

## **Carex cespitosa: reappraisal of its distribution in Europe**

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## *Carex cespitosa*: reappraisal of its distribution in Europe

### Abstract

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*Carex cespitosa* L. (*Cyperaceae*) has been traditionally regarded as widespread in Europe, being reported from most countries. However, its distribution is currently overestimated due to the ambiguous use of the name *C. cespitosa*, together with frequent taxonomic confusion, mainly with the closely related *C. elata* All. and *C. nigra* (L.) Reichard. We present a critical revision of the distribution of *C. cespitosa* in Europe W of the former USSR, based on herbarium material and literature. We confirm the presence of the species in 19 European countries, while its occurrence is considered as doubtful in another five countries. Data pertinent to the ecology and conservation status of the species in the different countries are also provided. It is considered threatened or nearly so in at least eight countries. Hybrids with *C. acuta* L., *C. elata* and *C. nigra* are morphologically characterized and discussed. Although chorological revisions of the European flora are commonly considered of relatively minor scientific relevance, the situation detected by our survey of *C. cespitosa* reveals the importance of, and need for, these basic works for the accurate knowledge of many species, especially for subsequent works on conservation biology and biogeography.

Additional key words: “*Carex caespitosa*”, chorology, conservation, endangered flora, hybrids

### Introduction

*Carex cespitosa* L. (misspelled as “*caespitosa*” in many works) is the type species of *C. sect. Phacocystis* Dumort. (Egorova 1999), one of the largest sections of the genus *Carex* L. (*Cyperaceae*) with approximately 90 species distributed worldwide (Dragon & Barrington 2008). Taxa belonging to *C. sect. Phacocystis* are characterized morphologically by oblong to cylindrical female spikes,

two stigmas and lenticular, frequently papillose, short-beaked utricles (Chater 1980; Egorova 1999; Luceño & Jiménez-Mejías 2008). The taxonomy of *C. sect. Phacocystis* is complex mainly due to hybridization processes and the faint morphological boundaries among many taxa (see Stoeva & al. 2005; Nakamatte & Lye 2007; Jiménez-Mejías & al. 2014). Many studies based on morphological and/or molecular data have contributed to elucidate the intricate relationships among its members in Europe

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(e.g. Faulkner 1972; Luceño & Aedo 1994; Stoeva & al. 2005; Wallnöfer 2006; Nakamatta & Lye 2007; Dean & Ashton 2008; Schönswetter & al. 2008; Jiménez-Mejías & al. 2011; Košnar & al. 2012; Jiménez-Mejías & al. 2012, 2014).

*Carex cespitosa* is widely distributed across the Palearctic (Egorova 1999), from the Iberian Peninsula (Jiménez-Mejías & al. 2007) to Japan (Ohwi 1965). In Europe, it becomes scarce towards S Mediterranean countries (Chater 1980), and it is absent from Africa (cf. Maire 1957). It comprises two subspecies; the typical one occurring across the whole range of the species except for E Siberia and Japan, where it is replaced by *C. cespitosa* subsp. *minuta* (Franch.) Vorosch. (Egorova 1999). The species is distinguished from related taxa by the entire scale-like reddish-purplish basal sheaths, epistomatic leaves, the lowermost bract shorter than the inflorescence, an inflorescence composed of 1 male spike and (1 or)2(or 3) female spikes of c. 30 mm length, and nerveless utricles (Chater 1980; Egorova 1999; Luceño & Jiménez-Mejías 2008; Fig. 1). *Carex cespitosa* is known to inhabit semi-terrestrial wet environments (Schultze-Motel 1968; Chater 1980), specifically wet meadows (Hájková & Hájek 2007; James & al. 2011) and peat bogs (Zajac & Zajac 2001), although it can also be found along river shores (De Boer 1974; Jiménez-Mejías & al. 2007).

Despite the fact that chorological revision works are frequently neglected and considered of minor relevance, the accuracy of such data is critical for phylogeographic and conservation biology studies. The actual distribution of *Carex cespitosa* in Europe has been greatly obscured, mainly due to: (1) the traditional use of the Linnaean binomial to refer to a wide array of tussock-forming plants within *C. sect. Phacocystis*, mainly corresponding to *C. elata* All. and tussocky forms of *C. nigra* (L.) Reichard (see Results); (2) the complex taxonomy of the section, historically characterized by many successive taxonomic rearrangements, nomenclatural changes and misidentifications; and (3) hybridization between members of the section, which blurs taxonomic boundaries. After a thorough herbarium revision and an extensive bibliographic survey, the distribution of *C. cespitosa* in Europe, W of the former USSR, is reappraised, the detected hybrids are listed and morphologically characterized, and the conservation status of the species in different European countries is revised.

## Material and methods

A total of 251 vouchers (284 herbarium specimens) of *Carex cespitosa* and its hybrids were studied from the following 45 herbaria: ARAN, B, BASBG, BBF, BM, BP, BREM, BRNU, BVS, C, CHE, CL, DE, G, GJO, HEID, HOMP, IAGB, JE, K, KRA, L, LI, LISU, M, MA, NLH, O, P, PR, PRC, ROZ, SALA, SAMU, SANT, SIB, SOM, STU, THR, UPOS, UPS, W, WA, WU and ZT.

Additional searches were carried out in BEO, BEOU, BERG, BOLO, BOZ, BUCA, BUNS, CRAI, FI, GDOR, GE, I, IASI, LJU, MSB, MSNM, PA, RO, ROV, SARA, SO, TO and UUV, but no material belonging to *C. cespitosa* was found. Among these herbaria, BEO, BEOU, BM, BUNS, FI, K, LJU, M, MA, MSB, RO, SO, SOM, TO and UPOS were visited in situ and their collections exhaustively checked. Previous reports of the species in the study area in Floras, checklists and chorological notes were critically revised (see sources for each country under Results). A special effort was made to exhaustively revise the W and S parts of the European distribution of the species, where it has been confused or has remained long unnoticed. Due to the extensive and relatively well-known distribution of *C. cespitosa* in Finland, Sweden, and Poland (see Results), the chorological revision in these three countries was not so intense as in the rest of the area. The conservation status of the species (see IUCN 2012 for the definition of the conservation categories) was checked in the corresponding national Red List for each country, if available.

## Results and Discussion

The distribution of *Carex cespitosa* in Europe W of the former USSR, based on herbarium records and reliable bibliographic data, is shown in Fig. 2 and Table 1. No vouchers or literature evidence were found for the occurrence of *C. cespitosa* in Belgium, Greece, Iceland, Ireland, Luxembourg, Macedonia, Malta, Portugal and European Turkey. Specimens studied are listed by country in Appendix 1.

### 1. Distribution

#### Albania

*Carex cespitosa* has recently been found in a single location during fieldwork in the NE part of the country, near the Kosovan border (Barina & al. 2011).

#### Austria

Citations in Austria before the late 19th century are not reliable, since the species was frequently misidentified as either *Carex nigra* or *C. elata* (cf. Ortman 1854). The species is relatively frequent close to the Austrian-Czech border in Lower Austria, at the E limit of the Bohemian Massif (Waldviertel district; Janchen 1977; Grulich & Chytrý 1993). In the rest of Austria, *C. cespitosa* is restricted to very few localities, mainly in the E regions of the country. It is absent from the two westernmost provinces, Tyrol and Vorarlberg (Fischer & al. 2008). For the Salzburg region only a single population, bordering the Alps, is currently known (Flachgau district; Eichberger & al. 2004; Eichberger & Arming 2004). An additional population reported from nearby (Reiter 1947) might be extinct (Wittmann & al. 1996). In Upper Austria it has lately been

