# BROOM SEDGE *CAREX SCOPARIA* IN GÖTTINGEN (LOWER SAXONY)

# BESEN-SEGGE *CAREX SCOPARIA* IN GÖTTINGEN /NIEDERSACHSEN)

- Thomas Meineke, Independent Scholar, Ebergötzen, Germany -

**Abstract:** A population of *C. scoparia* in a stormwater basin in the city of Göttingen (Lower Saxony, Germany), discovered in 2019 and growing strongly thereafter, is described. According to a review of the literature and accessible sources, this is the first annotated record of a fourth North American *Carex* species of the section *Argyroglochin* from the subgenus *Vignea* in Germany. Distinguishing features from similar species are presented. Possible routes of its introduction to Europe and the subsequent dispersal are discussed.

**Keywords:** *Cyperaceae*, *Carex scoparia*, Lower Saxony, stormwater basins, neophytes, zoochory

**Kurzfassung:** Beschrieben wird ein 2019 entdeckter und danach stark angewachsener Bestand der Besen-Segge *C. scoparia* in einem Regenrückhaltebecken auf dem Gebiet der Stadt Göttingen (Niedersachsen). Nach Auswertung der Literatur und zugänglichen Quellen ist dies der erste kommentierte Nachweis einer vierten nordamerikanischen *Carex*-Art der Sektion *Argyroglochin* aus dem Subgenus *Vignea* in Deutschland. Merkmale der Abgrenzung gegen ähnliche Arten werden dargestellt. Mögliche Wege der Einschleppung nach Europa und der sich daran anschließenden Ausbreitung werden diskutiert.

**Schlüsselwörter:** *Cyperaceae*, *Carex scoparia*, Niedersachsen, Regenrückhaltebecken, Neophyten, Zoochorie

## 1 Introduction

*Carex scoparia* SCHKUHR ex WILLD. 1805: 230 belongs to the section *Argyroglochin* (= *Cyperoideae*) in the subgenus *Vignea* (REZNICEK 1993, MASTROGIUSEPPE & al. 2002)[1]. With 94 species, it is the most species rich section of the subgenus (ROALSON & al. 2021). North America forms the centre of the geographic distribution with 72 native species (MACKENZIE 1931). In Europe, three native species occur (MACKENZIE l. c., REZNICEK 1993), of which the Holarctic distributed *Carex leporina* and *C. bohemica* grow in Germany (OBERDORFER 2001, BUTTLER & HAND 2008, GEBAUER 2021). The section *Argyroglochin* is characterized by crowded to moniliform inflorescences, consisting of

1 According to KOOPMANN & al. (2022), the valid name of the section is *Argyroglochin* DUMORT., Flor. Belg.:146, 1827, and *Ovales* KUNTH, Enum. Pl. 2:394, 1837 is a synonym. The priority of the name remains even after combining the sections *Ovales* and *Cyperoideae* G. DON in J. C. LOUDON, Hort. Brit. 376, 1830. On the question of infrageneric classification, see ROALSON & al. (2021) and WALLNÖFER & ESSL (2016).

structurally well-defined spikes, mostly ovate to acute elliptic, and the marginal wings of the utricles (MACKENZIE 1931, MASTROGIUSEPPE & al. 2002).

In Europe, eight *Argyroglochin* species endemic to North America and one species of the section also occurring on Kamchatka have been found so far (KARLSSON 2012, WALLNÖFER & ESSL 2016, KOOPMAN 2022, KOOPMAN & al. 2022, IPNI 2023). *Carex muskingumensis* arrived in Europe in the mid-20th century as a garden plant (JÄGER 2008) and has also appeared spontaneously since then. There are no definite findings about the circumstances that led to the establishment of the other North American sedges in Europe. So far, only *Carex crawfordii* is considered established (KOOPMAN 2022).

Documented are spontaneous occurrences in Germany of *C. crawfordii* (first in 1987), *C. muskingumensis* (first in 1984), and *C. cristatella* (2001) (GALUNDER & PATZKE 1988, KRAMER 1992, HEMM 2008, HAND & THIEME 2023). The discovery of other closely related *Argyroglochin* species was expected (GEBAUER 2021, MEYER 2023).

