EPPO Datasheet: *Dendrolimus sibiricus*

Last updated: 2022-01-27

IDENTITY

Preferred name: *Dendrolimus sibiricus*
Authority: Chetverikov
Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta: Lepidoptera: Lasiocampidae
Other scientific names: *Dendrolimus laricis* Chetverikov, *Dendrolimus superans sibiricus* Chetverikov
Common names: Siberian conifer silk moth, Siberian lasiocampid, Siberian moth, Siberian silk moth, larch caterpillar
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EPPO Categorization: A2 list
view more categorizations online...
EU Categorization: A1 Quarantine pest (Annex II A)
EPPO Code: DENDSI

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Notes on taxonomy and nomenclature

The species status of *Dendrolimus sibiricus* remained debatable for decades. At the beginning, the insect was erroneously identified as *D. segregatus* Butler, a species considered to be morphologically indistinguishable from *D. pini*. In 1903, Chetverikov described a new species, *D. laricis*, based on specimens from Siberia. Soon after, Peterson re-examined the genitalia of these three species and concluded that *D. segregatus* and *D. pini* were two separate species, and *D. laricis* was a synonym of *D. segregatus*. Furthermore, Chetverikov revised the type series of *D. segregatus* from China and Amur and compared its genital morphology with that of *D. laricis* from Asia and *D. pini* from Europe and concluded that *D. laricis*, which he subsequently renamed as *D. sibiricus*, was an independent species (see an extensive taxonomic review in Rozhkov, 1963). Many Russian scientists shared a different opinion and considered that the species should be referred to as *D. superans*, and that three subspecies could be distinguished: the Siberian moth *D. superans sibiricus* Tschetverikov, the white-lined silk moth *D. superans albolineatus* Butler and the Japanese silk moth *D. superans superans* Butler (Rozhkov, 1963; Yurchenko & Turova, 2007; Chistyakov *et al.*, 2016). However, according to the main international opinion, *D. sibiricus* and *D. superans* are two separate species (Mikkola & Ståhls, 2008), and based on molecular genetic data, *D. sibiricus* is a young species relatively recently separated from *D. superans* (Kononov *et al.*, 2016).

HOSTS

Dendrolimus sibiricus damages conifers from the Pinaceae family (Rozhkov, 1963; Kirichenko & Baranchikov, 2007). Other conifers (Taxaceae and Cupressaceae) are not suitable hosts (Kirichenko *et al.*, 2008). In its native range, *D. sibiricus* develops practically on all coniferous species of *Abies, Pinus, Larix,* and *Picea* (Rozhkov, 1963; Kirichenko & Baranchikov, 2007). In indoor experiments, the pest larvae could develop on European conifer species such as: *Abies alba, A. nordmanniana, Larix decidua, Picea abies, Pinus nigra, P. sylvestris* (Kirichenko *et al.*, 2008, 2009, 2011). Other potentially suitable hosts, non-native for Europe but grown there for various purposes were the North African *Cedrus atlantica* 'Glauca' and the North American species *Abies grandis, Picea sitchensis, Pinus strobus, Pseudotsuga menziesii*, and *Tsuga canadensis* (Kirichenko *et al.*, 2008, 2009).

Larix, Abies, and five-needle pines (*Pinus* spp.) are the preferred hosts of *D. sibiricus* both in nature and laboratory tests (Rozhkov, 1963; Kirichenko & Baranchikov, 2007, 2008). *Picea* is the least suitable host, and the two-needle pines (*Pinus sylvestris*, *P. nigra*) are the poorest (Kirichenko & Baranchikov, 2007; Kirichenko *et al.*, 2011). However, during outbreaks, the pest can attack *P. sylvestris*; for example, damage by *D. sibiricus* was documented in Transbaikalia in 1990s (Epova, 1999).

