European and Mediterranean Plant Protection Organization
Organisation Européenne et Méditerranéenne pour la Protection des Plantes

**Data sheets on quarantine pests**
**Fiches informatives sur les organismes de quarantaine**

# *Dendrolimus sibiricus* and *Dendrolimus superans*

## Identity

**Taxonomic position**: *Insecta*: *Lepidoptera*: *Lasiocampidae*
**Notes on taxonomy and nomenclature**: *Dendrolimus sibiricus* and *Dendrolimus superans* are two closely related allopatric taxa, the former widespread in continental Russia and the latter present in Sakhalin, the Kurile Islands and northern Japan. According to the main international opinion, these are two separate species. However, many Russian scientists consider that there is a single species *D. superans* with two subspecies: *Dendrolimus superans sibiricus* Tschetverikov and *Dendrolimus superans albolineatus* Butler (Rozhkov, 1963; Epova & Pleshanov, 1995). The two species are very similar and are treated together in this data sheet.

### *Dendrolimus sibiricus*

**Name**: *Dendrolimus sibiricus* Chetverikov
**Synonyms**: *Dendrolimus superans sibiricus* Chetverikov, *Dendrolimus laricis* Chetverikov
**Common names**: Siberian silk moth, Siberian moth, Siberian conifer silk moth, Siberian lasiocampid, larch caterpillar (in China) (English); сибирский шелкопряд (Russian)
**EPPO code**: DENDSI
**Phytosanitary categorization**: EPPO A2 action list no. 308

### *Dendrolimus superans*

**Name**: *Dendrolimus superans* Butler
**Synonyms**: *Dendrolimus superans albolineatus* Butler, *Dendrolimus albolineatus* Matsumura, *Dendrolimus yezoensis* Matsumura, *Odonestis superans* Butler
**Common names**: white-lined silk moth, Sakhalin silk moth, Japanese hemlock caterpillar (English), feuille morte du tsuga du Japon (French), Japanischer Douglasien-Spinner (German), белополосый шелкопряд (Russian), tuga-kareha (Japanese)
**EPPO code**: DENDSU
**Phytosanitary categorization**: EPPO A2 action list no. 330

## Hosts

*D. sibiricus* and *D. superans* can damage more than 20 species of *Abies*, *Pinus*, *Larix*, *Picea* and *Tsuga*. They can develop on practically all coniferous species in their natural area. The preferred hosts of *D. sibiricus* are: *Abies sibirica*, *Abies nephrolepis*, *Pinus sibirica*, *Pinus koraiensis*, *Larix gmelinii*, *Larix sibirica*, *Picea ajanensis*, *Picea obovata*. Those of *D. superans* are: *Pinus pumila*, *Larix kamtschatica*, *Picea ajanensis* and *Abies sachalinensis* (Rozhkov, 1963; Epova, Pleshanov, 1995). There are no specific reports concerning European species of conifers.

## Geographical distribution

### *Dendrolimus sibiricus*

**EPPO region**: Russia (eastern part of European Russia and practically all Asian Russia except the extreme north, Sakhalin and Kurile Islands; Fig. 1)
**Asia**: Russia (practically all Asian Russia except the extreme north, Sakhalin and Kurile Islands), Kazakhstan, China (Heilongjiang, Jilin, Liaoning, Neimenggu), Korea Democratic People's Republic, Korea Republic, Mongolia (north)
**EU**: absent
*D. sibiricus* is presumed to have originated in Siberia but has apparently been spreading westwards at a rate that has been variously estimated as 12 km per year or 40–50 km per year. In 1955, Okunev (1955) considered that it had reached longitude 37° or 38° in European Russia (including the White Sea coast), but a later opinion (Rozhkov, 1963) places the most western point much further to the east, at longitude 52° (Fig. 1). The furthest west at which outbreaks of *D. sibiricus* have occurred were in the regions of Perm and Udmurtia (Koltunov *et al.*, 1997; Gninenko, 1999), but in 2001, males of the species were captured in pheromone traps more than 1000 km to the west, close to Moscow.

