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The *Heleochloëtum alopecuroidis* association in the Pannonian Basin – fiction or reality?

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Abstract: The understanding of some plant communities can often be ambiguous if studies from multiple countries are considered, because goals and methods in each country may differ. The presented work is based on a detailed review of historic and recent literature about the association *Heleochloëtum alopecuroidis* in the Pannonian Basin and tangentially the adjacent regions within Central and SE Europe compared to authors' field data. The named community was generally reported in moderately saline and marshy habitats in lowland areas, nevertheless it is not documented by phytosociological relevés to be part of the halophytic alliance of *Cypero-Spergularion salinae*. We performed a critical assessment of stands with the species *Heleochloa alopecuroides* in halophytic vegetation where we added our own data from field research between 2003 and 2013 (1044 phytosociological relevés) and 354 unpublished and published relevés taken from the three National Phytosociological Databases (Czech Republic, Hungary, Slovakia). We conclude that association *Heleochloëtum alopecuroidis* cannot be properly described as being part of the Pannonian halophytic vegetation group. It should be therefore deleted from the vegetation surveys.

Key words: *Heleochloëtum alopecuroidis*; phytosociology; ecology; saline vegetation; Flora of the Pannonian Basin; Austria; Hungary; Romania; Serbia; Slovakia.

Introduction

Heleochloa alopecuroides (Piller et Mitterp.) Host ex Roem. is a Mediterranean Ponto- oriental element with a meridional Euro-Asian continental distribution range (Holub & Grulich 1999). The species' area expands from Southern Europe through the Middle East to Central Asia and Western Siberia. In Europe it occurs in the south of the Mediterranean northwards along the Breton peninsula (France), in northern Italy and in the Pannonian region (north to the Czech Republic, and Slovakia), east to Ukraine and the southern part of European Russia. It has also been found in North American as an alien species (Tzvelev1983; Conert 1983).

The species grows on periodically exposed bottoms and banks of water reservoirs and watercourses, in large field inundations flooded in spring, in muddy places with open pioneer vegetation, on river sediments, in drying ditches, and also in salt habitats in warm lowlands (Cincović & Kojić 1976; Conert 1983; Holub & Grulich 1999). It requires occasionally flooded, summer drying, alkaline and clay, often salty soil (Soó 1964; Dostál & Červenka 1992).

According to published data, *Heleochloa alopecuroides* occurs in several types of communities in Europe. First of all, the species is a typical component of vegetation of annual wetland herbs from the class *Isoëto-Nanojuncetea* Br.-Bl. et Tüxen ex Br.-Bl. et al. 1952. Within this vegetation, a number of associations with the presence of *Heleochloa alopecuroides* were described in Central and Southern Europe. At European scale, Brullo & Minissale (1998) processed the survey of communities of this class. They included communities where *Heleochloa alopecuroides* is one of the characteristic species of the alliance *Verbenion supinae* Slavnić 1951 and two associations within it: *Cypero-Heleochloetum alopecuroidis* Rivas Goday & Valdes in-Rivas Goday 1970 [syn. *Cypero fusci-Juncetum bufonii* (Felföldy 1942) Soó et Csürös 1949] and *Dichostylido micheliani-Gnaphalietum uliginosi* Timár 1947 [syn. *Dichostylido-Helochloetum alopecuroidis* Pietsch 1973].

In the north of its distribution range, *Heleochloa alopecuroides* is generally rare, and therefore its association is rare here as well. In Slovakia, the species was recorded in stands of the class *Isoëto-Nanojuncetea*, alliance *Eleocharition soloniensis* Philippi 1968. Valachovič et al. (2001) considered *H. alopecuroides* together with *Dichostylis micheliana* as a characteristic species of the *Cyperetum micheliani* Horvatić 1931 association. Stands of the association occupy soils flooded in the spring, and drying in the summer in inundation areas of larger rivers. They develop in the second half of the summer and in early autumn on drained beds and banks of oxbows and depressions (cf. Valachovič et al. 2001). Besides *Cyperetum micheliani*, the authors reported *H. alopecuroides* as a rare member of two

additional associations of the *Eleocharition soloniensis* alliance: *Eleocharito acicularis-Limoselletum aquaticae* Wendelberger-Zelinka 1952 and *Juncetum bufonii* Felföldi 1942. Both these associations are characteristic to periodically flooded mineral soils with low organic content.

