

Scolochloa marchica Düvel, Ristow & H. Scholz – a German-Polish endemic species of the lowlands and the distribution of *S. festucacea* (Willd.) Lk. in Poland

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Abstract. In the current study, an extensive worldwide herbarium search, including over 1500 herbarium sheets of *Scolochloa festucacea* (Willd.) Lk., was performed to find specimens of *S. marchica* Düvel, Ristow & H. Scholz. The latter is a recently described new species, whose primary distribution was found to be limited to the Brandenburg region in Germany and the Wolin Island in Poland. As a result of the query, *S. marchica* was not identified in any regions other than those previously known. This indicates that it is a German-Polish endemic species, with a limited distribution range. Taking advantage of flow cytometry, we analysed for the first time the nuclear DNA content of both *Scolochloa* species and the obtained 2C values correlated exactly with their chromosome numbers. These data allowed us to put forward a hypothesis of evolution of *S. marchica* from *S. festucacea*. The new results, together with those previously published, confirmed that we deal with a distinct species. Taking into account recent records of this endemic species, it is currently known from 9 extant and 6 historical localities in Germany. Field search for the species in its only historical locality in Poland, on the Wolin Island, was unsuccessful. The critical revision of herbarium and literature records of *S. festucacea* from the territory of Poland allowed us to generate an updated distribution map of this declining species, which deserves special protection.

Key words: *Scolochloa festucacea*, *Scolochloa marchica*, endemic species, grasses, distribution, flow cytometry, Central Europe, Germany, Poland

1. Introduction

Scolochloa marchica Düvel, Ristow & H. Scholz, was described in 2001 as a new species of the formerly monotypic genus *Scolochloa* (Düvel *et al.* 2001), based on findings of atypical individuals of *S. festucacea* (Willd.) Lk. in 1998 at Großer Wentowsee located north of Berlin, Germany. The new taxon was originally identified in the field at 3 localities (Düvel *et al.* 2001), all in the federal state of Brandenburg, but since then, several new stands of this species have been found (Bettinger *et al.* 2013). Besides, the historical and isolated occurrence of *S. marchica* on the Wolin Island (Poland) is documented by a single herbarium sheet.

This recently described species grows in habitats similar to those of *S. festucacea*, i.e. on lake shores,

along sluggish rivers, in swamps, sloughs and marshes, rarely in ditches and on wet meadows (Fig. 1), frequently together with other littoral reeds, like *Phragmites australis*, *Glyceria maxima*, and *Phalaris arundinacea* (Fischer & Kummer 1994; Conert 1998; Düvel *et al.* 2001).

Scolochloa marchica differs clearly from the other species in both morphological and cytogenetic characters (Table 1, Fig. 2) (Düvel *et al.* 2001). The most evident differences concern spikelet morphology. In contrast to *S. festucacea*, the former has glumes of even length and longer than lemmas, which are covered densely with hairs (Table 1, Fig. 2) (Düvel *et al.* 2001).

So far, *S. marchica* has been found only at the western limit of the European range of *S. festucacea*. The question arises if the new species occurs also in other parts



Fig. 1. *Scolochloa marchica* among *Phragmites australis* in a natural habitat – Silbergraben, Potsdam (photo by L. Bergmühl, 18 Aug 2023)

of the very wide distribution range of *S. festucacea*. The herbarium specimens verified previously (Düvel *et al.* 2001) suggested that *S. marchica* does not occur outside a very limited area in German and Polish lowlands. However, the number of verified specimens was low and did not cover the whole distribution range of *S. festucacea*. Therefore, we decided to revise herbarium specimens of *S. festucacea* from its whole distribution range, focusing especially on those from the Baltic region. Beside morphological characters, the most unequivocal

evidence discriminating species and hybrids is their chromosome number or nuclear DNA content. That is why we provide here the results of nuclear DNA content analysis of both species and the updated information on the general distribution range of *S. marchica*, as well as that of *S. festucacea* in Poland.

2. Material and methods

For microscopic observations and micrographs of *Scolochloa* spikelets, we used a Bresser Advance ICD 10x-160x microscope (Meade Instruments Europe GmbH & Co. KG, Germany).

Flow cytometry was applied for nuclear DNA content estimation. For the analysis, plants from the following locations were used: *S. festucacea* – Brandenburg, Potsdam, E shore of Lake Wublitz, 0.4 km S of Nattwerder, 31 Aug 2023, leg. L. Bergmühl; and *S. marchica* – Brandenburg, Potsdam Nuthetal, Silbergraben, S of Nuthedamm, 31 Aug 2023, leg. M. Ristow. Samples were prepared and analysed as previously described (Kalinowski *et al.* 2016). *Secale cereale* cv. Dankowskie (2C=16.19 pg; Doležel *et al.* 1998) and *Pisum sativum* cv. Set (2C=9.11 pg; Sliwinska *et al.* 2005) were used as internal standards for *S. festucacea* and *S. marchica*, respectively. Four leaves of each species were individually analysed with a CyFlow Ploidy Analyser (Sysmex Partec GmbH, Görlitz, Germany) flow cytometer. For each sample, at least 5000 nuclei were used to determine nuclear DNA content. Histograms were analysed using CyView 1.6 software. Coefficient of variation (CV) of the G_0/G_1 peak of the *Scolochloa* samples ranged from 6.15% to 6.74%. Nuclear DNA content was calculated from the ratio of the target species and the internal standard 2C peak positions on the histogram of fluorescence intensities.

To investigate the potential distribution of *S. marchica* in Poland, field research was conducted in 2022 and 2023 in the region of the Wolin Island and at other historical localities of *S. festucacea*, shown in Fig. 3 (insert).

Table 1. Morphological and cytogenetic differences between *Scolochloa marchica* and *S. festucacea* (based on Düvel *et al.* 2001 and own observations)

Trait	<i>S. marchica</i>	<i>S. festucacea</i>
Glumes	± even	uneven, upper longer than lower glume
Lemmas	shorter than glumes outer side densely hairy	longer than lower glume outer side smooth or slightly scabrid
Florets	embedded between glumes	protruding from glumes
Callus hair length	relatively long, ca. 2 mm	relatively short, 1-1.5 mm
Leaves	leaf ribs (veins) flat upper surface slightly scabrid, spine-like hairs sparse	leaf ribs protruding upper surface very scabrid, spine-like hairs abundant
Ploidy	hexaploid, $2n = 42$	tetraploid, $2n = 28$

