Acta Bot. Croat. 81 (1), 101–107, 2022
DOI: 10.37427/botcro-2022-007

CODEN: ABCRA 25
ISSN 0365-0588
eISSN 1847-8476

Chorological notes of *Carex* L. (Cyperaceae) for the Flora of the Balkans, with emphasis in Albania

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Abstract – Relevant chorological notes of genus *Carex* L. (Cyperaceae) for the flora of the Balkans are provided, with an emphasis on Albania and adjacent countries (North Macedonia and Montenegro). Our findings include new national species records and/or confirmations for Albania, Montenegro and North Macedonia (*C. agastachys*, *C. atrata*, *C. curvula*, *C. demissa*, *C. hispida*, *C. parviflora*), as well as other interesting records of rare and/or endangered *Carex* species in Albania (*C. castroviejoi*, *C. myosuroides*). Eventually, we provide relevant comments in order to clarify the taxonomy, distribution and/or ecology of *Carex* sections *Rhynchocystis* (*C. agastachys*, *C. pendula*) and *Aulocystis* (*C. ferruginea*, *C. kitaibeliana*, *C. lazarei*) in the Balkans.

Keywords: Albania, Balkans, *Carex*, chorology, conservation, endangered flora

Introduction

The Balkan Peninsula is one of the three large peninsulas in south Europe projecting into the Mediterranean Sea. It harbors a high plant species diversity and endemism as compared to the rest of Europe, with part of it included in the Mediterranean basin, one of the world´s hotspots of biodiversity (Myers et al. 2000, Mittermeier et al. 2011). Some of the countries belonging to the Balkan Peninsula, like Albania, Croatia or Bulgaria, span territories included in both the Mediterranean and the Eurosiberian floristic regions, which considerably increases their plant richness. Croatia and Greece, for example, also include areas that are considered to have been climatic refugia for plants during historical climatic oscillations like the Miocene cooling or the Pleistocene glaciations. These refugia are reservoirs of unique genetic diversity and evolutionary potential due to the long-term persistence of species, and therefore have high conservation priority (Médail and Quézel 1999, Médail and Diadema 2009).

Carex L. (Cyperaceae) is a megadiverse plant genus with an almost cosmopolitan distribution although with higher species diversity in the temperate and cold areas of both hemispheres. With ca. 2000 species it ranks among the three largest angiosperm genera in the world (POWO 2020), but it is only the 17th in the Euro-Mediterranean territory (ca. 232 species; Raab-Straube, *pers. comm.*). In the Balkan Peninsula (considered here to include Albania, Bosnia and Herzegovina, Bulgaria, Croatia, European Turkey, Greece, Kosovo, North Macedonia, Montenegro, Serbia, and Slovenia) there are 92 native *Carex* species according to the most up-to-date official checklist (Govaerts et al. 2021). However, a big issue is that this checklist does not consider the current political borders in the Balkans resulting from the breakup of the former Yugoslavia in the 1990s, which complicates the elucidation of the real number of *Carex* species in the Balkan countries formerly belonging to Yugoslavia. Therefore, floristic studies are needed to solve this problem for *Carex* and many other genera.

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In Albania, 58 *Carex* species have been recognized by Govaerts et al. (2021). The flora of this country has been intensively studied in recent years, and new floras and checklists have been recently published (Vangjeli 2015, Pils 2016, Barina et al. 2017, 2018).

Materials and methods

The sampling of *Carex* species was performed during a field campaign in Albania during July 2019. Fieldwork was complemented by the study of *Carex* specimens housed at Tirana University herbarium, Albania (TIR). Vouchers collected in the field were deposited at Pablo de Olavide University Herbarium, Seville, Spain (UPOS) and TIR. They were carefully studied and identified with the help of a Nikon SMZ645 stereoscopic microscope. A special effort was made to examine the most important diagnostic characters in the genus, using *Carex* sections as a gateway for taxonomic identification (e.g., Jiménez-Mejías et al. 2016). Identified species were checked against relevant global (Govaerts et al. 2021), European (e.g., Jiménez-Mejías and Luceño 2011), and Albanian (e.g., Vangjeli 2015, Pils 2016, Barina et al. 2017, 2018) floras and checklists. Finally, we performed a preliminary assessment of the conservation status of *C. atrata* and *C. parviflora* at the national level in Albania following criteria, categories, and guidelines from IUCN (2012a, b).

