EPPO Datasheet: *Ips duplicatus*

Last updated: 2021-10-19

IDENTITY

Preferred name: *Ips duplicatus*
Authority: (Sahlberg)
Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta: Coleoptera: Curculionidae: Scolytinae
Other scientific names: *Bostrichus duplicatus* Sahlberg, *Bostrichus judeichi* Kirsch, *Cyrtotomicus rectangulus* Ferrari, *Tomicus infucatus* Eichhoff
Common names: northern bark beetle
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EU Categorization: PZ Quarantine pest ((EU) 2019/2072 Annex III)
EPPO Code: IPSXDU

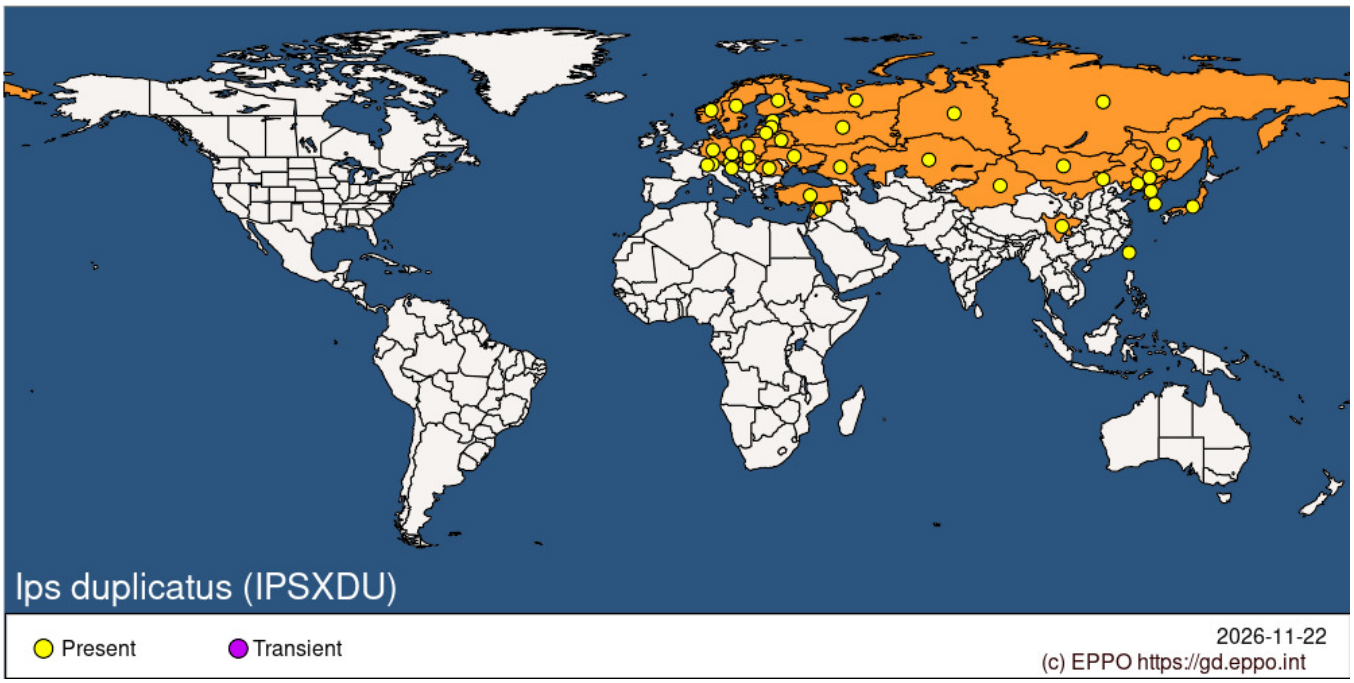
HOSTS

The main hosts of *I. duplicatus* are various species of spruce including *Picea abies* in Europe, *Picea obovata* in the European and Siberian parts of Russia, *Picea jezoensis* on Sakhalin Island (Russia), and *Picea koraiensis* in China. *I. duplicatus* may also attack pine (*Pinus* spp.), less commonly larch (*Larix* spp.), and in exceptional cases, fir (*Abies* spp.) Douglas fir (*Pseudotsuga menziesii*), and juniper (*Juniperus* spp.) (Izhevskiy *et al.*, 2005; Holuša & Grodzki, 2008; Kašák & Foit, 2015).

