

## ***Ranunculus polyphyllus* Willd. still grows in Slovakia**

**Daniel Dítě<sup>1</sup>, Miloš Balla<sup>2</sup> & Zuzana Dítě<sup>1</sup>**

<sup>1</sup> Institute of Botany, Plant Science and Biodiversity Center, Dúbravská cesta 8, 845 23 Bratislava, daniel.dite@savba.sk, zuzana.dite@savba.sk

<sup>2</sup> State Nature Conservancy of the Slovak Republic, Administration of the Latorica Protected Landscape Area, J. Záborského 1760/1, 075 01 Trebišov, milos.balla@soprsr.sk

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**Abstract:** *Ranunculus polyphyllus* is a Eurosiberian species of the Eurasian forest-steppe zone, extremely rare in the western part of its distribution range, in Central Europe. In Slovakia, this lowland semiaquatic plant has its westernmost border, where only a few historic locations are known, and which have not been confirmed since 1965: one on the Podunajská nížina Lowland and three on the Východoslovenská nížina Lowland. These records, however, do not include any vegetation data. The species has been recently rediscovered in Slovakia on the Východoslovenská nížina Lowland: one historical site was confirmed in 2020 in the periodically inundated pasture near Strážne settlement, and a second site was found in 2021 near Zemplínske Hradište in a flooded depression in intensively used agricultural land which was formerly used as rice fields. In its European range, this species has been observed only in natural wetlands, and its ability to occupy secondary habitats has not yet been reported. Here we provide new data on the recent occurrence of *Ranunculus polyphyllus* in Slovakia with regard to its vegetation and habitat conditions.

**Keywords:** delayed growing season, secondary habitats, re-discovery, temporary wetlands, threatened species.

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### **Introduction**

*Ranunculus polyphyllus* Willd. is an aquatic to semiaquatic perennial plant growing in shallow oligotrophic waters, drying lakes and channel beds, and on muddy places, salt marshes, semi-saline swamps, ravines and ponds (cf. Holub 1999; Panjković et

al. 2012). It is classed as a helophyte, having its overwintering buds under water, and therefore it has two growing forms: a submerged form which floats in the stagnant water, and its terrestrial form, which is specialized to drier conditions and develops a different leaf structure. There have been no observations about its ability to occupy secondary habitats such as field depression.

This Eurosiberian species is distributed in the Eurasian forest-steppe zone from northern Kazakhstan and the southern part of western Siberia to the Pannonian Basin, which forms the westernmost part of its distribution range (Holub 1999; Luferov & Borodina-Grabovskaya 2001). A reported isolated occurrence in SE Turkey, outside of its main area (Sorger & Bucher 1983), is dubious (cf. Panjković et al. 2012). In Central Eastern Europe it is distributed in the Pannonian Basin with very scattered, rare occurrences, with most localities found on the Great Hungarian Plain in the Tisza river catchment area (Jakab 2012). In the western part of Hungary it has only a single locality in the oligotrophic ponds and high sedges communities on the northern side of Balaton Lake (Kalo & Tóth 2010), which is the westernmost known locality of its range (Bartha et al. 2015). In Romania a few locations have been noted (Ciocârlan 2009) without providing vegetation and chorological data, while in Serbia, on its southwestern range, the species has been better studied, and was recently recorded on three sites in Vojvodina (Panjković et al. 2012). In Slovakia, the northwestern distribution limit, *R. polyphyllus* is also rare. It was recently reported at a single historical site in the Podunajská nížina Lowland near Komárno, but this has not been confirmed. The last record from the Východoslovenská nížina Lowland was published by Černocho (1965), and these data were referred to in Slovak Flora by Futák (1982) and in the Red Book of the Slovak and Czech Flora by Holub (1999). In neighbouring Ukraine, *R. polyphyllus* was reported recently, close to the Východoslovenská nížina Lowland (Kricsfalusy & Mihály 2009).