In Hungary, the species was observed in other habitat types – stands developed in field depressions and on the edges of fields. Makra (1995) observed *H. alopecuroides* in ruderalised stands of the class *Bidentetea tripartiti* R. Tx. & al. in R. Tx. 1950, alliance *Chenopodion rubri* Soó 1969, where the *Chenopodio rubri-Heleochloetum alopecuroidis* Timár 1950 association developed. Halophytes are not present in those types of vegetation, excepting the *Juncetum bufonii* association, where some facultative halophytes (sensu Krist 1940) such as *Pulicaria vulgaris, Lythrum hyssopifolia, Potentilla supina* and *Centaurium pulchellum* (Makra 1995; Borhidi 2003) may rarely be found. In the same class, Bodrogközy (1982) described the association *Echinochloo-Heleochloetum alopecuroidis* and the author included it within the *Bidention tripartitae* Nordh. 40 alliance. The association is typical especially on flooded corn fields (Bagi & Bodrogközy 1984).

The above-mentioned vegetation is dominated by annual species that develop on non-salinized or only slightly saline soils. Halophytes are only rarely present and most of them are facultative; obligate halophytes are usually absent. Stands developed in field depressions contain a significant number of ruderal species (Mucina 1993a; Valachovič et al. 2001; Sanda et al. 2008; Borhidi et al. 2012).

Heleochloa alopecuroides is also mentioned as part of the vegetation of annual graminoids of the class *Crypsietea aculeatae* Vicherek 1973, the *Cypero-Spergularion salinae* Slavnić 1948 alliance. These communities occupy banks and bottoms of saline lakes and periodically flooded saline habitats. Within this alliance, the *Heleochloëtum alopecuroidis* Rapaics 1927 ex Ubrizsy 1948 association is recognized and it is traditionally mentioned as endemic to the Pannonian Basin. This association appears mainly in the newer Hungarian literature (e.g. Soó 1980; Makra 1995; Borhidi 2003; Molnár & Borhidi 2003; Borhidi et al. 2012), but it is not known in the literature from other countries where Pannonian Basin extends – it is lacking in vegetation surveys of the Czech Republic (Vicherek 1973; Moravec et al. 1995; Šumberová 2007), Slovakia (Vicherek 1973; Jarolímek et al. 2008), Serbia (Kojić et al. 1998, Kneževič et al. 2002; Lakušić et al. 2005) and Austria (Mucina 1993a). Regarding Romania, in the halophytic vegetation of *Cypero-Spergularion* salinae alliance, *H. alopecuroides* is mainly known only in the stands of *Heleochloëtum schoenoidis* association (Popescu 2005; Lupaşcu & Anişei 2007). *Heleochloëtum alopecuroidis* association is mentioned only occasionally (Pop 2002; Sanda et al. 2008).

In view of the above distortions, the aims of the article are to: a) Solve the justification of the *Heleochloëtum alopecuroidis* association's description, comparing available literature with our own field data, b) Perform a critical assessment of stands with *Heleochloa alopecuroides* in halophytic vegetation of the Pannonian Basin.

Material and methods

Study area

In SE Europe, halophytic vegetation is developed predominantly in the continental Pannonian Basin, where it has been described in detail, especially for Hungary (cf. Eliáš et al. 2013).

The Pannonian Basin is situated at the boundary between Central Europe, Eastern Europe and the Balkans. It forms a topographically discrete unit surrounded by obvious geographic boundaries – the Carpathian Mountains, the Alps, the Dinarides and the Balkan Mountains (Hoffman & Davies 1983). It consists of a large Neogene basin, which occupies an area of ca 300 000 km^2, and was recently filled by a thick layer of fluvial and aeolian sediments (Fodor et al. 1999; Nemčok et al. 2006).

Regarding climate, the Pannonian Basin is included in a temperate, continental steppic bioclimatic region (Rivas-Martínez & Rivas-Saenz 2009). This continental climate zone usually has cold winters and hot, dry summers. The average annual temperature is about 10 °C, and annual precipitation reaches 400–500 mm in the central region (the Great Hungarian Plain) and 500–600 mm in the northwest area (the Danube lowland). In the summer, severe droughts may occur (Borhidi 1961; Miklós & Hrnčiarová 2002).

