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Short communication

The first record of non-indigenous cicada *Graptopsaltria nigrofuscata* (Motschulsky, 1866) (Hemiptera: Cicadidae, Polyneurini) in Slovakia

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Abstract

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This paper provides the first record of the large brown cicada *Graptopsaltria nigrofuscata* (Motschulsky, 1866) in Slovakia. This cicada species is native to Japan, Korea and China. An adult and several exuviae were found near the city of Martin, in Vrútky and Dražkovce in August 2022. The nymphs were introduced to Slovakia with white pine (*Pinus parviflora* Siebold & Zucc.), imported in pots from the Czech Republic. The pine trees were originally purchased in Japan, where *G. nigrofuscata* is one of the most common cicada species. The nymphs had been developing at the locations in Slovakia for about 5 years. Based on the number of exuviae, it can be assumed that the population was large enough for the cicadas to produce a new generation. Many potted plants from Japan are popular trees, and many companies buy them directly in Japan, so it is possible that the cicada *G. nigrofuscata* will gradually start to appear more often in the European region.

Keywords

cicada, non-native insects, pine trees, plant import, woody plant

Introduction

Changes in the global and urban climate create new environmental conditions for the growth and development of trees from warmer areas as well as the application of a wide range of allochthonous trees (Supuka, 2007). The introduction of non-native trees and the warming of the climate also bring with them negative phenomena, such as the invasion of thermophilic non-native plant and animal species (Benčať, 1982; Darnadyová, 2007). The pressure of invasive species is also related to the increasing frequency of exchange of goods and the globalization of trade (Zúbrik et al., 2007; Levine and D'Antonio, 2003). Herbivorous insects that are transported with their host plants have a high probability of becoming established because they do not have to search for their host. Ornamental trees intended for retail sale are increasingly imported from abroad. Despite precautions during importation, this provides new opportunities for the introduction of non-native insect species (Liebhold and McCullough, 2011). The majority of non-native insect species that reach Slovakia come from Asia or North America. In recent years, many

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thermophilic species have appeared, coming also from the Mediterranean area and other warm regions, which due to climate change, find suitable conditions for the survival and production of populations even outside the place of introduction (Kollár, 2014, 2020). Thermophilic insects also include some cicadas, leafhoppers and planthoppers (Hemiptera: Auchenorrhyncha). So far, approximately 560 species belonging to Auchenorrhyncha suborder have been discovered in Slovakia, of which six are singing cicadas (Janský and Okáli, 1993; Okáli and Janský, 1998). Several non-native and invasive species have also been recorded in the last 10 years (Janský, 2018, 2022; Janský and Strmisková, 2017; Janský and Šestáková, 2020). Some of them also pose a threat to agricultural crops. These are mainly small leafhopper species that can transmit various pathogens damaging ornamental and crop plants (Tóthová et al., 2015; Janský et al., 2021). Large cicada species occur less frequently. This contribution deals with the occurrence of a new non-native East Asian cicada species *Graptopsaltria nigrofuscata* (Motschulsky, 1866) in Slovakia. The only reported occurrence of this species of cicada in Europe was in western Germany, near Zerkall village (village near Nideggen, region of North Rhine-Westphalia) in 2018 (*naturgucker.de*, 2024). However, it was not possible to verify the relevance of this data due to the absence of a photograph or preserved specimen. *Graptopsaltria nigrofuscata* is widespread in Japan, Korea, and northern and central China (Fujiyama, 1979; Lee, 2008). Nymphs develop in the soil for 3–5 years, the adult appears from July to mid-September (Hayashi and Saisho, 2011). However, based on Kato (1956), the length of the life cycle of this species can be up to 7 years. Females lay eggs on dead branches or trunks in summer (Moriyama and Numata, 2008). In Japan, *G. nigrofuscata* is the most common species of cicada. In addition to forests, it is also widely distributed in urban environments (Fujiyama, 1979).

Materials and methods

Samples of cicadas were collected on private property located on the edge of the village Dražkovce (GPS 49.0477003N, 18.9564411E). The private area is bordered from the north by a main road and residential buildings. The Kalník stream flows along the property. Coastal vegetation consists of *Salix alba* L., *S. caprea* L. and *Alnus glutinosa* (L.) Gaertn. From the southern side, the plot passes into a mixed forest with a predominance of *Pinus sylvestris* L. *Picea abies* (L.) H. Karst. also grows there in smaller numbers. Of the deciduous trees, *Carpinus betulus* L., *Acer campestre* L., *Corylus avellana* L., *Prunus padus* L., *Prunus spinosa* L. and *Crataegus monogyna* Jacq. grow there. There is a lawn with ornamental trees directly on the property, particularly white pines (*Pinus parviflora* Siebold & Zucc.) cut as bonsai, planted directly in the soil and mulched with gravel and black pines (*Pinus nigra* J.F. Arnold). The plantings are supplemented by *Pinus mugo* Turra and *Taxus baccata* L.

