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UTRICULARIA BREMII (*LENTIBULARIACEAE*) REDISCOVERED IN SLOVAKIA

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Abstract. *Utricularia bremii* Heer, considered extinct in Slovakia for about 60 years, has been rediscovered in shallow fen pools at Hanšpilje (Plavecký Peter village, SW Slovakia) in 2006. The water of the fen pools is of moderate conductivity (272 μS cm^{-1}) and pH 7.0. As a result of peat extraction in the past, the site is covered by depauperated vegetation with fen species characteristic of the alliance *Caricion davallianae* and wetland species characteristic of the class *Phragmito-Magno-Caricetea.* Stands with *U. bremii* were classified as the association *Campylio stellati-Caricetum lasiocarpae* (class *Scheuchzerio-Caricetea fuscae*). Brief information on the vegetation history of the Hanšpilje site, its ecology, and the vegetation preferences of *U. bremii* are presented in the European context. Based on our results, we propose to change the status of *U. bremii* on the Slovak red list from 'extinct' to 'critically endangered'.

Key words: *Utricularia*, carnivorous plants, ecology, distribution

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INTRODUCTION

Within the family *Lentibulariaceae*, distributed throughout the world, *Utricularia* L. is one of the largest genera among carnivorous plants, including at least 214 species (Taylor 1989). *Utricularia bremii* Heer is recorded from Central and Western Europe in Belgium, Denmark, France, Switzerland, Germany, Italy, Czech Republic, Slovakia, Hungary and Ukraine (Taylor 1989; Rahman *et al.* 2001). Data from Poland, Serbia and Montenegro (Żukowski 1974; Blaženić & Blaženić 1996, 1999; Kosiba 2004) have not been verified.

Utricularia bremii is given in the 'data deficient' (DD) category in the global *IUCN Red List of Threatened Plants* (Lansdown 2011) but undoubtedly it is rare and endangered over its whole area (Casper 1974; Schnittler & Günther 1999). The rarity and vulnerability of this species is reflected in its status on national red lists of European countries: as endangered (EN) in Switzerland (Moser *et al.* 2002) and as critically endangered (CR) in Germany (Ludwig & Schnittler 1996), Austria (Niklfeld & Schratt-Ehrendorfer 1996; Fischer *et al*. 2008), Hungary (Király 2007) and the Czech Republic (Grulich 2012). It is also in the Red Book of Ukraine (Shelyag-Sosonko 1996). In the last edition of the 'Red list of ferns and flowering plants of Slovakia' (Feráková *et al.* 2001) it is classified as probably extinct (EX?). Its rarity and problems with reliable determination of the species are the main reasons why many dubious and incorrect data have been published; for example, Casper (1974) published a number of misidentifications of *U. bremii*. Similar problems with its determination are known from Slovakia. It was reported from the Záhorská nížina lowland (western Slovakia) several times, probably based on incorrect data published by Degen *et al.* (1923). There is only one reliably confirmed historical site of *U. bremii* in Slovakia: Senica, Pustý mlyn (Šípošová & Oťaheľová 1997). *Utricularia bremii* has not been found anywhere in Slovakia since 1948 (cf. Vydrová *et al.* 2009).

The preferred habitats of *U. bremii* usually cover shallow pools of minerotrophic mires, but it

can also occupy secondary habitats such as shallow pits after peat extraction (e.g., Pietsch 1965; Vydrová *et al.* 2009), shallow sandpits with very soft water (Třeboň region, S Bohemia, Czech Republic; Adamec 2012 in verb.), and floating vegetation among populations of *Phragmites australis* in oxbow pools (Lansdown 2011). Similarly to the majority of the species of the genus *Utricularia*, *U. bremii* requires a relatively stable water level (Šumberová *et al.* 2011).

In this paper we report the rediscovery of *U. bremii* in Slovakia and provide data on the vegetation and ecological characteristics of this new locality.

Materials and methods

Phytosociological relevés were sampled in June 2012 according to Braun-Blanquet's method (Barkman *et al.* 1964).

Water pH and electrical conductivity were measured directly at the site in ambient water using a CyperScan PC 300 device. The conductivity values were recalibrated to 20°C temperature and hydrogen-ion-based conductivity was subtracted (Sjörs 1950). Flowering plant nomenclature follows Marhold and Hindák (1998), except for *U. bremii*, which follows Taylor (1989). Names of syntaxa follow Šumberová (2011) and Šumberová *et al.* (2011). For syntaxa not cited in those publications the author and year of description are given with the first reference. Herbarium abbreviations follow Vozárová and Sutorý (2001).

