# Screening Aid

# Processionary Moths
*Thaumetopoea* spp.

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The genus *Thaumetopoea* contains approximately 15 species that are distributed across Europe, northern Africa, and the Middle East. *Thaumetopoea* are currently in the Notodontidae (Thaumetopoeinae), but were sometimes placed their own family (Thaumetopoeidae) in older literature. Moths in this genus are often referred to as “processionary moths” because their larvae (Figs. 1, 3) are gregarious and will form long lines or “processions” when moving to feed.

*Thaumetopoea* caterpillars are considered a serious health hazard because they are covered in long urticating setae (hairs) that contain a toxin (thaumetopoein). Severe skin dermatitis and allergic reactions in both people and animals can result from direct contact with larvae, larval nests, or larval setae that have been blown by the wind. In addition to creating health problems, heavy infestations of larvae can defoliate entire trees, although they are rarely responsible for tree mortality.

Two species of *Thaumetopoea* are of primary concern in western Europe. *Thaumetopoea processionea*, oak processionary moth (OPM), feeds primarily on oaks (*Quercus*), but has also been recorded on beech, birch, chestnut, walnut, and pine during times of heavy infestation. *Thaumetopoea pityocampa*, pine processionary moth (PPM), feeds on various species of Pinaceae (primarily *Pinus*). When planted overseas, Pinus radiata is heavily attacked, thus surveys in the U.S. should focus on this host in warm climates. A third species, *T. pinivora*, the eastern pine processionary (EPP), occurs in eastern Europe and also feeds on Pinaceae. Adults of the pine-feeding species (PPM, EPP) are present May-September, while those of the oak-feeding species (OPM) are present August-September.

This aid is designed to assist in the sorting and screening of processionary moth suspect adults collected from CAPS pheromone traps in the continental United States. Because many *Thaumetopoea* adults have similar wing patterns, three species are included in this single aid, which covers basic sorting of traps along with first and second level screening, all based on morphological characters. Basic knowledge of Lepidoptera morphology is necessary to screen for processionary moth suspects.

Fig. 1: *T. pityocampa* larvae (Photo by John H. Ghent, USDA Forest Service).

Fig. 2: *T. processionea* adults (Photo by Orchi, Germany).

Fig. 3: *T. processionea* larva (Photo by R. Altenkamp, Berlin, Germany).

**CAPS Approved Trapping Method:** Wing pheromone trap

*Thaumetopoea* pheromone traps should be sorted initially for the presence of moths of the appropriate size, color, and shape. Traps that contain moths meeting all of the following requirements should be moved to Level 1 Screening (Page 3):

1) Resting moths are approximately 10-17 mm (0.4-0.7 inches) long; this is also the average forewing length (Fig. 3).

2) Moths have an overall shape that is similar to the outline depicted in Fig. 3. Most notodontids will rest with their wings folded above their body in this manner (Fig. 5-6).

3) Moth forewings are gray to brown with dark markings - see the comparison of forewing colors in Fig. 4 and Figs. 5-7. The body is “fuzzy” or “hairy.”

4) Moth antennae are feathery (pectinate or plumose) to the apex (Figs. 3-5) and not filiform or threadlike.

Note that the appearance of moths caught in sticky traps can vary substantially depending on the amount of sticky glue on the moth (most individuals usually appear darker when covered in glue). For this reason, any small to medium-sized moth meeting the above criteria should be sent forward to Level 1 Screening.


Fig. 3: Outline and size of a resting *Thaumetopoea* male.

Fig. 4: Spread *Thaumetopoea processionea* male with typical wing pattern.

Fig. 5: *Thaumetopoea pityocampa* typical resting posture (Photo by Entomart).

Fig. 6: *Thaumetopoea processionea* typical resting posture (Photo by Gyorgy Csoka, Hungary Forest Research Institute, Bugwood.org).

# Level 1 Screening



Moths that meet the sorting requirements should be screened for suspect *Thaumetopoea*. Level 1 Screening is based on wing shape, coloration, and markings. Level 1 Screening is not difficult unless specimens are worn; in these cases screening may need to be performed by a trained Lepidopterist.

