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Juncus bulbosus f. *submucronatus* (Juncaceae), a new taxon from Europe, Australia, Canada, Chile, Azores and Morocco

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The paper describes a new taxon, *Juncus bulbosus* f. *submucronatus* J. Proćków, designates an epitype for *J. bulbosus* L. f. *bulbosus*, and details the distribution of both forms. The new form is native to most of Europe, NW Africa and Azores, and introduced to E Canada, SE Australia and S Chile. It is more frequent in western, central (excluding Poland) and southern Europe, contrary to f. *bulbosus* which is more common in northern Europe (excluding Iceland and Faroe Islands) and in Poland. A detailed key to all the infraspecific taxa of *J. bulbosus* is given. The new taxon differs from its closest relatives by the presence of dorsal (i.e. localised just below the apices of perianth segments) mucros usually pronouncedly or at least distinctly exceeding the perianth tops. The chromosome number for the new taxon (2n = 40) and ecological differences between the forms are given. In Poland f. *submucronatus* grows in eutrophic ponds and f. *bulbosus* thrives in oligotrophic *Lobelia* lakes.

Key words: bulbous rush, epitype, morphology, nomenclature, taxonomy, typification

Introduction

The paper is a part of a project to typify taxonomic synonyms of *Juncus bulbosus* L. (e.g., Proćków 2002, 2006a, 2006b, 2006c, 2007, 2008a, 2008b, 2008c), aimed at clarifying the intricate synonymy in this variable taxon. I also describe a new taxon, *Juncus bulbosus* f. *submucronatus*, designate an epitype for *J. bulbosus* L., and detail the distribution of the two forms (f. *bulbosus* and f. *submucronatus*) as well as selected characters which are useful in identification.

The height (length) of the plant varies according to habitat, from 1.5 cm on dry ground to 200 cm when floating. Most of its morphological characters are variable and correlated with water level. Specimens which are 'almost completely' dissimilar can be found in the same waterbody in consecutive years; non-metric characters are thus more applicable for infraspecific determination (Proćków 2008a).

As a result of the high morphological diversity of the bulbous rush, at least 60 synonyms (including new combinations) have been published. The status and range of the taxa to which

some of them apply have been recently revised (Kirschner 2002). The name *Juncus bulbosus* L. has already been typified as well (Snogerup 1985, Proćków 2002). In turn, *J. kochii* F.W. Schultz and *J. supinus* Moench var. *nigritellus* W.D.J. Koch have recently been lectotypified as homotypic (Proćków 2006a) and at present are best regarded as *J. bulbosus* L. subsp. *kochii* (F. W. Schultz) Reichg. (e.g., Casper & Krausch 1980, Proćków 2006a, 2008a). A recent taxonomic revision of *J. bulbosus* subsp. *bulbosus* and subsp. *kochii* clarified the doubtful status of *J. kochii* (Proćków 2008a); it should also be noted that both taxa were defined there to exclude f. *submucronatus* because the latter was planned to be treated at the subspecies rank. A problem is also the distributions of subsp. *bulbosus* and subsp. *kochii* which broadly overlap and are exceedingly wide. The subspecies occur together throughout a large part of the range of the species (so they are sympatric, not allopatric), however subsp. *kochii* is limited only to the western part of Europe.

Mucros on the dorsum of the outer perianth segments are not mentioned by earlier authors who studied *J. bulbosus* (e.g., Buchenau 1890, Snogerup 1972, 1985, Fernández Carvajal 1983, Kirschner 2002). When properly defined, they are diagnostic and vary among populations across Europe.

Material and methods

Morphology was studied using herbarium materials. Only specimens in which the dorsal mucros on the outer perianth segments were undamaged were designated as paratypes. Specimens with damage to the brittle mucros are not useful and are not cited. I strongly recommend that the perianth mucro, length and proportions should be examined using backlighting (even weak, i.e. also when the plants are glued to herbarium sheets).

In the following sections, the asterisk (*) is used to indicate that a randomly selected part of the material (or number of specimens) was also analysed biometrically.

A total of 5426 (1048*) plant specimens (including 2576 plants listed as paratypes here) of *J. bulbosus* f. *submucronatus* were examined (analysis of non-metric/metric characters) from 1164 herbarium sheets, including 228* (and including 587 sheets listed as paratypes here), from B*, BIL, BM*, BR*, C*, DBN*, DRAPN, E, GOET*, H*, HAL*, HBG*, KRA*, L*, LAU, LG*, LISU*, M*, MA*, MSB*, P*, PBMA, POZ*, S*, SZCZ, TAA, TRN*, TUB*, WA, WRSL*, WSRP & Herb. of Dpt. of Biodiversity & Plant Cover Protection, Wrocław University* (acronyms of Polish herbaria not mentioned in the *Index Herbariorum* follow Mirek *et al.* 1997). From within the range, the following parts of the plants were randomly selected and measured: 326 mature anthers, 326 filaments and 338 perianth segments, 306 capsules and 210 seeds. In order to determine the variation in the number of flowers in the heads, 303 randomly selected heads from HBG, POZ, WRSL & Herb. of Dept. of Biodiversity & Plant Cover Protection, Wrocław University were analysed.

A total of 3868 (784*) plant specimens of *J. bulbosus* f. *bulbosus* were examined (analysis of non-metric/metric characters) from 774 (115*) herbarium sheets (from B, BIL, BM, BR, C, DBN*, GOET, H*, HAL, HBG*, KRA, L, LAU, LG, M, MA, MSB*, POZ, S*, SZCZ, TAA, TRN, WA, WRSL*, WSRP & Herb. of Dpt. of Biodiversity & Plant Cover Protection, Wrocław University*). The collections come from (west to east): Iceland, Portugal, Spain, France, Ireland*, Scotland (including Orkney Islands and Inner Hebrides), England*, Belgium*, Holland, Germany* (including Frisian Islands), Switzerland, Austria, Poland*, Denmark (including Faroe Islands), Norway (including Lofoten Islands), Sweden*, Hungary, Finland*, Estonia, Latvia, Russia* (including Gulf of Finland*), Algeria, Tasmania, New Zealand, Nova Scotia, Newfoundland. From within this range the following parts of the plants were randomly selected and measured: 333 mature anthers, 333 filaments and 333 perianth segments, 483 capsules and 177 seeds. In order to determine the variation in the number of flowers in the heads, 903 randomly selected heads from LG, HAL & GOET were analysed.

Generally, the present study used methods similar to those employed in their research of the *Juncus buffonius* agg. by Cope and Stace (1978)

to distinguish the taxa and also by Proćków (2008a) to determine the bulbous rush subspecies. In addition to ranges of the most common values, their frequencies (percentages in brackets) for all the samples of the respective categories are given. Additional characters of f. *bulbosus* and f. *submucronatus* are compared in Table 1. The bulbous rush fruits were measured excluding the mucros (not clearly stated by Cope & Stace 1978), which are usually short within this species.

The map of proportion of the two bulbous rush forms in Europe is accessory to determine where the forms are more or less common and is based on a total of 1350 localities (all that were assignable to countries), 573 for f. *bulbosus* and 777 for f. *submucronatus*, with exact frequencies given in the caption to the map. All duplicate sheets, including exsiccates and cases where: (1) location (for example village) was the same and the sheets differed only in collection dates, and (2) the collection date was identical, and the location description differed only slightly, or it followed from the descriptions that the localities were adjacent to each other, were treated as single localities.

All specimens of *J. bulbosus* which could not be assigned to f. *bulbosus* or f. *submucronatus* were omitted from the analyses. It should be noted however that in the examined herbarium material (determination date prior to this publication) all of them were labelled as subsp. *bulbosus*, since at the beginning of my analysis I treated the new taxon as a variety; and so all

Table 1. A comparison of the additional differences between *Juncus bulbosus* f. *submucronatus* and f. *bulbosus*.

	f. *submucronatus*	**f. *bulbosus***
Shape of perianth segments	Usually narrower: lanceolate (Fig. 2E) to narrowly lanceolate and even broadly parallelsided or — in the case of inner perianth segments — elongate, parallelsided, or to lanceolate-elongate (Fig. 2C–D, F–G, Z) or lanceolate to elliptical (Fig. 2H)	Usually wider (Fig. 3A, D, E–H, and #fig. 2F, J): from lanceolate through widely lanceolate, ovate-elongate, ovate-lanceolate to ovate, or less often — and mainly in the case of inner perianth segments — to narrowly lanceolate or elongate (Fig. 3B, E, G, and #fig. 2I, L). Specimens which ceased to flower long ago and in which the scarious margin of their inner perianth segments is damaged should not be analysed — such segments may be then narrowly lanceolate
Width of scarious margin of inner perianth segments	Inner perianth segments when narrowly lanceolate, they can be narrowly scarious as well (Fig. 2F–G, H, Z), although sometimes in their upper, 1/4 height they may be widely membranous however (generally the membrane width varies even within heads)	More often widely (Fig. 3A, C–D, F, H, and #fig. 2F, H–K) membranous and most often along the entire margins (#fig. 2F, H–I, K–L)
Comparison of possibilities of length of anthers from inner (if present) and outer whorl of androecium	Anthers in both whorls, if present, roughly equal to filament length or rarely in internal whorl anthers fine (i.e. up to ca. 0.5 mm length), distinctly shorter than filaments and then only in some flowers. When 3 anthers — exceptionally all anthers fine; very exceptionally 6 fine anthers (only specimens from Thuringia, Germany, Jul. [18]84 *Steitz & Kuglers s.n.* at POZ)	Anthers at least in outer whorl, or in both whorls, if present, roughly the same length as filaments or if not — anthers exceeding 0.5 mm. Anthers of inner whorl (if present!) of a size most often corresponding to anthers of outer whorl (#fig. 2F–H). Exceptionally anthers of inner whorl shorter (*see* Jul. [19]64 *J. Ławrynowicz s.n.* at POZ)
Habit of shoots of ecological modification '*fluitans*' (shoots submerged/floating)	Elongated floating shoots or thin, very delicate or stout, more massive	Elongated floating shoots stouter

in Proćków 2008a.

the paratypes and non-paratypes (specimens not mentioned here but analysed when there was no doubt that they represented the new form, *see* above) on herbarium labels were determined as "var. *submucronatus*". The case of my determinations of "var. *bulbosus*" is analogous, they should bear labels with "f. *bulbosus*".