For revaluation of the red-list category and criteria of the species, the last version of *IUCN Guidelines for Using the IUCN Red List Categories and Criteria* were used (Anonymous 2010).

Results and discussion

Utricularia bremii was found in southwestern Slovakia in the Borská nížina lowland at Hanšpilje near Plavecký Peter village (48°33'14.85"N, 17°7'56.46"E, alt. 193 m a.s.l.) in 2006 and 2007 and was incorrectly determined as *U. minor* (*leg. Dítě 2007*, NI; Dítě 2007). Several years later, in 2011, the species was correctly determined by Vít Grulich (Brno, Czech Republic) and Lubomír Adamec (Třeboň, Czech Republic). It occurred in the central part of a fen in several shallow pools with a relatively stable water level during the whole vegetation season. At the site, individuals of the species *U. bremii* covered a total area of *ca* 30 × 20 m. The plants occupied isolated pools within populations of *Phragmites australis* and *Carex acuta*.

The *U. bremii* population at the site was very large in 2006. This amphibious species covered the water surface in a thick layer and created almost continuous cover. Also in 2007 we observed abundant flowering at several sites. During 2008–2012 we noted a decline in its abundance.

A single measurement of water parameters gave 272 μS cm^{-1} conductivity and pH 7.0. The vegetation with the occurrence of *U. bremii* was documented by two phytosociological relevés:

Relevé 1, 15 June 2012. Relevé area 2 m^2, cover of E_1 60%, E_0 10%, open water 100%, sampled by D. Dítě.

E_1: *Utricularia bremii* 3; *Phragmites australis* 2a; *Carex acuta* 1; *Juncus articulatus* 1; *Triglochin palustre* 1; *Carex viridula* +; *Eleocharis quinqueflora* +; *Liparis loeselii* r.

E_0: *Campylium stellatum* 2a; *Calliergonella cuspidata* 1; *Drepanocladus aduncus* 1.

The relevé documents the vegetation of fen pools with the occurrence of *U. bremii*; it falls within the variability of the alliance *Scorpidio-Utricularion minoris* Pietsch 1964.

Relevé 2, 15 June 2012. Relevé area 16 m^2, cover of E_1 50%, E_0 70%, open water 60%, sampled by D. Dítě.

E_1: *Carex acuta* 3; *Phragmites australis* 2b; *Utricularia bremii* 2a; *Carex viridula* 1; *Juncus articulatus* 1; *Triglochin palustre* 1; *Alnus glutinosa* +; *Eleocharis quinqueflora* +; *Eupatorium cannabinum* +; *Galium palustre* +; *Liparis loeselii* +; *Lycopus europaeus* +; *Lythrum salicaria* +; *Mentha aquatica* +.

E_0: *Drepanocladus aduncus* 3; *Calliergonella cuspidata* 2b; *Campylium stellatum* 2a; *Bryum pseudotriquetrum* 1.

The second relevé represents a successional stage of secondary vegetation developed in a fen that was damaged by peat extraction in the 1970s. The species composition of the vegetation includes