In Vrútky (GPS 49.1158325N, 18.9012789E) cicadas were also recorded on a private plot of land, which is situated in residential area. The area around the plot is surrounded by meadows. Woody plants, such as *Salix alba* L., *Populus tremula* L., *P. nigra* J.F. Arnold, *Alnus glutinosa* (L.) Gaertn. and Salix caprea L. grow along the flowing stream near the plot. A mixture of *Betula pendula* Roth and *Picea abies* (L.) H. Karst. also occurs in the immediate vicinity. *Picea omorika* (Pančić) Purk., cultivars of *Pinus mugo* Turra and a hedge of *Taxus baccata* L. were planted directly on the property. Dominants are *Pinus sylvestris* 'Beuvronensis' and *Pinus parviflora* Siebold & Zucc., cut for bonsai. The plants are

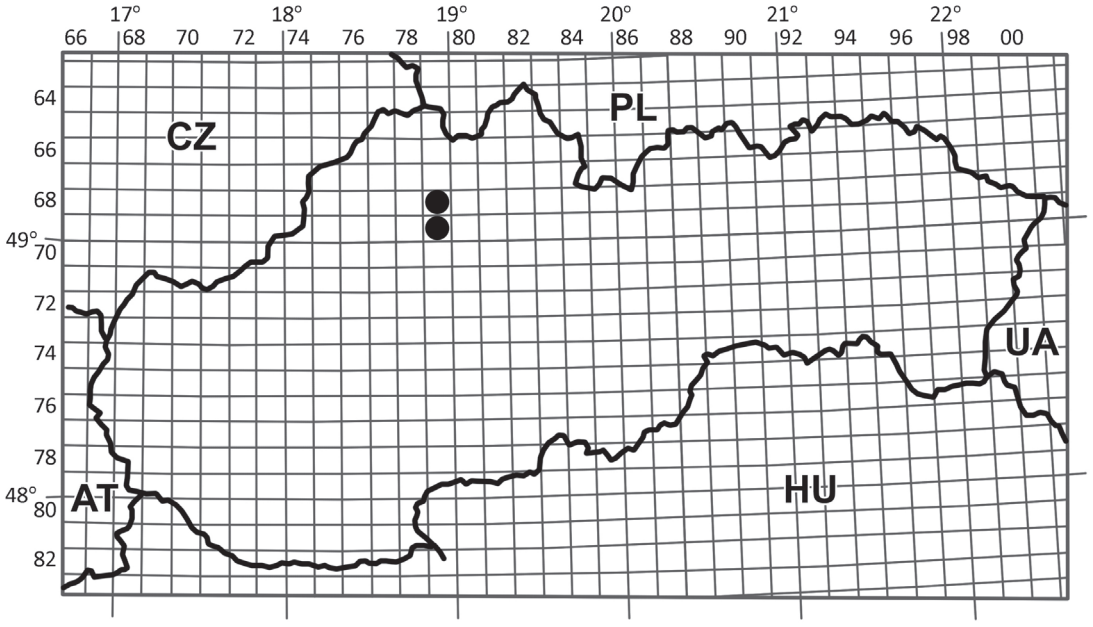

Fig. 1. Map of distribution of Graptopsaltria nigrofuscata in Slovakia.

Fig. 2. The adults of cicada *Graptopsaltria nigrofuscata* collected at Vrútky.

Fig. 3. Exuvium of *Graptopsaltria nigrofuscata* collected at Vrútky.

grown directly in the soil and mulched with gravel. Most of the land was covered with grass. The distance between localities Dražkovce and Vrútky is 8.6 km (Fig. 1).

An adult (Fig. 2) and several exuviae (Fig. 3) of the cicada species were recorded by direct observation during tree maintenance of pine trees *Pinus parviflora* Siebold & Zucc. (Fig. 4). Because the pines were shaped, they were of lower height and the insects on individual trees and around the trees could be counted visually. A live adult was recorded only at the locality Vrútky and was caught by individual collection. Exuviae samples were also collected. Documentary material is stored in the collections of the Zoological Department of the Slovak National Museum – Natural History Museum in Bratislava (SNM – PM). The records are listed according to orographic units. The localization data includes the name of the site, place of occurrence, host plant, grid mapping code of the Databank of the Fauna of Slovakia (DFS), altitude (m above sea level), date of collection (day, month, year), number of specimens, the name of the collector and the name of the determiner. The nomenclature and taxonomic classification were taken from the World Auchenorrhyncha Data-

Fig. 4. *Pinus parviflora*, the host plant of *Graptosaltria nigrofuscata* at Dražkovce site.

base (Dmitriev et al., 2022). The identification was made according to the key in Hayashi and Saisho (2011).