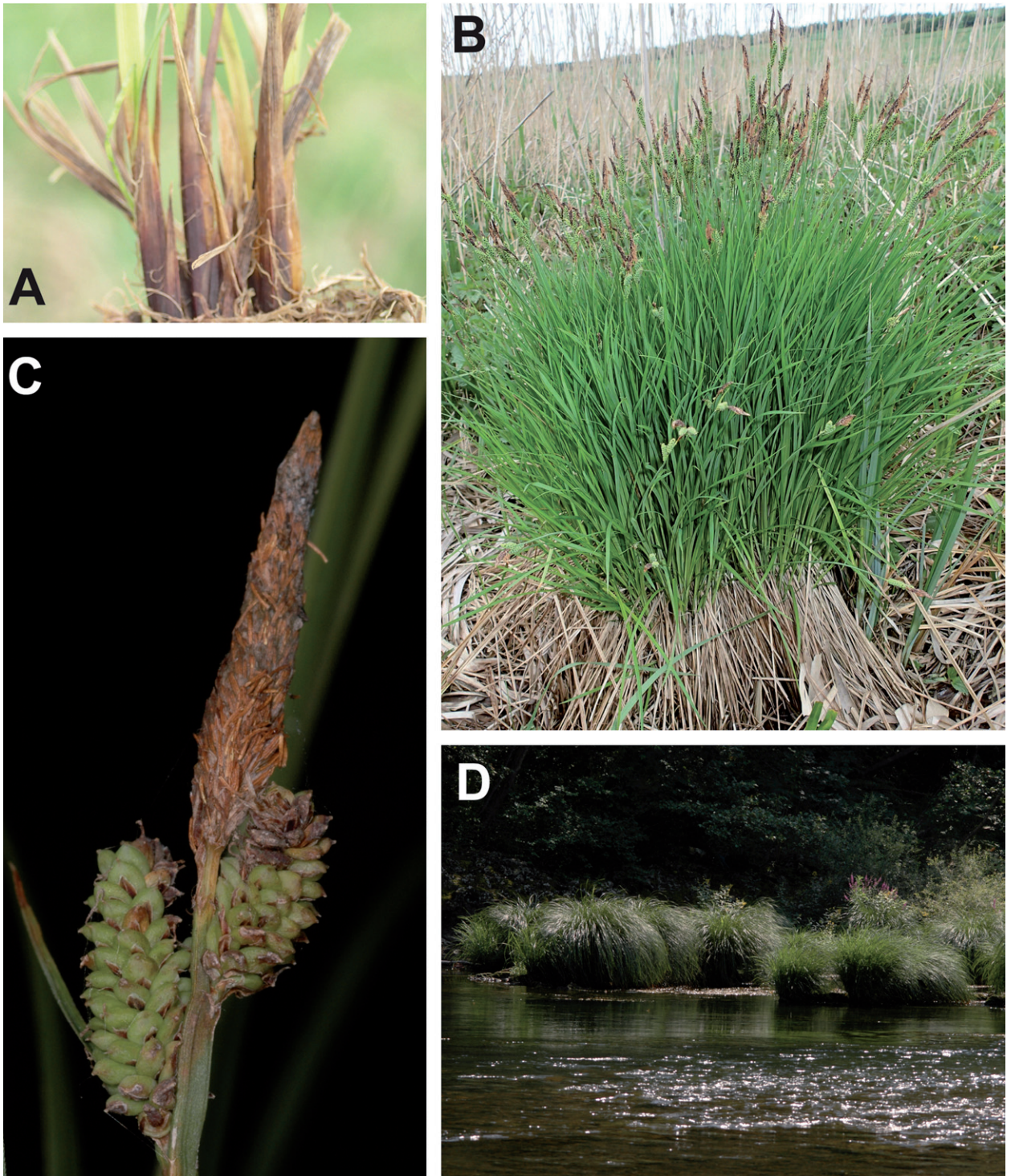


Fig. 1. *Carex cespitosa* representative photographs – A: basal sheaths; B: general habit; C: inflorescence with ripe utricles; D: river shore population. – A & B: Niederösterreich, Austria, photographed by C. Paschschwoell; C & D: Bidasoa River, Navarra, Spain, photographed by M. Luceño.

confirmed for the Bohemian Massif but it is considered as extinct in the lowland areas (Hohla & al. 2009). Further citations can be found for W Styria (next to Neumarkt in Steiermark; Melzer 1961, 1968), SE Styria and the nearby area of S Burgenland (Melzer 1968; Wallnöfer & al. 1991), and the nearby areas of Carinthia (Melzer 1966, 1969) – here, exceptionally, within the Alps.

The Red List of ferns and flowering plants of Austria (Niklfeld & Schratt-Ehrendorfer 1999) considers *Carex cespitosa* within category 2 (equivalent to Endangered – EN).

#### **Bosnia and Herzegovina**

We are not aware of any literature records concerning

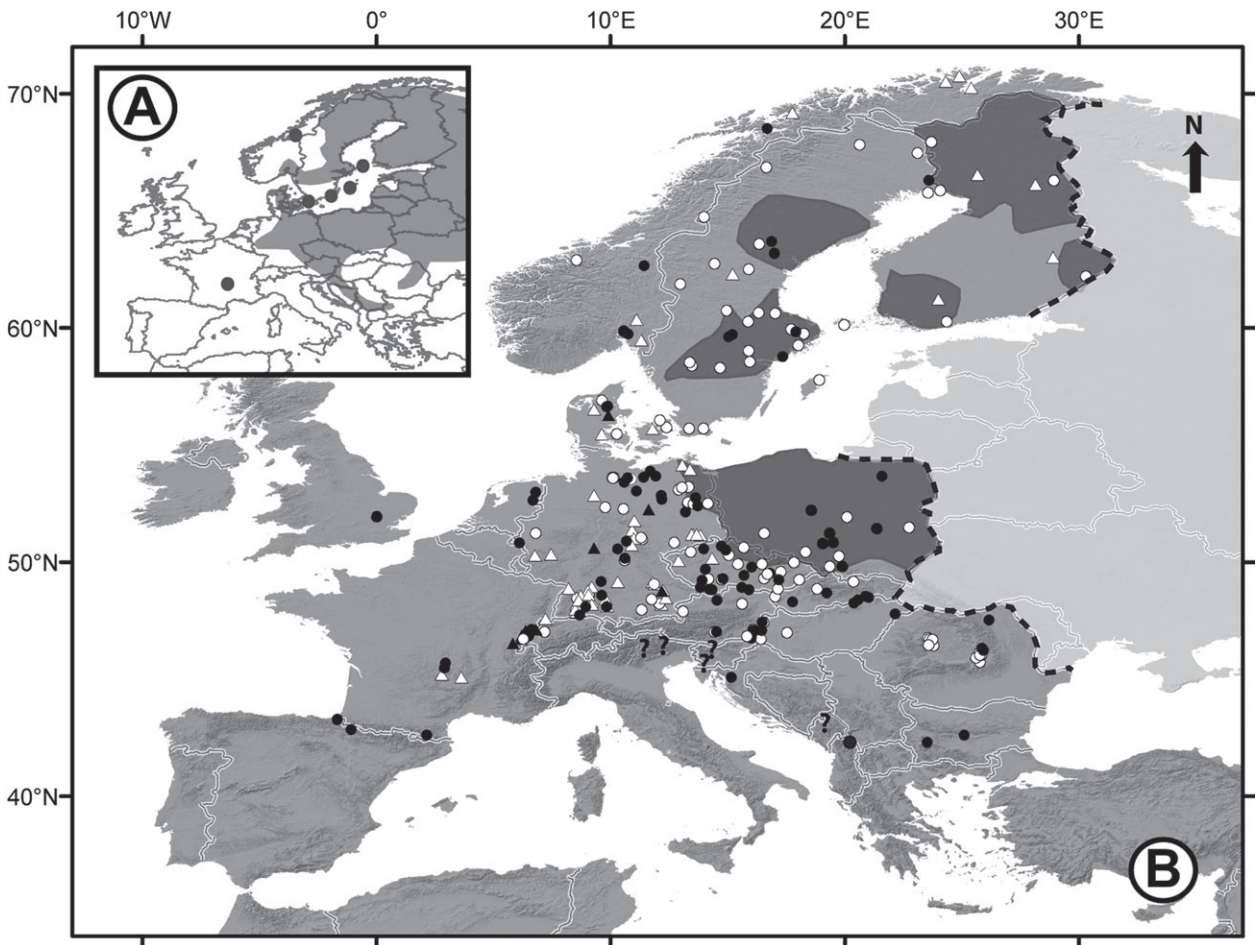


Fig. 2. *Carex cespitosa* distribution in Europe W of the former USSR based upon our data. – A: Approximate known range in 1950 as recorded by Hultén's revision (1950). Dots indicate isolated locations. – B: Distribution according to 267 reliable records (herbarium vouchers and literature). Areas in Scandinavia and Poland, where the distribution of populations has been reported as relatively dense, are indicated by dark shading (according to Mossberg & Stenberg 2005, and Zajac & Zajac 2001, respectively). Triangles indicate reliable bibliographic references; circles indicate checked herbarium vouchers; white shapes indicate data from and before 1968 (date of publication of *Carex* in Flora von Mitteleuropa; Schultze-Motel 1968); black shapes indicate data from and after 1969; question marks depict the doubtful occurrences in Italy, Slovenia and Montenegro.

the occurrence of *Carex cespitosa* in Bosnia and Herzegovina. The identity of a herbarium voucher housed at SARA "In fossis subexsiccatis vallis Stabrova ča prope Jelaš c. 1400 m, 8 Jul 1931, Maly (SARA)" could not be confirmed with certainty. We therefore consider its occurrence in Bosnia and Herzegovina as doubtful.

### Bulgaria

There are only three confirmed records of *Carex cespitosa* in Bulgaria, two of them very close together in the Yambol region (Yornanov & al. 1974; Stoeva & al. 2005), and a third near Sofia (Hájek & al. 2007). These Bulgarian populations are the southernmost in Europe.

Despite its rarity in the country, *Carex cespitosa* is not listed on the Red List of Bulgarian vascular plants (Petrova & Vladimirov 2009).

### Croatia

The only published records of *Carex cespitosa* from the current territory of Croatia are from the surroundings

of Rijeka (Rossi 1930; see also Ilijanić & Topić 2000). The record published in Flora croatica (Schlosser de Klekovski & Farkaš-Vukotinović 1896) is from Zemun ("Semlin"), near Beograd, nowadays part of Serbia. Moreover, the record from Srem ("Sirmien"; Schulzer von Müggenburg & al. 1866) is likely to be from current Vojvodina in Serbia. There is no herbarium material of this species available in the main Croatian herbaria (A. Alegro, pers. comm.). However, *C. cespitosa* has recently been observed from Drežničko polje, near Drežnica village in Velika Kapela (N Dinarides), and registered in the Flora Croatica Database (Topić 2011). This observation (confirmed by us from photographic material; Topić pers. comm.) constitutes the first reliable record for the country.

### Czech Republic

*Carex cespitosa* is rather scattered in the Czech Republic. The first reliable records in the country are from the late 19th and early 20th centuries (Čelakovský 1867; Oborný

Table 1. Summary of the distribution of *Carex cespitosa* in Europe W of the former USSR, based on herbarium records and reliable bibliographic data (see text for details). Countries where the occurrence is questionable are indicated by a question mark (?). When the number of confirmed extant populations is given as “undetermined” it most probably implies more than 20 populations. Bosnia and Herzegovina is excluded (doubtful occurrence based on a single herbarium voucher of unconfirmed identity).

