

Is the double-spined bark beetle *Ips duplicatus* a new threat to *Picea omorika* in urban habitats?

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Abstract: The double-spined bark beetle *Ips duplicatus* (Coleoptera: Curculionidae, Scolytinae) is an invasive forest pest having a broad range of coniferous hosts within Europe. We found this species to be also developing in the Serbian spruce *Picea omorika*. *Ips duplicatus* infested 14 (52%) of 27 *P. omorika* mature trees in an arboretum garden in northern Slovakia in Central Europe during the summer of 2019. Logs from the upper part of stems of *P. omorika* trees placed in electors in the laboratory, yielded a total of 179 individuals of three scolytine species, with prevalence of *I. duplicatus*. Our results show that *I. duplicatus* also colonized less likely host such as the Serbian spruce, causing threat to this ornamental tree and contributing to its mortality in urban habitats during hot and dry summer weather.

Keywords: Serbian spruce; invasive insect; tree health; urban forestry

The Serbian spruce, *Picea omorika* (Pančić) Purkyně occurs naturally only in small area at the boundary of Serbia and Bosnia-Herzegovina (Ballian et al. 2016). In the past it was planted for the production of timber (Savill et al. 2017). Today, *P. omorika* has been gaining in importance for its aesthetic appearance (a tree with the silvery sheen of the crown) and tolerance to pollution in urban habitats (Ballian et al. 2016). There are many cultivars of *P. omorika* growing as ornamental trees in towns and arboreta (Krüssmann 1985).

The Serbian spruce is the host of at least nine species of bark beetles in the Central and Western Palearctic regions (Pfeffer 1995). Currently there are no detailed data on insects and diseases affecting *P. omorika*, but it is susceptible to scolytine beetles

such as *Ips typographus* and *Dendroctonus micans* (Coleoptera: Curculionidae, Scolytinae) and a few other insect pests associated with Norway spruce (*Picea abies* L. Karsten) (Ballian et al. 2016).

The double-spined bark beetle *Ips duplicatus* Sahlberg (Coleoptera: Curculionidae, Scolytinae) is native to the Palearctic region (Wood & Bright 1992; Pfeffer & Knížek 1995; Duduman et al. 2011). It has a wide range of coniferous hosts within Europe, including species of the genera *Picea*, *Pinus*, *Abies*, *Larix*, *Juniperus* as well as *Pseudotsuga menziesii* (Pfeffer 1989, 1995; Mrkva 1994, Holuša & Grodzki 2008, Kašák & Foit 2015). In Central Europe, *I. duplicatus* was recorded prior in the beginning of the 20th century (Wermelinger et al. 2020) and in Slovakia was first reported in 1920 (Roubal

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1937–1941). Since the 1990s it has become a serious pest of conifer trees (Holuša et al. 2010; Olenici et al. 2010). Now it occurs in at least 20 European countries (EPPO 2020).

In 1997, this species was frequently caught in pheromone traps in Slovakia (Vakula et al. 2007), and since then it has been monitored in the country every year. The double-spined bark beetle mainly attacks 40–70 years old standing Norway spruce trees in managed forests, mostly up to 800 m a.s.l. (Grodzki 2003). Approximately 10–50 thousand cubic meters of spruce timber infested by *I. duplicatus* is harvested in Slovakia every year (Vakula et al. 2019).

Herein, we provide the first record of infestation of *P. omorika* by *I. duplicatus* (supported by abundance data in infested trees) in an urban habitat (arboretum garden) in northern Slovakia in Central Europe.

MATERIAL AND METHODS

Our observations were made in an arboretum located at Liptovský Hrádok, northern Slovakia (49°2'31.52"N, 19°43'29.14"E; 640 m a.s.l.). In total, 27 *Picea omorika* trees (90 years old) were present here along with *P. abies*, *P. orientalis*, *P. pungens*, and *Pinus sylvestris*. On August 20, 2019, a total of 14 (52%) *Picea omorika* trees, with symptoms of crown damage, were felled and then examined for infestation by tree-pathogenic fungi and bark beetles. Two logs (each 80 cm long, 11.3 and 14.1 cm in diameter), each from the upper part of stems harvested from two trees, were cut and placed separately in electors in the laboratory (12 h of daylight, temperature at 20 °C, humidity at 55%) to obtain emerging adults of scolytines. Beetles were collected weekly up to October 21, 2019, preserved in 75% ethanol, counted and determined according to Pfeffer (1989).