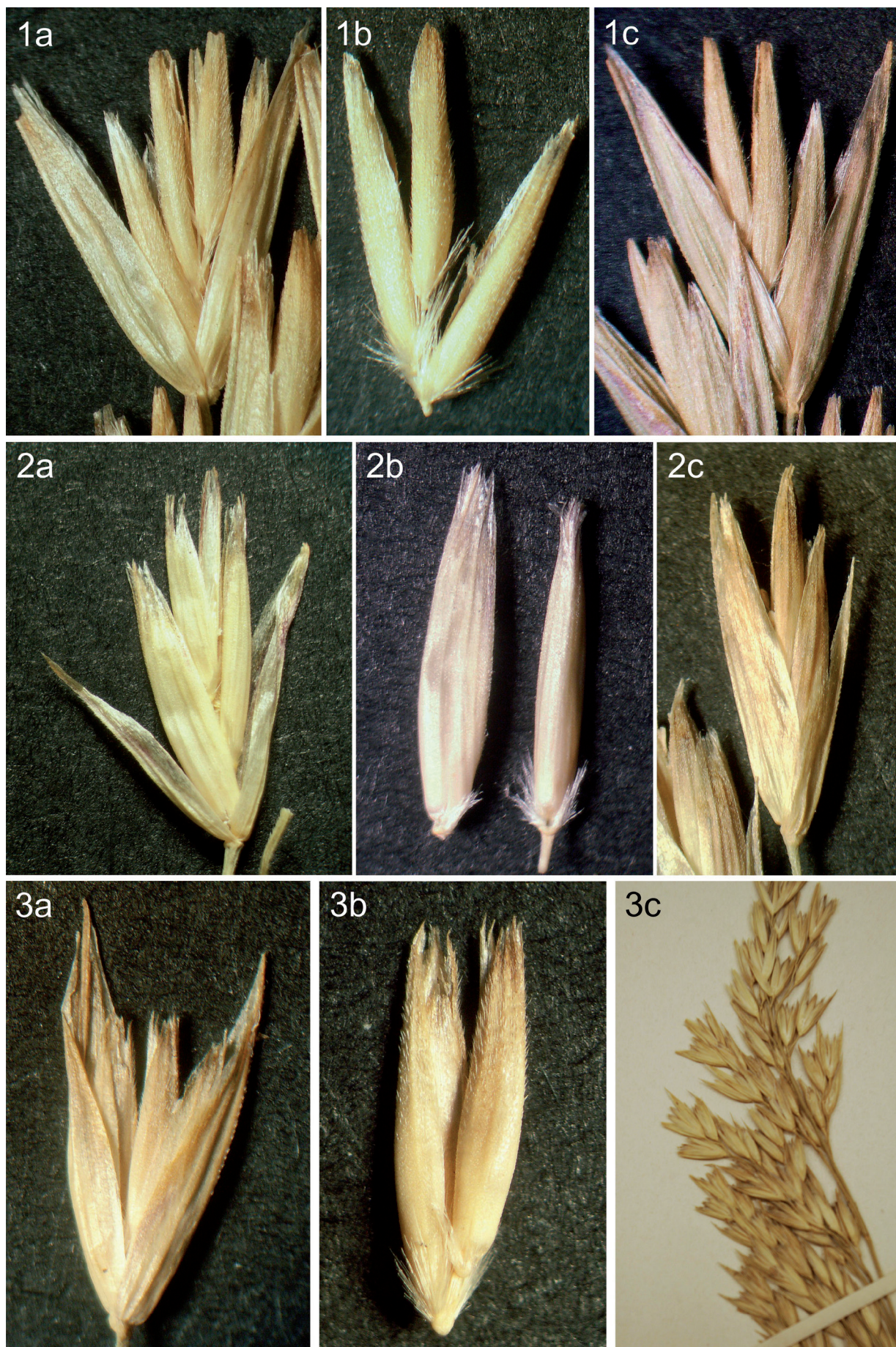


Fig. 2. Spikelet morphology of: (1a, 1b) *S. marchica* from Neuruppin (KRA224249), (1c) *S. marchica* from Neuruppin (KRA224254), (2a, 2b) *S. festucacea* from Lake Gopło (GMP herbarium), (2c) *S. festucacea* from Lake Jeziorak (KRA77110), (3a-c) *S. marchica*, Dorpat in Tiefland (?), com. von Uechtritz (WRS�) (photo 3c by E. Lenard, all the others by J. Kruk)

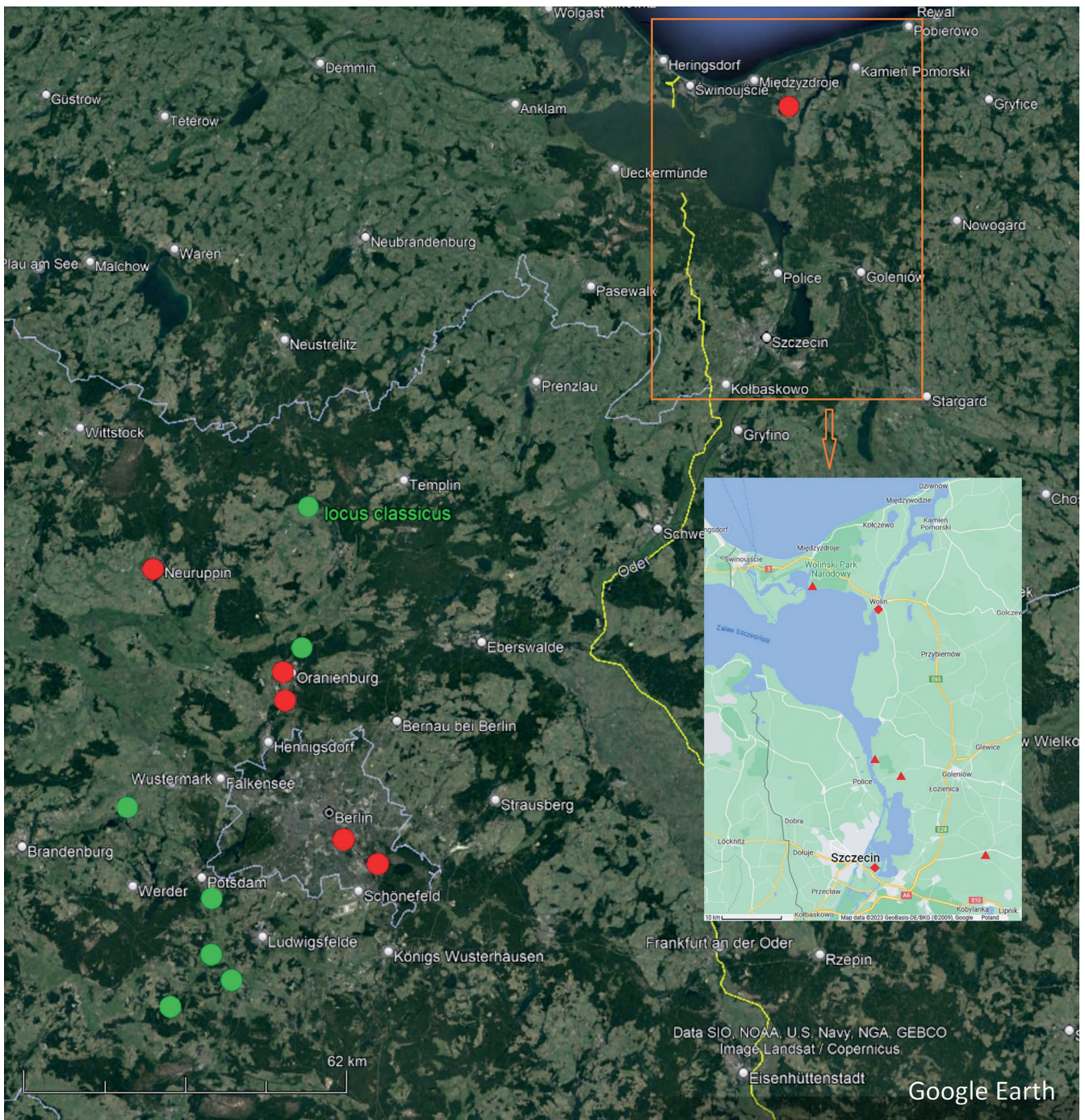


Fig. 3. General distribution map of *Scolochloa marchica*

Explanations: red dots – data before 1900, green dots – after 1980. Insert – distribution of *S. festucacea* in the Szczecin–Wolin region; diamonds – herbarium data, triangles – literature data (all before 1900)

Herbarium specimens of *S. festucacea* analysed in the search for *S. marchica* were from virtual herbaria (<https://www.gbif.org/species/5289768>, <https://virtherbard.senckenberg.de>, <https://www.jacq.org/#database>) or obtained from curators of other herbaria. In the case of virtual herbaria, only the number of specimens revised from a given herbarium is indicated. In the latter case, all the specimen data are provided in the Appendix 1. The following other herbaria were consulted for records of *S. festucacea* and *S. marchica*:

B, BILAS, FR, GFW, JE, KRA, KRAM, LATV, LBL, M, OLS, RIG, TRN, WA, and WRSL (abbreviations follow Thiers 2016).

For the preparation of an updated distribution map of *S. festucacea* in Poland, a number of unpublished herbarium data and literature data were provided. In the case of older herbarium and literature data, the original, German description on the herbarium labels and geographic names were given, as well as the appropriate translation. Maps from the Archive Maps of Poland and

Central Europe (<http://igrek.amzp.pl/>) were used for the identification of historical places. In some cases, if both herbarium and literature data referred to the same location and similar dates, the literature data were omitted. Among the references cited by Frey (2005), the following publications were omitted: Ascherson & Graebner (1898-1899), Pfuhl (1896) and Szulczewski (1951), as the localities given in those works are very general and covered by other publications cited in the current article.

The distribution map on the ATPOL grid (10 km × 10 km squares) (Zajac & Zajac 2001) was generated using Gnomon 3.3 software (Desmodus, Poland).

3. Results

3.1. DNA content analysis

The chromosome number of both species was earlier investigated by Düvel *et al.* (2001) (Table 1), but genome size was not analysed previously for any of these species. Flow cytometry measurements of nuclear DNA content (2C values) revealed that the value for *S. marchica* is nearly 1.5 times higher than that for *S. festucacea* (Table 2). This corresponds perfectly to the ratio of chromosome numbers (42/28) for both species, and indicates evidently that we deal with 2 distinct *Scolochloa* species.

Table 2. Nuclear DNA content (pg/2C) of the investigated *Scolochloa* taxa. The values are means ± SD ($n = 4$). The leaves analysed originated from 4 different plants of each taxon collected at the locations indicated in section 2 (Material and methods)

Taxon	DNA content (pg/2C)
<i>S. festucacea</i>	9.96 ± 0.13
<i>S. marchica</i>	14.88 ± 0.07

3.2. *Scolochloa marchica* – general distribution

Scolochloa marchica in Germany is currently known from 9 extant localities, i.e. Großer Wentowsee (N of Berlin), N of Oranienburg, Ketzin am Havel (W of Berlin – 2 populations), Potsdam (Drewitz and Schlaatz), and 3 populations south of Potsdam (Fig. 3 and subsection 3.3 – List of localities). Besides, the species is known from 5 historical sites represented by herbarium specimens, i.e. Neuruppin (NW of Berlin), Oranienburg and Pinnow (N of Berlin), and 2 in Berlin (Strahlau and Köpenick). The population at Neuruppin, nowadays extinct, was probably very abundant, as it is represented by

numerous herbarium sheets, as compared to those from other places. Taken together, *S. marchica* is restricted in central Brandenburg to the river systems of Nuthe, Havel, and Spree in the wider surroundings of Berlin, whereas in northern Brandenburg the known distribution is confined to 2 lakes.

