

***Ranunculus ophioglossifolius* a newly recorded Atlantic-Mediterranean element in the Hungarian flora: morphometric distinctness and functional trait variability**

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Abstract

Ranunculus ophioglossifolius is an amphibious plant species with a disjunct Atlantic–Mediterranean distribution, recorded for the first time in Hungary. Two populations were identified in the south-eastern part of the Pannonian Basin, extending the known range of the species northward. Field surveys, morphometric analyses and phytosociological sampling were conducted to assess its ecology, phenotypic variability and differentiation from three morphologically similar *Ranunculus* species. Linear discriminant analysis based on selected morphological traits provided high classification accuracy among the studied taxa. New functional trait data are presented, including seed mass and vegetative parameters, which are smaller in the Hungarian populations than the reported European values. These differences are consistent with environmentally induced phenotypic variability. Phytosociological data indicate that the species occurs in Pannonian wet saline meadow mosaics on solonetz soil, primarily within temporarily inundated microhabitats associated with *Agrostio stoloniferae*–*Alopecuretum pratensis*, *Caricetum melanostachyae*, and *Bolboschoenetum maritimi* communities. The occurrence of *R. ophioglossifolius* in the Pannonian Basin, together with comparable regional records, suggests that the species may represent either a previously overlooked or a recently established element of the Hungarian flora. These findings contribute to the understanding of species distributions and highlight the relevance of integrated taxonomic and ecological approaches in documenting range dynamics.

Key words amphibious plants; functional traits; detrended correspondence analysis; Pannonian Basin; phenotypic plasticity; range expansion; wet grasslands.

Introduction

Climate change is increasingly altering the distribution patterns of species associated with distinct biogeographical regions, with important consequences for local diversity and species richness (Sammarco & Strychar 2009; Diamond 2018; Zurell et al. 2024, Dyderski et al. 2025). In Hungary, recent climatic trends are characterised by hotter and drier summers, coupled with milder and wetter winters, indicating a gradual shift towards more Mediterranean-like conditions (Breuer et al. 2017; Csősz et al. 2026). These climatic changes are likely to facilitate the establishment and northward expansion of Mediterranean and sub-Mediterranean taxa. Accordingly, several such species have recently appeared or markedly expanded in Hungary and elsewhere in the Carpathian Basin, including *Anisantha diandra* (Roth) Tutin ex Tzvelev, *Anisantha madritensis* (L.) Nevski, *Avena barbata* Pott ex Link, *Catapodium marimum* (L.) C.E.Hubb., *Hainardia cylindrica* (Willd.) Greuter, *Parapholis incurva* (L.) C.E.Hubb., *Psilurus incurvus* (Gouan) Schinz & Thell. (Schmidt et al. 2025); *Catapodium rigidum* (L.) C.E.Hubb. (Bauer et al. 2025); *Himantoglossum calcaratum* (G.Beck) Schltr. (Kacsinecz et al. 2025); *Ophrys bertolonii* Moretti (Molnár V. et al. 2011); *Phalaris aquatica* L. (Süveges & Schmidt 2025); *Thlaspi alliaceum* L. (Molnár V. et al. 2024a) and *Torilis nodosa* (L.) Gaertn. (Kun et al. 2023).

Ranunculus ophioglossifolius Vill. is an amphibious species with a disjunct Atlantic–Mediterranean distribution. Its range extends from the Iberian Peninsula across southern Europe to the Caucasus and Asia Minor (eastwards to Iran), and from southern Sweden to North Africa, including Tunisia, Algeria and Morocco (Tutin 1964; Cook et al. 1998; GBIF 2024; POWO 2024+) (Fig. 1.). Outside this core range, the species also occurs in the Crimean Peninsula (Yena 2012). It has further become naturalised in Australia and New Zealand (Wilson 2007), where it occupies wetlands such as swamps and lagoons (Eichler et al. 2013; Webb et al. 1988). Herbarium records also indicate occasional occurrences outside its main range, including specimens attributed to *R. geoides* Siev. from North America (GBIF 2024).



Figure 1. European distribution of *Ranunculus ophioglossifolius*. Yellow dots indicate known occurrences based on GBIF (2025), the Flora Croatica Database and other published sources; black dots represent the first records from Hungary.

Within the Pannonian Basin, *R. ophioglossifolius* has been recorded rarely. Although occurrences are known from neighbouring countries, including Romania, Serbia and Croatia (Prodán 1910; Drăgulescu 2013; Dudáš et al. 2020), the species has not previously been documented within the present borders of Hungary (Király 2009). Its recent detection therefore raises questions concerning its origin and status in the region. At the same time, ongoing floristic research continues to reveal previously unrecorded populations of both native (Demeter 2022; Demeter & Szél 2022; Süveges 2022; Kelecsényi & Takács 2022; Bauer 2023; Molnár V. et al. 2024a) and alien plant species in Hungary (Takács et al. 2020; Csecserits et al. 2021; Kis 2022; Kovács et al. 2023; Kulcsár 2023; Molnár V. et al. 2024b).

The present study documents the first confirmed occurrence of *R. ophioglossifolius* in Hungary. It provides detailed morphological and ecological data from newly discovered populations and evaluates their differentiation from morphologically similar taxa. In addition, the study contributes new functional trait data to international databases and assesses the species' position within local plant communities using phytosociological methods. The findings offer new insights into the distribution, variability and ecological integration of the species at the northern margin of its range.

Material and methods

Field work

Phytosociological surveys, population size estimations and morphometric measurements of *Ranunculus ophioglossifolius* were conducted on 13 May 2024 near Királyhegyes (Csongrád–Csanád County, Hungary; 46.261396° N, 20.656461° E), where the species was first recorded. Population size was reassessed at the same site on 11 May 2025.

At Királyhegyes, surveys were carried out along a drainage ditch representing the core habitat of the species, where its highest density was observed. The occupied section of the ditch was delineated in the field and found to extend over approximately 200 m. Within this section, individuals were counted at regular 4 m intervals along the ditch, providing a systematic estimate of population density. In the surrounding meadow, where the species occurred only sporadically, the area was surveyed by thorough field inspection, and all detected individuals were counted.

In addition, a second population was discovered near Gyula (Békés County, Hungary; 46.593722° N, 21.290639° E), where population size estimation and phytosociological surveys were also conducted.

For the morphometric comparison, we selected three species occurring in Hungary: *Ranunculus polyphyllus* Waldst. et Kit., *Ranunculus lateriflorus* DC., and *Ranunculus flammula* L. These taxa were chosen because, in terms of morphology and habitat, the newly discovered *R. ophioglossifolius* most closely resembles them among the *Ranunculus* species documented in the New Hungarian Herbal (Király 2009). All three taxa are characterised by entire or minimally lobed leaves, a relatively small stature (5–20 cm), and a strict association with wetland habitats. For comparative morphometric analyses, specimens of *R. polyphyllus* and *R. lateriflorus* were collected near Újszentmargita (Hajdú-Bihar County, Hungary; 47.73709° N, 21.08021° E) on 12 May 2024. Specimens of *R. flammula* were collected near Debrecen (Hajdú-Bihar County, Hungary; 47.50851° N, 21.60306° E) on 31 May 2024. Voucher specimens were deposited in the Herbarium of the University of Debrecen (DE).

Morphometric study

Morphometric measurements were conducted on *Ranunculus ophioglossifolius* and three closely related *Ranunculus* species native to Hungary: *R. lateriflorus* DC., *R. polyphyllus* Waldst. & Kit. ex Willd., and *R. flammula* L. For each species, ten fully developed, flowering individuals were selected for morphometric analyses.

The following parameters were measured:

- number of generative shoots
- length of (longest) generative shoot (mm)
- number of basal leaves
- total number of flowers
- length of lamina of basal leaf (mm) (1st, 2nd, 3rd)
- width of lamina of basal leaf (mm) (1st, 2nd, 3rd)

- distance between widest point and origin of lamina on the basal leaf (mm) (1st, 2nd, 3rd)
- length of petiole of basal leaf (mm) (1st, 2nd, 3rd)
- length of peduncle (mm)
- length of lamina of cauline leaf (mm)
- width of lamina of cauline leaf (mm)
- distance between widest point and origin of lamina on the cauline leaf (mm)
- length of petiole of cauline leaf (mm)
- diameter of stem (mm)
- number of fruit / infructescence

Functional trait measurements

Leaf traits of *Ranunculus ophioglossifolius* were measured under controlled laboratory conditions. The methodology followed Török et al. (2013), E-Vojtkó et al. (2020) and McIntosh-Buday et al. (2022). The following traits were assessed: thousand-seed mass (g), fresh leaf mass (g), dry leaf mass (mg), leaf area (mm²), specific leaf area (SLA, mm² g⁻¹) and leaf dry matter content (LDMC, mg g⁻¹).