Host list: *Abies holophylla, Abies sibirica, Juniperus sp., Larix decidua, Larix gmelinii, Larix sibirica, Picea abies, Picea fennica, Picea jezoensis, Picea obovata, Picea omorika, Pinus cembra, Pinus koraiensis, Pinus sibirica, Pinus strobus, Pinus sylvestris, Pseudotsuga menziesii*

GEOGRAPHICAL DISTRIBUTION

The northern bark beetle *I. duplicatus* is a Eurasian species. The pest is widespread in Russia and neighboring Asian countries (Douglas *et al.*, 2019; CABI, 2021). In Europe it was originally restricted to northern countries, however, it has expanded its distribution range to Eastern Europe. In the middle of the last century, *I. duplicatus* spread to the southeast and has recently been moving west (Wermelinger *et al*., 2020).



EPPO Region: Austria, Belarus, Czechia, Estonia, Finland, Germany, Hungary, Kazakhstan, Latvia, Liechtenstein, Lithuania, Norway, Poland, Romania, Russian Federation (Central Russia, Eastern Siberia, Far East, Northern Russia, Southern Russia, Western Siberia), Slovakia, Slovenia, Sweden, Switzerland, Türkiye, Ukraine
Asia: China (Heilongjiang, Jilin, Liaoning, Neimenggu, Sichuan, Xinjiang), Japan (Honshu), Kazakhstan, Korea, Democratic People's Republic of, Korea, Republic of, Mongolia, Syrian Arab Republic, Taiwan

BIOLOGY

The northern bark beetle *Ips duplicatus* is native to Northern Europe, Siberia, and East Asia. It is adapted to low temperatures, short growing seasons, and usually has one generation per year in these areas (Wermelinger *?t al.*, 2020). In the southern regions, where it is spreading as a result of the expansion of its range, it can have two to three generations per year, depending on climatic conditions. *I. duplicatus* has a very similar biology to the widespread European spruce bark beetle *I. typographus*.

I. duplicatus usually overwinters as an adult stage in forest litter, but beetles can also overwinter in the phloem of trees when the last generation has not had time to complete full development. It most often attacks standing trees, 40-70 years old, which have been weakened by drought stress, or by pathogens, but rarely attacks fallen trees or cut logs (Izhevskiy *et al.*, 2005; Holuša & Grodzki, 2008; Holuša *et al.*, 2010; Wermelinger *et al.*, 2020). Usually, *I. duplicatus* colonizes the upper part of the trunk and large branches unlike *Ips typographus* which usually infests lower parts. However, under epidemic conditions, the part of the tree infested by *I. duplicatus* can be much larger and reach the middle and basal parts of the trunks.

The species is polygamous, and the males initiate gallery construction and produce an aggregation pheromone consisting of ipsdienol (Bakke, 1975) and E-myrcenol (Bakke, 1975; Byers *et al.*, 1990; Ivarsson *et al.*, 1993; Ivarsson & Birgersson, 1995).

After having excavated a nuptial chamber in the phloem, each male is joined by 1–5 females. The beetle produces a gallery system nearly identical to that of *I. typographus* but smaller (7-10 cm) and with maternal galleries. One female produces up to 60 offspring. The speed of brood development is similar to that of *I. typographus* (Schlyter *et al.*, 1987). Development of one generation under Central European climatic conditions usually takes about 6-8 weeks *I. duplicatus* can co-occur with some other species of bark beetles, mainly *I. typographus, I. amitinus* and *Pityogenes chalcographus*, which can be competitors (Holuša *et al.*, 2010).