Host list: *Abies nephrolepis*, *Abies sibirica*, *Larix gmelinii*, *Larix sibirica*, *Picea jezoensis*, *Picea koraiensis*, *Picea obovata*, *Pinus koraiensis*, *Pinus sibirica*, *Pinus sylvestris*

GEOGRAPHICAL DISTRIBUTION

The species range covers a large territory of Northeast Asia with a continental climate, reaching the latitudes of 63° north and 40° south and spreading from the coasts of Okhotsk and Sea of Japan (longitude 142°) to Central Russia (around 47°) (Rozhkov, 1963; Kononov *et al.*, 2016; The Federal Service, 2021). The western frontier of *D. sibiricus* range still remains obscure (Kononov *et al.*, 2016).

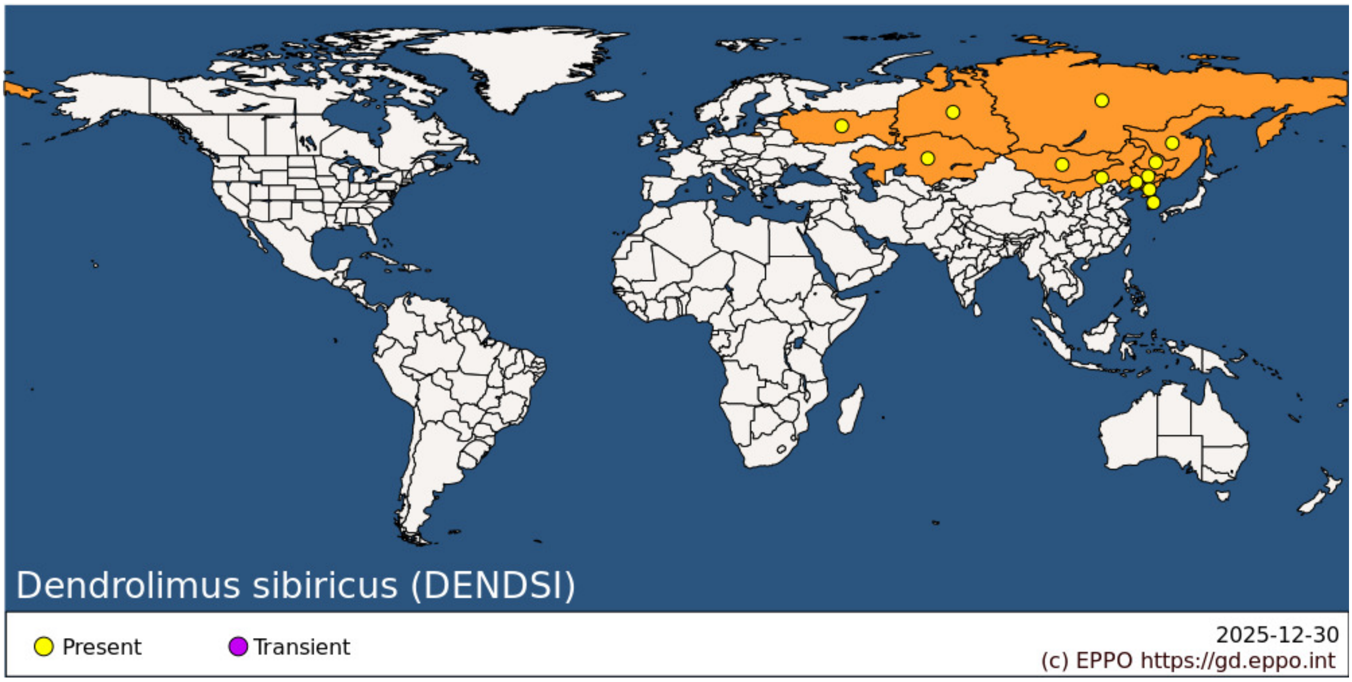
In Russia, the species occurs in Siberia, the Russian Far East, the Ural Mountains and is patchily distributed in Central Russia (Rozhkov, 1963; Boldaruev, 1969). In the Russian Far East, *D. sibiricus* exists in sympatry with *D. superans*; in Siberia, Ural Mountains and Central Russia, the range of *D. sibiricus* largely overlaps with that of *D. pini* (Kononov *et al.*, 2016). On Sakhalin, the species was initially identified as *D. superans albolineatus* (Yurchenko & Turova, 2007), but Kononov *et al.* (2016) examined the specimens collected on the island and identified them as *D. sibiricus*. In Siberia due to a warming climate, the distribution front moved northward and 300 m higher in mountains compared to that in 20th century (Kharuk *et al.*, 2017, 2020). In Central Russia, *D. sibiricus* is known in Permskaya oblast (nearby Ural Mountains) (56°E), Udmurtiya (52°E) and Marii El (47°E) (Rozhkov, 1963; Boldaruev, 1969; Mikkola & Ståhls, 2008; Kononov, 2016; The Federal Service, 2021). In 2001, a few males, originally identified as *D. sibiricus*, were captured in pheromone traps more than 1000 km to the west, near Moscow (Gninenko & Orlinskii, 2002). However, their taxonomic identification was questioned (Mikkola & Ståhls, 2008), and it is suspected that it was a misidentification of *D. pini* (Baranchikov *et al.* 2006). Nevertheless, the low genetic variability discovered in European Russia suggests that the pest is spreading westward (Kononov *et al.*, 2016).