Country	Regions	First published record	Number of confirmed extant populations	Conservation status
Albania	NE Albania	2011	1	not assessed
Austria	mainly E Austria, rare in Salzburg, upper Austria, Styria and Carinthia	late 19th century	undetermined	EN
Bulgaria	Yambol and Sofia	1974	3	not included
Croatia	NW Croatia	1930	1	not assessed
Czech Republic	scattered	1867	undetermined	NT
Denmark	scattered in Jutland and Zealand	19th century or before	24	LC
Finland	widespread	19th century or before	undetermined	not included
France	scattered in Massif Central and Jura, rare in E Pyrenees	19th century or before	undetermined	LC
Germany	widespread, but only common in the north and southwest	19th century or before	undetermined	VU
Hungary	scattered	1891	undetermined	EN
Italy?	Friuli-Venezia Giulia	second half of 20th century	–	not included
Montenegro?	Durmitor Massif	1933	–	not included
Netherlands	Drenthe and Overijssel	1974	2	“sensitive”
Norway	widespread in S Norway and Troms, rare in Sør-Trøndelag	19th century or before	undetermined	NT
Poland	widespread	19th century or before	undetermined	not included
Romania	Carpathians	1866	undetermined	not included
Serbia?	scattered	1976, probably before	–	not included
Slovakia	scattered	probably 19th century	undetermined	VU
Slovenia?	SE Alps	early 20th century	–	not assessed
Spain	W Pyrenees	2007	2	CR
Sweden	widespread	18th century <sup>1</sup>	undetermined	not included
Switzerland	Jura	1999 (1853 <sup>2</sup> )	undetermined	VU
United Kingdom	East of England	2012	1	not assessed

1 Described by Linnaeus (1753), implicitly including Sweden in the list of polynomials.

2 Cited by Godet (1853) but excluded by Welten & Sutter (1982); rediscovered by Cosson & Morcrette (1999).

1883–1886; Podpěra 1930). Localities are known almost all over the country, but the abundance of the species appears to be widely variable in different regions. Approximately 600 records are databased for the forthcoming Flora of Czech Republic (Grulich & Řepka, unpubl. ms.). This species prefers middle altitudes in relatively continental climatic conditions, like those in S Bohemia and SSW Moravia (Grulich 1990), where it can ascend to 1000 m a.s.l. in the Šumava Mountains. Some localities are situated in lower, warmer parts of C Bohemia and Moravia. The species is quite rare in W and E parts of Bohemia, in the Bohemian-Moravian Highlands, and in the E part of Moravia.

Although many sites for *Carex cespitosa* have been destroyed, the species is not particularly threatened in the Czech Republic. It is able to tolerate mowing (Hájková & Hájek 2007), and also a certain degree of reforestation (e.g. semi-shaded conditions below *Alnus*; Chytrý & Vicherek 1995). Therefore *C. cespitosa* is listed on the

Red List of Czech vascular plants (Grulich 2012; see also Danihelka & al. 2012) as a taxon of lower risk under the category Near Threatened (NT).

### Denmark

*Carex cespitosa* was formerly known from numerous localities throughout most of the Danish mainland (including North Jutlandic Island) and Baltic territories (Funen, Zealand and Bornholm) (Wiinstedt 1943; Hultén 1950), but due to agricultural expansion it has become rare (Løjtant & Worsøe 1993). At present only eight localities are known in Zealand and 16 in Jutland (Naturbasen 2013).

Despite the apparently clear decline in the populations of the species, *Carex cespitosa* is listed as Least Concern (LC) on the Danish Red List (DMU 2007).

### Finland

*Carex cespitosa* is widespread and locally common in

the N part of Finland, while less frequent in the south (Hultén 1950). It is therefore not included on the Red List of Finnish species (Rassi & al. 2010).

### France

*Carex cespitosa* has attracted the attention of French botanists due to its scarceness and, therefore, its distribution and conservation status have been very well studied, documented and brought up to date. It is distributed through the mountain systems of the Jura, Massif Central and Pyrenees, in C and S France, in the regions of Alsace, Franche-Comté, Auvergne and in the E Pyrenees (reviewed in Olivier & al. 1995 and Duhamel 2004). It appears to be relatively frequent at least in the Massif Central (Tort & al. 1988; Olivier & al. 1995; CHLORIS 2010) and rather common in Franche-Comté (Gillet & al. 1980; Prost 1992; Cosson & Morcrette 1999; Ferrez & Guyonneau 2005). However, it is only known from a single location in both the E Pyrenees (Villeneuve; cf. Terrisse 1994) and Alsace (étang d'Hirsingue; cf. Issler & al. 1965; Schultze-Motel 1968).

It is listed as Least Concern (LC) for the French territory (FCBN and MNHN 2012).

### Germany

*Carex cespitosa* is widely distributed throughout Germany. However, Schultze-Motel (1968) noted that it is only relatively common in the N and the SW (Baden-Württemberg). In the N half of the country, *C. cespitosa* appears in Schleswig-Holstein and Mecklenburg-Vorpommern. It is quite rare in Sachsen and Thüringen, almost absent in the NW lowlands (BfN 2005), and reported as extinct in Nordrhein-Westfalen (Wolff-Straub & al. 1999). From C Germany southwards, it can be found mainly in the Swabian Jura and upper Neckar and Danube basins (Höller 1964; Sebald 1998; Schönfelder & Bresinsky 1990).

The national Red List considers *Carex cespitosa* as Vulnerable (VU) (Korneck & al. 1996).

### Hungary

The first record of *Carex cespitosa* in Hungary was made by A. Waisbecker in 1891, from the foot of the Kőszeg Mountains (W Hungary). This classic locality still exists and the species is dominant there (A. Mesterházy, pers. obs.). Later, the species was recorded by Szodfridt-Tallós (1965) from the Őrség region (W Hungary), where it has recently been collected (A. Mesterházy, pers. obs.). Only one small population was known from the Dunántúli-Mountain Range (Szodfridt-Tallós 1962; confirmed by Lájér 2003). Scattered occurrences are known from Nyírség (Lájér 2003) and the Északi mountain range in NE Hungary (Bükk Hills, Upponyi Hills, Aggtelek Karst; Sulyok-Schmotzer 1999; Penksza-Salamon 1997a, b).

Due to its rarity, the latest national Red List of Hungary considers the species to be Endangered (EN) (Király 2007).

### Italy

*Carex cespitosa* was recorded for Italy in Flora europaea (Chater 1980) and Flora d'Italia (Pignatti 1982). In the most updated checklist of Italian plants (Conti & al. 2005), it was reported from the N regions of Piemonte, Lombardia, Friuli-Venezia Giulia and Liguria. Despite this alleged distribution, no Italian *C. cespitosa* specimen could be found during intensive searches in the collections of the main Italian herbaria (BERG, BOLO, FI, PA, RO and TO). Personal communication with the curators and staff from BOZ, GDOR, GE, MSNM, ROV and UVV was also without any positive result. The erroneous early use of the binomial *C. cespitosa* and the frequent confusion with similar species could help to explain this situation (Pignatti 1982). In fact, all the material labelled as *C. cespitosa* in these herbaria belongs to closely related species from *C. sect. Phacocystis*. Accordingly, the species has already been excluded from the Piemonte flora (Jiménez-Mejías & Selvaggi 2011).

To our knowledge, the only reliable reference to the presence of *Carex cespitosa* in Italy seems to be an old sheet from South Tyrol (Friuli-Venezia Giulia; NE Italy) in W ("Bolzano, com. P. Gredler"; Wallnöfer 2004). Nonetheless, the possibility of label misplacement cannot be excluded. In addition, Schultze-Motel (1968) also recorded *C. cespitosa* for the Italian Tyrol ("Cadore, Ampezzo, Unter-Friaul"). More fieldwork is necessary in these NE regions where the occurrence of this species could be likely.

The species is not included on the Red and Blue List of the Italian flora (Pignatti & al. 2001).

### Montenegro

The only reported occurrence of *Carex cespitosa* in Montenegro is in the lake Riblje jezero of Mount Durmitor ("In uligin. ad lac. Riblje jezero sub. m. Durmitor; Pantoček", see Rohlena 1942). Hayek (1933) indicated this species for Montenegro probably based on the same record. However, this locality has never been confirmed, and indeed *C. cespitosa* is not in the plant checklist from this locality (Birks & Walters 1972). Additionally, the material studied from this locality was unequivocally classified as *C. acuta* (8 Jul 1989, Stevanović & Jovanović, BEOU; 15 Jul 1991, Jovanović & al., BEOU). We therefore consider the occurrence of *C. cespitosa* in Montenegro as doubtful.

### Netherlands

At least three reliable locations have been reported for *Carex cespitosa* in the Netherlands, two of them in the province of Drenthe and the other one in Overijssel (De Boer 1974; Mennema & al. 1980). Older records are considered to be incorrect (Kern & Reichgelt 1954). The species is currently still known from the two northernmost sites in Drenthe (J. Koopman, pers. obs.).

On the Red List of the vascular plants of the Netherlands (Ministry of Agriculture, Nature and Food Qual-

ity 2004) *Carex cespitosa* is listed under the category “sensitive”, without a clear equivalence with the IUCN criteria.

