An example of a rare and little noticed intersectional *Carex* hybrid in Germany: *Carex pseudocyperus* L. x *C. rostrata* STOKES (= *Carex* x*justi-schmidtii* JUNGE)

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Abstract: Chorology and features of the intersectional hybrid *Carex pseudocyperus* L. x *C. rostrata* STOKES (= *Carex* x*justii-schmidtii* JUNGE) are presented as an example of rare and little noticed *Carex* hybrids. In Germany, voucher species of two occurrences were detected. In addition, the hybrid was detected anew at two current sites. That the nothospecies was found at very few sites emphasizes the notion that *Carex pseudocyperus* is taxonomically isolated in Europe.

1. Introduction

Understanding hybridisation is important for taxonomic research. Without understanding hybrids within a group of species, a conclusive classification is impossible (STACE 1986). Several authors stress the importance of hybridisation for investigating evolutionary processes and systematic questions, especially for the genus *Carex* (e.g. DRURY 1956, WALLACE 1975, CAYOUETTE & MORISSET 1985, CAYOUETTE 1987, CAYOUETTE & CATLING 1991, 1992, ARNOLD 1997).

Several characteristics of *Carex pseudocyperus* differ from those of all other species of the genus. In Europe, it is considered as being the only species in the section *Pseudocypereae* TUCKERM. ex KÜK (cf. EGOROVA 1999). Close to Europe, only *Carex antoniensis* A. CHEV., which is endemic to the Capeverdian Islands, belongs to this section (cf. RIVAS-CEMBELLIN & LEON-ARENCIBIA 1993). *Carex rostrata* belongs to the section *Vesicariae* MEINSH (EGOROVA 1999), which includes seven species in Europe. The fact that hybrids involving *Carex pseudocyperus* are rare, supports the notion that taxonomically the species is virtually isolated. This assumption is mainly based on morphological criteria.

Many data of *Carex* hybrids are old and poorly documented, which makes them suspicious (TOIVONEN 1981, CAYOUTTE & CATLING 1992). Even documented data are often hard to verify, because the herbarium material may lack important parts needed for a definite identification of the nothotaxa in question. Because in most cases hybrids have closely related parent species, frequently at least one of them is hard to identify. Taking into consideration vegetative features that, till now, were barely taken into account, at least in Central Europe hybrids of *Carex rostrata* belong to those *Carex* hybrids which can be most easily identified (cf. KIFFE & PALLAS 1995, KIFFE 1998, KIFFE & VAN DE WEYER 1998, KIFFE et al. 1999, KIFFE 2000).

The two *Carex* hybrids *Carex riparia* x *C. rostrata* (= *Carex* x*beckmanniana* FIGERT) and *Carex rostrata* x *C. vesicaria* (= *Carex* x*involuta* (BAB.) SYME) were included into the standard list of the fern and flowering plants of Germany (KIFFE 1998) as being nothotaxa that sometimes occur independently. These two hybrids are not only found as rare hybrids of the two populations of parent species. They can also occur beyond the close neighbourhood of their parent species and are capable of building up large populations by vegetative reproduction.

Of the other three *Carex rostrata* hybrids described for Germany, *Carex acutiformis* x *C. rostrata* (= *Carex* x*bakkerana* VAN DER PLOEG & RUDOLPHY) was detected seven times (KIFFE & VAN DE WEYER 1998, KIFFE & GUNNEMANN 2001, KIFFE in prep.). So far, *Carex lasiocarpa* x *C. rostrata* (= *Carex* x*prahliana* JUNGE) is only known from three locations in Schleswig-Holstein and Sachsen-Anhalt (KIFFE & MEIEROTT in prep.).

Until now, for Germany, only one occurrence of *Carex pseudocyperus* x *C. rostrata* was published by JUNGE (1904). Preparing a list of German *Carex* hybrids, the existing herbarium material was evaluated. Furthermore, present occurrences of the hybrid were searched for in areas where both parent species coexist.

2. Previous locations of the hybrid

At least in Europe, the hybrid of *Carex pseudocyperus* and *Carex rostrata* seems to be rare (cf. Wallace 1975, Schultze-Motel 1977). It was found for the first time in Sweden in 1891 (Thorstenson 1893), some years later also in Norway (Blytt 1897).
The first location for Germany was discovered by Junge in the Curauer Moor near Lübeck in 1903 (cf. Junge 1904). Paul (1906) described another site in Hinterpommern (today a part of Poland). Further occurrences of the hybrid in Europe were published for England (Petch & Swann 1956), Finland (Hylander 1966), and the Netherlands (Bakker et al. 1976).
Most records of *Carex pseudocyperus* x *C. rostrata* are known from Scandinavia. Hylander (1966) mentioned just nine locations for Sweden. Cayouette & Catling (1992) did not point out any occurrence of the hybrid in North America, although there is a large overlap in the areas of the parent species (Hultén & Fries 1986). Similarily, so far the nothospecies has not been detected in the former Soviet Union (Czerepanow 1995, Egorova 1999).