Vegetation data of Heleochloa alopecuroides species

The evaluation was based on analysis of published and unpublished phytosociological relevés and our own field research. We used 1044 phytosociological relevés collected during our research on halophytic vegetation (classes of *Thero-Salicornietea*, *Crypsietea aculeatae*, *Scorzonero-Juncetea gerardii* and *Festuco-Puccinellietea*) in 2003–2013 (Fig. 1). Data were sampled according to the Zürich-Montpellier approach using the adapted nine-grade Braun-Blanquet's scale (Barkman et al. 1964). In addition, 354 unpublished and published relevés (classes of *Thero-Salicornietea*, *Crypsietea aculeatae*, *Scorzonero-Juncetea gerardii* and *Festuco-Puccinellietea*) were obtained in the national phytosociological databases from the Czech Republic (Chytrý & Rafajová 2003), Slovakia (Hegedüšová 2007) and Hungary (Lájer et al. 2007). In total, 1398 phytosociological relevés were used for the study.

The nomenclature of taxa follows the Checklist of non-vascular and vascular plants of Slovakia (Marhold & Hindák 1998), and the names of syntaxa follow Borhidi et al. (2012). The vascular plant species considered as halophytes are according to the list of Krist (1940).

Results

History of the description of the Heleochloëtum alopecuroidis association

The first mention of *Heleochloa alopecuroides* stands on the association level was published by Rapaics (1927) in a study of saline soils in the surroundings of Szeged and Csongrád settlements (SE Hungary). The author mentioned the community of *H. alopecuroides*

