BIOLOGY and DAMAGE:

There is some belief that AGM is hybridizing with GM. The biology is similar for both species. There are four stages to the gypsy moth life cycle, producing one generation per year: egg, larvae (caterpillar), pupae (cocoon), and adult moths. Gypsy moth eggs overwinter in protected velvety egg masses which hatch in spring, usually at the same time as bud break of preferred hosts (early spring-May). Larvae cause all of the feeding damage done to host plants; adult moths do not feed.

If larvae hatch out on a suitable host they may begin feeding, or they may disperse by “ballooning” to a new location. Late instar larvae feed in the tops of trees at night, crawling back down the trunks during the day, although when populations are large they may feed day and night. The caterpillar stage lasts 8-12 weeks (May-July) depending on temperature, food quality, and population levels. Male larvae usually go through five instars and females through six before entering the pupal stage. Pupation occurs late June-early August and lasts 10-14 days. Adult moths emerge from July-September and live one to three weeks, during which time they mate and lay eggs. The smaller brown male moths emerge first and fly in rapid, zigzag patterns searching for females. When the larger white female moths emerge, they emit a chemical signal called a pheromone to attract the males. AGM females are very strong fliers, unlike GM females.

Because GM females can not fly, they usually deposit their eggs near their pupation site in any sheltered location, including the bark of trees, sides of buildings, vehicles, firewood and other outdoor objects. The AGM female may lay her eggs in the same places as the GM, or she may fly to other locations (including cargo ships, as noted above). Up to 1,000 or more individual eggs are laid in a single mass, and then covered with a dense protective layer of buff colored hairs from the female’s body. Eggs hatch out in the spring, completing the cycle.

IDENTIFICATION:

AGM and GM look nearly identical; they can not be accurately differentiated by visual examination. Scientists have developed genetic tests to distinguish one strain from the other, but the two strains appear able to interbreed, further complicating identification.

- Adult AGM moths are slightly larger (male wingspan 1½”, or 3.8 cm; female wingspan 3½”, or 8.9 cm) than GM (male wingspan ~ 1”, or 2.5 cm, female wingspan up to 2”, or 5 cm).
- Male moths are tan or grayish-brown to dark-brown with blackish wavy bands across the forewings.
- Female moths are creamy white with faint, dark wavy bands on the forewings.
- Antennae of moths differ by sex: males have large, wide, feather-like oblong antennae; females have long, narrow antennae.
- Notable trait of AGM females is the ability to fly.



Adult female AGM and egg masses. Manfred Mielke, USDA Forest Service, Bugwood.org.



Damage: leaves stripped, defoliated trees. Louis-Michel Nageleisen, Département de la Santé des Forêts, Bugwood.org



Pheromone baited traps are used to monitor for AGM. William A. Carothers, USDA Forest Service, Bugwood.org

- Buff colored egg masses are about 1½” long by ¾” wide (3.8 x 1.9 cm), although variation in size and shape is common; color may bleach out over winter.
- Egg masses are covered with velvety hairs from the abdomen of the female.
- AGM caterpillar is hairy and the body may vary in color from tan, to black, gray or yellow, with 5 pairs of raised blue dots and 6 pairs of raised red dots along the back.
- Mature caterpillar is about 1 to 2 inches long (2-5 cm).
- Dark brown pupal cases may be attached to trees or other structures by silken threads.

WHAT TO LOOK FOR:

- Velvety egg masses, buff to parchment colored, averaging 1½ inches long and ¾ inches wide (3.8 x 1.9 cm).
- Egg masses may be deposited in sheltered spots on almost any sort of surface.
- In spring, early instar caterpillars “ballooning” from foliage on silk strands.
- Feeding damage on multiple species of plants: shothole damage from early instar caterpillars, to complete defoliation from late instar stages.
- Dark colored to tan, hairy caterpillars up to 2 inches long (5 cm) with double rows of blue and red spots down the back.
- Brown moths (~ 1½” or 3.8 cm wingspan) or white moths (~ 3½” or 8.9 cm wingspan) flying about; most active at daytime during summer months.
- Debris from dead moths and caterpillars, frass, leaf litter, silken threads.

MONITORING:

The risk of continued introductions of AGM into North American port areas increases as trade increases with infested Asian and European countries. AGM detection and post-treatment monitoring programs in the west rely on pheromone baited traps set out in a grid in high-risk areas. If a single male moth is caught in the detection grid, the trapping grid is refined the following year. Three years of negative trapping results are required before an AGM infestation can be declared eradicated. Occasionally egg mass and larval surveys are also conducted near a positive catch site. Detection and delimiting programs are conducted jointly by state and federal agencies. In addition to trapping vulnerable North American sites, major ports and ships from the Russian Far East and Japan are part of an AGM trapping program conducted by USDA agencies for pre-inspection AGM-free certification prior to arrival at U.S. ports. Negotiations are underway to trap ports in China and Korea.

MANAGEMENT:

Early detection and eradication of AGM infestations are the goals of state and federal regulatory agencies, in order to prevent economic and environmental losses due to loss of foliage, trees or shrubs. Should AGM become established in

the U.S., the USDA Forest Service has estimated that resource losses and suppression costs would be in the billions of dollars. An Integrated Pest Management (IPM) program for AGM should include detection monitoring (trapping), eradication techniques, post-treatment monitoring, and public education to assist in the detection and management of this pest.

