Online unter der Lizenz CC BY 4.0

Neilreichia **9**: 269–282 (2018)

Notes on the distribution of *Spergularia echinosperma* and the newly recognized species *S. kurkae* in Austria

Pavel Kúr,[1] Clemens Pachschwöll[2] & Milan Štech[3]

1 Department of Botany, National Museum, Cirkusová 1740, 193 00 Praha, Czech Republic; e-mail: kur.pavel@gmail.com
2 Department of Botany and Biodiversity Research, University of Vienna, Rennweg 14, 1030 Wien, Austria; e-mail: clemens.pachschwoell@univie.ac.at
3 Department of Botany, Faculty of Science, University of South Bohemia, Branišovská 31, 370 05 České Budějovice, Czech Republic; e-mail: stech@prf.jcu.cz

A b s t r a c t : *Spergularia echinosperma* represents a rare species of dwarf rush communities (vegetation class Isoëto-Nano-Juncetea) bound to exposed bottoms of fishponds, sediment accumulations along rivers, exposed banks of oxbows, lakes and water reservoirs. Despite considered an endemic of Central Europe, *S. echinosperma* has only been poorly studied biosystematically until recently. Latest studies, however, radically changed our view of the species' evolution and taxonomy. *Spergularia kurkae* – an allotetraploid hybrid between diploid *S. echinosperma* and tetraploid *S. rubra* described in 1989 – has been demonstrated to be a stabilized self-seeding species. It grows in similar habitats as *S. echinosperma* but mostly occurs as a complete orphan, i.e., in the absence of any of the parental species. In addition, a new subspecies within *S. echinosperma* – *S. echinosperma* subsp. *albensis* – has been described recently. Mapping the distributions of these only recently distinguished taxa has so far been limited to the Czech Republic and parts of Germany, and information on their occurrence in other Central European countries is still lacking. The main goal of this study was to map the distributions of *S. kurkae* and both subspecies of *S. echinosperma* in Austria, using data from revised herbarium material. *Spergularia kurkae* was identified from collections from seven localities on exposed margins of fishponds and a river reservoir in the Waldviertel region (Lower Austria). Most of these occurrences are recent, having been discovered and collected after the year 2000. In contrast, *S. echinosperma* subsp. *albensis* was only found in two historical localities on the banks of the March River, both of them dating back to the first half of the 20th century. The other subspecies, *S. echinosperma* subsp. *echinosperma*, was not found among the herbarium material revised. As more intense floristic research in suitable habitats could lead to the discovery of more localities of these rare taxa, we present an updated determination key, which should aid field determination of the Austrian representatives of the genus *Spergularia*.

K e y w o r d s : Flora of Austria, *Spergularia*, Caryophyllaceae, Waldviertel, fishponds, Morava, March, Niederösterreich

Z u s a m m e n f a s s u n g : **Notizen zur Verbreitung von *Spergularia echinosperma* und der neu unterschiedenen Art *S. kurkae* in Österreich**
Spergularia echinosperma ist eine seltene, einjährige Art der Zwergbinsenfluren (Klasse der Isoëto-Nano-Juncetea), die an exponierte Teichböden, Flussufersedimente sowie ausgetrocknete Altarme und Stauseen gebunden ist. Obwohl ein Endemit Mitteleuropas, war *S. echinosperma* biosystematisch bis vor kurzem nur schlecht untersucht. Neuere Studien haben die Sicht auf die Taxonomie und Evolution dieser Art radikal verändert. Für *S. kurkae* – eine allotetraploide Hybride, die zwischen der diploiden *S. echinosperma* und der tetraploiden *S. rubra* steht und 1989 beschrieben wurde – konnte kürzlich gezeigt werden, dass sie selbstständig Samen bildet und eine stabilisierte Art darstellt. Sie wächst in ähnlichen Habitaten wie *S. echinosperma*, meist aber in Abwesenheit der

DOI: https://doi.org/10.5281/zenodo.1196424 Original article

Online unter der Lizenz CC BY 4.0

Parentalsippen. Weiters wurde erst kürzlich eine neue Unterart von *S. echinosperma* – *S. echinosperma* subsp. *albensis* – beschrieben. Nachdem die Kartierung der Verbreitung dieser neu unterschiedenen Taxa bis jetzt auf Tschechien und Teile Deutschlands beschränkt war, fehlen Daten aus anderen Ländern Mitteleuropas. Das Ziel dieses Artikels ist es, die Verbreitung von *S. kurkae* und der beiden Unterarten von *S. echinosperma* in Österreich, basierend auf Revisionen von Herbarbelegen, darzulegen. *Spergularia kurkae* konnte an sieben Lokalitäten im Waldviertel (Niederösterreich), an freiliegenden Uferbereichen von Fischteichen und am Ufer eines Stausees, nachgewiesen werden. Die meisten Vorkommen sind rezent, d.h., sie wurden ab dem Jahr 2000 entdeckt und besammelt. Im Gegensatz dazu stehen zwei historische Funde von *S. echinosperma* subsp. *albensis* vom Ufer der March, die auf die erste Hälfte des 20. Jahrhunderts zurückgehen. Die andere Unterart, *S. echinosperma* subsp. *echinosperma*, konnte im revidierten Herbarmaterial nicht gefunden werden. Nachdem vermehrte floristische Aktivitäten in geeigneten Habitaten zur Entdeckung weiterer Lokalitäten dieser seltenen Taxa führen könnten, präsentieren wir einen aktualisierten Bestimmungsschlüssel der in Österreich vorkommenden Sippen der Gattung *Spergularia*, der die Bestimmung im Feld erleichtern soll.

Introduction

Spergularia (Caryophyllaceae) is a genus of predominantly halophytic herbs with a nearly cosmopolitan distribution, but its highest diversity is in South America and the Mediterranean region (Rossbach 1940, Friedrich 1979, Monnier & Ratter 1993). It is a taxonomically challenging genus, which is reflected by the fact that the estimated number of species ranges from 20 (Friedrich 1979, Dvořák 1990) to 60 (Bittrich 1993, Hartman & Rabeler 2005).

In Central Europe, five species have traditionally been recognized (Friedrich 1979). Four of them are reported from Austria (Fischer & al. 2008; nomenclature follows Danihelka & al. 2012):

Spergularia marina (syn. *S. salina*) and *S. media* (syn. *S. maritima*, *S. marginata*) are obligatory halophytes widespread along seacoasts of nearly all continents, but threatened to extinction in natural halophilic habitats in Austria and the Czech Republic (Fischer & al. 2008, Grulich 2012, Kaplan & al. 2016). Due to salt spreading, both species, but especially *S. marina*, are currently increasing in secondary habitats along roads (Hohla 2003, Hetzel 2006, Kaplan & al. 2016).

Spergularia rubra is a common species of disturbed habitats like roadsides, footpaths or field margins (Friedrich 1979, Hartman & Rabeler 2005). It can be also occasionally found on riverbanks and in alluvial pools, which are its presumed primary habitats (Kaplan & al. 2016).