### *Dendrolimus superans*

**EPPO region**: Russia (Sakhalin, Kurile Islands).
**Asia**: Japan (Hokkaido and northern Honshu), Russia


 


**Fig. 1** Geographical distribution of *Dendrolimus sibiricus* (Rozhkov, 1963).

(Sakhalin, Kurile Islands) (Matsumura, 1925; Rozhkov, 1963; Epova, Pleshanov, 1995).
**EU**: absent

## Biology

### *Dendrolimus sibiricus*

The host/parasite relationship of *D. sibiricus* is characterized by cycles of slow build-up of population numbers over several years, reaching a peak (outbreak) followed by a population collapse. Outbreaks of *D. sibiricus* occur with a periodicity of 10–11 years (Rozhkov, 1963; Epova & Pleshanov, 1995; Vorontsov, 1995), usually last 2–3 years and are often preceded by 2–3 years of water deficit. It has been noticed that the cycle of these outbreaks in some parts of the geographical range of the pest coincides with the cycle of solar activity, with the maximum development of the outbreaks occurring in years of increasing number of sunspots (Galkin, 1975, 1992).

The first flight of *D. sibiricus* in the middle latitudes of its natural range usually occurs in the middle of July. Immediately after mating, females lay eggs on the needles, mainly in the lower part of the crowns. During outbreak years, eggs are laid throughout the tree and on the surrounding ground. One egg mass may contain few or up to 200 eggs. Each female lays an average of 200–300 eggs, with a maximum of 800 (Rozhkov, 1963; Vorontsov, 1995). Egg development usually takes 13–15 days (with an occasional maximum of 20–22). First-instar larvae eat the edges of needles and moult in 9–12 days. Second-instar larvae cause even more damage to the needles and develop for 3–4 weeks before moulting. Third-instar larvae descend to the soil in September and overwinter under moss. At the end of April, in the following year, the larvae return to the crowns, eat complete needles, and sometimes the bark of young shoots and cones. They moult after one month and again at the end of July or in August. In autumn, the larvae return to the soil and overwinter for a second time. In May and June of the following year, the larvae feed very intensively. During this period, they eat about 95% of the food that they need for their development and it is then that the major damage occurs. In total, larvae moult 5–7 times and have, correspondingly, 6–8 instars. In June, the larvae make cocoons and the development of pupae within them takes about one month. The full life cycle usually takes two years. In southern parts of the natural range, however, one generation can develop in a single year, whereas, in northern regions, the completion of a generation can sometimes take three years (Rozhkov, 1963; Galkin, 1993; Vorontsov, 1995).

### *Dendrolimus superans*

The biology of *D. superans* is very similar to that of *D. sibiricus*. Outbreaks have been recorded in Sakhalin since 1920, mainly in larch-pine forests in the northern part of the island. In the south, the pest damages spruce-fir forests but only one major outbreak has been recorded. Outbreaks also occur in spruce-fir forests on the Kurile islands (Epova & Pleshanov, 1995).

Flights of *D. superans* begin in June/July and last till August. The pest prefers mature forests (more than 50 years old). The life cycle may take one or two years (or even more) depending on climate conditions; development takes much longer in the north of Sakhalin than in the south (Bushmelev & Yurchenko, 1989; Gninenko & Baranchikov, 2004), and presumably than in Japan.