Regulatory

AGM is a regulated pest under the authority of the U.S. Department of Agriculture (USDA) Forest Service and the Animal and Plant Health Inspection Service (APHIS). Whenever AGM is detected, cooperative federal and state quarantines and eradication programs are implemented. An IPM approach is used, utilizing trapping to detect AGM moths, spraying with *Bacillus thuringiensis* var. *kurstaki* (B.t.k.) to reduce/eradicate populations, then intensive mass trapping again to determine the effectiveness of pesticide applications and to pinpoint the location of any remaining AGM. Applications may be made aerially (preferred over large areas or forest) or by ground sprayers; three applications are usually required to ensure eradication. There are restrictions on the movement and importation of bark and bark products, which may contain AGM egg masses. Wood chips, however, are not considered to pose any risk and are not regulated.

Genetic Control

In 1986 a new eradication method, Induced Inherited Sterility Technique, was developed and implemented by the USDA-APHIS, in which large numbers of radiation-sterilized AGM were released in an area to disrupt normal mating. Results of post-release trapping indicated the effect on AGM populations is variable, and the program was considered unsuccessful because it did not achieve eradication.

Chemical Control

Mass trapping at a density of up to 3-9 disparlure-baited pheromone traps/acre is often employed after eradication efforts to determine the effectiveness of B.t.k. applications, and to remove any remnant populations of AGM that were not killed by the B.t.k. treatment. Mass trapping by itself, using nine or more pheromone traps per acre, may remove large numbers of male moths from the breeding population, causing a population reduction. However, the results are too unreliable to use this technique as a sole eradication control treatment.

LOOK-ALIKE INSECTS and DAMAGE:

AGM adults are essentially identical to GM, and may frequently be confused with other common moths:

- Adult moths of AGM are slightly larger than adult GM moths.
- AGM females can fly; GM females do not fly in spite of having fully developed wings.
- GM females generally lay eggs near their pupation sites, whereas AGM may lay them many miles away.
- The males of several species of tussock moths may be mistaken for male AGM, but can be distinguished by different wing markings.
- Western tent caterpillar male moths are similar, but smaller in size with heavier bodies than AGM male moths.
- The females of some species of the woollybear family of moths (*Arctiidae*) are white, but can be distinguished from the AGM female moth either by having pure white forewings (no markings) or by having black markings that differ from AGM. These species include: Virginia tiger moth (*Spilosoma virginica*), Fall webworm (*Hyphantria cunea*), Dogbane tiger-moth or Delicate Cynia (*Cynia tenera*), Acrea moth (*Estigmene acrea*), Many-spotted Tiger Moth (*Turpiana permaculata*), and Dagger moths (*Acrionicta americana*, *A. lepusculina*, *A. innotata*).

AGM caterpillars have prominent hairs, which are neither dense nor tufted, and pairs of colorful raised dots down the back. They may be confused with the following common caterpillars:

- Tent caterpillars: less hairy than AGM, very different markings, feed in groups, produce dense silken tents in the crotches of tree branches.
- Fall webworms: usually light brown without colorful dots down the back, feed in groups, construct large loose silken tents around the foliage on which they are feeding.
- Tussock moth caterpillars (various species): much hairier, often with dense bunches (tussocks) of hair on the back.
- Dagger moth caterpillars (various species): densely covered with hairs, thin clumps of long hairs may spring out in some spots.
- Woollybears (various species): densely covered with hairs and highly variable in color, ranging from yellow to black, and may be banded; tend to wander on land.

AGM egg masses are generally oval, buff to yellowish brown in color, velvety in appearance, and relatively flat with a slight raised swelling in the middle.

- Some related moths, notably tussock moths, lay deeply piled masses of eggs and cover them with grayish body hairs. Differences in color and thickness of the egg masses reliably distinguish them from those of AGM.

AGM is a regulated pest and suspected sightings should be promptly reported. U.S. Department of Agriculture policy requires that federal and state quarantines and eradication programs be implemented as soon as possible when AGM is detected.

How to Report a Possible Sighting/Infestation

In Maryland:

University of Maryland Cooperative Extension Exotic Pest Threats Website:
<http://hgic.umd.edu/faq/sendAQuestion.cfm>

Maryland Department of Agriculture: call 410-841-5920 to report suspect pests; visit http://www.mda.state.md.us/plants-pests/invasive_species.php for information.

Nationally:

USDA-Animal and Plant Health Inspection Service (APHIS)
http://www.aphis.usda.gov/services/report_pest_disease/report_pest_disease.shtml

Adult AGM Actual Size:



Where to Get More Information:

UMD Cooperative Extension Exotic Pest Threats Website: <http://www.PestThreats.umd.edu/index.cfm>

APHIS AGM website: http://www.aphis.usda.gov/plant_health/plant_pest_info/gypsy_moth/index.shtml

NAPPO Power Point: <http://www.napponline.org/annualmtg/2007AnnualMtg-Highlights/BDickerson.pdf>

NY CAPS Alert: <http://www.agmkt.state.ny.us/caps/pdf/Asian%20Gypsy%20Moth%20Pest%20Alert.pdf>

Images: <http://www.forestryimages.org/browse/subthumb.cfm?sub=165&Start=1&display=60&sort=2>

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