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Short communication

***Carex phyllostachys* (Cyperaceae), a new species in Croatia**

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Running title: *Carex phyllostachys* in Croatia

Abstract – The occurrence of *Carex phyllostachys* (Cyperaceae) in the Croatian flora is documented here for the first time. This rare Euro-Caucasian species was found in June 2019 in deciduous sub-Mediterranean *Quercus pubescens*-*Carpinus orientalis* forests on Mosor Mt in central Dalmatia. This record represents the north-western distribution limit of this species. The habitat and ecology of *C. phyllostachys* in the Croatian flora is here presented, and morphological similarities with allied species (*C. distachya* and *C. illegitima*) are discussed. An identification key for *Carex* species belonging to the subgenus *Indocarex* in Croatia is provided.

Keywords: Adriatic, herbarium collections, Mosor Mt, sedges

Introduction

The genus *Carex* L. (Cyperaceae) is worldwide represented by about 2000 species (Govaerts et al. 2016). Of the 225 European species (Koopman 2015), 84 taxa belong to the Croatian flora (Nikolić 2019a, b). In the current century, some *Carex* species have been reported as new for Croatia or their presence has been confirmed for the Croatian flora. The first one, which occurrence in Croatia had previously been uncertain, is *Carex buekii* Wimm., found and confirmed by Alegro and Marković (1999) on the banks of the River Kupa. The occurrence of *C. randalpina* B. Walln. in the River Krapina valley was confirmed by Stančić (2009). Finally, *C. punctata* Gaudin was recorded by Koopman and Topić (2011) for three localities in wet grasslands, near the village Pisarovinska Bregana, River Dretulja and in Risnjak National Park, and it was added to the national lists of the vascular flora (Nikolić 2019a, b).

In June 2019, during field research on the vascular flora of Mosor Mt in central Dalmatia, a peculiar *Carex* population was found within deciduous sub-Mediterranean *Quercus pubescens* Willd. and *Carpinus orientalis* Mill. forests at an altitude of 1080 m a.s.l. Until then, according to Vladović (1994) and Nikolić (2019b), seven *Carex* taxa (*C. caryophyllea* Latourr., *C. distans* L., *C. divulsa* Stokes, *C. flacca* Schreb. ssp. *erythrostachys* (Hoppe) Holub, *C. halleriana* Asso, *C. humilis* Leyss., and *C. otrubae* Podp.) have been recorded for the flora of

Mosor Mt. Morphological survey of the newly found *Carex* population from Mosor Mt, showed some distinctive characteristics, such as very long leaf-like bracts of the lower female flowers, which greatly exceed the inflorescence. They are specific to *C. phyllostachys* C.A.Mey. which occurrence could be confirmed for the first time in the Croatian flora.

According to Chater (1980), in the European flora only *C. phyllostachys* and *C. distachya* Desf. belong to the subgenus *Indocarex* (Baillon) Kük., while Nilsson (1985) added *C. illegitima* Ces. to this subgenus. The Global Carex Group (2016) shows that *C. phyllostachys* is closely related to *C. illegitima* and *C. oedipostyla* Duval-Jouve, the latter from the Canary Islands, Southwest Europe and Northwest Morocco (Koopman 2015), while these three species are closely related to *C. distachya*. Most likely, *C. phyllostachys* is not closely related to the section *Phyllostachyae* which grouping only species occurring in North America (Starr et al. 1999). Therefore, the sectional position of *C. phyllostachys* is less clear and needs further research (see also Więclaw et. al. 2020).

The species *C. phyllostachys* was described and published by Meyer (1831: 30) from Talysh Mt in Azerbaijan (Caucasus). It is rare within its wide distribution range and, according to Koopman (2015) and Koopman et al. (2017), it is known from eleven countries in southern Europe and nearby Asia so far. In Asia the species is known from Armenia (Khandjian 2001), Azerbaijan, Georgia and The Russian Federation (North Caucasus; Egorova 1999), Turkey (Anatolia; Nilsson 1985), Syria (Mouterde 1966), and it was mentioned for North Iran (Kukkonen 1987, 1998). In Europe it was known till the eighties of the 20th century only from North Macedonia (Bornmüller 1924, 1928, Chater, 1980, Teofilovski 2011). Afterwards it has been found in Greece (Bergmeier 1988, Authier 1997), Albania (Barina and Pifkó 2011) and recently in Italy (Wagensommer et al. 2014) which is the westernmost distribution limit of this species so far. *Carex phyllostachys* has a scattered distribution, divided in three geographical areas, very far apart from each other: Caucasus and North Iran, south-eastern Turkey and north-western Syria, and the Balkans and Italy (Authier 1997, Wagensommer et al. 2014).

