Lymantria xylina

Scientific Name
Lymantria xylina Swinhoe, 1903

Synonyms:
Lymantria xylina xylina Inoue
Lymantria nobunaga Nagano
Lymantria xylina nobunaga Inoue
Lymantria nigricosta Matsumura
Lymantria horishanella Matsumura
Lymantria sakaguchii Matsumura*

*It is unclear whether this is an actual synonym of this species.

Common Name
Casuarina tussock moth, xylina tussock moth

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
Suggestion from CAPS Community

Pest Description
Eggs: Eggs are laid in a mass and covered by light-brown abdominal hairs from the female. Egg masses are usually found on small twigs or branches and can resemble moth cocoons (Hwang et al., 2007; Pogue and Schaefer, 2007).

Larvae: A full description of the larvae can be found in Pogue and Schaefer (2007). The length of the larva ranges from 45 to 47 mm (approx. 1 $^{3}/_{4}$ to 1 $^{7}/_{8}$ in). The head is cream speckled with brown running laterally. The abdomen can be either ground cream color with no markings or “covered with irregularly shaped brown spots giving a mottled appearance” (Pogue and Schaefer, 2007).

Pupae: No description available.

Adults: A full description of the adults can be found in Pogue and Schaefer (2007). This species is a fairly large moth (Hwang et al., 2007).

Female genitalia: “Ovipositor not telescopic; papillae anales quadrate, dorsal margin truncate; anterior and posterior apophyses short; ventral plate of ostium bursae round with apices merging creating a dorsal groove; ductus bursae very short, shorter than ventral plate of ostium bursae; corpus bursae oblong” (Pogue and Schaefer, 2007).

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 heavily sclerotized and straight to slightly convex, ventral margin with broad excavation; sacculus apex broadly rounded; saccus U-shaped; aedoeagus 0.70 – 0.71x height of genital capsule, slightly bent at middle; vesica an ovate, ventrally produced lobe; cornuti absent” (Pogue and Schaefer, 2007).

Biology and Ecology

This species has one generation per year in Fujian, Okinawa, and Taiwan (Sun and Shan, 1989; reviewed in Pogue and Schaefer, 2007). Gravid females are capable of flight, flying in the evening. After mating, females lay eggs on small twigs or branches, not on trunks like many other *Lymantria* species (reviewed in Pogue and Schaefer, 2007). Females only lay one egg mass (Sun and Shan, 1989). Egg masses are usually laid about 2 to 4 m (approx. 6 $^{1}/_{2}$ to 13 ft) aboveground (Li et al., 1981). Egg masses average about 593 eggs each with a range between 180 to 1,544 eggs (reviewed in Pogue and Schaefer, 2007).

Eggs are laid during June and July. Larvae undergo diapause in the eggs and hatch the following year during March or April (Li et al., 1981; Hwang et al., 2007; reviewed in Pogue and Schaefer, 2007). In China, eggs hatch during May (Sun and Shan, 1989).

Newly hatched larvae usually aggregate and then disperse by ballooning on spun silk in the wind to find a sheltered feeding site (Sun and Shan, 1989; reviewed in Pogue and Schaefer, 2007; reviewed in Hwang et al., 2007). The later instars eat more host material (Sun and Shan, 1989). There are usually five to six instars with the larval stage lasting 1.5 to 2 months (Hwang et al., 2007). Li et al. (1981) reported seven instars with larval development lasting 45 to 64 days. In China, the larval stage can be found from mid-March to mid-June (Sun and Shan, 1989).

The pupal stage lasts about two weeks (Hwang et al., 2007). Li et al. (1998) state that pupae can be found on branches and trunks of coast oak in mid-May, becoming most abundant in late May.

In Japan, adults begin appearing in late May and are most abundant in early June (Li et al., 1998). In China, adults are found from late May to late June (Sun and Shan, 1989). Adult males emerge several days before the females. Females attract males using a pheromone, and after mating, females deposit their eggs on or near host plants (Hwang et al., 2007).

Damage

There is limited information available on damage caused by *L. xylina*. In general, the main damage by *Lymantria* species is caused by larvae defoliating host trees. Outbreak populations can completely defoliate host trees. If defoliation is repeated, trees can become weakened and susceptible to disease. Tree mortality may also occur with repeated defoliations.

Pest Importance

This species is considered a pest on *Casuarina equisetifolia* and *C. cunninghamiana* in windbreak plantations in Taiwan and China (reviewed in Pogue and Schaefer, 2007). It is considered the most destructive pest of casuarina plantations in Taiwan. Nai et al. (2010) state that outbreaks of this species occur every five to ten years in Taiwan on casuarina.