*Thaumetopoea* males have triangular forewings that range in length from 10-17 mm. Different species may have slightly different wing coloration and pattern (Fig. 7), but all species have gray or brownish gray forewings with the same basic markings shown in Fig. 8. Hindwings in all species are light gray to white, and most have a dark patch at the anal angle that may extend towards the costa in some individuals. Suspect processionary moths have a combination of the following characters:

**1) Forewings gray or brownish gray**
**2) Three dark lines on the forewings running from costa to dorsum**
**3) A dark spot in the middle of the forewing towards the costa**
**4) Hindwings light gray to white**
**5) A dark patch at the anal angle of the hindwing**

Fig. 7: *Thaumetopoea* adults; top row: *T. processionea*; middle row: *T. pityocampa*; bottom row: *T. pinivora*. All images are ACTUAL SIZE.

Fig. 8: Primary wing markings for *Thaumetopoea* males. Forewing markings consist of three dark lines running from the costal margin to the dorsal margin and a conspicuous dark spot in the middle of the wing towards the costa. The lighter hindwings are marked with a dark patch at the anal angle.

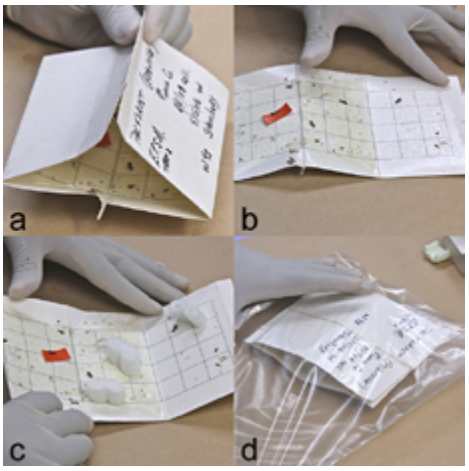


Fig. 9: Recommended packing method for shipment of sticky traps: a & b) open and unfold trap; c) place 2-3 packing peanuts in areas of trap with no moths; d) fold trap, secure with rubber band, and place in plastic bag (Photos by E. LaGasa, WSDA).

Moths meeting the above criteria should be moved to Level 2 Screening (Page 4). If this means forwarding suspects to another facility, follow the steps outlined in Fig. 9. Traps should be folded, with glue on the inside, making sure the two halves are not touching, secured loosely with a rubber band or a few small pieces of tape. Plastic bags can be used unless the traps have been in the field a long time or contain large numbers of possibly rotten insects. Insert 2-3 styrofoam packing peanuts on trap surfaces without moths to cushion and prevent the two sticky surfaces from sticking during shipment to taxonomists. DO NOT simply fold traps flat or cover traps with transparent plastic wrap (or other material), as this will guarantee specimens will be seriously damaged or pulled apart – making identification difficult or impossible.

Suspect *Thaumetopoea* should be cleaned before proceeding to Level 2 Screening. Instructions on cleaning specimens caught in sticky traps are found here: http://idtools.org/id/leps/tortai/dissections.html. Cleaned specimens should be pinned and labeled. Level 2 Screening is based on the presence of a sclerotized projection on the head and other wing pattern characters.

**A sclerotized head projection is found on all of the *Thaumetopoea* treated here.** Scales may need to be carefully removed from the head with a brush or forceps in order to view any head projections. The projection is located between the antennae, slightly above the compound eyes. In *T. processionea*, the head projection is a rounded dome and difficult to see without removing many of the head scales (Fig. 10). In *T. pityocampa*, the head projection is long, flat, and slightly bifid at the end (Fig. 11); this projection can often be seen on specimens without removing scales and appears from a distance as a dark bristle sticking out of the head. The projection in *T. pinivora* extends forwards, but it is not as pronounced as in *T. pityocampa*; head scales will likely need removed to see this structure (see Gomboc and Germain 2004). The proboscis is vestigial.

Fig. 10: *Thaumetopoea processionea* head; arrow denotes rounded sclerotized projection.

Fig. 11: *Thaumetopoea pityocampa* head; arrow denotes long flat sclerotized projection.

Species-specific wing pattern characters for all of the *Thaumetopoea* treated here are shown in Figs. 12-14. These characters are modifications of the generic markings shown in Fig. 8 and should be used with caution as they likely do not apply to all individuals within each species; see Groenen (2010) for a detailed discussion of the wing variation found in *T. processionea*.