Results

Graptopsaltria nigrofuscata (Motschulsky, 1866)

Dražkovce, private garden plot, on *Pinus parviflora* Siebold & Zucc., DFS 6979d, 426 m, 24/8/2022, 8 exuviae; lgt. Ľ. Donoval, det. V. Janský.

Vrútky, private garden plot, on *Pinus parviflora* Siebold & Zucc., DFS 6879c, 381 m, 24/08/2022, 1 ♀, 11 exuviae; lgt. Ľ. Donoval, det. V. Janský.

Exuviae of *G. nigrofuscata* were recorded at both localities in August 2022, which was the first observation of this species in Slovakia. All exuviae were collected only from specimens of *Pinus parviflora* Siebold & Zucc. shaped into bonsai. The pines had been imported in containers from Japan to Staré Město near Uherské Hradiště (Czech Republic) in 2016 where they were stored for about 1 year and then transported to Slovakia in May 2017. After transport, they were immediately planted on the sites. Five specimens of these pines were planted at Vrútky location and four specimens at Dražkovce. The pine trees were taken from the original containers directly at the locations where cicadas were later found. The exuviae were found on the branches and needles of the pines *Pinus parviflora*

Siebold & Zucc. and among the gravel under the pines. Only one adult was captured at the Vrútky site in August 2022. It was freshly hatched and unable to fly. Other adults have apparently moved to the surrounding higher trees. However, typical sounds produced by adult cicadas were not heard at the sites.

Discussion

The expansion of the trade with living plant material and the demand for interesting non-traditional types of trees in Slovakia is also accompanied by the introduction of exotic animal species. The foliage, wood and substrate in containers may contain the developmental stages of insects (Benčaľ, 1982; Knowler and Barbier, 2005; Liebhold et al., 2012, Galko et al., 2023). Some introduced insect species are only able to produce short-term populations restricted locally, others can spread in the landscape and be a potential risk to ecosystems. In Slovakia, the number of non-native insect species has been increasing every year, which is evidenced by the interest of experts in creating various lists of non-native species (e.g. Vakula et al. 2015; Kohútová and Oboňa, 2016; Kollár, 2020; Galko et al., 2023). *Graptopsaltria nigrofuscata* is another new non-native species for Slovakia. Even though this cicada species was collected in the north of Slovakia, its nymphs were able to adapt to local conditions and complete their development. The cicada nymphs were probably introduced from Japan with the substrate in the containers of commercially sold pine trees. According to the data provided by Fujiyama (1979), the original distribution area of *G. nigrofuscata* has very similar climatic conditions to Central Europe. Therefore it can be assumed that the nymphs in the conditions of Slovakia overcame development in the substrate for several years and were able to survive even in the colder, northern region of Slovakia. It remains to be seen whether this cicada species will be able to survive and find a more permanent population in Slovakia. The abundance of the species at the sites of occurrence was relatively high (19 exuviae and 1 adult) and, in our opinion, sufficient to create the next generation. Takakura and Yamazaki (2007) reported that the abundance of *G. nigrofuscata* populations may be regulated by birds, which actively catch and consume the adults. This factor probably also affected a certain part of the cicada population at the locations near Martin. In some countries in the world, some cicadas pose a risk to various ornamental and fruit trees and they have been classified as pests. For example, Boulard (1990) wrote that cicada adults can injure the bark of branches during oviposition and nymphs can weaken plants by sucking. Aizu et al. (1984) and Sato et al. (1995) realised a study about the damage to fruit trees and found that the developmental stages of *G. nigrofuscata* can damage roots, fruits, leaves and trunks by sap-sucking. During the inspection of the sites in Slovakia, no injuries or visual changes in the health status of pines and ornamental plants related to the presence of cicadas were detected. At present, we are unable to confirm or refute the possibility that this particular species of cicada poses a potential threat to plants in Slovakia. In addition to direct damage to woody plants by nymphs and adults, there is also a potential risk of the introduction of new entomopathogenic fungi and other pathogens being transmitted by the cicada bodies. Shimazu (1989) found spores of the entomopathogenic fungus *Metarhizium cylindrosporae* Chen et Guo, 1986 on *G. nigrofuscata* in an alder forest in Japan. This fungus infects various taxa of cicadas, causing them to die. Several native cicada species live in Slovakia, which could be potential hosts for *M. cylindrosporae*. There is a high probability that this cicada species will start to appear in other locations in Europe because several companies are trading with potted *P. parviflora* Siebold & Zucc. pines imported from Japan. From there, these pines are exported to plantations and greater distances across countries. Although *G. nigrofuscata* is an aesthetically interesting and large cicada species, we do not know how it will behave outside of its native range. Preventing the introduction of little-known non-native insect species from their native range is relatively difficult, as current control measures are mainly focused on known risky or dangerous species and many other species are overlooked. The presence of cicadas can be detected by visual inspection of plants, on which exuviae or adults may be present. Subsequently, the substrate is checked, and if the presence is confirmed, the substrate is treated with an approved insecticide.

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