### Norway

*Carex cespitosa* is a rare and scattered plant across most parts of Norway, although it can be locally common and sometimes dominant in the vegetation near the inner parts of the Oslofjord (S Norway), and in the Norwegian far north (Troms, Finnmark). South of the Arctic Circle, it is found mainly E of the Scandinavian Mountains, with the exception of the apparently disjunct populations from Sør-Trøndelag (CW Norway; Hultén 1950). Our revision revealed an old voucher from the county of Møre og Romsdal, close to the Sør-Trøndelag border (see Appendix 1).

On the Norwegian Red List of plants *Carex cespitosa* is included as Near Threatened (NT) (Solstad & al. 2010).

### Poland

*Carex cespitosa* is apparently common in Poland when compared with more W and S European countries. Therefore only 14 vouchers from Poland were studied. It is scattered throughout the country and is often common in bogs and peat-meadows (Zajac & Zajac 2001). It is therefore not listed on the Red List of Polish plants (Każmierczakowa & Zarzycki 2001).

### Romania

The first reference to *Carex cespitosa* in Romania dates back to the 19th century (Schur 1866, as *Vignantha “Dreyeri”*) and is placed very close to the town of Sibiu (“Narzissenwiese im jungen Wald bei Hermannstadt”). This locality is confirmed by herbarium vouchers deposited in BP and SIB, but it seems that the wet grasslands in which *C. cespitosa* occurred around Sibiu disappeared more than a century ago (Drăgulescu 2008). Since then, the species has been found in several other locations, mainly from intra-mountainous depressions, valleys or foothills of the Carpathian range (see Appendix 1). Herbarium revision revealed frequent misidentifications of *C. elata* or *C. nigra* vouchers as *C. cespitosa*. Therefore, we consider that the abundance of this species in Romania, as reported in older botanical literature, is probably overestimated.

*Carex cespitosa* is not listed on the Red List of Romanian species (Sârbu & al. 2007).

### Serbia

*Carex cespitosa* is recorded from several regions in the Flora of Serbia (surroundings of Beograd and Kragujevac, Cer and Plješevica Mountains, as well as Deliblatska peščara in Vojvodina; Jovanović-Dunjić 1976; see also the text for Croatia above). However, the in situ study of the collections deposited at BEO, BEOU (Belgrad) and BUNS (Novi Sad) did not confirm the occurrence in Serbia of this species, which thus remains doubtful.

### Slovakia

*Carex cespitosa* is scattered but not common in Slovakia. It seems to be absent in the warmest parts in S Slovakia. Most populations are known from the Záhorská nížina lowland in the westernmost part of the country and from the Carpathian valleys in C and N Slovakia (Hájková 2007).

In the last edition of the Red List of Slovakian flora *Carex cespitosa* was evaluated as Vulnerable (VU) (Feráková & al. 2001).

### Slovenia

Although Schultze-Motel (1968) listed *Carex cespitosa* for several regions of Slovenia (Koroška – Carinthia, Gorenjska – Upper Carniola, and Primorska – Slovenian Littoral), most of them correspond to territories currently in Austria and Italy, respectively (see ethnic regions considered by Mayer 1952). More recently, Martinčič (2007) only listed the Karavanke Mountains, although the identity of this record is unclear (A. Martinčič, pers. comm.). It is likely to be based on a note by A. Paulin in his edition of the Austrian flora (Križe near Tržič [Gorenjska]; Hayek & Paulin 1907). There is an additional record from Obrov in Primorska (Poldini 1980). However, none of the records is supported by herbarium material at LJU or other herbaria. Therefore, the occurrence of this species in Slovenia remains questionable, although fairly probable given the proximity of some Hungarian populations (Szentgyörgyvölgy; see Appendix 1).

### Spain

On the Iberian Peninsula, the presence of *Carex cespitosa* has been reported recently by Jiménez-Mejías & al. (2007) and subsequently recorded in Flora iberica (Luceño & Jiménez Mejías 2008). It is based on a single location in the Pyrenees along the N-facing Bidasoa river, in the Navarra region close to the French border. This population was previously misidentified as *C. elata* s.s. (cf. Luceño & Aedo 1994). Herbarium revision has revealed a second population in Sarries, in the Navarra region as well (see Appendix 1). This population is located in a S-facing valley in the River Ebro basin, 65 km S from the other known population. The Spanish populations constitute the westernmost limit of the global distribution of the species.

*Carex cespitosa* is listed on the Red List of Spanish vascular flora (Moreno & al. 2008) as Critically Endangered (CR).

### Sweden

*Carex cespitosa* is widespread and locally common in C Sweden (Almquist 1929; Malmgren 1982; Genberg 1992; Rydberg & Wanntorp 2001; Bertilsson & al. 2002), while rarer in the north (Danielsson 1994) and south (Sterner 1986; Edqvist & Karlsson 2007; Tyler & al. 2010). In this latter region, it is extinct in the Dal (Andersson 1981) and Blekinge districts (Fröberg 2006).



*Carex cespitosa* is not listed on the Red List of Sweden (Aronsson & al. 2010).

### Switzerland

*Carex cespitosa* has recently been rediscovered in Switzerland (Jura mountains, Vaud and Neuchâtel cantons; Cosson & Morcrette 1999; Morcrette & al. 2002; Druart 2004). It was first recorded from Neuchâtel in the 19th century (Godet 1853), but subsequently excluded from the Swiss flora (Welten & Sutter 1982; Moser & al. 2002). Populations from the Swiss Jura are located in the Upper Doubs basin and environs, like those from the French Franche-Comté (see under France above; Cosson & Morcrette 1999). We have detected additional herbarium vouchers from Bern and Schaffhausen cantons (see Appendix 1), not far from the populations in the Swiss and German Jura mountains. Due to the rarity of the species, the persistence of these populations should be checked.

The national conservation status for *Carex cespitosa* in Switzerland is Vulnerable (VU) (Druart 2004).

### United Kingdom

*Carex cespitosa* was excluded from the account of *Cyperaceae* for the British Isles by Jermy & al. (2007), who attributed all previous records to misidentifications. However, we found a reliable herbarium voucher of this species from E England (Hertfordshire: near West Mill, near Buntingford, 26 May 1960, *Dony 3815*, BM). The persistence of this population was recently confirmed; it is composed of about 300 tussocks approximately 2.5 km S of the original record in a spring-fed mire (James & al. 2012).

Due to its recent discovery in the United Kingdom, *Carex cespitosa* has not yet been included on any official list of endangered plants. The existence of a single known population could lead to its being considered as Critically Endangered (CR) (James & al. 2012).

## 2. Hybrids

Koopman (2011) reported seven hybrids of *Carex cespitosa* for the whole of Europe. In our study area, the following three hybrids of *C. cespitosa* with species of *C. sect. Phacocystis* have been found. Specimens studied are listed in Appendix 2.

### 1. *Carex cespitosa* × *C. acuta*

*Carex xallosepis* Rchb., Icon. Fl. Germ. Helv. 8: 233, t. 586. 1846.

This hybrid has been doubtfully recorded by Schultze-Motel (1968) from N Germany, and later confirmed by Kiffe (2001a) from the SW of the country. It has also been recorded recently from Finland, France, Norway, Russia, and Sweden by Koopman (2011). We have studied a single specimen from Austria (see below).

It can be distinguished from *Carex cespitosa* by the

longer spikes and the lowest bract, which is as long as or slightly longer than the inflorescence, while shorter in *C. cespitosa*. Regarding *C. acuta*, the hybrid is smaller in all its parts and has well-preserved, apparent, orangey, entire basal sheaths, instead of the brown, leaf-like, frequently inconspicuous and disintegrating basal sheaths typical of *C. acuta*. This hybrid plant strongly resembles the relatively frequent hybrid between *C. acuta* and *C. nigra* (*C. xelytroides* Fries.; see Jermy & al. 2007 for a detailed description), although the two can easily be separated because this latter has amphistomatic leaves, whereas *C. xallosepis* is entirely hypostomatic).

### 2. *Carex cespitosa* × *C. elata*

*Carex xstrictiformis* Alm. in Hartman, Handb. Skand. Fl., ed. 11: 469. 1879 = *Carex xfrankii* Podp., Vestn. Klubu Prír. v Prostejove 10: 6. 1908, nom. illeg. [non Kunth 1837].

This hybrid has previously been recorded from Germany (Schultze-Motel 1968; Kiffe 2001a, b) and Austria (Melzer 1988), and more recently from the Czech Republic, France, Italy and Sweden (Koopman 2011). It is easily identified due to its clearly intermediate morphological characters, both quantitative and qualitative, between the two parental species: leaves hypostomatic; basal sheaths enlarged, reddish, brown-reddish or yellowish-brown, sometimes with a ladder-fibrosille structure; male and female spikes show an intermediate length, generally longer than those in *Carex cespitosa* (20(–30) mm); utricles are faintly nerved or nerveless, with the inner side reddish.

### 3. *Carex cespitosa* × *C. nigra*

*Carex xbolina* O. Lang in Linnaea 24: 551. 1851 = *Carex xperaffinis* Appel in Jahresber. Schles. Ges. Vaterl. Cult. 1891(2): 158. 1892.

This hybrid has been recorded from the Czech Republic, Finland, France, Germany, Italy, Norway, Poland, Slovakia and Sweden (Schultze-Motel 1968; Kiffe 2001b; Koopman 2011). It is more variable than the previous ones, probably due to the highly variable morphology of *Carex nigra*.

The main diagnostic character is the amphistomatic leaves, therefore combining the feature from the hypostomatic *Carex cespitosa* and the epistomatic *C. nigra*. Rhizomes vary from densely caespitose to rhizomes with more or less enlarged internodes. Basal sheaths are mainly reddish, more labile than in *C. cespitosa*, and sometimes breaking up as in *C. nigra*. Utricles are suborbicular, faintly nerved or nerveless.