Two major outbreaks have been recorded in Japan: one in 1906 on *Acacia confusa* and *Casuarina* spp. and another in 1913 on casuarinas. Recent outbreaks have been recorded on casuarinas, specifically *C. equiselifolia*. *Casuarina equisetifolia* plantations serve as windbreaks on the western coastal areas of Taiwan and Peng-hu Island. Defoliation has been so severe that functionality of the windbreaks has been compromised (Chang, 1991).

In the United States *Casuarina* spp. are found primarily in Arizona, California, Florida, and Hawaii (Snyder, 1992). According to Rockwood et al. (n.d.) "[*Casuarina*] species have been widely used for shelterbelts and in landscaping as hedges and ornamentals; *C. glauca* has been frequently planted for soil stabilization near drainage ditches and lakeshores". Snyder (1992) states that although used for reclaiming eroded areas, many land managers condemn its use as it can threaten indigenous plants and animals due to its extremely fast and dense growth. This genus is listed as a noxious weed by Florida (USDA-NRCS, 2013). Although outbreaks have only been found in casuarina plantations, this species could be a potentially serious threat to other hardwoods and fruit trees (Shen et al., 2006).

Hwang et al. (2007) states that this species has recently begun infesting fruit trees in the lowland areas of Japan as well as hardwoods in urban centers. *Lymantria xylina* is becoming a major defoliator of hardwood and fruit trees in Taiwan (Shen et al., 2006). This species has been reported causing severe damage on: *Mallotus japonicus* (food wrapper plant), *Machilus thunbergii* (hong nan), *Ricinus communis* (castor bean), and *Syzygium samarangense* (syzygium) (reviewed in Pogue and Schaefer, 2007). *Lymantria xylina* has been recorded damaging fruit trees in orchards (Chao et al., 1996).

Severe outbreaks have occurred in Japan on Kume Island (in 1975-1976) and Okino Erabu Island (in 1989) and were recorded under the synonym *L. sakaguchi* (reviewed in Pogue and Schaefer, 2007).*

Work has been carried out on this species to determine if there are any effective biological control agents. Larvae of this species are highly susceptible to the fungus *Beauveria bassiana* (Chang, 1991; Tsay et al., 2001). Chemical application is also used to help control populations when the density is high. The combination of *Beauveria bassiana* and insecticides is even more effective at controlling the populations than just using pesticides (Chang, 1991).

*According to Pogue and Schaefer (2007), it is unclear whether this is an actual synonym of this species.

Known Hosts

This species is polyphagous, feeding mainly on hardwoods. "In Taiwan, *L. xylina* is recorded as feeding on 63 tree species belonging to 29 families (nearly $^{1}/_{4}$ of the species belong to the families Euphorbiaceae and the Fagaceae)." Important host families include Ebenaceae, Ericaceae, Lauraceae, Leguminosae, Moraceae, Myrtaceae, Rosaceae, Sapindaceae, Theaceae, and Ulmaceae (Pogue and Schaefer, 2007).

Acer serrulatum, *Acacia* sp. (acacia), *Acacia confusa* (small Philippine acacia), *Aleurites fordii* (tungoil tree), *Averrhoa carambola* (carambola), *Bauhinia variegata* (mountain ebony), *Bischofia javanica* (Javanese bishopwood), *Callicarpa formosana* (beautyberry), *Camellia* sp. (camellia), *Camellia oleifera* (tea oil plant), *Camellia sinensis* (=*Thea sinensis*) (tea), *Carpinus kawakamii*, *Castanea mollissima* (Chinese chestnut), *Castanopsis carlesii* var. *sessilis*, *Casuarina* spp. (sheoak), *C. cunninghamiana* (river sheoak), *C. equisetifolia* (beach sheoak), *Celtis sinensis* (Chinese hackberry), *Cinnamomum camphora* (camphortree), *Cyclobalanopsis longinux*, *Dimocarpus longan* (longan), *Diospyros discolor* (mabolo), *Diospyros eriantha*, *Diospyros kaki* (Japanese persimmon), *Distylium racemosum*, *Ehretia resinosa*, *Ehretia thyrsiflora*, *Elaeocarpus japonicus*, *Elaeocarpus serratus* (Ceylon olive), *Elaeocarpus sylvestris*, *Eriobotrya japonica* (loquat), *Eucalyptus globulus* (Tasmanian bluegum), *Ficus carica* (edible fig), *Ficus microcarpa* (Chinese banyan), *Glochidion zeylanicum*, *Hibiscus tiliaceus* (sea hibiscus), *Lagerstroemia subcostata*, *Limlia uraiana*, *Liquidambar formosana* (Formosan sweet-gum), *Litchi chinensis* (lychee), *Lithocarpus brevicaudatus* (=*Pasania brevicauda*), *Lithocarpus hancei* (=*Pasania ternaticupula*), *Macaranga tanarius* (parasol leaf tree), *Machilus japonica* (=*Persea japonica*), *Machilus thunbergii* (=*Persea thunbergii*) (hong nan)*, *Mallotus japonicus* (food wrapper plant)*, *Mallotus paniculatus*, *Mallotus repandus*, *Mangifera indica* (mango), *Melaleuca leucadendra* (punktree), *Paulownia fortunei*, *Piper kadsura*, *Pisidium guajava* (guava), *Pithecellobium dulce* (monkeypod), *Platanus oreintalis* (oriental plane tree), *Pyrus pyrifolia* (Chinese pear), *Quercus acutissima* (sawtooth oak), *Quercus glauca* (=*Cyclobalanopsis glauca*) (ring-cup oak), *Quercus salicina* (=*Cyclobalanopsis stenophylla*) (Japanese willowleaf oak), *Quercus variabilis* (Chinese cork oak), *Rhododendron* sp. (rhododendron), *Ricinus communis* (castor bean)*, *Salix* sp. (willow), *Salix babylonica* (weeping willow), *Salix warburgii* (water willow), *Schefflera heptaphylla* (=*S. octophylla*), *Scolopia oldhamii*, *Syzygium samarangense* (syzygium)*, *Terminalia catappa* (tropical almond), *Trema orientalis* (oriental trema), *Vaccinium bracteatum* (sea bilberry) (Sun and Shan, 1989;