## 2 Growth site of the Broom Sedge Carex scoparia in Göttingen

The plants were first noticed on June 2, 2019, in a 5000 $m^2$ and 2.50 m deep stormwater basin (Fig. 1a) which was created in 2013-2014 during the development of a new industrial area at the southwestern edge of the inner urban area of Göttingen (MTB 4425.342, 51.520 °N and. 9.905 °E, 152 m a. s. l.). Herbarium specimen vouchers are in the collection of the Natural History Museum Vienna and in the possession of the author (Fig. 3).

Until the construction of the stormwater basin, the site was characterized by agriculturally used Luvisol (Parabraunerde according to German nomenclature). Since the excavation, Pleistocene calcareous loess of clayey-silty texture is exposed (NIBIS® map server 2021).

During the observation period, flooding always remained limited to a few days. In midsummer, the marginal areas fell dry, while the more depressed areas remained mostly wet to moist. Willows *Salix* spp. quickly established on the periodically wet basin bottom. In order to keep the reservoir free, mulch mowing was therefore carried out regularly in the winter half-year, and in 2022 exceptionally again in June.

Numbers and cover of Broom Sedge increased exponentially during the three years of record: 2019: <10 plants, <1% cover; 2020: approximately 150 plants, 1% cover; 2022: >4000 plants, 60% cover on 1200 $m^2$ (Fig. 1b). The sedge flowered in the first decade of June, and again in late July/early August after mowing in the 2nd decade of June 2022.

Companion species (large number or high degree of cover is highlighted by underlining): *Carex acutiformis*, *Carex pseudocyperus*, *Eleocharis vulgaris*, *Epilobium hirsutum*, *Epilobium parviflorum*, *Equisetum arvense*, *Glyceria notata*, *Juncus articulatus*, *Juncus inflexus*, *Lycopus europaeus*, *Lythrum salicaria*, *Phragmites australis*, *Poa trivialis*, *Ranunculus repens*, *Salix alba* juv., *Salix smithiana* juv., *Salix viminalis* juv., *Trifolium hybridum*, *Tussilago farfara*, *Typha latifolia*.

## 3 Distinguishing from similar species

The doubtless identification of many *Argyroglochin* species, which are very similar in habit and moreover variable in flower morphology, requires the use of several characteristics on different plants. Ideally, flowering and fruiting material should be available. It is recommended to use identification keys of different North American authors. In the present case, a combination of the keys of MACKENZIE (1931), SCOGGAN (1978), GLEASON & CRONQUIST (1991), MASTROGIUSEPPE & al. (2002), HIPP (2008), and GEBAUER (2021) was applied.

Unaware of a possible occurrence of the Broom Sedge in Germany, one may first think of *Carex leporina* growing in the "wrong place" when seeing flowering plants. However, the scales of the middle flowers of a maturing spike are as long as the utricles, whereas they are much shorter in *C. scoparia* (Fig. 5). Apart from this and other separating morphological features, *C. leporina* grows naturally on base-poor, moist but not wet, sites with a focus in the lean grasslands of silicate areas (e.g., OBERDORFER 2001).

Further characteristics that distinguish the plants from Göttingen from five very similar North American species also found or expected in Germany, are listed in the following table (Tab. 1). The measurements are based on three to five leaf blades, inflorescences, utricles, achenes, and scales from eight plants collected on June 1 and 9 and September 1, 2022. Mean values are given in parentheses.

The shape of the inflorescences and the utricles varies considerably (e.g., HIPP 2008), as also found in Göttingen (Figs. 4a & 4b). For comparison, see the drawings in HOLMGREN (1998) and photographs in, e.g., WALLNÖFER & ESSL (2016: 120), JENKINS (2019), DZIUK (2023), and VERLOOVEN (2023). SCHKUHR (1806) already recorded such variability of the spike arrangement in his illustration (Fig. 5). The German name he gave to the species (Besenartiges Riedgras) is based on the similarity of the inflorescence, which often spreads on one side, with a crookedly worn-out broom.

MACKENZIE (1931), MASTROGIUSEPPE & al. (2002), and SCOGGAN (1978) accept two varieties, the widely distributed var. *scoparia* and var. *tessellata* FERNALD & WIEGAND (1910), which occurs only in the state of Maine (type locality). SCOGGAN l. c. moreover distinguishes five forms under var. *scoparia*. DZIUK (2023) found plants resembling the two varieties in a Minnesota population and therefore doubts their taxonomic status. Illustrations and keys by other authors (see above) seem to confirm this finding. The plants found in Göttingen also have lanceolate to oval-lanceolate utricles (Fig. 4).