Spergularia echinosperma has been regarded as the only European representative of the genus specialized to periodically flooded soils in freshwater habitats (Monnier & Ratter 1993). It is supposed to be a Central European endemic by some authors (Friedrich 1979, Dvořák 1990), although other reports outside this region exist (Monnier 1968, Jalas & Suominen 1983, Ratter 1990, Monnier & Ratter 1993, Hartman & Rabeler 2005, Chagneau 2013, Tison & al. 2014). The species has two main centres of distribution: Germany, where it grows in alluvial pools and riverbanks

Online unter der Lizenz CC BY 4.0

along the Elbe (Friedrich 1979, Jäger 2011, Bettinger & al. 2013), and the Czech Republic, where it grows exclusively in secondary habitats, especially drained fishponds (Friedrich 1979, Dvořák 1990, Kaplan & al. 2016). It is considered endangered (EN) in the Czech Republic (Grulich 2012), and it is also listed in the red lists of some federal states of Germany (Mecklenburg-Vorpommern: Voigtländer & Henker 2005; Schleswig-Holstein: Mierwald & Romahn 2006; Hamburg: Poppendieck & al. 2010; Sachsen: Schulz 2013). The reason is that it is confined to ephemeral dwarf rush communities that are threatened by river channelling and intensification of fishpond management (Popiela 2005, Šumberová & al. 2005, 2006, Šumberová 2011).

In Austria, *S. echinosperma* has so far only been known from three localities in the Waldviertel region. It was first reported in 1963 by Hans Metlesics (collector) and Friedrich Ehrendorfer (determination) from a drained bottom of Winkelauer Teich, a fishpond near Heidenreichstein (Janchen 1964, 1977). In 1982, it was observed by Max Haberhofer from an unspecified fishpond near Hoheneich (near Gmünd), unfortunately without collecting herbarium vouchers (H. Niklfeld, unpublished data from Floristic Mapping of Austria). This record, however, was not included in the Flora of Gmünd (Ricek 1984). In the last edition of the Austrian Red List of plants (Niklfeld & Schratt-Ehrendorfer 1999), it was treated as "vom Aussterben bedroht (G1)", which corresponds to "critically endangered (CR)". *Spergularia echinosperma* was later also reported from Schönauer Teich, a fishpond near Zwettl (Kriechbaum & Koch 2001, Koch & al. 2005, Bernhardt & al. 2008).

Spergularia echinosperma has long been considered a taxonomically critical species (Jage 1974, Dvořák 1990) due to its morphological similarity to *S. rubra*. Thus, the two species were frequently confused. The confusion was further enhanced by Dvořák (1989) who described an interspecific hybrid between the two species named *S. ×kurkae*. In his opinion, *S. ×kurkae* was an unstable primary hybrid occurring in sites with a common occurrence of the parental species forming hybrid swarms with them (Dvořák 1990). The author, however, never provided conclusive evidence on his claims. The only work where he published the results of his research was the Flora of the Czech Republic (Dvořák 1990), but his contribution was too sketchy and obviously incomplete. These were probably the main reasons why *S. ×kurkae* has not been listed in any other Central European floras or checklists (Fischer & al. 2008, Jäger 2011, Danihelka & al. 2012, Goliašová 2012) since then.

Recent biosystematic studies (Kúr & al. 2012, 2016, 2017), however, radically changed our view of the taxonomy of the *S. echinosperma*/*S. rubra* species group. *Spergularia ×kurkae* was shown to be an allotetraploid hybrid between the diploid *S. echinosperma* and the tetraploid *S. rubra*. Additionally, it was demonstrated that *S. ×kurkae* is a stabilized self-seeding species that is morphologically well delimited and reproductively isolated from the parents (therefore dropping the hybrid sign × from its name; Kúr & al. 2016). Detailed mapping of the species' distribution in the Czech Republic (Kaplan & al. 2016) revealed that it occupies similar habitats as *S. echinosperma*, i.e., drained bottoms of water reservoirs, especially fishponds (neither of the species occur in natural

Online unter der Lizenz CC BY 4.0

habitats in the Czech Republic). *Spergularia kurkae* is, however, more tolerant to habitat degradation (occurring in places where *S. echinosperma* does not grow, e.g., fish storage ponds) and is approximately twice as common as *S. echinosperma*.

Another major contribution to the taxonomy of this species group was the description of two subspecies within *S. echinosperma* differing significantly in their distribution and ecology (Kúr & al. 2017). The nominate subspecies, *S. echinosperma* subsp. *echinosperma*, occurs nearly exclusively in Bohemia where it prevails in the South Bohemian fishpond basins. It is restricted to drained bottoms of fishponds, and it is speculated that it might have its origin in natural lakes, which existed in South and South-West Bohemia and have frequently been transformed into fishponds. The other subspecies, *S. echinosperma* subsp. *albensis*, has its centre of distribution along the Elbe in Germany where it grows on exposed margins of alluvial pools and riverbanks, which are probably its primary habitats. Interestingly, this subspecies also occurs on drained fishpond bottoms in the eastern part of the Czech Republic where it might have been indigenous in alluvial habitats prior to their destruction in the 20th century (Kúr & al. 2017).

As the mapping of the distributions of *S. kurkae* and the two newly recognized subspecies of *S. echinosperma* has so far been limited to the Czech Republic and Germany, distribution data in other Central European countries is lacking. The aim of this article is to map distributions of these taxa in Austria.

Materials and methods

Material of the genus *Spergularia* from six main Austrian herbaria (GJO, GZU, LI, W, WHB, WU) and the personal herbaria of R. Hehenberger, M. Hofbauer and C. Pachschwöll, was revised using the updated diagnostic characters published by Kúr & al. (2012, 2017) and Kúr & Ducháček (2016). All specimens determined as *S. echinosperma* or *S. kurkae* were excerpted and their localities georeferenced. The species' distribution maps were constructed using the QGIS 2.18 software (http://www.qgis.org).

Results

In total, 17 specimens (excluding duplicates) belonging to *Spergularia echinosperma* or *S. kurkae* from nine distinct localities in Austria were found (Fig. 1). *Spergularia kurkae* was confirmed in seven localities in Waldviertel, two of them being identical with the published localities of *S. echinosperma* (the Winkelauer and Schönauer fishponds). With a single exception, these were dried out bottoms and margins of drained fishponds. One locality was the shore of a water reservoir (Stausee Ottenstein). Three of the records are historical, i.e., collected before the year 2000; the remaining four records represent recent localities from 2003 to 2017.

Online unter der Lizenz CC BY 4.0

Spergularia echinosperma subsp. *albensis* was found in two localities at the March River approx. 10 km away from each other. According to the herbarium labels, the plants grew on muddy riverbanks. Both records are historical, dating back to 1902 and 1934, respectively. No records of *Spergularia echinosperma* subsp. *echinosperma* from Austria were found among the specimens revised.

