

## DISTRIBUTION OF THE ARCTIC-ALPINE *RANUNCULUS GLACIALIS* (RANUNCULACEAE) IN THE CARPATHIANS, WITH A NEW LOCALITY IN THE FĂGĂRAȘ MOUNTAINS (ROMANIA)

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**Abstract.** In the course of a large-scale biogeographical study focused on *Ranunculus glacialis* L., the distribution of this arctic-alpine species in the Carpathians was analyzed in detail, based on literature and herbarium data. Several historical localities were visited during subsequent field work and material sampling in 2004–2009. The High Tatra Mts (Western Carpathians) are the only Carpathian massif where the species is relatively frequent in the alpine and subnival belts. It is also known from a few other high massifs (especially the Rodnei Mts and the Făgăraș Mts) but has been considered a very rare and critically endangered species there, without recently confirmed populations. The persistence of one of two historical localities in the Rodnei Mts (Eastern Carpathians) was confirmed in 2004. In the Făgăraș Mts (Southern Carpathians) it was not found at any of the previously reported sites, which suggests that it either became extinct or forms very small and spatially restricted populations there. However, a new large population of *R. glacialis* in the Făgăraș Mts was discovered in 2007. These recent findings confirm the contemporary occurrence of this species in all main parts of the Carpathians, but also confirm the status of the glacier buttercup as one of the rarest species in the mountain flora of Romania.

**Key words:** arctic-alpine plants, Carpathian Mts, chorology, rare species, Poland, Romania

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### INTRODUCTION

*Ranunculus glacialis* L. (Ranunculaceae) represents the arctic-alpine biogeographical element and is among the plants occurring exclusively in the harsh environment of the highest vegetation belts of mountains and of subarctic/arctic regions. In the Alps it is one of the few plants reaching the highest elevations in the nival zone (4270 m; e.g., Crawford 2008). Its distribution range includes most of the highest mountain ranges of Europe (Alps, Carpathians, Pyrenees, Scandinavian chain, Sierra Nevada), the arctic and subarctic regions including Svalbard, Iceland, eastern Greenland, and the Jan Mayen and Faroe Islands. There is also a small disjunct area in Alaska and the easternmost part of Siberian Beringia, where a geographically vicariant taxon, *R. glacialis* subsp. *chamissonis* (Schlecht.) Hult., was described (Hultén & Fries 1986).

In the easternmost part of the European range of *R. glacialis* in the Carpathians it was already

reported by 18<sup>th</sup>-century naturalists visiting the Tatra Mts, the highest massif of the whole chain; Townson (1797) mentions *R. glacialis* growing ‘luxuriously’ on scree as one of his botanical observations from excursions in the High Tatras. In his *Flora Carpatorum Principalium*, the first comprehensive botanical monograph of the Tatra Mts, Wahlenberg (1814) describes it as a plant growing *tantummodo in cacuminibus altissimis Carpati, ut in ipso vertice cacuminis Lomnitzensis et in vertice Krivani*. Indeed, as one of the most stenotopic high-mountain plant species, *R. glacialis* is known to occur in the Carpathians only on the highest massifs throughout the range. It has numerous populations only in the High Tatra Mts, in Poland and Slovakia (Western Carpathians; Pawłowski 1956; Pačlová 1977). Rare records are also known from the Romanian Carpathians, but until recently its presence in Romania was considered unconfirmed for more than a century, and it was classed among

the rarest and critically endangered plants in Romania (Negrean & Dihoru 2009).

In the course of a large-scale biogeographical study focused on *R. glacialis* I made a detailed review of the available data concerning the presence of this species in the main parts of the Carpathians, in parallel with field surveys aimed at verifying the historical records. This paper reports the results of that work. As the contemporary distribution of the species in the Tatra Mts is well known and documented, the focus was on the Southeastern Carpathians (Romania), where new data on the persistence of *R. glacialis* were gathered, including both positive and negative verification of several historical stations and the discovery of a new locality.

#### MATERIAL AND METHODS

The detailed analysis of historical data concerning *R. glacialis* was focused on the Southeastern Carpathians. The botanical literature devoted to the flora of the Romanian Carpathians was screened to gather records of the species. Herbarium materials of *R. glacialis* were also sought in herbaria holding important historical Carpathian collections (BP, BUC, BUCM, CL, KRA, KRAM, LW, SIB, W).

Several field surveys were made in 2004–2009, concentrating on historical localities reported from the main massifs: Rodnei Mts (Munții Rodnei, Eastern Carpathians) and Făgăraș Mts (Munții Făgărașului, Southern Carpathians), the sources of the most numerous records. All historical sites reported from these areas were examined in the field.

