

First penetration of pine processionary moth (*Thaumetopoea pityocampa*) in North Bulgaria

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Abstract

The pine processionary moth (*Thaumetopoea pityocampa*) was reported for the first time in North Bulgaria in 2022. Winter nests of the pest were observed in a number of pine plantations in more than 10 sites of four Forest State Enterprises (Troyan, Sevlievo, Gabrovo, Plachkovtsi). The penetration of the pest into the new localities is due to a long-distance dispersion by vehicles. In January 2023, the nests in new localities contained fifth-instar larvae of *T. pityocampa*. Only about 3% of them were empty as larvae had descended in the soil for pupation. Based on the high population density and presence of old nests in some localities, it was assumed that the pest penetrated into Northern Bulgaria most likely 3-4 years ago.

Keywords

Thaumetopoea pityocampa, North Bulgaria, expansion, long-distance dispersion

Introduction

The pine processionary moth, *Thaumetopoea pityocampa* (Denis & Schifferrmüller, 1775) (Lepidoptera: Notodontidae) is distributed in the coastal zone of the Mediterranean and some warmer regions in Europe, where climatic and habitat conditions are favorable for its development (Roques et al., 2015). The species is oligophagous – it is trophically associated with various pine species (*Pinus nigra*, *P. sylvestris*, *P. pinea*,

P. halepensis, *P. pinaster*, *P. canariensis*, *P. heldreichii*), but it can also accidentally feed on species of the genera *Larix*, *Cedrus* and *Pseudotsuga*. *T. pityocampa* was reported as the most important pest in pine forests in many countries (Devkota, Schmidt, 1990; Maputo, Battisti, 1990).

Thaumetopoea pityocampa was established for the first time in Bulgaria in 1906 – an imago was attracted by light in the region of Sofia (Drenovsky, 1923). It can certainly be assumed that *T. pityocampa* entered our country from the south at the beginning of the last century, because after the first report, many localities of the species were also reported in the Rhodopes, Pirin and Rila Mts. (Buresh, 1915; Drenovsky, 1923; Russkoff, 1929-1930). The first strong pest attacks were registered in 1924-1925 in the region of Chepelare and in 1927 – in Chepino Valley (Western Rhodopes) and around towns of Klisura, Karlovo and Kalofer (Central Bulgaria). The pine forests attacked by *T. pityocampa* gradually increased from 2.6 thousand ha in the 1950s, to 39.1 thousand ha in the 1990s (Mirchev et al., 2000). The growth of the attacked areas was intra-areal in the country as a consequence of the increase in pine plantations in the large-scale afforestation carried out in the second half of the 20th century. At the end of the century, the range of the species covered significant areas of South Bulgaria: Karlovo and Kalofer hollows, the valleys of the Struma and Mesta Rivers, and the mountain areas of Osogovo, Kraishte, Rila, Pirin, Slavyanka, the Rhodopes, Sredna gora, etc. The vertical distribution of *T. pityocampa* in Bulgaria is up to 1200 m a.s.l. on the north exposure, and 1350 m – on the south one.

The pine processionary moth is highly dependent on global warming as a species with a southern range and winter larval activity. The pest is expanding its range across Europe and has been reported by the International Panel on Climate Change as a biological indicator of climate change (Rosenzweig et al., 2007). Since the 1970s, a horizontal and vertical expansion of the range of *T. pityocampa* has been reported in a number of areas (Huchon, Démolin, 1971; Hodar et al., 2003). In the region of Paris, the range extension of the species to the north reached 87 km, and in northern Italy, the upper distribution line rose by 110-230 m (Toffolo et al., 2006).

In Bulgaria, an extension of the pest's range has also been registered. Since 1999, the species overcame the Kalofer heights and moved into the Kazanlak hollow (Mirchev et al., 2011, 2018). The annual expansion of the range of the pine processionary moth is 2.5-3.0 km. Currently, the species has expanded its distribution to the east, reaching the town of Gurkovo (unpublished). New localities of the pine processionary moth were established in 2019 in the region of Vitosha Mt. and near the town of Slivnitsa in the Sofia hollow (Zaemdzhikova, Doychev, 2019).

The average flight distance of male specimens of *T. pityocampa* is up to 50 km (Mirchev et al., 2013), and for females ones – up to 2.0-3.0 km (Démolin, 1969). The extension of the species' range is undoubtedly determined by the perimeter of flights by female specimens, so the rate of natural expansion could be expected to be slow. Robinet et al. (2007) pointed that the spread of the pest also depends on the presence of roadside and landscape afforestation in the settlements and roads, and the attraction of moths by passing car lights at night.

Information about the first penetration of *T. pityocampa* in North Bulgaria appeared at the end of 2022 and the beginning of 2023. Larval nests of the pest were observed in pine plantations of more than 10 sites in four Forest State Enterprises: Troyan (Beli Osam village, Chiflik village, Terziiysko village), Seylievo (Stokite village), Gabrovo (Gabrovo, Charkovo village), Plachkovtsi (Tryavna, Torbalazhi village, Nikolaevo village, Radino village, Enchovtsi village) (Fig. 1).

The penetration of the pine processionary moth into North Bulgaria undoubtedly happened not through a gradual expansion of its range, but through a long-distance dispersion. Having a nocturnal activity, the adults of *T. pityocampa* are attracted by the light of vehicles and can be transported to considerable distances, in this case through the Shipka and Troyan passes in the Central Balkan Range.

The pine processionary moth has two phenological forms – early (summer) and late (winter) (Mirchev et al., 2018). The larvae of the summer form hatch in late summer, feed in autumn and descend to hibernate in the soil until late October. The larvae of the winter form hatch in autumn, feed in winter and, depending on temperature conditions, pupate between January and April. In North Bulgaria, the winter form of *T. pityocampa* was found – at the time of survey (13-25 January 2023) the majority of the larvae were in the last (fifth) instar in the nests (Fig. 2A, B). As a result of the warm winter, about 3% of the nests were empty due to the larvae's descent for pupation in



Figure 1. Localities of *Thaumetopoea pityocampa* in North Bulgaria



Figure 2. *Thaumetopoea pityocampa* (Radino vill., 25.01.2023): A – winter nest on *Pinus sylvestris*; B – fifth-instar larvae in a nest; C – new and old nests on *Pinus nigra*

the soil. Based on the high population density of the pine processionary moth in the region of Troyan, Gabrovo and Plachkovtsi and the presence of old nests (Fig. 2C), it can be assumed that the penetration of the pest into Northern Bulgaria most likely occurred 3-4 years ago.

The possibility of survival of the pine processionary moth in North Bulgaria can be predicted by means of analyses of two main indicators – availability of a suitable food base, favourable temperature conditions for nutrition and development of the species in winter. In the places of penetration of *T. pityocampa* – Regional Forest Directorate of Lovech, Gabrovo and Veliko Tarnovo, the area of pine plantations is 19.0, 14.7 and 13.2 thousand ha, respectively (Mirchev et al., 2011), and therefore there are suitable conditions for nutrition of the species in the new habitats. The limiting temperatures (number of days in winter with temperatures below -16°C , daytime winter temperatures above $+6^{\circ}\text{C}$ and night-time winter temperatures above 0°C) in these areas are also favourable for the development and survival of *T. pityocampa* and to a significant extent correspond to the climatic conditions in the region of Karlovo and Kazanlak hollows in South Bulgaria, where the species is widespread.

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