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Two interesting wetland plant communities from the Ipeľ River inundation area, including the first record of *Elatinetum alsinastrum* in Slovakia

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Abstract: Two plant communities, *Eleochareto acicularis-Schoenoplectetum supini* and *Elatinetum alsinastrum* were recorded in the temporary field pools in the Ipeľ River inundation area (south-central part of Slovakia). Sandy soils with neutral to slightly alkaline reaction and low values of conductivity were typical for moderately closed, low and species poor to moderately rich stands with the dominance of *Schoenoplectus supinus*. On the contrary, species poor and open stands with *Elatine alsinastrum* dominance grew in shallow alkaline water with high conductivity. This community is documented in Slovakia for the first time.

Keywords: endangered plant species, exposed-bottom vegetation, *Isoëto-Nano-Juncetea*, *Schoenoplectus supinus*, phytosociology, temporary pools.

Introduction

Wetland vegetation, especially aquatic and marsh vegetation is very dynamic and variable in space and time. Nutrient regime and disturbance events (mainly flooding) are key factors controlling much of the floristic variation in wetland communities (KEDDY 2010). Temporary pools as small and shallow wetlands are

unique seasonal habitats with high species compositional and richness variability (DEIL 2005). In Central Europe, and especially in the Pannonian lowland, they are species-rich and can host many rare and endangered plant species (LUKÁCS et al. 2013). The herb layer of typical developed stands consists of annual, perennial or biennial wetland herbs of periodically flooded habitats belonging to *Isoëto-Nano-Juncetea* class and/or *Eleocharito palustris-Sagittarion sagittifoliae* alliance (class *Phragmito-Magno-Caricetea*). Although distribution, phytosociology and ecology of these vegetation types are well known in Slovakia (VALACHOVIČ 2001; ŠUMBEROVÁ & HRIVNÁK 2013), several plant communities were found new for this territory in last years, namely *Phalarido arundinaceae-Bolboschoenetum laticarpi* and *Tripleurospermo inodori-Bolboschoenetum planiculmis* (HROUDOVÁ et al. 2009), *Lythretum hyssopifolii-tribracteati* (ELIÁŠ Jr. et al. 2011), *Veronico anagalloidis-Lythretum hyssopifoliae* (ELIÁŠ Jr. et al. 2016) and *Eleocharito palustris-Alismatetum lanceolati* (HRIVNÁK et al. 2015).

Plant communities and flora of the Ipeľ River catchment area are relatively well documented compared to other regions in Slovakia. First botanical studies were conducted during the 1870s–1880s (e.g. FREYN 1872, MALESEVICS 1882). In the last two decades, special scientific effort was given mainly to variability of aquatic and marsh vegetation (HRIVNÁK 2002a,b, HRIVNÁK 2004a,b). These research activities discovered several interesting and rare plant communities including first findings for Slovakia (HRIVNÁK et al. 2001, HRIVNÁK 2009, HRIVNÁK et al. 2015).

High precipitation in southern Slovakia during the spring of 2013 created favourable conditions for the development of shallow water-logged depressions and exposed bottoms, which in turn promoted the existence of ephemeral herbaceous vegetation types. For example, the *Eleocharito palustris-Alismatetum lanceolati* association was firstly found by the authors in Slovakia during the vegetation season of 2013 (HRIVNÁK et al. 2015). We also recorded other stands with unique floristic composition and we provided their floristic, ecological and syntaxonomic characteristics in this paper.

Methods

Vegetation of exposed bottoms and shallow water-logged terrain depressions was sampled using the traditional Zürich-Montpellier approach in the inundation area of the central part of Ipeľ River catchment area (near the Kováčovce village, southern Slovakia; Fig. 1) in June 2013. The cover of plant species was recorded with the extended nine-degree Braun-Blanquet cover/abundance sampling scale (BARKMAN et al. 1964).

If water level was below soil surface (relevés no. 1, 2), three soil samples were randomly extracted from the uppermost mineral horizon (0–10 cm depth) and mixed to form a single sample per plot in order to reduce the effect of soil heterogeneity. They were air-dried at room temperature, crushed and passed through a 2 mm sieve. Soil pH and conductivity were measured in distilled water (1:5 soil:water ratio). If water level was above soil surface, water pH and conductivity were estimated directly in the field. EUTECH PC650 equipment was

used to measure pH and conductivity for both soil and water samples. Geographical coordinates (longitude, latitude), aspect and altitude were measured using a GPS equipment (Garmin GPSmap 62s). Slope was measured with a Suunto PM-5/360 PC declinator.

