*Lymantria dispar japonica**

*For regulatory purposes, the two subspecies, *L. d. asiatica* and *L. d. japonica,* and the three revised species in Pogue and Schaefer (2007), *L. albescens*, *L. postalba*, and *L. umbrosa*, are all considered Asian gypsy moths.

Specific information for this species is limited. When information specific to *L. d. japonica* is unavailable, information on Asian gypsy moths (AGM) as a group has been used.

Figure 1. Adult male of *Lymantria dispar japonica* (DAFF Archive, Bugwood.org).

Figure 2. Adult female of *Lymantria dispar japonica* (DAFF Archive, Bugwood.org).

Scientific Name

Lymantria dispar japonica (Motschulsky)

Synonyms:

Liparis dispar var. *japonica* Motschulsky
Porthetria hadina Butler
Porthetria japonica Kirby
Lymantria japonica Swinhoe
Liparis japonica Swinhoe
Lymantria dispar hadina Matsumura
Lymantria dispar obscrura Goldschmidt
Lymantria dispar nesiobia Bryk

Common Name

Japanese gypsy moth (JGM)

Type of Pest

Moth

Taxonomic Position

Class: Insecta, **Order:** Lepidoptera, **Family:** Lymantriidae*

*Recent classifications lower Lymantriidae to the subfamily Lymantriinae under the family Erebidae. See Pogue and Schaefer (2007).

Reason for Inclusion in Manual

PPQ Pest of Concern

Pest Description

Eggs: Egg mass color ranges from light yellow to dark brown (Pogue and Schaefer, 2007).

Larvae: A full description of the larvae can be found in Pogue and Schaefer (2007). Larval length is 35 to 40 mm (approx. 1 $^{3}/_{8}$ to 1 $^{9}/_{16}$ in) (Pogue and Schaefer, 2007).

Pupae: No description available.

Adults: A full description of the adults can be found in Pogue and Schaefer (2007).

Figure 3. Larva of *Lymantria dispar japonica* (Image courtesy of Michael Pogue, USDA-ARS).

Male genitalia: "Lateral processes absent from tegument/ uncus elongate, narrow, apex round; valve undivided, not fused ventrally; dorsal process contiguous with costal margin of valve, straight, apex narrowly rounded; juxta a square plate with dorsal margin concave to slightly convex, ventral margin with broad excavation; sacculus apex broadly rounded; saccus variable, V-shaped to narrow U-shaped; aedoeagus 0.75-0.79x height of genital capsule, straight, slightly curved proximal to opening of ductus ejaculatorius; vesica an ovate, dorsally produced lobe; cornuti absent" (Pogue and Schaefer, 2007).

Female genitalia: "Ovipositor not telescopic; papillae anales quadrate, dorsal margin truncate; anterior and posterior apophyses short; ventral plate of ostium bursae with sclerotized, strap-like processes merging medially to form a triangulate opening ductus bursae longer than in *L. obfuscata* or *L. d. dispar*; corpus bursae ovate" (Pogue and Schaefer, 2007).

Biology and Ecology

The biology and ecology of both the Asian and European forms of *L. dispar* are similar. The primary differences are: (i) Asian female moths fly (>20 km [>12 mi]) while European female gypsy moths are flightless; and (ii) the Asian strain has

slightly different host preferences than the European strain (reviewed in Drooz, 1985; Reineke and Zebitz, 1998; Charlton et al., 1999; reviewed in Wallner, 2000).

This subspecies will oviposit on white birch when present. Females will frequently lay egg masses on telephone poles and buildings. Overwintering occurs in the egg stage (reviewed in Pogue and Schaefer, 2007).

Once hatched, larvae have high dispersal ability and use silk threads to balloon to new areas; larvae do not usually aggregate. Duration of larval development and amount of larval molts can vary depending on food plant type (reviewed in Pogue and Schaefer, 2007).

This subspecies has one generation per year (Pogue and Schaefer, 2007).

Both male and female adults are attracted to lights (reviewed in Pogue and Schaefer, 2007).