Epitypification of *Juncus bulbosus* L. subsp. *bulbosus* var. *bulbosus* f. *bulbosus*

The lectotype of *Juncus bulbosus* (Herb. Linn. No. 449.27, right-hand-side specimen, LINN), with respect to the examined character (mucros on the dorsum of the outer perianth segments), is in a very poor condition, i.e. a great part of the upper fragments of its outer perianth segments is damaged, mainly by insects. Thus some mucros, when present, could be shorter/longer that the apices of the outer perianth segments; because of the damage the character is poorly visible. Generally in the present condition the outer perianth segments of the lectotype bear few mucros, mostly shorter than or at most as long as the apices of the perianth segments. Three mucros however are longer (below them there are hood-like, membranous terminations of apices of perianth segments), which indicates that the specimen could either have originally more such mucros which were later damaged, or such single mucros are these which can be found exceptionally in f. *bulbosus* (*see* Detailed description of mucros, following the description of the new taxon).

The lectotype of *J. bulbosus* is ambiguous and cannot be critically identified for precise application of the infraspecific name of a taxon, hence the need to designate an epitype (cf. McNeill *et al*. 2006: Art. 9.7). I decided to designate the specimen collected by Axel Arrhenius (no. 154), stored at C, as epitype for the name *Juncus bulbosus* L. f. *bulbosus*. This sheet contains 19 plants (seven glued and 12 not glued, in an envelope) with flowers and fruits in various stages of development. They clearly show the distinctive characters of the nominate form (no mucros on the dorsum of the outer perianth segments) and are very well preserved.

Juncus bulbosus L. subsp. *bulbosus* var. *bulbosus*

Sp. Pl.: 327. 1 May 1753. — [Lectotype (designated by Snogerup (1985: 20); restricted by Proćków (2002: 551)]: Herb. Linn. No. 449.27, right-hand-side specimen (LINN). — Epitype (here designated): Finland. Regio Aboënsis, par. Pargas, Gunnarsnäs, loco limoso subexsiccato, [60°16´N, 22°18´E], VIII.1893 *A. Arrhenius 154* (C). Plantae Finlandiae Exsiccatae e Museo botanico Universitatis Helsingforsiensis distributae. [Species in Finlandia australi et media sat raro occurit, ad septentrionem versus 64° parum superat.], "*Juncus supinus* Moench f. *pygmaeus* Marss.".

f. *submucronatus* J. Proćków, *f. nova* (Figs. 1 and 2)

Haec planta Junco bulboso f. bulboso similis, sed in capitulis eius, saltem in nonnulis partibus inflorescentiae, in dorsis, prope infra apices saltem partium tepalorum externorum (plerumque non minus in singulo trium tepalorum externorum), mucrones distinti (saepe praecellentes), plerumque acuti (rarius obtusi) fere significanter/illustriter vel saltem distincte (rarius solum modice) superantes illorum apices adsunt (Fig. 2).

Type: Poland. Polonia meridionali-occidentalis [SW Poland]. Palatinatus Silesia Inferior [Dolny Śląsk]: Wrocław Leśnica, 51°8´N, 16°51´E, ad ripam et in aqua piscinae eutrophicae, situ meridiano-occidentali lacus, 31.V.1999 *J. Proćków 990531/1* (holotype WRSL; Figs. 1 and 2A, B, E, L), *990531/2–17* (isotypes WRSL, Herb. J. Proćków).

Etymology: The plant is named after the sharp mucros usually present dorsally just below the apices of outer perianth segments *(= 'sub' + 'mucronatus')*.

Perennial, caespitose, whithout rhizomes, up to 1.5–25 cm high. Terrestrial leaves mostly subbasal, terete or slightly flattened to furrowed dorsally, pluritubular, up to 1.4 mm thick. Submerged leaves bitubular to pluritubular, long, hair-like thin; surface floating and emerged leaves ca. 1.2–2.0(2.2) mm thick. All the leaves imperfectly septate; auricles to ca. 1.5–2.0 mm long, obtuse, membranous. Leaf sheaths often strongly (or delicately) suffused with claret colour. Inflorescence of (1)2–8(19) [86.1%] semiglobose to obconical haeds. Heads each with (1)2–6(15) [90.8%] flowers, fine or larger, dense, compact, and sometimes when bear-

Fig. 1. Holotype of *Juncus bulbosus* f. *submucronatus* (*J. Proćków 990531/1*, WRSL). — **A**: Herbarium specimen. — **B**: Inflorescence.

ing numerous flowers (7–15), bristled. Tepals (1.7)2.0–2.9(3.4) [86.5%] mm long. Outer perianth segments most often distinctly (or only slightly) shorter than the internal (however in some flowers outer perianth segments can be distinctly and considerably longer than the internal, or both whorls are of the same length). Perianth segments lanceolate (Fig. 2E) to narrowly lanceolate and even broadly parallelsided or, in the case of inner perianth segments, elongate, parallelsided, or to lanceolate-elongate (Fig. 2C, D, F, G, Z) or lanceolate to elliptical (Fig. 2H). External perianth segments can be sharp, extremely rarely some of them with a pronounced, massive, sharp mucro at their apex; the mucro can sometimes be cherry-brown, black or dark brown, and in the last two cases often with a light tip. External perianth segments can also be only tapered or blunt, rounded, often with mucro set on the dorsum below the apex, especially in the case of blunt or rounded perianth segments, i.e.: *In the heads, at least in some parts of the inflorescence, dorsally, just below the apices of at least some outer perianth segments there are distinct (often pronounced), usually sharp (less often blunt) mucros* (Fig. 2) of varied appearance. Mucros occur *usually on at least one of the three outer perianth segments* and can be: (1) long and stout, not so rarely with a broad base, i.e. triangular in longitudinal section (Fig. 2H, J–M, S, U, W), (2) long and thin (Fig. 2A–D, H, J, O, Q–S, U), or (3) short and stout, often with

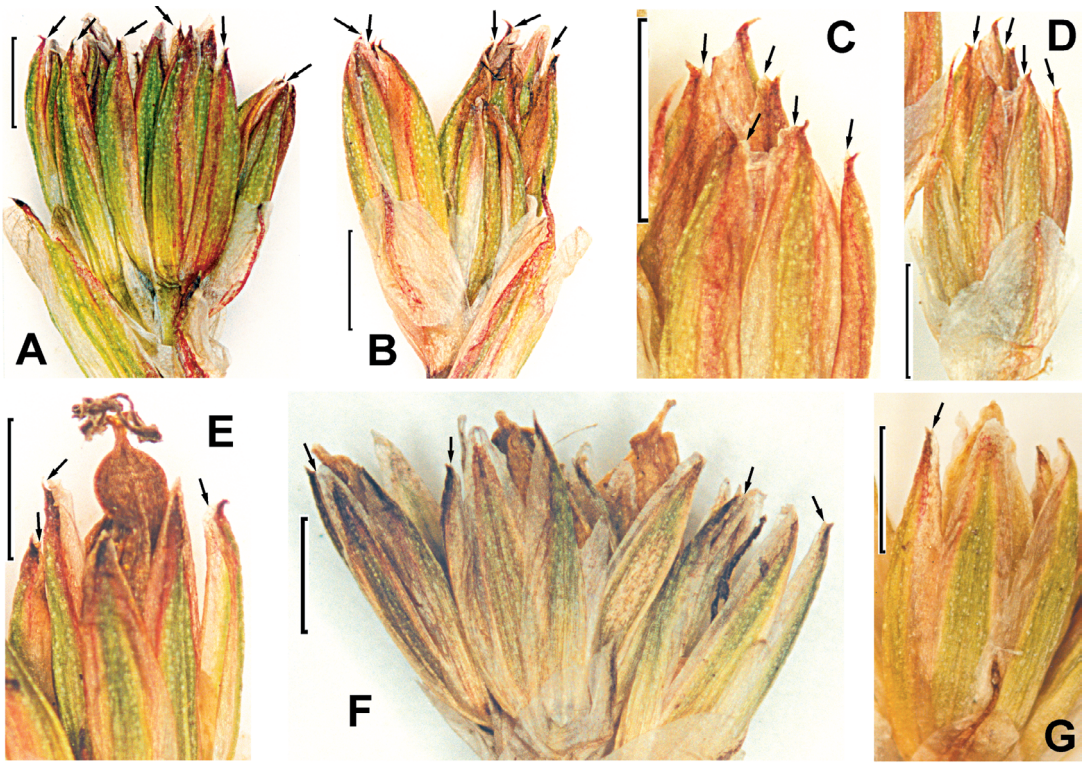
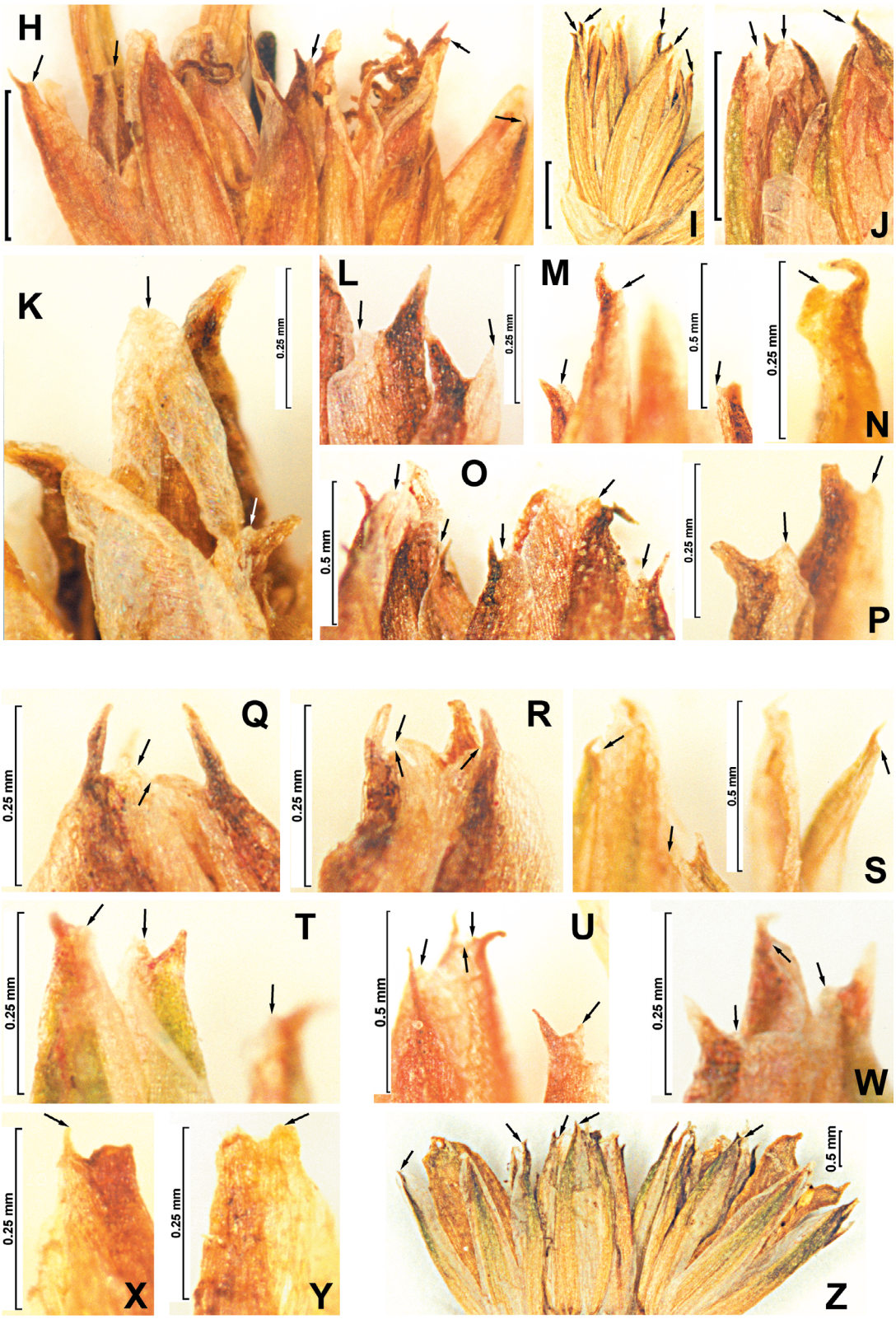