Based on the data gathered, a synthetic distribution map was prepared to give an overview of the distribution of *R. glacialis* across the Carpathians. Different symbols on it reflect the current status of the localities, visualizing the historical and contemporary situation of the species.

#### RESULTS

##### NEW LOCALITY OF *RANUNCULUS GLACIALIS* IN THE FĂGĂRAȘ MOUNTAINS

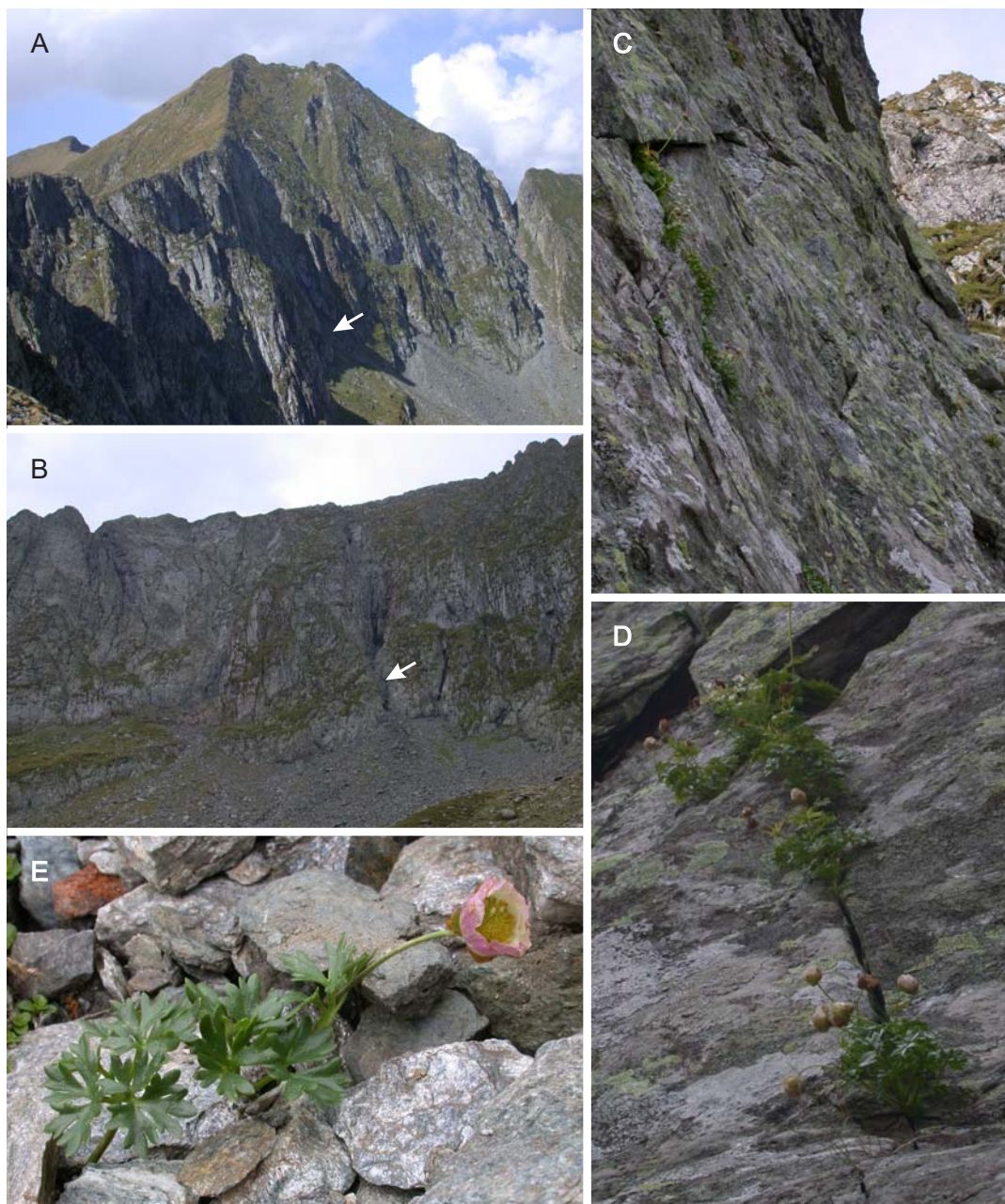
A previously unknown population of *Ranunculus glacialis* was discovered in the Făgăraș Mts (Southern Carpathians) on 20 August 2007. It is