Revised specimens of *Spergularia echinosperma* subsp. *albensis* and *S. kurkae* from Austria

Geographic coordinates (in WGS84 format) and sea-levels were taken from the herbarium labels or, if not present on the label, inferred from an online map (www.mapy.cz) or the DVD "Austrian Map Fly 5.0" (Bundesamt für Eich- und Vermessungswesen, Wien) and are given in square brackets. Quadrant numbers were, if not present on the labels, retrieved with overlays in AMap Fly 5.0 and given according to the Central European Flora Mapping System (Niklfeld 1971). All localities are in Lower Austria (Niederösterreich) and ordered from north to south. Numbers of localities correspond to Fig. 1.

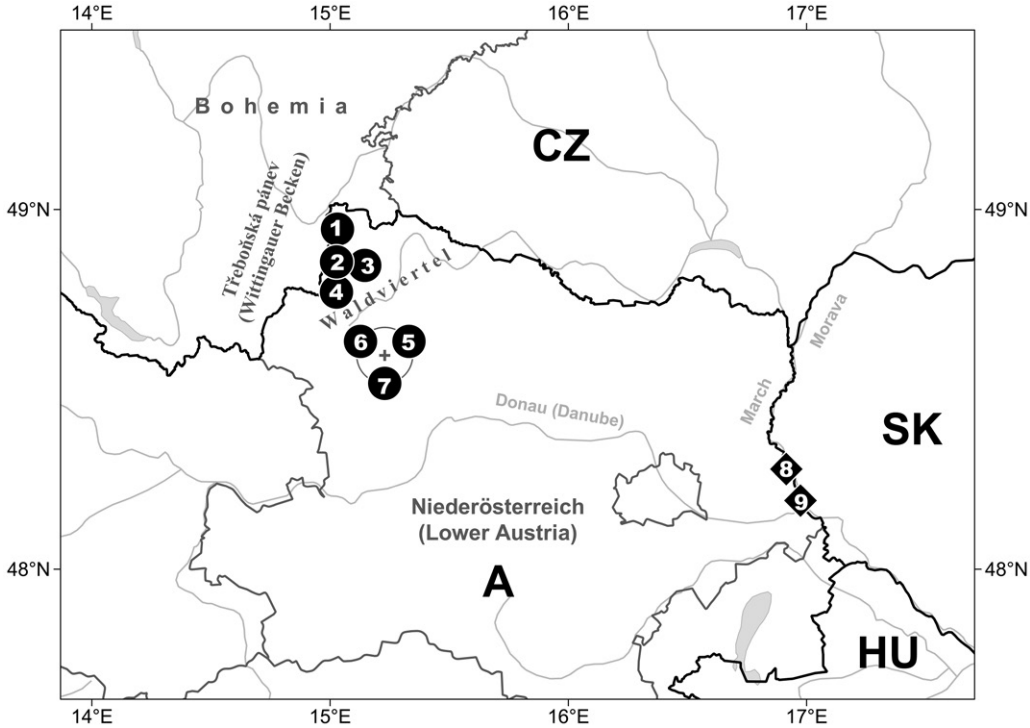

Fig. 1: Localities of *Spergularia kurkae* (circles) and *S. echinosperma* subsp. *albensis* (diamonds) in Austria. Distribution map generated by Pavel Kúr. — **Abb. 1:** Lokalitäten von *Spergularia kurkae* (Kreise) und *S. echinosperma* subsp. *albensis* (Rauten) in Österreich. Verbreitungskarte erstellt von Pavel Kúr.

Online unter der Lizenz CC BY 4.0

Spergularia kurkae in the northern Waldviertel (nördliches Waldviertel)

(1) Kufsteinteich: Im Schlamme des ausgetrockneten Kufsteinteiches bei Litschau im Waldviertel; [15°01′51″E 48°56′45″N, accuracy: 200 m]; [7056/3]; [574 msm]; leg. Johann Vetter, 15. 6. 1922 [as *Spergularia rubra*]; rev. P. Kúr, 2013 (W 1947-0016522, W 1952-0003310).

(2) Brandteich: S-Ufer des Brandteichs, ca. 1,5 km SO von Brand; 15°01′37″E 48°51′19″N; [7156/1]; 525 msm; sandiger Uferbereich; leg. M. Hofbauer & A. Berger, 23. 10. 2011 [as *Spergularia echinosperma*]; rev. P. Kúr, 2017 (WU 0095539).

(3) Winkelauer Teich: Winkelauer Teich südöstl. Heidenreichstein, Westufer; [15°08′26″E 48°50′43″N, accuracy: 100 m]; [7156/4]; 596 msm; Im feuchten Sand des Uferbereiches, mit *Sagina* cf. *apetala*, *Juncus tenageia*, *Alopecurus aequalis*, *Bidens radiatus*, *Gypsophila muralis*; leg. Hans Metlesics, 23. 8. 1963 [as *Spergularia echinosperma*]; rev. P. Kúr, 2013 (LI 228795); – Winkelauer Teich südöstl. Heidenreichstein; Ostufer; [15°08′49″E 48°50′42″N, accuracy: 100 m]; [7156/4]; 596 msm; Im feuchten Ufersand; mit *Juncus tenageia*, *Carex cyperoides* [= *Carex bohemica*], *Alopecurus aequalis*, *Veronica scutellata*, *Gypsophila muralis*, *Eleocharis ovata*, *Juncus bufonius*, *Bidens radiatus*, *Typhoides arundinacea* [= *Phalaris arundinacea*], *Peplis portula* [= *Lythrum portula*]; leg. Hans Metlesics, 23. 8. 1963 [as *Spergularia echinosperma*]; rev. P. Kúr, 2013 (LI 228783); – Auf dem flachen sandigen Ufer des Winkelauer Teiches bei Heidenreichstein; [15°08′43″E 48°50′44″N, accuracy: 200 m]; [7156/4]; 596 msm; leg. Helmut Melzer, 20. 10. 1963 [as *Spergularia echinosperma*]; rev. P. Kúr, 2013 (GZU 000060671).

(4) Unspecified pond near Hoheneich: Hoheneich; [15°01′36″E 48°46′18″N, accuracy: 2000 m]; [7256/1]; [c. 520 msm]; feuchte, sandige Teichufer; leg. [Eva] Schönbeck[-Temesy]; 23. 7. 1969, no. 4199 [as *Spergularia echinosperma*]; rev. P. Kúr, 2013 (WU-Schönbeck 0095562). According to the field biologist Axel Schmidt from Weitra (e-Mail to C. P.), this record can most likely be assigned to Höfentöckteich near Hoheneich, a pond (still) harbouring interesting vegetation of Isoëto-Nanojuncetea communities in dry years. Probably, this is the same locality as the floristic mapping record of M. Haberhofer from 1982.

