

**DISTRIBUTION ROUTES OF THE INVASIVE ALIEN SPECIES *I. GLANDULIFERA*
ROYLE IN THE ISKAR RIVER GORGE BETWEEN PLANA AND LOZENSKA MOUNTAINS
(SOUTHWESTERN BULGARIA)**

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Abstract

The object of study is the spread of the invasive alien species (IAS) *Impatiens glandulifera* Royle in a section of the Iskar River and its tributaries near the capital Sofia. The study area is 400 km², of which about 0.2% is occupied by the *Impatiens glandulifera* populations. The investigation was conducted in the period 2019-2022. The beginning of the *I. glandulifera*'s spread in the studied territory is not through the main stream of the Iskar River, but through one of its tributaries - the Vedena River. At the current stage, this IAS is not distributed in Bulgaria through the commercial network, its populations are distributed naturally. A clearer legislative framework is needed regarding the prohibitions and measures related to the trade in IAS on the territory of the country.

Keywords: Invasive plants, spread, populations, river vegetation

Introduction

Invasive alien plant species (IAS) invade many ecosystems worldwide, often having substantial negative effects on ecosystem structure and functioning [1]. Research on the distribution of IAS and their pathways of introduction is essential for understanding and tackling the invasion process [2]. Our ability to predict the spread of IAS is largely based on knowledge of previous invasion dynamics of individual species [3].

Himalayan balsam (*Impatiens glandulifera* Royle) is a highly invasive plant and considering the extend of its spread since its introduction to Europe from the Himalayas in 1839, there is an abundance of lessons which can be learned from studying the invasion of this IAS [4]. The species is in the list of Regulation (EU) No 1143/2014 of the European Parliament and of the Council of 22 October 2014 on the prevention and management of the introduction and spread of IAS.

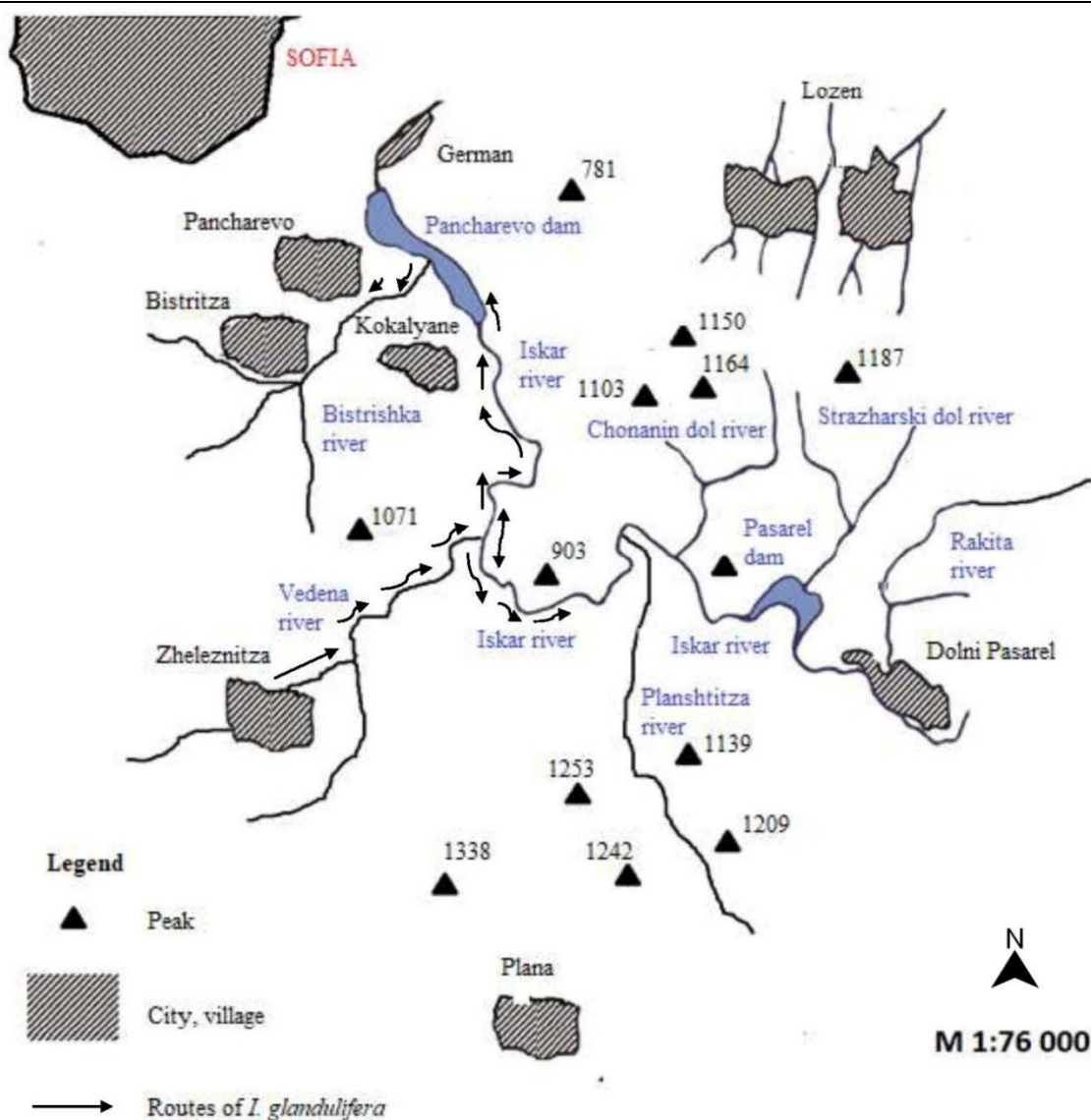
In Bulgaria *I. glandulifera* was first recorded in 1978, and its distribution was subsequently established in the Forebalkan, Balkan Range (Central), Sofia Region, Vitosha Region, Znepole Region, Valley of River