in the highest part of the Valea Viștișoara valley in the eastern part of the range, in the lowest area of steep rocky slopes of Mt. Gălbenele (2456 m), exposed to the NNE, at 2220–2300 m a.s.l. (45.61°N, 24.76°E). *R. glacialis* was growing there in its typical habitat: on siliceous bedrock (the area is dominated by crystalline schists; Papiu 1963), in crevices of vertical rocks and on the adjoining scree below (Fig. 1). The population was relatively large but dispersed along a distance of ca 150 m along the rock wall. About 80 tufts of plants were observed: 15 flowering and 34 vegetative individuals were counted in the rock crevices, and another 2 flowering and 30 vegetative individuals on the adjoining scree. The population was certainly more numerous but it was not possible to examine the whole area in detail.

The vegetation was sparse and *R. glacialis* was mostly growing alone. The main accompanying species dispersed in this site included these: (i) in rock crevices, *Anthemis carpatica* Willd., *Arabis alpina* L., *Artemisia eriantha* Ten., *Chrysosplenium alpinum* Schur, *Cystopteris fragilis* (L.) Bernh., *Doronicum carpaticum* (Griseb. & Schenk) Nyman, *Geum reptans* L., *Heliosperma pusillum* (Waldst. & Kit.) Rechb., *Oxyria digyna* L., *Poa laxa* Haenke, *Ranunculus pseudomontanus* Schur, *Saxifraga aizoides* L., *S. carpathica* Rechb., *S. moschata* Wulfen, *S. oppositifolia* L., *S. pedemontana* subsp. *cymosa* Engler, *Soldanella pusilla* Baumg., *Veronica baumgartenii* Roem. & Schult. and *Viola biflora* L.; (ii) on stabilized scree, *Anthemis carpatica* Willd., *Cerastium alpinum* L. subsp. *lanatum* (Lam.) Asch. & Graebn., *Epilobium anagallidifolium* Lam., *Luzula alpinopilosa* (Chaix) Breistr., *Pritzelago alpina* (L.) Kuntze, *Ranunculus crenatus* Waldst. & Kit., *Saxifraga androsacea* L., *S. rotundifolia* L. and *Veronica alpina* L.

##### OVERVIEW OF THE REPORTED LOCALITIES OF *RANUNCULUS GLACIALIS* IN THE CARPATHIANS

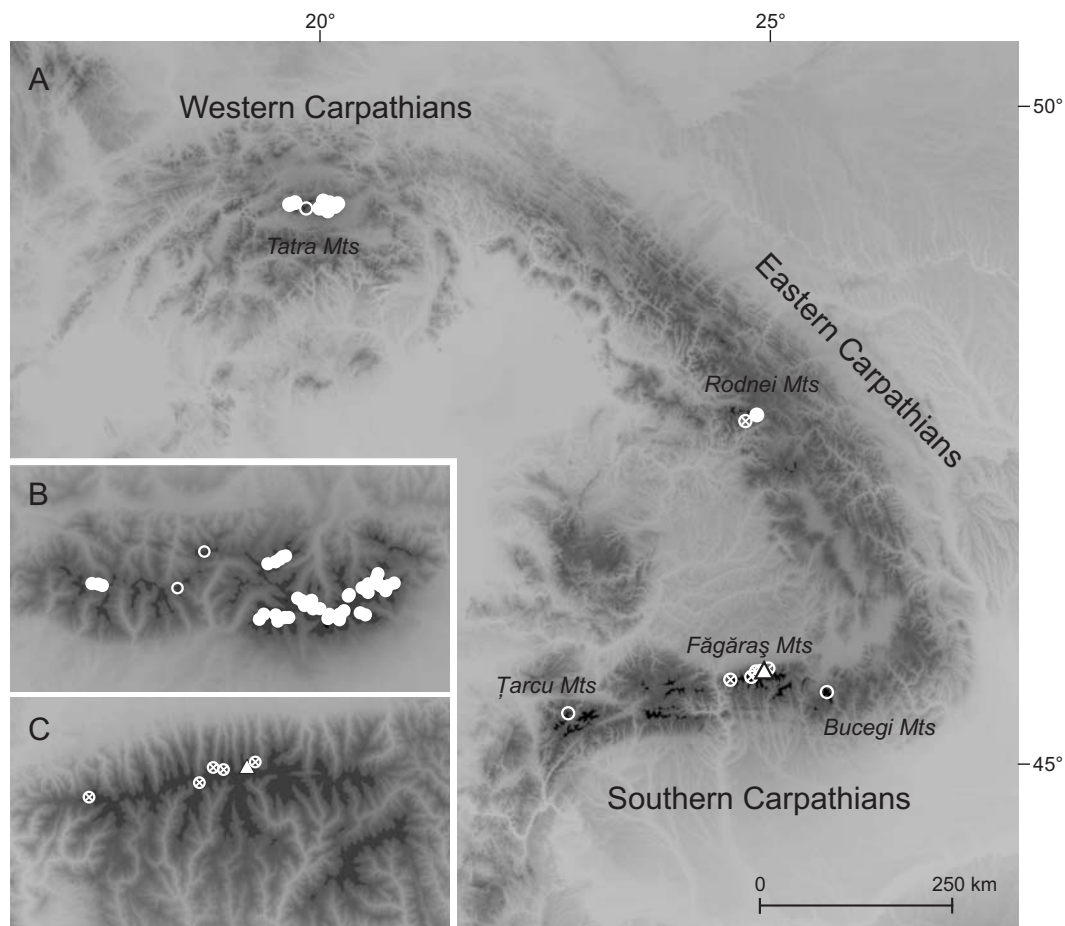
The presence of *R. glacialis* in the Western Carpathians (Tatra Mts) is well known and did not require confirmation in a study focused on the general distribution across the chain. Thus, only