Fig. 1. Map of the studied area.

Nomenclature of plant species follows the checklist of MARHOLD & HINDÁK (1998) and the names of plant communities are unified according to CHYTRÝ (2011), with the exception of *Elatinetum alsinastrum* NAGY J. et al. 2006, *Eleochareto acicularis-Schoenoplectetum supini* SOÓ & UBRIZSY in UBRIZSY 1948, *Lythretum hyssopifolii-tribracteati* Slavnič 1951 and *Eleocharito palustris-Alismatetum lanceolati* MINISSALE & SPAMPINATO 1985. Categories of endangered species (CR – critically endangered, EN – endangered, VU – vulnerable, NT – near threatened and LC – least concern) are presented according to contemporary version of Slovak Red List of vascular plants (ELIÁŠ Jr. et al. 2015).

Results and discussion

In the surroundings of the Kováčovce village, we sampled herbaceous stands of rare or not reported plant communities in the territory of Slovakia. Their species composition and site conditions are described below.

Eleochareto acicularis-Schoenoplectetum supini **(***Isoëto-Nano-Juncetea*, *Verbenion supinae*): These medium-closed and low-height stands with species-poor to medium-rich herb-layer were dominated by *Schoenoplectus supinus*. They were found on water-logged soils within arable lands (relevés no. 1, 2; Fig. 2). Diagnostic species of *Isoëto-Nano-Juncetea* class (e.g. *Cyperus fuscus*, *Dichodon viscidum*, *Juncus bufonius* agg., *Myosurus minimus*) were combined with marsh species of the *Phragmito-Magno-Caricetea* class (e.g. *Alisma lanceolatum*, *Phellandrium aquaticum*, *Typha latifolia*). The floristic spectrum was also enriched by nitrophilous wetland herbs and weeds such as *Alopecurus aequalis*, *Echinochloa crus-galli* and *Ranunculus sardous*. Species composition of these stands matched to *Eleochareto acicularis-Schoenoplectetum supini* association. Sandy soils with neutral to slightly alkaline reaction (pH 7.1 and 7.6) had relatively low content of soluble mineral elements (conductivity 99.1 and 146.1 µS/cm). Marsh and aquatic plant communities of the *Phragmito-Magno-Caricetea* and *Potametea* classes were recorded in the contact area of this vegetation.

Relevé No. 1: Kováčovce village, SSW, field depression on the margin of the Ipeľ River alluvia; longitude 19° 27′ 30.4″E, latitude 48° 05′ 19.7″N; altitude 151 m; area 11 m^2; aspect 100°; slope 2°; cover E_1 75 %, E_0 12 %; height of E_1 (3)20–50(70) cm; date 11. 6. 2013; authors R. Hrivnák, M. Slezák.

E_1: *Schoenoplectus supinus* 3, *Lindernia procumbens* 2m, *Alisma lanceolatum* 1, *Alopecurus aequalis* 1, *Ambrosia artemisifolia* 1, *Bolboschoenus laticarpus* 1, *Cyperus fuscus* 1, *Echinochloa crus-galli* 1, *Filaginella uliginosa* 1, *Potentilla supina* 1, *Ranunculus sceleratus* 1, *Xanthium albinum* agg. 1, *Agrostis stolonifera* +, *Cirsium arvense* +, *Dichodon viscidum* +, *Elymus repens* +, *Juncus bufonius* agg. +, *Lythrum hyssopifolium* +, *Myosurus minimus* +, *Persicaria lapathifolia* +, *P. maculosa* +, *Plantago uliginosa* +, *Polygonum aviculare* agg. +, *Rorippa austriaca* +, *Ranunculus sardous* +, *Typha latifolia* +, *Dichostilis micheliana* r, *Elatine alsinastrum* r, *Epilobium* sp. r, *Negundo aceroides* r, *Phellandrium aquaticum* r.

E_0: *Bryum* cf. *capillare* 2a.

Relevé No. 2: Kováčovce village, SSW, field depression on the margin of the Ipeľ River alluvia; longitude 19° 27′ 32.5″E, latitude 48° 05′ 20.6″N; altitude 151 m; area 9 m^2; aspect 250°; slope 2°; cover E_1 65 %, E_0 5 %; height of E_1 20(80) cm; date 11. 6. 2013; authors R. Hrivnák, M. Slezák.