Spergularia kurkae in the central Waldviertel (zentrales Waldviertel)

(5) Stausee Ottenstein: Stausee Ottenstein near Mitterreith, confluence of an unnamed rivulet into the Stausee/barrier lake (district: Zwettl); 15°15′15.6″E 48°36′56.5″N; 7357/4; 495 msm; Sandy lakeshore, c. 1 m above the water level; together with *Carex bohemica*, *Plantago major* subsp. *intermedia*, *Persicaria maculosa*, *Rorippa palustris* and others; on granodiorite; leg. R. Hehenberger, 4. 10. 2015, CP1052 [as *Spergularia echinosperma*]; rev. C. Pachschwöll, 2016; confirm. P. Kúr, 2016 (WU 0095543); – Stausee Ottenstein near Mitterreith, confluence of an unnamed rivulet into the Stausee/barrier lake (district: Zwettl); 15°15′15.5″E 48°36′56.5″N; 7357/4; 495 msm; Sandy lakeshore, c. 1 m above the water level; together with *Carex bohemica*, *Plantago major* subsp. *intermedia*, *Persicaria maculosa*, *Rorippa palustris* and others; on granodiorite; leg. C. Pachschwöll & R. Hehenberger, 5. 10. 2015, CP1053 [as *Spergularia*

Online unter der Lizenz CC BY 4.0

echinosperma]; rev. C. Pachschwöll, 2016; confirm. P. Kúr, 2016 (WU 0095542, photos in JACQ); – Stausee Ottenstein near Mitterreith, confluence of an unnamed rivulet into the Stausee/barrier lake (district: Zwettl); 15°15′15.6″E 48°36′56.5″N; 7357/4; 495 msm; Sandy lakeshore, c. 1 m above the water level; together with *Spergula arvensis*, *Carex bohemica*, *Persicaria maculosa*, *Rorippa palustris* and others; on granodiorite; leg. C. Pachschwöll, 12. 8. 2017, CP1072 [as *Spergularia kurkae*]; confirm. P. Kúr, 2017 (WU 0095540, PR 900402, 900403, 900404, W 2017-0011561).
(6) Rudmannser Teich: Western part of Rudmannser Teich near Zwettl (district: Zwettl); 15°12′37″E 48°35′22″N; 7457/1; 579 msm; Muddy, acidic lakeshore of a fishpond, together with *Isolepis setacea*, *Juncus articulatus*, *Potentilla norvegica*, *Gnaphalium uliginosum*, *Gypsophila muralis*, *Lythrum portula*, *Carex bohemica* and others; leg. Robert Hehenberger, 20. 7. 2012, CP1054 [as *Spergularia echinosperma*]; rev. C. Pachschwöll 2016; confirm. P. Kúr, 2016 (WU 0095541); – W-Ufer des Rudmannser Teichs bei Zwettl, Bez. Zwettl; 15°12′39.9″E 48°35′22.8″N; 7457/1; 579 msm; Schlammiges, bodensaures Teichufer; gemeinsam mit *Isolepis setacea*, *Juncus articulatus*, *Potentilla norvegica*, *Gnaphalium uliginosum*, *Gypsophila muralis, Lythrum portula* (= *Peplis portula*), *Carex bohemica* u.a.; leg. C. Pachschwöll & R. Hehenberger, 23. 8. 2012, CP475 [as *Spergularia echinosperma*]; rev. P. Kúr, 2016 (WU 0071017, photos in JACQ); – Western part of Rudmannser Teich near Zwettl (district Zwettl); 15°12′40.6″E 48°35′22.8″N; 7457/1; 579 msm; Muddy, acidic lakeshore of a fishpond; together with *Isolepis setacea, Juncus articulatus, Potentilla norvegica, Gnaphalium uliginosum, Gypsophila muralis, Lythrum portula, Carex bohemica* and others; leg. et det. C. Pachschwöll, 12. 8. 2017, CP1073; confirm. P. Kúr, 2017 (PR 900401).
(7) Schönauer Teich: 4 km SE Zwettl, Schönauer Teich, SE-Seite; [15°13′33″E 48°34′58″N, accuracy: 50 m]; [7457/1]; [580 msm]; Ufersaum; leg. Rainer Karl, 21. 6. 2003 [as *Spergularia echinosperma*]; rev. P. Kúr, 2013 (GZU-Karl 000241805); – Bei Zwettl nahe Rudmanns im Schönauer Teich; [15°13′33″E 48°34′58″N, accuracy: 50 m]; [7457/1]; [580 msm]; auf dem ziemlich abgetrockneten ufernahen Boden im dichten Bewuchs zerstreut; leg. Helmut Melzer, 21. 6. 2003 [as *Spergularia echinosperma*]; rev. P. Kúr, 2013 (LI 526897, GJO 26.910/5, GZU 000238883); – ESE von Zwettl, schlammiges Teichufer am Schönauer Teich SE von Rudmanns; [15°13′33″E 48°34′58″N, accuracy: 50 m]; [7457/1]; [580 msm]; leg. Thomas Barta, 21. 6. 2003 [as *Spergularia echinosperma*]; rev. P. Kúr, 2013 (W 2005-0009176).

<u>*Spergularia echinosperma* subsp. *albensis* in March valley (Marchtal)</u>
(8) Marchegg: Im Uferschlamm der March bei Marchegg; [16°54′52″E 48°16′50″N, accuracy: 1000 m]; [7767/1 or 7767/2]; [140 msm]; leg. Ernst Korb, 2. 10. 1902 [as *Spergularia salina*]; rev. W. Gutermann, 1977 to *S. echinosperma*; conf. P. Kúr, 2013 (W 1952-0003322).
(9) Markthof: Im Schlamm am Ufer der March unterhalb Markthof; [16°58′27″E 48°11′32″N, accuracy: 1000 m]; [7767/4 or 7867/2]; [137 msm]; leg. Ernst Korb, 17. 6. 1934 [as *Spergularia rubra*]; rev. P. Kúr, 2013 to *S. echinosperma* (W 1952-0003311).

Online unter der Lizenz CC BY 4.0

Discussion

In all the so far published localities of *Spergularia echinosperma* from Austria (Janchen 1964, 1977, Kriechbaum & Koch 2001, Koch & al. 2005, Bernhardt & al. 2008), only *S. kurkae* was found among the specimens revised. This species was discovered in five more localities. All recorded occurrences of *S. kurkae* are located in the Waldviertel region, and they are clearly related to the species' continuous distribution in the Třeboňská pánev Basin (Wittingauer Becken) in the Czech Republic (Kaplan & al. 2016). The currently known populations of *S. kurkae* in fishponds are small and consist of only a few individuals each, which are hard to find and should not be collected intensively. In contrast, the biggest population of *S. kurkae* can be found on the shores of a water reservoir at Stausee Ottenstein, in a secondary habitat with a maximum age of 60 years, which is sometimes used by bathers as it is in the vicinity of a public bathing spot ("Badeplatz Fürnkranzmühle"). Nevertheless, the criterion of being "critically endangered" ("vom Aussterben bedroht", G1) as applied for *S. echinosperma* by Niklfeld & Schratt-Ehrendorfer (1999) is suggested here as well for *S. kurkae*, unless more recent populations are found.