The present paper provides the first record of *C. phyllostachys* in the Croatian flora, which is the north-westernmost distribution limit of this species (so far). Moreover, morphological similarities with allied species (*C. distachya* and *C. illegitima*), habitat and ecology of *C. phyllostachys* in the Croatian flora are here discussed. An identification key for *Carex* species belonging to subgenus *Indocarex* in Croatia is provided as well.

Materials and methods

Study area

During a field trip on Mosor Mt, on June 5th 2019, a few specimens of *C. phyllostachys* were collected (43°31'40.77" N, 16°37'45.68" E) on some southern slopes along a hiking trail in deciduous sub-Mediterranean *Quercus pubescens* and *Carpinus orientalis* forest at an altitude of 1080 m a.s.l. (Fig. 1). Mosor Mt is located southeast of the city Split in central Dalmatia and it stretches in a direction parallel with the coastline. Although the mountain has the highest peak of 1340 m a.s.l., the vegetation of Mosor belongs entirely to the Mediterranean region. A great part of the plateau on Mosor, as well as its northern slopes, is covered with mesic calcareous sub-Mediterranean oak and hornbeam forests of the alliance *Fraxino ornio-Ostryion* Tomažič 1940 (Vladović 1994, Škvorc et al. 2017).

Plant material

Species identification was performed using taxonomic keys from Boott (1858), Chater (1980) and Nilsson (1985). Voucher specimens of *C. phyllostachys* are deposited in ZA, ZAGR and in J. Koopman's private herbarium. In order to prevent eventual misidentification of *C. phyllostachys* specimens with morphologically more or less similar *C. distachya* and *C.*

illegitima, their exsiccata were checked in five Croatian herbaria (CNHM, NHMS, ZA, ZAGR and ZAHO). In addition, the GBIF database (GBIF.org 2019) was searched for georeferenced records of *C. phyllostachys*, as well as scanned herbarium specimens in some (virtual) herbaria (B, E, FR, G, GJO, K, LE, MW, P, W and WU), for morphological comparison with the specimens from Mosor Mt. Abbreviations of herbaria follow Thiers (2020).

Results and discussion

Carex phyllostachys C.A.Mey., Verz. Pfl. Casp. Meer. 30 (1831)

Synonym – *Forexeta phyllostachys* (C.A.Mey.) Raf., Good Book 28 (1840)

Typification – First-step, designated by Nilsson (1985: 88), as holotype: "[Transcaucasus] in sylvis umbrosissimis montium Talüsch, 530 hexap. [954 m], s.d., C.A. Meyer 180" (LE!); Second-step, indicated by Egorova (1999: 547), as "ypus", ead., hoc loco (LE!); Third-step, designated by Egorova (2006: 242), as lectotype: "Herb. Ledebour. *Carex phyllostachys*. En. cauc. casp. N 180, C.A.Meyer" (LE!), and here we designate the number of herbarium LE 01064315!. Isolectotypes: LE 01064316!, LE 01064317!. The type of *C. phyllostachys* was initially erroneously designated by Nilsson (1985: 88), where the author indicated a holotype in LE and isotypes in G and K. According to the Art 9.10. of the ICN (Turland et al. 2018) such erroneous use of a term has to be treated as an error to be corrected. Afterwards, according to the Art. 9.3. the type was correctly designate as lectotype by Egorova (2006: 242). The specimen stored in G (G 00798631!) is collected in 1842 and does not belong to the original collection (1829-1830) from before 1831, while the specimen kept in K is just a photograph of a specimen in LE.

Morphological description – (based on the Croatian material, Fig. 2): Perennial, monoecious, caespitose, glabrous plant. Stems 20–40 cm long; basal sheaths dark reddish-brown, firmly enclosing stem bases. Leaves green or greyish-green, 2–3 mm wide, equalling or exceeding the stem; ± flat, rather flaccid, scabrid. Inflorescence reduced to 1–2 bisexual spikes, each with 1–3 male flowers at the apex of the branch, and 2–5 female flowers at the base. The male part of the spike 1–2 cm, rather dense, glumes pale brown; female part very lax, lowest flowers often distant. The lower, female flowers lack normal glumes, but have very long bracts instead, leaf-like, 7–22 cm long, dilated at the base, far exceeding the inflorescence, with the function of glumes. Utricles olive-brown, 5–6 mm long, distinctly many-veined, abruptly contracted into a short beak; beak 0.5 mm, often somewhat scabrid, mouth ciliate. Stigmas 3; nut pale brown, trigonous.

Karyology – Chromosome number $2n = 56$ (Więcław et al. 2020).