Phytosociology

Phytosociological sampling was conducted using 4 m² plots (n = 20) located at the outskirts of Királyhegyes and Gyula to assess the occurrence of *R. ophioglossifolius* within the plant community. In each plot, all vascular plant species were recorded, and their percentage cover was estimated. For species with cover values below 0.5%, presence was indicated by a “+” symbol. Sampling sites were selected to ensure the occurrence of *R. ophioglossifolius* in all plots. Recorded species were assigned to phytosociological classes according to the Pannonian Database of Plant Traits (Horváth et al. 1995; Sonkoly et al. 2023). The nomenclature of the plant communities follows Borhidi (2012).

Data analysis

Twenty-three morphometric variables were recorded for ten individuals of each of the four species. Linear discriminant analysis (LDA; ‘MASS’ package, Venables & Ripley 2002) was applied to the dataset to classify individuals into species-specific groups.

To identify the variables contributing most to group separation, Wilks’ lambda (Λ) statistics were calculated (‘klaR’ package, Weihs et al. 2005). Values close to one indicate low discriminatory power, whereas values approaching zero indicate a greater contribution to group separation.

Based on the most informative variables, a model selection procedure was performed by evaluating all possible combinations of these variables. Models were ranked according to classification accuracy and the number of variables included, with the aim of identifying the smallest subset of traits providing the highest discrimination among the four species.

To explore compositional differences among phytosociological relevés, detrended correspondence analysis (DCA, Hill & Gauch 1980) was performed (‘vegan’ package, Oksanen et al. 2026). Rare species were downweighted during ordination. Similarities among relevés were additionally assessed by hierarchical cluster analysis based on Bray–Curtis dissimilarity and the average linkage method.

All analyses were conducted in R version 4.2.1 (R Core Team 2022).

Results

First records in Hungary

On 13 May 2024, *Ranunculus ophioglossifolius* was recorded for the first time in Hungary by G. Jakab, near Királyhegyes (Csongrád–Csanád County, Királyhegyesi Ugar; Fig. 2A, B, D, E). The population occurred in a saline wet meadow, within an *Agrostio stoloniferae*–*Alopecuretum pratensis* Soó 1933 corr. Borhidi 2003 community, occupying the deepest sections of a periodically inundated drainage ditch characterised by tall-sedge meadow vegetation and periodically exposed muddy surfaces.

On 11 May 2025, we recorded the species approximately 60 km northeast of the previously documented population, in the vicinity of Gyula (Békés County) in an area known as Kis-Péli-dűlő. As with the earlier site, this habitat is characterised by features typical of a saline wet meadow and saline

marsh (Fig. 2C). Comparable to the Királyhegyes location, the plant community can be classified as *Agrostio stoloniferae*–*Alopecuretum pratensis*, although it exhibits here a notable transition towards a *Bolboschoenetum maritimi* Egger 1933 association.

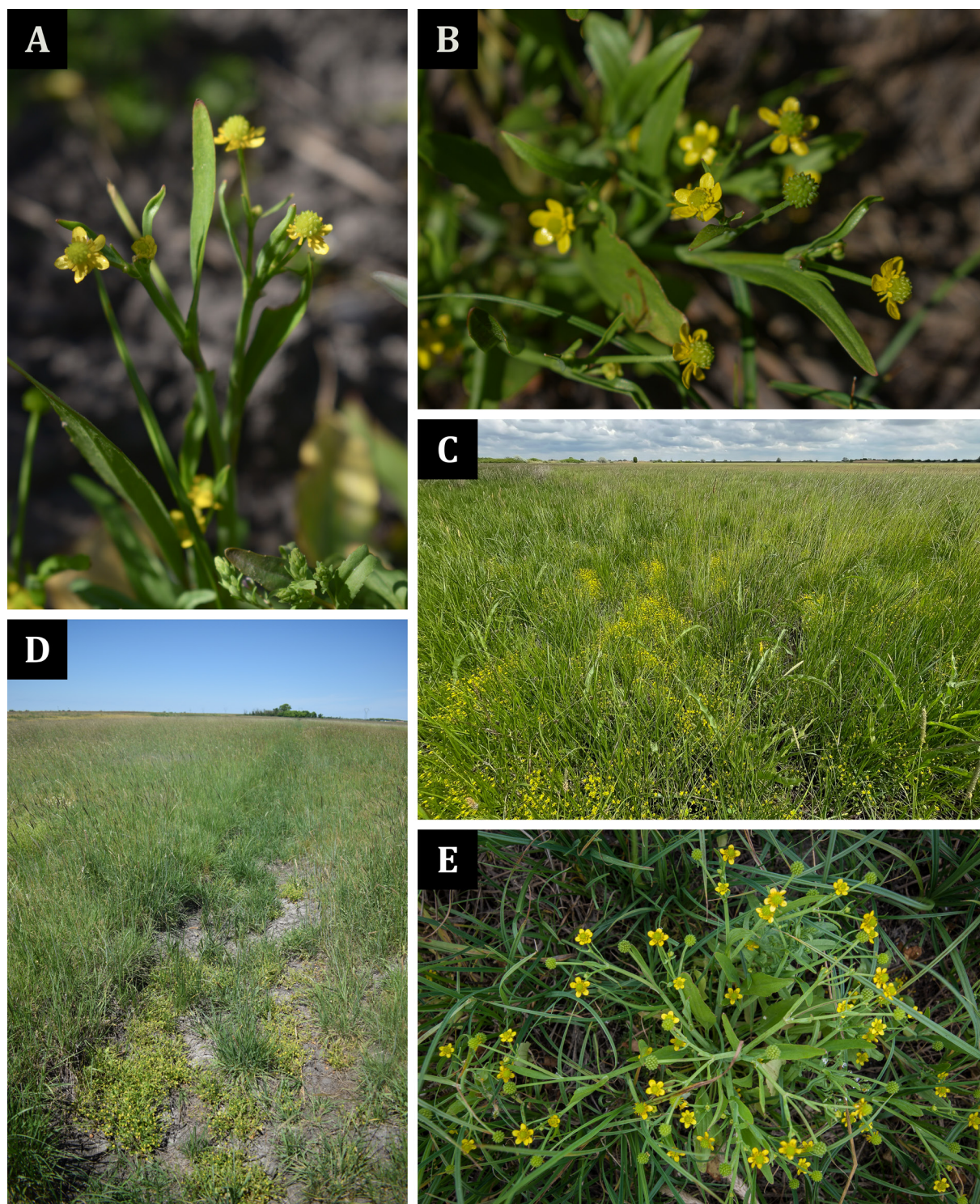


Figure 2. *Ranunculus ophioglossifolius*. A–B: flowering individuals in a drainage ditch at Királyhegyes; C: individuals in alkaline marsh habitat near Gyula; D: habitat at Királyhegyes; E: general habit. Photographs A–D by Sz. Kis, E by G. Jakab.

Population size

In 2024, a total of 2,150 individuals were counted along a 200 m section of the ditch at Királyhegyes, with a mean density of 43 ± 40.5 individuals per 4 m² (min = 0, max = 154). The population extended along approximately 620 m of the ditch, with scattered individuals occurring up to 10 m beyond both ends. The total population size was estimated at c. 6,600 individuals. An additional 87 individuals were recorded in the surrounding Pannonian saline wet meadows, mainly in open patches of the *Agrostio stoloniferae*–*Alopecuretum pratensis* community. In 2025, only 99 individuals were recorded in the ditch, including 30 individuals on pioneer soil surfaces on a tractor rut above the ditch.

In 2025, the population near Gyula was estimated to comprise c. 10,000 individuals, occupying an area of approximately 2,500 m².

Morphological characterisation of *Ranunculus ophioGLOSSIFOLIUS*

Morphological measurements (Table S1–S4) and field observations are summarised below (see also Fig. 5.). For each parameter, minimum and maximum values are given together with the mean $\pm$ standard deviation.

Ranunculus ophioGLOSSIFOLIUS is an annual species with erect, stiff stems. Generative shoots branch distally, and lateral shoots emerge above the subtending leaves; basal branching is rare. Stems are cylindrical and hollow, with a diameter of (2–)3–6.3(–7.8) mm above the soil surface.

Basal leaves are highly variable in shape, ranging from ovate, elliptic, deltoid to triangular, with entire or 3–5-lobed margins. Leaf bases may be cuneate, rounded or truncate. Blade length is 6–45(–158) mm and width (3–)7–17(–21) mm; petiole length ranges from (3.6–)20–40(–61) mm. The distance between the widest point and the base of the blade is (1.5–)3–6(–8) mm.