Results

Our fieldwork trips resulted in 134 *Carex* herbarium vouchers belonging to 44 different species. An additional species (*C. agastachys*) was studied from a collection housed at TIR. The finding of 13 of these species was considered relevant for the knowledge of the flora of the Balkans. As a result, we herein report new national records for two species: (i) *C. atrata* for Albania and North Macedonia, (ii) *C. parviflora* for Albania, Montenegro and North Macedonia. We confirmed the occurrence in Albania of four species whose presence was considered unproven or their status disputed: *C. agastachys*, *C. demissa*, *C. curvula* and *C. hispida*. We also provide additional records for two rare and/or endemic species to the Balkans (*C. castroviejoi*, *C. myosuroides*). The studied collections also shed light on the taxonomy, distribution and/or ecology in the Balkans of two problematic *Carex* groups (sections *Rhynchocystis* and *Aulocystis*).

Discussion

Carex atrata L. subsp. *atrata* (Fig. 1A)

This species is an arctic-alpine element distributed in the high latitudes and mountains of the western Palearctic, reaching marginally Greenland. In the Balkans, Govaerts et al. (2021) indicate its presence in Greece and the former Yugoslavia. Jiménez-Mejías and Luceño (2011) attributed these records to Bosnia, Croatia, Slovenia and Serbia, to which they added Bulgaria. *Carex atrata* has recently been reported for Albania by Pils (2016), Barina (2017a; also implicitly indicating North Macedonia, Montenegro and Kosovo) and Barina et al. (2018), based on a single known population from Mt. Korab, the highest peak (2764 m a.s.l.) of both Albania and North Macedonia. We visited this Albanian-North Macedonian population, and noticed it is nowadays composed of very few individuals (probably not more than a hundred) and confined to the very summit of Mt. Korab. This is a relatively large and conspicuous species, which is relatively easy to spot in the alpine meadows where it is found, so we believe individuals previously collected from lower altitudes collected at the beginning of 20th century (as low as 1800 m a.s.l.; J. Andrasovszky in 1917, see Barina 2017a) could have disappeared perhaps due to climatic warming and/or habitat degradation. If so, the only known Albanian-North Macedonian population of this species could be facing extinction, since individuals were only observed above 2650 m a.s.l. In addition, we observed flocks of sheep very close to the summit that were intensively grazing and nitrifying the alpine meadows where the species is found. Our preliminary assessment of the national conservation status of this species in Albania (and possibly also in North Macedonia) indicates that it probably fulfills the criteria to be considered critically endangered [CR B1ab(iii,v)+2ab(iii,v)]. Other populations located at lower altitudes from the Balkans (Montenegro, Kosovo; cf. Barina 2017a) and other European countries could be also endangered or have already disappeared (Gebauer, *pers. comm*).

While Barina (2017a) cited the Albanian specimens as belonging to *C. aterrima* Hoppe (as *C. atrata* subsp. *aterrima* (Hoppe) Hartm.), we confirm that the Korab population is *C. atrata* subsp. *atrata*. Both species can be distinguished by the utricle color, light-colored (yellow or greenish) above in *C. atrata*, thus contrasting with the blackish glumes, while they are dark-colored (blackish to almost black) in *C. aterrima*, thus not contrasting with the glumes (Gebauer and Jiménez-Mejías, unpubl. data).

