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Dendrolimus is a genus of lappet moths whose larvae are defoliators of coniferous trees in Europe and Asia. The genus contains approximately 30 species (depending on species/subspecies rankings), none of which are present in North America. Four species are covered here: *D. sibiricus*, *D. superans*, *D. pini*, and *D. punctatus*.

Dendrolimus sibiricus, the Siberian silk moth, and *D. superans*, the white-lined silk moth, were once treated as a single species (*D. superans sibiricus* and *D. superans albolineatus*), but recent molecular studies have demonstrated that they are distinct species. *Dendrolimus sibiricus* occurs over much of Russia and extends into Mongolia, China, and Korea; *D. superans* occurs from Japan north to Sakhalin and the Kurile Islands (Russia). Both species feed on a variety of coniferous trees (*Abies*, *Larix*, *Picea*, *Pinus*, *Tsuga*, etc.), causing significant defoliation and potentially the death of entire forests if trees are defoliated over several successive years. Outbreaks of *D. sibiricus* are cyclical and occur every 10-11 years, often following several years of drought. The full life cycle can take multiple years in northern locations (see EPPO 2005 for details). Adults are present June-August.

Dendrolimus pini, the pine tree lappet, is widespread across Europe, Central Asia, and Northern Africa. This species has a life cycle similar to that of *D. sibiricus*, with cyclical population outbreaks capable of defoliating entire forests. Larvae feed on many species of Pinaceae (*Abies*, *Cedrus*, *Juniperus*, *Larix*, *Picea*, *Pinus*, *Pseudotsuga*, etc.), although the preferred host is *Pinus sylvestris*. Adults are present June-August.

Dendrolimus punctatus, the Masson pine moth, occurs in China, Japan, Taiwan, and Vietnam. It is one of the most important forest pests in Southeast Asia, and defoliation of pine plantations during larval outbreaks causes significant economic loss. The primary host is *Pinus massoniana*, but larvae have been recorded feeding on a wide variety of other *Pinus*. Up to five overlapping generations per year are possible, with fewer generations in northern regions.

This aid is designed to assist in the sorting and screening of pine lappet suspect adults collected from CAPS pheromone traps in the continental United States. Because the *Dendrolimus* covered here are very similar, all are included in this single aid, which covers basic sorting of traps along with first level screening, all based on morphological characters. Basic knowledge of Lepidoptera morphology is necessary to screen for pine lappet suspects.

Dendrolimus sibiricus and *D. pini* are attracted to the same pheromone and the CAPS approved trapping method for these species is a modified gypsy moth milk carton pheromone trap (contact OTIS lab for details). *Dendrolimus punctatus* is attracted to a separate pheromone and should be surveyed for using a wing pheromone trap (Pherocon 1c). Although *D. superans* and *D. sibiricus* were once considered the same species, the pheromone for *D. superans* is currently not known. It is possible that *D. superans* will be attracted to *D. sibiricus*/*D. pini* pheromone traps, but this has not been tested.

Dendrolimus 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 35-50 mm (1.3-2.2 inches) long (Fig. 1).
- 2) Moths have an overall shape that is similar to the outline depicted in Fig. 1. Most lasiocampids will rest with their wings folded above their body in this manner (Figs. 2-3).
- 3) Moth forewings are gray to brown with variable markings - see the comparison of forewing colors in Figs. 2-3, 5, and 8-9.
- 4) Moth antennae are feathery (pectinate or plumose) (Figs. 2, 5) to the apex, although the branches are sometimes small – the antennae and not filiform or threadlike.

Note that the appearance of moths caught in sticky traps (*D. punctatus* survey) can vary substantially depending on the amount of sticky glue on the moth (most individuals usually appear darker when covered in glue). Any medium to large-sized moth meeting the above criteria should be sent forward to Level 1 Screening.