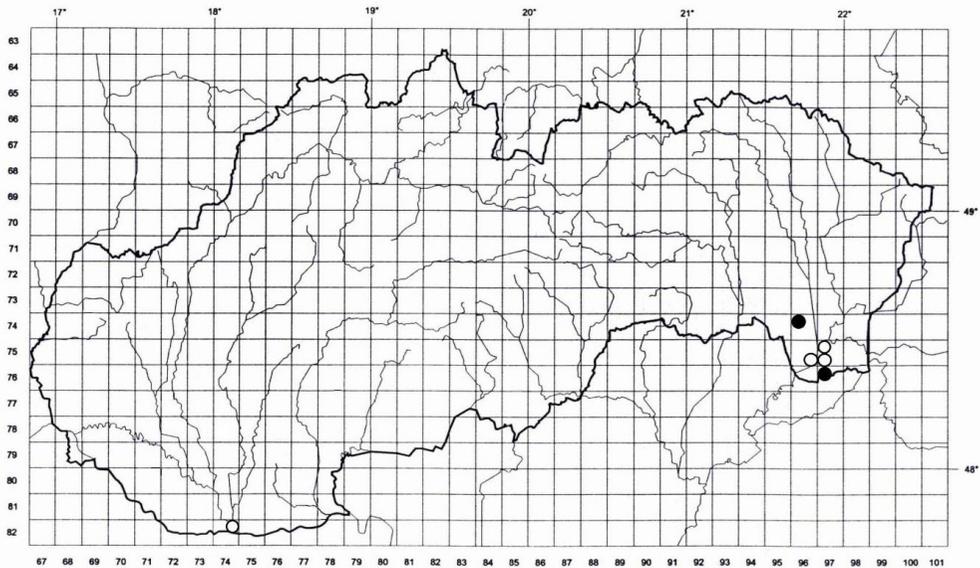
Its vulnerability status is the highest in Slovakia, where according to the IUCN Red List of Vascular Plants it is critically endangered (Eliáš et al. 2015), and in the Hungarian and Romanian Red Lists it is near threatened (Király 2007; Oprea 2005). The taxon is included in the European Red List as well (Bilz et al., 2011) under the category DD (data deficient). *R. polyphyllus* is an important indicator species of preserved lowland aquatic and semi-aquatic habitats, recently threatened by intensive agricultural activities and water regulations. From the aspect of vegetation ecology knowledge of this species is very scarce in Central and Eastern Europe.

Our aim was to provide new data concerning the recent occurrence of *Ranunculus polyphyllus* in the Východoslovenská nížina Lowland and to describe the vegetation and habitat conditions in which the species was recorded.

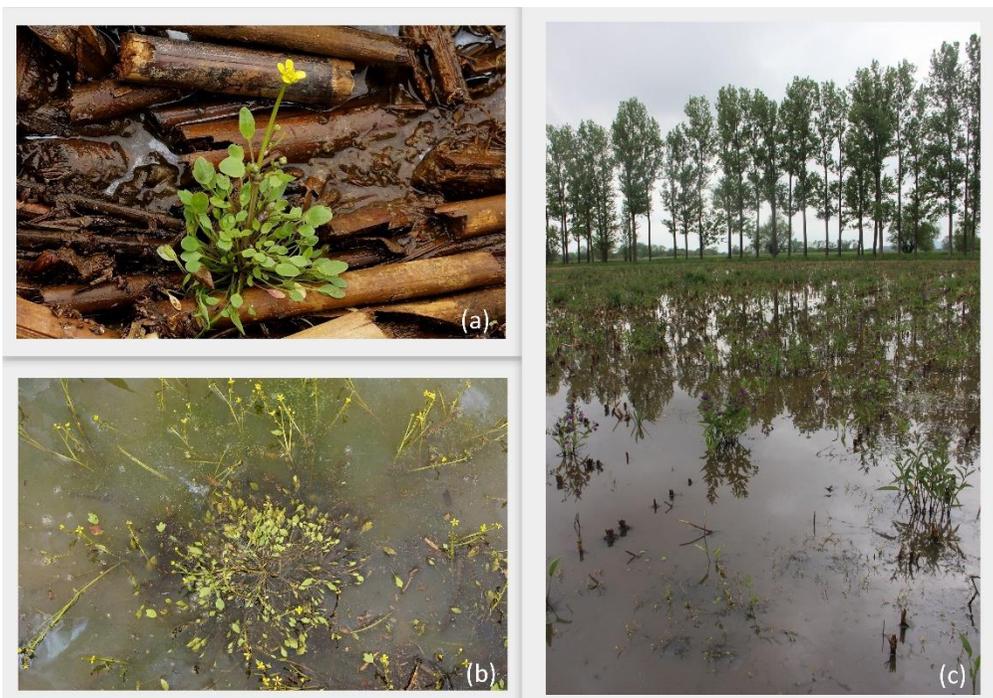
## Material and Methods

Phytogeographical division is used according to Futák (1984). Taxonomy and names of flowering plants follow Euro+Med (2021+). Herbarium acronyms are according to Vozárová & Sutorý (2001). Phytosociological relevés were sampled according to the Zürich-Montpellier approach (Barkman et al. 1964) using the

adapted nine-grade Braun-Blanquet's scale (Westhof & Van Der Maarel 1978). The coordinates of the relevés with the species were obtained by GPS equipment Garmin 60csx.