ALBANIA. Dibër county, Radomirë, Mt. Korab, alpine meadows at the summit, 41°47'23.62"N 20°32'49.81"E, 2764 m a.s.l., 18 Jul 2019, C. Benítez-Benítez, M. Míguez, S. Martín-Bravo and P. Jiménez-Mejías 174CBB19, UPOS-13414, TIR-8961 .

NORTH MACEDONIA. Polog region, Mavrovo and Rostusa, Mt. Korab, alpine meadows near the summit, 41°47'13"N 20°32'50"E, 2662 m a.s.l., 18 Jul 2019, C. Benítez-Benítez, M. Míguez, S. Martín-Bravo and P. Jiménez-Mejías 172CBB19, UPOS-13412, TIR-8960.

Carex castroviejoi Luceño and Jim.Mejías (Fig. 1B)

A member of the *C. flava* L. species complex (sect. *Ceratocystis* Dumort.), a group characterized by its difficult taxonomy, due to faint morphological boundaries, frequent hybridization processes (Jiménez-Mejías et al. 2012a, 2014), and even morphological convergence (Jiménez-Mejías et al. 2017). *Carex castroviejoi* has been recently described from the Pindos range in Northern Greece, where it grows in mountain bogs on ophiolitic rocks (Jiménez-Mejías and

Luceño 2009). It was later reported from serpentines in central-southern Albania (Jiménez-Mejías et al. 2012b), where it was apparently overlooked by Barina et al. (2018). The population cited here constitutes the new northernmost limit of this restricted Balkan endemic, hitherto only known from Albania and northern Greece (Jiménez-Mejías and Luceño 2011, Govaerts et al. 2021). It was found in the typical habitat reported for this species, boggy ground on serpentine rocks, in the Fushë-Lurë mountain range (NE Albania). Other Balkan reports for species belonging to the *C. flava* species complex have to be carefully examined (e.g., Pils 2016, Barina et al. 2018).

ALBANIA. Dibër county, Fushë Lurë, path to lakes from Lura hotel, wet meadows in *Pinus heldreichii* forest clearings, on serpentines, 41°48'27.05"N 20°13'11.28"E 1125 m a.s.l., 10 Jul 2019, C. Benítez-Benítez, M. Míguez, S. Martín-Bravo and P. Jiménez-Mejías 6CBB19, UPOS-13246, TIR-8949; Ibidem, Lura lakes, close to Liqeni i Madh, boggy

