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ALLIUM PARADOXUM (M.BIEB.) G. DON (AMARYLLIDACEAE) – A NEW INVASIVE PLANT SPECIES FOR THE FLORA OF BALTIC STATES

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Allium paradoxum (M. Bieb.) G. Don was recorded as a new species for the flora of Latvia and the Baltic States on the basis of plant material first collected by A. Bojāre and P. Evarts-Bunders in 2020. Relatively large population of this species was found in Rīga, in the Rumbula district (Eastern border of the city), on the slope of the river Daugava covered by natural vegetation, but near the private gardens zone and ruderal places. This species can be easily distinguished from other *Allium* species by one flat, 5-25 mm wide, keeled leaf per bulb, inflorescence with several bulbils and mostly with only one flower. The species is considered as invasive and spreading by means of bulbils. In Latvia the species has been identified in their typical habitat – disturbed forest and shrubland along the riverbank on damp soil.

Key words: *Allium paradoxum, Latvia, Baltic States, invasive plant, flora.*

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INTRODUCTION

Allium L. (Amaryllidaceae) is a genus of monocotyledonous flowering plants, containing more than 700 species. They are almost exclusively distributed in the Northern hemisphere from dry subtropics to boreal zone in the genus (Fritsch 2001). The genus *Allium* is characterized by herbaceous geophyte perennials with true bulbs, some of which are borne on rhizomes, and an onion or garlic odor and flavor (Wheeler et al. 2013). Various *Allium* have been cultivated from the earliest times, and about a dozen species are economically important as crops, or garden vegetables, and an increasing number of species are important as ornamental plants (Dilys 1992).

There are seven species of sedge occurring in the wild in Latvia – *Allium angulosum* L., *A. schoenoprasum* L, *A. ursinum* L., *A. oleraceum* L., *A. scorodoprasum* L., *A. vineale* L. and *A. montanum* F. W. Scmidt (Gavrilova & Šulcs 1999). Later, the list of Latvian vascular plants was debatably supplemented by two garden vegetables – *A. cepa* L. and *A. sativum* L. (Gavrilova & Šulcs 2005), which do not overwinter normally in Latvian climatic conditions. The situation is similar in the other two Baltic States: in Estonia –nine, supplemented by a few more cultivated species: *A. porrum* L., *A. ampeloprasum* L. and *A. fistulosum* L. (Kusk & Kukk 1998), in Lithuania – seven (*A. angulosum*, *A. schoenoprasum*, *A. ursinum, A. oleraceum, A.*

scorodoprasum, A. vineale and *A. lusitanicum* Lam, four of them are rare, included into the Red Data book of Lithuania (Karpavičiene 2004). Only one locality of *A. lusitanicum* is known in Lithuania, although very rare, this species is not included into the list of endangered species, as it could be possibly alien (Karpavičiene 2004). Another *Allium* species were mentioned in the Lithuanian flora due to misdetermination and in the Baltic flora it is noted that there is no herbarium material that confirms the species (Jankevičiene et al. 2003).

On 5th May 2020, a new species of the genus *Allium* was found in the environs of Rīga in the Rumbula city district (Eastern border of city) (Fig. 1), on the slope of the river Daugava covered by natural vegetation, but near the private gardens zone and ruderal places. The study of the specimens revealed that it is *A. paradoxum*, a species neither recorded previously in Latvia nor in the Baltic States.

MATERIAL AND METODS

The local research was carried out during the study on invasive flora of Latvia, which started in 2008 (Rutkovska et al. 2009, Evarts-Bunders et al. 2012, Evarts-Bunders & Evarte-Bundere 2020). Since morphological characters of *A. paradoxum* have not been described in the scientific literature of the Baltic States, it requires being published here. The present description of the species is based on the morphometric analysis of the material collected in Latvia. Similar studies traditionally are based mainly on dry specimens stored in herbaria. In the genus *Allium*, herbarium specimens of most taxa do not show all characters necessary for an exact determination. Because of their overall ephemeral life form, these plants show an extremely accelerated annual life cycle. The leaves are usually dry or withered when the plants are in full flower. Moreover, floral parts are strongly withered when the capsules develop. Well-functioning protection against water loss is effective even in the herbarium press, and plants may continue development as long as they are not fully dry (Fritsch 2001). As a result, herbarium specimens are usually represented in altered and atypical shape, color, morphology of flowers and bulbils or any other morphological characters. In this case, morphological characteristics and other values were analyzed and measured for fresh plant material, not herbaria. Some morphomentric values (fruit shape, seeds) are supplemented and precised in literature (Stearn & Campbell 2011, Dilys 1992, Stearn 1980, Vvedensky 1935). Herbaria from newly found locality was collected and stored in two different collections: DAU and HBA. The collected herbarium material is deposited in Herbarium of Institute of Life Sciences and Technology, Daugavpils University leg. P. Evarts-Bunders, DAU102201 (Evarte-Bundere et al. 2020), and in Herbarium of National Botanical garden, Salaspils, leg. A. Bojāre, HBA001185, HBA001186 and HBA001187. The collected *Allium* specimens was determined by Aiva Bojāre.

