*Dendrolimus sibiricus**

Figure 1. Adult male of *D. sibiricus* (Natalia Kirichenko, Bugwood.org).

Scientific Name
Dendrolimus sibiricus (Tschetverikov 1908)

*<u>Note:</u> *D. sibiricus* is now the preferred name for *D. superans sibiricus*.

<u>Synonyms:</u>
Dendrolimus laricis Tschetverikov
Dendrolimus superans sibiricus (Tschetverikov)

Common Names
Siberian silk moth, Siberian coniferous silk moth, Siberian lasiocampid

Figure 2. Eggs of *D. sibiricus* (Natalia Kirichenko, Bugwood.org).

Type of Pest
Moth

Taxonomic Position
Class: Insecta,
Order: Lepidoptera,
Family: Lasiocampidae

Reason for Inclusion
CAPS Target: AHP Prioritized Pest List (2012 – 2013)

Pest Description
<u>Eggs:</u> "About 2.2 x 1.9 mm [approx. $^{1}/_{16}$ in], elongate, light-green when laid, turning creamy-white, then becoming darker and spotted" (EPPO, 2005).

<u>Larvae:</u> "The mature larvae are 55-70 mm [approx. 2 $^{3}/_{16}$ to 2 ¾ in] long and the 2nd and 3rd segments are marked with blue-black stripes" (Orlinski, 2000). "Reddish setae are found on the sides of larvae, usually as red jagged bands or spots" (FAO, 2007). Larvae can be up to 110 mm [approx. 4 $^{5}/_{16}$ in] long (Baranchikov, 1997).

<u>Pupae:</u> "The pupa…is brown, 33–39 mm [approx. 1 $^{5}/_{16}$ to 1 ½ in] long in females, 28–34 mm [approx. 1 $^{1}/_{8}$ to 1 $^{5}/_{16}$ in] in males" (EPPO, 2005). "Pupation occurs in cocoons spun with silk, needles and small branches. Cocoon is gray or

brownish, 70 x 12 to 15 mm, compact, rough, with inclusion of hairs" (NBII, 2010).

Figure 3. Larva of *D. sibiricus* on (John H. Ghent, USDA Forest Service, Bugwood.org).

Adults: "The female adult has a wingspan of 60-80 mm [approx. 2 $^{3}/_{8}$ to 3 $^{1}/_{8}$ in]. The male adults have a wingspan of 40-60 mm [approx. 1 $^{9}/_{16}$ to 3 $^{1}/_{8}$ in]. The female body length averages 39 mm [approx. 1 ½ in], and the male body length averages 31 mm [approx. 1 $^{1}/_{4}$ in]. The color of the moths varies from light yellowish-brown or light gray to dark brown or almost black. Front wings are marked by two characteristic dark stripes. A white spot is located at the center of front wing" (Orlinski, 2000).

Biology and Ecology:
The life cycle is dependent on population density and varies from 2 to 4 calendar years in Russia (Baranchikov, 1997). In the southern parts of its native range, one generation can occur per year (EPPO, 2005). Due to this complex life cycle, adults from two generations can emerge simultaneously, causing sharp increases in the population during outbreaks (Baranchikov, 1997).

Soon after mating, females lay eggs on needles or branches of host plants (Baranchikov, 1997) mainly on the lower part of tree crowns. During outbreaks, eggs are laid throughout the tree as well as on the surrounding ground (EPPO, 2005). Females have a high reproductive potential, laying an average of 200 to 300 eggs per female (Orlinski, 2000). Eggs usually take 13 to 15 days to hatch (EPPO, 2005).

Male larvae have 5 to 9 instars (typically 5) while females have 6 to 10 instars (typically 6). Larvae overwinter coiled up under forest litter (Baranchikov, 1997). For the first overwintering period, larvae overwinter as second to third instarsand for the second period, as fifth to sixth instars (Baranchikov, 1997). Larvae may also undergo a summer diapause (NBII, 2010). Larvae cause the most damage after overwintering for a second time when they eat about 95% of the food needed for their development (EPPO, 2005). First instar larvae damage needle edges while older larvae will consume the entire needle (reviewed in NBII, 2010). Older larvae may also eat portions of plant buds, young cones, and the bark of first year shoots (NBII, 2010).

Once larvae mature, pupation occurs in cocoons in the host tree crowns. This occurs from mid-June to late July in Russia (Baranchikov, 1997). The pupal stage lasts about one month (EPPO, 2005).

Adults fly from the end of June to the beginning of August in Russia (Baranchikov, 1997).

Damage

Defoliation by *D. sibiricus* can cause host death and can be observed over large areas during outbreaks. Mortality is caused directly through defoliation, or indirectly by weakening host trees and leaving them susceptible for attack by secondary pests or predisposing the host plants to forest fires (reviewed in Orlinski, 2000).