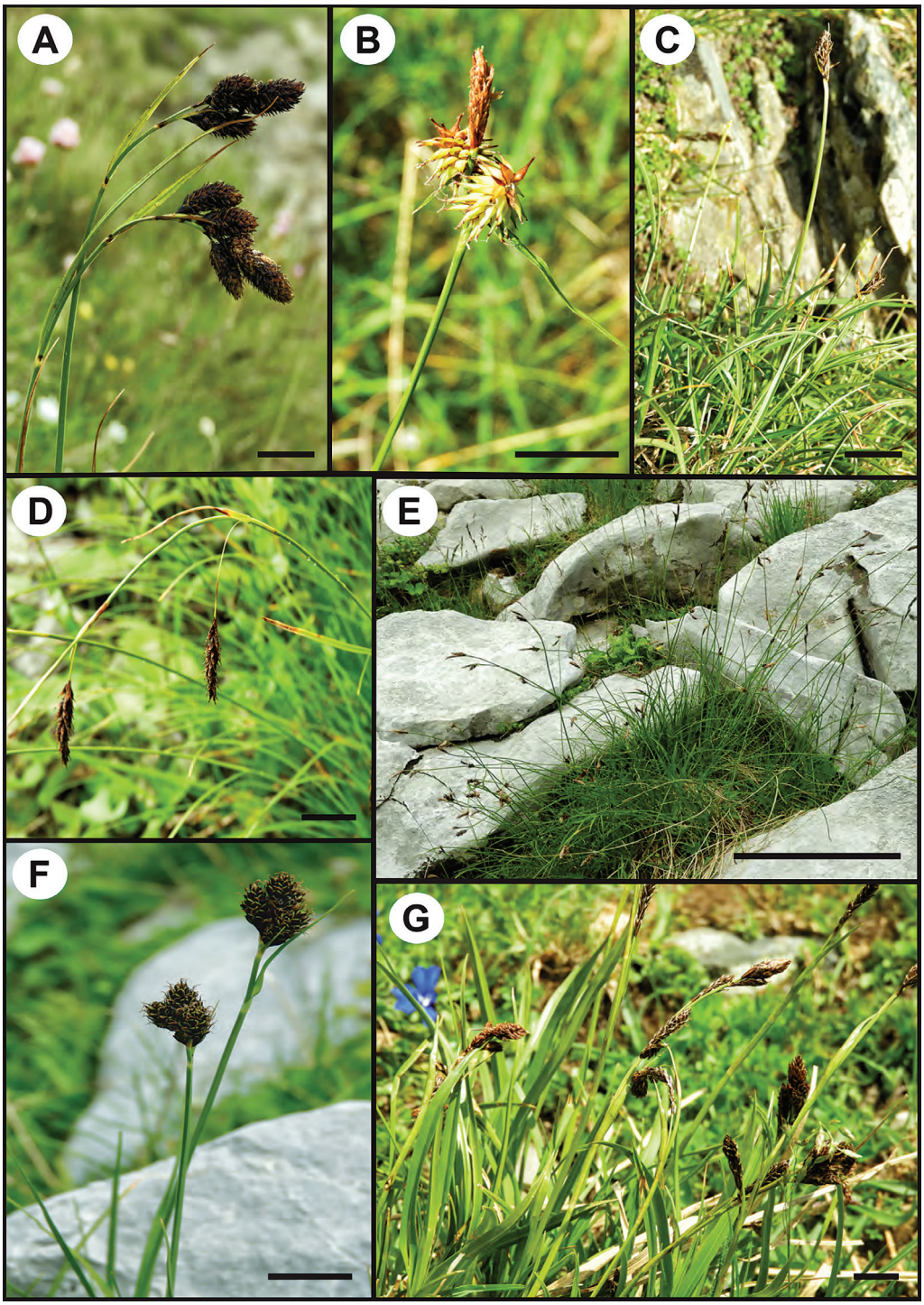

Fig. 1. Representative photos of some *Carex* species from Albania considered in this paper. A – *C. atrata* L. subsp. *atrata*, B – *C. castro-viejoi* Luceño and Jim.Mejías, C – *C. curvula* All. subsp. *curvula*, D – *C. ferruginea* Scop., E – *C. kitaibeliana* Degen ex Bech., F – *C. parviflora* Host, G – *C. lazarei* Jac.Koopman, Niketic, Wieclaw and Govaerts. Scale bar: 1 cm, except in E: 30 centimeters.

meadows, on serpentines, 41°47'13.41"N 20°11'40.56"E, 1735 m a.s.l., 10 Jul 2019, C. Benítez-Benítez, M. Míguez, S. Martín-Bravo and P. Jiménez-Mejías 20CBB19, UPOS-13260, TIR-8950.

***Carex curvula* All. subsp. *curvula* (Fig. 1C)**

It is distributed in the mountains of central and southern Europe. In the Balkans, it has been accepted for Albania, Bosnia-Hercegovina, Bulgaria and Slovenia (Jiménez-Mejías et al. 2011, Govaerts et al. 2021) but excluded from the flora of Greece (Dimopoulos et al. 2020). The presence of this species in Albania has been recently considered unproven by Barina et al. (2018), although it is recorded by Jiménez-Mejías and Luceño (2011), Pils (2016) and Govaerts et al. (2021). This was due to the lack of verified vouchers with specific localities (Barina et al. 2018). We here provide a voucher to confirm that this species should be included in the checklist of the flora of Albania.