The absence of *S. echinosperma* subsp. *echinosperma* in Austria is surprising as this subspecies is relatively frequent in the Třeboňská pánev Basin (Wittingauer Becken) just beyond the border (Kaplan & al. 2016, Kúr & al. 2017). This could be caused by insufficient attention of local botanists to the flora of drained fishponds in the Waldviertel, as it has been the case with *Coleanthus subtilis*. This species was thought to be extinct until its rediscovery in 1979 and 2000, respectively (Kriechbaum & Koch 2001). Alternatively, the absence of *S. echinosperma* subsp. *echinosperma* might be real if there were not enough fishponds with a favourable type of management. In the Czech Republic, *S. echinosperma* is approximately half as common as *S. kurkae* (Kaplan & al. 2016). It is less adapted to the currently prevailing fishpond management as it germinates better than *S. kurkae* (i.e., it has lower tendency to remain in the seed bank) and has a slower development (Kúr 2010, Šumberová & Kúr 2013). This presents a handicap when fishponds are drained less frequently and for too short a period. *Spergularia echinosperma* subsp. *echinosperma* also prefers pond bottoms with lower trophic levels, which are currently rare because of common fish-farming practices like manuring and liming (Šumberová & al. 2005, 2006, Bauer 2014).

Due to cheaper fish prices (e.g., of carp) in neighbouring countries, extensive fish farming in Austria is often no longer economically feasible, and is mostly done by monasteries like Stift Zwettl, the owner of Rudmannser and Schönauer Teich. The intensification of aquaculture in the Waldviertel following the initiative "Aquakultur 2020" or the transformation of fishponds into swimming lakes could cause an even faster loss of habitats (Matzinger 2014). Although the ecologically more important fishponds like Rudmannser Teich, Schönauer Teich, Winkelauer Teich and Kufsteinteich are included in the Natura 2000 area "Waldviertler Teich-, Heide- und Moorlandschaft" (see www.geoland.at), Austrian wetland habitats of Isoëto-Nano-Juncetea (EU Habitats Directive, Annex I: 3130) are endangered (Essl 2005, 2008), and those suitable for the hitherto not

Online unter der Lizenz CC BY 4.0

confirmed *S. echinosperma* subsp. *echinosperma* are critically endangered. Therefore, applied nature conservation initiatives like LIFE projects are urgently needed to preserve such habitats as well as the traditional way of fish farming.

New for the historical flora of Austria is the occurrence of *S. echinosperma* subsp. *albensis* on the riverbanks of March. This also represents the first confirmed report of *S. echinosperma* from its natural habitats in the Danube catchment area. The two historical specimens of *Spergularia echinosperma* in W have already been revised by Walter Gutermann (University of Vienna) in 1977, but never published. Thereafter, *S. echinosperma* has never been mentioned for this area in the literature (Janchen 1977, Schratt-Ehrendorfer 1999a, Fischer & al. 2008), or recorded in the field, although the river banks of March have been studied more intensively since the 1990s (Traxler 1990, Schratt-Ehrendorfer 1999b, Scheiblhofer 2009). The herbarium vouchers of *S. echinosperma* subsp. *albensis* from the March valley are more than 80 years old, and it is unknown whether this taxon still occurs in this area. As it has not been recorded for more than 40 years, *S. echinosperma* subsp. *albensis* should currently be treated as "extinct" ("ausgerottet, ausgestorben oder verschollen", G0; Niklfeld & Schratt-Ehrendorfer 1999) in Austria. There are a few unpublished records of *S. echinosperma* subsp. *albensis* from the Slovak side of the March/Morava as well as from other Slovak rivers in the Danube system (P. Kúr, unpub.), but these herbarium vouchers are also quite old, dating back to the first half of the 20th century. In the extremely dry year 2015, a brief field survey of the alluvial habitats of the March in the vicinity of Devínska Nová Ves in Slovakia (opposite to Markthof) was conducted. The existence of habitats capable of harbouring *S. echinosperma* subsp. *albensis* (i.e., sandy river deposits) was confirmed; the taxon itself, however, was not found. Reasons for the lack of *S. echinosperma* subsp. *albensis* in the March valley in present times could be the change of habitats. The river banks are more muddy than sandy due to general erosion, are richer in nutrients, lime content, organic compounds and fine substrate due to more intensive agriculture (fostering taller plant communities of the vegetation class Bidentetea tripartitae) and are more influenced by competitive alien plant species like *Acer negundo*, *Impatiens glandulifera*, *Symphyotrichum lanceolatum* or *Xanthium* spp. (von Lampe 1996, Täubling & Neuhauser 1999, Zulka & Lazowski 1999, Neuhauser & Stelzhammer 2014, L. Schratt-Ehrendorfer, pers. comm.).

It is therefore necessary to conduct more detailed field surveys in the March alluvial habitats. The historical occurrences of *S. echinosperma* on the Austrian and Slovak side of the March/Morava River, however, underline the priority of this region in nature conservation (Ružičková & al. 2004, Strohmaier & Egger 2011).

Conclusions

The example of *Spergularia kurkae* and *S. echinosperma* subsp. *albensis* clearly demonstrates the potential for the discovery of recently described taxa in new regions. As both

Online unter der Lizenz CC BY 4.0

taxa can be classified as endangered worldwide, their effective protection in all parts of their distribution areas is needed. The presented article shows the distribution of these taxa in Austria where both are at the edge of their distribution ranges and their protection is important and challenging. Hopefully, we will endorse more botanical interest in wetland habitats, which can eventually lead to discoveries of new localities for *S. kurkae*, re-discovery of *S. echinosperma* subsp. *albensis*, and discovery of *S. echinosperma* subsp. *echinosperma* in Austria. In order to help all interested botanists with field determination of the representatives of the genus *Spergularia*, we attach an updated determination key that reflects the recent changes in the taxonomy of this genus in Appendix 1.