Phenology – Flowering from May to June, fruiting from June to July.

Distribution in Croatia – Central Dalmatia, Mosor Mt (Fig. 1).

Habitat and ecology – In Croatia, *C. phyllostachys* grows on the southern slopes of Mosor Mt within deciduous sub-Mediterranean forests of the alliance *Fraxino orni-Ostryion* at an altitude of 1080 m a.s.l. It grows together with numerous mesophilous species, among others with *Quercus pubescens*, *Carpinus orientalis*, *Fraxinus ornus* L., *Acer monspessulanum* L., *Ostrya carpinifolia* Scop., *Pistacia terebinthus* L., *Melittis melissophyllum* L., *Sesleria autumnalis* (Scop.) F.W.Schultz, *Rosa* sp., *Silene italica* (L.) Pers., and *Teucrium montanum* L. Deciduous woodlands represent the primary habitat of *C. phyllostachys*, and therefore the Croatian population can be considered as native. In fact, *C. phyllostachys* is a submontane species, known from an altitude usually ranging from 700 to 1800 m a.s.l., where it grows in deciduous forests (Nilsson 1985, Khandjian 2001). In Armenia it was found in a shaded broad-leaved forest, on steep slopes along a rivulet, as well as at humid places in *Quercus* forest (Koopman et al. 2017). Similarly, in Italy it was found in *Q. pubescens* forest, in the bed of a

small dip at 400 m a.s.l. (Wagensommer et al. 2014). While most of the localities are in various deciduous forests, in Albania it was found in dry, open grasslands (Barina and Pifkó 2011), and the known habitats in Greece are also non-forest places (Authier 1997). Barina and Pifkó (2011) as well as Wagensommer et al. (2014) state grazing as the most serious threat for the species.

The species belonging to the subgenus *Indocarex* are morphologically characterised as monoecious, densely caespitose perennial plants, without creeping rhizomes, glabrous, with at least the terminal spike male at the apex, all spikes erect or nodding, lowest spike not pending, spikes lax, female flowers with 3 stigmas (Nilsson 1985, Egorova 1999). According to Chater (1980), *C. phyllostachys* and *C. distachya* are the only two species of the subgenus *Indocarex* occurring in Europe. *Carex distachya* is much more common in the studied region, and one of the characters which discriminates it from *C. phyllostachys* is the lower female bract which is shorter, reaching max. 5 cm (Authier 1997). Besides, *C. distachya* has normally developed female glumes, whereas *C. phyllostachys* has nude utricles; the elongate bracts have taken over the function of glumes (Egorova 1999). Another very rare and peculiar species is *C. illegitima* which has gynobasic lowest spikes, i.e. on long peduncles, arising from the base of the stem. Furthermore, *C. distachya* and *C. illegitima* are typically Mediterranean species growing primarily in evergreen *Quercus ilex* forests and maquis shrubland.

Searching through the GBIF database, we noticed one record of *C. phyllostachys* from Croatia in Herbarium Senckenbergianum (FR 0120985!). The material was collected on 30 May 2014 from Dubrovnik area, by Thomas Gregor and Lenz Meierott. In 2015, the reviewer of the material, Heinz Kalheber, thought it to be *C. phyllostachys*, which would mean that it is the first record of that very rare species from Croatia. Initially, Kalheber was not quite sure about his own determination, having written "könnte es sein" (could be), which has later been crossed out. We studied the scanned material from FR herbarium, and to our opinion this material from Croatia does clearly not belong to *C. phyllostachys*. There are too many female flowers, and they have normal female glumes, which are missing in *C. phyllostachys*. This specimen has only one, a bit longer bract, and to our opinion it clearly belongs to the much more common *C. halleriana*. Since in botanical literature no other information exists about the occurrence of *C. phyllostachys* in Croatia, our finding on Mosor Mt is indeed the first one.

Furthermore, the finding of *C. phyllostachys* in Italy by Wagensommer et al. (2014) was not the first one for the Italian flora. Chater (1980) was obviously unaware of some material from the Basilicata region in the Vienna herbarium (21 May 1977, leg. W. Burri and F. Krendl s.n., W 1994-0000725!), which was inserted in W after 1980. It was initially identified as *C. depauperata* With., but clearly belongs to *C. phyllostachys* (see Examined specimens below). On the same day at the same locality, these collectors, did still find *C. depauperata*: "Basilikata: von Laghi di Monticchio zum M. Vulture, ca 700-1000 m, Eichen-Kastanien-Wald, vulkanisches Gestein" (W).