Damage

The main damage is caused by larvae defoliating host trees.

Pest Importance

This subspecies is capable of reaching destructive outbreak levels. *L. d. japonica* has caused repeated severe defoliation and loss of persimmon crops (*Diospyros kaki*) in parts of Japan. It has also been known to cause damage to Japanese cedar (*Cryptomeria japonica*) (reviewed in Pogue and Schaefer, 2007).

Known Hosts

This species is polyphagous.

Major hosts

Corylopsis spicata and *Liquidambar formosana* (Chinese sweetgum) (reviewed in Pogue and Schaefer, 2007).

Other hosts

Alnus spp. (alder), *Betula* spp. (birch), *Betula platyphylla* (white birch), *Carpinus* spp. (hornbeam), *Castanea* spp. (chestnut), *Castanopsis* spp., *Celtis* spp. (hackberry), *Cerasis* spp., *Eriobotrya* spp. (loquat), *Corylus* spp. (hazelnut), *Cryptomeria* spp. (Japanese cedar), *Cryptomeria japonica* (Japanese cedar), *Cydonia* spp. (cydonia), *Diospyros* spp. (*Diospyros kaki* (persimmon)), *Fagus* spp. (beech), *Fraxinus* spp. (ash), *Hammamelis* spp., *Larix* spp. (larch), *Larix kaempferi* (Japanese larch), *Malus* spp. (apple), *Morus* spp. (mulberry), *Picea* spp. (spruce), *Pinus* spp. (pine), *Populus* spp. (cottonwood), *Prunus* spp., *Pyrus* spp. (pear), *Quercus* spp. (oak), *Rhododendron* spp. (rhododendron), *Robina* spp. (locust), *Rosa* spp. (rose), *Rubus* spp. (blackberry), *Salix* spp. (willow), *Tilia* spp. (basswood), *Ulmus* spp. (elm), *Wisteria* spp. (*Wisteria floribunda*), *Zelkova*

spp. (*Zelkova serrata* (Japanese zelkova)) (Schaefer et al., 1988; reviewed in Pogue and Schaefer, 2007).

Minor hosts
Alnus hirsuta[1] (reviewed in Pogue and Schaefer, 2007).

Hosts fed experimentally
Prunus yedoensis (Japanese Yoshino cherry), *Quercus acutissima* (sawtooth oak), and *Rosa multiflora* (multiflora rose) (Aratake and Kayamura, 1974).

[1]Considered an unsuitable host (reviewed in Pogue and Schaefer, 2007).

Pathogen or Associated Organisms Vectored

This species is not known to vector any pathogens or other associated organisms. This species can cause dermatitis and other skin conditions due to the poisonous spines on larvae (Kano, 1977).

Known Distribution

Asia: Japan (Pogue and Schaefer, 2007).

This species is found in Honshu, Shikoku, and Kyushu. It is locally established in parts of southern and western Hokkaido (Pogue and Schaefer, 2007).

Pathway

AGM have the potential to spread rapidly due to the females' ability to fly and the extensive host range of the larvae. Larvae can move through wind dispersal by "ballooning." Ballooning is when larvae climb trees or other objects and drop on a silken thread resulting in their becoming wind-borne. Apart from natural spread, AGM are most likely to be moved through human assisted means, specifically through movement of material infested with eggs. AGM females are attracted to light; therefore, eggs are frequently laid near light sources (USDA, 2012).

These behaviors can potentially lead to females being attracted to and laying eggs around dock areas, shipping containers, and vessels (Pogue and Schaefer, 2007). Egg masses can thus move through international trade easily.

The egg stage lasts approximately 9 months (Wallner, 2000) and is very tolerant to temperature and moisture extremes (USDA-FS, 1991). Egg masses can remain viable for extended periods of time. In addition, AGM hatch can be induced when ships from infested areas with cold climates reach our much warmer southern ports, even during winter months (USDA, 2012).