3. Results of the revision in German herbaria

Herbarium material was evaluated to find documented sites of the hybrid in Germany. Six specimens were discovered in HBG (Hamburg), three in B (Berlin), and two in KIEL (Kiel) for the site Curauer Moor first discovered by Junge in 1903:
– Lübeck: Curauer Moor, 06.05.1903, leg. P. Junge (HBG), 06.13.1904, leg. P. Junge (HBG), 06.18.1904, leg. P. Junge (B 2 x, HBG 2x), 06.18.1904, leg. J. Schmidt (B, HBG 2x, KIEL 2x).

Another occurrence was only documented by one herbarium specimen of Northeastern Lower Saxony:
– Lamstedt, 07.11.1928, leg. Wilshusen, det. A. Neumann 1959 (HBG).
The herbaria BFN, BOCH, BONN, BREM, GFW, GOET, HAL, JE, KOELN, KR, M, MSTR, MSUN, OSNA, REG, ROST and STU did not have any material of the sedge hybrid from German sites (acronyms according to Holmgren et al. 1990).

4. Presently established sites of *Carex pseudocyperus* x *C. rostrata*

The first site of *Carex pseudocyperus* x *C. rostrata* was discovered in a mesotrophic fen („Kleine Leber“) between Egsdorf and Klein Zesch (TK 3847/34) in Brandenburg (Dahme-Spreewald-Kreis) on 05.22.1998. The hybrid was noticed because both its disposition and the color of its leaves were similar to that of *Carex pseudocyperus.* Especially, the long, leaf-like bracts and the slim, long-beaked utricles pointed to *Carex pseudocyperus* (cf. Fig. 1a). However, the appearance of the inflorescences, which were rather young by that time, resembled that of *Carex rostrata*. In addition, the tufts had short runners never found in *Carex pseudocyperus* (cf. Fig. 1a). Furthermore, looking at the stomata revealed amphistomatic leaves. Together with the features described above, which are only found in *Carex pseudocyperus* in Central Europe, the diagnosis *Carex pseudocyperus* x *C. rostrata* was simple and final. Two tufts grew close to each other on an area of approximately 0.5 m^2. *Carex rostrata* stood close by, *Carex pseudocyperus* a few meters away. The hybrid grew at the rim of the fen, which was in part rummaged by wild hogs and altogether appeared quite disturbed.
The second site of *Carex pseudocyperus* x *C. rostrata* was discovered in an unexploited pond close to Gut Sunder near Meißendorf (Landkreis Celle, Lower Saxony, TK 3224/4) on 06.16.1998. One tuft was growing in 20 cm deep water. The sparse cover of the habitat included approximately 15 tufts of *Carex pseudocyperus* and much *Carex rostrata.* Besides that, the vicinity was dominated by *Carex elata*, *C. lasiocarpa, Phragmites australis*, *Eleocharis mamillata*, *Juncus articulatus*, *J. acutiflorus*, *J. effusus*, *J. bulbosus*, *Lysimachia vulgaris,* and *Sparganium erectum*. The occurrence of the hybrid could be confirmed for this site from 1999 until 2002. Between years, the variation of the water level was quite striking: it amounted to 20 cm in 1998, 40 cm in 1999 and 2002, and 30 cm in 2000 and 2001.