In Kazakhstan, *D. sibiricus* is found in the northeast (Kalba, Naryn-Kamm, Kürschim-Kamm Riges) (Rozhkov, 1963).

In China, it is known in the northeast (Heilongjiang, Jilin, Liaoning, Neimenggu) (Rozhkov, 1963; Yang & Gu, 1995; Kononov *et al.*, 2016).

In Mongolia, *D. sibiricus* occurs down to the latitude 40° (Rozhkov, 1963; Boldaruev, 1969; Kononov *et al.*, 2016).

In the Korean Peninsula, the pest is known from the northern part of the Democratic People's Republic of Korea, presumably in Hamgyong province (Rozhkov, 1963; Kononov *et al.*, 2016), and in the Republic of Korea in the provinces of Gangwon and Jeollanam (Jeong *et al*., 2018).



EPPO Region: Kazakhstan, Russian Federation (the) (Central Russia, Eastern Siberia, Far East, Western Siberia)
Asia: China (Heilongjiang, Jilin, Liaoning, Neimenggu), Kazakhstan, Korea, Democratic People's Republic of, Korea, Republic of, Mongolia

BIOLOGY

The population dynamics of *D. sibiricus* is characterized by cycles of slow build-up of population numbers over several years, reaching a peak (an outbreak) followed by a population collapse (Koltunov & Erdakov, 2013). Outbreaks of *D. sibiricus* occur with a periodicity of 10–12 years (Rozhkov, 1963) or longer time span (depending on the region) (Koltunov & Erdakov, 2013), and they usually last 2–3 years and are often preceded by 2–3 years of hot weather and water deficit during the vegetation season (Rozhkov, 1963; Kondakov, 2002).

In its natural range, *D. sibiricus* adults emerge from early July up to early August, with males appearing first (Prozorov, 1952). Soon after mating, females start laying eggs on twigs or needles, rarely on bark, mainly in the lower part of tree crowns. During outbreaks, eggs are laid in different parts of the tree crown and on the surrounding ground. An egg mass may contain up to 200 eggs. Each female lays an average of 200–300 eggs (with a maximum of 800) (Rozhkov, 1963; Boldaruev, 1969). Eggs development takes from one to two weeks (20 days maximum) (Rozhkov, 1963; Kirichenko, 2002). After hatching, larvae, consume some or the whole of the egg shell and move to feed on the needles; they gnaw the edges of needles and moult in 7–12 days (Prozorov, 1952; Kirichenko, 2002). At each instar, larvae require more time for development and consume more and more food and, thus, cause more damage to their host trees (Prozorov, 1952; Kirichenko, 2002). In the first year, larvae usually moult up to two times. Third-instar larvae descend to the soil in September and overwinter under the moss. At the end of April to early May of the following year, the larvae return to the crowns and feed on needles. They moult up to two times. In autumn, the larvae of the IV-V instars descend 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 consume about 95% of all food eaten during the whole larval development, and it is during this period that most damage occurs (Rozhkov, 1963; Kirichenko, 2002). In total during their life, larvae moult 5–7 times and have 6–8 instars, correspondingly (Prozorov, 1952; Rozhkov, 1963; Boldaruev, 1969; Kirichenko, 2002). Larvae of I-IV instars benefit from developing in small groups (up to 20 larvae), whereas mature larvae tend to stay apart from each other and, thus, spread within the tree crown (Kirichenko & Baranchikov, 2004). In foci where food is limited, mature larvae can withstand starvation for up to two weeks; during this period, they can disperse from the damaged spot searching for food resource (Prozorov, 1952).