ALBANIA. Dibër county, Radomirë, Mt. Korab, psicroxerophylous stony and blown pastures (fellfields) with *Vaccinium uliginosum*, 41°47'23.62"N 20°32'49.81"E, 2488 m a.s.l., 18 Jul 2019, C. Benítez-Benítez, M. Míguez, S. Martín-Bravo and P. Jiménez-Mejías 169CBB19, UPOS-13409, TIR-8963.

***Carex demissa* Hornem.**

Like *C. castroviejoi* (see above), *C. demissa* is another member of the *C. flava* group (sect. *Ceratocystis*). This amphi-Atlantic species is mostly distributed in eastern North America and western Europe, and is absent from most of eastern Europe (Govaerts et al. 2021). Nonetheless, in the Balkans, it has been reported from the former Yugoslavia (North Macedonia; Jiménez-Mejías and Luceño 2011) and Greece (Govaerts et al. 2021). However, its presence in Albania has been considered doubtful (Barina et al. 2018, Govaerts et al. 2021). *Carex demissa* is often confounded with the superficially similar *C. oederi* Retz., which is widely distributed across the northern hemisphere (Europe, Asia and North America), and has been confirmed for Albania (Jiménez-Mejías and Luceño, 2011, Barina et al. 2018 – sub *C. serotina* Mérat –, Govaerts et al. 2021; also confirmed from our own collections). We here confirm the presence in Albania of specimens that clearly fall within the morphological variation of *C. demissa* (see Jiménez-Mejías et al. 2014). Interestingly, in NE Albania (Fushë-Lurë range), it co-occurs with the closely related *C. castroviejoi*, with which it seems to form hybrids with intermediate morphology.

ALBANIA. Dibër county, Fushë Lurë, path to lakes from Lura hotel, wet meadows in *Pinus heldreichii* forest clearings, on serpentines, 41°48'27.05"N 20°13'11.28"E, 1125 m a.s.l., 10 Jul 2019, C. Benítez-Benítez, M. Míguez, S. Martín-Bravo and P. Jiménez-Mejías 11CBB19, UPOS-13251, TIR-8971; Ibidem, Lura lakes, close to Liqeni i Madh, boggy meadows, on serpentines, 41°47'13.41"N 20°11'40.56"E, 1735 m a.s.l., 10 Jul 2019, C. Benítez-Benítez, M. Míguez, S. Martín-Bravo and P. Jiménez-Mejías 33CBB19, UPOS-13273, TIR-8972; borders of streams in beech forest, 42°30'21"N 19°58'23"E, 1495 m a.s.l., 14 Jul 2019, C. Benítez-Benítez, M. Míguez, S. Martín-Bravo and P. Jiménez-Mejías 69CBB19, UPOS-13309, TIR-8973; Kukës county, between Novosej and Shistavec, boggy meadows, 41°59'15"N 20°36'5"E, 1375 m a.s.l., 16 Jul 2019, C. Benítez-Benítez, M. Míguez, S. Martín-Bravo and P. Jiménez-Mejías 129CBB19, UPOS-13309, TIR-8974 (typical, not-introgressed individuals); Dibër county, Fushë Lurë, path to lakes from Lura hotel, wet meadows in *Pinus heldreichii* forest clearings, on serpentines, 41°48'27.05"N 20°13'11.28"E, 1125 m a.s.l., 10 Jul 2019, C. Benítez-Benítez, M. Míguez, S. Martín-Bravo and P. Jiménez-Mejías 14CBB19, UPOS-13254, TIR-8975 (deviant specimens, probably introgressed with *C. castroviejoi*).

***Carex hispida* Willd. ex Schkuhr**

A circum-Mediterranean species whose distribution in the Balkans is in need of clarification. It is only reported for Greece by Jiménez-Mejías and Luceño (2011), to which Govaerts et al. (2021) added Albania, since it had been included in several floristic accounts (Meyer 2011, Vangjeli 2015). However, it has subsequently been excluded from the Albanian flora since the source voucher was misidentified and corresponded to the close relative *C. flacca* Schreb. (Pils 2016, Barina 2017b, Barina et al. 2018). We have collected and identified a voucher of *C. hispida* from northern Albania (Bajram Curri), easily recognized and distinguished from *C. flacca* by its wider leaves and rhizomes and longer male spikes and utricles, which confirms the presence of *C. hispida* in Albania.

