EPPO Datasheet: *Ips typographus*

Last updated: 2020-09-01

IDENTITY

Preferred name: *Ips typographus*
Authority: (Linnaeus)
Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta: Coleoptera: Curculionidae: Scolytinae
Other scientific names: *Bostrichus octodentatus* Paykull, *Dermestes typographus* Linnaeus, *Ips japonicus* Niijima
Common names: eight-dentate bark beetle, eight-spined engraver, eight-toothed spruce bark beetle, spruce bark beetle
view more common names online...
EU Categorization: PZ Quarantine pest ((EU) 2019/2072 Annex III)
EPPO Code: IPSXTY

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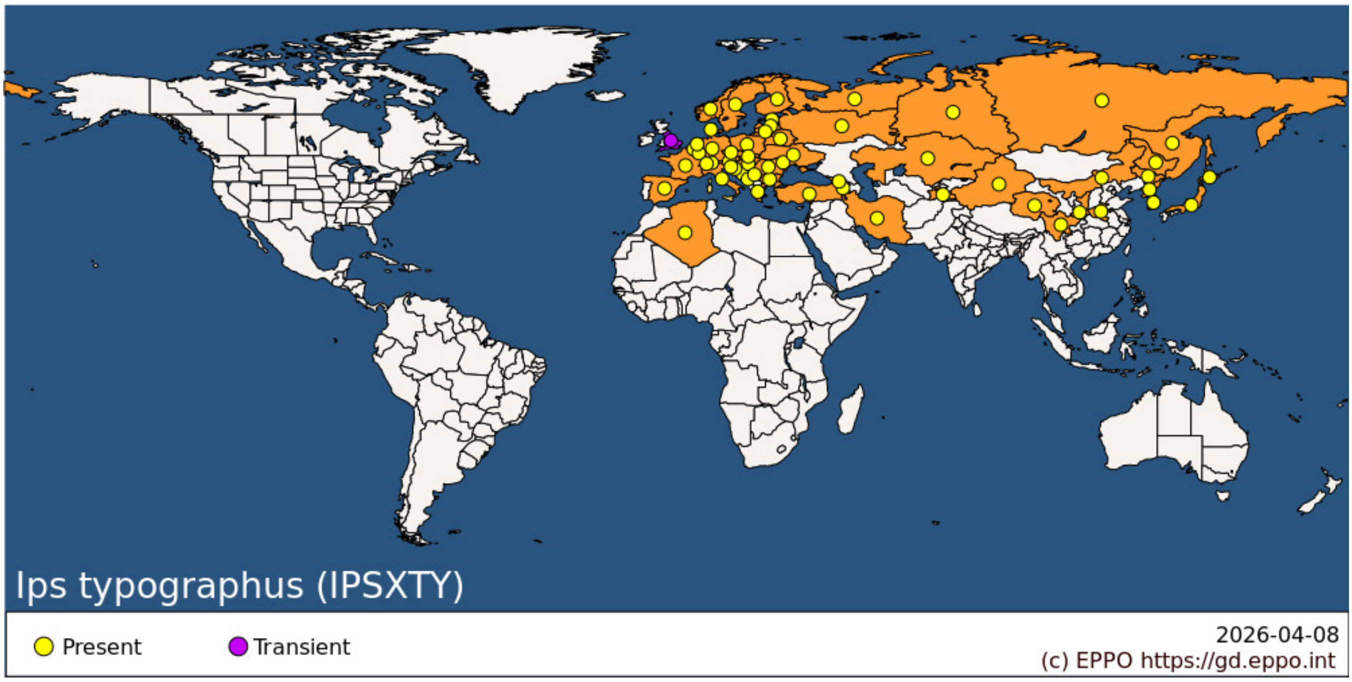
HOSTS

The main host of *I. typographus* in Europe is *Picea abies* (Norway spruce) and other species of *Picea* (e.g. *P. orientalis, P. jezoensis)* serve as hosts in Asia. It also attacks other conifers such as *Pinus* (*P. sylvestris, P. cembra, P. sibirica, P. koraiensis*), *Abies* (*A. alba, A sibirica, A. holophylla, A. nephrolepis, A. nordmanniana, A. sachalinensis*), *Larix (L. decidua, L. sibirica*) and *Pseudotsuga (P. menziesii*).