Suspect *Thaumetopoea* specimens (notodontids with a sclerotized head projection and wing coloration/pattern similar to Figs. 12-14) should be sent forward for identification. Specimens must be properly labeled and carefully packed to avoid damage during shipping.

Fig. 12: *Thaumetopoea processionea* male with species-specific characters marked (dark shading towards the apex of the forewing and a dark line extending from the anal angle across the hindwing; from Leraut 2006).

Fig. 13: *Thaumetopoea pityocampa* male with species-specific characters marked (brown discal spot and white fringe on majority of hindwing; from Leraut 2006).

Fig. 14: *Thaumetopoea pinivora* male with species-specific characters marked (lack of shading along costa at base of wing and dark fringe on hindwing; from Leraut 2006).


Fig. 8: *Lochmaeus bilineata*.


Fig. 9: *Lochmaeus bilineata*.


Fig. 10: *Heterocampa biundata*.


Fig. 11: *Heterocampa guttivitta*.


Fig. 12: *Schizura ipomoeae*.


Fig. 13: *Ianassa lignicolor*.


Fig. 14: *Heterocampa lunata*.


Fig. 15: *Heterocampa lunata*.


Fig. 16: *Misogada unicolor*.


Fig. 17: *Misogada unicolor*.


Fig. 18: *Ceolodasys unicornis*.

It is expected that other notodontids will be attracted to *Thaumetopoea* pheromone traps. **A sampling of potential non-target notodontids is shown here, but none of these species are known to be attracted to *Thaumetopoea* pheromone traps.** Non-targets encountered during CAPS surveys will vary by region.

**Key to Sort and Screen *Thaumetopoea* Suspects in the United States**

1. Moths approximately 10-17 mm long; overall shape is typical for a notodontid (Fig. 3); antennae feathery to the apex; proboscis vestigial; body hairy; and forewings gray or brown..... 2
1'. Moths larger or smaller than 10-17 mm long; overall shape not typically notodontid; antennae threadlike; proboscis well-developed; body not hairy; or forewings are not gray or brown .....Not *Thaumetopoea*

2. Forewings gray to brownish gray with three dark lines and a dark spot; and hindwings light gray to white with a dark patch at the anal angle (Fig. 8) ..... 3
2'. Forewings not gray to brownish gray or without three dark lines and a dark spot; or hindwings not gray to white or without a dark patch at the anal angle .....Not *Thaumetopoea*

3. Head with a sclerotized projection (Figs. 10-11)..... ***Thaumetopoea suspect***
3'. Head without a sclerotized projection .....Not *Thaumetopoea*

**Citation**

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**References for more information on *Thaumetopoea* and non-targets**

Battisti, A. 1997. The pine processionary caterpillar, *Thaumetopoea pityocampa*. In Fosbroke, S. L. and K. W. Gottschalk. U.S. Department of Agriculture Interagency Gypsy Moth Research Forum 1997: 16-17.

Gomboc, S. and J-F. Germain. 2004. Diagnostic protocols for regulated pests. *Thaumetopoea pityocampa*. EPPO Bulletin 34: 295-297.

Groenen, F. 2010. Variation of *Thaumeotpoea processionea* (Notodontidae: Thaumetopoeinae) in Europe and the Middle East. Entomologische Berichten 70: 77-82.

Lamy, M., M. H. Pastureaud, F. Novak, G. Ducombs, P. Vincendeau, J. Maleville and L. Texier. 1986 Thaumetopoein: an urticating protein from the hairs and integument of the pine processionary caterpillar (*Thaumetopoea pityocampa* Schiff., Lepidoptera, Thaumetopoeidae). Toxicon 24: 347-56.

Leraut, P. 2006. Moth of Europe, Volume 1: Saturnids, lasiocampids, hawkmoths, tiger moths. N.A.P. Editions, France. 387 pp.

Moth Photographers Group. Mississippi State U. (http://mothphotographersgroup.msstate.edu/Plates.shtml)

Powell, J. A. and P. A. Opler. 2009. Moths of western North America. University of California Press, Berkeley. 369 pp.

Simonato, M., A. Battisti, C. Kerdelhue, C. Burban, C. Lopez-Vaamonde, et al. 2013. Host and phenology shifts in the evolution of the social moth genus *Thaumetopoea*. PLoS ONE 8(2): e57192. doi:10.1371/journal.pone.0057192.

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