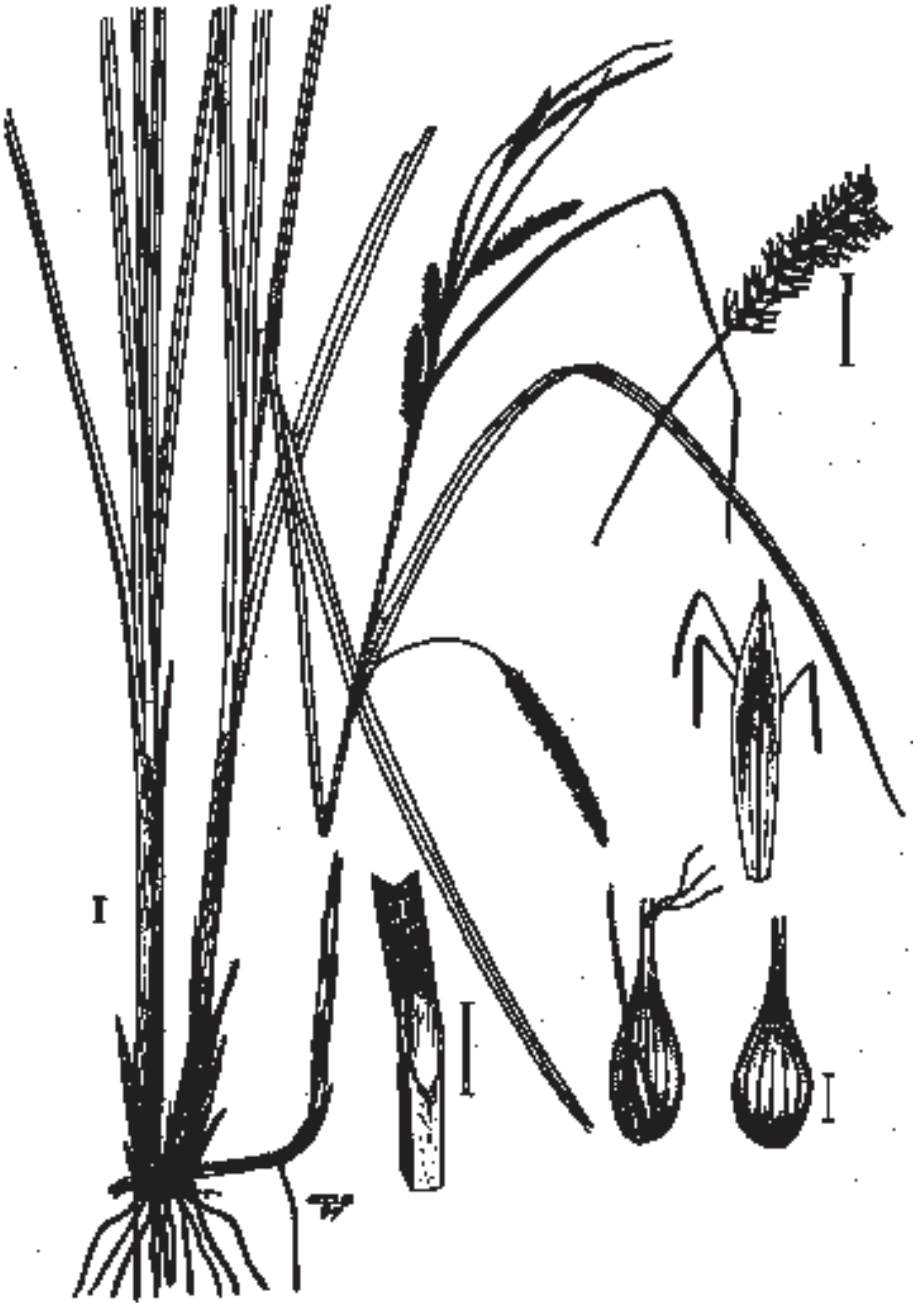

Fig. 1: *Carex pseudocyperus* L. x *C. rostrata* STOKES (= *Carex ×justi-schmidtii* JUNGE). Cultivated material from the site „Kleine Leber". a: habit; b: ligule; c: utricle with glume and utricle; d: glume of a staminate flower; e: detail pistillate spike.

5. Characteristics of the hybrid

The hybrid was described by THORSTENSON (1893), PETCH & SWANN (1956), BAKKER et al. (1976), ASCHERSON & GRAEBNER (1902/04: 230), JUNGE (1908: 228 f.), and KÜKENTHAL (1909: 758). Given that in most cases only specimens from one site or single specimens from various sites were available to the authors, some of their descriptions differ considerably from one another. In addition, a number of features weren't sufficiently taken into account. Thus, a detailed description of the hybrid is given based on specimens from the

sites in Brandenburg and Lower Saxony and Junge's material from the Curauer Moor deposited in B, HBG, and KIEL.
Voucher species were placed in B, GOET, HBG and MSTR.

5.1 General characteristics of *Carex rostrata* hybrids

In Central Europe, all *Carex rostrata* hybrids can be easily and definitely be identified with a combination of three key features (cf. KIFFE & PALLAS 1995, KIFFE & VAN DE WEYER 1998, KIFFE et al. 1999):

- Female flowers have three stigmata.
- The leaves are amphistomatic, i.e. in most cases stomata are almost equally distributed on the epidermis of both the adaxial and the abaxial side of the leaf. However, in many populations of *Carex* rostrata, specimens with up to 20 % of the stomata on the lower side of the leaf can be regularly found (cf. FETTWEIS 1951/52). Often, these stomata are organized along the emerging central vein, the edge of the leaf, or in one or two continuous rows between two veins. These populations should not be mistaken for the hybrid.
- When pressed together, the spongy tissue of the scales filled with aerenchyma feels like corrugated paper (cf. NEUMANN 1952).