The name *Carex sororia* Meinsh. has been applied to hybrids between *C. cespitosa* and *C. nigra*. However, careful examination of the type collection (at BM and K) revealed no evidence of hybrid origin. Indeed, the specimen at BM is rather typical *C. cespitosa*. Thus, we lectotypify *C. sororia* on the BM specimen, and the name is to be considered a mere synonym of *C. cespitosa*.

*Carex sororia* Meinsh., Fl. Ingr.: 404. 1878, nom. illeg. [non Kunth 1837] – **Lectotypus (designated here):** [Russia], “In turfosis regionis ad fl. Siworkam pr. Gatschinam”, Jun 1872 [Herbarium Fl. Ingricae 723, Cent. X] (BM 001067141 photo!; isolectotypus: K 000960440!).

### 3. Ecology

Even omitting the fact that the ecology of *Carex cespitosa* has been somewhat blurred mainly by its confusion with other plants (e.g. reported as a species of *Molinio-Juncetea* by Soó 1973 in C Europe, due to a misidentification with *C. elata*), its ecological preferences seem to be indeed wide when viewed in a European context. The habitats reported by the extant reliable records and herbarium vouchers (see Appendix 1) indicate in all cases a dependence on water, ranging from flooded ground to damp soil or underground water, probably in most (or all) cases with a high peat content and mesotrophic conditions, and in both open grasslands or more or less canopy-closed river forests. Thus, *C. cespitosa* can be found in swampy peat bogs (Tort & al. 1988; Ferrez & Guyonneau 2005), mires (Lájer 2003), and river beds (Jiménez-Mejías & al. 2007), but also commonly in not strictly aquatic habitats such as wet meadows and megaphorbic communities (Höller 1964; Morcrette 2000; Ferrez & Guyoneau 2005; Stoeva & al. 2005), and in some cases, areas subject to flooding by rivers (see Höller 1964; De Boer 1974). A preference for calcareous soils has been mentioned (e.g. James & al. 2012), but it seems to be rather inconstant.

Due to this ecological plasticity, *Carex cespitosa* is able to survive fluctuations and some degree of disturbance, such as grazing (James & al. 2012), or forest colonization as a result of ecological succession (e.g. by *Alnus*; Chytrý & Vicherek 1995).

### 4. Conservation status

The wide global distribution of *Carex cespitosa* across the Palearctic makes it difficult to apply the IUCN Red List conservation categories and criteria at the global level (IUCN 2012). Nonetheless, it appears highly unlikely that the species would fulfil some of them (i.e. very large extent of occurrence and area of occupancy for criterion B, unknown but surely above threshold total number of individuals for criteria C and D). For criterion A, the degree of reduction in population size is also unknown and difficult to estimate given the distribution of the species, although the presence of the species appears to have been considerably diminished in many European countries due to anthropogenic influences. Therefore, although the global conservation status of *C. cespitosa* is probably Least Concern (LC), conservation studies at country level and below appear advisable (IUCN 2012). Indeed, the species has been included under one of the threatened – or near threatened – categories in eight out

of the 19 countries for which we have confirmed its presence: Near threatened (NT) in the Czech Republic and Norway; Vulnerable (VU) in Germany, Slovakia and Switzerland; Endangered (EN) in Austria and Hungary; and Critically endangered (CR) in Spain. In the Netherlands the plant is considered as “sensitive”, indicating a certain degree of threat, and reports of decline have been given for Sweden. In only two cases – Denmark and France – is it explicitly considered as not threatened (Least Concern – LC). For Albania, Bulgaria, Croatia, Finland, Poland, Romania, Sweden and the United Kingdom it is not included in the national Red Lists. In the cases of Albania, Croatia and the United Kingdom its absence from the lists is due unequivocally to its recent discovery. The Bulgarian and Danish cases need revision, especially the latter, given the clear decline of the species in Denmark (see above).

### 5. Conclusions

*Carex cespitosa* occurs mostly scattered and is typically a rare plant in many European countries, especially in W and S Europe. The presence of the species is confirmed in 19 European countries. In each of Albania, Croatia and the United Kingdom only one extant population is known; in both the Netherlands and Spain only two; in Bulgaria only three. In Switzerland it is mostly restricted to the Jura Mountains. It is more widely distributed in France, where it inhabits three mountain systems: the Jura, the Massif Central, and the E Pyrenees, although it is very scarce in the last mentioned, with a single station. In Scandinavia and C Europe, its distribution seems to be more continuous, although in Denmark it appears to have disappeared from many places. The presence of *C. cespitosa* in Bosnia and Herzegovina, Italy, Montenegro, Serbia and Slovenia is in need of confirmation and further field work is necessary.

Although chorological revisions in Europe are commonly neglected as minor works of little relevance, the divergence between the situation depicted by the literature for *Carex cespitosa* and the actual one detected by our study highlights the importance of, and the need for, these basic works for the accurate knowledge of many species, especially for those threatened, rare or declining.

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## Appendix 1: List of *Carex cespitosa* specimens studied by country

- ALBANIA: in village Pac, next to brook “Lumi i Pacit”, in meadow, c. 560 m, 3 Jun 2009, *Barina & al.* 15375 (BP).
- AUSTRIA: BURGENLAND: Mittleres Burgenland, östlich von Lockenhaus im Günstal am Fuß des Arriegels in einem Sumpf in etwa 310 m, 4 Jun 1997, *Melzer* (LI); östlich von Güssing im Moschendorfer Wald, an vernässter Stelle einige prachtvolle Horste zusammen mit *Gagea spathacea* 20 Apr 1991, *Melzer* (LI). — LOWER AUSTRIA: St. Pölten-Waizendorf, 22 Apr 1899, *Teyber* (WU); Niederfladnitz, wet meadow 0.7 km NE, 6 May 1991, *Grulich* (BRNU). — SALZBURG: In pratis paludosis Salisburgi, auf den Sumpfwiesen bei Ursprung, no date, *Bausch* (HEID, with *Carex cespitosa* × *C. nigra*). — STEIERMARK: Raab-Gebiet. Fürstenfeld N, Bierbaum NE 260 m, 4 Jun 1966, *Höllner* (M); Bei Wildbad Einöd, nah der Ruine Neudeck 24 May 1959, *Melzer* (GJO); Lafnitztal, Bezirk Fürstenfeld, Gemeinde Fürstenfeld, N der Stadt Fürstenfeld, S Ledergassler 250 m, 4 Apr 2001, *Ernet & Zernig* (GJO); Südsteiermark, nördlich von Goritz bei Radkersburg in einem Auwäldchen am Dragabach einige Horste, 14 May 1992, *Melzer* (GJO). — UPPER AUSTRIA: Mühlviertel 1 km E Hagenberg, an der Fel-daist 200 m S Kumpfmühle, May 1977, *Pils* (WU).
- BULGARIA: SOFIA: prope Sofia, 1901, *Urumoff* (BRNU); Rila planina, po vlahzni trevisti mesta iztochno ot s. Dospěj, Samokovsko, 1000 m, 27 Jun 2007, *Hájek et al.* (SOM). — YAMBOL: mochurlivi, blatisti livadi pri c. Manolovo-Aleksandrovo, 22 Jun 1971, *Denchev* (SOM); mochurlivi livadi mezhdou Aleksandrovo i Manolovo, 8 Jun 1986, *Stoeva* (SOM).
- CZECH REPUBLIC: NORTH BOHEMIA: Spořice u Chomutova, no date, *Knaf* (PRC); Velemín, 1999, *Ducháček* (PR); Mimoň, 1983, *Hlaváček* (HOMP); Malý Rečkov, reserve Klokočka, 1994, *Molíková & Rydlo* (ROZ). — CENTRAL BOHEMIA: Lány, 1871, *Polák* (PRC); Praha-Motol, 1888, *Velenovský* (PRC); Loučeň, 1948, *Kaufman* (PRC); Příbram-Háje, 1983, *Hlaváček* (HOMP). — EAST BOHEMIA: Josefov, Novoplesský les, 1928, *Traxler* (PRC); Krouna, 9 Jul 1990, *Grulich* (BRNU); Česká Třebová, 1837, *Rybička* (BRNU). — SOUTH BOHEMIA: Strunkovice nad Volyňkou, 30 May 2005, *Vydrová* (BRNU); Smrkovice, 1877, *Velenovský* (PRC); Soběslav, 1943, *Vopravil* (PRC); Jamné, 30 Apr 2001, *Grulich* (BRNU); Nový Špičák, near destroyed village in military area, 21 Jun 2004, *Grulich & Vydrová* (BRNU); Volary, Soumarský Most, 31 May 2010, *Grulich* (BRNU); Želnavá, 21 May 1995, *Žíla* (LI); Podvoř u Boletic, 8 May 1995, *Žíla* (LI). — SOUTH MORAVIA: Vratěšín, 26 Jun 1991, *Grulich* (BRNU); Kuřim, 1928, *Šmarda* (BRNU); Pornice, wet forest Valachy, 1987, *Pluhař* (BRNU); Hodonín, 1946, *Holzknicht* (BRNU). —
- CENTRAL MORAVIA: Pavlov, wetlands Pavlovské mokřady, 1996, *Řehořek* (BRNU); Olomouc, 1907, *Podpěra* (BRNU); Olomouc, in pratis paludosis prope aquaeductum, 21 May 1927, *Otruba* (BASBG, K, P, WU); Kozlov, wet meadows Smolenská luka in military area, 2 May 2006, *Grulich* (BRNU). — SILESIA: Neplachovice, 1952, *Kousal* (PRC); Děhylov, 1956, *Vicherek* (BRNU).
- DENMARK: CENTRAL DENMARK: 1 km S of Pøt Mølle, near Hammel 18 Jun 1979, *Nielsen & al.* 831 (L, MA, SANT). — NORTH DENMARK: Ilsø NE of Arden, S of Aalborg, 9 Jun 1967, *Larsen & Laegaard* 296 (L, MA, P, SANT); meadow near Bramslev east of Hobro, 2 Jun 1980, *Schou* (BASBG, P); east of Hobro, 20 m, 14 Sep 2005, *Lye* 29306 (O). — SOUTHERN DENMARK: Søndersø, 9 Jun 1967, *Sørensen* (LISU). — ZEALAND: Selandia bor. in palude silvae Jonstrupvang, 28 Aug 1903, *Lorenten* (BRNU, G).
- FINLAND: ÅLAND: Jomala 1 km from the main highway along the road from Ingby village to Jomala village, 8 Jun 1962, *Alava* 2836 (UPS). — LAPLAND: Ylikyla, 12 Jul 1943, *Montell* (UPS); Tervola, near Lapin lääni, 40 m, 2 Sep 2004, *Lye* 28693 (O); Posio, Kaski-Posio, near Nurmivaara, 7 Jul 1949, *Marklund* (UPS); Alakitka, Virtaniemi, 1 Jul 1936, *Lindberg* 1845 (UPS); Muonio, 8 km Sirkka, 300 m, 29 Jul 1969, *Höllner* (M). — NORTHERN KARELIA: Tohmajärvi, Akkala, wet spruce forest at Väärämäki, 1 Jul 1966, *Alho* (BRNU). — NORTHERN OSTROBOTHNIA: Kuusamo, Alakitka, Virtaniemi, 1 Jul 1936, *Lindberg* 1845 (WU). — SOUTHERN FINLAND: Pusula (church village), Kalkki mäki, below the old limestone quarries, 3 Jun 1964, *Alava* 4100 (BRNU, UPS). — WESTERN FINLAND: Sääksmäki, Ikkala, Uotila, in fruticeto juxta ripam lacus, 27 Jun 1935, *Linkola* 1844 (P, UPS, WU).
- FRANCE: AUVERGNE: Besse, megaphorbie, bords du chemin carrossable conduisant au lac de Montcineyre, 11 Jul 1971, *Bosc* (BBF); Besse en Chandesse, lac de Montcineyre, tourbière de Champezade, 1250 m, 7 Aug 1984, *Lecoite Lorain* (RNG); Puy-de-Dôme, lac de Montcineyre, 3 Jul 1962, *Gaulle* (MA); Puy-de-Dôme, Narse d'Espinasse, près Randanne, 999 m, 10 Jul 1934, *d'Alleizette* 7340 (B, BRNU, G, MA, P, RNG); Puy-de-Dôme, dans le marais dit “Narse d'Espinasse”, commune de Saulzet-le-Froid, 1000 m, 11 Jun 1994, *Grenier* (B); Narse d'Espinasse, près Randanne, 10 Jul 1934, *Rotereau* (P); Narse d'Espinasse, Jun 1932, *Chassagne* (P); between Lac Cynése and Lac Bourdouze, 1170 m, 8 Jul 1949, *Tutin* (RNG). — FRANCHE-COMTÉ: prairies humides, le long de la route de Sainte Colombe aux Granges-Narboz, 20 Jun 1922, *Le Brun* (P); Ponterlier, Hautaud, Vallée du Dugeon nature reserve, wet meadows with *Salix* spp., 815 m, 24 Aug 2013, *Martín-Bravo* 87SMB13(UPOS); Morteau, Pont de la Roche, near