Host list: *Abies alba*, *Abies holophylla*, *Abies nephrolepis*, *Abies nordmanniana*, *Abies sachalinensis*, *Abies sibirica*, *Larix decidua*, *Larix sibirica*, *Picea abies*, *Picea glehnii*, *Picea jezoensis*, *Picea obovata*, *Picea omorika*, *Picea orientalis*, *Pinus cembra*, *Pinus contorta*, *Pinus koraiensis*, *Pinus sibirica*, *Pinus strobus*, *Pinus sylvestris*, *Pseudotsuga menziesii*

GEOGRAPHICAL DISTRIBUTION

I. typographus is widespread in two continents, Europe, including the European part of Russia, and Asia. It is widely distributed in the distribution range of its main host, *Picea abies*. The distribution in Asia is trans-Palearctic, covering Russia (Siberia and the Far East), China, Mongolia, Korean peninsula and Japan. It is also found in Africa in Algeria (Douglas *et al*., 2019). *I. typographus* is present both in the lowlands and mountains.



EPPO Region: Algeria, Armenia, Austria, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Czechia, Denmark, Estonia, Finland, France (mainland), Georgia, Germany, Greece (mainland), Hungary, Italy (mainland), Kazakhstan, Latvia, Liechtenstein, Lithuania, Luxembourg, Moldova, Republic of, Montenegro, Netherlands, Norway, Poland, Romania, Russian Federation (Central Russia, Eastern Siberia, Far East, Northern Russia, Western Siberia), Serbia, Slovakia, Slovenia, Spain (mainland), Sweden, Switzerland, Türkiye, Ukraine, United Kingdom (England)
Africa: Algeria
Asia: China (Heilongjiang, Henan, Jilin, Neimenggu, Qinghai, Shaanxi, Sichuan, Xinjiang), Iran, Islamic Republic of, Japan (Hokkaido, Honshu), Kazakhstan, Korea, Democratic People's Republic of, Korea, Republic of, Tajikistan

BIOLOGY

A comprehensive description of the biology and ecology of *I. typographus* is given by Chararas (1962), Christiansen & Bakke (1988), Wermelinger (2004), Maslov (2010) and Kausrud *et al*. (2011), EFSA (2017). The insect can overwinter in all development stages (eggs, larvae, pupae and adults). The eggs, larvae, pupae and adults overwinter in the galleries under the bark of the host tree and the adults can also overwinter in stumps, litter or mineral soil at a depth of 6-8 cm close to the tree where they developed. In the cold winter regions (e.g. in Russia), a 20-cm layer of snow is a reliable protection from frost for adults, but eggs, larvae and pupae die under the snow. According to Annila (1969), the mortality of beetles under the snow was 2-7% and above the snow was 65 -100%. Frosts below -24°C can cause 100% mortality beetle stages on standing trees. Larvae and pupae have supercooling points of -13 and -17°C, respectively, while adults can tolerate winter temperatures close to -30°C. Spring flights occur when the air temperature rises to about 18-20°C and temperature of forest litter reaches 8°C (Annila, 1969; Bakke *et al*., 1977a; Maslov, 2010).

Dispersal by adult flight can be very wide, sometimes over tens of kilometers (Forsse & Solbreck, 1985). Upon emergence, the males constitute 30–50% of the population (Lobinger, 1996). They start colonising either weakened (e.g. fallen trees) or healthy trees and attract conspeci?cs of both sexes with aggregation pheromones (Annila, 1969; Bakke, 1970, 1976; Bakke *et al*.,1977b; Birgersson *et al*., 1984).