Because of the significance of ships and cargo as a pathway, the United States works in conjunction with other governments (Russia, Japan, China, and South

Korea) to minimize AGM introductions. This is achieved through inspections and certifications of ships entering U.S. ports.

The risk associated with AGM travelling through international trade has also led to the development of a NAPPO Regional Standards for Phytosanitary Measures (RSPM), "Guidelines for Regulating the Movement of Ships and Cargoes Aboard those Ships from Areas Infested with the Asian Gypsy Moth." Human-mediated spread can also occur across land through movement of firewood, timber, rail cars, automobiles, and other inanimate objects (USDA, 2011).

Species identified to the genus level (*Lymantria* sp.) have been intercepted 6 times at U.S. ports of entry. Only one of these instances was known to have originated from a country where AGM is known to occur. Species identified only as *Lymantria dispar* have been intercepted 16 times with 7 interceptions occurring on material originating from countries where AGM is known to occur. Almost all of these interceptions occurred on ships and their miscellaneous cargo (AQAS, 2012; queried January 25, 2012).

Potential Distribution within the United States

This species is polyphagous and will likely find adequate alternative host plants (including ornamentals) in the United States. It may have a similar potential host range as the European gypsy moth (*L. d. dispar*) as their host ranges overlap.

Survey

CAPS-Approved Method*:

The CAPS-approved method is a trap and lure combination. There are two trap options: the paper delta trap with 2 sticky sides or the milk carton trap. The lure is available in either a laminate or string dispenser. The laminate is effective for 84 days (12 weeks) and the string lure is effective for 180 days (6 months). Traps should be checked every two weeks. **It is critical that samples be collected regularly, stored properly, and submitted to the Otis Lab as soon as possible to maintain the integrity of the DNA (see Handling and Submission of Suspect AGM Specimens for Identification below).**

02/03/14: The length of effectiveness for the Gypsy Moth String Lure has been revised from 84 days (12 weeks) to 180 days (6 months). The Gypsy Moth Laminate Lure is still effective for 84 days (12 weeks).

For 2014 surveys, if it is appropriate for your climate/ planned survey season, please use the Gypsy Moth String Lures for the full 180 days. If you ordered the string lures based on the 84 day length of effectiveness and have excess lures, please store the excess lures in unopened packages in a freezer for the next season. The lures may be stored for two years if stored in a freezer below 0°F.

IPHIS Survey Supply Ordering System Product Names:

1) Traps:
    - Milk Carton Trap
    - Paper Delta Trap, 2 sticky sides, Brown
    - Paper Delta Trap, 2 sticky sides, Green
    - Paper Delta Trap, 2 sticky sides, Orange
2) Lures:
    - Gypsy Moth Laminate Lure
    - Gypsy Moth String Lure
3) Pesticide Strip – DDVP (for use in milk carton traps only)

Trap Options

Use the following guidance to determine which trap type to use:

Paper Delta Traps:

Delta traps are used outside of areas that are generally infested with European gypsy moth, where catch is expected to be less than 10 moths per trap. The lure should be stapled inside the trap, to one of the non-sticky panels. The ends of the trap should be folded in. Trap color is up to the State and does not affect trap efficacy.

Milk Carton Traps:

The standard milk carton trap has a much higher capacity and should be used in areas where populations of European gypsy moth are established. The lure is typically stapled to a long garden tie that is, in turn, stapled to the inside of the trap at the top so that the lure hangs more or less in the center of the trap. A killing agent, a DDVP strip, is required for milk cartons traps. The DDVP strip should be stapled to the garden tie below the lure. The DDVP strip is effective for 8 weeks.

Trap Placement:

Traps should be hung in the immediate vicinity of preferred host trees. Milk carton traps should be hung using a string, tied to a branch of a host tree. Delta traps are most effective when attached directly to the bole of a host tree. If no host tree is available, another vertical surface such as a telephone pole can be used to hang the trap. Never hang the traps on branch tips.

Trap Spacing: When trapping for more than one species of moth (that require different lures), separate traps for different moth species by at least 20 meters (65 feet).

Survey Site Selection:

Traps should be placed in the immediate vicinity of preferred host plants.