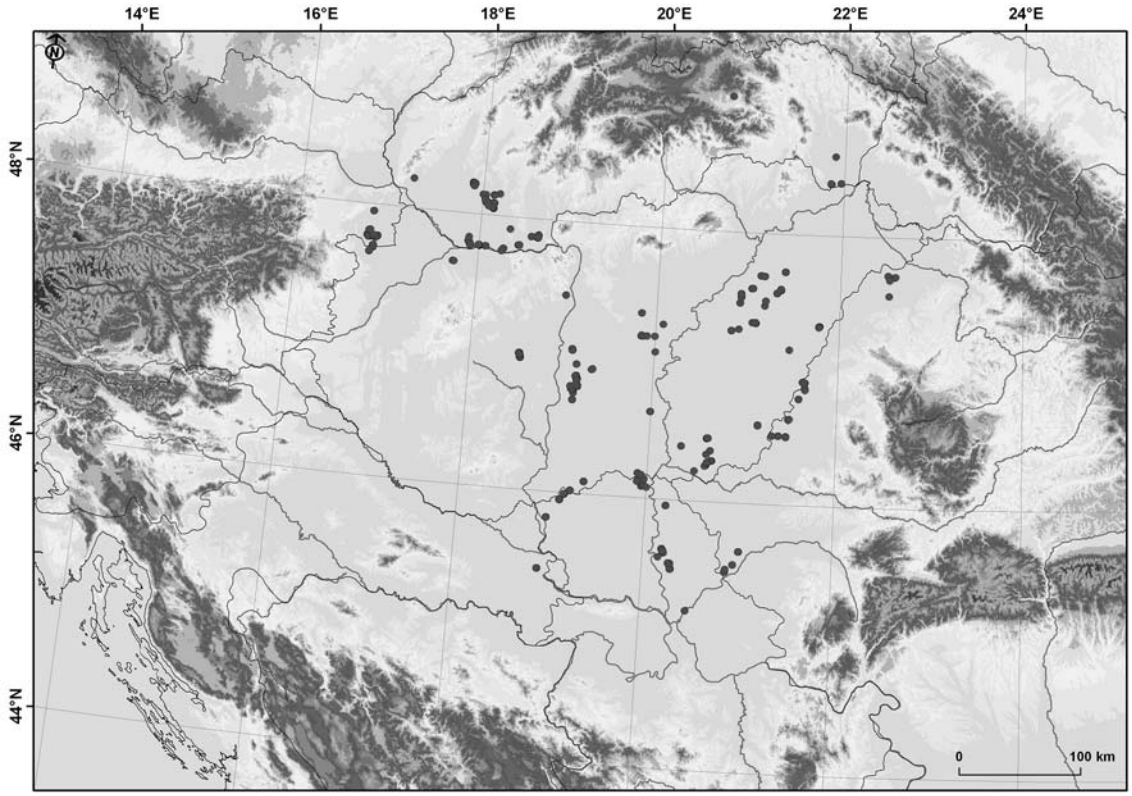

Fig. 1. Distribution of the relevés sampled in truly-halophytic communities used for evaluation of *Heleochloëtum alepecuroidis* association within the Pannonian Basin.

Table 1. History of the description of *Heleochloëtum alepecuroidis* association, ecology and species composition of those stands based on published works.

Author	Original name of the stands with *Heleochloa alopecuroides* dominance	Relevés	Ecology given by author	Species composition
Rapaics 1927	asz. *Heleochloa alopecuroides*	No relevés	Halophytic vegetation	No data published
Magyar 1928	*Heleochloa alopecuroides* stands	No relevés	Wet clayey soils, less saline shallow depressions in strongly cattle-trampled sites	*Crypsis aculeata, Glyceria poiformis, Heleochloa schoenoides, Mentha pulegium, Lysimachia nummularia, Polygonum aviculare, Potentilla reptans*
Soó 1933	asz. *Puccinellietum limosae normális* asz. *Puccinellietum limosae polygonosum avicularis*	No relevés	Strongly saline soils wet in spring and dry in summer, bottoms of salt lakes on clayey soils	No data published
Soó 1947	asz. *Crypsidetum aculeate*, CS. *Heleochloa alopecuroides* Soó (H. a. ass. Rapcs. 1927, Ubrizsy 1947, *Puccinellietum heleochloa* a. szoc. Ubrizsy), f. *Heleochloetum purum* Soó	Constancy table	Dry saline soils in the bottom of lakes	*Chenopodium chenopodioides, Juncus effusus, Phragmites australis, Typha angustifolia*
Soó 1957, 1964, 1973	asz. *Crypsidetum aculeate* subasz. *heleochloetosum alopecuroidis* Soó	No relevés	Strongly saline soils wet in spring and dry in summer, bottoms of salt lakes on clayey soils	No data published
Soó 1980	asz. *Heleochloëtum alopecuroidis* (Rapcs. 1927) Ubrizsy 1948	No relevés	Strongly saline soils wet in spring and dry in summer, bottoms of salt lakes on clayey soils	No data published

as "*Heleochloa alopecuroides* Association" without noting any characteristics among other types of halophytic vegetation of this area (Table 1).

Magyar (1928) described the occurrence of *Heleochloa alopecuroides* from Hortobágy (Eastern Hungary) more precisely. He stated that the species occured on wet clayey soils and it was the most common in less saline shallow depressions, especially in strongly cattle-trampled sites. The plant formed monodominant stands in microhabitats and was more frequent than the similar grasses *Crypsis aculeata* and *Heleochloa schoenoides*. *H. alopecuroides* outside of the examined region was often accompanied by *Heleochloa schoenoides* (cf. Magyar l. c.). Relevés documenting this plant assemblage were not given.