LOVIT & HAINES (2012) elevate var. *tessellata* to the rank of species (*Carex waponahkikensis*), based on the two characteristics already described by FERNALD & WIEGAND (1910) (darker scales and broader elliptical utricles) and the different distances between the tips of the scales and utricles. Additional photos of inflorescences, spikes, and female flowers of the two nominal sedges can also be found in JENKINS (2019). WALLNÖFER & ESSL (2016) avoid statements on the distinction of *C. scoparia*, found and cultivated in Austria, from *C. waponahkikensis*. They also do not comment on the infraspecific status of the plants. KOOPMAN (2015), KOOPMAN & al. (2022), and VERLOOVE (2016, 2023) also exclude this question. A comprehensive revision of the taxonomic status of *C. waponahkikensis* (formerly var. *tesselata*) seems necessary.

Table 1: Overview of North American *Argyroglochin* species found or expected in Germany

| Feature | *Carex scoparia* - Göttingen | Species to be excluded |
|---|---|---|
| Culm leaf width | 1.4-3.5 (2.5) mm | *C. cristatella*: 3-7.5 mm,<br>*C. muskingumensis*: 3-5 mm,<br>*C. tribuloides*: 3-7 mm |
| Leaf sheath ventral | white hyaline | *C. cristatella*, *C. muskingumensis* and *C. tribuloides*: green veined |
| Length x width and structure of inflorescence | 2-4 x 0.5-2.0 cm, crowded or loose to moniliform, stiffly erect or flexuous | *C. muskingumensis*: 5-9 x 1-2 cm<br>*C. bebbii*, *C. crawfordii* and *C. tribuloides*: erect and crowded |
| Length x width and shape of spikes | 0.5-1.0 cm x 0.3-0.8 cm, elliptical, apex predominantly acuminate | *C. muskingumensis*: lanceolate,<br>*C. cristatella*: spherical |
| Length of utricle scale | 3.9-5.0 (4.4) mm | *C. bebbii* and *C. tribuloides*: 2.5-3.5 mm,<br>*C. cristatella*: 1.6-2.3 mm |
| Length ratio scale/utricle | 0.8-0.9 | *C. cristatella*, *C. muskingumensis* u. *C. tribuloides*: 0.5 |
| Length x width of utricle | 3.9-5.8 (4.9) x 1.5-2.2 (1.8) mm | *C. bebbii*: 2.5-3.8 x 1.2-2.0 mm,<br>*C. crawfordii*: 3.4-4.1 x 0.9-1.3 mm,<br>*C. cristatella*:2.7-4.0 x 1.0-1.7 mm,<br>*C. muskingumensis*: 6.0-9.0 x 2.0-2.5 mm |
| Width of utricle wing | 0.25-0.5 (0.38) mm | *C. crawfordii* and *C. cristatella*: 0.1-0.2 mm |
| Distance between achene and tip of utricle | 2.6-3.35 (2.9) mm | *C. bebbii*: 1.2-2.2 mm,<br>*C. cristatella*: 1.5-1.8 mm,<br>*C. tribuloides*: 1.4-2.0 mm, |

## 4 Occurrence outside North America and growth requirements

Already since 1948 *C. scoparia* was found in Auckland (New Zealand) and from 1983 and 2011 in Tasmania and Victoria (Australia), respectively (HEALY & EDGAR 1980, ALA 2023, IPNI 2023). In Japan, there is an increasing number of records from 1996 onwards (KAWAKAMI & YAMAGUCHI 2023). CHEON & al. (2014) found *C. scoparia* in Korea in 2013 and 2014.

In Europe, Broom Sedge has appeared at eight localities in four countries; see following chronology (Tab. 2).