Time of year to survey:
"Gypsy moths have one generation annually; timing of flight depends on local climate, and can vary from May or June in very warm areas to September in colder climates" (Lance, 2006).

*For the most up-to-date methods for survey and identification, see Approved Methods on the CAPS Resource and Collaboration Site, at http://caps.ceris.purdue.edu/.

Key Diagnostics/Identification

CAPS-Approved Method*:
Molecular. Specimens that are suspected of being AGM should be submitted to the Center for Plant Health Science and Technology (CPHST) Otis Laboratory for testing. **It is critical that samples be collected regularly, stored properly, and submitted to the Otis Lab as soon as possible to maintain the integrity of the DNA. See Handling and Submission of Suspect AGM Specimens for Identification below.**

Keys to first instar larvae and last instar larvae of selected *Lymantria* species can be found in Pogue and Schaefer (2007).

*For the most up-to-date methods for survey and identification, see Approved Methods on the CAPS Resource and Collaboration Site, at http://caps.ceris.purdue.edu/.

Handling and Submission of Suspect AGM Specimens for Identification

Specimens that are suspected of being AGM should be submitted to the Center for Plant Health Science and Technology (CPHST) Otis Laboratory for testing (see Asian Gypsy Moth Trapping Submission Guidelines below). All specimens collected outside of the EGM quarantine areas will be analyzed. Specimens collected within generally-infested areas will be analyzed based on sub-samples of total catch because of the large number of insects which can be caught in some areas. **It is critical that samples be collected regularly, stored properly, and submitted to the Otis Lab as soon as possible to maintain the integrity of the DNA.** If traps cannot be checked regularly, it may be considered to trap when flight is expected rather than spreading resources out across the whole season.

Sample Handling
As a general rule, traps should be checked and samples removed every two weeks in order to reduce the degradation of the specimen's DNA. High temperatures and high humidity speed degradation of specimens and trapping schedules should be adjusted accordingly. If stored unfrozen the specimens should be in containers (paper bags or boxes) which will promote drying. Plastic containers retain moisture that favors the growth of bacteria and fungi, which will

quickly degrade the DNA. Specimens should be stored in a freezer if possible (if not, in a cool dry area) and shipped to the Otis Lab as soon as practical. Specimens should not be stored unfrozen for extended periods.

Sample Submission

Milk Carton Traps

- Layer moths loosely between wadded paper towels or tissue paper in a paper bag (brown lunch bag size) to prevent motion and specimen damage during shipment (one bag per trap; if more than one bag is required per trap, label appropriately). Label paper bag clearly with trap numbers matching paperwork.
- Staple or tape paper bag closed.
- Do not attach paperwork to individual bags.
- Do not use plastic bags or paper envelopes as these do not allow moisture release and thus promote fungal growth and decomposition of the moths.
- Do not send traps or paperwork for traps which contain no specimens.

Delta Traps

- Label each trap clearly with trap numbers matching paperwork.
- Package traps to avoid crushing during shipment.
- Do not attach paperwork to individual traps.
- Do not use Styrofoam peanuts or other small packaging materials that could potentially enter the traps.
- Do not disassemble the traps or remove moths from the trap.
- Do not ship traps with sharp staples exposed.

A PPQ Form 305 should be sent with each trap, stating the trap number, collection site, number of specimens (estimates okay), life stage, collection date, and date of last (previous) trap check (to determine maximum time that the moth may have been in the trap prior to the check). Specimens should be shipped via next day delivery for Tuesday through Friday arrival. They should be shipped to:

Molecular Diagnostics Unit
USDA, APHIS, PPQ
CPHST Otis Laboratory
1398 West Truck Road
Buzzards Bay, MA 02542-1329

For questions you can contact John Molongoski at:
Email: john.j.molongoski@aphis.usda.gov
Phone: 508-563-9303 ext. 218
Fax: 508-564-4398

