

NON-NATIVE *HELIX LUCORUM* LINNAEUS, 1758 (GASTROPODA: EUPULMONATA: HELICIDAE) AFTER TWELVE YEARS IN PRAGUE, CZECH REPUBLIC

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ABSTRACT: The first occurrence of *Helix lucorum* Linnaeus in the Czech Republic was reported 12 years ago, at the closed train station Žižkov in Prague. A part of the station is a ruderal habitat while large patches are covered with partly damaged concrete. At the site where it was first recorded, and where the density of *H. lucorum* is still the highest, this invasive snail has now almost completely replaced the original *H. pomatia* Linnaeus. However, it has not expanded either inside or outside the station area.

KEY WORDS: invasive species; *Helix lucorum*; Prague; Czech Republic

INTRODUCTION

Helix lucorum Linnaeus, 1758 (Eupulmonata, Helicidae) is an invasive species. It was first recorded in Prague in 2008, within the urban heat island, at the closed train freight station Žižkov (HORSÁK et al. 2010). The species was reported from the same locality four (PELTANOVÁ et al. 2012a) and ten years later (KORÁBEK et al. 2018). Currently, *H. lucorum* is included in the Czech Republic check-list and in the distribution maps of the molluscs of the Czech and Slovak Republics (HORSÁK et al. 2021).

The species is native to Anatolia, and to the southern and eastern Balkans; at present it is widespread in southern Europe, with the range extending from Spain to eastern Turkey (WELTER-SCHULTES 2012). It is assumed that it does not form subspecies. The Crimean form of *H. lucorum* is not regarded as a subspecies, but as a conchologically distinct population (KORÁBEK et al. 2018).

The reported expansion of *H. lucorum* reflects the general trend of northward spread of originally south-

ern snails. Over the last thirty years, the number of non-native species of terrestrial snails in the Czech Republic has increased from 5 to 15 (8% of all species); more than half of them are of Mediterranean origin. Since 2000, seven new non-native species (six of them Mediterranean) have been recorded. This trend reflects the global warming and the increase in the intensity of foreign trade over the past six decades, suggesting a synergistic effect of climate conditions and socio-economic factors on snail expansion (PELTANOVÁ et al. 2012b).

H. lucorum is spreading throughout Europe. It was recorded, among other countries, in Hungary (VARGA et al. 2010), in Slovakia (ČEJKA & ČAČANÝ 2014) and in Russia (Moscow; EGOROV 2017). The aim of this study was to check if the local population of *H. lucorum*, recorded for the first time 12 years ago, had spread from its initial locality at the closed railway station Žižkov and expanded to the nearby green areas.

MATERIAL AND METHODS

The closed railway station Žižkov is surrounded by walls and busy asphalted roads, but at one point

on its eastern side it is connected to the nearby undeveloped areas by a strip of wasteland (Fig. 1), with

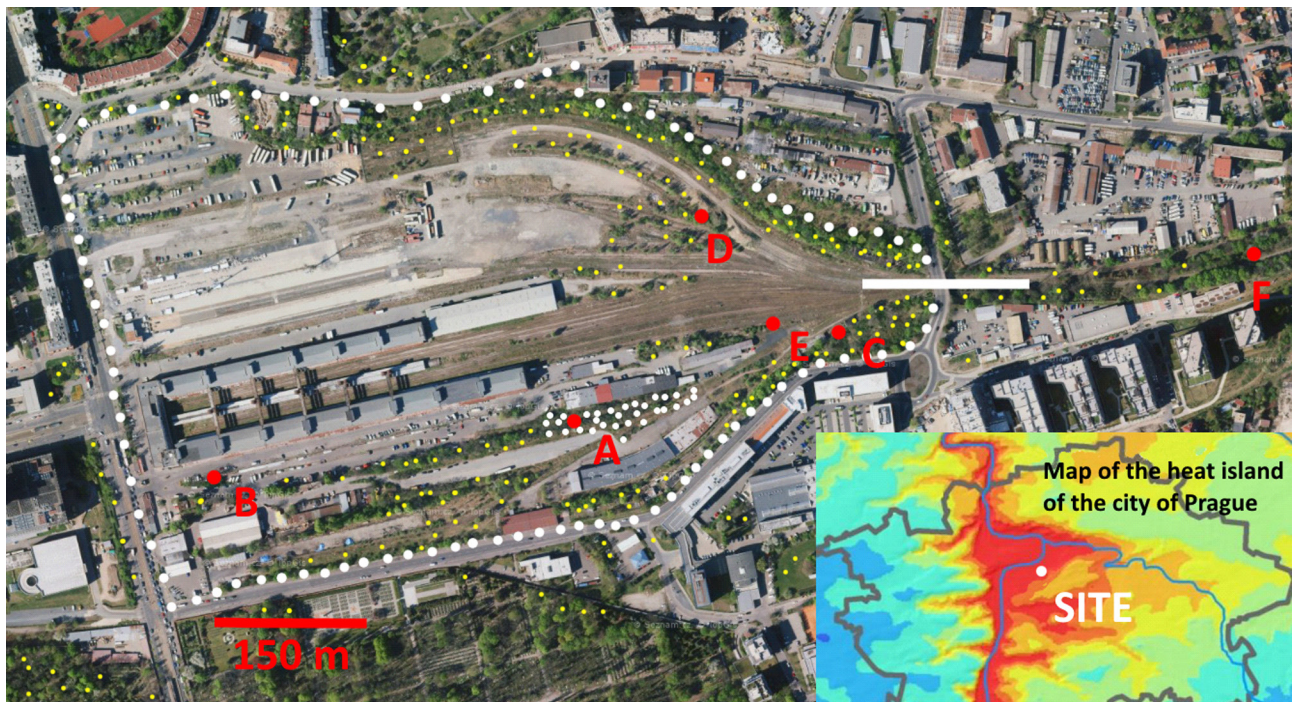


Fig. 1. Closed railway station Žižkov. The station boundary indicated with large white dots. The wide white line denotes the potential bio-corridor. Sites A–F indicated in red. The patch with high density of *H. lucorum* marked with small white dots. Yellow dots mark searched spots within and outside the station. Inset shows a map of Prague's heat island (ČESKÝ HYDROMETEOROLOGICKÝ ÚSTAV 2010), white dot in its centre – Žižkov railway station