Cauline leaves are rhomboid to lanceolate, with crenate or dentate margins and tapering bases. Leaf length is (13–)20–50(–55) mm, width (2.5–)5–13(–15) mm, and petiole length (2–)3–24(–34) mm. The distance between the widest point and the base is 6–18(–28) mm.

Flowers are golden-yellow, with five petals, numbering (1–)10–75(–145) per plant and borne on peduncles 2–23(–41) mm long. Each infructescence contains (34–)40–52(–54) achenes. Achenes are asymmetrically ovoid, with a black funiculus, clearly distinguishing the species from related taxa (Figs. 5, 6). Achene length is approximately 1.1–1.3 mm, and fruits within a cluster are loosely arranged.

Morphological differentiation of the studied species

Linear discriminant analysis (LDA) including all variables ($n = 23$) resulted in high classification accuracy (0.950; Fig. 3A). Based on Wilks' lambda statistics, ten variables contributed most strongly to group separation (Table 1).

Table 1. Results of Wilks' statistics showing the ten variables with the highest contribution to group-separating power in the dataset. The approximated F -statistics for the overall model, with corresponding p -values, and the partial model results (comparing inclusion versus exclusion of each variable) are presented.

Variable	Wilks' Λ	F	p	F (partial)	p (partial)
Length of (longest) generative shoot (mm)	0.215	43.750	<0.001	43.750	<0.001
Length of pedunculus (mm)	0.060	36.132	<0.001	30.487	<0.001
Number of fruits / infructescence	0.023	34.062	<0.001	17.820	<0.001
Number of basal leaves	0.009	35.980	<0.001	17.260	<0.001
Width of lamina of cauline leaf (mm)	0.006	32.675	<0.001	6.369	0.002
Length of petiole of cauline leaf (mm)	0.004	29.324	<0.001	3.918	0.017
Total number of flowers	0.003	26.480	<0.001	2.894	0.051
Number of generative shoots	0.003	24.079	<0.001	2.296	0.098
Width of lamina of 1st basal leaf (mm)	0.002	21.919	<0.001	1.757	0.177
Length of lamina of 2nd basal leaf (mm)	0.002	20.232	<0.001	1.726	0.184

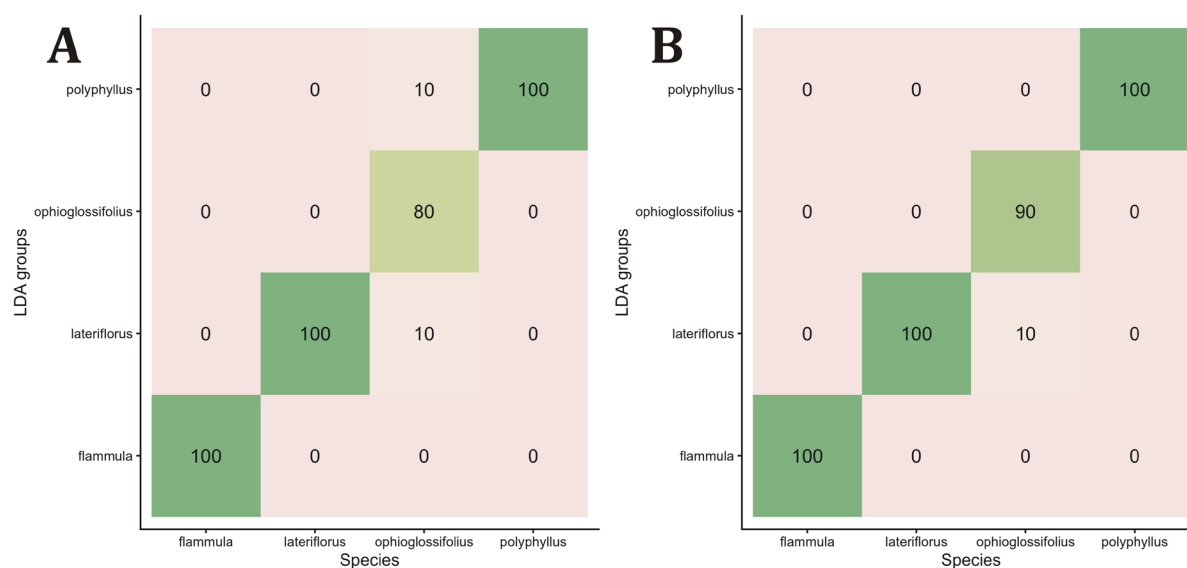


Figure 3. Classification accuracy of species identification using linear discriminant analysis: (A) all variables included; (B) selected subset of variables.

Using these variables, model selection increased classification accuracy to 0.975 (Fig. 3B). The best-performing model included seven variables (Table 2), although several models with similarly high accuracy (≥ 0.925) required as few as four variables (Table S7).

Table 2. Summary of variables included in LDA models with a high correctness rate (≥ 0.925 ; $n = 40$). The number of models indicates how often a variable was selected, while a “+” sign denotes inclusion in the best-performing model.

Variable	Number of models	Best model
Length of (longest) generative shoot (mm)	31	+
Length of pedunculus (mm)	38	+
Number of fruits / infructescence	28	+
Number of basal leaves	40	+
Width of lamina of cauline leaf (mm)	26	+
Length of petiole of cauline leaf (mm)	17	
Total number of flowers	26	
Number of generative shoots	34	+
Width of lamina of 1st basal leaf (mm)	23	+
Length of lamina of 2nd basal leaf (mm)	11	

Functional trait values

Mean values based on ten measurements (Table S6) were as follows: thousand-seed mass (TSM) 0.294 g, fresh leaf mass 0.095 g, dry leaf mass 14.6 mg, leaf area 388.6 mm², specific leaf area (SLA) 27.0 mm² g⁻¹, and leaf dry matter content (LDMC) 156.7 mg g⁻¹.

Phytosociology

Detrended correspondence analysis (DCA) revealed compositional differentiation among the relevés along a wet meadow–marsh vegetation gradient (Fig. 4). Relevés associated with *R. ophioglossifolius* showed a transitional floristic composition, containing both wet meadow species characteristic of *Agrostio stoloniferae*–*Alopecuretum pratensis* and marsh-related taxa linked to *Bolboschoenetum*

maritimi communities. Cluster analysis similarly separated relevés with stronger marsh influence from those with more meadow-like characteristics.

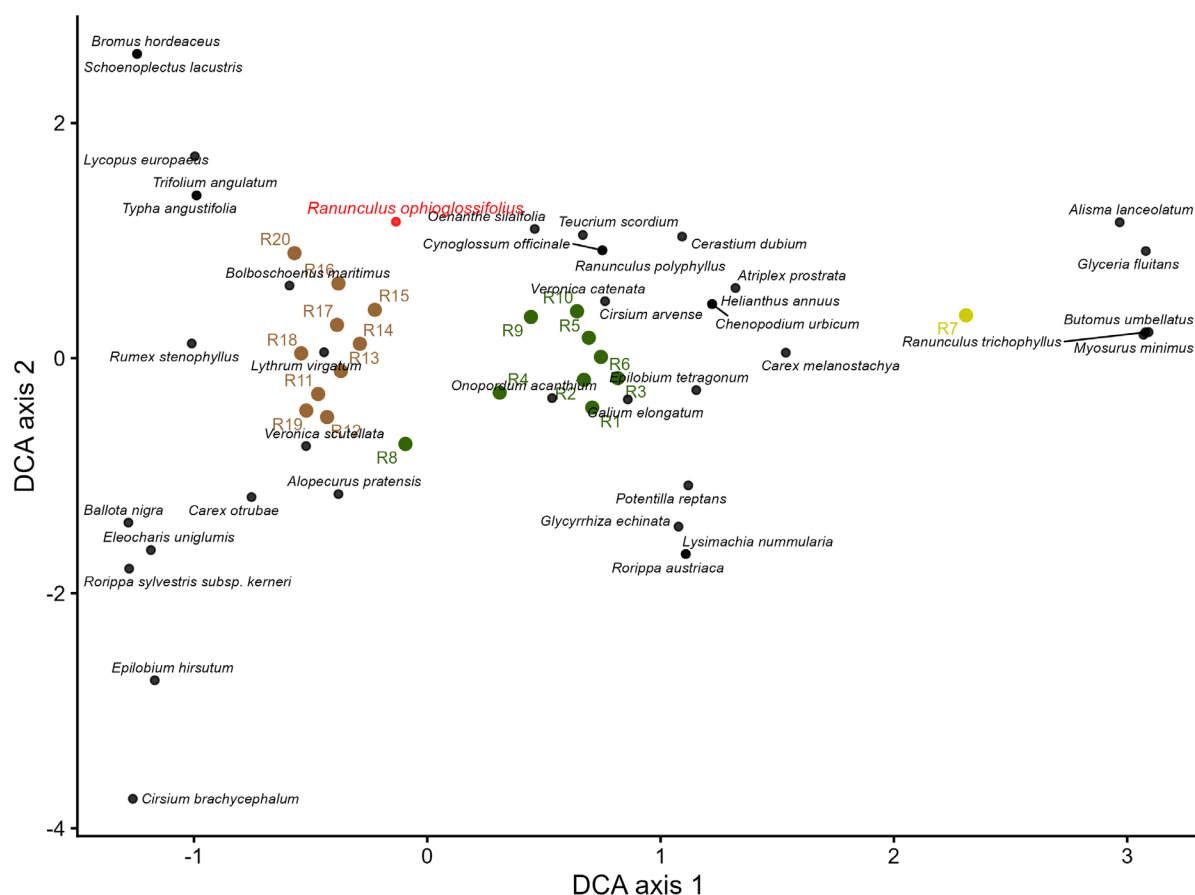


Figure 4. Detrended correspondence analysis (DCA) ordination of the phytosociological relevés coloured according to hierarchical cluster membership. *Ranunculus ophioglossifolius* is highlighted in red.

