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Escapes from allotment gardens – the threat fo urban rivers vegetation? Case study from the Kłodnica valley (southern Poland)

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INTRODUCTION

Despite increasing knowledge on the effect of invasive vascular plant species on the environment, many of them are still often cultivated in home or allotment gardens because of their ornamental values [1,2]. Some examples are tall rhizomatous perennials such as: *Aster novi-belgii* (up to 1.4 m) with violet flowers and yellow flowering *Helianthus tuberosus* (up to 3 m) and having red coloured leaves in autumn, long (growing up to 10 m) perennial vines – *Parthenocissus inserta*. Such species have low climate and soil requirements as well as long flowering period (up to November), making them easy to cultivate [3-6, Fig. 1]. However, the set of specific traits enable these plants escapes from cultivation and spread over long distances, e.g. along river valleys [7,8]. The urban river valleys are particularly prone to invasions, since the high level of natural and anthropogenic disturbances [9]. The Kłodnica river valley – the main river of the Upper Silesian Industrial Region belongs to the most heavily transformed urban river valleys in Poland [10].

The aims of the study conducted in the Kłodnica valley in Gliwice were:

1. To present the dynamics of changes in the distribution of *Aster novi-belgii, Helianthus tuberosus* and *Parthenocissus inserta* along the Kłodnica valley in Gliwice,
2. to identify the factors promoting and limiting the spread of the species under investigation.

Fig. 1. Invasive species under studies

STUDY AREA

The studies section of the Kłodnica valley is situated in Gliwice (Fig. 2). Gliwice city is located in western part of the Upper Silesia Industrial Region, in the Silesian Upland, southern Poland. The city has an area of 134 km^2 and 179, 806 inhabitants [11,12] The lenght of the Kłodnica river within the boundaries of Gliwice is 14.6 km, and its valley reaches a width of up to 40 m. The river has been under strong anthropopressure since 1794, when in the close vicinity of the Kłodnica valley ironworks as well as large workers' estates were established. During the construction of the Klodnica Canal (1806-1812), the natural vegetation cover was completely destroyed, the riverbed was regulated and straightened, and the riverbanks were concreted. The potential natural vegetation of the examined section of the Kłodnica valley was made up of ash-alder riparian forests (*Fraxino-Alnetum*) that were clearedd out. The actual vegetation consists of nitrophilous fringe communities (*Urtico-Aegopodietum podagrariae*, *Geo urbani-Chelidonietum maji*), aggregations of invasive species (*Aster novi-belgii*, *Helianthus tuberosus*, *Impatiens parviflora*, *Reynoutria japonica*, *Solidago gigantea*), communities dominated by expansive grass species (*Convolvulo arvensis-Brometum inermis*, *Calamagrostietum epigeji*) and rushes (*Phalaridetum arundinaceae*, *Phragmitetum australis*). Currently, the landscape of the Kłodnica Valley is dominated by compact urban and industrial buildings, allotment gardens and a dense road network. The poor quality of water in the river is caused by the discharge of large quantities of municipal and industrial waste water and salt water from hard coal mines [10].

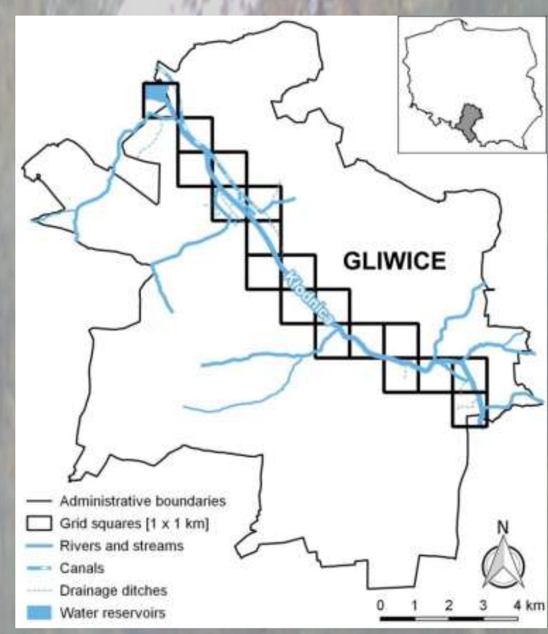

Fig. 2. Map of the study area within ATPOL grid squares (1 x 1 km)