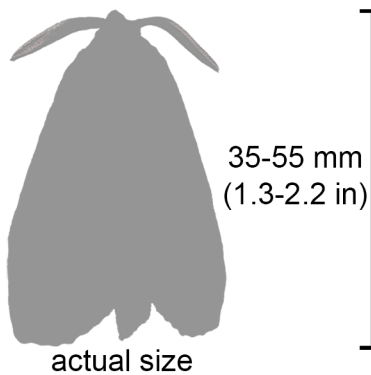


Fig. 1: Outline and size of a resting *Dendrolimus* male.



Fig. 2: Resting *Dendrolimus pini* male (Photo by Stanislaw Kinelski, Bugwood.org).



Fig. 3: Resting *Dendrolimus pini* male (Photo by Hannes Lemme, Bugwood.org).



Fig. 4: *Dendrolimus sibiricus* larva (Photo by John H. Ghent, USDA Forest Service, Bugwood.org).



Fig. 5: *Dendrolimus sibiricus* male (Photo by Natalia Kirichenko, Bugwood.org).

Moths that meet the sorting requirements should be screened for suspect *Dendrolimus*. Level 1 Screening is based on size, coloration, and wing markings. Because several similar non-targets are only present in the western U.S., screening difficulty is dependent upon location: easy in the East, relatively difficult in the West.

Screening for *Dendrolimus* in the eastern United States

Dendrolimus males are large relative to common non-targets in the East, specifically *Malacosoma*. *Malacosoma disstria* (Figs. 10j-k) utilizes the same (or similar) pheromone and is likely to be attracted to *Dendrolimus* traps. Other species of *Malacosoma*, such as *M. americanum* (Fig. 10n) and *M. californicum* (Fig. 10l-m) may also be found in traps. The average forewing length (FWL) for a male *Malacosoma* is approximately 10-15 mm; **the average FWL for target *Dendrolimus* is 20-40 mm**. Each target *Dendrolimus* is illustrated in actual size in Figs. 8-9.

Suspect *Dendrolimus* specimens (lappet moths similar to those in Figs. 8-9 with FWL 20-40 mm) should be sent forward for identification. Specimens must be properly pinned, labeled, and carefully packed to avoid damage during shipping.

Screening for *Dendrolimus* in the western United States

Screening for *Dendrolimus* in the West is more difficult because of similar species in the genera *Caloecia*, *Quadrina*, *Dicogaster*, and *Gloveria* (Figs. 10a-i), although it is not known if these species are attracted to pine lappet pheromone traps. *Malacosoma* (Figs. 10j-n), especially *M. disstria* (Figs. 10j-k), are the most likely non-targets, and can be eliminated based on size alone. Other non-targets can be similar in size, pattern, and coloration. Suspect *Dendrolimus* have a combination of the following characters:

- 1) Forewing length 20-40 mm
- 2) Forewings gray to brown with variable markings (Fig. 7)
- 3) Three dark lines on the forewings running from costa to dorsum in most individuals; the basal-most line is sometimes absent (Fig. 6)
- 4) A white spot in the basal 1/3 of the forewing (Fig. 7)
- 5) Hindwings usually solid brown; some individuals may have minimal darker shading on the hindwing (Fig. 7)

Forewing length of 20-40 mm can be used to separate *Dendrolimus* from smaller non-targets, but this size overlaps with the larger lasiocampids found in the West.

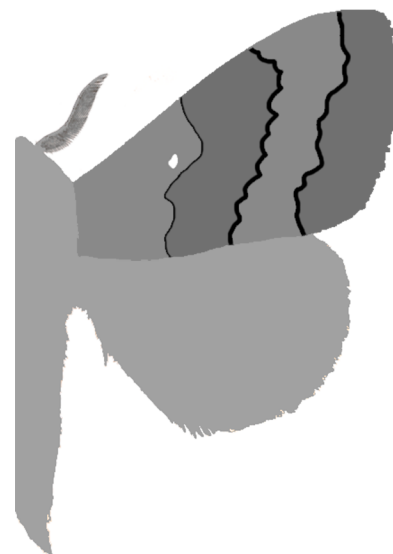


Fig. 6: Primary wing markings for *Dendrolimus* males. Although forewing markings can vary greatly, most individuals have three dark lines running across the wing (from costa to dorsum) and a conspicuous white spot in the basal 1/3 of the wing. Hindwings are solid brown in most individuals although darker shading is sometimes present.