Fig. 2 (**A**–**G** above and **H**–**Z** on the next page). Diagnostic features of *Juncus bulbosus* f. *submucronatus*; for details *see* description and Table 1. Scale bars = 1 mm if not indicated otherwise. Arrows indicate apices of outer perianth segments. Origin of the specimens: Poland (**A**, **B**, **E**, **L**): Dolny Śląsk, Wrocław Leśnica, *J. Proćków 990531/1* (holotype WRSL). Denmark (**C**, **D**, **T**, **U**, **W**): Nordjylland reg., Lake Madum, *K. Larsen 38757 & S. S. Larsen 12767* (MA 367357, LG), (**G**): Ringkøbing reg., Fasterholt, *K. Larsen 37434 & S. S. Larsen 10940* (LG). Spain (**F** and **Z**): Galicia, Pontevedra, Vila de Cruces, *M. I. Romero s.n.* (MA 546747). Belgium (**H**): Prov. Liège, Baraque Michel, *J. Lambinon 58/B/1939* (LG), (**J**): Prov. Liège, Mare en Fagnes (Grd Oueux), *L. Renard s.n.* (LG). Portugal (**I**, **K**, **M**, **P**): Porto, arredores, Ermezinde, Alfena, *J. Castro s.n.* (MA 188346). Detailed provenance unknown (**N**): Fr. Bohemia, *Willk s.n.* (MA 146142). Holland (**O**): prov. Utrecht, boggy ditch along railroad tracks from Maarn to Maarsbergen, *P. A. Mennega 154* (MA 166453). Germany (**Q** and **R**): Saxony, im Colditzer Forst nordöstlich Buchheim, *P. Gutte 21192 [M-B] 24914 [MdP]* (MA 277542). France (**S**): Alsace, Haut-Rhin dpt., Ueberstrass, am Etang Neuf, *E. Berger 4308 & 17672* (MA 589857), (**X** and **Y**): Aquitaine, Gironde dpt., La Teste a Buch, *J. Lange s.n.* (MA 146134).

a widened base i.e. triangular in longitudinal section (Fig. 2E–F, I, T, Z) or else (4) (very) fine, short and delicate/(very) thin (Fig. 2E, G). *All such mucros are usually pronouncedly or at least distinctly (less often only slightly) exceeding the apices*. They are most often rather numerous but best visible especially in the upper, youngest part of the inflorescence, and most of all in buds, just before blooming but also in young perianths in slightly later stages of blooming and, although not always in all buds, sometimes practically only there! In some, especially older parts of the inflorescence the mucros may be scattered or absent, because in places, often in lower, older parts of the inflorescence they may be broken off and thus invisible or their length cannot be estimated (Fig. 2M, O–P, X–Y). They can also be poorly visible in the entire inflorescence, for example when the plants are collected too late, i.e. when they had (long) ceased to flower. (In all such cases when there is no certainty as to what type of mucros got damaged, the specimens should not be determined as f. *submucronatus*!). Thus the mucros are rarely well visible in the heads at an advanced stage of fruiting, because they are very brittle and break easily. A part of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the mucros is sometimes bent in different directions: outwards i.e. downwards, often strongly, for example hook-like or horizontally, at a nearly right angle (Fig. 2A–E, J–K, O, U), or weakly hook-like bent inwards (Fig. 2D, N, R–S), i.e. it may also appear that they only indistinctly or not at all exceed the apices of the outer perianth segments. Thus the mucros in spite of their actual length optically may not exceed the perianth segment apices, although if properly positioned towards the apices, they would conform to the diagnosis. Sometimes some mucros give an impression of being apical, but at their bases (below them) there is a more or less visible, distinct hood-like terminated membranation of the perianth segment apex (Fig. 2L, Q–R, U), although sometimes it is only developed as a narrow ridge. Unfortunately in older parts of the inflorescence such membranation can be broken/damaged and the mucros may appear at least partly to grow out of the perianth segment apices and thus not dorsally. Mucros in viviparously overgrown heads are much less clearly visible, and in heads infected by the homopteran (Homoptera, Psyllodea) *Livia junci* they can be completely invisible. Mucros in the inflorescence can occasionally be accompanied by single, few, shorter spines, for example thick, massive and sharp or fine and short, which do not exceed the apices of the outer perianth segments but e.g., they may be either almost equally long or shorter than the perianth. Exceptionally in some parts of the inflorescence there may be additional spines relatively far below the perianth segment apices and thus not exceeding the apices. Sometimes a small part of mucros has the form of fine, massive, tapered tubercles, also not exceeding the perianth apices (Fig. 2H, J).

Inner perianth segments at apex blunt, usually gently rounded, less often (poorly) tapered or sharp and then usually not in all the flowers of the plant. (Attention: in dry material the apical membranation can be rolled to resemble a sharp termination; very rarely membranes of some inner perianth segments of the plant are really sharply terminated.) Perianth segments green or greenish; sometimes on their margins (sometimes only narrowly) and in their upper parts, and usually not in all perianth segments of the plant, with distintly cherry/claret/cherry-brown or carmine-coloured (or only suffused) living part. Thus the colouration pertains to the perianth leaf itself and not to its membrane while the central part remains green, i.e. the area outside the margins and the upper part. However the perianth segments often on a considerable area can also be cherry (claret-brown/brown-cherry/claret/carmine) suffused or stronger coloured, brown-claret/carmine. After cessation of flowering the perianth may become brown. Perianth segments in both whorls generally marginally widely or very widely membranous, mainly in their upper part i.e. 1/4 to 2/3 from top, mainly in the case of inner perianth segments, but also on their entire length. Outer perianth segments can be especially strongly membranous. Inner perianth segments, when narrowly lanceolate, can be narrowly scarious as well (Fig. 2F–G, H, Z), although sometimes in their upper, 1/4 part they may be widely membranous. However, generally the membrane width varies even within heads.

Anthers usually 3, or exceptionally 6, and then often only in some flowers, their number may vary within heads, 1/2–2/3 as long as tepals. Anthers (0.3)0.5–0.7(1.1) [71.2%] mm long, filaments (0.4)0.6–0.9(1.2) [76.7%] mm long, anther/filament length ratio (0.3)0.6–1.0(1.7) [67.2%]. Anthers in both whorls, if present, roughly equal to filament length or rarely in internal whorl anthers fine, distinctly shorter than filaments and then only in some flowers. When 3 anthers, exceptionally all anthers may be fine; very exceptionally 6 fine anthers (only specimens from Thuringia, Germany, Jul. [18]84 *Steitz & Kuglers s.n.*, POZ).