soil only sparsely covered with herbage along the railway tracks (not used for decades). This strip of undeveloped land may serve as a bio-corridor.

To monitor the spread of *H. lucorum*, I used the Mumladze method which I modified (MUMLADZE 2013). During a tour in September 2018, in the centre of the Žižkov station, I found a spot which was favourable for molluscs. Most of the station's space is concrete-covered. Snails can only be found in a few places where the vegetation patches are close to the crumbling buildings and the terrain tends to be rugged. At site A, in the summer I found a high density of snails, not only *H. lucorum*, but also smaller helicids, such as the common *Cepaea nemoralis* (Linnaeus, 1758).

Other collections took place during the dormant period from the beginning of winter to early spring, when the soil was visible. During the growing sea-

son, the soil, especially around site A, is covered with dense leaves of herbs, and the snails are difficult to find. After the leaves have fallen, it is much easier to find empty shells. In the spot where I observed (in both summer and winter) the highest density of *H. lucorum* (site A), I collected all the empty shells of *Helix* from a 10 × 10 metres plot, and counted the number of shells of *H. lucorum* and *H. pomatia* Linnaeus, 1758.

I used the same method in the other sites, and collected all the shells of the genus *Helix* from 10 × 10 metres plot in each. I also chose one place (a recently abandoned landfill) outside the station – site F. Besides, I searched the entire area of the station and its close surroundings (not only sites A–E and F) and collected shells of the genus *Helix* during the winter/early spring between 2018 and 2021.

RESULTS

During its 12 years of occurrence, *H. lucorum* spread neither through the closed station, nor outside it (Fig. 1). It was only found in larger numbers in a patch of a few hundred square metres (site A and nearby). In this area, it significantly outnumbered the native *H. pomatia*. The numbers of shells of *H. lucorum* and *H. pomatia* in the surveyed sites are shown in Table 1.

Table 1. Numbers of *Helix* shells found in the surveyed sites

Site	Geographical coordinates	<i>H. pomatia</i>	<i>H. lucorum</i>
A	50°05.06'N, 14°28.63'E	6	83
B	50°05.03'N, 14°28.34'E	4	12
C	50°05.11'N, 14°28.86'E	2	4
D	50°05.17'N, 14°28.74'E	0	1
E	50°05.13'N, 14°28.66'E	0	1
F*	50°05.15'N, 14°29.20'E	20	0

* – outside the station.



DISCUSSION

There are at least four mechanisms of passive dispersal of terrestrial molluscs: anemochory, hydrochory, zoochory and anthropochory (KRAMARENKO 2014). The expansion involves two distinct spatial scales: transcontinental and intra-continental. Most transcontinental expansions are cases of spread of European species to Africa, the Americas and Australia. Outside Europe, *H. lucorum* was found in North America, northern Africa and China (GBIF SECRETARIAT 2019). It was also recorded in Uzbekistan (IZZATULAYEV 2013). In Europe this synanthropic species, besides accidental passive dispersal, was also introduced intentionally for commercial purposes and now it is regarded as one of the most conspicuous snail newcomers in Eastern, Central and Western Europe (MIENIS & RITTNER 2010, KORÁBEK et al. 2018). Its colonies in Prague and Moscow survived inside the city heat islands (EGOROV 2017). Now it is common in Budapest where the populations were established in the last 30 years (PÁLL-GERGELY et al. 2019). In France, besides the heat island of Paris, *H. lucorum* occurs in the south of the country (MUSÉUM NATIONAL D'HISTOIRE NATURELLE (Ed.) 2003–2021). In northern Greece the activity of *H. lucorum* is primarily controlled by humidity, while temperature and photoperiod affect the activity only when days are long and cool or short and hot (LAZARIDOU-DIMITRIADOU & SAUNDERS 1986).

Although the introduced population of *H. lucorum* has inhabited the locality for twelve years and it now outnumbers the native *H. pomatia*, it is not expanding any further, therefore in Prague it currently does not meet the criteria of an invasive species.

H. pomatia was found to prefer habitats with the smallest possible difference between the air temper-

ature and the temperature of the substratum (VOSS et al. 2001). This may limit the accessibility of the bio-corridor to snails and thus explain the absence of any *Helix* in certain parts of the station. In the northern and eastern parts of the station large patches of concrete cover the ground; they may cause frequent temperature differences between air and subsoil.

The population of *H. lucorum* lives only in a narrow, broken strip of greenery, but it does not spread even within the area, where there are no physical barriers to dispersal. Therefore, the dry substrate in most of the area can be regarded as a very likely limiting factor. A long dry strip of land in the eastern end of the station, of about two hundred and fifty metres, apparently prevents *H. lucorum* from penetrating the potential bio-corridor with wet vegetation along the railway tracks. This indicates that the expansion-preventing factors are rather local, associated with the microclimate of the locality. *H. lucorum* should still be regarded as a potentially invasive species.

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