In Poland, *S. marchica* is known from only one historical stand at Wolin, represented by one herbarium specimen (Fig. 4). It is not certain if “Wollin” (in German) refers to the town of Wolin or the Island of Wolin. The label has no date, but taking into account the living period of H. Seehaus (1813-1891) and that of J. Winkelmann (1842-1921), it can be inferred that the specimen is from the late 19th century. Two other herbarium specimens preserved from Wolin and Szczecin (Stettin), stored in GFW herbarium, were revised as *S. festucacea*. The plants from the other localities in this region (see Fig. 3, insert), mentioned in the literature, i.e. Lebbin [Lubin] (Conert 1998), Schwankenheim [Kielpinica], Fürstenflagge [Bolesławice], Ihnazoll [Inica near Sowno] (Schmidt 1840, 1848; Müller 1898) could not be verified because of the lack of the corresponding herbarium materials. Moreover, among localities of *S. festucacea*



Fig. 4. Herbarium specimen of *Scolochloa marchica* – Wollin, Herbarium Seehaus, com. Winkelmann (before 1900) (GFW17193) (photo by E. Seeber)

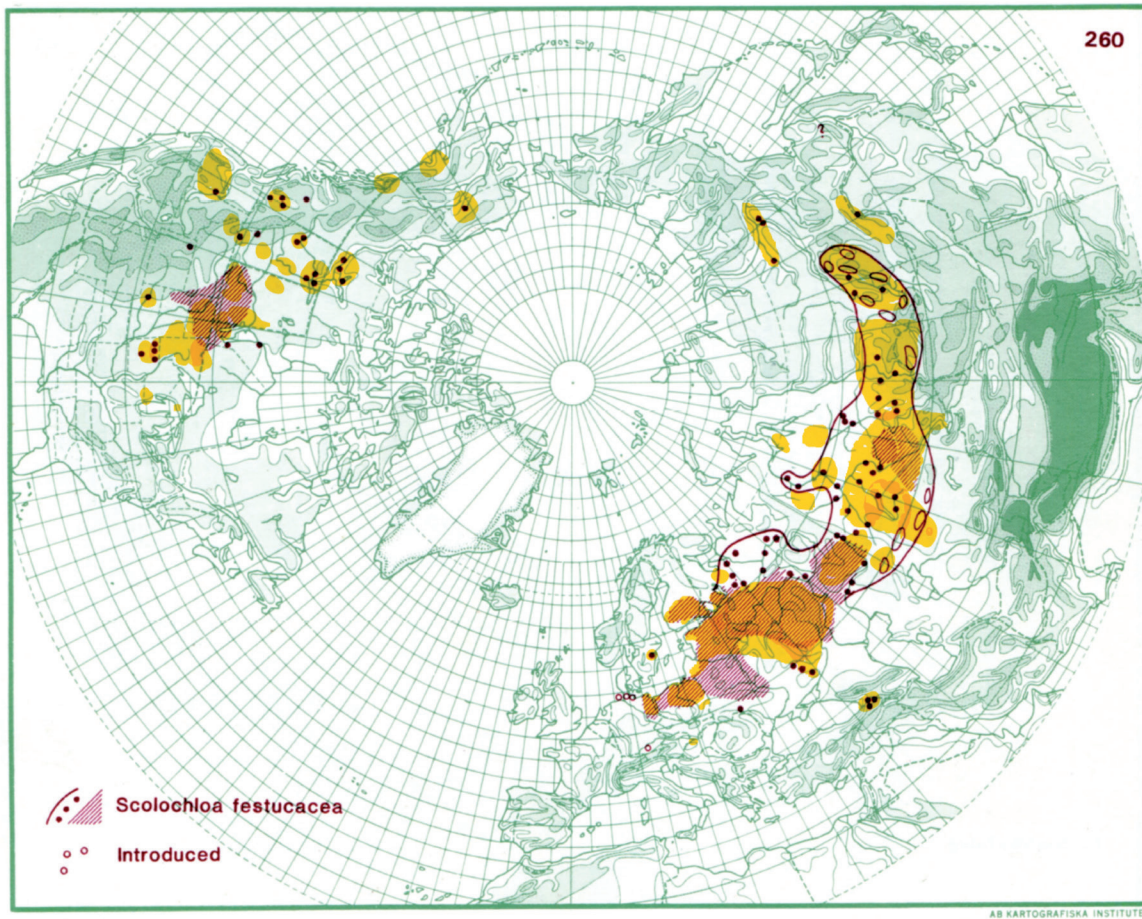


Fig. 5. General distribution map of *Scolochloa festucacea* according to Hultén & Fries (1986, reproduced with permission). Verified herbarium specimens originated from areas highlighted in yellow

given by Müller in the third edition of *Flora von Pommern* (Müller 1911), but not in the previous editions (Müller 1898, 1904), we found Wollin (Kreis Randow, Germany). In that region, there are two closely situated small villages with the name Wollin: one near Randowtal and the other near Penkun. The origin of Seehaus and Winkelmann's herbarium specimen from these villages can be rather excluded, as the area of botanical interest of both botanists was Szczecin and the Wolin Island region. On the other hand, Conert (1998) mentions Lebbin [Lubin] as an example of the localities of *S. festucacea* on the Island of Wolin, suggesting that there were more of them. Unfortunately, the original source data for this note are unknown.

In 2022 and 2023, extensive field search for *S. festucacea* at the historical sites (besides Szczecin) was performed, as well as at other, selected sites with appropriate habitats on the Wolin Island, i.e. lake shores, bogs, along rivers, and the southern island coast. However, the species was not found there.

Scolochloa festucacea shows circumboreal distribution in the Northern Hemisphere (Fig. 5). In Eurasia it occurs from Germany and Baltic countries in the west, to Yakutsk region in the Far East, and to the Caucasus

(Georgia) in the south. Two isolated stands of *S. festucacea* in Europe were found in the last few decades in Hungary (Király 2005) and Sweden, close to Uppsala (Johansson 1987). In North America it grows from Alaska to the Great Lakes region. Among the Baltic countries, *S. festucacea* is rare in Poland and particularly in Lithuania, where it is included in the Red Data Book (Rašomavičius 2021), but further north it is considerably more frequent, especially in Estonia and Finland. The latter countries are represented in various herbaria by a high number of collected *S. festucacea* plants, accounting for over 500 specimens that were available for the analysis (see Appendix 1). In this study, over 1500 herbarium specimens of *S. festucacea* were verified, from nearly the whole area of its distribution (Fig. 5), and among these specimens – only 6 were identified as *S. marchica*: from the Brandenburg region and one specimen of doubtful origin, labelled “Dorpat in Tiefland”, com. von Uechtritz (WRSL). That specimen shows most of the characters of the florets typical for *S. marchica* (Fig. 2). The lemma is covered with hairs only in the upper part, in contrast to the typical *S. marchica* where the hairs are found on the entire surface of the lemma. As none of the very numerous herbarium specimens

investigated from Tartu (Dorpat) region showed characters of *S. marchica*, the locality “Dorpat” could be false, as most probably that specimen originated from the Brandenburg region.

3.3. *Scolochloa marchica* – list of localities

Germany

Type: Germany, Brandenburg, Landkreis [district] Oberhavel, Halbinsel [peninsula] des Großen Wentow-Sees, 8 July 1999, leg. M. Düvel, M. Ristow & H. Scholz (B101277008, holo-; Hb. Ristow, B101277007, iso-); Landkreis Oberhavel, Halbinsel des Großen Wentow-Sees bei [near] Wentow, with *Phragmites australis*, Aug 28, 1998, leg. Düvel (B101264122 & B100449489);

Neuruppin, Seeufer [lake shore], June 1876, leg. Warnsdorf (JE); Mark Brandenburg: nördlich [north of] Ruppiner See, jenseitiges Seeufer [on another side of lake], July 1867, leg. Warnsdorf (B); Neu-Ruppiner See, See-Ufer, einzeln [individually], July 1878, leg. Granzow (B); Neuruppin, am Seeufer, July 1878, leg. J. Warnsdorf (KRA224249); Neuruppin: auf Wiesen [on meadows], July 1882, leg. Joh. Warnsdorf (H596270); Neu Ruppiner See, 688, leg. Warnsdorf (KRA224254);

Schloßgarten bei [near] Oranienburg, (s.d., before 1850), leg. A. Dietrich (Hb. Dietrich, University of Potsdam); In einem Seitenarm der Havel bei [In a branch of Havel River near] Pinnow (s.d., before 1900) (JE); Friedrichsthal, Niederung nördlich des Malzer Kanals [lowland north of Malzer Canal], 2022, leg. J. Halfmann & Y. Rothe (Hb. Ristow);