Capsule (2.0)2.5–3.3(4.2) [83.7%] mm long, most often distinctly longer than perianth, but not so rarely also shorter than or equal to the perianth, most often narrow, elliptical or (strongly) elongate, narrow elliptical, or narrowly elongate, then narrowed at apex, but also wide elliptical with a blunt, rounded apex, apically trigonous, and with a short beak, unilocular. Mature capsule light (Fig. 2F–G, Z) or dark (Fig. 2E–F): from beige through dark beige, brown-beige, light brown to brown, also greenish-straw, green/greenish-beige, greenish-(light)brown or straw brown/beige; sometimes

capsules bicoloured, exposed part brown, part hidden by the perianth, green-straw; they burst with three sutures. Seeds (0.4)0.5–0.6 [85.2%] mm long, 0.2–0.3 mm wide, length/width ratio: (1.6)2.0–2.6(3.0) [75.7%], wide elliptical or elliptical, apically narrowed, in the shape of a more or less elongated lemon, which can be more or less flattened at the apex, usually light brown, less often beige, dark beige, brown-beige, or orange-brown.

Detailed description of mucros of *J. bulbosus* f. *bulbosus*

Mucros on dorsum of outer perianth segments usually absent (Fig. 3A–D, G, H) or, when present, then distinctly sharp (less often blunt), smaller/shorter/fine or larger/longer, but *usually not exceeding the apices*. Most often they are much shorter then the apices (Fig. 3E, F, N–R, W, X), and sometimes only developed as at most bluntly/rounded tubercle, then often indistinctly marked (Fig. 3L), or (slightly) sharpened swellings (Fig. 3I–K, M). Generally the mucros, when present, are usually few in the inflorescence, scattered, very rarely more numerous. The mucros can be: (1) fine but distinctly longer, triangular in longitudinal section, i.e. with a widened base (Fig. 3N, O) or thin (Fig. 3E–F, O), or (2) (very) fine, short, massive (Fig. 3I–K, P and Q) or indistinct (Fig. 3L, M). Rarely they can be hook-like (Fig. 3W), but their tips (when straightened) would not exceed the apices of outer perianth segments from whose dorsum they protrude. Exceptionally single mucros as long as or longer than the apices of outer perianth segments and thus can exceed them (slightly) as well. Extremely rarely some mucros seem to grow dorsally, but below them there is no membranous, hood-like margin of the perianth apex and thus such mucro is apical. Also relatively rarely the mucros may be located dorsally, but far from the apex (Fig. 3I–K, M, O, Q, W, X).

Outer perianth segments sharply terminated, not so rarely with a massive, stout or thin and delicate spine-like, sometimes bent (Fig. 3U) mucro at the apex (Fig. 3S–U). The mucro is apical also when the upper part of perianth membranation runs along it. The mucro can be chestnut brown, sometimes with a light tip.

Chromosome numbers

The chromosome number for *J. bulbosus* f. *submucronatus* (2n = 40) was taken from the specimens collected from its type locality (Wrocław Leśnica, Dolny Śląsk, SW Poland, 51°8´N, 16°51´E) and is the same as for f. *bulbosus* and subsp. *kochii* (Casper & Krausch 1980, Oberdorfer 1994, Rutkowski 1998).

Distribution

The new form is native to most of Europe, NW Africa and Azores; it is introduced in E Canada, SE Australia and S Chile (compare Kirschner 2002 and Proćków 2008b). At the initial stage of my studies on the variation of the bulbous rush, I was convinced that the mere presence or absence of mucros on the dorsum of the outer perianth segments was enough to diagnose infraspecific taxa, however after examining a more extensive material it turned out that this was not the case. I realised rather soon that within one population (a few plants on a herbarium sheet from a single set) there were flowers both with mucros on the dorsum of the outer perianth segments, and without them, but then the mucros usually did not exceed the apices (f. *bulbosus*). Thus only after having defined the length proportion of the mucros and apices of the outer perianth segments a geographical pattern became apparent: f. *submucronatus* occurs in Australia and South America (and is lacking the nominal form there), while f. *bulbosus* occurs in New Zealand and Tasmania (and f. *submucronatus* is lacking there). Moreover f. *submucronatus* is more frequent in western, central (excluding Poland) and southern Europe, contrary to the nominal form which is more common in northern Europe (excluding Iceland and Faroe Islands) and in Poland (Fig. 4). The range of subsp. *kochii* is limited to western Europe, up to eastern Germany and north and northwestern Sweden at most (Proćków 2008a). A distribution map of

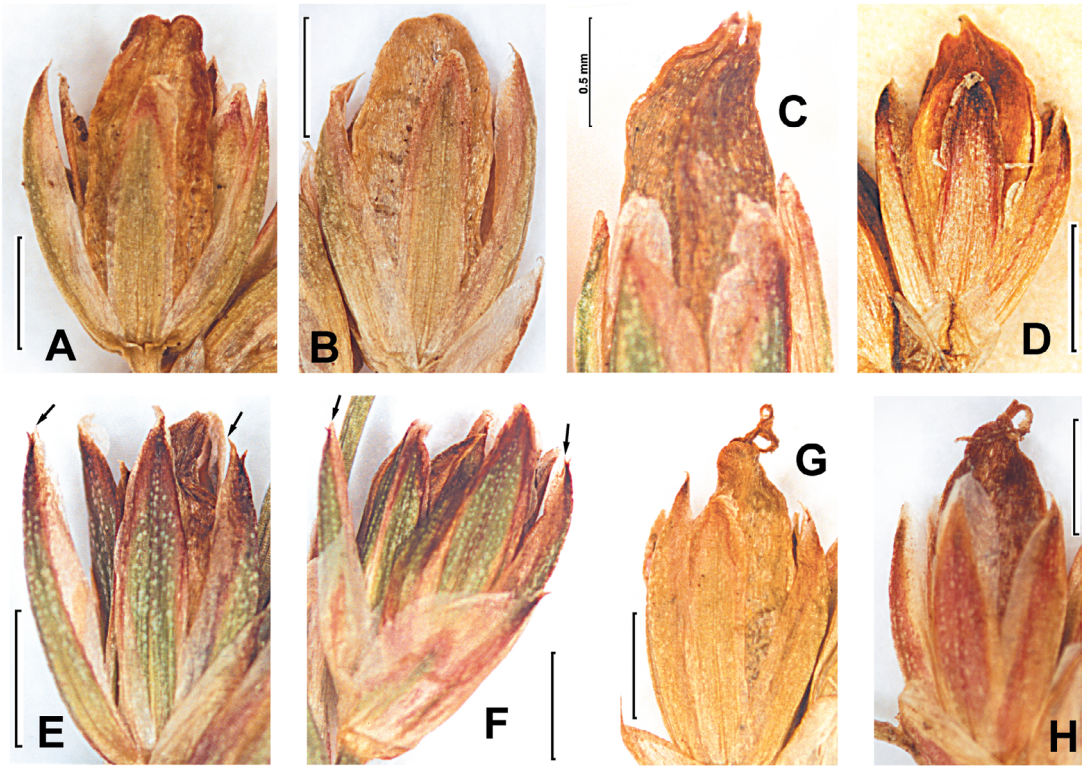
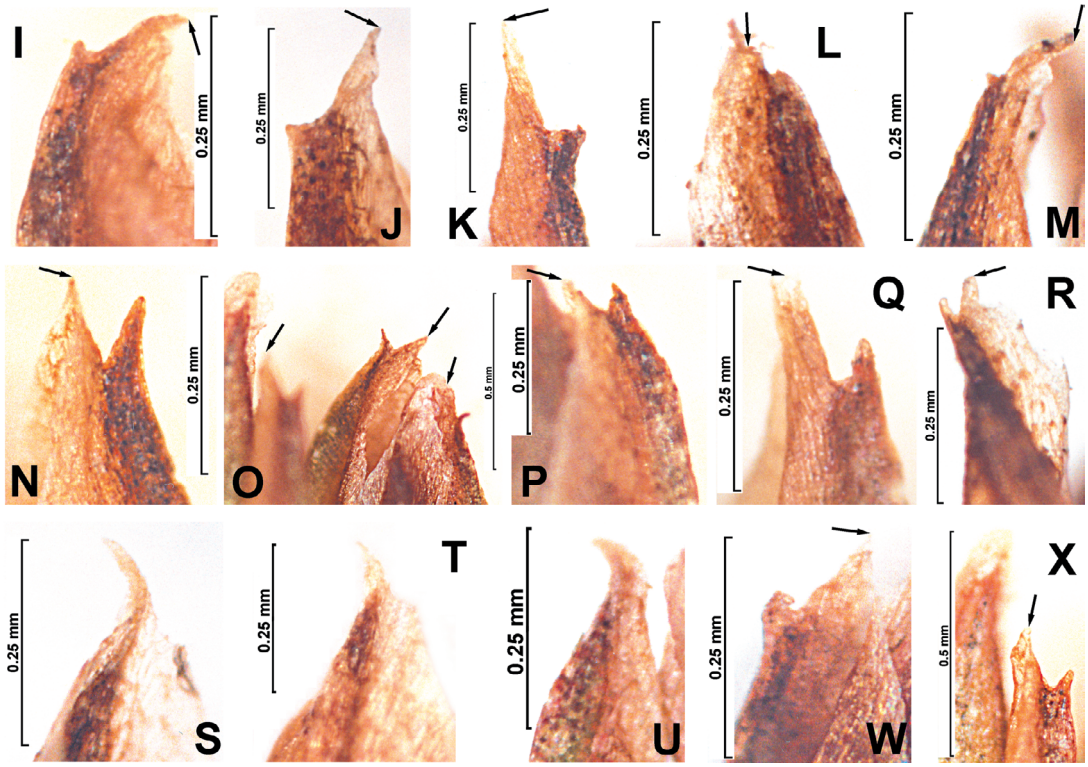


Fig. 3 (**A**–**H** above and **I**–**W** on the next page).Diagnostic features of *Juncus bulbosus* f. *bulbosus*; for details *see* Detailed description of mucros (just after description of the new taxon) and Table 1. Scale bars = 1 mm if not indicated otherwise. Arrows indicate apices of outer perianth segments. Origin of the specimens: Finland (**A**, **B**, **G**, **H**): Regio Aboënsis, par. Pargas, Gunnarsnäs, *A. Arrhenius 154* (epitype, C). Germany (**C**): Schleswig-Holstein, Reinbek, Tonteich, *H. Scholz 2999a* (WRSL 6040). Poland (**D**): Górny Śląsk, [distr. Będzin], torfowiska k. Strzemieszyc, *B. Pawłowski & J. Walas 286* (WA 42260), (**E**, **F**, **I**, **K**, **N**, **O**, **P**, **Q**, **W**, **X**): Pomorze, regio Bory Tucholskie, distr. Chojnice, lacus Czarne prope vicum Kiedrowice, *W. Gugnacka 46* (WRSL 68860), (**S**, **T**, **U**): Pomorze, distr. Człuchów, Jezioro Krasne near Przechlewo and Nowa Wieś Człuchowska, *J. Proćków 30719/2* (Hb. J. Proćków). England (**J**, **L**, **M**, **R**): East Norfolk, Winterton Ness, *P. D. Sell 62/470* (WRSL 24711).

the bulbous rush subspecies was published by Hultén and Fries (1986: 93, map 186).