**Fig. 1.** New locality of *Ranunculus glacialis* L. in the Făgăraș Mts. A & B – general aspect of the locality (arrow) on NNE slopes of Vf. Gălbenele; C & D – plants growing in rock crevices in lower parts of the slope; E – flowering individual growing on scree.

the general characteristics of its distribution in this area are included here. As the status of the species was unclear in the Southeastern Car-

pathians, all relevant records are listed below in detail, based on the literature and herbarium data.



**Fig. 2.** Distribution of *Ranunculus glacialis* L. in the Carpathians. A – general distribution; B – detailed localities in the Tatra Mts; C – detailed localities in the Făgăraș Mts. White triangle – new locality reported; white circle – currently known locality; crossed circle – historical locality searched and not confirmed in the field during the present study; open circle – historical locality not verified in the field during the present study.

**WESTERN CARPATHIANS: TATRA MTS.** The High Tatra Mts are the only Carpathian massif where the species is relatively frequent in the alpine and subnival zones. It forms usually small populations at the highest elevations; the number of localities well exceeds 50 (Fig. 2B). Pačlová (1977) gave a good overview of localities in the High Tatras, so it is not repeated here. I visited and confirmed most localities in 2004–2009; the largest population was in the summit area of Lomnický štít, especially on the slope towards Hrebeň Vidiel crest (M. Ronikier, pers. obs.). *R. glacialis* is rare in the West Tatras. The few recently confirmed

localities are restricted to the high-mountain group of Rohače, Tri Kopy and Banikov peaks (M. Ronikier & A. Ronikier, pers. obs.). There are very old reports of it from Kamienista peak (under the name *Oxygraphis vulgaris* Freyn; Sagorski & Schneider 1891) and from the Czerwone Wierchy massif (Soó – cited by Pawłowski 1956), but they are not confirmed and thus uncertain. Pawłowski (1956) considered them doubtful, but a herbarium sheet representing *R. glacialis* and labeled ‘Czerwone Wierchy. 4.VIII.1910 A. Żmuda’ exists (KRAM 338). A detailed field revision of uncertain localities in the Tatra Mts is ongoing.

EASTERN CARPATHIANS: MUNȚII RODNEI. Mt. Ineu – *Kuhhorn* (Fuss 1866); *In apice a. Ineu*, as *R. glacialis* L. *rubriflora* (Porcius 1878); *Inău* (Nyárády 1953); represented by herbarium materials: *Radna, az Ünökő tsucsján ereszkedve le nyugatra sziklákon, 858 Augustus 17-dik, már el volt virágozva, tsak ezt az egy példányt kaptam. 860 Julius 25 – kén ugyanott kaptam többet is, de ritkán! Gyűj. Czetz (CL 40131); Am Felsen... [?] unter den Spitz des Ineu; jedoch selten; bei Rodna. Porcius [no date], as *Ranunculus glacialis* L. var. *roseus* Hegetschw. (Herb. Janka; CL 40130); Hung. orient.; comit. Beszterce-Naszód; in fissuris rupium montis Ünökő, alt. 2280 m, solo gneiss. 25.07.1937, Dr. Andreánszky G. (BP 599840); Comit. Beszterce-Naszód. In alpe Ünökő supra pagum Radnaborberek; in saxosis. Alt. cca 2250 m, 20.08.1942, Herbarium Dris Z. Kárpáti (BP 389250); Munții Rodnei, Vf. Ineu (versant vestic), stâncărie șistoasă abruptă, 2230 m, lat. 47°31'N, lon. 24°53'E, 19.08.2004, M. Ronikier (CL 656545). Locality confirmed in 2004 (cf. Ronikier 2004). Mt. Corongiș – *Auf dem Korondsys bei Rodna*, as *Hecatonia glacialis* a. *albiflora* (Schur 1866); *Corongiș* (Nyárády 1953); represented (most probably) by herbarium materials: *In summis alpium jugis Rodnaer Alpen, oberst... A Bilz[?] Aug July. 1847. Dr. Schur*, as *Ranunculus glacialis* L. var. *critmifolia* var. *puberula. albiflora* (Herbarium Schur in LW; Fig. 3). Searched but not confirmed in the field (cf. Ronikier 2004).*