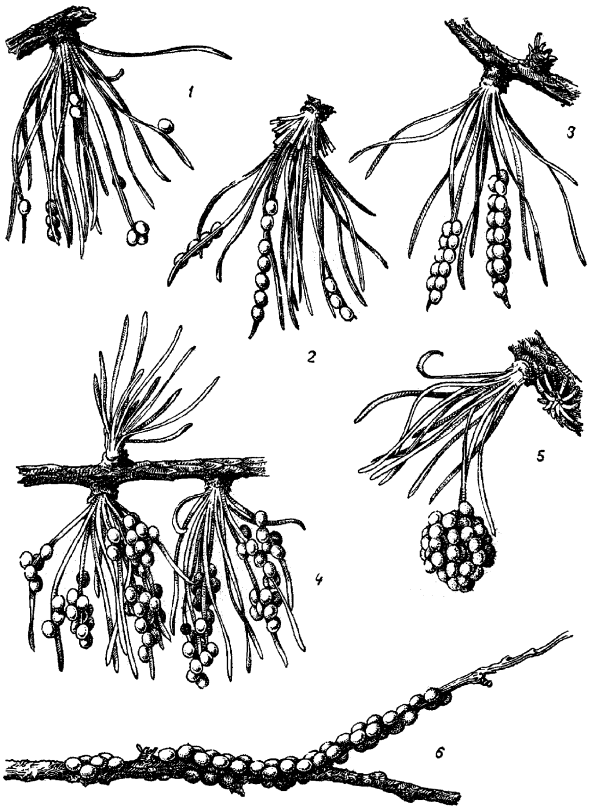


**Fig. 2** Egg masses of Dendrolimus sibiricus.

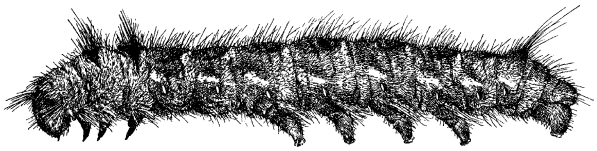

**Fig. 3** Caterpillar of *Dendrolimus sibiricus*.

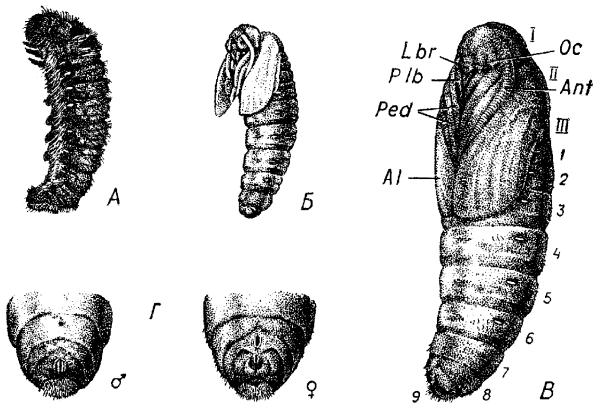


**Fig. 4** Caterpillar before pupation and pupa of *Dendrolimus sibiricus*.

## Detection and identification

### Symptoms

Defoliation of *Pinus*, *Larix*, *Abies* or *Picea* spp. is usually very spectacular. The presence of caterpillars is easily detected. The caterpillars and adults can easily be distinguished from related species, even from the European *Dendrolimus pini*, which is the most closely related species. Adult males can be captured using pheromone traps containing a specific pheromone (Pletniev *et al*., 1999).

### Morphology

*Eggs*

About 2.2 × 1.9 mm, elongate, light-green when laid, turning creamy-white, then becoming darker and spotted (Fig. 2).

*Larva*

The caterpillar (Fig. 3) is 50–80 (*D. sibiricus*) or 60–82 (*D. superans*) mm long. The following description of the full-grown caterpillar applies to both species: mainly black or dark-brown with numerous spots, with long hairs; the 2nd and 3rd segments crossed by blue-black stripes; labrum in the middle shallowly incised, epicranium fuscous maculated, in the middle with a pale on each side with a yellowish-brown longitudinal stripe; each segment dorsally covered with silvery scales, reflecting a light shade of golden, so that in fresh specimens the dorsal hexagonal markings not distinct; stigma yellowish-white, on its sides with some reddish markings and white scales; dorsal marking of each abdominal segment hexagonal. Ventral surface with a series of fuscous spots (*D. sibiricus*) or a yellowish-brown stripe (*D. superans*) (Matsumura, 1925; Bushmelev & Yurchenko, 1989).

*Pupa*

The pupa (Fig. 4) is brown, 33–39 mm long in females, 28–34 mm in males.

*Adult*

The female wingspan is 60–80 mm in *D. sibiricus* (Fig. 5) and 77–102 mm in *D. superans*, and the male 40–60 or 60–79 mm, respectively. The female body length averages 39 mm, and the male 31 mm, in *D. sibiricus*. The following description applies to both species: colour from light yellowish-brown or light grey to dark brown or almost black; fore wings crossed by two characteristic dark stripes; white spot situated at the centre of the fore wing; antemedial line to the primaries straight from the costa to the discoidal spot, then becoming oblique, reaches the hind margin at the inner side of the discoidal spot; vein 9 to the primaries opening at the costa and not reaching apex. The postmedial line is much incurved near the costa in *D. sibiricus* and only slightly incurved in *D. superans* (Matsumura, 1925; Bushmelev & Yurchenko, 1989).