Table 2: Overview of currently known occurrences of *Carex scoparia* in Europe (Nation abbreviations: A = Austria; B = Belgium; NL = Netherlands; SK = Slovakia)

| Year | Nation | location / habitat | source |
|---|---|---|---|
| 1982, 1992 | SK | Leles, on the river Latorica / oxbow (Fluvisol, calcareous) | ŘEPKA et al. 1997 |
| 2009, 2011 | A | Rohr in valley of river Krems, Upper Austria / stormwater basin | WALLNÖFER & Essl 2016 |
| 2012, 2018, 2021 | NL | Son - Sonniuspark, North-Brabant / stormwater basin (wet in winter, dry in summer) | KOOPMAN 2015, BRUINSMA & al. 2021, KOOPMAN & al. 2022 |
| 2013 | B | Hechtel, Flanders / fresh stormwater basin | VERLOOVE 2016, 2023 |
| 2014, 2015 | B | Menen, West-Flanders / stormwater basin | VERLOOVE 2016, 2023 |
| 2015 | B | Dadizele, West-Flanders / open areas of a fresh stormwater basin | VERLOOVE 2016, 2023 |
| 2015, 2017 | NL | Venlo-Tradeport North, Limburg / ditch bank | KOOPMAN et al. 2022 |
| 2021 | NL | Hapert - Kempisch Bedrijvenpark, North-Brabant / pool, ditch bank | Observation International 2023 (observer: VAN WALSUM, S.) |

Since the first records at two cut-off oxbow lakes of the Latorica River in south-eastern Slovakia in 1982 and 1992, the number of sightings increases significantly from 2009. The most frequently mentioned habitats are young stormwater basins. About characteristics of the soil only ŘEPKA & al. (1997) provide information. They emphasize the high content of magnesium and calcium cations.

The natural range extends over various more or less humid summer-warm climates of North America. Broom Sedge is absent from desert areas and higher mountainous terrain. It otherwise has a nearly transcontinental distribution in both the U.S. and Canada (IPNI 2023). In the north-eastern U.S., it is one of the most common sedges of wet grasslands (LICHEVAR 2005, BROWN & ELLIMAN 2020).

Summarizing the information in the floristic literature of North America, Broom Sedge shows a preference for open and at most moderately shaded, but especially moist to alternately moist sites: bogs, swamps, wet meadows, lakeshores, stream banks, moist depressions, ditches, and floodplains, as well as corresponding habitats along roadsides. According to MASTROGIUSEPPE & al. (2002),

it grows mostly on acidic, often sandy soils, but according to MOHLENBROCK (2011) also in calcareous fens.

In the North American literature, no evidence of association with specific plant communities was found. European occurrences can be assigned to reed beds and sedge meadows (*Phragmitetalia australis*) as well as transitions to floodplain grassland (*Potentillo-Polygonetalia*).

Apart from light, sufficient water content of the soil and an open vegetation cover, *C. scoparia* does not seem to have any special requirements under suitable climatic conditions. The comparatively euryecious character is consistent with the progressive global distribution.

## 5 Hypotheses on the appearance in Europe and the status in Germany

There is no definite knowledge about the routes of most North American sedges to Europe. Also, the origin of the Broom Sedge in Göttingen could not be clarified. BRUINSMA & al. (2021) suggest that with the landing of U.S. paratroopers in 1944, introduced diaspores survived until retention ponds were constructed in 2009 and then germinated. This is contradicted by the viability of the seeds, which is limited to less than five years ŻUKOWSKI & al. 2010).

In North America, *C. scoparia* and related species are used in wild plant seeds for revegetation of stormwater detention basins and creation of wet grasslands (e.g., Minnesota Department of Transportation 2023, OSC 2023). Thus theoretically, the sedge could have arrived in Göttingen via the sowing of imported seed. However, there is no evidence of seeding of species of the (North American) wet grassland in this site.

The first European find in 1982 in Slovakia dates to the Cold War period and indicates a potential gateway to Western Europe further back in time. In the 1970s and 1980s, the expansion of U.S. military facilities in West Germany reached a peak: 37 U.S. Army military installations and 10 Air Force airfields covering a total area of 940 km$^2$ (CUNNINGHAM & KLEMMER 1995). Planning, organization, and execution of structural facilities, including open space design, were the responsibility of the U.S. Army Corps of Engineer – USACE (GRATHWOOL & MOORHUS 2005), which is characterized by a remarkably broad range of activities. Undoubtedly, this included construction of stormwater management facilities and possibly re-vegetation using North American seeds. In addition, an unconscious introduction via military equipment regularly transported from the USA to Germany must be considered.