**Fig. 1** Distribution of *Ranunculus polyphyllus* in Slovakia: ○ – historical localities, ● – recent localities.



**Fig. 2** Photo-documentation of *Ranunculus polyphyllus* – terrestrial form (a), submerged form (b) and the locality Čaplina where the species was found near Zemplínske Hradište (c). Photo: Daniel Dítě, Miloš Balla (15. 5. 2021).

## Results

### Revision of the published data

There are very few data on the occurrence of *Ranunculus polyphyllus* from Slovakia, a fact which confirms its rare status. The species has been recorded only in the Pannonian region (Fig. 1).

**Pannonicum:** **6. Podunajská nížina Lowland:** Komárno, confluence of the river Váh into the Danube (Domin 1925 in Futák 1982). – **8. Východoslovenská nížina Lowland:** between Somotor and Veľký Kamenec, in the drying swamp at the northern foot of Tarbucka hill (Černochoch 1965). – Vojka, in a swamp SW from the settlement (Černochoch 1965). – Svätušie, in a swamp SW from the settlement (Černochoch 1965) – Bodrog NW (Májovský 1961 SLO in Futák 1982) = dvor Keresztúr? (Holub 1999).

The first two localities from eastern Slovakia published by Černochoch (Tarbucka, Vojka) were included by Futák in The Flora of Slovakia (Futák 1982) and by Holub (1999) in the Red Book of the Czech and Slovak Republic. Holub (l.c.) regards the site near Tarbucka as having disappeared due to ploughing, like the site at Bodrog (= dvor Keresztúr), as well as the site near Komárno where the species has not been observed since 1925. The sites found by Černochoch (1965) are the last known published localities of the species. Since then, it has not been observed in Slovakia and its occurrence has not been confirmed during the detailed floristic research of the Potiská nížina Lowland carried out by Bogoly (1994). This study concerns only the literature data by Černochoch (1965) SW of Vojka, from the oxbow of the Krátke Tice nature reserve.

### New localities of *Ranunculus polyphyllus*

During the floristic survey of the Východoslovenská nížina in May 2020 the second author found new, as yet unknown localities of *Ranunculus polyphyllus* north of Strážne, at the site Opátske piesky on the edge of the depression on the pastures (48°22'48.0" N, 21°51'16.1" E). We were unable to verify this location in May, 2021. The flat depression where the species grew the previous year had an increased water level in spring 2021, and had been severely trampled by grazing cattle after the heavy rainfalls. The site conditions have been more or less constant without any changes for decades, and the species is likely to survive here. We assume that *R. polyphyllus* will appear there again, when the conditions become more favourable.

We found a second site, called Čaplíny on 9. 5. 2021, near Zemplínske Hradište (Trebíšov district), 1 km NE of the village (Fig. 2). The populations were part of the initial, semi-aquatic vegetation occupying a recently abandoned maize field. They numbered hundreds of individuals and occupied an area of at least 2 hectares. The distribution of the species was scattered, with larger populations evident in only a few places. In this instance, the submerged form predominated, while the terrestrial form was infrequently found in the exposed, muddy surface. The micro-site with a

higher concentration of individuals is documented by the following phytosociological relevé:

Ondavská rovina, Zemplínske Hradište, vast flooded field depression, 99 m, 48°35'37.1" N, 21°44'42.5" E, 16 m<sup>2</sup>, E1: 10 %, open water height 30 cm, 15. 5. 2021.

E<sub>1</sub>: *Ranunculus polyphyllus* 2a, *Persicaria lapathifolia* 1, *Symphytum officinale* 1, *Carex acutiformis* +, *Ranunculus repens* +, *Ranunculus sceleratus* r.

In addition to the species listed in the relevé, on the previously dried, muddy surface *Lythrum virgatum*, *Myosurus minimus*, *Veronica scutellata* and *Tripleurospermum inodorum* were abundant, *Cardamine matthioli*, *Cerastium pumilum* subsp. *glutinatum* and *Lycopus exaltatus* with lower frequency, and a single rosette of *Cirsium brachycephalum* was recorded. The coenological classification was not relevant, due to the very early stage of vegetation development. The delayed growing season in 2021, the low average temperatures during the spring, and the intensive flooding of the site are reasons for the very low species number.

In the past, this area was a part of vast grasslands in the Ondava river catchment area, which due to the permanent high water table were used as pastures and hay meadows. After meliorations were completed in the 1950s, rice fields were established. As these were not successful, the fields were then used for growing other crops. In wet years, several waterlogged places were left uncultivated, but in the drier years the periodically flooded initial vegetation was occasionally ploughed.