SOUTHERN CARPATHIANS: MUNȚII BUCEGI. *Auf dem Butsets bei Kronstadt*, without a precise locality, as *Hecatonia glacialis* a. *albiflora* (Schur 1866); represented by herbarium materials: *Butsets bei Kronstadt. Kalk. Juli. Dr. Schur* [no date], as *Ranunculus glacialis* L. *albiflorus* (Herbarium Schur in LW; Fig. 3). MUNȚII FĂGĂRAȘULUI (Fig. 2C). Mt. Draguș – *In alpiibus: Arpascher, Utsaer, Dreguscher und Fogarascher Alpen* (Fuss 1866); represented by herbarium materials: *In apb fogarasch... [?] Dragus, aug 817 [?]* (Herbarium Baumgartenianum, CL 5498); Sibiu, herbarium M. Fuss no. 12.034 (*leg. J.C.H. Baumgarten*; no date) and herbarium K. Ungar no. 38293 (*leg. J. C. H. Baumgarten*; no date). Searched but not confirmed

in the field. Mt. Gălbenele – the new locality found in 2007, presented herein (see above); represented by herbarium materials: *Romania, Southern Carpathians, Făgăraș Mts, highest part of the Valea Viștișoara valley, steep rocky slopes of Vf. Gălbenele (2456 m), exposed to NNE, at elevation 2220–2300 m a.s.l. Rock crevices and humid scree, crystalline bedrock. Coord.: 45.61°N, 24.76°E, leg. A. Ronikier & M. Ronikier, 20.08.2007 (KRAM 582140). Mt. Ucea Mare – *In alpiibus summis Fogarasensibus utpote Teritza et Utscha Mare [...]* *Aug. Baumg.* (Fuss 1846); *In alpiibus: Arpascher, Utsaer, Dreguscher und Fogarascher Alpen* (Fuss 1866); *Ucea Mare* (Nyárády 1953); no herbarium materials found. Searched but not confirmed in the field. Mt. Tărăța – *Ad confinia Transylvaniae in cacumine alpium Fogarasiensium, utpote Teritza raro, Aug. Baumg.* (Fuss 1846); *Creasta Tărăța* (Nyárády 1953); no herbarium materials found. Searched but not confirmed in the field. Mt. Arpașu – *In alpiibus: Arpascher, Utsaer, Dreguscher und Fogarascher Alpen* (Fuss 1866); *Arpașul* (Nyárády 1953); no herbarium materials found. Searched but not confirmed in the field. Mt. Suru – *Surul* (Nyárády 1953); represented by herbarium materials: *Pe vârfulur Surului, Argeșiu, Julie 1898, Maximil. Zielinski, elev farm.* (BUC 322260). Searched but not confirmed in the field. Historical presence of *R. glacialis* in the Făgăraș Mts is additionally confirmed by a herbarium sheet from J. C. H. Baumgarten's herbarium but without precise locality indicated: *Ex alpb. Fogarasch., Aug. 1817 [or 1877?] obs. me [?]* (Herbarium Baumgartenianum, CL 5502). MUNȚII ȚARCU. Represented by one herbarium sheet without detailed locality or date specified, erroneously identified as *Ranunculus alpestris* L.: *Szarkó in Banatu, Herbarium J. Dorner* (BP 230236); according to a revision note, revised as *R. glacialis* in 1988 by Arto Kurtto (University of Helsinki).*

## DISCUSSION

The occurrence of *Ranunculus glacialis* was confirmed in all the main parts of the Carpathian chain (Western, Eastern and Southern Carpathians).