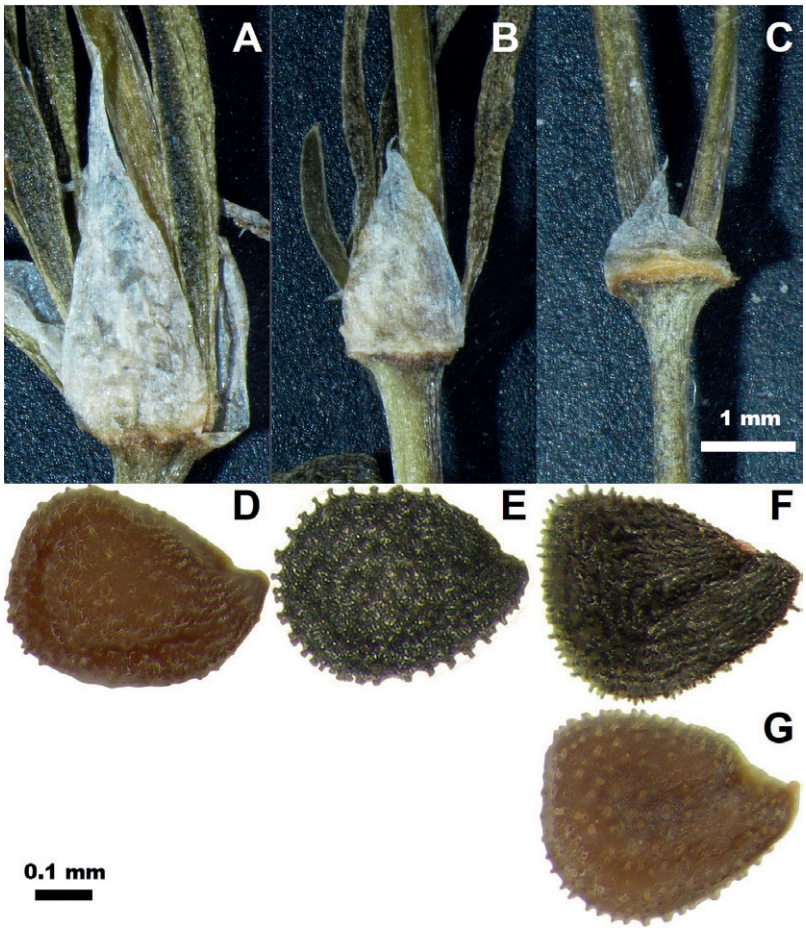

Fig. 2: Stipules (A–C) and seeds (D–G) of *Spergularia rubra* (A, D), *S. kurkae* (B, E), *S. echinosperma* subsp. *echinosperma* (C, F), and *S. echinosperma* subsp. *albensis* (C, G) based on Kúr & Ducháček (2016) and Kúr & al. (2017) (Photos: Pavel Kúr). — **Abb. 2:** Nebenblätter und Samen von *Spergularia rubra* (A, D), *S. kurkae* (B, E), *S. echinosperma* subsp. *echinosperma* (C, F), und *S. echinosperma* subsp. *albensis* (C, G) basierend auf Kúr & Ducháček (2016) und Kúr & al. (2017) (Fotos: Pavel Kúr).

Online unter der Lizenz CC BY 4.0

Appendix 1: Determination key for the genus *Spergularia* in Austria

1a Seeds light brown, their surface smooth or very sparsely verrucose, papillae at most 0.01 mm high, seeds winged or not; dark glands below the notches of calyx present; young stipules typically connate up to half of their length. – Leaves thick, ± succulent, bright green **2**

1b Seeds brown, dark brown or black, their surface sparsely to very densely verrucose, papillae at least 0.01 mm high, seeds always unwinged; dark glands under the notches of calyx typically absent; young stipules typically free or only shortly connate. – Leaves ± non-succulent, bright or dull green **3**

2a Petals up to 5 mm long, stamens 5–10; capsules 5–10 mm long, majority of capsules with mostly winged seeds ($2n = 18$) ***S. media***

2b Petals up to 3 mm long, stamens 1–5; capsules 3–6 mm long, majority of capsules without or with only a small portion of winged seeds ($2n = 36$) ***S. marina***

3a Stipules of middle and lower leaves at least 1.8× longer than wide (Fig. 2A); seeds brown to dark brown, testa sparsely verrucose, papillae conical, in the density of 5–9 papillae per quarter of seed circumference (Fig. 2D) ($2n = 4x = 36$) ***S. rubra***

3b Stipules of middle and lower leaves at most 1.7× longer than wide; seeds black or brown to dark brown, testa densely to very densely verrucose, papillae often with broadened tips, in the density of 8–17 per quarter of the seed circumference **4**

4a Stipules of middle and lower leaves 0.7–1.2× longer than wide (Fig. 2C); seeds black or brown to dark brown, 0.4–0.5 mm long, testa very densely verrucose, 12–17 papillae per quarter of seed circumference; capsules 2.5–3.5 mm long ($2n = 2x = 18$) ***S. echinosperma***

– Seeds black (Fig. 2F) ***S. e.* subsp. *echinosperma***

– Seeds brown to dark brown (Fig. 2G) ***S. e.* subsp. *albensis***

4b Stipules of middle and lower leaves 1–1.7× longer than wide (Fig. 2B); seeds black, 0.5–0.6 mm long, testa densely verrucose, 8–14 papillae per quarter of seed circumference (Fig. 2E); capsules 3–4.3 mm long ($2n = 4x = 36$) ***S. kurkae***

Acknowledgements

We are much obliged to Robert Hehenberger (Paudorf, A), who discovered the new locality of *S. kurkae* at Stausee Ottenstein, for sharing information about his discovery; to Markus Hofbauer (Vienna, A) for lending us his herbarium material from Brandteich for revision; to Harald Niklfeld (Vienna, A) for his help with Austrian floristic literature and for unpublished data from Floristic Mapping of Austria; and to Uwe Amarell (Offenburg, D) for his help with German literature sources. Gerald M. Schneeweiss (Vienna, A) and one anonymous reviewer are gratefully acknowledged for their constructive comments which improved the manuscript. This work was supported by the Ministry of Culture of the Czech Republic (DKRVO 2017/10, National Museum, 00023272) (P. Kúr).

Online unter der Lizenz CC BY 4.0

References

Bauer C. (2014): Waldviertler Teiche. – Denisia **33**: 157–166.

Bernhardt K.-G., Koch M., Kropf M., Ulbel E. & Webhofer J. (2007): Comparison of two methods characterising the seed bank of amphibious plants in submerged sediments. – Aquatic Bot. **88**: 171–177. https://doi.org/10.1016/j.aquabot.2007.10.004

Bettinger A., Buttler K. P., Caspari S., Klotz J., May R. & Metzing D. (Eds.) (2013): Verbreitungsatlas der Farn- und Blütenpflanzen Deutschlands. – Schiffweiler: Netzwerk Phytodiversität Deutschlands e. V.; Bonn: Bundesamt für Naturschutz. – Onlinemaps: https://karten.deutschlandflora.de/map.phtml

Bittrich V. (1993): Caryophyllaceae. – In Kubitzki K., Rohwer J. & Bittrich V. (Eds.): The families and genera of vascular plants **2**: 206–236. – Berlin: Springer.

Chagneau D. (2013): Confirmation de la presence de *Spergularia echinosperma* (Celak.) Asch. & Graebn. – E.R.I.C.A. **26**: 29–34.

Danihelka J., Chrtek J. Jr. & Kaplan Z. (2012): Checklist of vascular plants of the Czech Republic. – Preslia **84**: 647–811.