Each male that has excavated a nuptial chamber in the phloem is joined by one to four females, which each bore a maternal gallery in the phloem, parallel to the phloem ?bres and lay one by one eggs at regular intervals (Anderbrant, 1990), each in a small niche created in the lateral wall of the maternal gallery. If there is one female per male, the maternal gallery is directed towards the top of the tree. However, if there are two females per male, the galleries extend upwards and downwards. When there are three females, one gallery extends upwards and two galleries extend downwards. The egg niches are located on both sides of the maternal galleries. Each female lays up to 80 eggs.

Oviposition and fecundity are dependent on the population/infestation density and temperature, where lower temperatures inhibit fecundity (Wermelinger & Seifert, 1999; CABI, online).

After egg-laying, the parent adults often re-emerge, ?y away and establish sister broods on new host trees. Each larva excavates an individual gallery perpendicular to the maternal gallery. Pupation occurs in a small niche in the phloem, at the end of each larval gallery. After metamorphosis, the young adults remain under the bark for maturation feeding before they disperse.

The number of generations per year depends on the climatic conditions. In favourable climatic conditions, the full development of one generation takes from 2 to 3 months. In the lowlands of Europe, the insect usually has two generations (excluding sister generations), but during extremely hot and long summers the number of generations can reach three. In the mountains, especially at higher altitudes, as well as in the north of Eurasia, only one generation develops per year.

At low, endemic population levels, the beetles mostly establish on weakened trees. When populations increase, for example after a storm has provided a large amount of suitable material, the beetles start attacking healthy trees. Host trees have defense mechanisms against attacking beetles (e.g. resin exudates and changes in the chemical composition of the phloem) (Christiansen *et al*., 1987). During the infestation process by the beetles, pathogenic ophiostomatoid fungi which are transmitted by the beetles inoculated to the host (Solheim, 1986; Kirisits, 2004; Linnakoski *et al*., 2016) and thus both pests contribute to tree death.

The impact of fungi associated with *I. typographus* has been analysed by many authors (e.g. Solheim, 1986; Yamaoka *et al*., 1997; Viiri & Lieutier, 2004; Salle *et al*., 2005; Linnakoski *et al*., 2016). Kirisits (2004) indicated 23 species of ophiostomatoid fungi associated to *I. typographus* that are isolated from the galleries of the beetles. Some of these species (e.g. *Endoconidiophora polonica* [= *Ceratocystis polonica* = *Ophiostoma polonicum*]) are virulent tree pathogens (Christiansen, 1985). The major triggers for *I. typographus* outbreaks are the availability of weakened trees or storm-felled timber, summer rainfall de?cits and warm temperatures.

DETECTION AND IDENTIFICATION

Symptoms

Trees that are infested by *I. typographus* have discoloured crowns. Frass (light-brown sawdust) can be found on the bark in the basal part of the stems of standing trees. The entrance holes of the beetles are visible on the surface of the bark. Initially these are found in the stem below the crown base. Subsequent attacks occur in the lower parts of the stem, including attacks at human eye-level. Usually three but sometimes two or four female galleries run from a nuptial chamber under the bark of plant host. Length may vary with gallery density, but 10-12 cm is an average length. Woodpeckers, in search of developing larvae, often break off the bark of attacked stems (Chararas, 1962; CABI, online). Blue-stain fungi are normally transferred with the beetle and grow into the wood around the gallery.

Morphology

Adult. The adults are 4.0-5.5 mm long, 2.3-2.5 times longer than wide, cylindrical, brown to dark brown, shiny and hairy. The antennae are clavate. Both sexes have four spines at each side of the elytral declivity. The third is the largest and is capitate. The declivity surface is dull and finely punctate (Balachowsky, 1949; Grüne, 1979; Douglas *et al*., 2019).

Egg. The eggs are whitish-grey, ovate, less than 1 mm long. They are laid individually in niches along both sides of the maternal gallery.

Larva. The larvae and adults are similar in size. They are white, cylindrical and legless, with small, brown, chitinous heads and brown mandibles.