Brandenburg, Havelland, Tongrube N-Rand [clay pit at N edge of] Ketziner See, an der Einmündung der [at a junction of] Brandenburger Chaussee, 12 Aug 2001, leg. M. Ristow & B. Seitz (Hb. Ristow); Brandenburg, Havelland, Schmählwiese am S-Rand von [on S edge of] Ketziner See, 12 Aug 2001, leg. M. Ristow & B. Seitz (Hb. Ristow);

Potsdam-Drewitz, Nuthewiesen am Silbergraben, 19 June 1999, leg. Kummer (B); Potsdam-Schlaatz, Nuthewiesen zwischen Nuthe-Schnellstraße und [between Nuthe expressway and] Stadtteil Schlaatz, 8 July 1999, leg. Kummer (B); Potsdam, Ortsteil Drewitz SO [SE of] Potsdam, Nuthewiesen entlang [along] des Silbergrabens, 9 June 2002, leg. F.G. Dunkel (M0324231); Potsdam (Brandenburg): Potsdam-Drewitz, Nuthewiesen am Silbergraben, ca. 680 m SO der Brücke des [SE of bridge of] Nuthedamms über die Nuthe [over Nuthe River], an einer Brücke eines Wiesenwegs [at a bridge on a meadow path], 15 Aug 2013, leg. U. Amarell (BR00000032097979);

N-Ende [N end of] Grössinsee zwischen [between] Tremtsdorf und Mietgendorf, Röhricht am Feuchtwiesenrand, leichter Salzeinfluß [reedbeds on edges of a wet meadow, slight influence of salt], 8 July 2014,

leg. W. Petrick & M. Ristow (Hb. Ristow); 0.75 km N of Löwendorf (b. Trebbin), E-Seite des Bruchs [E side of bog], with *Phragmites*, 1993 obs. A. Herrmann (as *Scolochloa* sp.), 8 July 2014, leg. W. Petrick & M. Ristow (Hb. Ristow); Glienicke-See, 1 km WNW of Döbrikow, Seeröhricht, 10 Aug 2013, leg. M. Ristow & B. Groth (Hb. Ristow), location given by Hudziok (1974) for *S. festucacea*;

Strahlau, Berlin, 1843, leg. Anonymous (P03631289); Strahlau bei der Kirche [near church], July 1868, W. Vattke (scrispsit) (JE);

Köpenick, 1873, leg. Becker (JE); Berlin: Köpenick, Aug 1890, leg. Lehmann (L.1266382); Köpenick, Aug 1896, leg. Lehmann (B);

Allemagne Orientale: Brandenburg, July 1910(9), leg. Leonhard? (CLF148582).

Poland

Wollin, Herbarium Seehaus, com. Winkelmann (GFW17193).

Other countries – location questionable
Dorpat in Tiefland, com. von Uechtritz (WRS�).

3.4. *Scolochloa festucacea* in Poland

Scolochloa festucacea is declining and threatened in Poland (Frey 2010), so it was placed on the Red List and classified as VU (Kaźmierczakowa *et al.* 2016). In this study, a critical review of herbarium specimens and literature data on the species was performed and based on these data an updated distribution map in Poland was generated (Fig. 6). As compared to the previously published distribution map of *S. festucacea* (Frey 2005), several corrections and updates were included. Its localities in Poland are scattered mainly in the north of the country, reaching Warsaw, the Vistula River valley, and Lublin Highlands southwards (Fig. 6). Altogether, *S. festucacea* was reported from 22 localities represented by herbarium specimens and from about 40 localities described in the literature, the majority of which are historical data from the late 19th century and early 20th century. These records correspond to 32 ATPOL squares representing data from before 1941, 10 squares – from the period between 1941-1980, and 11 squares indicating data obtained after 1980 (Fig. 6). Among herbarium specimens listed previously by Frey (2005), two from OLS and one from LBL were currently not found in the corresponding herbaria, so these specimens were not available for the taxonomic revision. All the other herbarium specimens examined belonged to *S. festucacea*. The reports on the occurrence of *S. festucacea* in the south of Poland (Zajac & Zajac 2001) are incorrect (Frey 2005). The corresponding herbarium specimens, deposited in KRA, belong to *Festuca arundinacea*.

List of localities of *Scolochloa festucacea* in Poland

Herbarium specimens

- AB34** (ATPOL grid 10 km x 10 km) – auf der Plagge [island name] am 2 Strom [river] (?) bei Wollin, leg. A. Lehman (GFW060633); Wollin, 1868, leg. Lehmann (GFW060632);
- AB83** – Exemplar pomeranum [Pomeranian specimen], Stettin [Szczecin], June/July, leg. Anonymous (GFW060631);
- CC67** – An der Montwy unweit Ostrow [at Mątwy, not far from Ostrów], in Kreise Inowrazlaw [Inowrocław district], 4 July 1892, leg. Spribille (L.1266349); Montwy, 1889, leg. Spribille (POZ-V-0136083);
- CC98** – Przewóz, szuwar y n/Gopłem [rushes by Lake Gopło], 13 June 1994, leg. J. Chmiel (Hb. of Gopło Millenium Park, GMP);
- DA80** – Danzig, Alter Mottlauarm bei Walddorf [Gdańsk, an old arm of Motława River near Olszynka], June 1906, leg. H. Preuss (TRN-B.S.1388); Danziger Niederung, Alter Mottlauarm bei Walddorf, June 1906, leg. H. Preuss (TRN-B.S.1420); Danziger Niederung [Gdańsk Lowland], Walddorf, June 1906, leg. H. Preuss (TRN-B.S.1428); Kr. Danzig, Alter Mottlauarm bei Walddorf, June 1906, leg. H. Preuss (TRN s.n.); Danzig, 16 June 1912, leg. H. Steffen (L.1266386);
- DB76** – Iława, Lake Jeziorak, 10 July 1971, leg. E. Nowak (TRN s.n.); Iława, Lake Jeziorak, 24 July 1974, leg. M. Rajewski et W. Gugnacka; (KRA77110, KRAM216297, LBL029511, TRN s.n., WA133172, H596267, AMD.122834, L.1334035);
- DB81** – Graudenz [Grudziądz], an dem nördlichen Teil des Rudnicker Sees [at N shore of Lake Rudnickie], 30 Aug 1874, comm. Caspary (TRN-B.S.972); Graudenz, Am See von Rudnick [by Lake Rudnik], 2 July 1879, leg. Scharlock (TRN-B.S.1057); Graudenz, Am Ufer bei grossen Sees von Rudnick [shore by large Lake Rudnik], 30 July 1874, leg. R. Caspary (TRN s.n.); Graudenz: Gestade des Sees von Rudnick [shore of Lake Rudnik], 2 July 1879, leg. Scharlock (US04035021); Graudenz: Rudnick, 2 July 1879, leg. Scharlock (UGDA-OLS0012433);
- DC11** – Mlewo, on meadows by a canal, 15 July 1901, leg. K. Stempska (POZ-V-0136082);
- EB49** – Nikolaiken [Mikołajki], Sumpfiger Seerand, ca. 1-2 m vom Ufer [swampy edge of a lake, ca. 1-2 m from its shore], 6 July 1908, leg. Fibelkorn (U.1511751);
- EB67** – Ortelsburg [Szczytno], Marxowöner [Marxöwer] See [Lake Marksoby], 13 July 1890, leg. Abromeit (TRN s.n.);
- ED26** – między Wołą a Czystem pod Warszawą [between Wola and Czyste near Warsaw], (probably 19th century), leg. Anonymous (KRA223343);

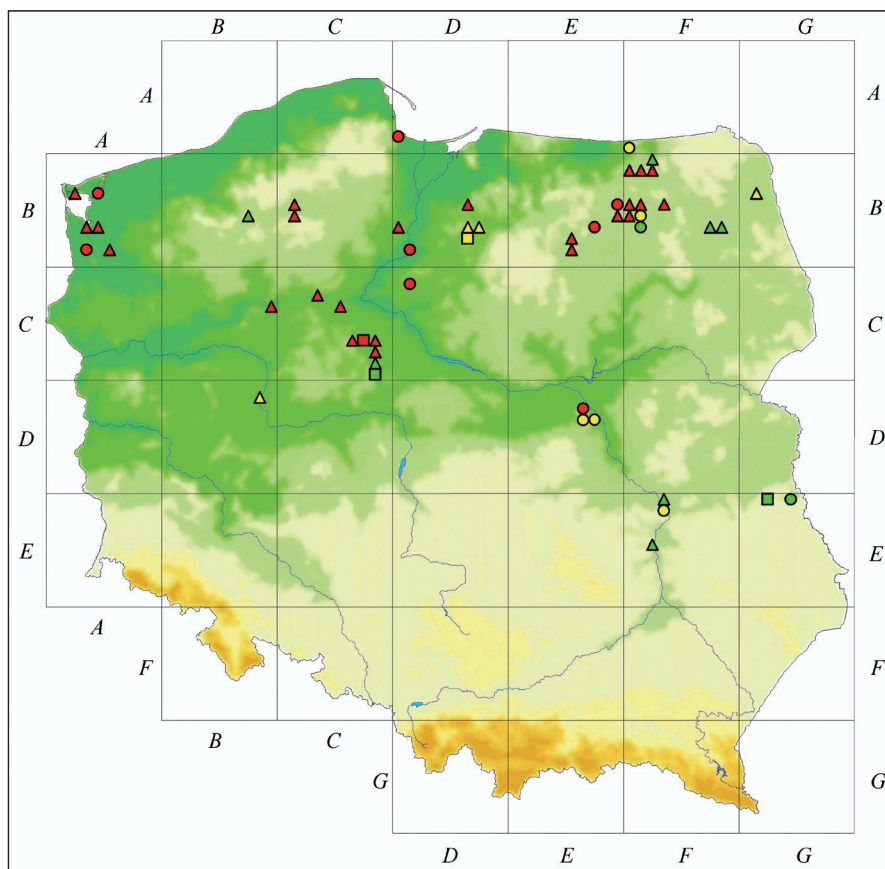


Fig. 6. Distribution map of *Scolochloa festucacea* in Poland on the ATPOL grid

Explanations: red symbols – records before 1941; yellow – between 1941 and 1980; green – after 1980; dots – only herbarium specimens; squares – both herbarium and literature data; triangles – literature and other data. If there are multiple records from the same square, the most recent is illustrated using an appropriate colour