At well-shielded military sites, the development and establishment of the first populations may have gone unnoticed for years. Bird species that used the appropriate habitats then most likely carried the seeds with them on their migratory routes, either on their toes, in their feathers, or in their digestive tracts. Plant dispersal by waterfowl has a considerable and at mostly underestimated scale (e.g., GREEN & al. 2016).

Mallard (*Anas platyrhynchos*), Little Ringed Plover (*Charadrius dubius*), Jack Snipe (*Limnocryptes minimus*) and water Rail (*Rallus aquaticus*), observed for example at the Göttingen site, are capable of epizoic transport over many kilometres. In principle, entrainment in the digestive tract by the Little Crake (*Zapornia parva*), which is closely tied to such wetlands but rare in Germany, is also conceivable. In the Netherlands, numerous seeds of *Carex pseudocyperus* have been

found in its crop (TEN KATE 1948). According to RUNDLE & SAYRE (1983), its North American native and widespread relative, the Sora (*Porzana carolina*) preferentially consumes the seeds of *Carex tribuloides*, a species very similar to the Broom Sedge that may occur in the same habitats, during spring migration. If the diaspores are excreted undigested at other sites, they may form new stocks there.

A herbarium specimen voucher of *C. scoparia* without further documented circumstances of its finding from 2010 near Aldenhoven in the district of Düren (Virtual Herbarium VH/en 2023) supports the assumption that the Broom Sedge came to Germany quite some time ago. Occurrences on screened areas, in artificially created sites, and the confusion risk may have prevented early discoveries. Similar comments are made by GALUNDER & PATZKE (1988) concerning the first record of *C. crawfordii*.

In any case, it is advisable to critically review all reports of sedges from stormwater basins that include *Carex leporina* (e.g., SEIFERT 2014, HOLTMAN & al. 2019, LSBG Hamburg 2020), especially if they concern calcareous or base-rich sites.

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Anschrift des Verfassers

Dr. Thomas Meineke
Kirchtal 29
D – 37136 Ebergötzen
E-Mail: info@ubs-meineke.de

## Abbildungen

Fig. 1a: 

Fig. 1b: 

Fig. 1a & 1b: Stormwater basin in Göttingen with mass population of *C. scoparia*. Meineke, 9.6.2022.

Abb. 1a & 1b: Regenrückhaltebecken in Göttingen mit Massenbestand von *C. scoparia*. Meineke, 9.6.2022.

Fig. 2: Inflorescences of *C. scoparia*. Meineke, 9.6.2022.
Abb. 2: Blütenstände von *C. scoparia*. Meineke, 9.6.2022


Fig. 3: Herbarium specimen voucher of *C. scoparia* collected on 9.6.2022.
Abb. 3: Herbarbeleg von *C. scoparia*, gesammelt am 9.6.2022.

Fig. 4a

Fig. 4b

Fig. 4a & 4b: Scales and utricles of one plant each from 9.6.2022 (top) and 1.9.2022 (bottom). Length of the white line corresponds to 2 mm.

Abb. 4a & 4b: Spelzen und Schläuche jeweils einer Pflanze vom 9.6.2022 (oben) und 1.9.2022 (unten). Länge der weißen Linie entspricht 2 mm.


Fig. 5: "Besenartiges Riedgras" *Carex scoparia* (No. 175 - plants in the middle) from SCHKUHR 1806, "... one of the great botanical classics, highlighted by 93 beautiful colored plates of exceptional quality, even by today's standards" (ROBERTSON 1979). A herbarium specimen voucher can be found in the herbarium SCHKUHR, which is kept in the collection of the University of Halle (BRAUN & WERNER 2007). - Reproduction with permission of the Thuringian University and State Library Jena (Signature: 8 MS 12115:2).

Abb. 5: „Besenartiges Riedgras" *Carex scoparia* (No. 175 - Pflanzen in der Mitte) aus SCHKUHR 1806, „ ... one of the great botanical classics, highlighted by 93 beautiful colored plates of exceptional quality, even by today's standards" (ROBERTSON 1979). Ein Herbar-Beleg befindet sich im Herbarium SCHKUHR, das in der Sammlung der Universität Halle aufbewahrt wird (BRAUN & WERNER 2007). - Wiedergabe der Reproduktion mit Erlaubnis der Thüringer Universitäts- und Landesbibliothek Jena (Signatur: 8 MS 12115:2)