the bridge, wet meadows with tall herbaceous vegetation and *Salix* spp., 755 m, 24 Aug 2013, *Martín-Bravo 90SMB13* (UPOS). — LANGUEDOC-ROUSSILLON: Matemale, Tour de Creu, prados húmedos próximos a las ruinas de la torre, 8 Jul 2012, *Jiménez-Mejías & Sandoval 125PJM12* (UPOS).

GERMANY: BADEN-WÜRTTEMBERG: Alpenvorland, Um-mendorfer Ried, Westrand, mindestens 10 Horste in Feuchtwiese zwischen Radweg und Bach Baar, 4 Jun 1996, *Sebald 12737* (STU); Naturschutzgebiet Birkenried zwischen Geisingen und Pföhren, nasse Wiese am Rand, 2 Jun 1967, *Sebald 1620* (STU); Bärenthal, bei Sportplatz, zahlreich, 10 Jul 1980, *Sebald 7521* (STU); auf Torfwiesen im Juragebiet des Hochplateaus der badischen Baar zw. Kirchen und Aulfingen, 675 m, 4 Jun 1895, *Schatz 16* (B, BASBG, BREM, BRNU, P, STU, W); 2 km W Wiesensteig, an der Fils, 5 Horste, 29 Jun 1984, *Sebald 8771* (STU); Schönbuch, nasse Waldwiese nördlich Breitenholz, Brennten-hau, 480 m, 18 May 1965, *Sebald* (STU); Torfgrube bei Schopfloch, 1932, *Müller* (STU); Schwäbische Alb, Blatt Nendingen, zahlreich in nassen Wiesen im Bäratal oberhalb Ensisheim, 690 m, 16 May 1967, *Sebald 1550* (STU); Wiese 1 km östl. Mittelstein-bach, 14 May 1970, *Sebald 3186* (STU); Schopflocher Torfgrube, 6 May 1951, *Leidolf* (STU). — BAYERN: wet meadow 1 km southwest of the Fitzendorf, 6 Jun 1998, *Kiffe* (B); Isental, Wasentegernbach W, Tal-sole, 435 m, 20 May 1961 (M); Königsberg, 12 Jun 1873 (BREM); Isental, Wasentegernbach W, Talsole, 20 May 1961, *Höller* (M); Dorfen Isental, Dorfen E, Wampeltsham N Moorwiese, 26 Jun 1972, *Höller* (M); Schwarze Laber, Vogelbrunn, 1 Jun 1963, *Höller* (M); Schwarze Laber, Vogelbrunn Flussufer, 1 Jun 1963, *Höller* (M); Umgebung von Wörth a. Main, Trennfurt, Auwäldchen am Springbach, 8 May 1990, *Wolfstetter* (M); Grabfeld, im Grenzstreifen nördlich Rothausen, 26 May 1990, *Angerer* (M); östlich Rottenburg Markt, etwa südlich vom Str.-km 12.6, in der Uferregion des Otterbaches, 16 May 1984, *Mergenthaler* (M); Kreis Parsberg, 1 km nördlich Deusmauer, Jul 1979, *Merxmüller* (M); Isental, Wasentegernbach NW, Hügelland Grosskatzbach, Weiher, 20 May 1961, *Höller* (M); Vilsbiburg N, Dietelskirchen SW, Hügelland, 21 May 1962, *Höller* (M); Vilsbiburg N, Dietelskirchen E, Kl. Vils, 21 May 1962, *Höller* (M); Vilstal bei Solling, Quelltümpel, 28 May 1959, *Höller* (M); Mehlmühle an der Isen bei Dorfen, 29 May 1975, *Angerer* (M); Erding, Flachmoorwiesen entlang der Isen, 1.5 km ost-nordöstlich Kloster Moosen bei Dorfen, 22 May 1965, *Hertel 4975, 4979, 4977* (M); Erding, Flachmoorwiesen der Isenniederung, 1.5 km ost-nordöstlich Kloster Moosen bei Dorfen/Isen, 22 May 1965, *Hertel 4965* (M); NW Aicha, bei Siegenburg, im Wald Schache und am Perkabach, 13 Jun 1941, *Mergenthaler* (M); Gr. Laaber-Tal, Oberhatzkofen SW, 19 Jun 1964, *Höller* (M); S Erlsdorf, 16 May 1985, *Meierott*