A general description of the biology of *I. duplicatus* is provided by Izhevskiy *et al.*, (2005); Holuša & Grodzki (2008), Holuša *et al.*, (2010), CABI (2021), Wermelinger *et al.*, (2020).

DETECTION AND IDENTIFICATION

Symptoms

Galleries are usually found in standing trees, less often on logs, and in the upper part of trees where the bark is relatively thin. Larger branches can also be used for reproduction. Each gallery has up to five longitudinal female egg galleries. Trees that are infested by *I. duplicatus* have discoloured crowns. The needles are lighter in colour and often fall to the ground. The frass can be found on the bark, on the basal part of the tree trunk. Woodpeckers, in search of larvae, often break off the bark of infested trees.

Morphology

Adult

Beetles are 2.6-4.3 mm long, 2.3-2.5 times longer than wide; dark-brown, shiny and hairy, with four spines at each side of the elytral declivity. The second and third spines arise from a tumescence which forms an arcuate ridge between them. This is most distinct in the male where the third spine is the largest and is capitate (Balachowsky, 1949; Grüne, 1979; Douglas *et al*., 2019; CABI, 2021).

Egg

The eggs are whitish-grey, ovate and small (0.7 mm long).

Larva

The larvae and adults are similar in size, white, cylindrical and legless.

Pupa

The pupae have many free segments (pupa libera). They are white and similar in size to the adults.

Detection and inspection methods

The symptoms of early infestations are not very evident. The standing infested trees die during the *I. duplicatus* colonisation, with an obvious discolouration of their crown, which becomes brown, and then grey after the needles have shed (EFSA, 2017). The frass on the bark surface and around the tree base is easy to find during periods of good weather. However, it disappears after rainfall. Another obvious symptom of infestation is bark that has been broken off by woodpeckers (CABI, 2021; EFSA, 2017).

I. duplicatus mostly attacks individual weakened standing trees in the stands. Attacked trees are often dispersed inside the stands and sometimes on the stand edges.

The nuptial chambers, maternal galleries on the infected dying trees are easy to find under the bark. The galleries of *I. duplicatus* are however very similar to those of *Ips typographus* (Balachowsky, 1949). The sapwood shows blue staining due to the fungi that are carried by the beetles.

Pheromone traps can also be used for detection.

Ips species identification is possible by using the illustrated dichotomous key and interactive LUCID keys developed by Douglas *et al.* (2019). Both include multiple routes to identification of one or both sexes of *Ips* species including *I. duplicatus*. Research is also being carried out on the use of molecular tests for *I. duplicatus* (Becker *et al.*, 2021).

PATHWAYS FOR MOVEMENT

Studies carried out in laboratory conditions have shown that *Ips* spp. can fly continuously for several hours, but in

nature, the flight distances are usually much shorter. It was found that the flight distance of a related species, *Ips sexdentatus*, is usually about 5 km, but some individuals can fly up to 45 km (Jactel & Gaillard, 1991). Nilssen (1978) reports that beetles have been found in the stomach of trout in lakes 35 km from the nearest spruce forest, probably carried by the wind. Spread over long distances can occur by transporting the pest under the bark of logs, as well as with plants for planting, isolated bark or wood chips.

PEST SIGNIFICANCE

Economic impact

Since the end of the last century, this beetle has become an invasive species in European spruce forests (Wermelinger *et al.*, 2020; CABI, 2021). With the expansion of the range of *I. duplicatus* to the south, under certain conditions when it reaches 3 generations, it can become an economically important pest (Holuša *et al.*, 2010).