Symptoms of larval infestation include external feeding (defoliation) and visible frass (CABI, 2011). Defoliation usually occurs over extensive areas and can be seen from satellites when populations are at outbreak levels (Kharuk et al., 2004).

Pest Importance

Orlinski (2000) states that *D. sibiricus* "is considered the most important pest of coniferous forests in Russia (from the center of European Russia to the Far East), Kazakhstan, Northern China, Korea, and Northern Mongolia." Outbreaks can cover several million hectares (Kharuk et al., 2004). For example, an outbreak from 1999 to 2002 in the Republic of Yakutia (Russia) damaged over 8 million hectares of larch stands (reviewed in Kirichenko et al., 2008). Mortality can be as high as 100% in attacked stands. Tree mortality is less for outbreaks in larch forests, although they are more prolonged (FAO, 2007).

This species can attack and kill healthy trees over large areas (Orlinski, 2000). It can cause significant defoliation in both natural and planted forests (FAO, 2007). *D. sibiricus* can cause tree mortality or predisposition to attack by secondary organisms, decrease host product value, and lead to domestic or foreign market loss due to its presence (Orlinski, 2000). Attacks to hosts can cause loss of vigor, reduction in growth, and reduced seed crops (FAO, 2007). Outbreaks may lead to a disruption in forest succession through host mortality in both overstory and understory host conifers causing losses of future seed crops (Buck, 2008).

Outbreaks are most common in pure larch or fir stands but can also affect mixed stands of fir, spruce, and five-needle pine (reviewed in Kirichenko et al., 2008).

Cycles are characterized by a slow population buildup over several years which causes an outbreak and subsequent population collapse (EPPO, 2005). Outbreaks in stands of fir and five-needle pine have defined focal areas with high larval densities for 2 to 3 successive years before the population collapses (FAO, 2007).

Known Hosts

D. sibiricus is polyphagous, damaging over 20 species in several genera in its native range (including *Abies* (fir), *Larix* (larch), *Picea* (spruce), *Pinus* (pine), and

Tsuga (hemlock)). It can develop on almost all of the coniferous species found in its native range. If introduced into North America, it could potentially adapt to many conifers found here due to its broad host range (Orlinski, 2000).

Major hosts
Abies nephrolepis (=*A. gracilis*), *Abies sachalinensis* (Sakhalin fir), *Abies sibirica* (Siberian fir), *Larix gmelinii* (=*L. dahurica*) (Dahurian larch), *Larix sibirica* (=*L. sukaczevii*, =*L. russica*) (Siberian larch), *Picea jezoensis* (=*Picea ajanensis*) (Yeddo spruce), *Picea obovata* (Siberian spruce), *Pinus koraiensis* (Korean pine), and *Pinus sibirica* (Siberian pine) (Orlinski, 2000; EPPO, 2005; CABI, 2011; EPPO, 2012).

Minor hosts
Abies spp. (fir), *Larix* spp. (larch), *Picea* spp. (spruce), *Pinus* spp. (pine), and *Tsuga* spp. (hemlock) (EPPO, 2012).

Experimental hosts
Abies alba (silver fir), *Abies grandis* (grand fir), *Abies nordmanniana* (Nordmann fir), *Cedrus atlantica* (Atlas cedar)*, *Larix decidua* (European larch), *Picea abies* (Norway spruce), *Picea sitchensis* (Sitka spruce), *Pinus nigra* (Austrian pine), *Pinus strobus* (eastern white pine), *Pinus sylvestris* (Scots pine), *Pseudotsuga menziesii* (Douglas-fir)*, and *Tsuga canadensis* (eastern hemlock)* (Kirichenko et al., 2008; Kirichenko et al., 2009).

*These genera are not present in the natural range of *D. sibiricus* (Kirichenko et al., 2008).

Pathogens Vectored
This species is not known to vector any pathogens or associated organisms. However, damage by this species can lead to attacks by secondary pests. These secondary pests can lead to host death and predispose the hosts to fire (reviewed in Kirichenko et al., 2008).

Larvae have stinging hairs that can lead to allergic reactions in individuals living near populations. Exposure to the hairs or secretions of the larvae can cause severe dermatitis and systemic reactions in joints and other parts of the body (FAO, 2007).

Known Distribution
Asia: China, Kazakhstan, Korea, Mongolia, and Russia (Orlinski, 2000; EPPO, 2012).

Potential Distribution within the United States
Conifer forests are found throughout much of North America. If introduced into the United States, natural spread of *D. sibiricus* could occur. In Russia, *D.*

sibiricus has recently been extending its range westward by 12 to 50 km (7.5 to 31 mi) per year (Orlinski, 2000).

Pathway

This species has not been intercepted at U.S. ports of entry. Only one *Dendrolimus* spp. has been intercepted according to PestID. This species originated from Japan (where *D. sibiricus* is not known to occur) on *Pinus* spp. (AQAS, 2012; queried March 5, 2012).