However, while it is a relatively frequent element of high-mountain vegetation in the High Tatras (Western Carpathians) it is one of the rarest alpine species in the flora of the Romanian Southeastern Carpathians. Negrean and Dihoru (2009) stated that despite various field surveys by several botanists the plant has not been observed for last 100 years in Romania and that its contemporary status was unknown. According to the literature, herbarium materials and data gathered in the present study, ten localities of *R. glacialis* have been reported from the Southeastern Carpathians over the last 200 years since the species was discovered there: two from the Eastern Carpathians and eight from the Southern Carpathians (Fig. 2A). A distribution synopsis of alpine species of *Ranunculus* in Romania was published by Rațiu (1982) but it gave only part of the data on *R. glacialis*. In particular, it did not include localities in the Bucegi Mts (mentioned in the literature by Schur 1866) and in the Țarcu Mts.

If my reading of the unclearly written date on the label of herbarium sheet CL 5498 is correct, the oldest herbarium materials from the Romanian Carpathians may date back to 1817 and represent plants collected by J. C. H. Baumgarten in the Făgăraș Mts, probably on Vf. Draguș, not far from the new locality reported here. The species was not yet mentioned in *Enumeratio...* (Baumgarten 1816) but it was included by Fuss (1846) in the *Mantissa I* to this monograph, based on Baumgarten's original herbarium materials. The available data suggest that the Făgăraș Mts, the second highest Carpathian massif, harbors the most numerous populations of *R. glacialis* in Romania. A total of six localities have been reported from this area. Original information on these sites was given in early works by Fuss (1846, based on materials of Baumgarten; 1866) and Schur (1866). Subsequent flora accounts seem to have relied on these data without reporting any new details (e.g., Simonkai 1886; Javorká 1924; Nyárády 1953; Rațiu 1982). No herbarium materials or precise information on observations of this species after the 19<sup>th</sup> century were found. Interestingly, Pușcaru-Soroceanu (1977) and Pușcaru-Soroceanu *et al.* (1977) mention *R. glacialis* in their vegetation data but they

do not provide any localities and no related herbarium materials were found. This suggests that it may have been observed somewhere in this area in the second half of the 20<sup>th</sup> century, but without details and documentation it remains unclear. None of the historical localities were confirmed in my recent field work. The high-mountain topography is complicated, access to sites is difficult, and the historical locations are described only very generally; all this leads us to suppose that at least some of these populations, small and hard to locate, may still persist. Also, some historical place names are difficult to interpret. For example, the mention of 'Arpașu' given by Nyárády (1953), based on which I focused a field search on Vf. Arpașu Mare and Mic peaks, may be misleading. In the old literature, the name 'Arpascher Gebirge' used by Fuss (1866) and Schur (1866) may refer to the larger vicinity of Arpașu peak (as explained by Simonkai 1886 in the introductory part). Schur (1866) additionally mentions 'Keprereaszé', which may indicate that the observation did not refer to Vf. Arpașu itself but rather to Vf. Capra located nearby. It has not yet been possible to check this possibility in the field. Although the previously known localities were not confirmed, the discovery of the new and relatively large population on the slopes of Vf. Gălbenele does confirm the persistence of *R. glacialis* in the Făgăraș Mts.

Two other intriguing localities have also been reported from the Southern Carpathians. One of them was published by Schur (1866) and represented by his herbarium material kept in LW (Fig. 3) but mostly ignored in more recent synthetic works (Nyárády 1953; Rațiu 1982). It concerns the Bucegi Mts, one of the most important hotspots of alpine flora in Romania (Coldea *et al.* 2009); unfortunately, no locality details were provided. The species was not mentioned in the detailed regional monograph of Bucegi by Beldie (1967) and most probably was not revisited after Schur's discovery. Another mostly unknown locality was recorded in the Țarcu Mts in the westernmost part of the Southern Carpathians (Banat region). A herbarium specimen with a general description of origin pointing to this massif is kept in the Budapest herbarium. The collection is not dated but according



**Fig. 3.** Original herbarium sheet by J. F. Schur (Herbarium Schur, LW) with collections of *Ranunculus glacialis* L. from the Bucegi Mts (upper part) and from the Rodnei Mts (lower part). Photo T. Khmil.

to the information on the herbarium sheet it comes from the collection of J. Dorner (1808–1873) and therefore can presumably be dated before 1873. This collection was almost completely overlooked and apparently is not mentioned in the Romanian literature at all. It was revised by A. Kurtto in 1982, however, probably during work for *Atlas Florae Europaeae*, and included in the distribution map presented in the *Atlas* (Jalas & Suominen 1989). As in the case of the locality in the Bucegi Mts, it probably was never found again. Neither *R. alpestris* (also very rare in the Southern Carpathians; M. Ronikier, pers. obs.) nor *R. glacialis* were mentioned by Boşcaiu (1971) in his meticulous monograph of this area. However, the potential habitats for *R. glacialis* in the Țarcu Mts are not as large as in the Bucegi Mts (M. Ronikier, pers. obs.); it will be interesting to make a focused field survey in this massif.