In recent years, more frequent and hotter periods of drought have favoured the infestation of spruce trees by bark beetles (Mezei *et al.*, 2017; Knížek & Liška, 2018). A significant increase in the distribution area and population density of *I. duplicatus* in recent years has been observed in the Czech Republic, Romania, Slovakia and Poland (Holuša *et al*., 2010; Olenici *et al.*, 2009; Duduman *et al*., 2011; Knížek & Liška, 2018). In the northeastern part of the Czech Republic, *I. duplicatus* was involved in up to 80 % of spruce infestations (Holuša *et al*., 2010). It should be noted that in these countries *I. duplicatus* often colonizes younger trees with thinner bark, in contrast to *I. typographus* which usually prefers older trees (Duduman *et al.*, 2011; Wermelinger *et al*., 2020).

The damage from *I. duplicatus* is difficult to assess because it is often found together with *I. typographus* (Grodzki, 2012; Duduman *et al.*, 2011; Wermelinger *et al.*, 2020).

Control

According to Wermelinger *et al*. (2020), the challenge with northern bark beetle infestations is that its management is more complex than for *I. typographus*. Firstly, sanitation felling during winter is generally only effective against *I. typographus*, not against *I. duplicatus*, because the second generation of *I. duplicatus* leaves its brood trees in autumn to overwinter in the litter layer. Additionally, *I. duplicatus* infestations occurring in tree crowns are more difficult to detect. Because of this beetle's faster larval development, the crowns often turn brown only after the beetles have already left the trees (Holuša *et al.*, 2010; EFSA, 2017).

Control measures for *I. duplicatus* are similar to those for other bark beetles and include the use of pheromone traps for monitoring and mass trapping of the pest with trap trees.

Phytosanitary risk

I. duplicatus is absent in the islands of Great Britain, Ireland and Greece that are EU Protected Zones, and in these areas, the introduction of conifers (round wood; plants for planting, isolated bark) from countries where this pest is present is banned (EFSA, 2017).

Due to the expansion of the range to the western and southern territories, and also considering that the northern bark beetle can be a primary pest, some countries (Morocco, South Africa, Jordan, Turkey) included *I. duplicatus* in their quarantine lists (EFSA, 2017; EPPO, 2021a).

If *I. duplicatus* were always accompanied by *I. typographus*, it would be irrelevant for trees whether they are infested by *I. typographus* alone or by both bark beetle species; as they are bound to die in any case (Wermelinger *et al.*, 2020). If, however, the northern bark beetle was able to colonize and eventually kill a substantial number of trees in its own right, this could lead to additional mortality in Norway spruce (*Picea abies*) or other conifers. Moreover, the northern bark beetle can also carry ophiostomatoid fungi: *Ceratocystis polonica; Ophiostoma bicolor; O. penicillatum; O. piceae; O. piceaperdum; Ophiostoma* sp.*; Pesotum* sp. It is considered that *C. polonica* is a particularly virulent pathogen (Kirisits, 2004).

PHYTOSANITARY MEASURES

If it is judged necessary to take phytosanitary measures against *I. duplicatus*, those taken against *I. typographus* and other *Ips* species would be effective (EPPO, 2021b). The following phytosanitary measures recommended by the EPPO Standard PM 8/2 (3) 'Coniferae' are considered to be effective against bark beetles. Plants for planting, cut branches (including cut Christmas trees), round wood or other parts of the host plants of *I. duplicatus* originating from the countries in which *I. duplicatus* 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, 2009a), or fumigated with appropriate fumigant, or treated with ionizing radiation (EPPO, 2009b). Harvesting wood residues, processing wood residues, hogwood and wood chips of the host should be produced from debarked or heat-treated wood. The heat treatment is also required for import of isolated bark. Wood packaging material should meet requirements of ISPM no. 15 (ISPM, 2018).

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Datasheet history

This datasheet was first published in 1997 in the second edition of 'Quarantine Pests for Europe', and revised in 2021. 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 (1997) *Quarantine Pests for Europe (2nd edition)*. CABI, Wallingford (GB).

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