R. Soó deserves credit for the most complete descriptions of the community. Initially, Soó (1933) pointed to *Heleochloa alopecuroides* as a characteristic species of the "*Puccinellietum limosae normális*" association and in the *Puccinellietum limosae polygonosum avicularis* subassociation (*Puccinellion* alliance). The stands developed in strongly saline soils which were wet in spring and dry in summer. He also mentioned the community *Crypsis-Heleochloa* from the bottoms of salt lakes on clayey soils and stated that in the autumn the stands were enriched by ruderal species of saline pastures. Like previous authors, Soó (1933) did not describe this vegetation in more detail. In the next work, Soó (1947) allocated the vegetation with *Heleochloa alopecuroides* into the association *Crypsidetum aculetae* (Bojko) Soó 1933 consociation „CS. *Heleochloa alopecuroides* Soó (H. a. ass. Rapcs. 1927, Ubrizsy 1947, *Puccinellietum heleochloa* aszoc. Ubrizsy)". He incorporated this syntaxon to the class *Puccinellietallia* Soó 1940, alliance *Puccinellion distantis* Soó 1933. Soó (l. c.) provided a constancy phytosociological table of *Heleochloa alopecuroides* relevés (Table 8, p. 16) sampled by G. Ubrizsy in 1947 near Szarvas (column 1) and by Soó near Gyoma (column 2 – variant ruderalis *Polygonum aviculare*), without giving the number of relevés used for creating the constancy values of the table. The exact date and location of the sampling is missing as well. Two species are included with constancy V – *Heleochloa alopecuroides* with abundance 2–3 and *Crypis aculeata* with abundance 5. Other species with high constancy (III.) were recorded:*Polygonum aviculare* (abundance 1–3), *Chenopodium urbicum* (1–2), *Mentha pulegium* (1) and *Pulicaria vulgaris* (1). Recorded subhalophytes (sensu Krist 1940) with constancy II and low cover were: *Myosurus minimus* (1–3), *Matricaria recutita* (1), *Lotus tenuis* (1), *Trifolium fragiferum* (1), ruderal species such as *Echinochloa crus-galli* (1), *Tripleurospermum inodorum* (1), *Xanthium strumarium* (1) and species of disturbed, periodically flooded habitats such as *Verbena supina* (1–2), *Bidens tripartita* (1), *Polygonum lapathifolium* (1), *Rorippa sylvestris* (1), and *R. austriaca* (1). Obligate halophytes *Plantago tenuiflora, Pholiurus pannonicus* and *Hordeum geniculatum* were present with low abundance (1) and constancy (I), and subhalophytes of salt steppes like *Festuca pseudovina* and *Bupleurum tenuissinum* were also found. Besides the above mentioned species (cf. Soó 1947), the stands of *Heleochloa alopecuroides* included many taxa indicating lower salt content in the soil or its absence, e.g. *Carex stenophylla, Poa angustifolia, Setaria viridis*, etc. Since species are considered as weeds, Soó (l. c.) distinguished a variant „ruderale" with co-dominant *Polygonum aviculare* (column 2). In this variant, halophytes were lacking except for *Hordeum geniculatum*. Finally, Soó (l. c.) mentioned a second variant (p. 17) where species-poor monodominant stands of *Heleochloa alopecuroides* developed in dry soils in lake bottoms of the Hortobágy region. *H. alopecuroides* was accompanied with a few other species like *Phragmites australis*, *Typha angustifolia*, *Juncus effusus* and *Chenopodium chenopodioides*. The author assessed those stands as facia *Heleochletum purum* within the *Crypsidetum aculetae* association, consociation *Heleochloa alopecuroides*.

In the next survey of Hungarian plant communities, Soó (1957) included *Heleochloa alopecuroides* vegetation as subassociation *heleochloetosum alopecuroidis* within association *Crypsidetum aculeate* of the alliance *Cypero-Spergularion salinae* Slavnić 1948. He classified the *H. alopecuroides* vegetation in the same way in his further works (Soó 1964, 1973). Finally, the separate *Heleochloëtum alopecuroidis* (Rapcs. 1927) Ubrizsy 1948 association (*Thero-Salicornietea* class, *Crypsidetalia aculeatae* order, *Cypero-Spergularion* alliance) was delimited in the sixth volume of Hungarian vegetation survey of (Soó 1980). Therefore, the name *Heleochloëtum alopecuroidis* has not been properly published, and there is no phytosociological material available regarding this association.