Wagensommer et al. (2014) discussed the phytogeographical connection of the Apennines, especially the Apulia region, and south-eastern Europe through some species with amphi-Adriatic distribution. The connection between the Apennines and the Balkans has been discussed recently also at community level (e.g. Di Pietro and Wagensommer 2014, Terzi et al. 2018). The new record of *C. phyllostachys* on the eastern Adriatic coast is interesting because it might represent another plant species which underlines the connection between the Apennine and the Balkan flora.

Identification key for *Carex* subgenus *Indocarex* in Croatia

- 1a. Lowest spike(s) long pedunculate, arising from base of stem, gynobasic *C. illegitima*
 1b. Lowest spike(s) sessile or shortly pedunculate, not gynobasic 2

- 2a. One or more spikes; utricles nude, i.e. without glumes, lowest female bracts leaf-like, 5–22 cm long *C. phyllostachys*
2b. More than one spike; lowest female glumes less than 5 cm long 3
- 3a. Leaves 0.5–1.5 mm wide; utricles almost without veins, beak not scabrid
..... *C. distachya* var. *distachya*
3b. Leaves 0.9–2.5 mm wide; utricles with 2 distinct veins, beak somewhat scabrid
..... *C. distachya* var. *phyllostachioidea*
[only known from Asian W Turkey and the E Aegean Islands]

Examined specimens (*specimina visa*) – **Armenia:** Provinz Syunik, ca. 19 km SSE Kapan, Nerkin Hand, entlang dem Fluss E der Ortschaft, 680 m, 46.52972°E, 39.06083°N, 16 June 2016, R. Karl s.n. (GJO 0095051).

Azerbaijan: *In sylvis umbrosissimis montium Taliusch, locis humidiusculis*, alt. 530 hexap., s.d., C. A. Meyer 160 (LE 01064315, LE 01064316, LE 01064317); *In humidis sylvarum umbrossimarum*, Trans-Caucasia, 1831, C.A. Meyer s.n. (LE 01064318, LE 01064319); Mont Talysh, 1836, C.A. Meyer s.n. (P 01668651); *In faucibus Yataghanov-tshaj prope Lerik, in sylvis*, 4 May 1915, A. Grossheim s.n. (MW 0653631); Taliusch, C.A. Meyer s.n., 1842 (G 00798631).

Georgia: Transcaucasia, Tiflis, *in dumetis ad ostium fl. Armazis-tzchali prope stat. viae ferr. Mtzchet*. 17 May 1923, B. Schischkin s.n. (MW 0653630, P 00293691).

Greece: Epire, nord-ouest Grèce, entre Vradeto et le Filakio, 1550 m, 2 June 1993, P. Authier s.n. (P 01668650, P 01668652); Thess., Kato Olimbos, zw.Kallipefki u. Kranea, Hangkante, mäßig beweidet, mäßig tiefgründig, real.frisch, c.1050 m ü.NN, grasige Fläche im Kontakt zu *Q.coccif.*-Gebüsch, zus. m. *Carex praecox*, 10 August 1986, E. Bergmeier 83-14v/3 (B).

Iran: Mazanderan, Harz Valley, Darli above Panjab, 2000 m, 52.283333°E, 36.166667°N, 30 July 1959, P. Wendelbo s.n. (E 00353692).

Italy: Basilikata: N-Seite des M. Vulture, knapp unterhalb der Gipfelregion, ca. 1200-1300 m, Kalkschläge in der Buchenwaldregion, vulkanisches Gestein, 21 May 1977, W. Burri & F. Krendl s.n. (W 1994-0000725, sub *C. depauperata*); Apulia, Prov. Bari, Santeramo in Colle, loc. Alessandrelli, Cula da Chioppo, UTM (ED50): 33T 0645 E 4515 N, 440 m, *Quercus pubescens* Willd. s. l. wood, at the ground of a small valley, 16 May 2012, R.P. Wagensommer, E.V. Perrino, G.N. Silletti s.n. (FI, BI).

North Macedonia: Bitola – nad s. Gorno Srpce, po kraevite na dabova šuma, silikat, 1000 m, 14 June 2009, A. Teofilovski s.n. (MKNH); Babuna Pass, c. 1000, 25 May 1918, H. Burgeff s.n. (B).

Syria: Slenfé, 24 June 1946, F. Louis s.n. (P 00293692, P 00293695); Attik Gheuzbel, 29 April 1937, F. Louis s.n. (P 00293693); Slenfé, s.d., F. Louis s.n. (P 00293694).

