

# 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

[view more common names online...](#)

**EU Categorization:** PZ Quarantine pest (Annex III)

**EPPO Code:** IPSXDU

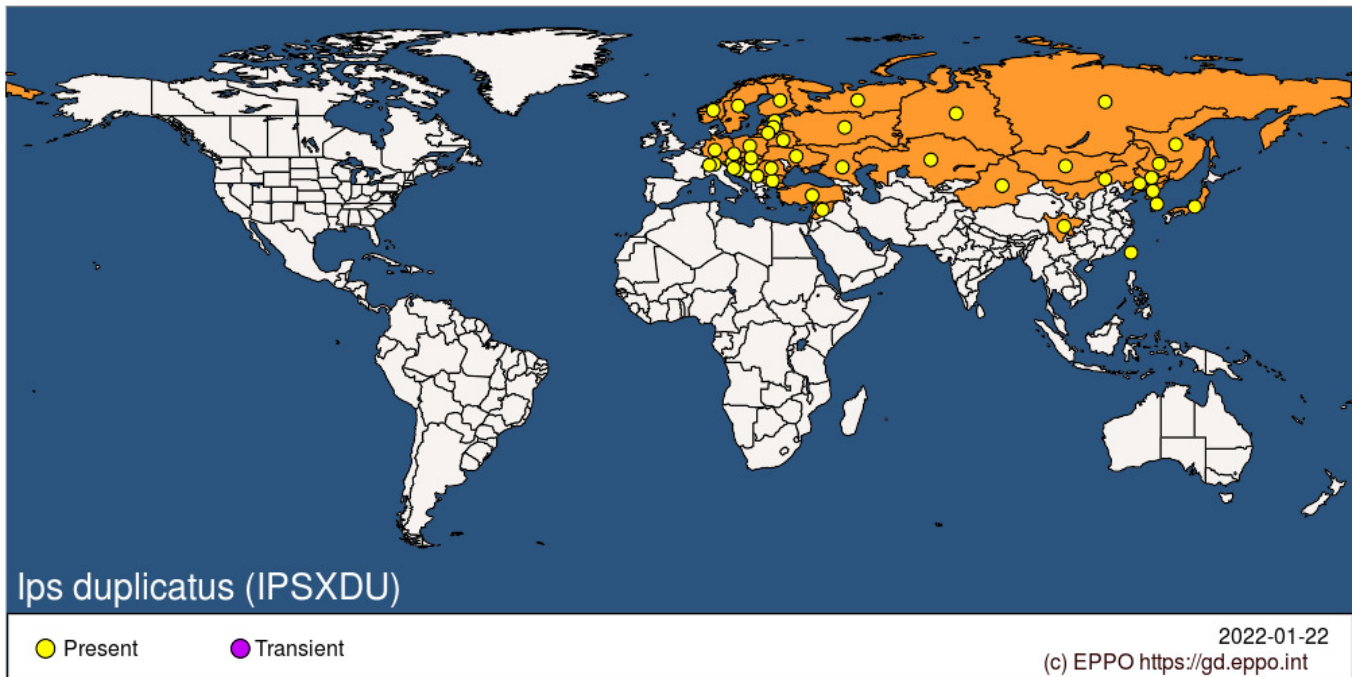
## HOSTS

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 cajanderi*, *Larix decidua*, *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, Bulgaria, Croatia, Czech Republic, Estonia, Finland, Germany, Hungary, Kazakhstan, Latvia, Lithuania, Norway, Poland, Romania, Russia (Central Russia, Eastern Siberia, Far East, Northern Russia, Southern Russia, Western Siberia), Serbia, Slovakia, Slovenia, Sweden, Switzerland, Turkey, Ukraine

**Asia:** China (Heilongjiang, Jilin, Liaoning, Neimenggu, Sichuan, Xinjiang), Japan (Honshu), Kazakhstan, Korea Dem. People's Republic, Korea, Republic, Mongolia, Syria, 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 *et 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).