Asian Gypsy Moth Trapping Submission Guidelines

Specimens trapped in the field can be analyzed for the presence of Asian genetic markers by submitting the specimens to the CPHST Otis Laboratory. All specimens submitted from outside the generally-infested area will be analyzed. Because of the quantity of specimens submitted from within the generally-infested area, only a small fraction can be analyzed. **Collect captured moths a minimum of every two weeks to minimize DNA degradation of the specimens, more frequently in warm climates.**

Store specimens in a cool, dry location (frozen if possible).
Ship ASAP after collection

MILK CARTON TRAPS

DO layer loose moths between wadded paper towels or tissue paper in paper bag (brown lunch bag size) to prevent motion and specimen damage during shipment.

DO label paper bag clearly with trap numbers matching paperwork.

DO staple or tape paper bag closed.

DO NOT attach paperwork to bags.

DO NOT use plastic bags or paper envelopes as these promote fungal growth and do not allow moisture release.

DO NOT send traps or paperwork for traps which contain no specimens.

DELTA TRAPS

DO label each trap clearly with trap numbers matching paperwork.

DO package traps to avoid crushing during shipment.

DO NOT attach paperwork to traps.

DO NOT use Styrofoam peanuts for packaging.

DO NOT disassemble the traps or remove moths from the trap.

SHIPPING

DO send a PPQ Form 305 for each trap sent.
Include: • Trap number • Collection Date
• Collection Site • Life Stage
• No. of specimens (estimates OK)

DO package moths / traps to prevent crushing or motion during shipping. Moths must be received whole with antennae and legs attached to body.

DO ship via next day delivery for Tuesday through Friday arrival.

DO ship ASAP after each collection.

DO keep moths frozen until shipment.

DO keep specimens dry.

DO NOT attach paperwork to traps or bags.

DO NOT use Styrofoam peanuts with delta traps.

DO NOT send traps or paperwork for traps with no specimens.

SHIP TO:
John Molongoski
USDA, APHIS, PPQ
CPHST Otis Laboratory
1398 West Truck Road
Buzzards Bay, MA 02542-1329
- Voice: (508) 563-9303 ext 218
- Fax: (508) 564-4398
- Email: john.j.molongoski@aphis.usda.gov

PPQ Form 305 can be obtained from the Otis Lab via phone or email requests. Please do not hesitate to contact us if you have any questions.

Easily Confused Pests

This species is similar to *L. d. dispar* and *L. d. asiatica* (Pogue and Schaefer, 2007).

"The males of *L. d. japonica* are very similar to *L. d. dispar*, but *L. d. japonica* has a larger forewing length in both the male (25-32 mm [approx. 1 to 1 ¼ in]) and female (34-41 mm [approx. 1 $^{5}/_{16}$ to 1 $^{5}/_{8}$ in]) than in the smaller *L. d. dispar* with forewing length of 14-22 mm [approx. $^{9}/_{16}$ to $^{7}/_{8}$ in] for males and 20-30 mm [approx. $^{13}/_{16}$ to 1 $^{3}/_{16}$ in] for females. Genitalia among the males of the three subspecies are virtually identical, as are those of the females. The female wings of *L. d. japonica* have a distinct brown cast, whereas they are distinctly white in *L. d. dispar* and *L. d. asiatica*. The black form in late stage larvae can be found, but it is very limited in its percentage of the total population (Schaefer and Furuta, 1979(81))" (Pogue and Schaefer, 2007).

Commonly Encountered Non-targets

The trap and lure for *L. dispar japonica* can also trap *Lymantria monacha* (although there is a more optimal trap and lure for this species). It may also trap *L. obfuscata* (Indian gypsy moth), *L. concolor* (concolorous tussock moth), and *L. mathura* (rosy moth) (Lance, 2006).

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This datasheet was developed by USDA-APHIS-PPQ-CPHST staff. This pest is included as a target in the Asian Defoliator Survey. Additional information can be found in the **Asian Defoliator Pathway-based National Survey Guidelines**. Cite this document as:

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Revised February 4, 2014: Revised the length of effectiveness of the Gypsy Moth String Lure.