Pupa. The pupa has many free segments. It is white and similar in size to the adult (up to 5 mm).

Detection and inspection methods

The discoloration of attacked trees, due to the abnormal colour of the needles, is clearly visible. The bark that is broken off by woodpeckers is also a clear symptom of infestation. The frass on the bark surface and at the tree base is easy to find. When looking under the bark, the nuptial chambers, maternal galleries, larvae and pupae are easy to locate. In the advanced phase of attack, the entrance holes and galleries under the bark can be found on standing trees. Similar symptoms can also be observed on fallen trees or logs gallery (Chararas, 1962; Christiansen & Bakke, 1988; Maslov, 2010; CABI, online).

PATHWAYS FOR MOVEMENT

Laboratory experiments have shown that adult *Ips* spp. can fly continuously for several hours. In the field, however, flight has only been observed to take place over limited distances and then usually downwind. The major part of the population, however, seems to fly within the forest (below tree tops), but nevertheless seems able to cover large areas during extended and repeated flights over several days. Roughly 10% of the population flies above the forest canopy and have the possibility of travelling considerable distances with winds sometimes over tens of kilometers (Forsse & Solbreck, 1985). Betles have been found in the stomach of trout in lakes 35 km from the nearest spruce forest, probably carried by the wind (Nilssen, 1978). Dispersal over long distances is also possible when transporting infested logs, firewood, wood chips, wood residues or bark.

PEST SIGNIFICANCE

Economic impact

Though *I. typographus* is the most damaging of all the European *Ips* spp. and the one which is sometimes reported to behave as a primary pest, it is nevertheless most often a secondary pest, attacking and killing trees which are already stressed for other reasons (Schwenke, 1996), or damaged by storms (Forster, 1993). It reproduces in the wood of spruce trees that have recently died, but when abundant it can colonize and kill living trees.

There are records of outbreaks dating from the fifteenth century (Germany). The losses in million cubic metres of wood that occurred during some of these outbreaks were as follows (Wellenstein, 1954; Schwerdtfeger, 1955; Worrell, 1983; Christiansen & Bakke, 1988; EFSA, 2017; CABI, online):

The losses of wood during *Ips typographus* outbreaks in some European countries.

Country	Years	Wood losses (in million cubic metres)
Germany	1857-1862	4.0
Germany	1868-1875	4.0
Germany	1917-1923	1.5
Germany	1940-1941	1.0
Germany	1944-1948	30.0

Sweden	1976-1979	2.0	
Norway	1970-1981	5.0	
Poland	1981-1987	9.0	
Czech Republic	1991-1999	6.7	
Austria	1993-1997	8.2	
Belarus	1993-1997	10.4	

Outbreaks can develop very quickly in spruce stands that are damaged by wind or snow, or stressed by drought or air pollution (Grodzki *et al.*, 2004). During such outbreaks, the population may increase sufficiently to start an epidemic. In an epidemic situation, *I. typographus* can overcome the resistance of healthy trees (Hedgren & Schroeder, 2004).

Since the turn of the 21st century, new outbreaks have developed in Germany, Switzerland, Austria, Slovakia, Poland, the Czech Republic, Ukraine, Lithuania (Grodzki, 2005), Georgia and Asia, including China. A recent outbreak in Central Europe has been ongoing since 2003 (Krehan & Steyrer, 2004; Lindelow & Schroeder, 2008; Lubojacký & Knízek, 2013). A significant increase in numbers of bark beetles occurred in the large area of the European Russia due to the hot and drought summer in 2010. As a result of this outbreak, the loss of spruce wood in just one Moscow region for 2010-2014 amounted to 22.2 million cubic meters.

Control

I. typographus is the only European *Ips* species important enough to be subject to control in Europe. The main aim of managing *I. typographus* is to minimize attacks on living trees. The most effective measure is to remove infested trees from the forest before the new generation of adult beetles emerges. Sanitation felling of infested trees involves the harvesting of windthrown timber (to remove breeding substrates), as well as the sanitation felling of infested standing trees (Wermelinger, 2004). In order to prevent the further development of bark beetles (pupae or young adults inside the bark) the debarking of logs is recommended, followed by the destruction, processing or composting of the bark.