The best documented locality of *R. glacialis* in the Romanian Carpathians is in the Eastern Carpathians on the slopes of Vf. Ineu peak in the Rodnei Mts, one of the most popular botanical sites of the Romanian Carpathians. The oldest herbarium sheets found are not dated, but the presence of this population was already documented by Fuss (1866) and Porcius (1878). The most recent herbarium documentation for this locality before the present study comes from 1942; it was not found in the second half of the 20<sup>th</sup> century (Coldea 1990). The persistence of the species in the Rodnei Mts was confirmed during the field survey in 2004 (already reported by Ronikier 2004). A small population was found on steep western slopes of Vf. Ineu, but there probably are other small groups of plants in the vicinity. On the other hand, the second locality, reported by Schur (1866), the rocky, calcareous Vf. Corongiș nearby, was not confirmed during the present work.

In the recently published Romanian 'Red Data Book' of vascular plants, *Ranunculus glacialis* is ranked as critically endangered (IUCN category CR; Negrean & Dihoru 2009). It was listed as a vulnerable high-mountain taxon by Coldea *et al.* (2009). The present revision of the distribution confirms that the species is one of the rarest elements of the high-mountain flora of the Southeastern Car-

pathians. The historical localities, if still extant, harbor small and spatially restricted populations. However, the persistence of the species is confirmed in both the Eastern and the Southern Carpathians. The newly reported locality on the slopes of Vf. Gălbenele (Făgăraș Mts) is quite large and located in a rarely visited valley; this improves the view of the persistence of the species in the Southern Carpathians. The Romanian populations in this area represent the southeastern limit of the species range and should be strictly protected and monitored. On the other hand, the data provide more confirmation of the key importance of Romanian massifs such as the Făgăraș Mts and the Rodnei Mts for the persistence of rare elements of high-mountain flora in the Southeastern Carpathians.

The habitats of *R. glacialis* in the Carpathians include the highest mountain sites. In the Tatras it occurs fairly often on moister and richer granitic sites and mylonitic passes and gullies (rock crevices, scree). In the Southeastern Carpathians it also occurs mostly on crystalline bedrock (gneiss, crystalline schists – *Glimmerschiefer*) but it was also reported on calcareous bedrock in the Bucegi Mts and on Vf. Corongiș in the Rodnei Mts (Schur 1866). It is a characteristic species of high-mountain vegetation growing in non-calcareous scree habitats, *Androsacetalia alpinae* (Matuszkiewicz 2005). The new locality described here conforms to these characteristics. Populations of such stenotopic high-mountain species as *R. glacialis* inhabiting small islands of the alpine zone, and restricted to the highest parts of the mountains, are likely to be strongly affected by the disappearance of suitable niches due to predicted climate warming (Thuiller *et al.* 2005). The *R. glacialis* populations in the Carpathians are included in an ongoing molecular biogeographical study which will yield estimates of their genetic divergence and relationships with populations in other parts of the distribution area. Those findings will be used to assess their history and to support the implementation of appropriate conservation measures (M. Ronikier & P. Schönswetter, unpubl. data).