- ED36** – Warszawa-Dawidy, nad jeziorem [by a lake], 27 July 1979, leg. B. Sudnik-Wójcikowska (WA133173) (the species at this location was still extant in 2013 but not in 2015, Kalinowski pers. com.); Warszawa-Paluch, wilgotna łąka nad rowem melioracyjnym [wet meadow over a drainage ditch], 29 Aug 1980, leg. B. Sudnik-Wójcikowska (WA133174);
- ED37** – Warszawa (Moczydło), skraj Lasu Kabackiego [edge of Kabaty Woods], 1 Aug 1979, leg. B. Sudnik-Wójcikowska (WA133175);
- FA90** – Węgorzewo, 15 July 1958, leg. L. Olesiński (OLS); specimen not found in the herbarium, so verification of *S. marchica/festucacea* not possible;
- FB51** – Kwik pow. [district] Pisz, na brzegach rzeczki Wyszki łączącej jezioro Śniardwy z jeziorem Białoławki [on banks of Wyszki River connecting lakes Śniardwy and Białoławki], 14 Aug 1952, leg. J. Mądalski (KRAM469907);
- FB61** – Lake Pogubie Wielkie near Pisz, 4 Aug 1982, leg. J. Dziedzic (OLS); specimen not found in the herbarium, so verification not possible; Ostpreußen [East Prussia], Vorderer Pogauer See [Lake Pogubie Wielkie], bei Johannisburg [Pisz], 10 July 1986, leg. H.-J. Schweitzer (FR s.n.);
- FE13** – Puławy, dolina Wisły [Vistula valley], 5 July 1969, leg. D. Fijałkowski (LBL029510);
- GE02** – Wojewodschaft [voivodship] Lublin, Jetizca-See [Lake Wytyckie/Wytyczno?], Röhricht am Seeufer [rushes by its shore], 8 Aug 1994, leg. C. Blümel, M. Succow, D. Fijałkowski (GFW42795);
- GE04** – Lake Wspólne, 1996, leg. M. Kucharczyk (LBL); specimen not found in the herbarium, so verification not possible;

Literature and other data

- AB32** – Lebbin [Lubin] (Conert 1998);
- AB63** – Schwankenheim [Kielpinica] (Schmidt 1840, 1848; Müller 1898);
- AB64** – Fürstenflagge [Bolesławice] (Schmidt 1840; Müller 1898);
- AB85** – Ihnazoll (Krug) [Inica near Sowno] (Schmidt 1840; Müller 1898);
- BB57** – Trzesieka (Rutkowski 1982);
- BC39** – Chodzież (Wodziczko *et al.* 1938);
- BD18** – Puszczykowo-Niwka (Urbański 1955);
- BD39** – Śrem (Wodziczko *et al.* 1938);
- CB41** – zw. Konzungsee u. Platzig [between Lake Końskie and Płaszczycza]; Brahefl. b. Prechlau [Brda River near Przechlewo] (Abromeit 1898-1940);
- CB51** – Konzungsee b. Ziethen [Lake Końskie near Szczytno]; NO-Ufer d. Kl. Ziethensees b. Ziethen [NE shore of Lake Szczytno Małe near Szczytno]; Ufer d. kl. Insel, die d. Ausfluß d. Brahe aus d. Gr. Ziethensees zunächst liegt [shore of a small island, close to outflow of Brda River from Lake Szczytno Wielkie] (Abromeit 1898-1940);
- CC23** – Josephowo [Józefkowo] (Bock 1908);
- CC35** – Netze-Wiesen [meadows by Noteć River] (Nutzhorst) (Bock 1908);
- CC66** – Trlong-See (Broniewitz) [Lake Pakowskie Południowe, Broniewice] (Bock 1908);
- CC67** – Montwy-Wiesen (Popowitz) [Mątwy meadows, Popowice] (Bock 1908)
- CC68** – Lojewo-See [Lake Łojewo = Lake Szarlej] (Bock 1908)
- CC78** – Goplosee (Kruschwitz) [Lake Gopło-Kruszwica] (Bock 1908);
- CC88** – Racice, Rusinowo, Kicko, Ostrowo, Popowo, Bachorza, Rzeszynek, Tarnówko (Lake Gopło) (Chmiel 1997);
- CC98** – Nowe Połajewo, Łuszczewo, Przewóz (Lake Gopło) (Chmiel 1997);
- DB46** – Ewingsee [Lake Ewingi] (Abromeit 1898-1940);
- DB60** – N-Ufer d. Radsees b. Głodowo [N shore of Lake Radodzież near Głodowo] (Abromeit 1898-1940);
- DB66, DB67, DB76** – Lake Jeziorak (Bohr, Rejewski 1973);
- DB67** – Widlungsee [Widłagi gulf of Lake Jeziorak] (Abromeit 1898-1940);
- DB81** – Wäldchen an Rondzen (Sanio 1882);
- EB59** – Mündung d. Schwarzen Flusses in d. Gartensee [mouth of Schwarze River, i.e. Lake Malinówko near Lake Gardyńskie] (Abromeit 1898-1940);
- EB75** – N Ufer d. Kl. Schobensees b. Materschobensee [N shore of Lake Sasek Mały near Lake Sasek Wielki] (Abromeit 1898-1940);
- EB85** – Ufer d Sawitzfl. zw. Kutzburgmühle u. Jankowen [left riverbank of Sawica between Papiernia and Jankowo] (Abromeit 1898-1940);
- FB02** – Lake Żabinki (Grzybowski, Endler 2002);
- FB10** – Mauersee b. Gutten [Lake Mamry near Guty] (Abromeit 1898-1940); Angerburger See bei Lötzen (Sanio 1882);
- FB11** – Woy sacksee [Lake Wojsak] (Abromeit 1898-1940);
- FB12** – Goldapgarsee [Lake Gołdopiwo] (Abromeit 1898-1940);
- FB40** – Zufluß in d. Spirdingsee aus dem Luknainer See an d. Brücke [tributary of Lake Śniardwy from Lake Łuknajno, near a bridge] (Abromeit 1898-1940); Spirdingsee b. Luknainen [Lake Śniardwy near Łuknajno] (Abromeit 1898-1940);
- FB41** – Tirklosee b. Eckersberg [Lake Tyrkło near Okartowo] (Abromeit 1898-1940);
- FB43** – Abflußgraben am Aryssee W. v. Werder [outflow of a drainage ditch at Lake Orzysz, W of Ostrów] (Abromeit 1898-1940);
- FB50** – Beldahnsee b. Nikolaiken [Lake Beldany near Mikołajki] (Abromeit 1898-1940);

- FB67** – Biebrza National Park, przy korycie rz. Ełk (Łek) między kan. Rudzkim a Jegrznią [near Ełk River between Rudzki Canal and Jerzgnia River] (Werpachowski 2000), original literature data from 1975 & 1994;
FB68 – Biebrza National Park, Kopytkówka River, Aug 2021, P. Kalinowski pers. com., species identification based on photos;
FE03 – Kolonia Opatkowice (Kucharczyk 2001);
FE42 – Pawłowice (Kucharczyk 2001);
GE02 – (Fijałkowski 1994);
GB31 – Lake Mikaszówek, Lake Krzywe, channel between lakes Krzywe and Kruglak (Kłosowski and Tomaszewicz 1979).

Incorrect data

- BB58** – WRSL, “Dyminek near Biały Bór”, leg. Lorinser (Frey 2005), origin of this specimen is Trittelwitz bei Demmin (Vorpommern, Germany);
FC97 – Drohiczyn (Ambrożewska 1961), this record is incorrect according to Kalinowski (pers. com.). This is also suggested by the lack of information on the species in her corresponding publication (Ambrożewska 1965);
FD50 – Wola Rębkowska (Głowacki & Zawada 1995). The herbarium specimens from this location (WSPR22372) and Ulan-Majorat (WSPR22373), determined as *S. festucea*, belong to a different species.

