

Two new alien species of Boraginaceae in the flora of North Macedonia

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Abstract



In this paper, the authors disclose the first records of two adventive species of fam. Boraginaceae in the vascular flora of North Macedonia - *Nonea lutea* and *Symphytum orientale*. They originate from the urban area of Skopje while the ones for *Nonea lutea* also from the vicinity of Kumanovo. The current status and spreading potential of each species are discussed, as well as the supposed pathways of their introduction. The presented results are based on the authors' field study, and regarding *Nonea lutea*, also on two additional herbarium collections from MKNH. Photographs of the reported species, their habitats and a map of their distribution in the country are provided.

Keywords: *Nonea lutea*, *Symphytum orientale*, Boraginaceae, flora, North Macedonia.

Introduction

In the flora of North Macedonia fam. Boraginaceae is represented by the considerable number of taxa. According to the treatment in The Flora of the Republic of Macedonia (Matevski 2010), it includes 79 species and 23 subspecies, classified in 20 genera. The cited author did not take in consideration several earlier reported species which were recently not confirmed or their presence is considered doubtful. Subsequently, Teofilovski (2011, 2019) published one additional species and subspecies, *Anchusa thessala* Boiss. & Spruner and *A. stylosa* subsp. *spruneri* (Boiss.) Selvi & Bigazzi. All the so far published taxa in the country were of a native origin.

As a continuation of the authors' previous observation of an unknown *Symphytum* L., conducted in 2014 near the Botanical Garden in Skopje, in spring 2022 the locality was revisited and the population was documented. Thereby, 1 km north-east, near Private

general hospital Re-Medica, a second population of the same species was also discovered. During the field work on the first locality, several individuals of a notable represent of *Nonea Medic.* were also recorded. The plants were identified as *Symphytum orientale* L. and *Nonea lutea* (Desr.) DC., both of them with an adventive origin in the country. Two collections of *Nonea lutea* from 2009 were additionally found in the Herbarium of the Institute of Biology, Faculty of Natural Sciences and Mathematics in Skopje (MKNH), one from the central part of the city of Skopje (leg. M. Kostadinovski & R. Čušterevska) and the other from the wider vicinity of Kumanovo (leg. V. Matevski, det. R. Čušterevska).

The checking of the relevant literature showed that both species have not been reported from the territory of North Macedonia yet. Considering the new data valuable regarding the knowledge of the adventive flora of the country, on this occasion we present them to the scientific public.

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Materials and methods

The new data are based on plant material collected during the field research conducted by the authors of the current paper accompanied by some relevant collections from the Herbarium of the Institute of Biology, Faculty of Natural Sciences and Mathematics in Skopje (MKNH). The identification was performed according to Chater (1972) and Pawlovski (1972). The nomenclature and taxonomy of the plant are consistent with the Euro + Med (2006-) database. Appropriate floristic literature is used to provide data for the native general distribution and the adventive spreading of each species. Herbarized specimens of both taxa are preserved in the private Herbarium of the first author and MKNH.

Results and discussion

Nonea lutea (Desr.) DC. (Figs. 1, 3)

Boraginaceae

Distribution in North Macedonia. Skopje, near Vardar River, in the vicinity of the hotel “Holiday Inn”, April 13, 2009, leg. M. Kostadinovski & R. Čušterevska, det. R. Čušterevska (MKNH); Skopje, Gazi Baba, near the concrete fences of Botanical Garden and the student complex “Stiv Naumov”, 42°0'0.15"N, 21°27'15.86"E, Murch 29, 2022, leg. & det. A. Teofilovski (herb. A. T.); Kumanovo, between village Slatina and Pčinja river, Golubica, 42°7'0.16"N, 21°49'20"E, 357 m, October 8, 2009, leg. V. Matevski, det. R. Čušterevska (MKNH).

These are the first records of this species in North Macedonia.

Native general distribution and habitats. Southernmost parts of E Europe and parts of SW Asia (SE Ukraine, SW Russia, Azerbaijan, Armenia, Georgia, NE Turkey, N Iran), in various dry habitats: sandy and rocky places, steppe, agricultural lands, roadsides, and oak forests (Gams 1926; Popov 1953; Chater 1972; Baytop 1978; Valdes 2011). The status of a native species in Serbia given by Valdes (2011) is incorrect, obviously based on a wrong interpretation of the data presented by Cincović & Kojić (1974).