Ranunculus ophioglossifolius occurred in wet meadow habitats within a mosaic of *Agrostio stoloniferae*–*Alopecuretum pratensis* association in both populations. Based on constancy values, the most frequent species were *Alopecurus pratensis* (95%), *Oenanthe silaifolia* (90%), *Bolboschoenus maritimus* (60%), *Rumex stenophyllus* (50%), *Lythrum virgatum* (50%) and *Carex melanostachya* (50%) (Table S5). Most recorded species belonged to the syntaxa *Molinio-Arrhenatheretea* (36.0%), *Phragmitetalia* (22.6%), *Bolboschoenion maritimi* (14.4%) and *Puccinellietalia* (10.6%).

At the Királyhegyes site, *Carex melanostachya* was the dominant species in 70% of the relevés, followed by *Alopecurus pratensis* and *Bolboschoenus maritimus*. Consequently, the vegetation occupying the deeper sections of the Pannonian saline wet meadow, particularly along the ditches, more closely aligns with the description of *Caricetum melanostachyae* Balázs 1943 (Borhidi 2012). Notably, while *R. ophioglossifolius* occurred here in greater numbers, it was also present within the surrounding *Agrostio stoloniferae*–*Alopecuretum pratensis* association.

At the Gyula site, *R. ophioglossifolius* dominated 30% of the surveyed plots, whereas *Alopecurus pratensis* dominated 40%. In two further relevés, *Bolboschoenus maritimus* was the dominant species, and in one, *Schoenoplectus lacustris* prevailed. Consequently, this habitat can be classified within the *Agrostio stoloniferae*–*Alopecuretum pratensis* association, demonstrating a transition towards *Bolboschoenetum maritimi*.

Some protected species had also occurred including *Eleocharis uniglumis* and *Cirsium brachycephalum*. The co-occurrence of other *Ranunculus* species was also observed (*R. polyphyllus* and *R. trichophyllus*).

Based on phytosociological surveys, we propose classifying *R. ophioglossifolius* within the *Agrostio stoloniferae*–*Alopecuretum pratensis* association (Table S5).

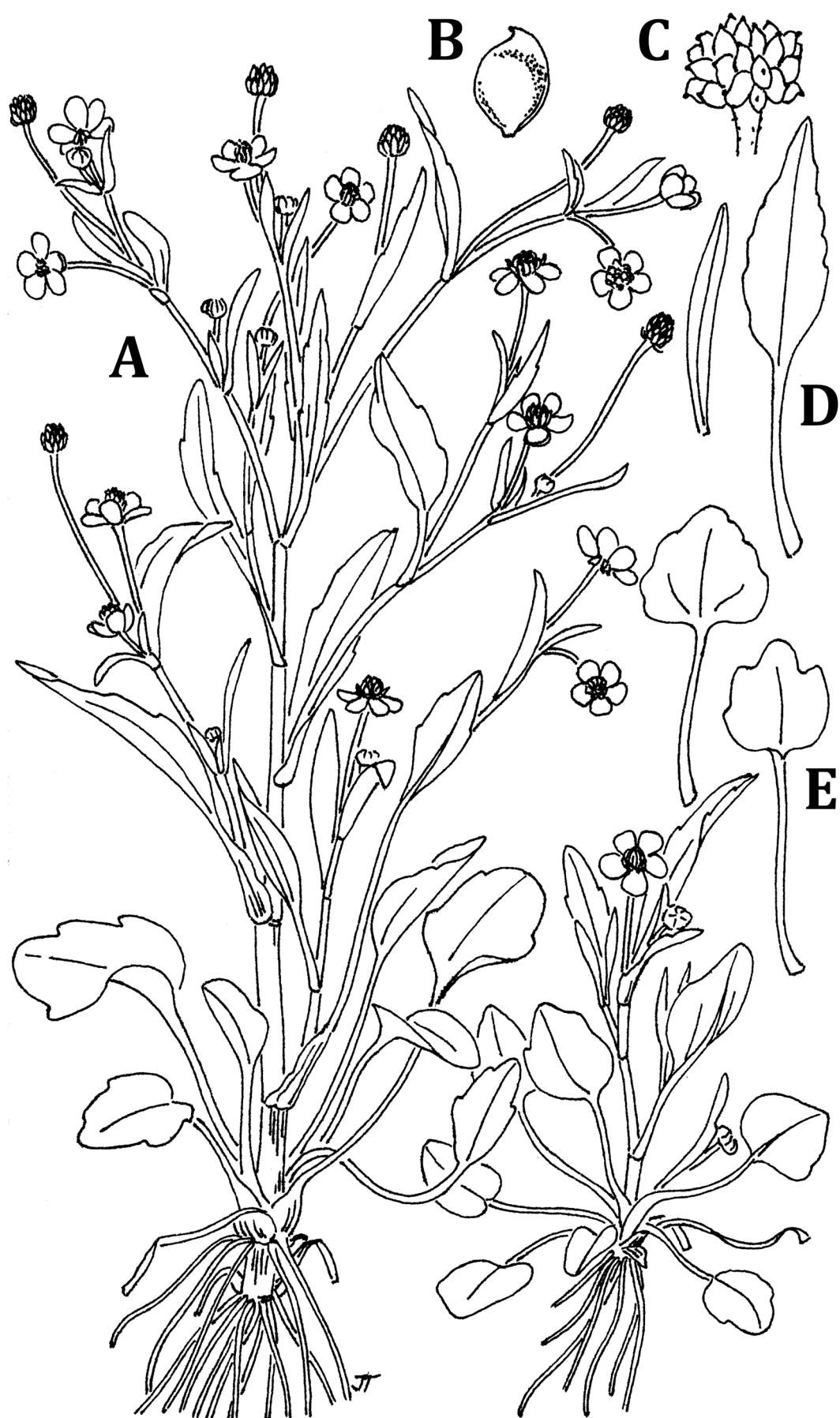


Figure 5. *Ranunculus ophioglossifolius* (illustration by Jana Táborská). A: flowering individuals; B: achenes; C: aggregate of achenes; D: cauline leaves; E: basal leaves.

Discussion

The Pannonian Ecoregion represents a well-defined biogeographical unit encompassing primarily the central Carpathian Basin and southern Moravia (Soó 1947; Fekete et al. 2016). Although *Ranunculus ophioglossifolius* has not previously been recorded in Hungary, it has been documented within the vegetation of the Pannonian Ecoregion, particularly in the Eupannonicum (Prodán 1910; Drăgulescu 2013; Dudáš et al. 2020).

Historical evidence also suggests an earlier presence of the species in the region. In 1798, Pál Kitaibel noted the species in his travel diary (Iter Magnováradiense) under the name *R. oppositifolius* (Gombocz 1945). Although the corresponding herbarium specimen has been lost (Jávorka 1935), this record supports the possibility that the species may have occurred in the Hungarian flora previously. Similar rediscoveries of native plant species have been documented in Hungary (Molnár & Türke 2007; Molnár V. et al. 2017). Taken together, these data suggest that *R. ophioglossifolius* may represent a previously overlooked or recently established element of the flora.

Within the Pannonian Basin, the species was first documented in 1909 in the Bezdán marshes (Serbia) (Prodán 1910), with additional historical and herbarium records from Croatia and Romania (Schlosser & Vukotinović 1869; Drăgulescu 2013; Dudáš et al. 2020). These records indicate that the species has long been present, albeit sporadically, in the broader region.