Chao et al., 1996; Chang, 1991; Hwang et al., 2007; reviewed in Pogue and Schaefer, 2007; CABI, 2008).

In the scientific literature for this species, most plants identified as hosts refer to plants used for food or shelter and do not consider their role on larval development (Hwang et al., 2007). Hwang et al. (2007) found that the most suitable host plants were *Averrhoa carambola*, *Dimocarpus longan*, *Liquidambar formosana*, *Litchi chinensis*, and *Terminalia catappa*. Hwang et al. (2007) also found that the range of host plants used by larvae increased with larval age.

*These trees were observed to be severely defoliated by this species (Chao et al., 1996).

Pathogen or Associated Organisms Vectored

This species is not known to vector any human or animal pathogens. Defoliation caused by the larvae can lead to weakening of host trees making them more vulnerable to diseases.

Known Distribution

Asia: China, India, Japan, and Taiwan (reviewed in Chao et al., 1996; Pogue and Schaefer, 2007; reviewed in Nai et al., 2010).

Pathway

Females are attracted to lights and can be drawn towards port areas. Females may lay eggs on shipping containers or vessels. If vessels contaminated with egg masses arrive in suitable climates and egg hatch occurs after diapause, *L. xylina* may establish in new areas (Pogue and Schaefer, 2007).

Potential Distribution within the United States

Pogue and Schaefer (2007) state that this species has the potential to become a serious invasive species in semitropical locations in the United States including: Hawaii, southern California, and Florida.

Survey

CAPS-Approved Method*:

The CAPS-approved method is a trap and lure combination. The trap is a paper delta trap with two sticky sides. The lure is available as a string dispenser. The string lure is effective for 28 days (4 weeks).

Any of the following Trap Product Names in the IPHIS Survey Supply Ordering System may be used for this target:

Paper Delta Trap, 2 sticky sides, Brown
Paper Delta Trap, 2 sticky sides, Green
Paper Delta Trap, 2 sticky sides, Orange

The Lure Product Name is *Lymantria xylina* Lure.

Method Notes: Trap should be used with ends open. Trap color is up to the State and does not affect trap efficacy.

Do not place lures for two or more target species in a trap unless otherwise recommended.

Trap Placement:
Traps should be hung in the immediate vicinity of preferred host trees. 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:
This species is univoltine in its native range. Adults begin appearing during late May and are most abundant during early June in Japan (Li et al., 1998). In China, adults are found from late May to late June (Sun and Shan, 1989).

*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/.

Literature-Based Methods:
Trapping: The Taiwan populations are attracted to the pheromone *cis*-7,8-epoxy-2-methyleicosane (named xylinalure for the moth) and are not enantiomer specific. This means that the population is attracted to both (+)-xylinalure and (-)-xylinalure (Gries et al., 1999). However, the Okinawa population only responds to (+)-xylinalure and not (-)-xylinalure (Pogue and Schaefer, 2007).

When trapping for *L. xylina*, Gries et al. (1999) used sticky 2-liter delta milk carton traps suspended from trees about 2 m (approx. 6 $^{1}/_{2}$ ft) above the ground. This species has also been trapped using milk carton traps with (+)-disparlure (Chao et al., 1996; reviewed in Gries et al., 1999).

Not recommended: Females are attracted to and fly towards lights; however, this survey method is not species specific (Pogue and Schaefer, 2007).

Key Diagnostics/Identification

CAPS-Approved Method*:
Morphological.

When sorting non-target Lymantriidae from trap collections, use Ferguson (1978).