Fig. 3. The landscape of the Kłodnica valley in Gliwice

RESULTS

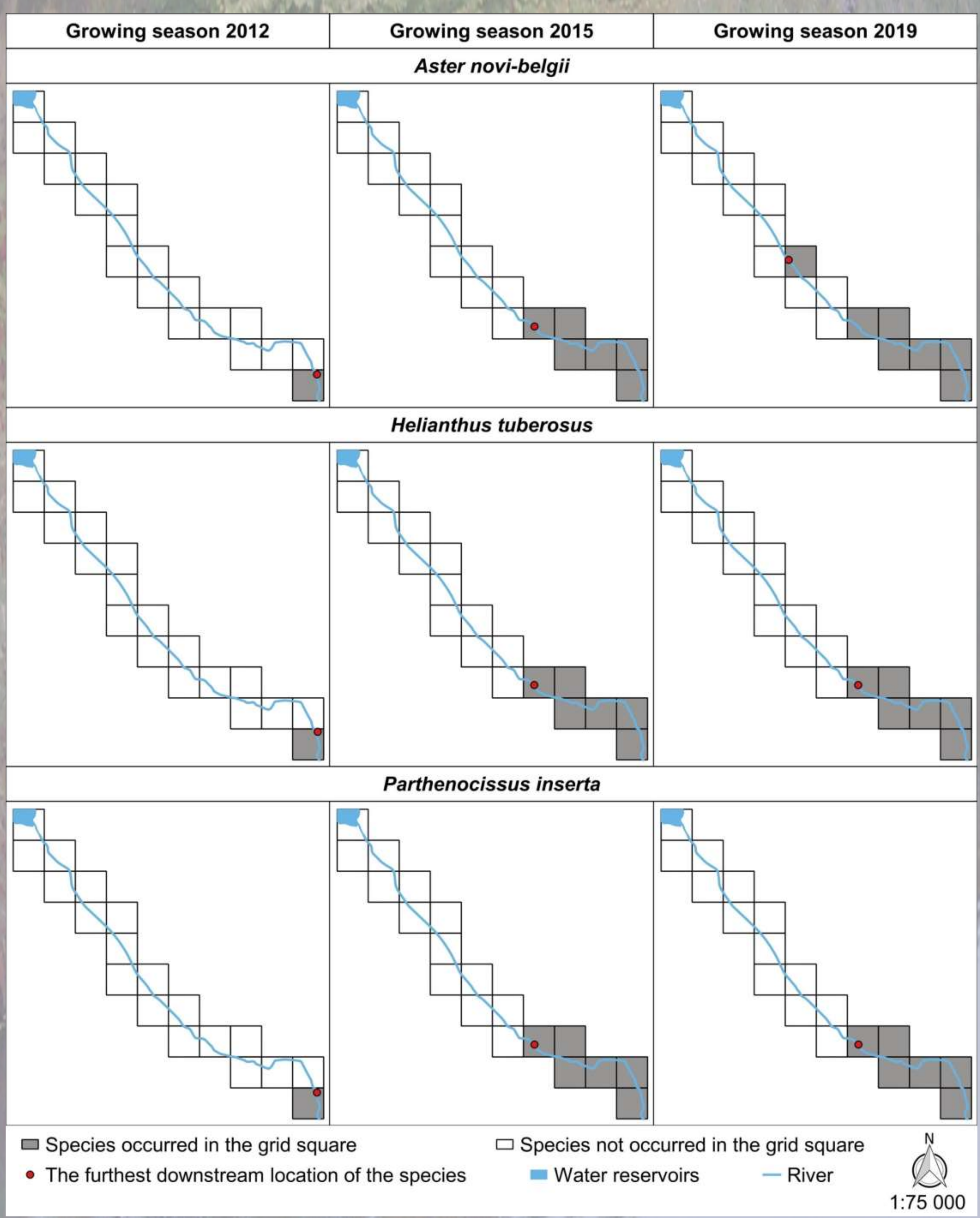

Fig. 4. Changes in the distribution of investigated ornamental invasive vascular plant species along the Kłodnica valley in Gliwice during growing seasons 2012-2019

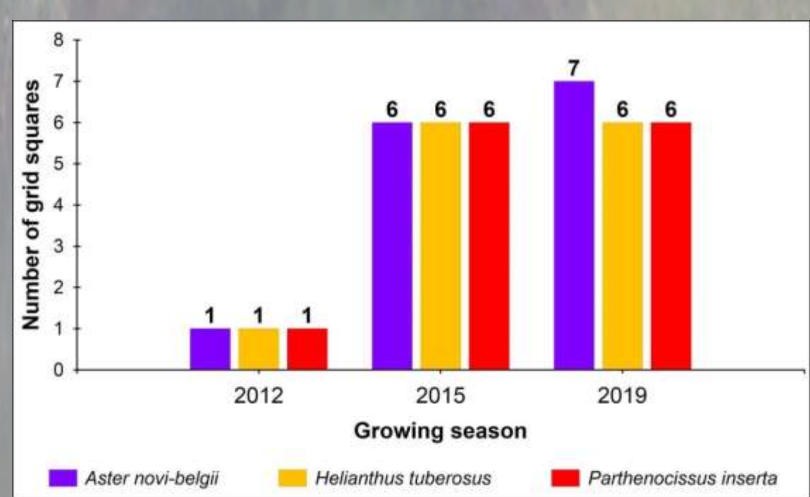

Fig. 5. Changes in the number of squares occupied by investigated invasive species in growing seasons 2012-2019