Turkey: Prov. Hatay dist. Belen (Amanus), Karlik tepe above Soguk Oluk, 900 m, tufted scrub on limestone, 24 April 1957, P.H. Davis, I.C. Hedge s.n. (E 00353694); Prov. Adana dist. Bahçe (N.Amanus): Dumanli Dag above Haruniye, 900 m, Ostrya scrub, 19 April 1957, P.H. Davis, I.C. Hedge s.n. (E 00353695); Prov. Adana dist. Bahçe (N.Amanus): Dumanli Dag above Haruniye, 700 – 900 m, in scrub on metamorphic slopes, 19 April 1957, P.H. Davis, I.C. Hedge s.n. (E 00353696); *Quercetum*, A6 Sivas: nsvr: Subehri–Zara, *Quercetum* am Kuşkayasi Geçidi, 1810 m, 3 June 1990, M. Nydegger 45622 (FR 0025713).

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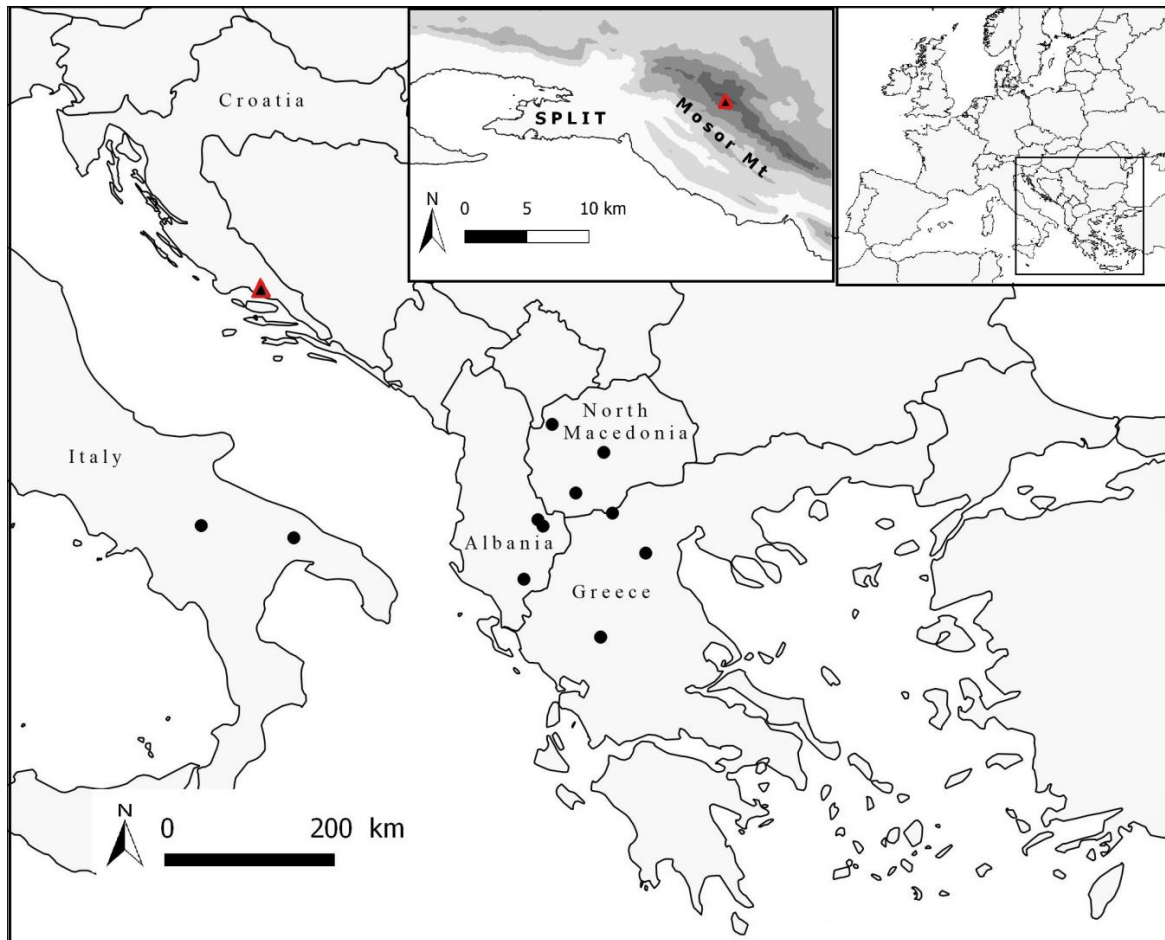


Fig. 1. Distribution of *Carex phyllostachys* C.A.Mey. in Europe, based on herbarium and literature data; the new record in Croatia is indicated with a red triangle.



Fig. 2. Herbarium specimen of *Carex phyllostachys* C.A.Mey. collected on Mosor Mt in 2019 (ZAGR-53784).