Revision of Heleochloa alopecuroides vegetation from Pannonian saline habitats based on recent data

During the survey of saline habitats in the Pannonian Basin between 2003 and 2013 we visited a number of sites of halophytic vegetation throughout Hungary (large areas surrounding of Kiskunság, Hortobágy and Körös-Maros national parks), Austria (Lake Neusiedl), South Moravia (Czech Republic), southern and eastern Slovakia, NE Croatia, North Serbia (Vojvodina) and NW Romania. During the survey, we did not confirm vegetation largely dominated by *Heleochloa alopecuroides* and we did not find even one such relevé in the published or unpublished works in the investigated area except data given by Soó (1947). In our opinion, however, those data can not be considered as association *Hleochloëtum alopecuroidis*. We have found this species rarely (3 phytosociological relevés) in other types of ceonologicaly ambivalent saline vegetation e.g. on country roads in Hungary (Kiskunság National Park, around the saline lake Kelemen-szék) or in Vojvodina in the drainage channel of saline pastures near the saline lake Okanj (Elemir). Based on the above cited units (class *Thero-Salicornietea*, alliance *Cypero-Spergularion salinae*) which refer to vegetation of dried bottoms of saline lakes in the sources of Soó (1957, 1964,

1973, 1980) we reviewed our data obtained from the salt lakes of the Pannonian Basin. We have visited saline lakes around the Neusiedl See (NE Austria), in Vojvodina (N Serbia) and especially in Hungary. Overall we examined the natural vegetation of more than 20 saline lakes, but we have not observed anywhere even the presence of *Heleochloa alopecuroides*. Based on these data, we claim that *Heleochloëtum alopecuroidis* association does not exist within the halophytic communities of the Pannonian Basin.

Discussion

Soó (1980) used two sources for creating the scientific name of the *Heleochloëtum alopecuroidis* association: Rapaics (1927) and Ubrizsy (1947). Although Rapaics (1927) created the name of the association ("*Heleochoa alopecuroides* asz."), he did not support it with a phytosociological relevé. Ubrizsy (1947, 1948a, b, c) did not publish any work devoted to the *Heleochloa alopecuroides* vegetation and he did not refer to the publication of Rapaics (1927).The currently used name *Heleochloëtum alopecuroidis* Rapaics ex Ubrizsy 1948 was created step by step by Soó in his vegetation surveys (Soó 1933, 1947, 1957, 1964, 1973, 1980) without any published relevé. The single published synoptic table (Soó 1947) would be sufficient for valid description of the association, but it was associated with another syntaxonomical rank (consociation). As a conclusion, the *Heleochloëtum alopecuroidis* Rapaics 1927 is *nomen nudum* (Art. 2b, Weber et al. 2000), while the *Heleochloëtum alopecuroidis* Rapaics ex Ubrizsy 1948 is a phantom name (see Mucina 1993b). The later name *Echinochloo-Heleochloetum alopecuroidis* Bodrogközy 1982 is *nomen nudum* as well. No other name is available for this type of vegetation.

Soó (1947) characterized stands of *Heleochloa alopecuroides* named "*Crypsidetum aculeatae* cons. *Heleochloa alopecuroides*" in considerable detail, giving a constancy phytosociological table (Table 8). The species composition was heterogeneous and relatively species-rich, similar to vegetation of degraded overgrazed nitrogen-enriched saline soils of the *Puccinellion* alliance and can be considered as a transition between saline and ruderal vegetation. With a higher presence of *Crypsis aculeata*, it could be regarded as a degraded stand of the *Crypsietum aculeatae* association. However, taking into account the ecological requirements of the species in the table, the existence of this type of vegetation is unlikely. If *Crypsis aculeata* (column 2 in the table of Soó 1947) is removed, the stands are more related to the communities of the *Bidentetea tripartitae* class. This is also particularly apparent from variant named "asz. *Crypsidetum aculetae*, cs. *Heleochloa alopecuroides*, f. *Heleochletum purum*", where species-poor monodominat stands of *Heleochloa alopecuroides* were accompanied by wetland species such as *Phragmites australis*, *Typha angustifolia*, *Juncus effusus* and *Chenopodium chenopodioides*. Those species are not considered as typical (obligate) halophytes (except the latter mentioned species). However, *Ch. chenopodioides* can also grow on non-saline soils, if there is enough nitrogen (Eliáš et al. 2009; Dítě & Eliáš pers. observation) and high nitrogen content is typical of the stands of *Bidentetea tripartitae* class (Jarolímek et al. 1997; Šumberová 2005).

