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Eastern Hemlock (*Tsuga canadensis*) as a new host of *Pityokteines spinidens* in the arboretum in Europe

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Abstract: Bark beetle *Pityokteines spinidens* (Coleoptera: Curculionidae: Scolytinae) is widespread across Europe. We identified this species as a pest of *Tsuga canadensis* in western Bohemia's Americká zahrada National Nature Monument Arboretum. This discovery suggests that *P. spinidens* could infest any conifer within the Abietoideae subfamily. Given its status as a known pest of various *Abies* species, its potential impact on related conifers warrants further attention.

Keywords: Abietoideae; Abies; bark beetle; urban forestry; pest

Eastern Hemlock [*Tsuga canadensis* (L.) Carrière, 1855] originates from North America, with its introduction to Europe in 1736 and documented presence in Bohemia since 1812 (Pohl 1812). Today, *T. canadensis* is common in dendrological gardens and even forest stands in the Czech Republic (T. Fiala, pers. observ.). This species ranks among temperate European forests' most invasive exotic conifers (Fanal et al. 2021).

In its native range, *T. canadensis* hosts a range of bark beetle species, often associated with the closely related Western Hemlock (*T. heterophylla* Sarg., 1898) (Wood 1982). Documented species include *Ips borealis* Swaine, 1911 and *Orthotomicus latidens* (Le Conte, 1874), though local records remain uncertain (Kleine 1935). Furthermore, Kleine (1935) listed *Pityophthorus micrographus* (Linnaeus, 1758), but Pfeffer (1936) later corrected this as a misidentification. Most recent findings mention bark beetles such as *O. erosus* (Wollaston, 1857) (Walter et al. 2010), *P. pityographus* (Ratzeburg, 1837), *Trypodendron lineatum* (Olivier, 1800), and *Xyleborinus saxesenii* (Ratzeburg, 1837) (Bright & Skidmore 1997). However, no bark beetle species were recorded directly on *T. canadensis* by Wood (1982) or Wood and Bright (1992). A more detailed and recent list of bark beetles attacking *T. canadensis* in its native range is provided by Marchioro et al. (2024).

In Central Europe, three bark beetle species from the genus *Pityokteines* are known, all associated with fir (*Abies* spp.) and potentially damaging to various fir species. The most common, *Pityokteines spinidens* (Reitter, 1895), causes significant damage to fir stands (Knížek et al. 2019). Rare instances of larch (*Larix decidua* Mill., 1768) infestation have also been noted recently (Knížek et al. 2019). We document the first case of *P. spinidens* infesting *T. canadensis* under central European conditions in an arboretum in western Bohemia.

MATERIAL AND METHODS

Observations were conducted in the Americká zahrada National Nature Monument arboretum, located

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in Chudenice, western Bohemia (49°27'41.29" N, 13°9'29.65" E; 515 m a.s.l.). The arboretum contains 170 woody taxa from various global regions, including 41% North American, 19% Asian, and 31% European (Prokopová 2022). Among these were three *Tsuga canadensis* specimens and associated species: *Abies grandis* (Douglas ex D.Don) Lindl., 1833, *A. concolor* (Gordon & Glend.) Lindl. ex Hildebr., 1861, *A. nordmanniana* (Steven) Spach, 1841, and *Pseudotsuga menziesii* (Mirb.) Franco, 1950. On October 18, 2024, two 40-year-old *T. canadensis* trees exhibiting symptoms of severe crown damage were inspected for bark beetle infestation. Samples were taken from trunks and branches and analyzed under a microscope (Bresser Advanced ICD Microscope 10–160 ×; Bresser GmbH, Rhede, Germany). These specimens (three individuals) are dry-preserved in the first author's collection. The first author identified the bark beetle species.

RESULTS AND DISCUSSION

The infested *Tsuga* trees showed no visible signs of infestation from a distance during the summer of 2024 (*sensu* M. Prokopová, pers. observ.). Branches began to wither in September 2024, leading to complete tree dieback by October 2024 (Figure 1A). Most entry holes on the trunks contained