Non-native distribution. The adventive occurrence of *N. lutea* was known since the second half of 19 century, as escapes from botanical gardens in Austria, Germany (Gibs 1926) and Italy (Cechii & Selvi 2017). Nowadays it is spread as an alien (locally naturalized) species in many other parts of C, W & S Europe [Croatia (Dalmatia), Czech Republic, Denmark, France, Great Britain, Hungary, Romania, Serbia (Niš), Slovakia, Spain, Switzerland] as well as in USA, Japan and Australia (Gams 1926; Verloove 2006; Valdes 2011; Cecchi & Selvi 2017) (for additional references see Eberwein 2011). According to a study performed in the city of Olomouc, Czech Republic (Dvořák et al. 2019), besides its myrmecochory, pointed out by Gams (1926), human activities also contribute to the successful spreading of this species. In the cited study the species spreading in the city of Olomouc is considered not dramatically fast since it was settled only in four localities within 100 years.

Regarding the Balkan Peninsula, besides Serbia and Dalmatia, also Macedonia was mentioned as an



Figure 1. *Symphytum orientale* (left) and *Nonea lutea* (right), growing together near the fence of the student complex “Stiv Naumov” (May 2, 2022. Photo. A. Teofilovski)

area of its occurrence (Hayek 1931). The later data refers to a territory composed of the largest part that presently belongs to Greece and Bulgaria and a smaller part presently representing the major part of North Macedonia. Interestingly, the occurrence of this species has not been confirmed in any of the three countries yet. All reported localities of *N. lutea* in the Balkan Peninsula should be considered non-native.

Status and path of introduction in North Macedonia. *Nonea lutea* is of adventive origin in the country. Its status seems not to be casual though its spreading potential is probably rather low. The behavior of this species in the local conditions needs further observation to define its status and the threats from its possible invasiveness.

It is difficult to determine how this annual species was introduced in North Macedonia based on the present information. It was never cultivated in the botanical garden in Skopje and most probably also in the home gardens in the country from which it could have escaped. The most probable way of its introduction could be accidental imports of seeds, alongside grains or some other agricultural products that originated from the area of its occurrence.

Description. Setose-hispid and glandular-pubescent annual; stems 10-60 cm, erect or ascending, branched. Leaves 2-7 x 0.5-2 cm, obtuse or acute, entire or dentate. Calyx 6-10 mm at anthesis, 10-20 mm in fruit; teeth ½ as long to almost as long as tube. Corolla 7-12 mm; limb 5-15 mm in diameter, pale yellow, divided to c. ½ into ovate-orbicular lobes. Nutlets 3.5-6 mm, longer

than wide, oblong-ellipsoid, rugose, ribbed; collar-like basal ring smooth. $2n=14$. (Chater 1972)

Notes on *Nonea* Medic. in North Macedonia. Another three *Nonea* species occur in North Macedonia, all of them of a native origin and known from a considerable number of localities: *N. echioides* (L.) Roem. & Schult., *N. pallens* Petrovič, and *N. pulla* DC. (Matevski 2010). The Mediterranean species *N. obtusifolia* Willd., reported but not confirmed from the vicinity of Valandovo (Stojanoff 1928), could be also present in the southernmost part of the country. From the first three species, *N. lutea* can be easily distinguished at least with the longer than wide nutlets (vs. wider than long) while from the latter one with the yellow corolla (vs. blue, brown, or purplish).

***Symphytum orientale* L.** (Figs. 1, 2, 4)

Boraginaceae

Distribution in North Macedonia: Skopje, Gazibaba, Botanical Garden and its close vicinity, ruderal shady places, 42°0'3.06"N, 21°27'15.17"E, autumn 2014, observ. A. Teofilovski, Murch 29, 2022, leg & det. A. Teofilovski; Skopje, Gazi Baba, near Private general hospital Re-Medica, below canopies of an *Acer negundo* three-line, 42°0'31.74"N, 21°27'37.68"E, Murch 29, 2022, leg & det. A. Teofilovski.