Dvořák F. (1989) Chromosome counts and chromosome morphology of some selected species. – Scripta Fac. Sci. Nat. J. E. Purkynianae Brun., Biol. **19**: 301–322.

Dvořák F. (1990): *Spergularia* – kuřinka. – In Hejný S. & Slavík B. (Eds.): Květena České republiky **2**: 81–86. – Praha: Academia.

Essl F. (2005): 3130 Oligo- bis mesotrophe stehende Gewässer mit Vegetation der Littorelletea iniflorae und/oder Isoëto-Nanojuncetea. – In Ellmauer T. (Hrsg.): Entwicklung von Kriterien, Indikatoren und Schwellenwerten zur Beurteilung des Erhaltungszustandes der Natura 2000-Schutzgüter **3**. Lebensraumtypen des Anhangs I der Fauna-Flora-Habitat-Richtlinie: pp. 50–58. – Wien: Umweltbundesamt.

Essl F. (2008): Rote Liste der gefährdeten Biotoptypen Österreichs. Binnengewässer, Gewässer- und Ufervegetation Technische Biotoptypen und Siedlungsbiotoptypen. Monographien Umweltbundesamt **134**. – Wien: Neuer Wissenschaftlicher Verlag.

Fischer M. A., Oswald K. & Adler W. (2008): Exkursionsflora für Österreich, Liechtensteinund Südtirol. 3. Aufl. – Linz: Biologiezentrum der Oberösterreichischen Landesmuseen.

Friedrich H. C. (1979): Familie Caryophyllaceae. – In Rechinger K. H. (Ed.): Gustav Hegi, Illustrierte Flora von Mitteleuropa **3/2**. Angiospermae, Dicotyledones 1. Phytolaccaceae, Amaranthaceae, Chenopodiaceae, Illecebraceae, Caryophyllaceae, Portulacaceae. 2nd ed.: pp. 763–1182. – Berlin & Hamburg: Paul Parey.

Goliašová K. (2012): *Spergularia* (Pers.) J. Presl et C. Presl. – Pakolenec. – In Goliašová K. & Michalková E. (Eds.): Flóra Slovenska **6/3**: 88–99. – Bratislava: Veda.

Grulich V. (2012): Red List of vascular plants of the Czech Republic: 3rd edition. – Preslia **84**: 631–645.

Hartman R. L. & Rabeler R. K. (2005): *Spergularia*. – In Flora of North America Editorial Committee (Eds.): Flora of North America north of Mexico **5/2**: 16–23. – New York & Oxford: Oxford University Press.

Hetzel G. (2006): Die Neophyten Oberfrankens. Floristik, Standortcharakteristik, Vergesellschaftung, Verbreitung, Dynamik. – PhD thesis, Universität Würzburg.

Hohla M. (2003): „Plants on the road“ – neue Pflanzen begleiten unsere Straßen. – ÖKO-L **25**: 11–18.

Jage H. (1974) Vorarbeiten zu einer Flora der Dübener Heide und ihrer näheren Umgebung. – Verh. Bot. Vereins Prov. Brandenburg **109–111**: 3–55.

Jäger E. J. (2011) Exkursionsflora von Deutschland. Gefäßpflanzen: Grundband. 20th ed. – Heidelberg: Spektrum Akademischer Verlag.

Jalas J. & Suominen J. (Eds.) (1983): Atlas Florae Europaeae. Distribution of Vascular Plants in Europe. **6**. Caryophyllaceae (Alsinoideae and Paronychioideae). – Helsinki: The Committee for Mapping the Flora of Europe & Societas Biologica Fennica Vanamo.

Janchen E. (1964): Catalogus florae Austriae **1**. Zweites Ergänzungsheft. – Wien: Springer.

Online unter der Lizenz CC BY 4.0

Janchen E. (1977): Flora von Wien, Niederösterrech und Nordburgenland. 2nd ed. – Wien: Verein für Landeskunde von Niederösterreich und Wien.

Kaplan Z., Danihelka J., Štěpánková J., Ekrt L., Chrtek J., Zázvorka J., Grulich V., Řepka R., Prančl J., Ducháček M., Kúr P., Šumberová K. & Brůna J. (2016): Distributions of vascular plants in the Czech Republic. Part 2. – Preslia **88**: 229–322.

Koch M., Bernhardt K.-G., Webhofer J. & Kriechbaum M. (2005): Alte Teichlandschaften im österreichischen Waldviertel: Vegetation und Diasporenpotential des Schönauer Teiches bei Zwettl. – Bot. Jahrb. Syst. **126**: 133–147. https://doi.org/10.1127/0006-8152/2005/0126-0133

Kriechbaum M. & Koch M. (2001): *Coleanthus subtilis* (Poaceae) wiederentdeckt. – Neilreichia **1**: 51–56.

Kúr P. (2010): A cytological, morphometric, and ecological study of *Spergularia echinosperma* in the Czech Republic and its comparison with a closely similar species *S. rubra*. – MSc thesis, University of South Bohemia.

Kúr P. & Ducháček M. (2016): Rod kuřinka (*Spergularia*) – výzva ke sledování [Genus *Spergularia* – an appeal for monitoring]. – Zpr. Moravskoslez. pob. ČBS **5**: 47–54.

Kúr P., Amarell U., Jage H. & Štech M. (2017): Taxonomy and evolutionary diversification of the Central European endemic *Spergularia echinosperma* (Caryophyllaceae). – Phytotaxa **305**: 149–164. https://doi.org/10.11646/phytotaxa.305.3.3

Kúr P., Košnar J., Koutecký P, Tremetsberger K. & Štech M. (2016): Origin of *Spergularia ×kurkae*, a hybrid between the rare endemic *S. echinosperma* and its widespread congener *S. rubra*. – Preslia **88**: 391–407.

Kúr P., Štech M., Koutecký P. & Trávníček P. (2012): Morphological and cytological variation in *Spergularia echinosperma* and *S. rubra*, and notes on potential hybridization of these two species. – Preslia **84**: 905–924.

Matzinger T. M. E. (2014): Teiche in der Landschaft. Bedeutung, Funktionen & Gefährdung. – Schriftenreihe des Bundesamts für Wasserwirtschaft **36**. – Gebharts: Bundesamt für Wasserwirtschaft.

Mierwald U. & Romahn K. (2006): Die Farn- und Blütenpflanzen Schleswig-Holsteins. Rote Liste **1**. – Flintbeck: Landesamt für Natur und Umwelt des Landes Schleswig-Holstein.

Monnier P. (1968): Synopsis du genre *Spergularia* (Pers.) Presl au Maroc. – Naturalia Monspel., Sér. Bot. **19**: 87–113.

Monnier P. & Ratter J. A. (1993): *Spergularia* (Pers.) J. & C. Presl. – In Tutin T. G., Burges N. A., Chater A.O., Edmondson J. R., Heywood V. H., Moore D. M., Valentine D. H., Walters S. M. & Webb D. A. (Eds.): Flora Europaea **1.** 2nd ed.: 186–188. – Cambridge (U.K.): University Press.