## REFERENCES

- Bakke A (1975) Aggregation pheromone in the bark beetle *Ips duplicatus* (Sahlberg). *Norwegian Journal of Entomology* **22**, 67-69.
- Balachowsky A (1949) Coleoptera, Scolytides. Faune de France 50. P. Lechevalier, Paris, France.
- Becker M, König S & Hoppe B (2021) A simple PCR-based approach for rapid detection of *Ips typographus* and *Ips duplicatus* in the presence of (associated) symbionts and parasites. *Journal of Plant Diseases and Protection* **128** (2), 527-534.
- Byers JA, Schlyter F, Birgersson G & Francke W (1990) E-myrcenol in *Ips duplicatus*: an aggregation pheromone component new for bark beetles. *Experientia* **46**, 1209–1211.

- CABI (2021) Invasive Species Compendium, online. Datasheet report for *Ips duplicatus* (double-spined bark beetle). Available online: <https://www.cabi.org/isc/datasheet/28823> [Accessed: 11 September 2021]
- Douglas HB, Cognato AI, Grebennikov V & Savard K (2019) Dichotomous and matrix-based keys to the *Ips* bark beetles of the World (Coleoptera: Curculionidae: Scolytinae). *Canadian Journal of Arthropod Identification*, **38**, 234 pp. <https://doi.org/10.3752/cjai.2019.38>
- Duduman ML, Isaia G & Olenici N (2011) *Ips duplicatus* (Sahlberg) (Coleoptera: Curculionidae, Scolytinae) distribution in Romania – preliminary results. *Bulletin of the Transilvania University of Bras?ov Series II* **4**, 19–26. <https://www.cabi.org/isc/FullTextPDF/2012/20123387814.pdf>
- EFSA (2017) PLH Panel (EFSA Panel on Plant Health), Jeger M, Bragard C, Caffier D, Candresse T, Chatzivassiliou E, Dehnen-Schmutz K, Gilioli G, Jaques Miret JA, MacLeod A, Navajas Navarro M, Niere B, Parnell S, Potting R, Rafoss T, Rossi V, Urek G, Van Bruggen A, Van der Werf W, West J, Winter S, Kertesz V, Aukhojee M, Grégoire J-C. Scientific Opinion on the pest categorisation of *Ips duplicatus*. *EFSA Journal* **15**(10), 5040, 25 pp. <https://doi.org/10.2903/j.efsa.2017.5040>
- EPPO (2009a) Standard PM 10/6 Heat treatment of wood to control insects and wood-borne nematodes. *EPPO Bulletin* **39**(1), p 31. <https://doi.org/10.1111/j.1365-2338.2009.02227.x>
- EPPO (2009b) Standard PM 10/8 Disinfestation of wood with ionizing radiation. *EPPO Bulletin* **39**(1), 34-35. <https://doi.org/10.1111/j.1365-2338.2009.02229.x>
- EPPO (2021a) EPPO Global Database (available online). <https://gd.eppo.int> EPPO (2021b) *Ips typographus*. EPPO datasheets on pests recommended for regulation. Available online. <https://gd.eppo.int>
- Grodzki W (2012) Two types of Norway spruce *Picea abies* (L.) H. Karst. infestation by the double spined bark beetle *Ips duplicatus* C.R. Sahlb. (Coleoptera: Scolytinae) in southern and north-eastern Poland. *Folia Forestalia Polonica series A* **54**, 169–174. <https://zenodo.org/record/30734/files/grodzki-12-3-4.pdf>
- Grüne S (1979) Brief illustrated key to European bark beetles. M. & H. Schaper, Hannover, Germany.
- Holuša J & Grodzki W (2008) Occurrence of *Ips duplicatus* (Coleoptera: Curculionidae, Scolytinae) on pines (*Pinus* sp.) in the Czech Republic and southern Poland - Short Communication. *Journal of Forest Science* **54**, 234–236. <https://doi.org/10.17221/18/2008-JFS>
- Holuša J, Lubojacký J & Knížek M (2010) Distribution of the double-spined spruce bark beetle *Ips duplicatus* in the Czech Republic: spreading in 1997–2009. *Phytoparasitica* **38**, 435–443. <https://doi.org/10.1007/s12600-010-0121-9>
- ISPM (2018) International Standards for Phytosanitary Measures no. 15. Guidelines for Regulating Wood Packaging in International Trade. FAO, Rome (IT).
- Ivarsson P & Birgersson G (1995) Regulation and biosynthesis of pheromone components in the double spined bark beetle *Ips duplicatus* (Coleoptera, Scolytidae). *Journal of Insect Physiology* **41**, 843–849.
- Ivarsson P, Schlyter F & Birgersson G (1993) Demonstration of de novo pheromone biosynthesis in *Ips duplicatus* (Coleoptera: Scolytidae): inhibition of ipsdienol and E-myrcenol production by compaction. *Insect Biochemistry and Molecular Biology* **6**, 655–662.
- Izhevskiy SS, Nikitskiy NB, Volkov OG & Dolgin MM (2005) [Illustrated guide to coleopteran – xylophagous pests of forests and timber of Russia]. Tula: Grif and Co. 218 pp (in Russian).
- Jactel H & Gaillard J (1991) A preliminary study of the dispersal potential of *Ips sexdentatus* with an automatically recording flight mill. *Journal of Applied Entomology* **112**, 138-145.
- Kašák J & Foit J (2015) Double-spined bark beetle (*Ips duplicatus*) (Coleoptera: Curculionidae): a new host – Douglas fir (*Pseudotsuga menziesii*) – Short Communication. *Journal of Forest Science* **61**(6), 274-276.