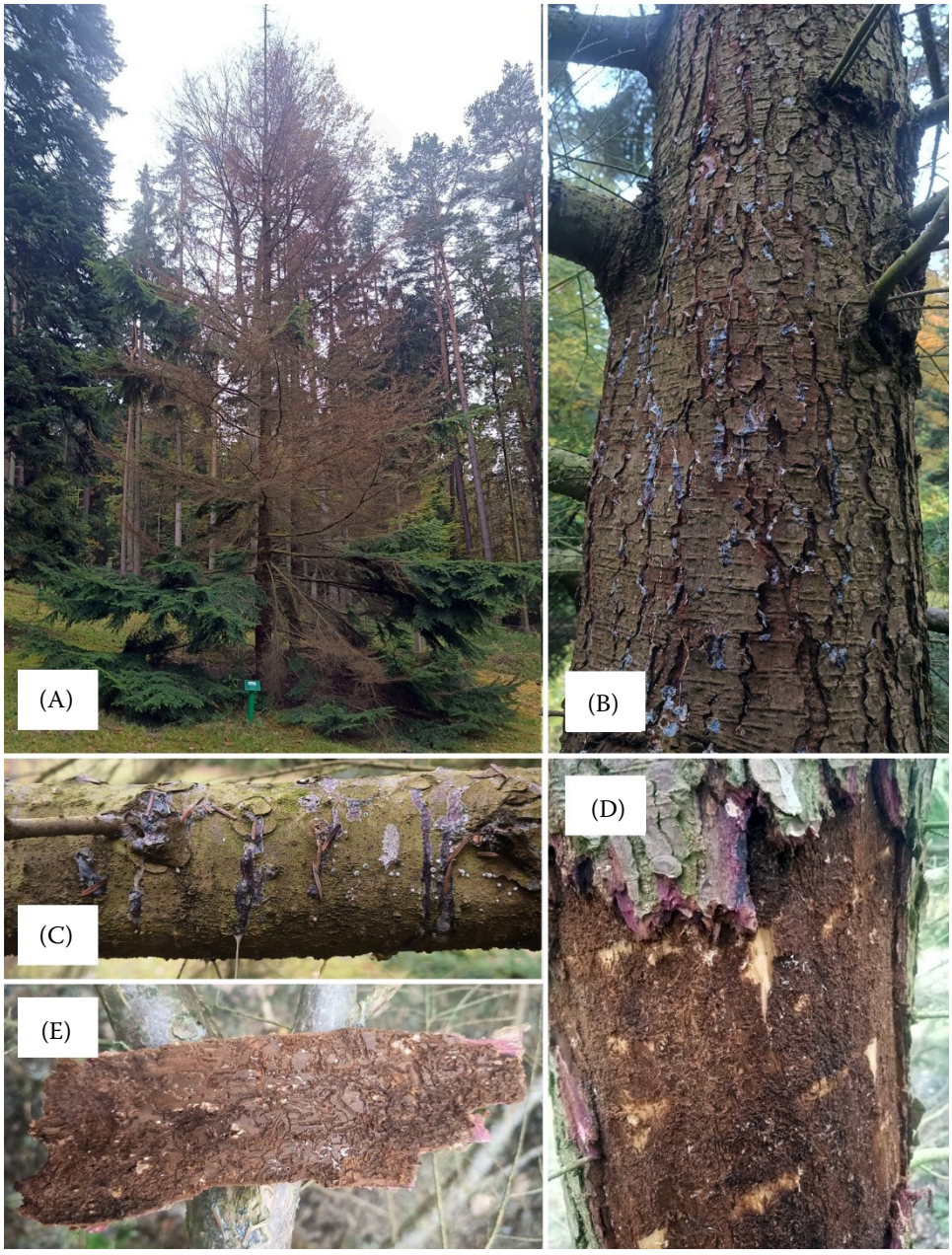

Figure 1. *Pityokteines spinidens* infestation on Eastern Hemlock
(A) overview of infested trees; (B) resin-filled entry holes on the trunk; (C) resin-filled entry holes on branches; (D) galleries on the trunk surface; (E) galleries within the bark structure

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beetles preserved in resin (Figures 1B and 1C). At approximately 1.5 m above ground, a fully larval gallery was discovered on a section of the trunk spanning approximately 30 cm in height, containing deceased beetles of both sexes (Figures 1D and 1E).

The damage observed on *T. canadensis* closely resembled injuries previously documented on *T. heterophylla* in western Bohemia, caused by the bark beetle *Pityogenes chalcographus* (Linnaeus, 1761) (Fiala et al. 2022a). This represents Europe's first recorded instance of *P. spinidens* infesting *T. canadensis*. Three dead specimens of *P. spinidens* were recovered at the site, one a damaged male and two females (Figure 2).

P. spinidens typically have two generations per year (Pfeffer 1955). However, it remains uncertain whether the observed infestation originated from the flight of overwintering beetles in spring, which took an extended period to kill the trees, or, much more likely, from a summer F1 generation that led to rapid dieback. Although *P. spinidens* is known for its distinctive gallery structure (Pfeffer 1955), none were observed on these trees. Instead, the galleries consisted of randomly clustered larval tunnels, with maternal galleries barely distinguishable (Figures 1D and 1E), likely obscured by additional feeding from callow beetles during their mature feeding phase. On novel host trees, these gallery patterns are atypical, as demonstrated by *P. spinidens* infestations on larch (Larix sp.) (Knížek et al. 2019) and similar deviations in bark beetle gallery structures on new host species (Rosenberger et al. 2018; Bleiker et al. 2023).

Pityokteines spinidens primarily infests various fir species (*Abies* spp.) (Knížek et al. 2019). In the vicinity of the Americká zahrada National Nature Monument, *Abies alba* Mill., 1768 is common, where *P. spinidens* has been previously documented (Pfeffer 1955). This species typically infests thinner fir trunks (Pfeffer 1955) and continues to cause localized damage (Lubojacký et al. 2024). It is, therefore, likely that the beetles originated from nearby fir trees. However, on *T. canadensis*, the beetles were also found on branches. Belonging to the same family (Pinaceae) and subfamily (Abietoideae) as *A. alba*, *T. canadensis* may be similarly susceptible. In contrast, larch, which *P. spinidens* rarely infests, belongs to the same family but a different subfamily (Knížek et al. 2019).

In urban forestry, parks, and city forests, native and non-native bark beetles are an increasing threat, with infestations affecting approximately 10% of exotic conifers within a year (Fiala et al. 2022a).

Arboretum managers and forest owners must recognize that introducing exotic tree species does not ensure resilience to climate change (Zinchenko et al. 2019; Kerchev & Krivets 2021; Vakula et al. 2021; Fiala et al. 2022b; Fiala & Holuša 2023). Given *Pityokteines*'s known impact on various *Abies* species, related conifers, including those in urban forests, are also at risk.

Figure 2. *Pityokteines spinidens* (A) damaged male; (B) female; all from Eastern Hemlock in Americká zahrada National Nature Monument Arboretum

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