Niklfeld H. (1971): Bericht über die Kartierung der Flora Mitteleuropas. – Taxon **20**: 545–571. https://doi.org/10.2307/1218258

Niklfeld H. & Schratt-Ehrendorfer L. (1999): Rote Liste gefährdeter Farn- und Blütenpflanzen (Pteridophyta und Spermatophyta) Österreichs, 2. Fassung. – In Niklfeld H. (Ed.): Rote Listen gefährdeter Pflanzen Österreichs. Grüne Reihe Bundesministerium Umwelt, Jugend und Familie: pp. 33–151. – Graz: austria medien service.

Popiela A. (2005): Isoëto-Nanojuncetea species and plant communities in their eastern distribution range (Poland). – Phytocoenologia **35**: 283–304. https://doi.org/10.1127/0340-269X/2005/0035-0283

Poppendieck H.-H., Bertram H., Brandt I., Kreft K.-A., Kurz H., Onnasch A., Preisinger H., Ringenberg J., Prodzinski J. v., Wiedemann D. (2010): Rote Liste und Florenliste der Gefäßpflanzen von Hamburg. – Hamburg: Freie und Hansestadt Hamburg, Behörde für Stadtentwicklung und Umwelt, Abteilung Naturschutz.

Ratter J. A. (1990): *Spergularia* (Pers.) J. Presl & C. Presl [nom. cons.] – In Castroviejo S., Laínz M., López González G., Montserrat P., Muñoz Garmendia F., Paiva J & Villar L. (Eds.): Flora Iberica **2**: 149–161. – Madrid: Real Jardín Botánico.

Ricek E. W. (1984): Die Flora der Umgebung von Gmünd im niederösterreichischen Waldviertel. – Abh. Zool.-Bot. Ges. Österreich **21**: 1–204.

Rossbach R. P. (1940): *Spergularia* in North and South America. – Rhodora **42**: 57–83, 105–143, 158–193, 203–213.

Online unter der Lizenz CC BY 4.0

Ružičková H., Banásová V. & Kalivoda H. (2004): Morava River alluvial meadows on the Slovak–Austrian border (Slovak part): plant community dynamics, floristic and butterfly diversity – threats and management. – J. Nat. Cons. **12**: 157–169. https://doi.org/10.1016/j.jnc.2003.07.003

Scheiblhofer J. (2009): Vegetationsausstattung und Landschaftsstruktur kontinentaler Tieflandauen am Beispiel der unteren March. – Diplomarbeit, Univ. Wien.

Schratt-Ehrendorfer L. (1999a): Gefährdete Farn- und Blütenpflanzen des österreichischen March-Thaya-Tales. – In Kelemen J. & Oberleitner I. (Hrsg.): Fließende Grenzen. Lebensraum March-Thaya-Auen: pp. 353–361. – Wien: Umweltbundesamt.

Schratt-Ehrendorfer L. (1999b): Zur Flora und Vegetation des österreichischen March-Thaya-Tales. – In Kelemen J. & Oberleitner I. (Hrsg.): Fließende Grenzen. Lebensraum March-Thaya-Auen: pp. 181–202. – Wien: Umweltbundesamt.

Schulz D. (2013): Rote Liste und Artenliste Sachsens. Farn- und Samenpflanzen. – Dresden: Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie.

Stelzhammer M. & Neuhauser G. (2014): Renaturierung Untere March-Auen: Konzept Habitatverbesserung Weiche Au – Neophytenbekämpfung. – Wien: Umweltverband WWF Österreich. – http://www.zobodat.at/pdf/WWF-Studien_59_2014_0001-0027.pdf [aufgerufen am 15. Nov. 2017].

Strohmaier B. & Egger G. (2011): Die Bedeutung der March-Thaya-Auen für den Schutz der biologischen Vielfalt in Österreich und prioritäre Handlungsfelder für deren Sicherung. – Wiss. Mitt. Niederösterr. Landesmus. **22**: 279–300.

Šumberová K. (2011): Isoëto-Nano-Juncetea Br.-Bl. et Tüxen ex Br.-Bl. et al. 1952. – In Chytrý M. (Ed.): Vegetace České republiky. **3**. Vodní a mokřadní vegetace [Vegetation of the Czech Republic 3. Aquatic and wetland vegetation]: 309–312. – Praha: Academia.

Šumberová K. & Kúr P. (2013): *Spergularia echinosperma* agg. – okruh kuřinky ostnosemenné. – In Lepší P., Lepší M., Boublík K., Štech M. & Hans V. (Eds.): Červená kniha květeny jižní části Čech [Red data book of the flora of the southern part of Bohemia]: pp. 390–392. – České Budějovice: Jihočeské muzeum v Českých Budějovicích.

Šumberová K., Horáková V. & Lososová Z. (2005): Vegetation dynamics on exposed pond bottoms in the Českobudějovická basin (Czech Republic). – Phytocoenologia **35**: 421–448. https://doi.org/10.1127/0340-269X/2005/0035-0421

Šumberová K., Lososová Z., Fabšičová M. & Horáková V. (2006): Variability of vegetation of exposed pond bottoms in relation to management and environmental factors. – Preslia **78**: 235–252.

Täubling A. & Neuhauser G. (1999): Die Geschichte der Landschaft. – In Kelemen J. & Oberleitner I. (Hrsg.): Fließende Grenzen. Lebensraum March-Thaya-Auen: pp. 57–77. – Wien: Umweltbundesamt.

Tison J.-M., De Foucault B. & Hallé F. (2014): Flora Gallica: Flore de France. – Mèze: Biotope Editions.

Traxler A. (1990): Zwergbinsengesellschaften in Ostösterreich. – Diplomarbeit, Univ. Wien.

Voigtländer U. & Henker H. (2005): Rote Liste der gefährdeten Höheren Pflanzen Mecklenburg-Vorpommerns. – Schwerin: Umweltministerium Mecklenburg-Vorpommern.

Von Lampe M. (1996): Wuchsform, Wuchsrhythmus und Verbreitung der Arten der Zwergbinsengesellschaften. – Diss. Bot. **266**: 1–353.

Zulka H. P. & Lazowski W. (1999): Hydrologie. – In Kelemen J. & Oberleitner I. (Hrsg.): Fließende Grenzen. Lebensraum March-Thaya-Auen: pp. 24–50. – Wien: Umweltbundesamt.

Received 19 November 2017
Revision received 28 December 2017
Accepted 2 January 2018

ZOBODAT - www.zobodat.at

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: Neilreichia - Zeitschrift für Pflanzensystematik und Floristik Österreichs

Jahr/Year: 2018

Band/Volume: 9

Autor(en)/Author(s): Kur Pavel, Pachschwöll Clemens, Štech Milan

Artikel/Article: Notes on the distribution of Spergularia echinosperma and the newly recognized species S. kurkae in Austria 269-282