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## REFERENCES

- BAUMGARTEN J. C. H. 1816. *Enumeratio Stirpium Magno Transsilvaniae Principatus*. I. Libraria Camesinae, Vindebonae.
- BELDIE A. 1967. *Flora și vegetația munților Bucegi*. Editura Academiei Republicii Populare Române, București.
- BOȘCAIU N. 1971. *Flora și vegetația Munților Țarcu, Godeanu și Cernei*. Editura Academiei Republicii Populare Române, București.
- COLDEA G. 1990. *Munții Rodnei. Studiu geobotanic*. Editura Academiei Române, București.
- COLDEA G., STOICA I. A., PUȘCAȘ M., URSU T., OPREA A. & INTRABIODIV CONSORTIUM 2009. Alpine–subalpine species richness of the Romanian Carpathians and the current conservation status of rare species. *Biodivers. Conserv.* **18**: 1441–1458.
- CRAWFORD R. M. M. 2008. *Plants at the margin. Ecological limits and climate change*. Cambridge University Press, Cambridge.
- FUSS M. 1846. *Joh. Christ. Gottl. Baumgarten Enumerationis Stirpium Transilvaniae Indigenarum Mantissa I*. Typis Theod. Steinhaussen, Cibinii.
- FUSS M. 1866. *Flora Transsilvaniae excursoria*. Typis Haeredum Georgii de Closius, Cibinii.
- HULTÉN E. & FRIES M. 1986. *Atlas of North European Vascular Plants north of the Tropic of Cancer*. 2. Koelz Scientific Books, Königstein.
- JALAS J. & SUOMINEN J. (eds) 1989. *Atlas Florae Europaeae. Distribution of Vascular Plants in Europe*. 8. Nymphaeaceae to Ranunculaceae. The Committee for Mapping the Flora of Europe & Societas Biologica Fennica Vanamo, Helsinki.
- JÁVORKA S. 1924. *Magyar Flóra (Flora Hungarica)*. Studium, Budapest.
- NEGREAN G. & DIHORU G. 2009. *Ranunculus glacialis* L. In: G. DIHORU & G. NEGREAN (eds), *Cartea Roșie a plantelor vasculare din România*, pp. 443–444. Editura Academiei Române, București.
- NYÁRÁDY A. 1953. *Ranunculaceae*. In: T. SÄVULESCU (ed.), *Flora Republicii Populare Române*, pp. 396–661. Editura Academiei R.P.R., București.
- PACLOVÁ L. 1977. *Rastlinstvo subnivalného stupňa Vysokých Tatier. Zborník Prac o Tatranskom Národnom Parku* **19**: 169–256.
- PAPIU V. C. 1963. *Geologie și drumetie. Trasee în Carpații Românești*. Editura Științifică, București.
- PAWŁOWSKI B. 1956. *Flora Tatr*. **1**. Państwowe Wydawnictwo Naukowe, Warszawa.
- PORCIUS F. 1878. *Enumeratio Plantarum Phanerogamicarum districtus quondam Naszódienensis*. N. K. Papp, Claudiopolis.
- PUȘCARU-SOROCEANU E. 1977. *Considerații asupra metodei și sistemului fitosociologic Braun-Blanquet aplicate la studiul pajiștilor din R.S. România*. In: *Comunicări de Botanică, a X-a Consfătuire Națională de Geobotanică*: 95–107. Universitatea din București, Facultatea de Biologie, București.
- PUȘCARU-SOROCEANU E., CSURÓȘ Ș. & GHIȘA E. 1977. *Aspecte din flora și vegetația Munților Făgăraș (Carpații Meridionali)*. In: *Comunicări de Botanică, a X-a Consfătuire Națională de Geobotanică*, pp. 17–34. Universitatea din București, Facultatea de Biologie, București.
- RAȚIU F. 1982. *Corologia unor specii alpine ale genului Ranunculus în Carpații Românești*. *Contr. Bot. Univ. 'Babes-Bolyai' Cluj-Napoca* **22**: 143–153.
- RONIKIER M. 2004. *Ranunculus glacialis* in the Rodnei Mountains – rediscovered after a century. *Contr. Bot. Univ. 'Babes-Bolyai' Cluj-Napoca* **39**: 5–6.
- SAGORSKI E. & SCHNEIDER G. 1891. *Flora der Centrankarpathen*. I. Verlag von Eduard Kummer, Leipzig.
- SCHUR J. F. 1866. *Enumeratio Plantarum Transsilvaniae*. Apud Guilielmum Braumüller, Vindobonae.
- SIMONKAI L. 1886. *Erdély Edényes Flórájának helyesbített Foglalat (Enumeratio Florae Transsilvanicae vesculosae critica)*. Kiadja a Kir. Magyar Természettudományi Társulat, Budapest.
- THUILLER W., LAVOREL S., ARAUJO M. B., SYKES M. T. & PRENTICE I. C. 2005. *Climate change threats to plant diversity in Europe*. *Proc. Natl. Acad. Sci. U.S.A.* **102**: 8245–8250.
- TOWNSON R. 1797. *Travels in Hungary with a short account of Vienna in the year 1793*. Printed for G. G. and J. Robinson, London.
- WAHLENBERG G. 1814. *Flora Carpatorum Principalium. Impensis Vandenhöck et Ruprecht, Göttingae*.