E_1: *Schoenoplectus supinus* 4, *Alisma lanceolatum* 1, *Elymus repens* 1, *Typha latifolia* 1, *Alopecurus aequalis* +, *Amaranthus retroflexus* +, *Apera spica-venti* +, *Dichodon viscidum* +, *Echinochloa crus-galli* +, *Myosurus minimus* +, *Negundo aceroides* +, *Phellandrium aquaticum* +, *Polygonum aviculare* agg. +, *Ranunculus sardous* +, *R. sceleratus* +, *Rumex sanguineus* +, *Tripleurospermum inodorum* r.

E_0: *Bryum* cf. *capillare* 1.

Although the association *Eleochareto acicularis-Schoenoplectetum supini* was described for the first time by Ubrizsy & Soó (in UBRIZSY 1948) from rice fields in southeastern Hungary, these stands are recently known especially from temporal ponds of large river floodplains situated across Hungary (BORHIDI et al. 2012). In Slovakia, it was reported by several authors in regional studies (e.g. HEJNÝ 1960)

Fig. 2. Stands of *Eleochareto acicularis-Schoenoplectetum supini* (on the top) and *Elatinetum alsinastrum* (bellow) in the Ipeľ river inundation area near the Kováčovce village (all photos: R. Hrivnák, 11. 6. 2013).

and was also listed in both national vegetation checklists (MUCINA & MAGLOCKÝ 1985, JAROLÍMEK et al. 2008). In spite of long-term and intensive research of marsh vegetation in Slovakia, these stands have not yet been recorded by phytosociological relevés. HEJNÝ (1960) published this community from the experimental rice fields of the Eastern Slovakia, which were developed on sandy soils with periodic fluctuation of water level during the year, but without additional floristic data. The *Eleochareto acicularis-Schoenoplectetum supini* was therefore considered to be a vanished community in Slovakia (VALACHOVIČ 2001). Similarly ZLACKÁ et al. (2006), which summarised distribution and phytosociological patterns of *Schoenoplectus supinus* in Slovakia, did not find any support for its occurrence in this region (however, it should be noted that relevé number 11 in Table 1 could be most likely arranged into *Eleochareto acicularis-Schoenoplectetum supini*). Later, JAROLÍMEK et al. (2008) did not adopt these outcomes and included this association in the checklist of vegetation units of Slovakia. Recently, syntaxonomical and ecological revision of the class *Isoëto-Nano-Juncetea* in the Czech Republic and Slovakia repeatedly did not produce any clearer evidence about the target association (ŠUMBEROVÁ & HRIVNÁK 2013).

Unlike to the original description of the community (UBRIZSY 1948), the Slovak stands of *Eleochareto acicularis-Schoenoplectetum supini* showed some small floristic differences. For example, co-dominant species *Eleocharis acicularis* was absent in relevés from Slovakia due to different ecological conditions (e.g. relatively quick decrease of water under the soil surface). Similarly, other extremely rare species in Slovakia, such as *Elatine hungarica* and *E. triandra* (ŤAVODA & GOLIÁŠOVÁ 2008, TAKÁCS et al. 2013, ELIÁŠ Jr. et al. 2015), had higher frequency in the original diagnosis and were entirely lacking in the stands of the association near the Kováčovce village. The occurrence of *Oryza sativa* suggests connection of Hungarian stands to rice fields. In addition to the dominance of *Schoenoplectus supinus*, both datasets contain an abundant group of diagnostic species of the classes *Isoëto-Nano-Juncetea* and *Phragmito-Magno-Caricetea*, supporting the assignment of Slovak stands into the *Eleochareto acicularis-Schoenoplectetum supini*. Its ephemerality is most likely responsible for the fact that this fragmentary and small-scaled community has been overlooked. Moreover, vegetation with *Schoenoplectus supinus* is in general sensitive to climatic conditions, pronounced intra-annual water level fluctuations and intensive effect of agricultural activities. These characteristics result either in strong compositional changes of exposed bottoms or development of other vegetation types, frequently with the absence of this species for a long time.

Elatinetum alsinastrum **(***Isoëto-Nano-Juncetea*, *Eleocharition ovatae*)**:** This herbaceous community includes open stands with a dominance of *Elatine alsinastrum* and admixture of perennial wetland species such as *Alisma lanceolatum*, *Bolboschoenus laticarpus* and *Typha latifolia*. It was found in terrain depression of arable field with shallow stagnant (2–20 cm) and relatively warm (17 ºC) water (relevé no. 3; Fig. 2). Slightly alkaline water (pH = 7.8) showed high

content of soluble mineral elements (water conductivity = 1110 µS/cm). While a typical marsh vegetation of *Phragmition australis* and *Eleocharito palustris-Sagittarion sagittifoliae* alliances (class *Phragmito-Magno-Caricetea*) was recorded in the contact area, a mosaic of stands with phytosociological affiliation to the *Eleocharition ovatae* alliance (class *Isoëto-Nano-Juncetea*) grew on the exposed bottom.