Species distribution map was prepared using the square method, which is related to the geographical coordinates where one square is approximately 7.6 x 9.3 km (Tabaka et al. 1980).

RESULTS

***Allium paradoxum* (M. Bieb.) G. Don** 1827. Mem. Wern. Nat. Hist. Soc. 6: 72.

MORPHOLOGY

Perennial light-green plant, bulbs almost spherical, 1 cm in diameter, outer tunics membranous. Stem up to 15-30 cm, stems triangular in section with relatively acute angles. Leaves flat, keeled, 20-25 mm wide, each bulb forms only one leaf.

Spathes 2, each 1-2.5 cm long, whitish and semitranslucent. Inflorescence sparse, with 3-5 small, green, subglobose bulbils and with only one flower, rarely – without flowers, (var. *paradoxum).* The plants found in Latvia as invasive belong to this variety. Other variety var. *normale* is characteric by inflorescence without bulbils and up to 10 flowers is known only from botanical gardens and some private collections.

Flower stalks 2-4 cm long, perianth bell shaped, 8-12 mm long and 5-6 mm wide, white with faint longitudinal green midveins. Stamens shorter than tepals, united at base, stigma 3-lobed. Fruit – appr. 5 mm long capsule, seeds with white appendage, capsule rarely produced in Europe (Stearn 1980) Seed quality and germination is unknown in local population, and, most likely, plant spreads here by bulbils (Fig. 2, 3).

Bloom during the end of April and first half of May, fruits in June.

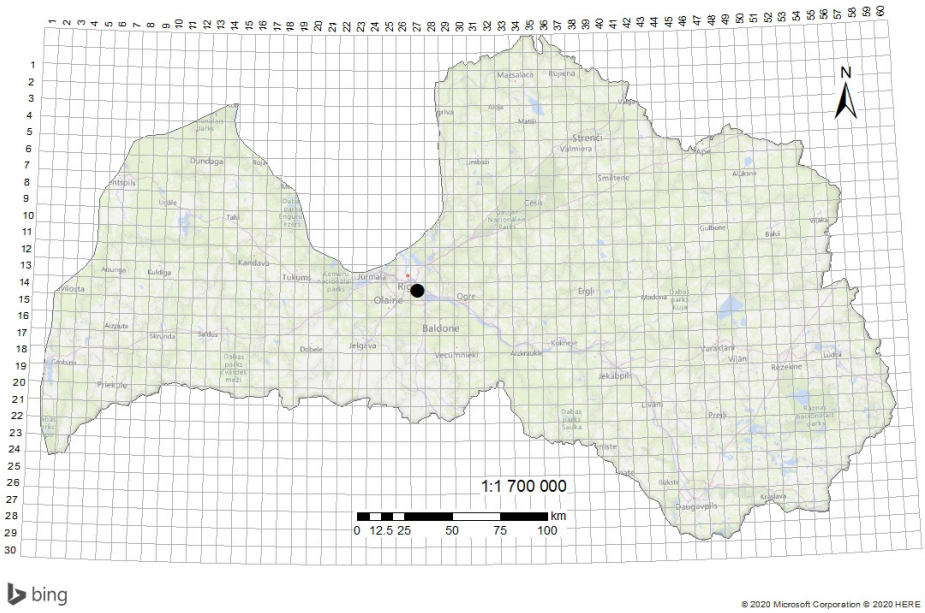

Fig. 1. Map showing the distribution of *Allium paradoxum* (M. Bieb.) G. Don. in Latvia.

Fig. 2. *Allium paradoxum* (M. Bieb.) G. Don. in newly discovered locality in Rumbula, Rīga, Latvia (Photo: A. Bojāre).