Struma, Valley of River Mesta, Rila Mts, Mt Sredna Gora, Rhodopi Mts, Thracian Lowland, up to about 1500 m a.s.l. [5].

The purpose of the present publication is to investigate the main distribution routes of the *I. glandulifera* populations in one of the biggest localities of this IAS in Bulgaria- the area of Iskar river gorge between Plana and Lozenska mountains.

Materials and methods

The investigation was conducted in the period 2019-2022. The object of study includes the section of the Iskar River and its tributaries between the villages of Pancharevo and Dolni Pasarel close to the capital Sofia (Southwestern Bulgaria) (Pic. 1). The study area is approximately 400 km², of which about 0.2% is occupied by the *I. glandulifera* populations [6]. The altitude is between 650-1100 m a.s.l. Средната годишна сума на валежите е 590.7 mm. Максималната средна месечна температура е през юли (21.5°C), а минималната през м. януари – 1.5°C. Soils are Fluvisols according to World Referent Base of Soil Resources [7].



Picture 1. Map of the study area

The Research methods include:

1. Reference based on literary sources, including scientific publications and citizen science data.
2. Field monitoring of the distribution of *Impatiens glandulifera* populations
3. Conversations with residents of the villages in the study area.
4. Filling out a questionnaire during the meetings with plant, landscape and horticulture business representatives (flower exchanges, garden centers and flower shops) in the study area and the capital located in the immediate vicinity. In addition, the most frequently sold IAS were identified from the catalogs and stands of the companies

Results and discussion

The results of the present study, which tracked the distribution of *I. glandulifera* populations along the Iskar River and its tributaries (Pic. 2.), show the following: Localities of the species were found in Zheleznitsa village and along the entire length of the Iskar tributary - the Vedena River (Pic. 1). The plant has not been found in the Bistrizia village, but its localities are observed in the lower part of other Iskar tributary- the Bistriska River near its mouth in the area of Pancharevo village.