Although the flora of the Southern Crisicum is predominantly characterised by Pontic elements, several Mediterranean species have also been recorded, including *Trifolium subterraneum* (Csapody 1940), *Sedum caespitosum* (Molnár V. et al. 2024a), *Myosotis sicula* (Jakab 2005), *T. ornithopodioides* (Jakab & Tóth 2003), *Callitriche brutia* (Mesterházy et al. 2025) and *Lythrum borysthenicum* (Mesterházy 2017). The salt marshes of the Pannonian Ecoregion provide suitable habitat not only for Mediterranean species but also for certain taxa of Atlantic origin (Dítě et al. 2026). The occurrence of *R. ophioglossifolius* is consistent with this floristic pattern, even if the species remains rare. The Pannonian region may therefore represent part of the northern limit of its distribution. Increasingly mild winters may facilitate the establishment of Mediterranean and sub-Mediterranean species in the area.

The morphological characters of the Hungarian populations are consistent with descriptions in the European literature (Tutin 1964). Our results indicate that *R. ophioglossifolius* can be reliably distinguished from related species based on leaf morphology (Fig. S1–4.), achene characters and overall habit.

Trait data for *R. ophioglossifolius* remain scarce in international databases (Kattge et al. 2020; Kleyer et al. 2008). The smaller seed mass observed in the Hungarian populations (0.294 mg) compared to published values suggests substantial intraspecific variability. This difference may be related to local environmental conditions, such as reduced water availability. Similarly, plant height showed considerable variation and appears to be influenced by surrounding vegetation. Such variability is consistent with the pronounced phenotypic plasticity typical of amphibious species (Cook & Johnson 1968; Mommer et al. 2006; Noël et al. 2007; Molnár V. et al. 2015).

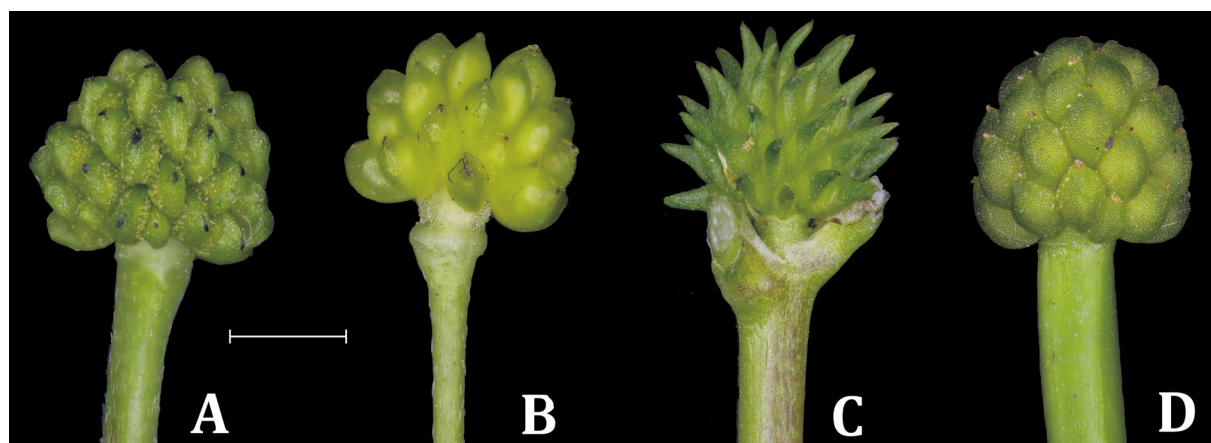


Figure 6. Aggregates of achenes of the four studied species. A: *Ranunculus ophioglossifolius*; B: *R. flammula*; C: *R. lateriflorus*; D: *R. polyphyllus*. Scale bar = 3 mm. Photographs by Sz. Kis.



Figure 7. Achenes of the studied species. A: *Ranunculus ophioglossifolius* (scale bar = 2 mm); B: *R. flammula* (scale bar = 2 mm); C: *R. lateriflorus* (scale bar = 1 mm); D: *R. polyphyllus* (scale bar = 1 mm).

The marked decline of the Királyhegyes population between 2024 and 2025 may be associated with reduced spring precipitation and increased vegetation cover within the ditch. Similar observations have been reported from other sites (Prodán 1910). In *R. ophioglossifolius*, plant performance is positively related to the duration of inundation (Mony et al. 2010), and periodic flooding therefore plays a key role in maintaining suitable habitat conditions (Dring & Frost 1971). Former watercourse ditches may therefore serve as important refugia for the species.

Across its range, *R. ophioglossifolius* occurs in a wide variety of plant communities (Mucina et al. 2016). The Hungarian populations were found in *Caricetum melanostachyae*, *Agrostio–Alopecuretum pratensis* and *Bolboschoenetum maritimi* communities, differing somewhat from many core-range habitats. Notably, while the species is generally considered non-saline, populations in the Pannonian region occur in alkaline marshes and meadows (Axmanová 2022).

Given its rarity and habitat specificity, *R. ophioglossifolius* may warrant consideration for legal protection under Hungarian nature conservation laws, particularly as wetland habitats are increasingly threatened by drought and declining groundwater levels. The statutory basis for the protection of other *Ranunculus* species occurring in comparable habitats (*R. polyphyllus* and *R. lateriflorus*) is provided by Decree No. 13/2001 (V. 9.) KÖM on protected and strictly protected plant and animal species, strictly protected caves, and the publication of plant and animal species of nature conservation importance within the European Community.

Overall, the occurrence of *R. ophioglossifolius* in Hungary highlights the dynamic nature of species distributions in the Pannonian region. Whether these populations represent long-term overlooked persistence or recent colonisation remains uncertain. However, their presence underscores the importance of continued floristic and ecological monitoring under changing climatic conditions.

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Supplementary Material



Figure S1. Characteristic leaves of *Ranunculus flammula*. A – basal leaves, B – cauline leaves. Scale bar = 2 cm.



Figure S2. Characteristic leaves of *Ranunculus lateriflorus*. A – basal leaves, B – cauline leaves. Scale bar = 2 cm.



Figure S3. Characteristic leaves of *Ranunculus polyphyllus*. A – basal leaves, B – cauline leaves. Scale bar = 2 cm.



Figure S4. Characteristic leaves of *Ranunculus ophioglossifolius*. A – basal leaves, B – cauline leaves. Scale bar = 2 cm.

Table S1–S4. The results of the measurements of the morphological plant traits of the four *Ranunculus* species studied were derived from ten individuals per species.**Table S1.**

<i>Ranunculus ophioglossifolius</i>, 13 May 2024 Királyhegyes, N46.26134° E20.65653°	1	2	3	4	5	6	7	8	9	10
Number of generative shoots	1	1	1	1	1	4	1	6	10	3
Length of (longest) generative shoot (mm)	41	46	66	62	118	146	177	194	221	298
Number of basal leaves	2	2	3	3	10	8	6	12	14	7
Total number of flowers	1	3	7	10	20	33	23	54	145	38
Length of lamina of 1st basal leaf (mm)	5.7	9	6	12	8.5	23	11	26	30	18
Width of lamina of 1st basal leaf (mm)	7.3	7.2	5	14	7.9	18	10	21	20	16
Distance between widest point and origin of lamina on the 1st basal leaf (mm)	1.5	2.3	2	3	3.4	5	4.5	7	6	5
Length of petiole of 1st basal leaf (mm)	12	16	12	24	14.3	43	20	43	61	57
Length of lamina of 2nd basal leaf (mm)	7	12	8	158	11	10	12	18	11	15
Width of lamina of 2nd basal leaf (mm)	8.2	18	8	12	6	10.3	12	15	14	9
Distance between widest point and origin of lamina on the 2nd basal leaf (mm)	3.5	3	2	3	4.8	2	3	6	4.4	7
Length of petiole of 2nd basal leaf (mm)	14	11	13	19	10.4	17	28	42	40	39
Length of lamina of 3rd basal leaf (mm)	12	12	15	17	16.9	19	25	16	15	11
Width of lamina of 3rd basal leaf (mm)	8.2	3	12	13	15.5	17	9	14	13	7
Distance between widest point and origin of lamina on the 3rd basal leaf (mm)	5.5	6.5	8	4	2.7	4	6	4	5.9	4.4
Length of petiole of 3rd basal leaf (mm)	13	3.6	17	18	36	30	21	33	47	42
Length of pedunculus (mm)	10	2.2	9	2.4	2.1	8	8	4.2	5.6	41
Length of pedunculus (mm)	13	2.2	5	19.5	14.7	5.7	18	14	13	37
Length of pedunculus (mm)	14	14	9.6	2.4	3.3	23	25	28	27	16
Length of lamina of cauline leaf (mm)	19	13.4	28	24	31	39	39	49	55	54
Width of lamina of cauline leaf (mm)	4.5	2.5	9	8	12	8	15	14	9	10
Distance between widest point and origin of lamina on the cauline leaf (mm)	13.6	6.4	10	11	13	17	18	23	28	22

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Table S1

Length of petiole of cauline leaf (mm)	3.1	2	14	7.6	19	15	34	25	4	13
Diameter of stem (mm)	2	2.2	3.7	4.9	4.9	4.7	5.5	5.5	7.8	4.7
Number of fruits / infructescence	40	48	34	48	54	47	46	54	51	42

Table S2.