This species may move through cut flowers or branches, wood products, or plants for planting (EPPO, 2012) and can move as a contaminating pest on other products (Kirichenko et al., 2008). It may also move through Russian sea ports (Baranchikov, 1997), similar to gypsy moth species.

Both adult males and females are capable of long distance flight, either on their own or through air currents. Larvae can also be moved with the assistance of air currents (Orlinski, 2000).

Survey

CAPS-Approved Method*:

The CAPS-approved method is a trap and lure combination. The trap is a milk carton trap. The lure is effective for 28 days (4 weeks). A killing agent, a DDVP strip, is also required. This trap and lure combination may also be used to report negative data for the CAPS target *Dendrolimus pini*.

IPHIS Survey Supply Ordering System Product Names:

1) *Dendrolimus pini – Dendrolimus sibiricus* Lure
2) Milk Carton Trap

The lure is hung inside the top of the trap at the level of the entry ports. Preferably, the lure is placed inside the lure holders, which are typically distributed with the lures, and the lure holder is stapled to the trap. If the lure holder is not available, the lure can be stapled to a garden tie and hung inside the trap. The killing agent, the DDVP strip, is placed in the bottom of the trap.

The funnels (Figure 3) that are used in the modified milk carton trap (see trap modification instructions below) are no longer available. If you have funnels leftover from previous seasons, please continue to use them. If you do not have the funnels, continue to use the modified milk carton traps.

Figure 3. Internal funnel for *Dendrolimus* traps. (Image courtesy of David Lance, USDA-APHIS-PPQ.)

Trap modification instructions:

Modify the standard gypsy moth milk carton by cutting a single large entry port (2.5 cm wide x 3 cm (1 x 1 $^{3}/_{16}$ inch) high) in each side by using a utility knife or similar tool to cut out the section of paperboard between the two existing entry ports. A plastic funnel (Figure 3) is placed inside the trap (tube-down) so that the top edge of the funnel is at the level of the bottom of the entry ports.

The funnels can be reused for multiple years if cared for properly. Funnels should be removed from traps at the end of the season, washed in soap and water, rinsed, and stored dry. Please keep the funnels and re-use in subsequent years or ship the funnels back to the Otis lab so that other states may use them.

*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/.

Survey site and selection:
Traps should be hung in trees that are presumed to be potential hosts. In Asia, multiple species of larch, fir, spruce, and pine are attacked (Lance, 2006).

Time of year to survey:
"The available literature indicates that adult [*D. sibiricus*] and *D. pini* may be present from June to August in their native ranges (presumably on the earlier side in more southern areas), so detection trapping should focus on that period" (Lance, 2006).

Literature-Based Methods:
Before the development of the sex pheromone, *D. sibiricus* was monitored in Siberia and the Far East through air and ground inspections and systematic caterpillar sampling by shaking and felling trees in sample plots (Baranchikov et al., 2003).

A pheromone has been used since 2000 to monitor the population of *D. sibiricus* in the Asian portion of Russia (reviewed in Baranchikov et al., 2006).

Identification

CAPS-Approved Method*:
Morphological. Genitalia dissection is required to get to the genus level. Identification to species level requires confirmation by Lepidoptera specialist. For adults, use Passoa (2009).

*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/.

Easily Confused Pests

"The taxonomy and synonymy of the genus *Dendrolimus* is complex. Many Russian scientists recognize the species *Dendrolimus superans* (the coniferous moth) with two subspecies: *Dendrolimus superans sibiricus* Tschetverikov (Siberian moth) and *Dendrolimus superans albolineatus* Matsumura (Sakhalin moth) (Rozhkov 1963, Epova and Pleshanov 1995). But, according to international opinion, *Dendrolimus superans sibiricus* is synonymous with *Dendrolimus sibiricus* (Siberian moth), and *Dendrolimus superans albolineatus* with *Dendrolimus superans*" (Orlinski, 2000).

This species can be confused with *Dendrolimus pini* (Orlinski, 2000).

The genus *Dendrolimus* is not found in North America (Orlinski, 2000).

Dendrolimus sibiricus may be confused with other lasiocampids, including multiple species in the genus *Gloveria*, which occur in the U.S. *D. sibiricus* may be differentiated from *Gloveria* by dissecting the male genitalia (Passoa, 2009). The valve of *Dendrolimus pini* and *D. sibiricus* have two projections, the smaller one either $^{1}/_{5}$ or $^{3}/_{4}$ as long as the larger one (Passoa, 2009). The valve of *Gloveria* have a single projection (Passoa, 2009).

Commonly Encountered Non-targets

The trap and lure for this species may also catch a significant number of the following non-target native insects: *Malacosoma disstria* (forest tent caterpillar), *Malacosoma californicum* (western tent caterpillar, lower probability), and *Malacosoma americanum* (eastern tent caterpillar, low probability) (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** [link]. Cite this document as:

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