Alternatively, the infested logs may be sprayed with or immersed in water, which stops insect development and causes considerable mortality. Spraying infested logs with insecticides, such as pyrethroids.

The approach used to control *I. typographus* changed in the end of the 20th century with the discovery and production of an aggregation pheromone for the species. Since the 1970s, traps baited with pheromone lures have been commonly used for monitoring of *I. typographus* (Bakke, 1970; 1989; Bakke *et al.*, 1977a,b; Furuta *et al.*, 1985; Hrasovec *et al.*, 1995; Jakuš, 1998; Maslov, 2010).

Trap trees, pheromone traps, treated trap trees, standing trap trees and lure-baited fallen wood have been frequently used to capture and reduce numbers of *I. typ*ographus (Grégoire & Evans, 2004; Zahradník & Knízek, 2007). Trap-trees (freshly-felled spruce trees) are exposed to infestation and then removed or debarked.

Phytosanitary risk

I. typographus is not included to the EPPO Lists of pests recommended for regulation as a quarantine pests but is listed by OIRSA, the EU and some non-European counties. It has been repeatedly intercepted at ports in the United States (286 interceptions out of 6,825 inspection records for 1985–2000) and in New Zealand (43 interceptions out of 722 inspection records for 1952–2000) and this is a cause for concern in these countries (Haack, 2001; Brockerhoff *et al*., 2003; EFSA, 2017).

In the EPPO region, *I. typographus* is already common throughout the natural range of its hosts and has probably reached the natural limits of its distribution. Though it can be a serious pest, in epidemic form, from time to time, especially on trees which are stressed for other reasons, this does not qualify it as a quarantine pest. It does, however, present a certain risk to the islands of Great Britain and Ireland where *P. abies* does not naturally occur and where other *Picea* species and *Pinus sylvestris* have been widely planted. Between 1994 and 2015, there have been 34 interceptions of *I. typographus* and 26 interceptions of *Ips* spp. in the UK and Ireland (EFSA, 2017). The main pathways of entry are wood of *Abies, Larix, Pinus, Picea* and *Pseudotsuga* from countries where the pest is present. The probability of natural spread to these islands remains low, so phytosanitary measures could be justified.

PHYTOSANITARY MEASURES

Countries in which *I. typographus* is absent may require phytosanitary measures to be applied to the coniferous commodities imported from the areas where this pest is present. The following phytosanitary measures recommended by the EPPO Standard PM 8/2 (3) ‘Coniferae’ are considered to be effective against bark beetles including *I. typographus*. Plants for planting, cut branches (including cut Christmas trees), round wood or other parts of the host plants of *I. typographus* originating from the countries in which *I. typographus* is present should originate from a pest-free area. If not, the following phytosanitary measures are required to import round wood from the area where the pest is present: wood should be bark-free or heat-treated (EPPO, 2008a), or fumigated with appropriate fumigant, or treated with ionizing radiation (EPPO 2008b). Harvesting wood residues, processing wood residues, hogwood and wood chips of the host should be produced from debarked wood or heat-treated. The heat treatment is also required for import of isolated bark. Wood packaging materials should meet requirements of ISPM no. 15 (ISPM, 2018).

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CABI and EFSA resources used when preparing this datasheet

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Datasheet history

This datasheet was first published in 1992 in 'Quarantine Pests for Europe' and revised in 1997. It is now maintained in an electronic format in the EPPO Global Database. The sections on 'Identity', 'Hosts', and 'Geographical distribution' are automatically updated from the database. For other sections, the date of last revision is indicated on the right.

CABI/EPPO (1992/1997) *Quarantine Pests for Europe (1st and 2nd edition)*. CABI, Wallingford (GB).

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