These are the first records of this species in North Macedonia.

Native general distribution and habitats. SW Ukraine, E Bulgaria (Strandza Mt. and coastal parts), and NW & C Turkey (Pawlowski 1972; Wickens 1978;



Figure 2. *Symphytum orientale*, its habitat and invasiveness in the tree-park of Botanical Garden in Skopje (April 23, 2020. Photo. R. Čušterevska)



Figure 3. Distribution of *Nonea lutea* in North Macedonia



Figure 4. Distribution of *Symphytum orientale* in North Macedonia

Petrova 1989; Valdes 2011), in dump shady places and forests.

Non-native distribution. Parts of W & S Europe: naturalized in France and Italy, with unknown status in Great Britain and, with a status of cultivated - doubtfully escaping species, in Switzerland (Valdes 2011).

Status and path of introduction in North Macedonia. Considering the range of its native distribution as well as the anthropogenic character of the habitats, the recorded populations are considered adventive. In and around Botanical Garden in Skopje, it exists for probably more than a decade and currently is well naturalized in the new environment. The population consists of several hundred vital individuals, dominating the herbaceous vegetation on the major part of the locality (Fig. 2). It inhabits more or less shady places in and near the tree-park and hedges as well as shady shrubby and waste places. Among the ruderal species occurring together with *S. officinale*, as the most abundant are the following ones: *Gallium aparine* L., *Taraxacum officinale* s.l., *Lamium purpureum* L., *Rumex crispus* L., *Stellaria media* (L.) Cirillo, *Veronica persica* Poir., *Bromus sterilis* L., and *Viola odorata* L. On the second locality, one-kilometer northeast, near the Private general hospital Re-Medica, the species is just recently settled, probably as a spreading of the above-mentioned population. About 10 individuals were observed here, growing below an *Acer negundo* tree-line.

It is not clear how this species was introduced in Skopje. It was never cultivated in the mentioned botanical garden, however, due to the pronounced ornamental characteristics, could be cultivated and escaped in the past from the nearby home gardens. Accidental import of seeds could be another possible path of the species introduction.

Symphytum orientale is an invasive species, however, it's spreading in the city of Skopje seems to

be limited due to the restricted presence of appropriate mesic habitats.

Description. Perennial herb. Stock fusiform. Stem up to 70 cm or more, much-branched. Leaves ovate, subcordate or rounded or truncate at base, densely hairy on both surfaces, rather softly hispid, often subtomentose beneath; the lower long-, the upper short-petiolate, the uppermost sessile, not decurrent. Calyx 6-9 (-12) mm, lobed to $\frac{1}{4}$ - $\frac{2}{5}$. Corolla (13)14-18(-19) mm, white; lobes not recurved. Scales lingulate, and the marginal papillae up to $2\frac{1}{2}$ times as long as wide. Stamens with filament c. $\frac{2}{5}$ as long as anther; anthers 2.5-3.5(-4) mm, ($2\frac{1}{2}$)3-5(-5 $\frac{1}{2}$) times as long as wide. (Pawlowski 1972)

Notes on *Symphytum* L. in North Macedonia. The genus *Symphytum* includes exclusively perennial herbs. Of 33 species known in the Euro-Mediterranean zone (Valdes 2011), besides the newly recorded *S. orientale* the following four species are present in North Macedonia: *Symphytum bulbosum* K. F. Schimp., *S. officinale* L., *S. ottomanum* Friv., and *S. tuberosum* L. (Matevski 2010). All of them are of a native origin and, particularly the latter, with a rather wide distribution in the country. *S. orientale* can be easily distinguished from all of them with each of the following morphological characteristics: upper leaves never decurrent, calyx lobed not more than $\frac{2}{5}$ of the length, and corolla white.

Conclusions

Nonea lutea and *Symphytum orientale* are reported as new adventive species in the flora of North Macedonia. Both of them are recorded in the urban area of Skopje and the first one is also in the vicinity of Kumanovo. *Symphytum orientale* is already naturalized and with pronounced invasiveness in and around Botanical

Garden in Skopje while the present information is not sufficient to define the status of *Nonea lutea*.

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