Ecological differences

In Poland, f. *bulbosus* grows mainly in oligotrophic waters, within communities of *Littorelletea uniflorae*, while f. *submucronatus* grows mostly in eutrophic habitats, e.g. within communities of *Potametea* (*Nymphaeion* alliance), together with *Potamogeton natans*, *Polygonum amphibium* (‘*natans*’), *Batrachium circinatum*, *Potamogeton crispus*, *Myriophyllum spicatum* or *Ceratophyllum demersum* (Proćków 2000, 2004) and also on the shores. The “eutrophic” bulbous rush populations are rich and all the specimens are in very good condition (Dajdok & Proćków 2003). Therefore the situation is rather surprising for modern phytosociology because to date *Juncus bulbosus s. lato* was a characteristic species for *Littorelletea uniflorae* (e.g. Oberdorfer 1994, Matuszkiewicz 2001). At the moment, there is no information coming from outside Poland on nutrient content within habitats of the two forms. After analysis of information included on herbarium labels it can be said that subsp. *kochii* seems to be more common in peatbogs than the nominate subspecies but there are no detailed records in the literature which would confirm such a relationship.



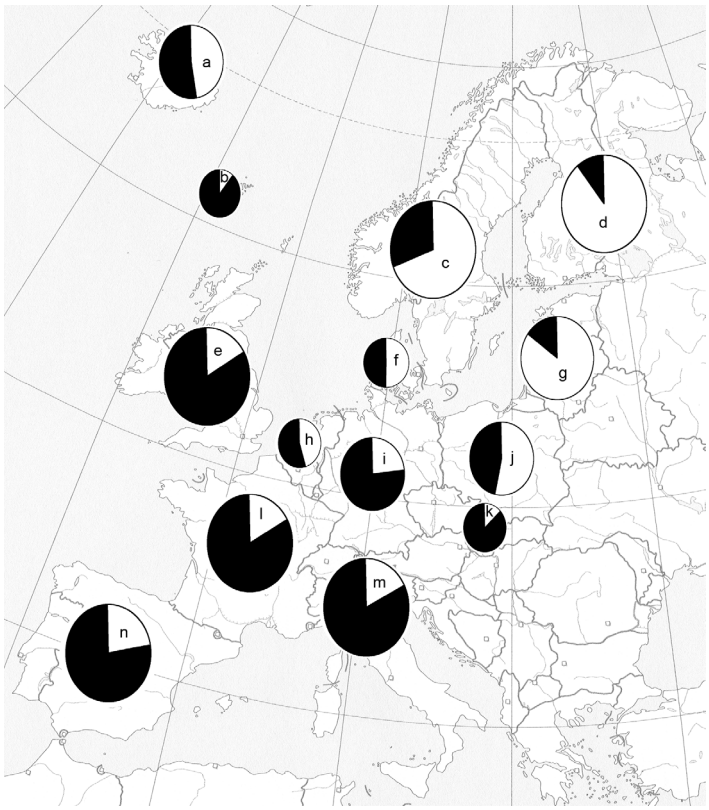


Fig. 4. Numbers of localities of the analysed bulbous rush forms (white = f. *bulbosus* [first number], black = f. *submucronatus* [second number]) in Europe [573/777 = 1350 total]. — a: Iceland [8/9]; — b: Faroe Islands [1/8]; — c: Norway and Sweden [62/28]; — d: Finland (including Åland Islands) and Russia, Karelian Republic (including Gulf of Finland islands) [160/19]; — e: Great Britain (including Orkney Islands, Inner Hebrides, Isle of Man, Channel Islands) and Ireland [14/68]; — f: Denmark (including North Frisian Islands) [10/10]; — g: Estonia, Latvia, Lithuania and Russia (Kaliningrad Province) [17/3]; — h: Belgium and Holland [55/67]; — i: Germany (including East and North Frisian Islands) [91/297]; — j: Poland [117/104]; — k: Czech Republic, Slovakia and Hungary [3/19]; — l: France [14/66]; — m: Austria, Switzerland, Italy (including Sardinia) and Corsica [6/28]; — n: Portugal and Spain [15/51].

Key to the infraspecific taxa of *Juncus bulbosus*

1a. Outer anthers (0.2)0.4–0.5(0.7) mm long, when anthers of inner whorl are tiny/midget (Proćków 2008a: fig. 2C, D), they are most often clearly shorter than those of external whorl of the same flower (Proćków 2008a: fig. 2B, D); filaments 6 (Proćków 2008a: fig. 2C, D), quite exceptionally 3; outer perianth segments acuminate (Proćków 2008a: fig. 2A–E), i.e. most often long-awned (terminating with a thin, hair-like awn) or with a sharp, long, and thin hair-like spine on top and usually clearly longer than inner perianth segments (Proćków 2008a: fig. 2E); inner perianth segments usually acute (Proćków 2008a: fig. 2A, B, D) or acuminate (Proćków 2008a: fig. 2E) — often with protracted point (or long-awned) or dagger-like prolonged; perianth most often dark (Proćków 2008a: fig. 2A, C): chestnut brown, dark brown, cherry-brown, or cherry-chestnut blackish, or even brown- or cherry-black, and usually narrow (Proćków 2008a: fig. 2A, B): narrow lanceolate, lanceolate, or (narrow) elongate; capsule (1.5)2.0–2.5(2.9) mm long, often spherical, or symmetrically wide (Proćków 2008a: fig. 2D) or narrow (Proćków 2008a: fig. 2A, C) elliptical, and in places not covered by perianth, most often dark (e.g. brown or brown-beige; Proćków 2008a: fig. 2C), usually shiny (Proćków 2008a: fig. 2D); all shoots of terrestrial specimens nearly always erect (and often rather stiff), often dark- or bluish-green; plants most often form compact tufts; heads exceptionally and then only poorly viviparous (Proćków 2008a) ..... subsp. *kochii*

1b. Outer anthers (0.3)0.5–0.7(1.2) mm long; filaments most often 3 (Proćków 2008a: fig. 2F, G), exceptionally 6; outer perianth segments acute (Proćków 2008a: fig. 2I–K), thus never long-awned!, although sometimes with a rather massive, short spine on top (Proćków 2008a: fig. 2I, J), and usually clearly shorter than inner perianth segments (Proćków 2008a: fig. 2J–L); inner perianth segments usually obtuse (Proćków 2008a: fig. 2F, I–L), most often gently rounded; perianth usually (dark) green (Proćków 2008a: fig. 2F, H–L), although often to a considerable degree suffused with cherry/claret colour (Proćków 2008a: fig. 2J), usually considerably wider (Proćków 2008a: fig. 2F, J): ovate-lanceolate, ovate-elongate, or even ovate, rarely elongate (Proćków 2008a: fig. 2I, L) but for f. *submucronatus* narrower, i.e. more similar to of subsp. *kochii;* capsule (1.8)2.5–3.3(4.2) mm long, most often clearly elongate (Proćków 2008a: fig. 2F, H–L), light (Proćków 2008a: fig. 2F, H, I, K, L; e.g. beige), and most often matt (Proćków 2008a: fig. 2F, H, J–L); at least older shoots of terrestrial specimens usually decumbent or creeping, rarely erect, and usually bright green; plants most often form loose tufts; heads often viviparous, and then most often densely overgrown with young shoots (Proćków 2008a) ..... subsp. *bulbosus*

2a. In the heads, at least in some parts of the inflorescence, dorsally, just below the apices usually of at least one of the three outer perianth segments there are distinct (often pronounced), usually sharp (less often blunt) mucros (Fig. 2), which are usually pronouncedly or at least distinctly (less often only slightly) exceeding the apices .... f. *submucronatus*

2b. Mucros on the dorsum of the outer perianth segments absent (Fig. 3A–D, G, H) or, when sometimes present — then usually not exceeding the apices. Most often they are much shorter then the apices (Fig. 3E–F, N–R, W–X), and sometimes only developed as at most bluntly/rounded tubercle, then often indistinctly marked (Fig. 3L), or (poorly) sharpened swellings (Fig. 3I–K, M). Generally such mucros, when present, usually are few in the inflorescence, scattered, very rarely more numerous ..... f. *bulbosus*