(M); Sandharlanden W, Waldrand, 5 Jun 1965, *Höller* (M); Markt Schwaben W Giggling, 15 May 1973, *Höller* (M); Isental, Dorfen E Flachmoor, 22 May 1965, *Höller* (M); Kleine Laber Tal, Mallersdorf Bhf, 23 May 1963, *Höller* (M); Sünching südöstlich von Regensburg, 5 Jun 1898, *Vollman* (M). — BERLIN: Forsthaus Fahlenberg am Gosener Kanal, 8 Jun 1975, *Benkert* (B); Jungfernheide, 25 May 1901, *Lackowitz* (B); Jungfernheide, 19 Jun 1901, *Woller* (MA); Karlshorst, im Walde, 8 Jun 1910, *Gross* (B); Möchernitz südlich vom Spandauer Schifffahrtskanal, 28 Apr 1895, *Schulz* (B); Spandauer Stadtheide, 15 Jun 1901, *Schulz* (B); Karlshorst in schattigen Waldstellen, Jun 1906, *Gross* (P). — BRANDENBURG: Fürstenberg, Boberow-See, 1960, *Freitag* (JE); Lange-Damm-Wiesen nahe Hennickendorf, Sumpfwiese zwischen Hügel 1 und 4, 10 May 1974, *Stohr* (B); Lychen, in allen Wiesen, 25 May 1889, *Heiland* (B); Maxsee bei Müncheberg, in feuchter Wiese, 6 Jun 1936, *Krumbholz 1936/19* (B); Rheinsberg, auf einer Sumpfwiese nördlich von Möckern, 19 May 1902, *Schulz* (B). — HAMBURG: Bramfeld, Jun 1891, *Fritsche* (L); Farmsen, 10 Jun 1891, *Schmidt* (JE); Wandsbeck, Jun 1892, *Pram* (JE). — NIEDERSACHSEN: Braunschweig, 1 Jun 1891, *Kuehn* (CHE); Hannover, auf der Döhrener Masch, *Jahn* (JE); Verden, Westen, 18 May 1933, *König* (BREM). — MECKLENBURG-VORPOMMERN: Grimmen, 6 Jun 1917, *Schenz* (L); Kreis Lübz, Nasse, ungepflegte Wiese vor dem Quassliner Moor bei der Quassliner Mühle, 24 Jun 1980, *Heinrich* (B); Peenetal, Gützkow, Jun 1956, *Bissé* (JE). — NORDRHEIN-WESTFALEN: Düsseldorf 1893? (BREM). — SACHSEN: Hohenstein, am Pechgraben, Jun 1894 (JE); Meiningen, zwischen Herpf und Bettenhausen, 28 Jun 1972, *Meinunger* (JE); Weimar, 24 Jun 1924, *Rothmaler* (JE). — SACHSEN-ANHALT: Magdeburg, Aken, feuchter Erlen-Birken-Bruch, c. 2 km nordöstlich Aken, 27 May 1984, *Zündorf 4573* (JE); Wolmirstedt, Rogätz, Wiese von dem NSG "Rogätzer Hang", 26 Jun 1979, *Westhus* (JE). — THÜRINGEN: Erfurt, Neu-Schmidtsteds, May 1884, *Reimerkes* (JE); Gotha, Nasswiese in einer Schleife des Kleinen Leinakanals, c. 800 m nördlich Wipperoda, 12 May 1992, *Zündorf 10635* (JE).

HUNGARY: BORSOD-ABAÚJ-ZEMPLÉN COUNTY: Gábor Sramkó, Zubogy, 20 Jun 2008, *Sramkó* (DE); Büttös, Rakaca-patak mentén, 25 Jun 2008, *Sramkó & Gulyás* (DE); Tornaszentjakab, 16 May 1997, *Penksza* (BP); Ragály, magassásosokban a Csörgő-patak mentén Zubogy közelében, 1 Jun 1999, *Somlyai* (BP); Királd, Kerek-rét"nedves réten monodomináns, 13 May 2007, *Beránek* (BP). — SZABOLCS-SZATMÁR-BEREG COUNTY: in prato uliginoso "Ótanyai-dűlő" juxta canalem "Ótanyai-csatorna" pr. pag. Piricse, 3 Jun 1998, *Felföldy* (BP); in pratis uliginosis regionis "Júlia-liget" pr. pag. Piricse, 3 Jun 1998, *Felföldy* (BP). — VAS COUNTY: 8 Jun 1891, *Waisbecker 339* (SAMU); Kőszeg, wet meadow, May 1897, *Wais-*



- becker* (BRNU, P); Kőszeg, patakban, 28 May 1897, *Waisbecker 340* (SAMU). — ZALA COUNTY: Szentgyörgyvölgy, A falutól délre a jugoszláv határ közelében, 5 Jun 1963, *Szodfridt* (BP).
- NETHERLANDS: DRENTHE: Spijkerboor, 8 Jun 1973, *Bakker & van der Ploeg* (L).
- NORWAY: AKERSHUS: Ås, S of Pollevatn, 1 m, 4 Sep 2003, *Lye 27961* (NLH); Bærum, Kalvøya, 0.5 m, 6 Jun 2004, *Lye 28348* (NLH, THR); Brønnøya, 1 Jul 1904, *Fridtz* (C). — HEDMARK: Ringsaker, between Kolstad and Skog, 215 m, 12 Aug 2005, *Lye 29129* (O). — MØRE OG ROMSDAL: Insula Naesø, 1893, *Kükenthal* (P). — TROMS: Skånland, S of Tennvatn, 25 m, 23 Jul 2006, *Lye 29912* (O).
- POLAND: DOLNOŚLĄSKIE VOIVODESHIP: Wrocław-Ciążyn, meadow along river Oława, 26 Apr 1953, *Nowak* (BRNU, WA). — LUBELSKIE VOIVODESHIP: Długie near Lublin, meadow along Bystrzyca, 25 Apr 1950, *Fijałkowski* (KRA). — ŁÓDZKIE VOIVODESHIP: Wzgórze Opoczyńskie, Antoniew, wet meadow, 29 May 2010, *Trojecka-Brzezińska* (KRA). — MAŁOPOLSKIE VOIVODESHIP: Near Cracow, meadow, 31 Apr 1941, *Waszacyk* (KRA). Łabienów, wet meadow, 28 May 1938, Łańcucka (KRA). Karpaty Zachodnie, Beskid Makowski (Średni), Trzemesnia near Myślenice, pow. myślenicki, among *Phragmites australis* in wet meadow; about 325 m a.s.l., 14 May 1999, *Bartoszek* (KRA). — MAZOWIECKIE VOIVODESHIP: Całowanie, 20 Apr 1963, *Nowak* (WA); about 2 km west of Pakosław, 7 Jun 2003, *Nobis* (KRA). — PODLASKIE VOIVODESHIP: Puszcza Białowieska, rezerwat, 1922 (WA). — ŚWIĘTOKRZYSKIE VOIVODESHIP: west of Marciel, 1 May 2002, *Nobis* (KRA); 2 km west of Sprowa, along river Pilica, 31 May 2008, *Bielecki* (KRA); Krasów, Mezoreg. Niecka Włoszczowska, wet meadow, 8 Jun 2010, *Bielecki* (KRA); Bebelno, Mezoreg. Niecka Włoszczowska, along ditch, 28 Jun 2008, *Bielecki* (KRA). — WARMIŃSKO-MAZURSKIE VOIVODESHIP: Ruciane-Nida, wet meadow near lake Guzianka Wielka, 5 Jun 2001, *Grulich* (BRNU).
- ROMANIA: CLUJ (department of): in herbidis vallis altioris, quae Malomvölgy [*Valea Morilor*] dicitur, ad Felek [*Feleacu*] Kolosvarini, 4 Jun 1904, *Borbás* (CL); Monostori erdei mocsárók [*pădurea Mănăştur*], Bélteki (CL); Strajá mc. (*Dealul Straja*) és a Nagy Csolt [*Dealul Cioltul Mare*] hegyek között egy hegyi mocsárban, Ajton [*Aiton*] község felett, c. 550 m, 5 May 1912, *E.I. Nyárády* (CL); in paludosis Kakova (*Cacova Ierii*) sehr häufig, 8 May 1905, *Barth* (SIB). — ALBA (department of): in pratis humidis Torodzko [*Torockó/Rîmetea*], 1 Jun 1885, *Barth* (SIB); in paludosis “Aranyász” inter pagos Rîmetea et Colţeşti, 22 May 1957, *Gergely* (CL); in paludosis “Kerekeger” propre pag. Colţeşti, 19 May 1957, *Gergely* (CL). — SIBIU (department of): Hermannstadt Narzissen Wiese [*Sibiu, pajiştea cu narcise – Dumbrava Sibiului*], *Fuss* (SIB, BP). — BRAŞOV (department of): Prejmer, prin pădure, 6 May 1966, *Morariu & Danciu* (BVS). — COVASNA (department of): Băile Malnaş, 7 Jun 1969, *Danciu* (BVS); Ozunca, în mlaştină, 26 May 1968, *Danciu* (BVS); Vâlcele, în fâneţe umede în Valea Simbrezii, 17 May 1968, *Danciu* (BVS); Valea Zălanului, 9 Jun 1969, *Danciu* (BVS). — HARGHITA (department of): in pratis uliginosis ad fontanum Borvîz, pr. pag. Csíkszentkirály (*Sâncrăieni*), 6 Jul 1941, *Soó* (CL); Erdély, Csíki medence, Csíkszentkirály (*Sâncrăieni*), Borsáros forrásláp (keleti rész), 23 May 2007, *Somlyay & al.* (BP); Erdély, Csíki medence, Csíkverebes (*Vrabia*) Külső Égés (Csemő) rétláp, 22 May 2007, *Somlyay & al.* (BP). — SUCEAVA (department of): sat Brădăţel (comuna Horodniceni), 9 Jun 1976, *Lupu* (IAGB).
- SLOVAKIA: BRATISLAVA (region of): in turfosis paludosis Abrod prope Velké Leváre, 1929, *Scheffer* (PRC). — NITRA (region of): Trábeč Mts., clearings in Mt. Vreteno, 30 May 1980, *Bleho* (BRNU); Žilina (region of): in paludosis ad Turóctölgyes [Dubové], 31 May 1914, *Margittai* (PRC); Turčianske Teplice, park of Dolná Štubňa, Jun 1992, *Škoviřová* (M). — BANSKÁ BYSTRICA (region of): Mičiná, Mičinské travertíny reserve, wet meadow, 10 May 1991, *Grulich* (BRNU). — PREŠOV (region of): Poprad, in paludosis Tiefergrund prope Késmárk [Kežmarok, Hlboká dolina], 8 Jun 1909–1917 May 1911, *Nyárády* (PRC).
- SPAIN: NAVARRA: Lesaka, Zalain, orilla del Bidasoa, 20 m, 20 Jun 1981, *Aizpuru & Catalán* (MA); Lesaka, Zalain, orilla del Bidasoa, 30 m, 18 May 1983, *Aizpuru & Catalán* (ARAN, MA); Lesaka, Zalain, orilla del Bidasoa, 30 m, 16 Jul 2006, *Jiménez-Mejías & al.* (UPOS); Sarries, saucedá-aliseda, 1 Jun 1986, *Aizpuru & Catalán* (SALA).
- SWEDEN: ÄNGERMANLAND: Ramsele kom., Nässjö, 21 Jun 1928, *Alm* (UPS); Junsele kom., Junsele west of river bridge, 5 Aug 1979, *Mascher* (UPS); Sollefteå kom., Näs in Långsele, 93 m, 17 Aug 2011, *Lye 33393* (O). — DALARNE: Leksand kom., Grytnäs church village, 15 Jun 1911, *Samuelsson* (UPS); Idre kom., Foskdalsvallen, below Stådjan, 7 Jul 1905, *Ringselle & Pettersson* (UPS); Hedemora kom., Jälkarbyn, 24 Jun 1915, *Samuelsson* (UPS). — GÄSTRIKLAND: Sandvikens kom., Högbo par., Jädråparken, 26 Jun 1942, *Henriksson* (UPS); Gävle kom., Valbo par., Alnäs-tjärn, 23 Jun 1918, *Smith* (UPS). — GOTLAND: Hellvi, Kylley, 14 Jun 1928, *Fries* (UPS). — JÄMTLAND: Bergs par., Svenstavik, 16 Jun 1936, *Lange* (UPS); Frostviken par., Vallåns valley facing Jormliklumpen, 9 Jul 1934, *Nannfeldt* (UPS). — MEDELPAÐ: Ånge kom., Borgsjö par., E. Sillre, 11 Jul 1904, *Johansson* (UPS). — NORRBOTTEN: Kalix kom., Nederkalix par., Säivisnäs, northernmost farm, 2 Jul 1959, *Alm* (UPS); Haparanda kom., Torneå par., Isosuo, 22 Jul 1928, *Holmberg* (UPS); Övertorneå kom., Armasjärvi mire, 50 m, 27 Aug 2005, *Lye 29192* (O); Pajala kom., Tärendö par., at the junction of the streams Na-