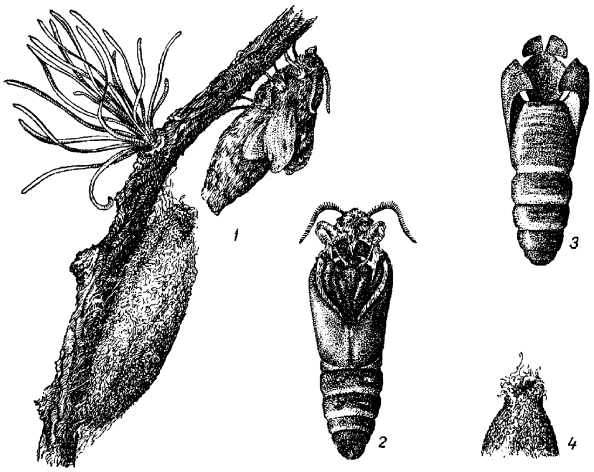


**Fig. 5** Cocoon and neonate adult moth of *Dendrolimus sibiricus*.

## Pathways for movement

Both species can spread by flight of the adult moths (up to 100 km per year) (Rozhkov, 1963). All stages of the life cycle can be transported on plants moving in trade, particularly plants for planting and cut branches (including Christmas trees). During outbreaks especially, eggs and larvae may be associated with wood carrying bark, or isolated bark, and may be present as contaminating pests on other products.

## Pest significance

### Economic impact

*Dendrolimus sibiricus*

*D. sibiricus* is the most important defoliator of coniferous trees (*Pinus sibirica*, *Larix sibirica*, *Abies sibirica*, *Picea obovata*) in Russia and Kazakhstan (Rozhkov, 1963; Epova & Pleshanov, 1995; Vorontsov, 1995), and one of the most important defoliators of *Larix gmelinii* in China (Yang & Gu, 1995). Outbreaks occur over enormous areas (many thousands of hectares) and often lead to the death of entire forests. The evaluation made by Florov (1948) showed that, during a period of 90 years (1855–1945), *D. sibiricus* killed at least 4 million ha of Russian forests. According to Kolomets (1958), during the 25-year period 1932–1957, *D. sibiricus* damaged 7 million ha of forests in Western Siberia and Chita Oblast alone, causing the death of forests in half of this area. Similar data has been published by many other scientists (e.g. Rozhkov, 1963).

During outbreaks, trees can be defoliated during 2–3 successive years and many trees are unable to withstand such a long period of defoliation. Furthermore, the outbreaks of *D. sibiricus* are also very often followed by outbreaks of wood borers (scolytids, cerambycids and others), particularly *Ips typographus, Ips subelongatus* (OEPP/EPPO, 2005a), *Scolytus morawitzi* (OEPP/EPPO, 2005b), *Monochamus galloprovincialis*, *Xylotrechus altaicus* (OEPP/EPPO, 2005c), *Melanophila guttulata* (Pavlovskii & Shtakelberg, 1955; Rozhkov, 1963; Mamaev, 1990; Epova & Pleshanov, 1995; Vorontsov, 1995). These pests are able to kill trees which are heavily stressed by *D. sibiricus*. Forests may also be predisposed to forest fires. Reforestation of affected areas is often very complicated and takes much time, resulting in serious changes in the environment over large areas.

*Dendrolimus superans*

*D. superans* is similar in importance on Sakhalin. In 1959/1964, the pest severely damaged larch-pine forests on 15 356 ha, and caused the death of 6526 ha of forests (Govorukhin, 1965). In 1986/1989, the pest caused the death of 1800 ha of forests (Pechenina, 1991). During outbreaks, pest populations reach 300–1000 pupae per tree, trees can be defoliated during 2–3 successive years and many trees are unable to withstand such a long period of defoliation. Dry forests situated on slopes of southern and south-western exposure are most susceptible. Furthermore, as for *D. sibiricus*, outbreaks of *D. superans* are very often followed by outbreaks of wood borers (scolytids, cerambycids and others). These pests are able to kill trees which are heavily stressed by *D. superans* (Govorukhin, 1965; Bushmelev & Yurchenko, 1989; Pechenina, 1991; Gninenko & Baranchikov, 2004). Similar outbreaks of *D. superans* occur in northern Japan (Maeto, 1991). It may be noted that other *Dendrolimus* spp., e.g. *Dendrolimus spectabilis* (Butler), occur further south in Japan, and in Korea, and probably present a similar risk, although they have not been evaluated in detail.