5.2 Vegetative characteristics of *Carex pseudocyperus* x *C. rostrata*

Carex rostrata x *C. pseudocyperus* grows in scattered tufts with short underground runners. The color of the basal sheaths is between gray and dark brown with, depending on the population, a little or an obvious touch of crimson red. The basal sheaths have either a very delicate ladder-like network or individual fibrilla (cf. Fig. 1a). Looking at the herbarium material, the leaves of the flowering culms were 4-6(-7) mm wide. Leaves of vegetative culms get 1-2 mm wider. Grown under very nutritious conditions, cultivated specimens from both sites had leaves at the vegetative shoots that were up to 13 mm wide (measurements taken from life material). The lower halves of the leaves are deeply keeled downwards along the central vein, so they look almost as being folded. Further up, the leaves are only weakly keeled downwards along the central vein, so they appear rather flat. The laminae to the left and right of the central vein are weakly keeled upwards in the middle. These keels are dull, contrasting with the pointed keel of the central vein. The leaves are pale green to green with a slight and cold gray glimmer. They don't look different on the adaxial vs. abaxial side. The laminae and especially their margins feel rough.

5.3 Characteristics of the flowering shoots of *Carex pseudocyperus* x *C. rostrata*

The stems of the flowering shoots are acutely trigonous, upright or sloping upright and hang slightly over when they are mature. Flowering stems get 40-70 cm high, they are as long as or shorter than the leaves of the vegetative shoots. They are quite rough below the inflorescence.
The inflorescences get 5.5-23.0 cm long. Some of them are short and compressed, with widely overlapping pistillate spikes. In such cases, one or few spikes tower over staminate spikes inserting right above them, as e.g. in *Carex pseudocyperus*. However, there are also inflorescences with almost no overlapping pistillate spikes, as in *Carex rostrata*. Within one specimen, the shape of the inflorescences varies a lot. The habit of the material from the first site in Brandenburg rather resembles *Carex rostrata,* while that of the second site in Lower Saxony resembles *Carex pseudocyperus.* However, the habit of the hybrid seems to be closely related to its development. A comparison of similarly developed cultivated plants from both sites did not reveal any major differences.
The number of pistillate spikes varies between (1-)3-4, with three being found in most specimens. The size of the lowest pistillate spikes is (25-)40-55(-75) x (7-)8-9 mm. Pistillate spikes are cylindrical, with stems mostly 10-15 mm, rarely up to 45 mm long. Usually, they stand upright in the inflorescence, in few cases they nod and hang down as in *Ca-*

rex pseudocyperus. The specimens from Lower Saxony only had one narrow cylindrical terminal staminate spike. The ones from Brandenburg, besides that one (and once two) spike, had much smaller staminate spikes (Fig. 1a). The specimens collected by Junge in the Curauer Moor had (1-)2 staminate spikes, all spikes being of roughly the same size as the terminal one. Staminate spikes grow to a size of (20-)30-45(-55) × 2-2.5(-3) mm.
The glumes of the female flower are longish-lineal, drawn out into a long, fine, ciliate arista (cf. Fig. 1c) or they don't have such an arista. In the latter case, they have a sharp tip, are red brown with a paler greenish stripe in the middle, and are narrower and in most cases clearly shorter than the utricles. The glumes of the male flowers are longish, with a sharp tip or an arista, either brown to deep brown with a light ciliated margin and an only slightly paler stripe in the middle, or more or less monochromatic pale brown.
The utricles are longish to lanceolate, slightly puffed up (Fig. 1c), overall (5-) 5.5-6.0 mm long and 1.5-1.8 mm wide, and have an oval to circular cross section. They gradually narrow into an almost 2 mm long, clearly toothed, straight beak. Moreover, they are 4-5 mm long and insert at an angle or nearly horizontally. Mature utricles are pale brown with 5-6 clearly distinguishable brown nerves on the outside.
The bracts of the inflorescence are mostly leaf-like and much longer than the inflorescence. The lowest get as long as 20-40 cm, only seldomly being short and almost setaceous. In most of the measured specimens the relation between the length of the bract and the length of the inflorescence was greater than 1.5 : 1, often it amounted to 2 : 1 to 5 : 1. The lowest bract of an inflorescence is usually the longest, while bracts gradually get shorter as they insert higher in the inflorescence. Usually, the topmost bracts are only a few cm long and setaceous, with a leaf-like base.
Like all *Carex rostrata* hybrids of Central Europe, *Carex pseudocyperus* × *C. rostrata* seems to be completely sterile.

6. Zusammenfassung

Beispielhaft für seltene und wenig beachtete *Carex*-Hybriden in Deutschland werden die Chorologie und die Merkmale der intersektionellen Hybride *Carex pseudocyperus* L. × *C. rostrata* Stokes (= *Carex* ×*justii-schmidtii* Junge) behandelt.
Innerhalb Deutschlands konnten von zwei Vorkommen Herbarbelege gefunden werden. Außerdem konnte die Hybride an zwei aktuellen Fundorten neu nachgewiesen werden. Das seltene Auftreten der Sippe unterstreicht die weitgehende taxonomische Isolation von *Carex pseudocyperus* in Europa.

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