After several years, in 2020, the micro-site of *Ranunculus polyphyllus* was ploughed again and maize was planted there. After harvesting the field was left unploughed due to autumn flooding, and the stubble with a high amount of organic waste was abandoned until the following year. At the time of recording, the species was abundant in a vast, flooded depression.

## Discussion

There are no coenological or ecological data on the occurrence of *Ranunculus polyphyllus* in the territory of Slovakia so far. Futák (1982) describes it as a characteristic species of the alkaline wet meadows of the alliance *Beckmannion*, which is practically the single phytosociological remark reported from Slovakia. According to Soó (1966) and Borhidi (2003), in the western part of the Pannonian Basin the species is characteristic for the aquatic floating community *Batrachietum aquatilis-Ranunculetum polyphylli* as well as for alkaline wet meadows from the alliance *Beckmannion erucaeformis* (like ass. *Agrostio stoloniferae-Alopecuretum pratensis* and *Agrosti-Eleochari-Alopecuretum geniculati*). Except for a few observations in wheel tracks in Hungary (Mesterházy in litt.) it has not been reported in secondary habitats. Similarly in Serbia, where according to the most consistent study of the species (Panjković et al. 2012) it was detected only in natural wetlands: on drying edges of freshwater ponds, between tussock sedge communities (ass. *Caricetum elatae* and *Caricetum ripariae*) and moderately saline meadows

(*Bolboschoenetum maritimi continentale*). In Ukraine, close to the Slovak border and the discovered locality, it was also reported in semi-natural lowland habitat along the Uh River valley (Kricsfalusy & Mihály 2009).

The site Opátske piesky north of Strážne settlement is a unique lowland locality in Slovakia. Several rare species are present in the rugged micro-relief of former sand dunes and waterlogged interdunal depressions. Many of them are salt-tolerant, indicating specific alkaline habitats, such as *Beckmannia eruciformis*, having rich populations maintained by extensive livestock grazing (Dítě et al. 2011). Another characteristic species to this habitat is *Galatella sedifolia* (Melečková et al. 2016), and not far from there *Cirsium brachycephalum* (Mártonfi 2014), *Bupleurum tenuissimum*, *Elatine alsinastrum*, *Lotus tenuis*, *Trifolium fragiferum* subsp. *bonannii* or *Ranunculus lingua* (Dítě D., Dítě Z., Eliáš jun. P. 2000–2021 not.) were also recorded. In the recent past, *Anacamptis palustris* subsp. *elegans* was also confirmed there (Bogoly 1994), however, in more recent years it was has not been recorded.

*Ranunculus polyphyllus* is not the only threatened species to be re-discovered in recent years in east Slovakia. Other extremely rare species whose occurrence is restricted to temporary wetland habitats of the Východoslovenská nížina Lowland include *Schoenoplectus supinus* (Zlacká et al. 2006), *Ludwigia palustris* (Dítě et al. 2017) and *Carex bohémica* (Dítě et al. 2015). The recent occurrence of *R. polyphyllus* underlines the uniqueness of the intensively used landscape of Východoslovenská nížina which still harbours a variety of Slovakia's preserved wetland habitats. At the same time, it emphasizes the need for a more complete study of this area regarding its flora. Other, historically known species in the area still waiting for re-discovery are *Aldrovanda vesiculosa* (Oťahelová & Feráková 1999), *Trifolium diffusum* (Feráková & Kubát 1999) and *Schoenoplectus mucronatus* (e.g. herbarium specimen by Margittai 1928 BRNM).

## Conclusions

Despite a period of almost 60 years during which the occurrence of *Ranunculus polyphyllus* in the East Slovakian lowlands was not confirmed, we assume that it has undoubtedly occurred in the area at all times in suitable years.

The reason for the long absence of evidence is the very narrow ecological niche of the species (oligotrophic environment, high water level during spring), which requires conditions which may not be present in each year. Its short life cycle and its inconstant appearance, which is influenced by the fluctuating groundwater level and changing weather conditions, also limit its permanent observation. And last but not least, the sporadic and insufficient floristic survey of the region Východoslovenská nížina Lowland, compared to the relatively well explored area of the Podunajská nížina Lowland in west Slovakia is certainly a factor. The recently found sites should be visited each year, in order to obtain more vegetation data. We also highlight the need for further information about the ecological circumstances, distribution and population trends of *R. polyphyllus* in its European area, as it is an important flagship species of the fragile semi-aquatic habitats. Temporary wetlands on secondary

habitats, e.g. field depressions like those where the species was found, should be therefore studied in more detail.

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