RESULTS AND DISCUSSION

In May 2019, declining *P. omorika* trees were partially defoliated, with yellow to reddish-brown needles in the crown (Figure 1). The decline progressed throughout the growing season. On August 20, 2019, all of the felled trees with symptoms of crown damage were inhabited by *I. duplicatus* in the upper part of stem, with galleries (Figure 2), larvae, pupae and adults of this species found under the bark. The honey fungus [*Armillaria ostoyae*, (Romagnesi) Herink] was recorded at the base of four stems of the felled trees (29%).



Figure 1. A Serbian spruce, *Picea omorika*, infested by *Ips duplicatus*, partially defoliated with yellow to brown-reddish needles in the crown



Figure 2. Galleries of *Ips duplicatus* under the bark of Serbian spruce

They usually consist of 2–3 slightly curved maternal tunnels, each 4–7 cm long. Larval tunnels are approximately 5 cm long

Over the period August 20 – October 21, 2019, in total 179 adults belonging to three bark beetle species emerged from the logs in electors, namely: *I. duplicatus*, *I. typographus*, and *Pityogenes chalcographus*. *Ips duplicatus* was the most abundant species. It dominated bark beetle assemblages in each log (abundant with 67.6 or 70.4%, respectively) having densities of 1.7 and 2.2 specimens per 1 dm². Variation in abundance, relative abundance (in percentage) and density of the recorded species are shown in Table 1.

<https://doi.org/10.17221/7/2021-PPS>Table 1. Scolytine species emerged from two logs of *Picea omorika* from the locality Liptovský Hrádok in the period August 20 – October 21, 2019

Species	Log 1			Log 2		
	A	RA (%)	D	A	RA (%)	D
<i>Ips duplicatus</i>	48	67.6	1.7	76	70.4	2.2
<i>Ips typographus</i>	6	8.4	0.2	11	10.2	0.3
<i>Pityogenes chalcographus</i>	17	23	0.6	21	19.4	0.6

A – abundance; RA – relative abundance (%); D – density of adults per 1 dm²

Other recorded Coleoptera included five beetles of *Pogonocherus fasciculatus* DeGeer (Cerambycidae), and three beetles of *Rhizophagus depressus* Fabricius (Rhizophagidae). *Rhizophagus depressus* is a bark beetle predator of at least nine scolytine species including *Ips typographus* and *Pityogenes chalcographus* (Kenis et al. 2004).

Wood and Bright (1987) as well as Pfeffer (1989, 1995) do not list *P. omorika* as a host of *I. duplicatus*, and the European and Mediterranean Plant Protection Organization (EPPO) global database for hosts and pests categorizes its occurrence on the Serbian spruce as incidental within the genus *Picea* (EPPO 2020). Hence, our study provides first insights into the occurrence of *I. duplicatus* on *P. omorika*. It is suggested that this species of bark beetle may be present on the Serbian spruce frequently and abundantly (not incidentally) in the upper part of stem where it could outcompete i.e. *P. chalcographus*. *I. typographus*, *P. chalcographus* and *Armillaria ostoyae* rank among common pests of *P. omorika* (Vujičić & Budimir 1995; Ballian et al. 2016).

The decline of *P. omorika* within its native range, connected with excessive droughts, has been observed recently, suggesting that this rare and endangered tree species (Ballian et al. 2006, 2016) will face difficulties in adapting to climate change (Ivetic & Aleksic 2016). Trees weakened by the drought and the tree-pathogenic fungi of the genus *Armillaria* are preferred by *I. duplicatus* (Holuša 2004). *Ips duplicatus* can complete three generations per year if the weather is warm (Holuša et al. 2003). Its high numbers in Central Europe increase the significance of this secondary pest in respect of Norway spruce, Scots pine (Holuša & Grodzki 2008; Vakula et al. 2019) and other conifer species such as *P. omorika*. The frequent occurrence and predominance of *I. duplicatus* in infested *P. omorika* trees may present an additional threat to them in hot and dry summer weather. In Slovakia, the summer in 2018 was the hottest over the last four

decades, and that of 2019 was also exceptionally dry and warm (Sitková & Konôpka 2020).

Optimal breeding habitats of *I. duplicatus* in Central Europe are found in altitudes up to 800 m (Grodzki 2003; Holuša 2004). We recorded this species to be developing in *P. omorika* trees in town at 640 m a.s.l., with other conifer species and a Norway spruce forest nearby. *Ips duplicatus* occurs in forests near villages and towns as well as in agricultural landscapes and/or around sawmills and timber yards (Zahradník & Knížek 1998, Kašák & Foit 2015).

The occurrence of *I. duplicatus* can be overlooked in infested trees, as discoloration remains invisible for a long time after the attack (Schlyter & Anderbrant 1993). Therefore, the health of *P. omorika* and other coniferous hosts for bark beetles should be systematically monitored in urban greening and forests. We recommend removal of infested trees from public places before new beetles emerge.

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