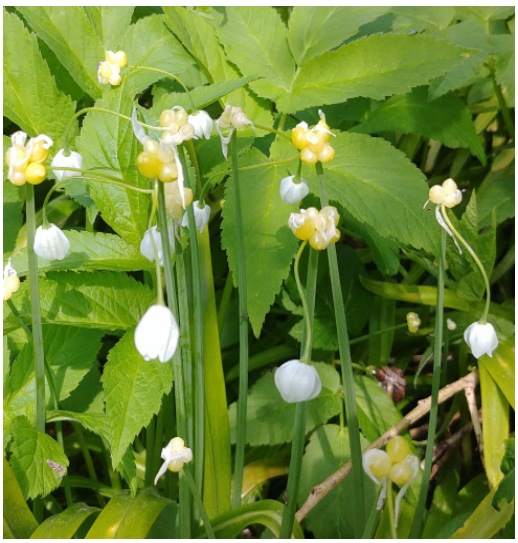

Fig. 3. *Allium paradoxum* (M. Bieb.) G. Don. in Rumbula, Rīga, Latvia with flowers and bulbils. (Photo: A. Bojāre).

DISTRIBUTION

Species is native of the Caucasus, (Grossheim 1940; Kudryashova 2006) and mountainous regions of Iran and Turkmenistan - Kopet Dagh (Turkmen-Khorasan Mountain Range) and grows preferably in shadowy mountain forests on dump, rich soils (Vvedensky 1935, Nikitin & Geldihanov 1988, Wendelbo 1971). At the same time, *A. paradoxum* can be very invasive in different natural and disturbed habitats, and is increasingly abundant throughout western and central Europe. In deciduous woodland habitats this *Allium* can form wide groups, and as a green carpet can exclude other native species, especially for early flowering ephemerophytes (Stace & Crawley 2015, Stace 2019, Annonymoys 2020a).

The species was first collected on 5th May 2020 in Latvia, Rīga city, Rumbula district, the Daugava river bank slope, disturbed forest and shrubland, near private gardens zone [56°52'48.9252", N, 24°13'4.18434"E] as a monodominant (Fig. 1, 2). The locality is relatively natural and located outside areas of high-rise houses and industrial territories, right next to the new-built Daugava promenade. The nearest surroundings can be characterized as an area of small gardens and residential houses dating to the mid of the 20th century and the species is, most believable, garden escaper from these territories. It should be emphasized that population of *A. paradoxum* is very vital, abundant (Fig. 2), the locality is 50-60 m long and 10-15 m wide with average number of individuals of appr. 2-3 thousands. The species here is a co-dominant with *Aegopodium podagraria* L., and clearly shows a high level of invasiveness.

DISCUSSION

A. paradoxum is not recorded as alien plant species in other Baltic States so far, and known only as ornamental plant catalogues of some plant nurseries and collections of botanical gardens. The species is mentioned in Belarus flora - Minsk city, cultivated in gardens as a decorataive plant (Dubovik 2017), but not yet recognized as invasive or potentially invasive. This plant is considered as non-native garden escaper since the 19th century – in Germnay, where it escaped from parks and botanical gardens and has naturalized since 1865 (Hegi 1939; Annonymous 2020a), in Czech republic known since 1867, where it grows in parks, gardens, but also in forests as invasive species (Krahulec & Duchoslav 2010).

In British Isles *A. paradoxum* was introduced into cultivation in 1823 and was first recorded in the wild near Edinburgh in 1863 (Annonymous 2020b). It can be very invasive in disturbed habitats, and is locally increasingly abundant throughout its range, especially in Edinburgh, Glasgow and Cambridge areas (Clement & Foster 1994). Affected habitats – a wide variety of, usually ungrazed, situations such as along river-banks, roadsides, field margins, other waste ground, and in woodland and shrubland habitats (Stace & Crawley 2015, Annonymous 2020b). In Ireland the species is known as rather rare garden escaper since 1979, established on riversides and also by rivers, mostly in eastern part (Reynolds 2002), in Sweden – since 1990 (Tyler et al. 2007), but not recognized as invasive. In Latvia the species was found in similar habitats - disturbed forest and shrubland along the Daugava river. In all cited countries *A. paradoxum* spread effectively by means of bulbils, and in Latvia, most likely, the plant also spreads in the same way. Such kind of vegetative propagation is characteristic only for one variety – *A. paradoxum* var. *paradoxum.* It should be noted, that the nearest known cultivation site - National Botanical garden in Salaspils is only 8 km away from a newly found locality, but only *A. paradoxum* var. *normale* is growing here, and no signs of invasions have been observed.

Newly identified locality of *A. paradoxum* in Latvia may seem a very far and isolated from the nearest localities and main part of the known invasions. Nevertheless, it must be remembered that this *Allium* species is cultivated as ornamental or even food plant in private gardens, this finding was to some extent predictable. Even more – new

findings of this species are very possible in similar sites – along disturbed riverbanks, abandoned gardens and other places.

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