Selected specimens examined (= paratypes, *see* Material and methods; material analysed biometrically marked with an asterisk; all the specimens seen by the author): **AUSTRIA**. 24 Jul. 1893 *K. Rechinger s.n.* (KRA); *[L. Mörkingryn] s.n.* (L 106317, except of the middle one plant); 15 Aug. 1878 *E. Witting s.n.* (B); *G. Kleesadl 927* (LG); Sep. [19]22 *Baschant s.n.* (B); 13 Jul. 1952 *H. Schäftlein s.n.* (LAU); *F. Welwitsch s.n.* (TUB 11105*). **AZORES**. *H. Drouet s.n.* (BM 577855); *C. Cedercreutz s.n.* (H 1312097); *W. Trelease 946* (BM 577962); *B. Goncalves 3272* (BM 577869); *A. Hansen 206a* (C, the left-handed plant only); *A. Hansen 184* (C*). **BELGIUM**. 9 Jul. 1879 *A. Gravis s.n.* (LG); 5 Aug. 1877 *A. Gravis s.n.* (LG); 14 Jun. 1959 *L. Renard s.n.* (LG); Sep. 1927 *V. N. J. Lambert s.n.* (LG); *P. Van der Veken 9742* (H 1136608, BR 1031868); Les lieux inondés à la Campin[e], *R. Courtois s.n.* (LG); *J. Lambinon 83/B/471 & J. Rouselle* (LG); 8 Aug. 1877 *H. Vandenbroek & F. Cujrir s.n.* (LG); *E. Marchal 82* (LG, the left plant only); *J. Lambinon 58/B/1939* (LG: Fig. 2H); 9 Jun. 1812 *H. Donckier s.n.* (LG); Aug. 1898 *M. Halin & A. Marèchal s.n.* (LG); Aug. 1883 *E. A. L. Chapuis s.n.* (LG, except of the bottom left plant); *E. Serusiaux 14/B/414* (LG*); 23 Jun. 1957 *L. Renard s.n.* (LG, Fig. 2J); 22 Jul. 1949 *J. Damblon s.n.* (LG); 9 Jul. 1908 *P. Doubleman s.n.* (LG); 14 Jul. 1872 *H. Donckier s.n.* (LG); *R. Fabri 1031*, *Exsicc. 13759* (MSB 27064*, the top plant only); Aug. 1884 *P. Halin s.n.* (LG); 9 Jul. 1949 *L. Renard s.n.* (LG, except of the top left plant); 10 Sep. 1975 *Debaisieux*, *Monfort & Hechtermans s.n.* (LG, the right-handed plant only); *B. Maurentius s.n.* (L 106243); *J. Goffart s.n.* (LG, except of the middle & right plants in the middle line); 20 Jul. 1932 *A. Marèchal s.n.* (LG); 31 Jul. 1932 *H. Henin s.n.* (LG); Genck, marais, *G. Dewalque s.n.* (LG); 6 Aug. 1954 *J. Lambinon s.n.* (LG); *E. Janmoulle s.n.* (BR 1099718); *V. Herman s.n.* (BR 1099696); *V. Herman 850804.20* (LG); *G. A. Uccle s.n.* (BR 1031729); 1 Aug. 1970 *A. Louette s.n.* (LG*, except of the left plant); *H. Verheggen 81* (LG); *Dethioux 549* (BR 71031762); *G. C. Brown & Lerd 1646* (BM 577942); *F. Stockmans s.n.* (BR 1099715); 4 Jul. 1909 *P. Doubleman s.n.* (LG); *Crumbel & Proven s.n.* (BM 577833). **CORSICA**. *E. Reverchon 440* (E 80768, MA 19253, S*); *E. Reverchon s.n.* (B, two sheets, L 106391, L 106392, M 10216); *J. Lambinon*, *R. Deschatres & J. Rouselle 81/Co/223* (LG); *E. Reverchon 214* (LAU). **CZECH REPUBLIC**. *J. Kučera 154* (C*, H 1311480, LG, MA 188348, WRSL 26580*); *J. Chrtek & B. Křísa 23* (LG); 18

Aug. 1893 *J. Jahn s.n.* (S*); 18 Aug. [18]93 *J. Jahn s.n.* (C*); *Oborny 276* (C*, H 1311477, L 106341); 1 Sep. 1904 *J. Vetter (?) s.n.* (S*); 21 Jul. 1914 *J. Vetter (?) s.n.* (S*); 27 Jul. 1916 *J. Vetter (?) s.n.* (S*); *Koch s.n.* (L 106381); Jul. 1852 *H. W. Reichardt s.n.* (B); *V. v. Cypers s.n.* (MA 19270); *Cypers 614* (S). **DENMARK**. *K. Larsen 29314 & S. Larsen 6348* (BR, H 1078494, LG); *E. Kullberg 740* (BM 577900, KRA 77627, MA 206148); *Ch. Boldt s.n.* (H 1311464); *K. Larsen 37434 & S. S. Larsen 10940* (H 1547198, M 10093, MA 346728, MA 353378, MSB 27073*); *K. Larsen 38757 & S. S. Larsen 12767* (BR, H 1575403, LG: Fig. 2U, M 10092, MA 367357: Fig. 2C, D and T, MA 367357 (D), MSB 27072*); 16 Aug. 1957 *H. Piotrowska s.n.* (POZ). **ESTONIA**. 19 Jun. 1962 *H.-E. Rebassoo s.n.* (TAA). **FAROE ISLANDS**. *K. Hansen 10794* (C, KRA 91816). **FINLAND**. *H. Hollmén s.n.* (MA 94750, MA 94738). **FRANCE**. *E. Berger s.n.* (M 10219); *E. Berger 4308* (M 10220); *E. Berger 4308 & 17672* (H 1690928, LG, M 10217, MA 589857: Fig. 2S, MSB 60477*); *E. Berger 4308 & 6349* (BR, the bottom plant only, C, the bottom plant only, H 1047712, LG, M 10224, MA 277549); Hag[u]enau, *s. coll. s.n.* (B); 24 Jun. 18[51/88] *J. Lange s.n.* (C*, the two top plants); 24 Jun. 1851 *J. Lange s.n.* (C, MA 146134: Fig. 2X,Y); Landes près de Bordeaux, *s. coll. s.n.* (LAU); *Guétrot 2239 & 4143-2* (P); *R. Fabri & R. Schumacker 820531/13* (BR, LG); 14 Aug. 1907 *A. St-Yves s.n.* (LAU); 18 Jul. 1860 *A. Pérard s.n.* (LAU); *coll. illeg. s.n.* (BM 577966); *A. Raynal-Roques & P. Blanc 22054* (LG); *M. Martinea s.n.* (MA 19262); *J. Duvigneaud 76 F 701* (LG, except of: the top right-handed plant and in the second line the left-handed plant and a part of left-handed tuft in the third line); 5 Oct. 1958 *E. Berger s.n.* (LG); *H. Merxmüller 56/54 & 5622* (M 10222); *Hoppe s.n.* (H 1311475); *W. de Schoenefeld s.n.* (H 1311487); *W. D. J. Koch (?) s.n.* (L 106382); *F. Sennen 2858* (MA 19273); *F. Sennen 2859* (L 106439, MA 19274); *R. Lugagne 4614/5376* (BR, L 106442, LG); *R. Prin 5375* (LG); *A. Kneucker 81* (BM 577897, L 106436, MA 254379); 29 Aug. 1905 *H. Schenck s.n.* (POZ); *F. G. Schultz 56 bis* (C*); *F. G. Schultz 56* (L 106340, L 106359, the second plant from the left only, C, the left-handed plant only); *Schultz s.n.* (L 106361); *J.-B. Mailho 2130* (C); 15 [Jul] 1843 *Jaceard s.n.* (LAU); *L. Chevallier 3161* (BM 577842); *Mennema 2778* (L 106263); *R. de Litardière 5793* (MA 425891, P); Jul. 1876 *J. P. Tray s.n.* (LAU); 25 Jun. 1902 *A. St-Yves s.n.* (LAU); [Iku] Lyon, *Litton s.n.* (DBN*, the two middle plants only); Aug. 1810 ? *D. Dupuy s.n.* (LG); 20 Jun. 1848 *Aunter s.n.* (C*, the middle plant only). **FRISIAN ISLANDS**. Jul. 1869 *F. Buchenau s.n.* (C, L 106372); 1858 *Th. Schütz s.n.* (C*); [18]38 *Th. Schütz s.n.* (C*); 20 Jul. [18]58 *Th. Schütz s.n.* (C*). **GERMANY**. 23 May 1895 *Th. Linder s.n.* (LG, C); *F. Förster s.n.* (M 10242, the two bottom plants only); *O. Sebald 8174* (M 10283); *J. Camper s.n.* (L 106358, the left-handed plant only); *Th. Linder s.n.* (M 10276, M 10277); 30 Jun. 1904 *A. Maillefer s.n.* (LAU); *C. Correns s.n.* (M 10250); *Schreber 946* (M 10189); 14 Aug. 1917 *Dihm s.n.* (LG); *TK 98* (M 10349); Jul. [18]77 *Hesse s.n.* (GOET); *A. Walther s.n.* (H 1311478, L 106386, L 106437, the two left-handed plants only); *F. Schuhwerk s.n.* (M 10348); *P. Brixle 5623* (M 10342); *O. Renner s.n.* (M 10202); *E. Hepp s.n.* (M 10148); 24 Aug. 1885 *A. Peter s.n.* (GOET); *Peter s.n.* (M 10192); Jul. 1890 *Appel s.n.* (LAU); *H. Meusel s.n.* (HAL 55266); *H. Merxmüller 5624* (M 10341); *Herz s.n.* (M 10145); *K. P. Buttler 18508* (M 10149); *J. Wenninger & P. Döbbeler 2536* (M 10368); *Ade s.n.* (M 10144); *E. Hepp s.n.* (M 10143); *E. Dörr s.n.* (M 10169*, M 10167, M 10170, M 10173, M 10358); *W. Subal s.n.* (M 10353); 4 Jul. [19]15, *[Dilmer] s.n.* (C*); *[Dilmer] 133* (M 10366); *W. Lippert 23756* (M 10357); *H. Wild s.n.* (M 10360); *J. Simon s.n.* (M 10153); *Schmidt s.n.* (M 10183, M 10186, M 10187); *Zuccarini s.n.* (M 10188); *Martins s.n.* (M 10195); *H. & H. Doppelbaur 18478* (M 10175*); *F. Vollmann s.n.* (M 10208); *Arnold s.n.* (M 10146, except of the part of the left-handed tuft, M 10147, M 10180, M 10335); *H. & R. Lotto s.n.* (M 10150); *J. Höfer s.n.* (M 22468, M 10152, M 10184); *K. Starcs 3534* (M 10163); *K. Starcs 3528* (M 10200, M 10201); *F. Vollmann s.n.* (M 10142, M 10151, M 10177, M 10179); *Loritz s.n.* (M 10141); *Progel s.n.* (M 10181); *Schimper 1408* (M 10305); *Petzi, Poeverlein & Vollmann s.n.* (M 10191, M 10193); 6 Aug. 1927 *O. Schwarz s.n.* (S*, except of top right-handed plant); Jul. 1889 *G. Hansperch s.n.*, *Hallier 171*, *Garcke 1837* (POZ); 3 Oct. 1895 *O. & R. Schulz s.n.* (B); Jul. 1912 *R. Schulz s.n.* (B); zwischen Tegel & Königswald, *Willdenow s.n.* (HBG*, except of the left-handed plant); *K. Werner 2528* (HAL 1335); *A. Matthies s.n.* (M 10075); *Heiland s.n.* (MA 171911); *Sartonus s.n.* (M 10263, exept the two bottom plants); Jul. 1909 *A. W. Peipers s.n.* (B); 11 Aug. 1899 *H. Schenck s.n.* (POZ); *J. Koch s.n.* (M 10273); *A. W. Peipers s.n.* (L 106440, L 106443); Wetterau, *s. coll. 461* (HBG*); *C. Kausch 2880 [V. S.]* (L 106348); *H. Meissner 9a/60* (GOET); *W. Hilbig s.n.* (HAL 65645); *F. Buchenau s.n.* (L 106307, the right-handed plant only); 9 Jul. [18]78 *Vocke s.n.* (GOET); *M. Steiner s.n.* (MSB 27070*); 2 Jul. 1928 *F. Vogeler s.n.* (HBG*); *W. Miemmann s.n.* (H 1311470); *W. Schummann s.n.* (MA 19271, MA 171904); *D. Podlech s.n.* (MSB 27067); *A. Schumacher 570 7*, *570 12*, *570 19*, *570 20* (HBG*); *M. Schenck 596* (POZ*); *Holler s.n.* (M 10258); 21 Jul. 1907 *L. Gross s.n.* (POZ); *H. Kalheber 73-676* (MSB 27075*); *W. D. J. Koch (?) s.n.* (L 1065367); *Hoock s.n.* (M 10082); *D. Podlech 1434* (MSB 27066*); *A. Schumacher 570 4*, *570 9* (HBG*); 29 Aug. 1912 *L. Gross s.n.* (POZ*); *Mann s.n.* (M 10264); *W. Dietrich s.n.* (M 10068, the right-handed plant only); *Ruppert 104* (M 10057); *J. K. Hasskarl s.n.* (L 106311); *F. Winter 1045* (L 106395, L 106396); *J. Schuhler 164* (M 10238, the two bottom plants only); *J. Schuhler s.n.* (M 10244); *Fischer s.n.* (L 106324); 20 Aug. [18]63 *H. Zimmermann s.n.* (WRSL*); Aug. [18]66, *H. Zimmermann s.n.* (HBG*); *P. Gutte 21192 [M-B] 24914 [MdP]* (MA 277542: Fig. 2Q,R); *I. Rindt s.n.* (HAL 1334); *H. Dörfelt s.n.* (HAL 47987); *L. Schellhammer s.n.* (HAL 21732, HAL 24856, HAL 24857); *Schreber 953* (M 10309); *P. Gutte 34378* (WRSL 69420*); 18 Jul. [19]04 *O. Th. Schmidt s.n.* (HBG*); 5 Oct. 1876 *E. Hippe s.n.* (HBG*); 25 Aug. 1895 *P. Magnus s.n.* (HBG*); *O. Woitkowitz 475* (HAL 23589); 17 Jun. [18]83 *K. Schliephacke s.n.* (HBG*); *K. Larsen*, *L. Holm-Nielsen*, *S. Jeppesen & P. Pedersen 58* (BM 577904, BR, C*, H 1015354, KRA 66210, L 106270, M 10282, MA 194753, S*); 25 Jul. 1927 *F. Vogeler s.n.* (HBG*); 12 Jul. 1891 *W. A. Zimpel s.n.* (HBG*, except of the top right plant); 16 Aug. 1947 *O. Rohweder s.n.* (HBG*); Jul. [19]81 *Poppendieck s.n.* (HBG*); 14 Jun. [18]85 *E. Erichsen s.n.* (HBG*); Sep. 1866