Relevé No. 3: Kováčovce village, SSW, field depression on the margin of the Ipeľ River alluvia; longitude 19° 27′ 36.4″E, latitude 48° 05′ 29.7″N; altitude 151 m; area 12.5 m^2; aspect 0°; slope 0°; cover E_1 40 %, E_0 0 %; height of E_1 15–20 cm; date 11. 6. 2013; depth of stagnant water 2–20 cm; authors R. Hrivnák, M. Slezák.

E_1: *Elatine alsinastrum* 3, *Alisma lanceolatum* 1, *Typha latifolia* +, *Cirsium arvense* +.

This pioneer community was originally described by NAGY et al. (2006) from the catchment area of the Bodrog River in northeastern Hungary and assigned into *Eleocharition ovatae* alliance (ut *Nanocyperion*). These small-scaled stands are extremely species-poor and their physiognomy is driven by dominant species *Elatine alsinastrum*. They usually settle clayey soil substrates, which are periodically flooded by shallow and warm water with a neutral to slightly alkaline reaction (NAGY et al. 2006, 2009; BORHIDI et al. 2012). All available phytosociological relevés have been sampled only in the Bodrogköz region, but an additional occurrence on suitable habitats in other Hungarian regions (e.g. the Tisza plain) can be assumed (BORHIDI et al. 2012). The same is also true for Slovakia, where new findings of this association can be expected in other parts of country with the occurrence of *Elatine alsinastrum* (ŤAVODA & GOLIÁŠOVÁ 2008), particularly in waterlogged field depressions of agricultural land in southeastern regions.

Although species composition of these stands clearly matched to the association *Elatinetum alsinastrum*, its original affiliation to a higher rank syntaxa appears to be unclear and still under debate. Well-developed stands contain several typical marsh species such as *Alisma lanceolatum*, *Alopecurus aequalis*, *Lycopus europaeus*, *Sparganium erectum* or *Typha angustifolia*, whereas diagnostic species of the *Isoëto-Nano-Juncetea* class reach only low frequency (see NAGY et al. 2006, 2009). These floristic features accompanied by ecological affinity of this vegetation to relatively warm water bodies with stagnant, shallow and fluctuating water during the vegetation period suggest its relation to the *Eleocharito palustris-Sagittarion sagittifoliae* alliance (class *Phragmito-Magno-Caricetea*) rather than *Eleocharition ovatae* alliance (*Isoëto-Nano-Juncetea* class). However, we are aware that only a detailed comparative analysis of all accessible relevés of the association with phytosociological data from these two alliances can produce an unambiguous syntaxonomic decision about its affiliation to higher vegetation units. Therefore, we preliminary keep *Elatinetum alsinastrum* within the alliance *Eleocharition ovatae* (*Isoëto-Nano-Juncetea*).

Botanical survey of studied locality suggested that these habitats can also harbour several endangered vascular plants such as *Dichostylis micheliana* (EN), *Dichodon viscidum* (NT), *Elatine alsinastrum* (NT), *Lindernia procumbens*

(VU), *Lythrum hyssopifolia* (LC), *Rumex palustris* (LC), *Schoenoplectus supinus* (VU) and *Myosurus minimus* (NT). The most interesting findings correspond to the presence of *Dichostylis micheliana* and *Schoenoplectus supinus*, which are for the first time recorded in the Ipeľ River catchment area (BUBÍKOVÁ et al. 2016). Similarly, species *Elatine alsinastrum* is considered extremely rare in this territory (ELIÁŠ Jr. in ELIÁŠ Jr. 2013, POPIELA et al. 2013, BUBÍKOVÁ et al. 2016).

In conclusion, the presented plant communities have ephemeral occurrence in the surroundings of the Kováčovce village. Fields with temporary pools are intensively cultivated and only specific ecological conditions (optimal climatic characteristics, floods and subsequently gradual decrease of water level within vegetation period) affect their development. If the existing agricultural utilization and micro-sites properties will be preserved, long-term survival with irregular occurrence of these communities is expected.

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