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Literature-Based Methods:
Work has been done on developing DNA barcodes as a highly accurate method of identifying lymantriid species (including *L. xylina*). This would allow identifications of life stages not easily identified by morphology, like the egg and larval stage (Ball and Armstong, 2006).

Easily Confused Pests

"*Lymantria xylina* resembles *L. apicebrunea*, but *L. xylina* lacks the brown forewing outer margin that is present in *L. apicebrunnea*. Also, and unlike *L. apicebrunnea*, *L. xylina* is pink on the legs and has a pink neck and underside. The labial palpus is larger and black in *L. xylina* and smaller and white in *L. apicebrunnea*. In *L. xylina* the saccus in the male genitalia is wider and stouter than that in *L. apicebrunnea*" (Pogue and Schaefer, 2007).

References

Ball, S. L. and K. F. Armstrong. 2006. DNA barcodes for insect pest identification: a test case with tussock moths (Lepidoptera: Lymantriidae). Canadian Journal of Forest Research 36: 337-350.

CABI. 2008. *Lymantria xylina*. Crop Protection Compendium. Accessed January 30, 2013 from: www.cabi.org/cpc.

Chang, Y. –C. 1991. Integrated pest management of several forest defoliators in Taiwan. Forest Ecology and Management 39: 65-72.

Chao, J. –T., P. W. Schaefer, Y. –B. Fan, and S. –S. Lu. 1996. Host plants and infestation of casuarina moth *Lymantria xylina* (Lepidoptera: Lymantriidae) in Taiwan. Taiwan Journal of Forest Science 11(1): 23-28.

Ferguson, D. C. 1978. Noctuoidea (in part): Lymantriidae. Fasc. 22.2. In R. B. Dominick et al. The Moths of America North of Mexico.

Gries, G., P. W. Schaefer, G. Khaskin, R. Hahn, R. Gries, and J. –T. Chao. 1999. Sex pheromone components of casuarina moth, *Lymantria xylina*. Journal of Chemical Ecology 25(11): 2535-2545.

Hwang, S. –Y., F. –C. Hwang, and T. –C., Shen. 2007. Shifts in developmental diet breadth of *Lymantria xylina* (Lepidoptera: Lymantriidae). Journal of Economic Entomology 100(4): 1166-1172.

Li, Y. –G., S. –L. Chen, Q. –M. Xie, Q. –J. Cai, J. Wu, Y. –W. Li, X. –Q. Zheng, Z. –W. Zhu, B. –T. Zhou, and H. –Q. Zheng. 1981. Studies on the Lymantriid moth *Lymantria xylina* Swinhoe (abstract). Acta Entomologica Sinica 24(2): 174-183.

Nai, Y. –S., C. –Y. Wu, T. –C. Wang, Y. –R. Chen, W. –H. Lau, C. –F. Lo, M. –F. Tsai, C. –H. Wang. 2010. Genomic sequencing and analyses of *Lymantria xylina* multiple nucleopolyhedrovirus. BMC Genomics 11:116.

Pogue, M. G. and P. W. Schaefer. 2007. A review of selected species of *Lymantria* Hübner [1819] including three new species (Lepidoptera: Noctuidae: Lymantriinae) from subtropical and temperate regions of Asia, some potentially invasive to North America. Forest Health Technology Enterprise Team Technology Transfer. FHTET-2006-07.

Rockwood, D. L., R. F. Fisher, L. F. Conde, and J. B. Huffman. No date. *Casuarina* L. ex Adans. Accessed August 15, 2013 from: http://www.na.fs.fed.us/pubs/silvics_manual/volume_2/casuarina/casaurina.htm.

Shen, T. –C., C. –M. Tseng, L. –C. Guan, and S. –Y. Hwang. 2006. Performance of *Lymantria xylina* (Lepidoptera: Lymantriidae) on artificial and host plant diets. Journal of Economic Entomology 99(3): 714-721.

Snyder, S. A. 1992. *Casuarina* spp. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Accessed August 15, 2013 from: http://www.fs.fed.us/database/feis/.

Sun, X. and W. S. Shan. 1989. Lymantriid forest pests in China. *In* Proceedings, Lymantriidae: a comparison of features of New and Old World tussock moths; June 26 – July 1, 1988; New Haven, CT. Gen. Tech. Rep. NE-123. Broomall, PA: United States Department of Agriculture, Forest Service, Northeastern Forest Experiment Station.

Tsay, J. –G., M. –J. Lee, and R. –S. Chen. 2001. Evaluation of *Beauveria bassiana* for controlling casuarina tussock moth (*Lymantria xylina* Swinhoe) in casuarina plantations. Taiwan J. For. Sci. 16(4): 201-207.

USDA-NRCS. 2013. The PLANTS Database. National Plant Data Team, Greensboro, NC. Accessed August 15, 2013 from: http://plants.usda.gov.

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: Added the lure dispenser type and the length of effectiveness.