Fig. 7: Typical male *D. sibiricus* with forewing markings outlined in Fig. 6.

[continued on Page 4]

Dendrolimus superans



Dendrolimus sibiricus



Fig. 8: *Dendrolimus* adults; left column: *D. superans*; right column: *D. sibiricus*. All images are ACTUAL SIZE.

Wing coloration and pattern varies greatly in *Dendrolimus*. Most individuals are brown, dark brown, or gray, with markings that form lighter or darker bands on the wings. The basic forewing pattern is illustrated in Fig. 6: three dark lines that run across the wing (from costa to dorsum). The intensity of these lines may vary, often with the basal-most line absent, and the dark lines may be bordered with white in some individuals. Bands of contrasting color are often present between the outer two lines and at the base of the wing; see examples in Figs. 8-9.

A prominent white spot is located in the basal 1/3 of the forewing. This spot is present in nearly all individuals, but may be difficult to see in worn specimens.

[continued on Page 5]

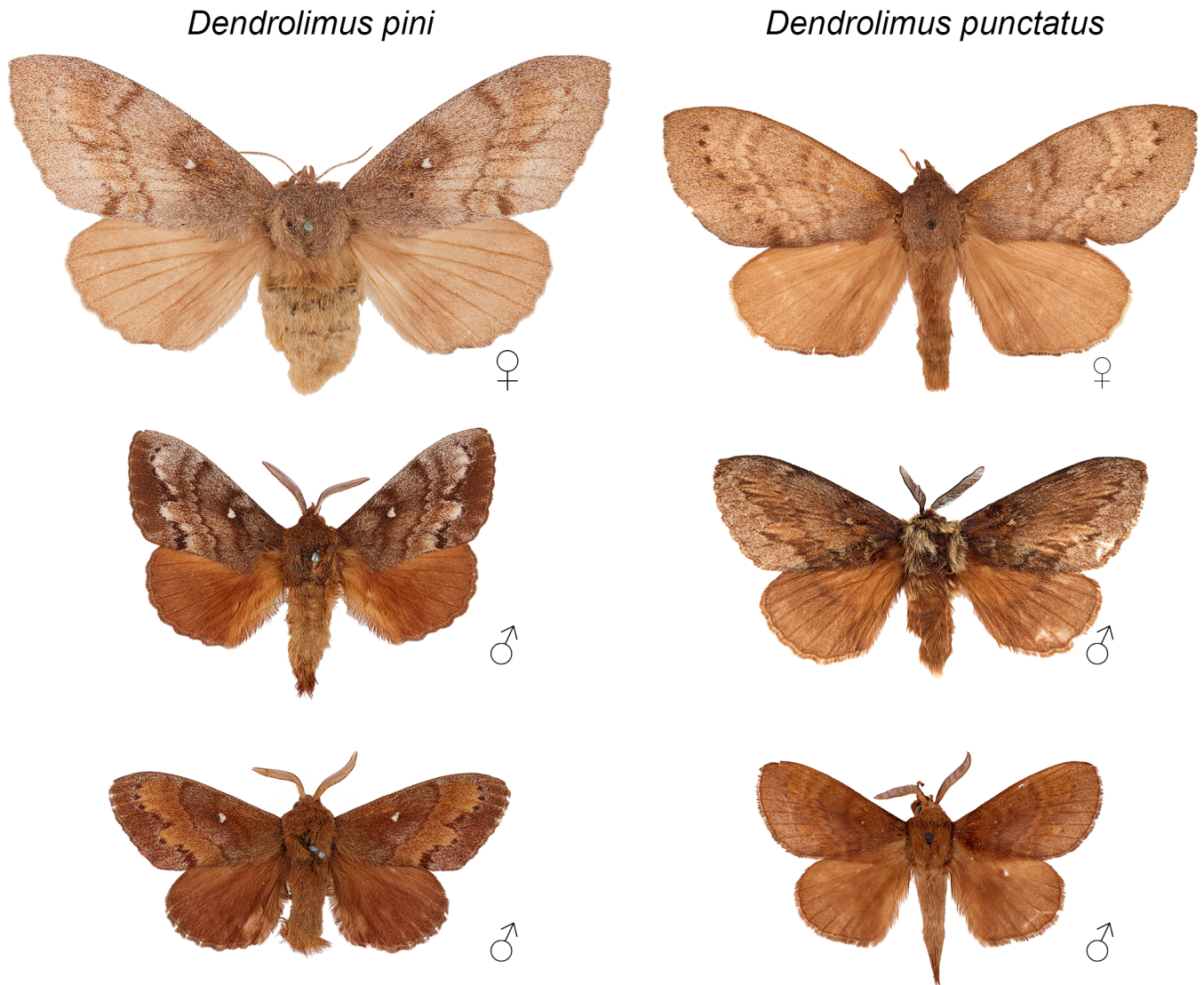


Fig. 9: *Dendrolimus* adults; left column: *D. pini*; right column: *D. punctatus*. All images are ACTUAL SIZE.

Dendrolimus hindwings are usually a shade of solid brown (brown, tan, dark brown, grayish brown, etc.). Some individuals may have minimal darker shading on the hindwing, but the hindwings are never translucent or marked with white, as is found in several non-target *Gloveria* (Figs. 10d, e, h).

Suspect *Dendrolimus* specimens (lappet moths similar to those in Figs. 8-9 with 20-40 mm forewings that are gray to brown with two or three dark lines running from costa to dorsum, a white spot in the basal 1/3 of the forewing, and solid brown hindwings) should be sent forward for identification. Specimens must be properly pinned, labeled, and carefully packed to avoid damage during shipping.

An assortment of non-target lasiocampids are illustrated (in actual size) on Page 6. Except for *Malacosoma disstria* (Fig. 10j-k), these species have not been verified to be attracted to *Dendrolimus* pheromone.