Picture 2. Locality of *I. glandulifera* in the study area (photo: P. Glogov)

The distribution of *I. glandulifera* along the Iskar River is limited in the section Pancharevo-Devil's bridge (the mouth of the Vedena River). After the Dolni Pasarel village on the road to Samokov, along the Iskar river, no localities of this IAS are observed at the current stage. However, they are found on the banks of another of the tributaries of the Iskar river - the Okolska River, where they were most likely spread unintentionally by the cars of fishermen or tourists.

In the end, it could be assumed with great probability that the spread of *Impatiens glandulifera* along the Iskar river in the study area started from its tributary- the Vedena river. Another evidence in favor of this statement is the fact that the first information about the presence of a population of *I. glandulifera* comes from a study by Assyov, Vassilev (2004) [8], who established the species in the Vitosha floristic region, on the banks of the Vedena River in the Zheleznitsa village.

The present survey on the distribution of *I. glandulifera* in the study area found that this species is rarely cultivated intentionally in the gardens of local villages and cottage areas. According to the local people, Hymalayan balsam has established itself using the river flow and has displaced valuable economic and ornamental plants. And every year most of them take measures individually to eliminate it. Tourists are encountered who in July and August (the months in which the plant bears fruit) pick the inflorescences for bouquets without knowing about the invasive influence of Hymalayan balsam and without realizing that in this way they are inadvertently helping its spread.

Meetings with questionnaire were conducted with 3 flower exchanges, 31 flower shops and 12 garden centers. The responses to the survey questions were as follows (Table 1):

Table 1.

Summary of questionnaire responses from local representatives of business with plants

| Question | Yes | No |
|---|-------|-------|
| Do you currently sell <i>I. glandulifera</i> ? | 0% | 100% |
| Have you ever sold this particular species of genus <i>Impatiens</i> before ? (incl. Was it ordered by a customer?) | 0% | 100% |
| Do you sell other <i>Impatiens</i> species? | 100% | 0 |
| Have you heard of invasive alien plants? | 67.4% | 32.6% |
| Do you have any idea which of the plant species you sell are IAS? | 23.9% | 76.1% |

Other result from questionnaire show that 81.1% of all companies included in the survey use internet for the purchase and sale of plants, which confirms the data of [9] that internet trade is the most preferred option for the import of seeds and the entry of IAS. In the assortment of companies engaged in the supply of decorative plants, there are other exotic species from the genus *Impatiens* (and their varieties), which at the present stage are not categorized as invasive, including *I. balsamina*

L., *I. walleriana* Hook.f., *I. parviflora* DC and *I. hawkeri* W.Bull. Some of the garden centers offer for sale other IAS that occur near the study area such as *Buddleja davidii* Franch., *Opuntia humifusa* (Raf.) Raf., *Lupinus poliphyllus* Lindl. and *Helianthus tuberosus* L.

It is striking the high percentage of surveyed traders who do not know (or do not accept the fact) that some of the plants they sell are invasive and threaten biological diversity. Another part of them emphasize

the beneficial properties of IAS - for example, some agro-exchanges sell invasive foreign species such as *Amorpha fruticosa* L., because of their honey-bearing qualities.

I. glandulifera and other IAS included in the list of Regulation (EU) No 1143/2014 cannot be intentionally bred, transported, reproduced or released into nature. The regulation was transposed into the Bulgarian Biodiversity Act (created 2002 and last amended in 2022), but in its provisions, the issue of trade in IAS within the country is not specified in sufficient detail at this stage, which does not lead to specific sanctions for traders.

Conclusions

The beginning of the *I. glandulifera*'s spread in the studied territory is not through the main stream of the Iskar River, but through one of its tributaries - the Vedena River.

At the current stage, this IAS is not distributed in Bulgaria through the commercial network, its populations are distributed naturally.

A clearer legislative framework is needed regarding the prohibitions and measures related to the trade in IAS on the territory of the country.

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