In June, the larvae spin thick cocoons attaching them to twigs or branches. During outbreaks, mature larvae can pupate on any substrate (tree bark, stems of herbaceous plants etc.) (Rozhkov, 1963). Pupal development takes up to 25 days (Rozhkov, 1963). The full life cycle usually takes two years (Rozhkov, 1963; Boldaruev, 1969), with larvae passing winter in diapause and some undergoing facultative summer diapauses (Kirichenko & Baranchikov, 2002).

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 to four (exceptionally five) years (Rozhkov, 1963; Vinokurov & Isaev, 2002; Kirichenko, 2002).

DETECTION AND IDENTIFICATION

Symptoms

Defoliation of *Abies*, *Larix*, five-needle *Pinus*, and *Picea* spp. is usually very spectacular. The presence of larvae in dense populations is easily detected visually, whereas in low density populations, it is necessary to beat trees to check for the presence of larvae (which fall on fabric spread under the tree crown prior to tree beating). The adults are distinguished reliably from related species, in particular from the European *D. pini* by male genitalia. Adult males can be captured using pheromone traps containing a specific pheromone (Pletnev *et al.*, 2004). However, according to Baranchikov *et al.* (2006), the synthetic pheromones prepared for *D. pini* and *D. sibiricus* attract both species equally well. Only dissection of males and careful examination of their genital structures may allow species identification in such a case (Pet'ko *et al.*, 2004). Eggs laid in clusters can be found on needles, twigs and occasionally on bark (Rozhkov, 1963).

Morphology

Eggs

About 2.2 × 1.9 mm, oval, light-green when laid, turning creamy-white in a few hours, then becoming greyish and finely spotted (Rozhkov, 1963).

Larva

A newly hatched larva is 5-5.5 mm long, mature larva 50–80 mm (exceptionally 88 mm) (Rozhkov, 1963). The body is mainly black or dark-brown with numerous spots and long setae. Behind the 1st and the 2nd thoracic segments and on the VIII abdominal segment, there are clusters of dark blue setae which protect larvae against predators (Rozhkov, 1965). They break off easily and can cause severe eye inflammation, skin dermatoses and arthritis-like disease in humans (Rozhkov, 1965). The 2nd and 3rd thoracic segments are crossed by blue-black stripes; labrum shallowly incised in the middle, epicranium fuscous maculated, in the middle with a pale spot on each side with a yellowish-brown longitudinal stripe; each segment dorsally covered with silvery scales, reflecting a shade of gold, so that in fresh specimens the dorsal hexagonal markings are not distinct; stigma yellowish-white, on its sides with some reddish markings and white scales; dorsal marking of abdominal segments hexagonal. Ventral surface with a series of fuscous spots (Rozhkov, 1963).

Pupa

The pupa is brown, 33–39 mm long in females, 28–34 mm in males, in greyish silk cocoon (Rozhkov, 1963).

Adult

The wingspan is 60–80 mm in females and 40–60 mm in males. The female body length averages 39 mm, and the male 31 mm. The forewing is from light yellowish-brown or light grey to dark brown or almost black; forewings crossed by two characteristic dark stripes; white spot situated at the centre of the forewing; 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 (Rozhkov, 1963).

For more details regarding detection and identification of *D. sibiricus* see EPPO Standard PM 7/157 (EPPO, 2024).