<i>Ranunculus lateriflorus</i> , 12 May 2024 Újszentmargita N47.73709° E21.08021°	1	2	3	4	5	6	7	8	9	10
Number of generative shoots	1	3	2	1	1	1	3	3	3	3
Length of (longest) generative shoot (mm)	47	77	114	139	176	193	76	136	187	186
Number of basal leaves	2	2	2	2	2	2	3	2	4	3
Total number of flowers	1	12	12	7	17	18	6	13	42	43
Length of lamina of 1st basal leaf (mm)	7.4	11.5	8	15	26	15	15	22	10	19
Width of lamina of 1st basal leaf (mm)	3.5	8	6	9.2	12	9	11	12	6	12
Distance between widest point and origin of lamina on the 1st basal leaf (mm)	3.6	4.2	4	7.6	8.7	6	7	7	4	8
Length of petiole of 1st basal leaf (mm)	26	32	20	61	66	62	46	66	31	48
Length of lamina of 2nd basal leaf (mm)	7.6	12	11	16	31	13	7	33	9	29
Width of lamina of 2nd basal leaf (mm)	4.1	6	6	8	10	7	4.3	16	4	13
Distance between widest point and origin of lamina on the 2nd basal leaf (mm)	4	4.4	4	6	11	5.7	4.1	9	6	11
Length of petiole of 2nd basal leaf (mm)	20	22	31	36	55	25	21	58	16	78
Length of lamina of 3rd basal leaf (mm)	-	-	-	-	-	-	-	-	-	18
Width of lamina of 3rd basal leaf (mm)	-	-	-	-	-	-	-	-	-	8
Distance between widest point and origin of lamina on the 3rd basal leaf (mm)	-	-	-	-	-	-	-	-	-	5
Length of petiole of 3rd basal leaf (mm)	-	-	-	-	-	-	-	-	-	26
Length of peduncle (mm)	2.5	2.3	1.7	1.2	1.3	1	0.9	7	1.6	1.5
Length of peduncle (mm)	0.9	12.7	1.4	1.8	1.8	1.4	1.4	1.2	1.5	0.9
Length of peduncle (mm)	0.8	3.2	0.8	1.1	0.8	0.8	1.2	1.4	1.3	1.7
Length of lamina of cauline leaf (mm)	8.6	28	26	28	44	40	35	43	32	45
Width of lamina of cauline leaf (mm)	2.6	11	9.4	10	9	13	12	15	8	16

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Table S2

Distance between widest point and origin of lamina on the cauline leaf (mm)	6.1	11	8	12	17	12	13	12	17	17
Length of petiole of cauline leaf (mm)	4.2	29	44	38	14	29	33	45	23	42
Diameter of stem (mm)	1.2	2.2	2.6	3.2	4.4	3.6	5	7.7	4.9	7
Number of fruits / infructescence	32	39	52	38	47	29	33	38	31	37

Table S3.

<i>Ranunculus polyphyllus</i>, 12 May 2024 Újszentmargita, N47.73709° E21.08021°	1	2	3	4	5	6	7	8	9	10
Number of generative shoots	1	1	1	2	3	1	3	2	1	1
Length of (longest) generative shoot (mm)	75	100	91	93	74	171	154	82	108	106
Number of basal leaves	13	10	8	11	16	10	16	17	8	17
Total number of flowers	5	6	6	9	13	9	13	7	14	9
Length of lamina of 1st basal leaf (mm)	5.2	6.5	5	8.4	6.4	13	8.8	6.4	5.5	6.5
Width of lamina of 1st basal leaf (mm)	4.9	4.6	3	5	6.4	9.8	6.6	4.6	3.7	5
Distance between widest point and origin of lamina on the 1st basal leaf (mm)	4	5	4	6	3.2	9	6.5	4.5	3.7	4.9
Length of petiole of 1st basal leaf (mm)	17	16	12	15	9	22	16	10	7	11
Length of lamina of 2nd basal leaf (mm)	3.9	4.3	3.7	8.7	7	7.7	7.6	8	5.2	6.5
Width of lamina of 2nd basal leaf (mm)	1.7	2.5	2	5	6.2	6	5	5.9	2	5.2
Distance between widest point and origin of lamina on the 2nd basal leaf (mm)	2	2.8	1.7	6	4.2	4.8	4.4	6	2.3	5
Length of petiole of 2nd basal leaf (mm)	12	11	12.4	19.7	17	14.5	17	8.7	11	12
Length of lamina of 3rd basal leaf (mm)	5.3	4.7	2.9	5.7	6.2	9	8	7.4	5.2	5.2
Width of lamina of 3rd basal leaf (mm)	3.2	3.4	1.5	4.7	4.2	6.5	6	5.3	3.8	4.8
Distance between widest point and origin of lamina on the 3rd basal leaf (mm)	4	3.8	2	4.5	4	5.7	4	6.3	3.1	2.4
Length of petiole of 3rd basal leaf (mm)	13	11	8.7	13.4	15	18	16	12	9	10
Length of peduncle (mm)	15	38	28	57	24	46	36	19	24	30
Length of peduncle (mm)	24	29	23	46	19	41	28	28	28	23
Length of peduncle (mm)	21	25	31	43	28	11	16	24	14	22

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Table S3

Length of lamina of cauline leaf (mm)	8	10.5	8.2	6.7	8.9	13	11	10	9.5	9.3
Width of lamina of cauline leaf (mm)	2.9	4	2	2.7	4.4	5	3	4	2.2	4
Distance between widest point and origin of lamina on the cauline leaf (mm)	4.4	4.3	3.6	4.2	6.7	6	5.6	5.1	2.2	7
Length of petiole of cauline leaf (mm)	6.9	10	1.1	2	1.7	1.4	9	10	1.5	2
Diameter of stem (mm)	1.4	1.3	1.4	1.2	2.4	2.1	1.6	2.6	1.9	1.8
Number of fruits / infructescence	18	30	24	21	22	27	20	19	19	20

Table S4.

<i>Ranunculus flammula</i>, 31 May 2024 Debrecen, N47.50851°, E21.60306°	1	2	3	4	5	6	7	8	9	10
Number of generative shoots	1	1	1	1	1	1	1	1	1	1
Length of (longest) generative shoot (mm)	380	330	410	310	350	420	340	450	400	570
Number of basal leaves	3	2	2	2	2	2	2	4	2	2
Total number of flowers	4	2	8	2	2	4	2	16	6	20
Length of lamina of 1st basal leaf (mm)	21	17	23	15	19	54	21	26	57	25
Width of lamina of 1st basal leaf (mm)	10	8	9	5	8	9	9	11	11	14
Distance between widest point and origin of lamina on the 1st basal leaf (mm)	7	8	10	7	8	22	6	11	22	9
Length of petiole of 1st basal leaf (mm)	35	42	50	41	46	61	92	40	76	59
Length of lamina of 2nd basal leaf (mm)	28	24	53	32	29	57	25	30	32	45
Width of lamina of 2nd basal leaf (mm)	6	8	12	13	7	6	7	12	10	18
Distance between widest point and origin of lamina on the 2nd basal leaf (mm)	13	10	19	13	11	21	8	13	13	18
Length of petiole of 2nd basal leaf (mm)	25	51	68	59	55	44	92	41	87	58
Length of lamina of 3rd basal leaf (mm)	-	-	-	-	-	-	-	-	-	-
Width of lamina of 3rd basal leaf (mm)	-	-	-	-	-	-	-	-	-	-
Distance between widest point and origin of lamina on the 3rd basal leaf (mm)	-	-	-	-	-	-	-	-	-	-
Length of petiole of 3rd basal leaf (mm)	-	-	-	-	-	-	-	-	-	-
Length of peduncle (mm)	37	41	45	51	38	76	28	58	40	58

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Table S4

Length of peduncle (mm)	32	31	37	19	25	37	25	39	38	37
Length of peduncle (mm)	17	17	17	4	23	32	4	33	36	28
Length of lamina of cauline leaf (mm)	50	55	45	36	46	58	36	77	58	86
Width of lamina of cauline leaf (mm)	5	5	4	4	5	12	5	6	5	13
Distance between widest point and origin of lamina on the cauline leaf (mm)	35	28	20	15	28	28	16	41	31	48
Length of petiole of cauline leaf (mm)	17	7	15	4	7	5	21	5	4	9
Diameter of stem (mm)	2.9	2.1	3.9	2.2	3	4	3	4	5	6
Number of fruits / infructescence	25	29	28	27	34	20	38	36	20	35

Table S5. Phytosociological relevés on habitats of *Ranunculus ophioglossifolius*. 1–10: near Királyhegyes, 13. 05. 2024.; 11–20: near Gyula, 11. 05. 2025. Plot size: 4 m². Due to the overlapping nature of plant coverage, the sum of the cover percentages for individual species may be greater than the cover of the herb layer (%).