4. Discussion

During our extensive herbarium search, we analysed over 1500 specimens from the whole distribution range of *S. festucea*, but we found only 6 herbarium sheets of *S. marchica*, all originating from the region of Brandenburg. Therefore, it can be concluded that we deal with an endemic species limited to a relatively small area of the state of Brandenburg and the Wolin Island. The only herbarium sheet corresponding to *S. marchica* from outside this area, was most probably wrongly labelled (Turku, Estonia), as discussed previously. The name appearing on the label of this sheet is “von Uechtritz” (as com.) but neither Rudolph nor his father Max visited Estonia or Russia. According to the WRSL curator (Dr E. Lenard), among over 800 herbarium sheets with the name “von Uechtritz”, none is from Russia. Nevertheless, “com.” (*communicavit, comissum?*) suggests that the collection of the specimen was only ordered by von Uechtritz but it was gathered by an unknown collector. Therefore, this issue cannot be resolved at the moment.

The chromosome number of *S. marchica* ($2n = 42$, hexaploid) determined previously (Düvel *et al.* 2001) was different from the known numbers found for *S. festucea* ($2n = 28$, tetraploid) from different countries: Poland (Pogan *et al.* 1985), Sweden (Löve & Löve 1944), Canada (Löve 1981), and Russia (Takhtajan 1993). Moreover, the currently performed analysis of genome size of both species, revealed that the obtained values correlate perfectly with chromosome numbers, i.e. we do not observe any loss of DNA following polyploid formation (genome downsizing), which is found frequently in angiosperms (Leitch & Bennet 2004). These data shed light on the origin of *S. marchica*. First, it is hardly probable that *S. marchica* is a hybrid of *S. festucea* and an unidentified species of a different genus, with a chromosome number of $2n = 56$. Another scenario is that *S. marchica* was formed first by polyploidization of *S. festucea* to a taxon with $2n = 56$ (octoploid –

unknown or extinct), followed by hybridization of *S. festucea* with the octoploid to give chromosome number of $2n = 42$ in *S. marchica*. However, the most straightforward possibility is hybridization of the tetraploid *S. festucea*, introducing an unreduced gamete ($n = 28$), with the tetraploid carrying a normal gamete ($n = 14$). As genome downsizing was found to correlate with increasing age of polyploids (Leitch *et al.* 2008), the lack of such an effect in *S. marchica* may indicate that this species has evolved relatively recently. Generally polyploidization is considered often as one reason of being more resilient to extreme environments (cf. e.g. Van de Peer *et al.* 2021). Thus *S. marchica* could have evolved around one of the last glaciations. Further research on the chromosomal and genetic variability might provide insight into the evolutionary relationship and history of both *Scolochloa* taxa.

The presented genetic data and the pronounced morphological differences between *S. festucea* and *S. marchica*, together with a very limited distribution of the latter, suggest that *S. marchica* evidently deserves the rank of a separate species. Currently, however, it is treated as a synonym of *S. festucea* in the Kew World Checklist (<https://powo.science.kew.org>) for unknown reasons.

Scolochloa marchica is represented only by 14 herbarium sheets among ca. 150 representing *S. festucea* from the Berlin area and surrounding regions, collected in the late 19th and early 20th century (based on data in Appendix 1 and Düvel *et al.* 2001), indicating that *S. marchica* even in historical times was evidently less common than *S. festucea* in this area. Even though new localities of *S. marchica* have been found in recent years, nowadays it is also considerably less frequent than *S. festucea* in Germany and deserves special protection. In Poland, *S. marchica* is probably an extinct species, known from one historical location on the Wolin Island. Similarly, although *S. festucea* was known from several historical localities in the Szczecin-Wolin

region, it has not been recorded from this area for a long time. Nevertheless, it is puzzling why *S. festucacea* was not mentioned in the 2 monographs on the flora of the Wolin Island (Lucas 1860; Piotrowska 1966). Although none of the *Scolochloa* species were found in this region during current field studies, a rediscovery of at least *S. festucacea* in this area cannot be excluded.

As indicated in the distribution map (Fig. 6), *S. festucacea* is evidently a declining species in Poland, as the majority of the records come from the late 19th and early 20th century, and only 11 localities were confirmed after 1980. Unfortunately, the majority of localities from northern Poland, where the species was recorded relatively numerously, are historical. Currently, *S. festucacea* probably exists only in the regions where the most abundant stands were reported in the past, i.e. by lakes Gopło, Jeziorak, Masurian Lakes, and possibly also in the Augustów Forest. Besides, the recent record from the Biebrza National Park also suggests that the species might still exist there. Undoubtedly, it should be classified as EN (endangered) or even CR (critically endangered) both in the Polish Red Data Book of Plants and in the Polish Red List of Pteridophytes and Flowering Plants.

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Appendix 1. Herbarium specimens of *Scolochloa festucacea* verified for the presence of *S. marchica*. The numbers in brackets, following a country name, indicate the total number of herbarium sheets verified from each country. In older collections the species occurs under different synonyms, e.g. *Arundo festucacea* Willd., *Aira arundinacea* Lilj., *Donax borealis* Trin., *Festuca borealis* (Trin.) Mert. & K. or *Grapphephorum arundinaceum* Asch. For further details see section 2. Further specimens of *S. festucacea* are cited in Düvel *et al.* (2001)

Scolochloa marchica

KRA224249, Neuruppin am Seeufer, Juli 1878, leg. J. Warnstorf; KRA224254, Neu Ruppín, 688, leg. Warnstorf; CLF148582, Allemagne Orientale: Brandenburg, Juillet 1910(9), leg. Leonhard?; H596270, Neuruppin: auf Wiesen, Juli 1882, leg. Joh. Warnstorf; L.1266382, Köpenick, Aug. 1890, leg. Lehmann; P03631289, Strahlau, Berlin, 1843, leg. Anonymous; WRSL s.n., Dorpat in Tiefland, com. von Uechtritz (location questionable).

Scolochloa festucacea

Germany (148)

KRA224253, Berlin, s.d., leg. Anonymous; KRA486591, Böhne b. Rathenow: Havelufer, 6.1898, leg. R. Hülsen; KRA223342, Stralow bei Berlin, 4.7.1869, leg. Anonymous; KRAM236135, bei Trittelwitz nächst Demmin in Pomerania, 6.1860, leg. Müller; KRAM235242, Berlin, 25.6.1853, leg. J. Körnicke; WA135149, Brandenburg, Havel, 7.1967, leg. Buchwald; POZ-V-0136085, bei Pritzerbe, 6.1867, leg. Hülsen; WRSL s.n., Berlin Stralow, Juli 1878, leg. Philippi; WRSL s.n., Trittelwitz bei Demmin (Pommern), com. Lorinser; WRSL s.n., Brandenburg: am Seddiner See, 6.7.1928, leg. R. Frase; WRSL s.n., Böhne: Havelufer, Juni 1903, leg. R. Hülsen; B s.n., Binnenufer b. Greifswald, 12.9.1956, leg. E. Schenk; B s.n., In der Peene bei Trittelwitz bei Greifswald, 1860, leg. Zabel; B s.n., Brandenburg, Havelland, Beetzsee an der N-Spitze von Lünow, 30.6.2008, M. Ristow 814/08; B s.n., Havelwiesen bei Brandenburg, 2.7.2001, M. Düvel; B s.n., Seddinsee, 18.6.1951, leg. Denckmann; B s.n., Königs-Wusterhausen: Senzig, 14.6.1895, leg. W. Scheppig; B s.n., In fossis profundis circa Berolinum, 1817, leg. Bergemann; B s.n., Berlin-Grunewald: Havelufer bei Schildhorn, 3.9.1990, H. Scholz; B s.n., Berlin-Tegel: Tegeler See, 5.10.1961, leg. H. Scholz; B s.n., Berlin-Siemensstadt: Spandauer Schifffahrtskanal, 30.6.1962, leg. Sukopp; AMD - 8, B - 1, BR - 14, CLF - 2, DR - 5, FR - 3, GOET - 1, H - 6, L - 30, LUX - 1, LY - 16, LYJB - 1, MPU - 3, P - 20, PI - 2, U - 6, US - 7, VT - 1, VTA - 1

Poland (36)