PATHWAYS FOR MOVEMENT

The adults of *D. sibiricus* can spread by flight. In field observations, they flew up to 15 km (Pet'ko, 2004) or up to

50 km (Boldaruev, 1969). Rozhkov (1963) estimated that females may disperse over up to 120 km and males up to 280 km, which, however, needs to be proven by records in nature. All immature stages (eggs, larvae, pupae) can be unintentionally 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 is the most important defoliator of conifers (*Larix sibirica, Abies sibirica, Pinus sibirica, Picea obovata*) in Russia (Rozhkov, 1963; Kondakov, 2002), 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 (Kondakov, 2002; Fomin *et al.*, 2019). During the last century, at least nine outbreaks were reported in Central Siberia covering the territory of more than 8 million hectares (Kondakov, 2002; Kharuk *et al.*, 2017, 2020). During outbreaks, trees can be defoliated during 2–3 successive years and many of them are unable to withstand such a long period of defoliation (Rozhkov, 1963). Furthermore, the outbreaks of *D. sibiricus* are often followed by population increase of wood boring insects (scolytids, cerambycids, buprestids and others), particularly *Ips acuminatus, I. sexdentatus, I. typographus, I. subelongatus*, *Monochamus sutor*, *M. galloprovincialis, M. urussovi, Xylotrechus pilosus, Melanophila guttulat*a, *Buprestis strigosa* (Krivets & Chemodanov, 2005; Averenskiy & Isaev, 2011). Some of these insects kill trees stressed by *D. sibiricus*. Furthermore, severely affected tree stands are predisposed to fires. Reforestation of affected areas is often very complicated and takes much time, resulting in serious ecological and economical losses over large areas (Rozhkov, 1963; Kondakov, 2002).

Control

Significant control efforts against *D. sibiricus*, mainly aerial treatment with chemical and bacterial products, are undertaken during outbreaks in Asian Russia (Rozhkov, 1963; Kondakov, 2002; Krivets & Chemodanov, 2005; Yurchenko & Turova, 2007). Various natural enemies: the egg parasitoids *Telenomus gracilis, T. tetratomus, Trichogramma dendrolimi, Ooencyrtus pinicolus;* the larval parasitoid *Rogas dendrolimi,* and pupal parasitoids from the Tachinidae family*;* the microorganisms *Bacillus thuringiensis* subsp. *dendrolimus, Bacillus thuringiensis, Beauveria bassiana,* polyhedrosis viruses and some other viruses play an important role in the regulation of the pest population density (Kolomiets, 1962; Rozhkov, 1963, 1965; Boldaruev, 1969; Yurchenko & Turova, 2002).

Phytosanitary risk

Dendrolimus sibiricus is considered to be a very serious defoliator of coniferous forests in the areas where it occurs and is likely to be able to establish in further EPPO countries, particularly those in the north. It is very likely that *D. sibiricus*, which has a wide host range within the Pinaceae family in its native range, will 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. It is likely that it will also be able to attack tree species from genera that are absent from its native range, but which have been shown to be highly suitable hosts in experiments, such as *Pseudotsuga, Tsuga, Cedrus.*

PHYTOSANITARY MEASURES

Dendrolimus sibiricus was added in 2002 to the EPPO A2 list, and endangered EPPO member countries are thus, recommended to regulate it as a quarantine pest. The species seems to be slowly spreading westwards, and it is important to conduct surveys using pheromone traps in areas at the border of its present range (Pletniev *et al.*, 1999) in order to achieve early detection and timely apply control measures to contain or eradicate it.

To prevent the introduction of *D. sibiricus* 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 FAO (2017). Such commodities should originate from pest-free areas, or produced under physical protection, or imported during winter. Wood should be debarked or heat-treated, or originate in a pest-free area, or be also imported during winter (EPPO, 2018).

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Datasheet history

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EPPO (2005) Data sheets on quarantine pests. *Dendrolimus sibiricus* and *Dendrolimus superans*. *EPPO Bulletin* **35** (3), 390-395. https://doi.org/10.1111/j.1365-2338.2005.00878.x

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