Sampling point ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Constancy (%)	Mean cover (%) ± SD
Festuco-Puccinellietea																						
<i>Cerastium dubium</i>					2																5	2.0
Puccinellietalia																						
<i>Rumex stenophyllus</i>		4									20	10	8	3	10	10	5	20	10	8	55	9.8 ± 5.6
Puccinellion limosae																						
<i>Myosurus minimus</i>		+				+	2														15	2.0 ± 0
Beckmannion eruciformis																						
<i>Cirsium brachycephalum</i>																			+		5	< 0.5
Agrostio-Alopecuretum pratensis																						
<i>Ranunculus ophioglossifolius</i>	1	5	3	3	1	4	1	4	4	24	10	8	15	25	33	42	15	3	1	10	100	10.6 ± 11.8
Artemisio-Festucetalia																						
<i>Trifolium angulatum</i>																+					5	< 0.5
Molinio-Arrhenatheretea																						
<i>Alopecurus pratensis</i>	20	17	11	16	6	10		53	1	5	35	35	25	20	15	10	15	20	45	6	95	19.2 ± 14.0
Molinetalia																						
<i>Oenanthe silaifolia</i>	0,5	0,5	2,5		4	1	1	+	1	+	5	3	3	1	15		7	6	2	5	90	3.6 ± 3.7
<i>Veronica scutellata</i>		+									+	+				+	+				25	< 0.5
<i>Teucrium scordium</i>										5		+						1	+		20	3.0 ± 2.8
Bolboschoenetea																						
Bolboschoenetalia																						
Bolboschoenion maritime																						
<i>Bolboschoenus maritimus</i>				4	5	5		5	20		+		2			15	25	30	25	10	60	13.3 ± 10.2
<i>Eleocharis uniglumis</i>													+				1	1	1		20	1.0 ± 0.0
Phragmitetea																						
<i>Alisma lanceolatum</i>							+									+					10	< 0.5
Phragmitetalia																						
<i>Carex melanostachya</i>	30	32	22	10	12	25,5	3	8	21	25											50	18.9 ± 9.9

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Table S5														
<i>Galium elongatum</i>	8	1	10	7	1,5	0,5		5	2	5		45	4.4 ± 3.4	
<i>Epilobium tetragonum</i>		0,5	0,5									10	0.5 ± 0.0	
Phragmition														
<i>Butomus umbellatus</i>							6					5	6.0 ± 0	
<i>Schoenoplectus lacustris</i>											25	5	25.0 ± 0	
<i>Typha angustifolia</i>											+	5	< 0.5	
Glycerio-Sparganion														
<i>Veronica catenata</i>					0,5	2			1			1	20	1.1 ± 0.6
<i>Glyceria fluitans</i>							2					+	10	2.0 ±
Potamogetonetea														
<i>Ranunculus trichophyllus</i>	+	+		+	+	+	10		+				35	10.0 ± 0
Ruppietea														
Ruppietalia														
Ranunculetum aquatilis-polyphylli														
<i>Ranunculus polyphyllus</i>									+				5	< 0.5
Isoeto-Nanojuncetea														
Cyperetalia fusci														
<i>Chenopodium urbicum</i>							+						5	< 0.5
Chenopodietea														
<i>Atriplex prostrata</i>	+	1	1	2	6	2	+						35	2.4 ± 2.1
Artemisietea														
Artemisietalia														
Arctio-Ballotetum nigrae														
<i>Ballota nigra</i>											+		5	< 0.5
Calystegietalia														
Glycyrrhizetum echinatae														
<i>Glycyrrhiza echinata</i>	1								+				10	1.0 ± 0
Onopordetalia														
Onopordetum acanthii														
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Table S5

<i>Cynoglossum officinale</i>																						5	< 0.5
<i>Onopordum acanthium</i>																						5	< 0.5
Secalietea																							
<i>Helianthus annuus</i>																						5	< 0.5
Indifferent																							
<i>Lythrum virgatum</i>		+		3								+	1	2	1	2	1	+	+			50	1.7 ± 0.8
<i>Carex otrubae</i>	2,5											0,5	3		1	5		2	3	5		40	2.8 ± 1.6
<i>Lycopus europaeus</i>	+																2	+	+		1	25	1.5 ± 0.7
<i>Potentilla reptans</i>	+	+																				10	< 0.5
<i>Rorippa sylvestris</i> subsp. <i>kernerii</i>																			0,5	+		10	0.5 ±
<i>Rorippa austriaca</i>	+																					5	< 0.5
<i>Lysimachia nummularia</i>	+																					5	< 0.5
<i>Cirsium arvense</i>																						5	< 0.5
<i>Bromus hordeaceus</i>																						5	< 0.5
<i>Epilobium hirsutum</i>																						5	< 0.5
Cover of herb layer (%)	65	55	50	45	38	50	25	75	55	60	70	60	55	50	80	80	75	85	90	65			
Species number per sampling points	13	13	7	9	10	13	9	6	8	8	9	8	7	6	6	10	10	13	10	9			

Table S6. Results of leaf trait measurement of *Ranunculus ophioglossifolius*.

Traits	1	2	3	4	5	6	7	8	9	10	Mean
Fresh leaf mass (g)	0.167	0.117	0.045	0.076	0.069	0.094	0.089	0.076	0.068	0.144	0.095
Dry leaf mass (mg)	24.0	17.0	6.3	12.0	11.0	15.3	15.3	12.7	12.0	20.7	14.6
Leaf area (mm ²)	611.0	491.7	204.7	340.7	314.3	389.7	366.3	318.0	303.7	546.3	388.633
SLA (mm ² /g)	25.458	28.922	32.316	28.389	28.576	25.413	23.891	25.105	25.306	26.435	26.619
LDMC (mg/g)	143.43	144.89	140.74	158.59	159.42	162.55	171.64	165.94	176.47	143.52	154.334
Weight of 100 seeds (g)	0.0294	0.0278	0.0310								

Table S7. Summary of the LDA models with a high correctness rate (≥ 0.925 , $n = 40$). K is the number of variables included in the model. The table is sorted by the correctness rate of the model and by the K value.

Model ID	Variables	K	Correctness
855	Length of (longest) generative shoot (mm)	7	0.975
	Length of peduncle (mm)		
	Number of fruits / infructescence		
	Number of basal leaves		
	Width of lamina of cauline leaf (mm)		
	Number of generative shoots		
	Width of lamina of 1st basal leaf (mm)		
683	Length of (longest) generative shoot (mm)	6	0.95
	Length of peduncle (mm)		
	Number of basal leaves		
	Length of petiole of cauline leaf (mm)		
	Total number of flowers		
	Number of generative shoots		
864	Length of (longest) generative shoot (mm)	7	0.95
	Length of pedunculus (mm)		
	Number of fruits / infructescence		
	Number of basal leaves		
	Total number of flowers		
	Number of generative shoots		
	Width of lamina of 1st basal leaf (mm)		
982	Length of (longest) generative shoot (mm)	8	0.95
	Length of peduncle (mm)		
	Number of fruits / infructescence		
	Number of basal leaves		
	Total number of flowers		
	Number of generative shoots		
	Width of lamina of 1st basal leaf (mm)		
1017	Length of lamina of 2nd basal leaf (mm)	9	0.95
	Length of (longest) generative shoot (mm)		
	Length of peduncle (mm)		
	Number of fruits / infructescence		
	Number of basal leaves		
	Width of lamina of cauline leaf (mm)		
	Total number of flowers		
187	Number of generative shoots	4	0.925
	Width of lamina of 1st basal leaf (mm)		
	Length of (longest) generative shoot (mm)		
	Length of peduncle (mm)		
260	Number of basal leaves	4	0.925
	Width of lamina of cauline leaf (mm)		
	Length of (longest) generative shoot (mm)		
	Length of peduncle (mm)		
413	Number of basal leaves	5	0.925
	Length of petiole of cauline leaf (mm)		
	Number of generative shoots		
	Length of (longest) generative shoot (mm)		
477	Number of basal leaves	5	0.925
	Width of lamina of cauline leaf (mm)		
	Length of petiole of cauline leaf (mm)		
	Total number of flowers		
513	Length of peduncle (mm)	5	0.925
	Number of fruits / infructescence		