KRA223343, między Wolą a Czystem pod Warszawą [between Wola and Czyste near Warsaw], leg. Anonymous; KRA77110, KRAM216297, LBL029511, TRN s.n., WA133172, H596267, AMD.122834, L.1334035, all specimens: Iława, Lake Jeziorak, 24.7.1974, leg. M. Rajewski et W. Gugnacka; KRAM469907, na brzegach rzeczki Wyszki łączącej jezioro Śniardwy z jeziorem Białoławki [on banks of Wyszki river connecting Śniardwy and Białoławki lakes], Kwik pow. [district] Pisz, 14.8.1952, leg. J. Mądalski; LBL029510, Puławy, dolina Wisły [Vistula Valley], 5.7.1969, leg. D. Fijałkowski; POZ-V-0136082, Mlewo, on meadows by the channel, 15.7.1901, leg. K. Stempska; TRN-B.S.972, Graudenz, an dem nördlichen Teil des Rudnicker Sees [Grudziądz, at the north shore of Rudnickie Lake], 30.8.1874, comm. Caspary; TRN-B.S.1057, Graudenz, Am See von Rudnick [by the lake of Rudnik], 2.7.1879, leg. Scharlock; TRN-B.S.1388, Danzig, Alter Mottlauarm bei Walddorf [Gdańsk, an old arm of Mołtawa River near Olszynka], Juni 1906, leg. H. Preuss; TRN-B.S.1420, Danziger Niederung, Alter Mottlauarm bei Walddorf, Juni 1906, leg. H. Preuss; TRN s.n., Marxowöner [Marxöwer] See, Ortelsburg [Marksoby Lake, Szczytno], 13.7.1890, leg. Abromeit; TRN-B.S.1428, Danziger Niederung, Walddorf, Juni 1906, leg. H. Preuss; TRN s.n., Kr. Danzig, Alter Mottlauarm bei Walddorf, Juni 1906, leg. H. Preuss; TRN s.n., Graudenz, Am Ufer bei grossen Sees von Rudnick [shore by the lake of Rudnik], 30.7.1874, leg. R. Caspary; TRN s.n., Iława, Lake Jeziorak, 10.7.1971, leg. E. Nowak; UGDA-OLS0012433, Graudenz: Rudnick, 2.7.1879, leg. Scharlock; WA133173, Warszawa-Dawidy, nad jeziorem [by the lake], 27.7.1979, leg. B. Sudnik-Wójcikowska; WA133174, Warszawa-Paluch, wilgotna łąka nad rowem melioracyjnym [wet meadow over drainage ditch], 29.8.1980, leg. B. Sudnik-Wójcikowska; WA133175, Warszawa - skraj Lasu Kabackiego [edge of Kabacki Forest], 1.8.1979, leg. B. Sudnik-Wójcikowska; GFW060633, auf der Plagge am 2 Strom (?) bei Wollin, leg. A. Lehman; GFW060632, Wollin, 1868, leg. Lehmann; GFW060631, Exemplar pomeranum, Stettin, June, July, leg. Anonymous; GFW42795, Wojewodschaft Lublin, Jetizca - See (Wytyckie, Wytyczno Lake?), Röhricht am Seeufer, 8.8.1994, leg. C. Blümel, M. Succow, D. Fijałkowski; FR s.n., Ostpreußen, Vorderer Pogauer See (Pogubie Wielkie Lake), bei Johannsburg [Pisz], 10.7.1986, leg. H.-J. Schweitzer; L.1266386, Danzig, Wallgraben, 16.06.1912, leg. H. Steffen; U.1511751, Sumpfiger Seerand, ca. 1-2 m vom Ufer, Nikolaiken, 6.7.1908, leg. Fibelkorn; L.1266349, An der Montwy unweit Ostrow, in Kreise Inowrazlaw, 4.7.1892, leg. Spribille;

US04035021, Graudenz: Gestade des Sees von Rudnick, 2.7.1879, leg. Scharlock;
Herbarium of the Gopło Millennium Park, s.n., szuwary n/Gopłem [rushes by the Gopło Lake], Przewóz, 13.6.1994, leg. J. Chmiel;
Kruglak Lake, Augustów Forest - literature data (Pogan *et al.* 1985). The plants were analyzed for chromosomes number ($2n = 28$);
Kopytkówka river, Biebrza National Park, Aug 2021, P. Kalinowski pers. com., the species was verified based on photos.

Lithuania (21)

BILAS: 91473, Ignalinos raj. (region), Alksnas ež. (lake), 14.07.2010, leg. Z. Sinkevičienė; 70733, Ignalinos raj., Rūžas ež., Vilnokai, 30.7.2003, leg. Z. Sinkevičienė; 70734, Ignalinos raj., Prūtas ež., Prūtelė, 19.7.2006, leg. Z. Sinkevičienė; 66353, Lazdijų raj., Rimietis ež., 5.7.2000, leg. Z. Sinkevičienė; 50327, Utenos raj., Tauragnas ež., 29.7.1993, leg. Z. Sinkevičienė; 23144, Varenos raj., Ūla, 26.6.1979, leg. B. Kiežienė; 57987, Ignalinos raj., Visaginas ež., 3.7.1996, leg. Z. Sinkevičienė; 57596, Zarasų raj., Drūkšiai ež., 31.7.1997, leg. Z. Sinkevičienė; 57597, Plungės raj., Burgalis ež., 23.8.1996, leg. Z. Sinkevičienė; 57598, Plungės raj., Paburgė, 15.7.1997, leg. Z. Sinkevičienė; 57601, Lazdijų raj., Rimietis ež., 26.06.1991, leg. V. Rasomavičius; 57602, Plungės raj., Burgis ež., 24.6.1996, leg. Z. Sinkevičienė; 57603, Plungės raj., Burgis ež., 24.6.1996, leg. Z. Sinkevičienė; 60252, Zarasų raj., Skirnas ež., 7.1997, leg. J. Balevičienė; Zarasų raj., Drūkšiai ež., Yliškė, 16.7.1982, leg. B. Kiežienė; 60254, Zarasų raj., Drūkšiai ež., Vysniava, 23.7.1982, leg. B. Kiežienė; 50363, Varenos raj., Rudnios, Ūla, 7.8.1983, leg. Z. Sinkevičienė; 60255, Zarasų raj., Drūkšiai ež., Vosyliškės, 5.7.1996, leg. J. Balevičienė; 60256, Zarasų raj., Drūkšiai ež., Tilžė, 23.7.1982, leg. L. Šidla; 60257, Zarasų raj., Smalvas ež., 18.07.1983, leg. A. Tučienė.

K – 1

Latvia (76)

LATV: 87022, Alūksnes raj., Alūksnes ez., 25.7.1986, leg. L. Tabaka; 81078, Cēsu raj., Jaunpiebalga, Gauja r. (river), 10.7.1985, leg. L. Tabaka; 71654, Cēsu raj., Jaunpiebalga, Gauja r., 22.7.1983, leg. B. Cepurite; 83066, Cēsu raj., Gauja r., N of Abrupe, 16.7.1985, leg. I. Fatare; 43894, Daugavpils raj., Mazais Kalupes ez., 16.7.1978, leg. Z. Eglīte; 474449, Daugavpils raj., Riču ez., 19.8.1979, leg. L. Tabaka; 42275, Daugavpils raj., Riču ez., 23.7.1978, leg. L. Tabaka; 115948, Daugavpils raj., Riču ez., 4.9.2007, leg. U. Suško; 115941, Daugavpils raj., Riču ez., 31.8.2007, leg. U. Suško; 115932, Daugavpils raj., Riču ez., 10.7.2007, leg. U. Suško; 471104, Daugavpils raj., Riču ez., 20.6.1979, leg. L. Tabaka; 116194, Daugavpils raj., Sila ez., S of Silene, 6.09.2008, leg. U. Suško; 110237, Daugavpils raj., Sila ez., 7.06.1990, leg. U. Suško; 102696, Dobeles raj., Bukaiši, 11.07.1990, leg. B. Cepurite; 81243, Gulbenes raj., Ludza ez., 12.6.1986, leg. H. Zarina; 112679, Gulbenes raj., Stāmerienas ez., 23.8.2001, leg. G. Gavriloza; 34304, Gulbenes raj., Lejasciems, Gauja r., 5.8.1976, leg. G. Klavina; 115590, Jēkabpils raj., Bancānu ez., 20.09.1997, leg. U. Suško; 66856, Jēkabpils raj., Klaucānu ez., 7.7.1982, leg. L. Tabaka; 64771, Jēkabpils raj., Priekulānu ez., 7.7.1982, leg. Z. Eglīte; 46798, Kraslavas raj., Ardavs ez., 9.8.1979, leg. Z. Eglīte; 109605, Kraslavas raj., Cārmaņa ez., 19.07.1996, leg. V. Baroniņa; 109600, Kraslavas raj., Dridžis ez., 18.07.1996, leg. V. Baroniņa; 93552, Kraslavas raj., Dridžis ez., 4.08.1988, leg. U. Suško; 51716, 51103, Kraslavas raj., Sakovas ez., 8.07.1979, leg. B. Talla; 51716, Kraslavas raj., Jazinkas ez., 8.8.1979, leg. Z. Šlangena; 109811, Kraslavas raj., Visolda ez., 16.07.1996, leg. I. Kabucis; 93629, Kraslavas raj., Visolda ez., 4.9.1988, leg. U. Suško; Limbažu raj., Lauvas, Svētupe r., 29.6.1969, leg. G. Klavina; 11767, Ludzaj raj., Dunākļa ez., 24.7.1960, leg. K. Birkmane; 33477, 33477, Ludzaj raj., Uzkojes ez., 16.6.1977, leg. Z. Eglīte; 50931, Ludzas raj., Zilupe, 7.7.1979, leg. B. Talla; 11766, Ludzas raj., Kurjanovas ez., 22.7.1960, leg. K. Birkmane; 50942, Ludzas raj., Ludzas ez., 8.7.1979, leg. B. Talla; 113056, Ludzas raj., Vecslabada, Dziļezers ez., 30.5.2002, leg. M. Laiviņš; 6795, Ludzas raj., Zvirgzdenes ez., 9.7.1970, leg. L. Tabaka; 67640, Ludzas raj., Cirmas ez., 10.07.1970, leg. K. Birkmane; 117623, Ludzas raj., Vecslabada, Istras ez., 16.06.2010, leg. U. Suško; 67243, Madonas raj., Krustkalnu rez. (reserve), Svētupe r., 7.8.1982, leg. L. Tabaka; 84827, Madonas raj., Lielais Līdēris ez., 15.6.1986, leg. G. Gavriloza; 86936, Madonas raj., Lielais Līdēris ez., 15.6.1986, leg. L. Tabaka; 79830, Madonas raj., Liezēris ez., 23.7.1985, leg. H. Zarina; 12049, Madonas raj., Lubanas ez., 12.7.1940, leg. Sabardina; Preiļu raj., Aglona, Ciriša ez., 12.8.1979, leg. G. Kļaviņa; 11764, Preiļu raj., Rušona ez., 21.7.1960, leg. K. Birkmane; 109808, Rēzeknes raj., Petrovka, Rušons ez., 16.7.1996, leg. I. Kabucis; 112363, Rēzeknes raj., Adamovas ez., 15.07.2001, leg. V. Baroniņa; 41443, Rēzeknes raj., Adamovas ez., 16.8.1977, leg. J. Jukna; 32480, Rēzeknes raj., Bižas ez., 16.8.1976, leg. I. Fatare; 116189, Rēzeknes raj., Kaunatas ez., 28.6.2008, leg. U. Suško; 46418, Rēzeknes raj., Pujātu ez., 8.6.1979, leg. Z. Eglīte; 109900, Rēzeknes raj., Rāznas ez., 17.7.1996, leg. I. Kabucis; 34338, Smiltene raj., Vidaga, Gauja r., 8.8.1976, leg. G. Kļaviņa; 18324, Smiltene raj., Vidaga, Gauja r., 9.7.1975, leg. B. Talla; 38794, Valmieras raj., Vecate, Salaca r., 16.8.1977, leg. G. Kļaviņa.