J. A. Schmidt s.n. (HBG*); Aug. [18]85 *J. Schmidt s.n.* (HBG*); Hamburg, *s. coll. s.n.* (S*); 26 Jul. 1928 *F. Vogeler s.n.* (HBG*); 8 Aug. 1921 *J. Schmidt s.n.* (HBG*); Jul. 1895 *Appel s.n.* (B); 11 Aug. 1912 *J. Bornmüller s.n.* (B); Jul. [18]84 *Steitz & Kuglers s.n.* (POZ); *Roth s.n.* (L 106357); *P. Wirtgen 109* (LG); *P. Wirtgen 51 & 1049* (LG, the right-hand plant only); 21 Sep. [18]87 *F. C. Laban s.n.* (HBG*); Jul. 1891 *Haus s.n.* (HBG*); *J. Lange s.n.* (L 106306, the top left plant only); *s. coll. 225* (L 106306, the middle bottom plant only); *A. Nieschalk 570 10 (A. Sch.)* (HBG). **GREAT BRITAIN**. *A. Melderis 90* (C*, S*); *A. Melderis 84* (S*); *R. S. Adamson & Hunts s.n.* (BM 577810); *B. Welch 4625* (S*); *P. W. Ball s.n.* (MA 173314, MA 175383); Lancashire, *Litton s.n.* (DBN*, the three top and one bottom right-handed plants); Sep. 1870 *J. L. Warren s.n.* (DBN*); *J. F. Duthie s.n.* (BM 577846); *R. Meinertzhagen s.n.* (BM 577918); *D. Naill 93* (BM 577847); *H. J. Riddelsdell 1646* (BM 577941); 1839 *Litton s.n.* (DBN*); Aug. [18]89 *Burr s.n.* (DBN*); bogs and swamps, *D. Sorper s.n.* (DBN*, the middle plant only). **HOLLAND**. *Martens 965* (M 10316, the left-handed plant only); *den S. C. J. van der Scheer 159* (LG); *P. A. Mennega 154* (MA 166453: Fig. 2O); 7 Sep. 1947 *V. O. s.n.* (S*). **ICELAND**. *N. Polunin 12119* (BM 577933); *[Stefánhefanmiz] 485/89* (C); 4 Aug. [18]68 *Chváalunch s.n.* (C, the bottom right plant only). **IRELAND**. *R. L. Praeger 30* (DBN*); *C. D. Preston 94/105* (DBN); 19 Jul. 1964 *M. J. P. Scannell s.n.* (DBN*); 21 Jul. 1964 *M. J. P. Scannell s.n.* (DBN); Jul. 1877 *R. Barrington s.n.* (DBN*, the left-handed plant only); 26 Jun. 1870 *R. M. B. s.n.* (DBN); *R. L. Praeger 17* (DBN*); 1 Aug. 1884 *H. C. Levinge s.n.* (DBN); *R. W. Scully 1356* (DBN*); bog at Prosperous, Aug. 1864 *s. coll. s.n.* (DBN*); 21 Jul. 1966 *M. Scannell s.n.* (DBN); Island of Achill, 1873 *s. coll. s.n.* (DBN*); 14 Jul. 1896 *N. Colgan s.n.* (DBN*); 11 Jul. 1983 *M. Scannell s.n.* (DBN*); 21 Jul. 1868 *R. M. B. s.n.* (DBN, the middle top plant only); *A'damse biologen 384* (L 106272). **ITALY** (incl. Sardinia). *Balsamo 963* (M 10292); *A. Fiori 2818* (KRA, LAU); *E. Reverchon 266* (BR, C*, left part of the sheet, LAU). **NORWAY**. *J. Johansson s.n.* (H 1131400); 18 Aug. 1927 *S. A. Hoëg s.n.* (C*). **POLAND**. 8 Aug. 1950 *Z. Czubiński s.n.* (POZ, three sheets); 18 Aug. 1951 *Z. Czubiński s.n.* (POZ, three sheets); 3 Aug. 1960 *W. Żukowski s.n.* (POZ); 24 Aug. 1966 *S. Lisowski s.n.* (POZ); 24 Jul. 1965 *S. Lisowski & F. Szafrański s.n.* (POZ); 23 Jul. 1914 *Kalkreuth s.n.* (TRN); 26 Aug. 1955 *I. Dąmbska s.n.* (POZ*); 28 Aug. [19]62 *F. Celiński s.n.* (POZ); Jul. 1904 *Bothe s.n.* (B); 28 Jul. 1933 *F. Krawiec s.n.* (POZ); 7 Aug. 1956 *H. Piotrowska s.n.* (POZ*, three sheets); 30 Jul. [18]69 *Th. Hellwig s.n.* (WRSL*); *K. Latowski s.n.* (PBMA 2708); 20 Jun. 1961 *S. Lisowski s.n.* (POZ); *J. Kujawa-Pawlaczyk 103/95* (DRAPN); 2 Aug. [18]99 *H. Pinkwart s.n.* (WRSL*); *Alt 495* (S*); 11 Jul. 1905 *Geinzmann s.n.* (WRSL*); *E. Kozioł 890* (WA 70175); *G. Hansperch s.n. (Garcke 1837)* (POZ); 29 Jul. [18]87 *J. Barber s.n.* (WRSL*); *J. Proćków 990706/1*,2-16* (WRSL, Herb. J. Proćków); *J. Proćków 990928/1-2* (WRSL, Herb. J. Proćków); *J. Proćków 990706/51*-52*,53-56* (WRSL, Herb. J. Proćków); *V. v. Cypers s.n.* (MA 19408); 27 Jun. [19]37 *Buchs s.n.* (WRSL*); 24 Jul. 1906 *Schoepke s.n.* (WRSL*); Bosdziener Teich bei Myslowitz, *s. coll. s.n.* (WRSL*); *J. Kornaś s.n.* (KRA 72696, KRA 100236); *W. Wojewoda s.n.* (KRA 65156); *[Ray] s.n.* (KRA 92409, KRA 92509, KRA 92515, KRA 92536); *E. Baradziej*, *A. Frey & K. Luchter s.n.* (KRA 162170, KRA 162169); *K. Nowak s.n.* (WA 44925); *M. Kopij s.n.* (WA 44295); *Z. Głowacki s.n.* (WSRP 3854, WRSL 35948*); 12 Aug. 1876 *C. Sanio s.n.* (HBG*); *A. Sokołowski s.n.* (BIL 62555, BIL 64765). **PORTUGAL**. *Malato-Beliz 25293 & J. A. Guerra* (MA); *W. Rothmaler & A. P. Silva 15478* (S*); *P. Lopese & G. Pedro 2251* (MA 412463); *Fontes*, *Myre*, *Rainha & R. S. Dias 1213* (LAU, S); *Fontes*, *Myre*, *Rainha & R. S. Dias 1215* (LAU); *R. Jorge s.n. (Malato-Beliz 1416)* (L 106385, MA 277545); *A. Moller s.n.* (MA 19275); *A. R. Pinto da Silva*, *A. N. Teles & B. Rainha 86494* (LG); *Welwitsch 324* (LISU P7749); *Welwitsch 391* (C*, GOET); *s. coll. s.n.* (LISU P7745); *P. W. s.n.* (LISU P7747); *J. de Matos 2301* (MA 188341); *J. de Matos 2303* (M 10232); *A. Fernandes & Sousa (Malato-Beliz 1319)* (MA 277755); *M. da Silva 22608* (MA 19265); *Malato-Beliz & J. A. Guerra 25296* (LG, MA 212460); *Malato-Beliz & J. A. Guerra 25654* (BR, C*, LG, MA 277557); *M. Beliz 6318*, *A. Raimundo & J. A. Guerra* (MA 277543); *Malato-Beliz 22164 & J. A. Guerra* (MA 277556); *A. R. da Cunha s.n.* (LISU P7743); *J. Castro s.n.* (MA 188346: Fig. 2I,K,M,P); *A. Rozeira*, *M. d'Alte & J. Castro s.n.* (MA 188342). **RUSSIA**. *K. Linkola s.n.* (H 224988). **SPAIN**. *B. M. Allen 8800* (BM 577830); *M. Costa*, *S. Rivas-Martinez & E. Valdés-Bermejo 2213 EV* (MA 254227), *2223 EV* (MA 254225, MA 373366), *2230 EV* (MA 254220); *M. Costa*, *P. Cubas*, *M. C. Prada & E. Valdés-Bermejo 1872 EV* (MA 254219, MA 373369); *M. Costa*, *M. Gutiérrez & E. Valdés-Bermejo 2094 EV* (MA 254224), *2173 EV* (MA 254228, MA 373377); *S. Castroviejo 752 SC* (MA 254217); *I. Zubia s.n.* (MA 19266, MA 19272); *L. Villar (JACA 556486)* (LG, MA 478515); *E. Guinea 221* (MA 164799); *S. Silvestre s.n.* (MA 196031); 12 Aug. 1878 *L. Leresche s.n.* (LAU, C*, right part of the sheet); *M. Luceño & P. Vargas s.n.* (MA 514329); *G. López*, *M. Luceño*, *A. Regueiro & P. Vargas 942 PV* (MA 407299); *G. Nieto Feliner 990 GN* (MA 317430, MA 317430 (D)); *E. Rico s.n.* (MA 205075, MA 205076); *T. Romero s.n.* (MA 568177); *E. Temprano 135 ET* (MA 317431, MA 317431 (D)); *J. Rodr.-Oubiña & R. I. Louzán s.n.* (MA 595102); *D. Belmonte s.n.* (MA 328148); *M. I. Romero s.n.* (MA 546747: Fig. 2F,Z); *R. P. B. Merino s.n.* (MA 19257); *A. Segura Zubizarreta 15863* (MA 353425); ex Hispania, *s. coll. s.n.* (C*, the left handed plant only). **SWEDEN**. 18 Aug. 1878 *A. J. Grevellius s.n.* (KRA); *B. E. E. Duyfjes & A. Kanis 296* (L 106318); *G. Ankarswärd s.n.* (H 1540615); Göteborg, Boh [ceronst Mozlanda], *s. coll. s.n.* (KRA*); Sep. 1927 *J. E. Palmér s.n.* (C); Aug. 1927 *K. Bökman s.n.* (KRA); *S. Snogerup 3414* (H 1472247); *G. Samuelsson 470* (C, H 1311445, L 106253); *G. A. Ringselle s.n.* (MA 19263); Sep. 1913 *A. Hülphers s.n.* (KRA); *R. O. J. Wallengren s.n.* (H 1311432). **SWITZERLAND**. 28 Jun. 1923 *W. Koch s.n.* (S*); 7 Jul. [18]78 *H. Wegelin s.n.* (LAU); *Eggler s.n.* (M 10214); *F.-O. Wolf s.n.* (M 10215); *Jäggi s.n.* (E 80766, M 10213); Aug. 1871 *Jäggi s.n.* (LAU); Aug. 1871 *Eggler s.n.* (LAU); 22 Jul. [18]86 *Wilczek s.n.* (LAU); 4 Sep. [18]89 *[Wilczek] s.n.* (LAU); 20 Jul. 1868 *J. S. Blanchet s.n.* (LAU); *J. Muret s.n.* (L 106328); Aug. [18]68 *Boll s.n.* (LAU); Einsiedeln, Schachen, 8 Jul. [18]69 *s. coll. s.n.* (LAU); 16 Jul. 1908 *C. Ostenfeld s.n.* (C*); *W. Koch & E. Sulger Büel 14344* (MA 353457); *L.*