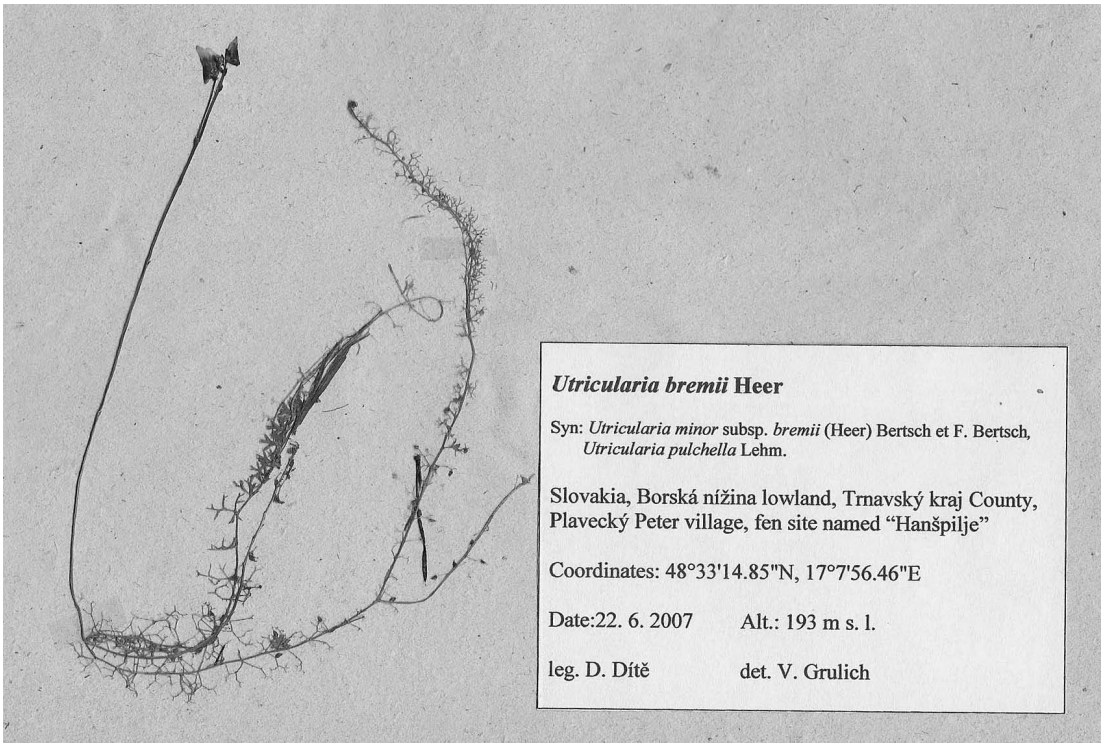

Fig. 1. Herbarium specimen of *Utricularia bremii* Heer collected at the Hanšpilje site in 2007 (specimen stored in NI).

fen species characteristic for the alliance *Caricion davallianae* Klika 1934 (e.g., *Eleocharis quinqueflora*, *Triglochin palustre*, *Campylium stellatum*) and wetland species typical for the class *Phragmito-Magno-Caricetea* (e.g., *Carex acuta*, *Phragmites australis*, *Lycopus europaeus*). Such vegetation with the occurrence of *U. bremii* can be classified as an atypical stage of the association *Campylio stellati-Caricetum lasiocarpae* (class *Scheuchzerio-Caricetea fuscae*).

The large fens covered more than 200 ha. The maximum depth of organic sediments was 690 cm (Raučina 1968). However, from most of these fens the peat was extracted down to the sandy substrate as early as the 1970s (Stanová & Grulich 1993).

In the Hanšpilje fen, peat initiation started during the Late Glacial *ca* 14,500 years ago (Hájková *et al.* 2012a). Bryophytes *Scorpidium scorpioides* and *Calliergon trifarium* as well as some vascular plants (e.g., *Carex limosa*) were identified from macrofossils (Hájková *et al.* 2012b). All these species are considered relicts in Central Europe (Hájek *et al.* 2011).

For that site, no vegetation studies were published either before or after peat extraction. At the end of the 20th century the vegetation was formed by dense populations of *Phragmites australis*, and juvenile *Alnus glutinosa* plants were observed in some places. Several fen species such as *Carex viridula, Eleocharis quinqueflora, Eriophorum latifolium, Juncus articulatus* and *Triglochin palustre* grew at a few open sites (Jasík, Dítě & Vlčko, unpubl. data). Surprising and valuable was the discovery of a large population of *Liparis loeselii* at the site (Vlčko *et al.* 1999; Mereďa & Hodálová 2011), and *Cyperus flavescens*, another very rare fen species (Dítě 2001).

Since 2000 seasonal management measures have been implemented at the site. The measures include mowing of reed stands and cutting of self-established trees to improve conditions for fen species.

At present the most common vegetation type at the site is represented by the association *Campylio stellati-Caricetum lasiocarpae* Klötzli 1969 of the alliance *Caricion davallianae* Klika 1934. Depressions with *Utricularia* species belong also to vegetation units from the alliance *Scorpidio-Utricularion minoris*. At several sites *Phragmites australis* is still the dominant species because fluctuations of the water level during the vegetation period have a negative impact on the development of fen vegetation cover. These fluctuations are reflected in the lower abundance and vigor of the *U. bremii* populations, which can be said to be declining. Accumulation of organic matter deposited in bladderwort pools, especially during management activities, also has a negative effect on the population size of *U. bremii*.