### Control

Significant control efforts against *D. sibiricus* and *D. superans* (mainly aerial treatment with chemical and bacterial products) are undertaken during outbreak years in Russia (Ivliev, 1960; Ageenko, 1969; Baranovskii, Remorov & Lamikhov, 1988; Maslov, 1988; Bushmelev & Yurchenko, 1989; Epova & Pleshanov, 1995; Vorontsov, 1995) and other countries within the range of the pests.

Under non-outbreak conditions, the natural enemies of *D. sibiricus* (the egg parasitoids *Telenomus gracilis*, *Telenomus tetratomus*, *Trichogramma dendrolimi*, *Ooencyrtus pinicolus*; the larval and pupal parasitoid *Rhogas dendrolimi*; the micro-organisms *Bacillus dendrolimus*, *Bacillus thuringiensis*, *Beauveria bassiana*, polyhedrosis viruses and some other viruses) play an important role in the regulation of its population density (Nikiforov, 1970; Gorshkov, 1973; Baranovskii, Remorov & Lamikhov, 1988; Yang & Gu, 1995; Vorontsov, 1995). An even longer list, additional to the above, is available for *D. superans*: *Telenomus dendrolimusi*, *Pachyneuron solitarius*, *Exorista larvarum*, *Masicera ashingivora*, *M. zimini*, *Apanteles ordinarius*, *Apanteles liparidis*, *Campoplex leptogaster*, *Stylocryptor profligator*, *Anilasta valida*, *Habronyx heros*, *Exochilum giganteum*, *Isorepus stercorator*, *Agria punctata*, *Echynomia magna*, *Larvaevora larvarum*, *Pimpla instigator*, *Pimpla disparis*, *Pimpla pluto*, *Pimpla tabatai*, *Apechtis dendrolimi*, *Parasarcophaga uliginisa*, *Parasarcophaga albiceps*,

*Pseudosarcophaga affinis* and *Sarcophaga carnaria*; many species of coleopteran (mainly *Carabidae*), hemipteran (mainly *Pentatomidae* and *Reduviidae*) and hymenopteran predators. The most numerous and efficient natural enemies of *D. superans* seems to be *Telenomus* spp., which usually infests 20–40% of eggs of the pest. During outbreaks, the parasitization level may reach 35% of larvae and 70% of pupae (Matsumura, 1925; Ivliev, 1960; Kasparyan, 1965; Bushmelev & Yurchenko, 1989; Yurchenko & Turova, 2002; Gninenko & Baranchikov, 2004).

### Phytosanitary risk

*D. sibiricus* and *D. superans* are both considered as very serious defoliators of coniferous forests in the areas where they occur and are very likely to be able to establish in most EPPO countries, particularly those in the north and centre of the region. It is very likely that these *Dendrolimus* spp., which have a wide host range on different conifer genera in their native range, should be able to attack other species of the same genera in the western part of the EPPO region, where they are important forest and amenity trees.

## Phytosanitary measures

*D. sibiricus* was added in 2002 to the EPPO A2 action list, and endangered EPPO member countries are thus recommended to regulate it as a quarantine pest. Similarly, *D. superans* was added to the list in 2005. *D. sibiricus* is apparently slowly spreading westwards, and it may be useful, in areas at the border of the present range, for surveys to be conducted using pheromone traps (Pletniev *et al*., 1999) to detect entry of the pest, and for control measures to be used for suppression of the pest, with a view to containment and eradication. *D. superans* is relatively unlikely to invade the adjoining areas where *D. sibiricus* already occurs, and so presents more of an A1 risk to the western part of the EPPO region.

To prevent introduction of both *D. sibiricus* and *D. superans* by international movement of commodities, plants for planting and cut branches of host plants from the infested areas should be free from soil according to OEPP/EPPO (1994). Alternatively, such commodities could originate in a pest-free area, be produced in protected houses, or fumigated, or imported during winter. Wood should be debarked or heat-treated, or originate in a pest-free area, or be imported during winter, and isolated bark should be treated to destroy contaminating insects.

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