Pache s.n. (M. Moreillon 363) (LAU); 6 Jul. [18]90 *S. Aubert s.n.* (LAU); *A. Eddy 1970 s.n.* (BM 577860); *Schreber 1320 (= 954)* (M 10289); 12 Jul. 1861 *J. Rhines s.n.* (LAU). **TURKEY**. *P. Uotila 27085* (H 1202762, except of the *Poaceae* specimen). **MOROCCO**. *R. Dahlgren & P. Lassen 43a-15* (C*); *Schousboe 146* (BM 577949). **AUSTRALIA**. *R. Coveny 6264* (L 106281). **CANADA**. *M. L. Fernald & K. M. Wiegand 5140* (BM 577862). **CHILE**. *O. Zöllner 22874* (HBG*). **LOCALITIES UNKNOWN**. *Loiseleur s.n.* (L 106383, the two top plants only); Boim. septent., 1852 *K. Leithner s.n.* (B); *s. coll. s.n.* (MA 148825); In turfis torfalis ad Bremerlake, *s. coll. s.n.* (KRA); *L. Delyosalle s.n.* (BR 810853); Laguenau, *P. Blind s.n.* (LAU); near Burtle, Turf-Moore, 1848 *Th. Clark s.n.* (S*); Marais des Chaumespoussies près de La Chasic[o/a], *s. coll. s.n.* (LAU); 12 Jul. 1820 *Aunter s.n.* (C); *G. Hansperch s.n.*, *Hallier 171*, *Garcke 1837* (POZ); Pommern, 26 Jul. [19]55 *A. Lüderwaldt s.n.* (B); *Willk s.n.* (MA 146142: Fig. 2N); in ericetis, *R. Courtois s.n.* (LG); *Crubbe* [*illeg.*] *s.n. (Hallier 171*, *Garcke 1837)* (POZ); *D. Hampe s.n.* (L 106380); [Waldbroke - *illeg.*], 1888 *s. coll. s.n.* (POZ); *W. D. J. Koch (?) s.n.* (L 106364, the top plant only); *A. B. Jackson s.n.* (L 106345, the top left plant only); 1867 *J. D. Meyer s.n.* (B); *M. Funk s.n.* (M 16564, M 16565, M 17522); *C. Correns s.n.* (M 10086); *s. coll. 547* (L 106353, L 106354, the bottom plant only); *Persoon s.n.* (L 106370 ex Hb. Schultes, the two top plants only); *Koch 24 (Weiss)* (L 106377, except of the bottom plant, L 106378, the top right plant only); *W. D. J. Koch s.n.* (L 106379); *R. Courtois s.n.* (LG as '*Juncus subverticillatus supinus*' with 'Etiquette de A. Lejeune'); *Grimm 972* (M 10313); *Funk 950* (M 10301); *dat. illeg. Rostrup s.n.* (C*, the top middle and right plants only); *s. loco*, *coll. illeg. s.n.* (C*, the left-handed plant only, as *Juncus supinus* Wahlbg = *Juncus subverticillatus* Wulf = *Juncus uliginosus* Meyer); *s. coll. s.n.* (L 106344); *s. loco*, 30 Jan. [18]80 *s. coll. s.n.* (LAU as *Juncus uliginosus* Roth); *s. coll. s.n.* (MA 19277); *s. coll. s.n.* (L 106339, except of the two top plants).

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