Kirisits T (2004) Fungal associates of European bark beetles with special emphasis on the ophiostomatoid fungi. In: Lieutier F, Day KR, Battisti A, Gregoire JC and Evans HF (eds.) Bark and wood boring insects in living trees in Europe, a synthesis. Springer, Netherlands, 181–236.

Knížek M & Liška J (2018) Occurrence of forest damaging agents in 2017 and forecast for 2018. Supplementum, VULHM, Jiřlovisřteř, 70 pp (in Czech).

Mezei P, Jakuř R, Pennerstorfer J, Havařov M, řkvarnina J, Ferenřfk J, Slivinsk J, Biřrov S, Bilřfk D, Blařenec M & Netherer S (2017) Storms, temperature maxima and the Eurasian spruce bark beetle *Ips typographus* – An infernal trio in Norway spruce forests of the Central European High Tatra Mountains. *Agricultural and Forest Meteorology* **242**, 85–95.

Nilssen AC (1978) Development of a bark fauna in plantation of spruce (*Picea abies* (L.) Karst.) in North Norway. *Astarte* **11**, 151-169.

Olenici N, Duduman ML, Tulbure C & Rotariu C (2009) *Ips duplicatus* (Coleoptera, Curculionidae, Scolytinae) – an important insect pest of Norway spruce planted outside its natural range. *Revista Přdurilor* **124**, 17–24 (in Romanian).

Schlyter F, Byers JA & Lřfquist J (1987) Attraction to pheromone sources of different quantity, quality, and spacing: density-regulation mechanisms in bark beetle *Ips typographus*. *Journal of Chemical Ecology* **13**, 1503-1524.

Wermelinger B, Mathis DS, Knížek M & Forster B (2020) Tracking the spread of the northern bark beetle (*Ips duplicatus* [Sahlb.]) in Europe and first records from Switzerland and Liechtenstein. *Alpine Entomology* **4**, 179–184. <https://doi.org/10.3897/alpento.4.53808>

## ACKNOWLEDGEMENTS

This datasheet was extensively revised in 2021 by Dr Oleg Kulinich (All-Russian Center for Plant Quarantine). His valuable contribution is gratefully acknowledged.

## How to cite this datasheet?

EPPO (2022) *Ips duplicatus*. EPPO datasheets on pests recommended for regulation. Available online. <https://gd.eppo.int>

## 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* (2<sup>nd</sup> edition). CABI, Wallingford (GB).



Co-funded by the  
European Union