Another publication which reported *Heleochloa alopecuroides* communities was by Timár (1952). He studied vegetation of small depressions which dried out in mid-summer, in saline hay meadows and pastures in the area of the Körös-Maros (SE Hungary). Here, dense stands of the *Crypsietum aculeae* association developed in the muddy humic-saline soils. The author also mentioned stands physiognomically similar to *Heleochloa alopecuroides* consociation within this community. Phytosociological relevés or characteristics of the stands are lacking. In another work, Timár (1957) examined vegetation conditions of lake Fehértó and he also discussed vegetation with *Heleochoa alopecuroides* in more detail. Here the author followed the lead of Soó (1947) and included those stands within the consociation *Heleochloa alopecuroides* Soó within the *Crypsidetum aculeate* association (the *Puccinellietalia* Soó order, the *Puccinellion distantis* Soó alliance). According to Timár's phytosociological table (pp. 382–383), *H. alopecuroides* (with abundance + to 1, in one case 2) formed a part of stands with a dominance of *Alisma lanceolatum* (abundance 3 – 4). Some other species were recorded with low coverage, e.g. *Schoenoplectus tabernaemontani, Eleocharis palustris*, *Mentha pulegium* etc. According to species composition, those stands are not halophytic vegetation of the *Cypero-Spergularion salinae* alliance. We consider this vegetation as a wetland community with hydrophytes and species of dry bottoms with less saline soils of the *Butomo-Alismetum lanceolati* association (*Oenanthion* alliance, *Phragmito-Magnocaricetea* class).

Bodrogközy (1958, 1962, 1965a, b, c, 1966, 1970, 1980, 1987) and Bodrogközy & Györffy (1970) published numerous papers on saline vegetation in Hungary and Vojvodina, but they mentioned *Heleochloa alopecurides* only in two relevés in a single work (Bodrogközy 1965a) as an accessorial species (abundance +) of the *Agrostio-Beckmannietum* association. We think that it is sufficient evidence that *Heleochloëtum alopecuroidis* association sensu Soó is not a plant community vanishing due to the negative land use changes, like other vegetation of periodical wet saline habitats (Dítě et al. 2014), but that actually the association did not exist at all.

On the contrary, the species is often found as a component of weed vegetation, e.g., Bodrogközy (1982) incorrectly described the *Echinochloo-Heleochloetum alopecuroidis* association developed in permanently flooded fields (the description of the community does not contain phytosociological relevé, art. 2b of the code). The author equated this community first with the *Heleochloëtum alopecuroidis* association (*Cyperio-Spergularion* alliance) in accordance with Soó's vegetation surveys (1964–1980), but he departed from Soó

in the chapter Results and described those stands as *Echinochloo-Heleochloetum alopecuroidis* subas. *heleochloetosum alopecuroides* within the *Bidention tripartitae* class. The publication of Bodrogközy (1982) is an example of how Soó's vegetation surveys influenced later phytosociological works in Hungary and to an extent in Romania. After 1980, many Hungarian authors mentioned the questionable association *Heleochloëtum alopecuroidis* within the *Cypero-Spergularion salinae* alliance, always without phytosociological relevés: Makra (1995); Fekete et al. (1997); Borhidi (2003); Molnár & Borhidi (2003); Bölöni et al. (2011); Borhidi et al. (2012). In Romania, *Heleochloëtum alopecuroidis* is mentioned in a few works. Among them, Pop (2002) provides the most detailed characteristics similar to the work of Soó (1947) and includes it in the *Cypero-Spergularion* alliance. In the constancy phytosociological tables (pp. 298–299), *Heleochloa alopecuroides* reached abundance 2–5 (constancy V.) and other dominant species were *Puccinellia distans* (abundance 1–2, constancy I., III.), *Mentha pulegium* (abundance + – 2, constancy I, III), *Pulicaria vulgaris* (abundance + – 2, constancy I.), *Cynodon dactylon* (abundance + – 1, constancy I., III), *Echinochloa crus-galli* (abundance +–1, constancy I. – IV.), and *Hordeum hystrix* (abundance + – 1, constancy I., V.). The author noted a significant number of weeds and ruderal species with low abundance and frequency (e.g., *Cichorium intybus, Polygonum aviculare*, *Setaria glauca*). He also pointed out species of the *Isoëto-Nanojuncetea* alliance (*Cyperus fuscus*), the *Bidention* alliance (*Bidens tripartita*) and some obligate halophytes as *Tripolium pannonicum* or *Plantago maritima*. Pop (l.c.) describes them as stands developed in micro-depressions of slightly saline soils. Therefore we believe that this type of vegetation is similar to that described by Bodrogközy (1982), which may be included within the class *Bidention tripartitae*. Nevertheless, neither can this attempt be considered as validation of the *Heleochloetum alopecuroidis*, because this paper was published after 1979 but did not contain any nomenclatorical type of the association.