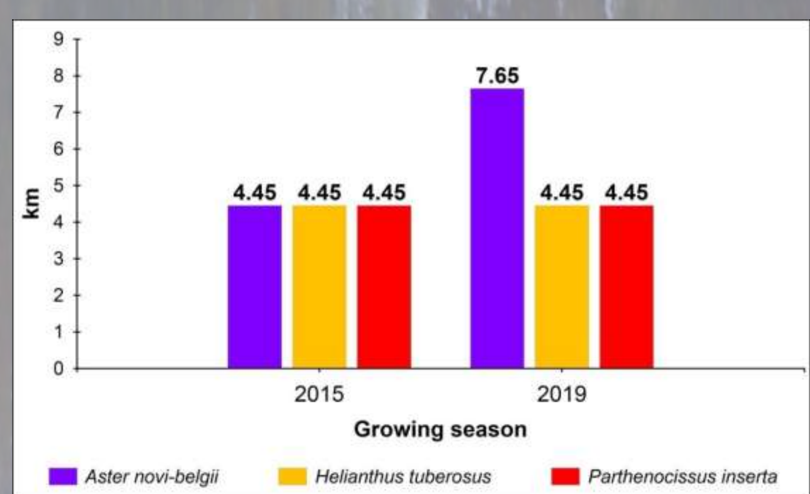

Fig. 6. Distance between the first location (2012) and the most distant locations of examined invasive species found during subsequent observations (2015 and 2019)

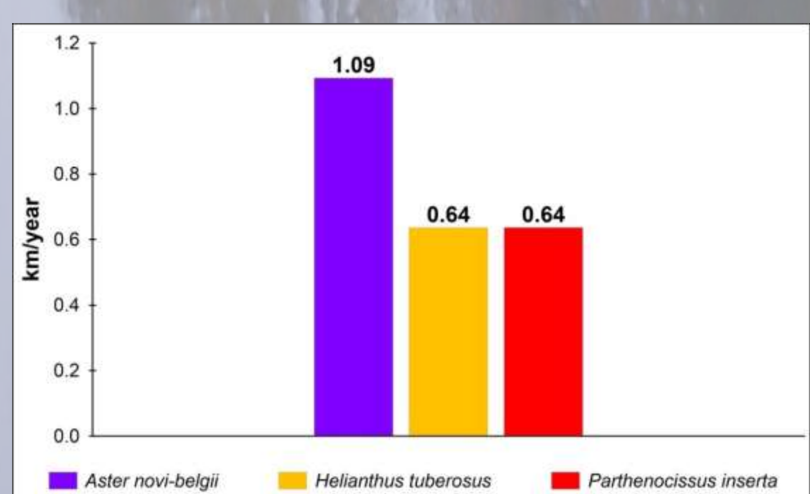

Fig. 7. The rate of spread of studied invasive species along the Kłodnica valley in Gliwice

MATERIALS AND METHODS

Field research

The choice of sample plots

19 ATPOL grid squares situated along Kłodnica valley in Gliwice [13,14]

Investigated species

3 ornamental invasive vascular plant species [1]

Aster novi-belgii

Helianthus tuberosus

Parthenocissus inserta

Data analysis

The species frequency

Number of grid squares occupied by examined species

The rate of species spread

Factors promoting and limiting the spread of species

CONCLUSIONS

1. The highest increase in the number of occupied squares was recorded for *Aster novi-belgii* (from 1 squares in 2012 growing season to 7 squares in 2019 growing season), then *Helianthus tuberosus* and *Parthenocissus inserta* (from 1 to 6) (Fig. 4 and Fig. 5).
2. Taking into account the distance between the first (2012) and last (2019) record of a given species, *Aster novi-belgii* spread furthest down the river (7.65 km), followed by *Helianthus tuberosus* and *Parthenocissus inserta* (4.45 km) (Fig. 4 and 6).
3. The highest rate of spread along the Kłodnica valley had *Aster novi-belgii* (1.09 km/year), followed by *Helianthus tuberosus* and *Parthenocissus inserta* (0.64 km/year) (Fig. 7).
4. To factors promoting the spread of the studied invasive species belong: periodic flooding of the valley banks, hydrotechnical and earthworks, the transfer of diasporas with soil, as well as, strong competitive abilities of alien plants.
5. To factors limiting the spread of the investigated species belong: frequent mowing of the valley banks in the centre of Gliwice and lack of well-developed soil on the river banks. In unmown sites expansion of examined taxa was hampered by other exotic plants, that succesfully compete with them for empty niches (mainly *Solidago gigantea* or *Reynoutria japonica*).

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