The association *Campylio stellati-Caricetum lasiocarpae* at the Hanšpilje site, in a mosaic with the fen pools hosting *U. bremii*, is related to the relatively high and stable water level. The electrical conductivity of the water in this community was always more than 200 μS cm^{-1}, and pH usually approximated neutral values (cf. Hájek & Hájková 2011). The conductivity values measured directly in the water at the Hanšpilje site were consistent with published data. Adamec (2010) reported that conductivity values above 200 μS cm^{-1} and pH 7.15 are suitable for *ex situ* cultivation of *U. bremii*. From Swiss localities, Schlegel (1999) gave the optimal interval of pH values for the species as 7.4–8.7. However, Adamec (unpubl. data) repeatedly measured conductivity in the range of 25–110 μS cm^{-1} and pH in the range of 5.5–7.0 at several localities of *U. bremii* in southern Bohemia, in natural (forest pools) or artificial (shallow sandpits) habitats. One may conclude that within oligomesotrophic habitats the species has a wide ecological amplitude with respect to water conductivity and pH.

The published data on the ecology and vegetation preferences of *U. bremii* are sparse. Moravec (1995) and Ellenberg (1996) regarded *U. bremii* as a member of species-poor vegetation of shallow mire pools, and also as a diagnostic species of the alliance *Sphagno-Utricularion* (class *Littorelletea uniflorae*). Šumberová *et al.* (2011) published the occurrence of *U. bremii* in the latter alliance. In Central Europe this type of vegetation has become very rare recently, however, and it usually develops only fragmentarily in small patches (Šumberová *et al*. 2011; Valachovič & Oťahelová 2001). We recorded *U. bremii* in plant communities of the alliance *Scorpidio-Utricularion minoris*. This vegetation type is reported in several European vegetation surveys (Pietsch 1965; Wallnöfer 1993; Pott 1995; Valachovič & Oťahelová 2001), which include communities of mineral-rich water. Stands of the alliance *Scorpidio-Utricularion minoris* differ from those of the alliance *Sphagno-Utricularion* by the presence of brown mosses (from the genera *Drepanocladus, Campylium*, etc.) and the absence of *Sphagnum* species (cf. Valachovič & Oťahelová 2001). The vegetation characteristics of the preferred habitats are published in more detail from three countries where *U. bremii* has been confirmed recently. Vydrová *et al.* (2009) recorded several types of aquatic plant communities from the largest and richest locality of *U. bremii* in the Czech Republic. It was found in floating aquatic plant communities (*Lemno-Utricularietum*, *Utricularietum australis*), aquatic plants rooted in the bottom (*Potametum natantis*), and in the vegetation of stoneworts (*Nitelletum flexilis, Charetum globularis*). *Utricularia bremii* was present also in the vegetation of oligotrophic water bodies (*Sparganietum minimi*, *Sphagno-Utricularietum*). Besides those communities, Vydrová *et al.* (2009) noted a distinctive type of vegetation (community with dominance of *Utricularia bremii*) with high cover of *U. bremii* (40–70%). Stands of this vegetation type were recorded in small open forest pools. Their bottoms were covered by fine organic mud and the water in most of the pools was deep (50–80 cm), rarely shallower. It was very rarely recorded on open banks of pools in *Sphagnum* stands. Sometimes it was accompanied by other aquatic macrophyte species such as *Nitella flexilis* and *Potamogeton natans*, and species from neighboring littoral vegetation were present sparsely (e.g., *Agrostis canina*, *Carex canescens*). According to Vydrová *et al.* (2009), the ecological characteristics of the vegetation type with dominance of *U. bremii* are similar to those of the association *Utricularietum*

australis. This is supported by the fact that *U. australis* and *U. bremii* are often recorded together at one site. Only the occurrence of *U. bremii* with peat mosses was considered a different vegetation type related to plant communities of the alliance *Sphagno-Utricularion*. In Switzerland the species was reported from stands of this alliance (ass. *Sparganietum minimi*) by Schlegel (1999), who noted that *U. bremii* might also be found within stands of the associations *Scorpidio-Utricularietum minoris* and *Caricetum elatae*, because *U. bremii* was found among tufts of *Carex elata* on lake margins. In northern Italy, *U. bremii* was found in various types of wetland vegetation, including pools in wet meadows as well as permanent wetlands (Beretta *et al.* 2011).

Based on our results and the IUCN classification, we propose revaluation of the status of *U. bremii* on the Slovak red list, changing its category from 'extinct' (EX?) to 'critically endangered' – CR B2a(ii)b(iii); C2a(ii).

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