In contrast, Sanda et al. (2008) refers to the *Heleochloetum alopecuroidis* association as an abundant vegetation unit of river inundations of Romania. However, they identified it with muddy and sandy river bank communities of small, annual hygrophytes from the *Isoëto-Nanojuncetea* alliance. This is evident from the fact that they used associations *Dichostylido-Heleochloetum alopecuroidis* (Timár 1950) Pietsch 1973 and *Lindernio-Crypsidetum alopecuroidis* Popescu 1996 as synonyms of the *Heleochloëtum alopecuroidis*.

In the northwestern border of Pannonia (Moravia), *H. alopecuroides* has been long considered extinct (Holub & Grulich 1999) and therefore vegetation with this species is not mentioned here (Moravec et al. 2005; Šumberová et al. 2007). Out of the Pannonian Basin, Tzonev et al. (2008, 2009) recently published the association *Heleochloëtum alopecuroidis* Rapaics et Ubrizsy 1948 (sic!) from Bulgaria. They classified it within the vegetation of bare bottoms in salt-affected soils of *Cypero-Spergularion salinae* alliance, the *Crypsietalia aculeatae* order. However, the authors unusually classified this vegetation within the *Isoëto-Nanojuncetea* class. In four published relevés, *H. alopecuroides* reached an abundace of 25–75%. This syntaxon is very similar to the *Crypsietum aculeate* association. The described communities were found near the villages of Rudnik (Burgas district) and Blatec (Sliven district). The pioneer vegetation occupied the drying bottoms of temporary pools, and their maximum development occurred soon after the water receded. Total cover varied between 50 and 90% and the phytocoenoses had poor species composition (5–7 species per relevé). Other species, often participating in the communities, were *Puccinellia convoluta*, *Echinochloa crus-galli* and *Cynodon dactylon* (Tzonev et al. 2008). Obligate halophytes were not present except for *Puccinellia convoluta*, which is not typical for the *Cypero-Spergularion salinae* alliance. This type of vegetation might be considered as *Heleochloëtum alopecuroidis* association though it is necessary to describe it legally with a supporting phytocenological relevé (see Weber et al. 2000) and then to transfer it to a more appropriate class and alliance than in the past in the territory of Pannonian Basin. According to species composition in the work of Tzonev et al. (2008), this type of vegetation is most similar to subhalophytic stands of degraded and ruderalised pastures, however, further study is needed to clarify the phytosociological aspects of *H. alopecuroides*. Even though Tzonev et al. (2009) were the first who published individual relevés of the association, that study still cannot be considered as a valid description or validation of the name because no nomenclatural type was assigned. We can conclude that the *Heleochloëtum alopecuroidis* association, as was suggested in the works of Rapaics (1927), Soó (1933–1980), Pop (2002) and Tzonev (2009) does not exist.

We can conclude that in the available literature we have not found phytosociological relevés with *Heleochloa alopecuroides,* which could be classified into the halophytic vegetation of the *Cypero-Spergularion* salinae alliance and the *Heleochloëtum alopecuroidis* association. Likewise, we have never sampled during our field research vegetation dominated by *H. alopecuroides*, although we collected more than 1,000 phytosociological relevés of halophytic vegetation including stands developed on bare bottoms of salt lakes across the Pannonian Basin. This leads us to conclude that *Heleochloëtum alopecuroidis* association does not exist in the Pannonian region and it should be removed from the vegetation surveys and from the habitat No. 1530 "Pannonic salt steppes and salt marshes" of the Natura 2000 system. *Heleochloa alopecuroides*-dominated stands can be found in communities only within the classes *Bidentetea* and *Isoëto-Nanojuncetea* in non-saline or slightly saline soils in temporarily developed vegetation of bare bottoms and inundated field depressions.

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