	Number of basal leaves		
	Width of lamina of cauline leaf (mm)		
	Total number of flowers		
514	Length of peduncle (mm)		
	Number of fruits / infructescence		
	Number of basal leaves	5	0.925
	Width of lamina of cauline leaf (mm)		
	Number of generative shoots		
515	Length of peduncle (mm)		
	Number of fruits / infructescence		
	Number of basal leaves	5	0.925
	Width of lamina of cauline leaf (mm)		
	Width of lamina of 1st basal leaf (mm)		
548	Length of peduncle (mm)		
	Number of basal leaves		
	Width of lamina of cauline leaf (mm)	5	0.925
	Length of petiole of cauline leaf (mm)		
	Number of generative shoots		
640	Length of (longest) generative shoot (mm)		
	Length of peduncle (mm)		
	Number of fruits / infructescence	6	0.925
	Number of basal leaves		
	Width of lamina of cauline leaf (mm)		
674	Number of generative shoots		
	Length of (longest) generative shoot (mm)		
	Length of peduncle (mm)		
	Number of basal leaves	6	0.925
	Width of lamina of cauline leaf (mm)		
689	Length of petiole of cauline leaf (mm)		
	Number of generative shoots		
	Length of (longest) generative shoot (mm)		
	Length of peduncle (mm)		
	Number of basal leaves	6	0.925
768	Total number of flowers		
	Number of generative shoots		
	Width of lamina of 1st basal leaf (mm)		
	Length of peduncle (mm)		
	Number of fruits / infructescence	6	0.925
769	Number of basal leaves		
	Width of lamina of cauline leaf (mm)		
	Total number of flowers	6	0.925
	Width of lamina of 1st basal leaf (mm)		
	Length of peduncle (mm)		
771	Number of fruits / infructescence		
	Number of basal leaves	6	0.925
	Width of lamina of cauline leaf (mm)		
	Number of generative shoots		
	Width of lamina of 1st basal leaf (mm)		
852	Length of (longest) generative shoot (mm)		
	Length of peduncle (mm)		
	Number of fruits / infructescence	7	0.925
	Number of basal leaves		
	Width of lamina of cauline leaf (mm)		

	Total number of flowers		
	Number of generative shoots		
858	Length of (longest) generative shoot (mm)		
	Length of peduncle (mm)		
	Number of fruits / infructescence		
	Number of basal leaves	7	0.925
	Length of petiole of cauline leaf (mm)		
	Total number of flowers		
	Number of generative shoots		
861	Length of (longest) generative shoot (mm)		
	Length of peduncle (mm)		
	Number of fruits / infructescence		
	Number of basal leaves	7	0.925
	Length of petiole of cauline leaf (mm)		
	Number of generative shoots		
	Width of lamina of 1st basal leaf (mm)		
883	Length of (longest) generative shoot (mm)		
	Length of peduncle (mm)		
	Number of basal leaves		
	Width of lamina of cauline leaf (mm)	7	0.925
	Length of petiole of cauline leaf (mm)		
	Total number of flowers		
	Number of generative shoots		
889	Length of (longest) generative shoot (mm)		
	Length of peduncle (mm)		
	Number of basal leaves		
	Width of lamina of cauline leaf (mm)	7	0.925
	Total number of flowers		
	Number of generative shoots		
	Width of lamina of 1st basal leaf (mm)		
894	Length of (longest) generative shoot (mm)		
	Length of peduncle (mm)		
	Number of basal leaves		
	Length of petiole of cauline leaf (mm)	7	0.925
	Total number of flowers		
	Number of generative shoots		
	Length of lamina of 2nd basal leaf (mm)		
897	Length of (longest) generative shoot (mm)		
	Length of peduncle (mm)		
	Number of basal leaves		
	Total number of flowers	7	0.925
	Number of generative shoots		
	Width of lamina of 1st basal leaf (mm)		
	Length of lamina of 2nd basal leaf (mm)		
910	Length of (longest) generative shoot (mm)		
	Number of fruits / infructescence		
	Number of basal leaves		
	Width of lamina of cauline leaf (mm)	7	0.925
	Total number of flowers		
	Number of generative shoots		
	Width of lamina of 1st basal leaf (mm)		
938	Length of peduncle (mm)		
	Number of fruits / infructescence		
	Number of basal leaves		
	Width of lamina of cauline leaf (mm)	7	0.925
	Total number of flowers		
	Number of generative shoots		
	Width of lamina of 1st basal leaf (mm)		
968	Length of (longest) generative shoot (mm)		
	Length of peduncle (mm)	8	0.925

	Number of fruits / infructescence		
	Number of basal leaves		
	Width of lamina of cauline leaf (mm)		
	Length of petiole of cauline leaf (mm)		
	Total number of flowers		
	Number of generative shoots		
	Length of (longest) generative shoot (mm)		
	Length of peduncle (mm)		
971	Number of fruits / infructescence	8	0.925
	Number of basal leaves		
	Width of lamina of cauline leaf (mm)		
	Length of petiole of cauline leaf (mm)		
	Number of generative shoots		
	Width of lamina of 1st basal leaf (mm)		
974	Length of (longest) generative shoot (mm)	8	0.925
	Length of peduncle (mm)		
	Number of fruits / infructescence		
	Number of basal leaves		
	Width of lamina of cauline leaf (mm)		
	Total number of flowers		
	Number of generative shoots		
	Width of lamina of 1st basal leaf (mm)		
975	Length of (longest) generative shoot (mm)	8	0.925
	Length of peduncle (mm)		
	Number of fruits / infructescence		
	Number of basal leaves		
	Width of lamina of cauline leaf (mm)		
	Total number of flowers		
	Number of generative shoots		
	Length of lamina of 2nd basal leaf (mm)		
977	Length of (longest) generative shoot (mm)	8	0.925
	Length of peduncle (mm)		
	Number of fruits / infructescence		
	Number of basal leaves		
	Width of lamina of cauline leaf (mm)		
	Number of generative shoots		
	Width of lamina of 1st basal leaf (mm)		
	Length of lamina of 2nd basal leaf (mm)		
978	Length of (longest) generative shoot (mm)	8	0.925
	Length of peduncle (mm)		
	Number of fruits / infructescence		
	Number of basal leaves		
	Length of petiole of cauline leaf (mm)		
	Total number of flowers		
	Number of generative shoots		
	Width of lamina of 1st basal leaf (mm)		
979	Length of (longest) generative shoot (mm)	8	0.925
	Length of peduncle (mm)		
	Number of fruits / infructescence		
	Number of basal leaves		
	Length of petiole of cauline leaf (mm)		
	Total number of flowers		
	Number of generative shoots		
	Length of lamina of 2nd basal leaf (mm)		
981	Length of (longest) generative shoot (mm)	8	0.925
	Length of peduncle (mm)		
	Number of fruits / infructescence		
	Number of basal leaves		
	Length of petiole of cauline leaf (mm)		
	Number of generative shoots		

993	Width of lamina of 1st basal leaf (mm)	8	0.925
	Length of lamina of 2nd basal leaf (mm)		
	Length of (longest) generative shoot (mm)		
	Length of peduncle (mm)		
	Number of basal leaves		
	Width of lamina of cauline leaf (mm)		
	Total number of flowers		
	Number of generative shoots		
	Width of lamina of 1st basal leaf (mm)		
	Length of lamina of 2nd basal leaf (mm)		
1013	Length of (longest) generative shoot (mm)	9	0.925
	Length of peduncle (mm)		
	Number of fruits / infructescence		
	Number of basal leaves		
	Width of lamina of cauline leaf (mm)		
	Length of petiole of cauline leaf (mm)		
	Total number of flowers		
	Number of generative shoots		
	Width of lamina of 1st basal leaf (mm)		
	Length of (longest) generative shoot (mm)		
1018	Length of peduncle (mm)	9	0.925
	Number of fruits / infructescence		
	Number of basal leaves		
	Length of petiole of cauline leaf (mm)		
	Total number of flowers		
	Number of generative shoots		
	Width of lamina of 1st basal leaf (mm)		
	Length of lamina of 2nd basal leaf (mm)		
	Length of (longest) generative shoot (mm)		
	Length of peduncle (mm)		
1023	Number of fruits / infructescence	10	0.925
	Number of basal leaves		
	Width of lamina of cauline leaf (mm)		
	Length of petiole of cauline leaf (mm)		
	Total number of flowers		
	Number of generative shoots		
	Width of lamina of 1st basal leaf (mm)		
	Length of lamina of 2nd basal leaf (mm)		
	Length of (longest) generative shoot (mm)		
	Length of peduncle (mm)		