rkausjoki and Koinujoki (c. 10 km N of Kompelusvaara village), 22 Jul 1958, *Alm* (UPS); Jukkasjärvi, 19 Jul 1954, *Björkman* (UPS). Öland. Borgholm, Jul 1912, *Forsselius* (UPS). — SKÅNE: Lund kom., Fågelsong, 5 Jun 1884, *Tufvesson* (UPS); Tommelilla kom., Andrarum, 26 Jun 1929, *Holmberg* (UPS). — SÖNDERMANLAND: Stockholm, Brännkyka par., Högdalen, 5 Jun 1949, *Danielsson* (UPS); Vingåker kom., near Vingåker railway station, Jun 1877, *Elgenstierna* (UPS); Nyköping kom., 300 m south of Hånö, 8 m, 16 Aug 2011, *Lye 33391* (O); Prés marécageux près de Stockholm, May 1858, *Andersson 2565* (P). — UPPLAND: Uppsala kom., Västra Eriksberg at Hågaån, 23 Jun 1960, *Lundqvist 2475* (UPS); Uppsala kom., Fjällnora, shores of Ramsen, 17 m, 16 Aug 2011, *Lye 33392* (O); Norrtälje kom., Fasterna par., Mörby, 2 Jun 1931, *Plengier* (UPS); Äentuna par. 1 km NW of Storvreta on E bank of Fyris River, 9 Jun 1968, *Lundqvist 5977* (UPS). — VÄSTERGÖTLAND: Skara kom, Skaraberg, 5 Sep 1915, *Alm* (UPS); Götene kom, Kinnekulle, Martorp, 15 Jun 1928, *Skårman* (UPS); Norrköpings kom, Kullerstad par., near Måstorp, 8 Jul 1932, *Hylander* (UPS); Ödehögs kom, Tollstad par., Omberg, Alvastra monastery, 6 Jul 1951, *Smith* (UPS). — VÄSTMANLAND: Lindesbergs kom, Ramsberg par., Håkonsboda, 6 Jun 1989, *Sundkvist* (UPS); Lindesbergs kom, Siggebohyttan, 8 Jun 1986, *Asklund* (UPS).

SWITZERLAND: BERN: Fäggen, Apr 1845, *Schatch* (ZT). — SCHAFFHAUSEN: Herblingen, 25 May 1971, *Isler-Hübscher* (ZT); Fulachtal, Herblingen, 11 Jul 1979, *Kummer* (ZT).

UNITED KINGDOM: HERTFORDSHIRE: near West Mill, near Buntingford, 26 May 1960, *Dony 3815* (BM); Braughing (Hamel's) Meads, spring-fed mire beneath a steep, wooded hill overlooking the flood plain of the river Rib, 10 May 2011, *James* (UPOS).

## Appendix 2: List of *Carex cespitosa* hybrid specimens studied

*Carex cespitosa* × *C. acuta*. — AUSTRIA: STEIERMARK: Raab-Gebiet, Fürstenfeld N, Bierbaum NE 260 m, 4 Jun 1966, *Höller* (M).

*Carex cespitosa* × *C. elata*. — AUSTRIA: CARINTHIA: Nahe der steirischen Grenze südlich von Mühlen in einem Flachmoor auf dem Hörfeld, 20 Jun 1976, *Melzer* (M). — CZECH REPUBLIC: CENTRAL MORAVIA: Olomouc, in paludosis prope aquaeductum, 21 May 1927, *Otruba* (K). — DENMARK: ZEALAND: in palude silva Tisvilde, Jun 1887, *Holm* (CHE). — FRANCE: FRANCHE-

COMTÉ: Marais du Sour paist Besançon, Jun 1846, *Grenier* (K). — GERMANY: BAYERN: Freising SW, 12 May 1947, *Höller* (M). — BERLIN: in der Möchernitz, 14 Jun 1901, *Conrad* (B); in der Möchernitz, am Spandauer Kanal, 12 Jun 1902, *Conrad* (P). — MECKLENBURG-VORPOMMERN: Kreis Nordwest-Mecklenburg, Neukloster, Feuchtwiesenbrache am Ortsausgang südöstl. der Straße nach Wismar (“Am Düsterberg”), 9 Jun 1997, *Kiffe* (B). — SACHSEN-ANHALT: Krs. Stendal, bei Ferchels nördlich der Biologischen Station “Untere Havel” (B). — THÜRINGEN: Weimar, Ettersburg, 16 Jun 1894, *Bornmüller* (B).

*Carex cespitosa* × *C. nigra*. — AUSTRIA: SALZBURG: In pratis paludosis Salisburgi, auf den Sumpfwiesen bei Ursprung, no date, *Bausch* (HEID, with *C. cespitosa*). — CZECH REPUBLIC: CENTRAL MORAVIA: distr. Boskovic, Újezd u Boskovic, wet meadow 2 km E from village, 9 Jul 2000, *Karkanová* (BRNU); Olomouc, Šternberk, in pratis turfosis supra Nedvězí (Nebes) prope Německá Libina, 5 Jun 1932, *Otruba 780* (K). — FRANCE: LANGUEDOC-ROUSSILLON: Matemale, Tour de Creu, prados húmedos bajo las ruinas de la torre, 8 Jul 2012, *Jiménez-Mejías & Sandoval 125bisPJM12* (UPOS). — GERMANY: BAYERN: Oberbayern, Pöcking, Kr. Starnberg, Moorgraben in Luss, 8 Jun 1958, *Poelt* (M). — BRANDENBURG: Biesenthaler Becken südl. Biesenthal, Feuchtwiese am Südrand des Streesees, 21 May 1998, *Kiffe* (B); Lkr. Oberhavel, Feuchtwiese westlich des Nehmitzsees, 11 Jun 2001, *Kiffe* (B); Westende des Dretzsees nördl. Teschendorf, “Kleine Herrenwiese”, Feuchtwiese, 21 May 1998, *Kiffe* (B); südwestlich Lychen, im gestörten Randbereich im Erlenbruch des Mellenseemoores südlich Mellensee, 14 May 1999, *Kiffe* (B). — HESSEN: Vogelsbergkreis, NSG “Mühlwiesen bei Niedermoos”, Feuchtwiese am Abfluss des Niedermooser Teiches, 18 May 2001, *Kiffe* (B). — NIEDERSACHSEN: Stade, Schwingetal nordöstl., Mulsam, in einer c. 10 Jahre alten Erlenpflanzung auf einer Feuchtwiese an einem Bach nördl. der Schwinge, 29 May 1997, *Kiffe* (B); Niedersachsen, Lkr. Lüchow-Dannenberg, SE Jiggel (bei Clenze), Jiggeler Moor, 14 Jun 1998 (B). — MECKLENBURG-VORPOMMERN: Kreis Parchim, Sternberg, südöstl. Dabel, Feuchtwiese am Weg auf die Halbinsel am Klein-Pritzer See, 10 May 1997, *Kiffe* (B). — SCHLESWIG-HOLSTEIN: Kreis Herzogtum Lauenburg, Hellbachtal bei Mölln, 17 May 1997, *Kiffe* (B); Kreis Herzogtum Lauenburg, nordöstl. Lauenburg, Feuchtwiese bei Stötebrück, westlich des Elbe-Lübeck-Kanals, 12 Jun 1999, *Kiffe* (B). — POLAND: SILESIA: distr. Lubin [Luben], Zimna Woda [Kaltwasser], wet meadow, 11, 18 and 25 Jun 1903, *Figert 11284* (BRNU). — SLOVAKIA: distr. Banská Bystrica, Mičiná, reservation Mičinské travertíny, wet meadow, 10 May 1991, *Grulich* (BRNU).