RIG: 2235, Latgale, Jasmuižas dzirnavu, 12.7.1923, leg. Edv. Jansons; 23047, Seeufer bei Rēzekne, 17.7.1887, Herb. E. Lehmann; 2058, Ādaži raj., Carnikava, Dūņezers-Lilastes ez., 6.7.1906; Rēzeknes apr. (apriņķis), Ješa (Ežezers) ez., 11.8.1936, leg. G. Vilerts; 260, Cēsu raj., Jaunpiebalga, Gauja r., 10.7.1985, leg. U. Suško; Madonas apr., Lielais Līdēris ez., 1.8.1940, leg. H. Stares; Rīgas raj., Garezers, 21.6.1977, leg. M. Lāce; 1010, Madonas raj., Sāviena, 30.6.1914, leg. N. Malta; 23043, Laudona, Svētupe r., 21.6.1974, leg. G. Abele, A. Piterans; 23042, Gulbenes raj., Sinole, Gauja r., 9.8.1968, leg. E. Wimba; 23041, Valmieras raj., Vecate, leg. E. Wimba; 23040, Valmieras raj., Vecate, Salaca r., 8.1968, leg. E. Wimba; 23039, Kraslavas raj., Sauleskalns, Dridžis ez., 23.7.1967; Madonas apr., Lubanas ez., 13.7.1938, leg. H. Ledus; 23049, Madonas apr., Lubeja raj., Lideres ez., 1.8.1940, leg. H. Stares; 23046, Daugavpils raj., Riču ez., 13.7.1983, leg. G. Abele; Kraslavas raj., Ežezers ez.; 23044, Madonas raj., Krustkalnu rez., Labones ez., 27.8.1977, leg. L. Miezīte (?); Ludzas apr., Pildas ez., 11.7.1939, leg. H. Ledus-Stares; Ludzas apr., Zvirgzdenes ez., 5.7.1939, H. Ledus.

Estonia (174)

KRAM236136, Tartumaa, parish Rõngu, Lake Võrtsjärv, 15.7.1930, leg. K. Eichwald; RIG: Herb. Balticum 226, Livland, Kreis

Dorpat, 28.7-9.8.1902, leg. Winkler;
FR - 1, H - 3, MHA - 1, TAA - 115, TAM - 19, TU - 33, US - 1

Finland (356)

KRAM284624, Sb. Kuopio, Hirvilahti, 5.8.1899, leg. E.J. Buddén; WA135153, Satakunta, par. Hämeenkyrö, Manhala, Lehtiniemi, 16.8.1910, leg. B. Florström; B s.n., Joutsa, rural commune, ca 350 m S from the church, N shore of Joutsansalmi, ..., in the lake shore in shallow water, 10.7.1992, leg. P. Alanko;
ALA - 1, BG - 4, BR - 1 CBPF - 1, H - 330, L - 2, LY - 1, P - 1, TRH - 1, TROM - 4, U - 1, US - 5, WAG - 1

Sweden (87)

KRA224251, Norrköping, 6.1867, leg. Fr. Emguist?; TU319742, Norrköping, Himmelstadlund, 7.1888, leg. P. Olsson;
AMD - 3, BG - 23, BR - 2, CLF - 2, DR - 2, GOET - 1, H - 18, L - 6, LY - 7, MPU - 2, O - 2, P - 6, TRH - 6, TROM - 2, US - 10

Hungary (1)

BP654981, Győr-Moson-Sopron county, 2 km west from Földsziget settlement, in "Csíkos-éger", in swamps and planted Euramerican poplar forests, 47°39'56"N, 17°07'01"E, 113 m, CEU 8368.2, 6.9.2004, leg. G. Király.

Russia (433)

KRA224252, Herbarium Flora Ingricae, 1866, leg. Anonymous; KRAM227886, Provincia Kaluga, distr. Spas-Demensk, prope pag Zajaczia Gora, lacus Bezdon, 29.6.1974, leg. M. Bazhenova, V. Makarov, G. Proskuriakova, A. Choldeeva; KRAM215999, Nowosibirskaja obl., Kolywanskij raj., Pochta, pojma r. Ob, 30.7.1966, leg. N. Logutienko, A. Iksanowa; WA135150, Turgaiskaja obl., 1908, leg. M.I. Krascheninnikow;
ALA - 1, ALTB - 17, BR - 1, DR - 1, H - 129, IRKU - 25, K - 1, L - 2, LY - 1, MHA - 58, MICH - 3, MW - 174, NS - 1, NY - 3, P - 2, TUL - 3, U - 1, US - 6

Kazakhstan (12)

WA135151 & WA135152, Akmolinskaja obl., Kuzsmurunskaja wolost, 1909, leg. F. Sjelinsky;
MW - 9, US - 1

Georgia (3)

KRAM524799 & KRAM524800, Javakheti, Akhalkalaki District, environs of Lake Tabatskuri, ca. 1937 m, 10.8.2003, leg. M. Eristavi, T. Gviniashvili, L. Jinjolia, Ch. Gagua; B s.n., dito, 2.8.2004, T. Gvianiashvili & L. Jinjolia

Canada and United States (165)

KRA277102, Plants of Kandiyohi County, Minnesota, USA, S of Skanning Lake, 13.6.2001, leg. T.J.S. Whitfeld; KRAM057778, Alberta, Peace River District, Lac Cardinal Prov. Park, 15.7.1969, leg. J. Looman; KRAM39949, Saskatchewan, E. of Leinan, 3.9.1969, leg. J. Looman; KRAM097182, Saskatchewan, Ruby Lake, 11.8.1971, leg. J. Looman; WA135154, Mackenzie District, Northwest Territories, Canada, Near Hook Lake, 3 miles E of Slave River, 28.7.1965, leg. W.J. Cody;
ALA - 2, ASC - 1, BR - 3, VDB - 1, CAN - 2, CHSC - 1, CMC - 1, COLO - 3, DES - 1, GA - 3, H - 7, L - 6, LEA - 1, LSU - 2, MA - 1, MICH - 10, MIN - 34, MW - 1, NY - 28, OAC-BIO - 6, OSC-V - 3, P - 4, TRH - 2, US - 47, USCH - 1, USF - 1, VT - 2, WIN - 2

Collected at unknown location (12)

AMD.122836, H596264, K000913371, K000913373, K000913374, L.1266335, L.1266378, L.1266380, L.1334034, LY0653421, LY0653424, US947644