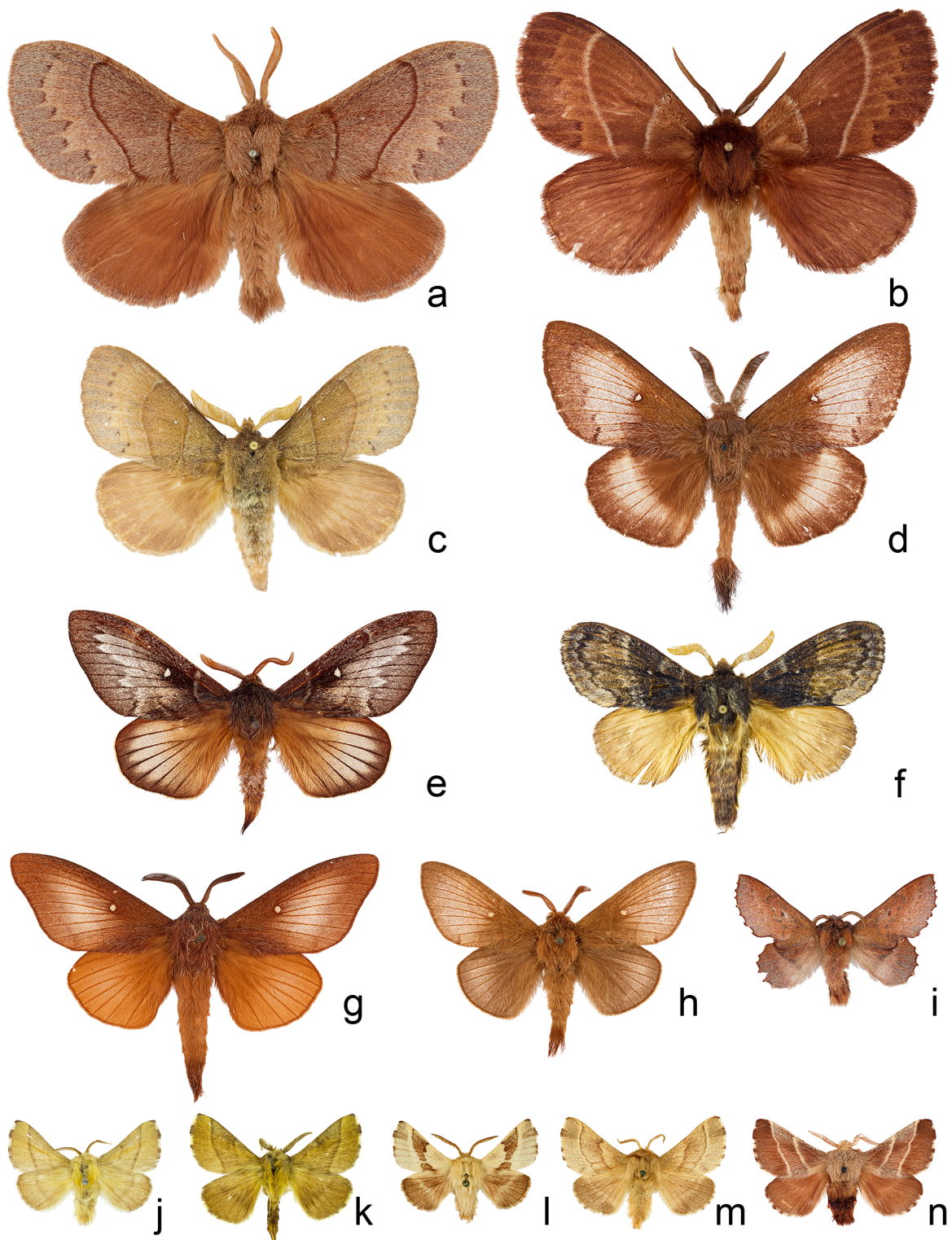


Fig. 10: Non-target adults; a-b: *Dicogaster coronada*; c: *Quadrina diazoma*; d: *Gloveria gargamelle*; e: *Gloveria arizonensis*; f: *Caloecia junenalis*; g: *Gloveria medusa*; h: *Gloveria howardi*; i: *Phyllodesma americana*; j-k: *Malacosoma disstria*; l-m: *Malacosoma californicum*; n: *Malacosoma americanum*. All images are ACTUAL SIZE. Note that the majority of these species have not been verified to be attracted to *Dendrolimus* pheromone traps and that non-targets encountered during CAPS surveys will vary by region.

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

1. Moths approximately 35-50 mm long; overall shape is typical for a lappet (Fig. 1); antennae are feathery; and forewings are gray or brown 2
- 1'. Moths larger or smaller than 35-50 mm long; overall shape not typically lappet; antennae threadlike; or forewings are not gray or brownNot *Dendrolimus*
2. Traps/specimens originate from the eastern United States 3
- 2'. Traps/specimens originate from the western United States 4
3. Forewing length is 20-40 mm ***Dendrolimus* suspect**
- 3'. Forewing length is less than 20 mm or more than 40 mmNot *Dendrolimus*
4. Forewing length is 20-40 mm; forewings are gray to brown with two or three dark lines running from costa to dorsum and a white spot in the basal 1/3 of the forewing; hindwings are solid brown ***Dendrolimus* suspect**
- 4'. Forewing length is not 20-40 mm; forewings are not gray to brown, without two or three dark lines running from costa to dorsum, or without a white spot in the basal 1/3 of the forewing; hindwings are not solid brown and may be translucentNot *Dendrolimus*

Citation

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

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