ALBANIA. Kukës county, road from Bajram Curri to Kukës (SH23), borders of stream, on serpentines, 42°21'45"N 20°7'47"E, 500 m a.s.l., 15 Jul 2019, C. Benítez-Benítez, M. Míguez, S. Martín-Bravo and P. Jiménez-Mejías 106CBB19, UPOS-13346, TIR-8959.

***Carex myosuroides* Vill.**

An artic-alpine species (formerly known as *Kobresia myosuroides* (Vill.) Fiori) with a wide distribution in the Northern Hemisphere and shared by many of the main European mountain ranges (Pyrenees, Alps, Apennines, Carpathians and Balkans). In the Balkans, it has been reported for Bulgaria and the former Yugoslavia (Govaerts et al. 2021), where it has been indicated from Bosnia, Croatia, Montenegro, Kosovo, North Macedonia, Serbia and Slovenia (cf. Stevanović et al. 2009, Jiménez-Mejías and Luceño 2011). It was not cited for Albania until Barina et al. (2011, sub *Kobresia myosuroides*; see also Pils 2016) indicated a single small population in the north (Albanian Alps, Mt. Maja e Shënikut). Another previous report from southeastern Albania was discarded (Barina et al. 2011, 2018). We herein cite the second confirmed known population in Albania, also from the Albanian Alps, close to the previously known one. It is reported here due to the apparent rarity of the species in the country, although it has been indicated from several bordering areas (Stevanović et al. 2009).

ALBANIA. Kukës county, Prokletije (Albanian Alps), Valbonë valley, path from Valbonë valley to Kolata peak,

dry rocky grassland on limestone, shelves among rocky crests, 42°28'39.98"N 19°48'37.15"E, c. 1900 m a.s.l., 12 Jul 2019, C. Benítez-Benítez, S. Martín-Bravo and P. Jiménez-Mejías 52CBB19, UPOS-13292, TIR-8952.

***Carex parviflora* Host (Fig. 1F)**

This orophilous species is disjunctly distributed in the mountains of central and southern Europe. In the Balkans, it has been reported from Bulgaria and the former Yugoslavia (Govaerts et al. 2021), which corresponds to Slovenian populations (Jiménez-Mejías and Luceño 2011). To our knowledge, these are the first national reports of this species for Albania, North Macedonia and Montenegro. Two distant populations were found during our field campaign in border areas of two mountain ranges, one in the Valbonë valley (Albanian Alps, N Albania) and the second one on Mt. Korab (NE Albania), in both cases with individuals across the Albania-Montenegro and Albania-North Macedonia border, respectively. This implies a considerable increase in the species' range in southeastern Europe, with a disjunction of more than 230 km to the closest previously known populations in SW Bulgaria (Pirin National Park) and about 500 km to those in Slovenia. Due to these biogeographical peculiarities, and since the number of observed individuals was very small in both populations, especially on Mt. Korab (probably less than a hundred), they should be granted legal protection in the corresponding countries, and further searches for more populations and/or individuals would be desirable. A tentative assessment of the national conservation status suggests that this species should be considered at least as Vulnerable (VU D2) in Albania, but further data may indicate that the actual conservation category could be more critical (EN or CR).

ALBANIA. Kukës county, Prokletije (Albanian Alps), Valbonë valley, path from Valbonë valley to Kolata peak, subalpine mesophilous grassland on limestone, 42°29'3.70"N 19°53'8.80"E, ca. 1900 m a.s.l., 12 Jul 2019, C. Benítez-Benítez, S. Martín-Bravo and P. Jiménez-Mejías 50CBB19, UPOS-13290, TIR-8951; Dibër county, Radomirë, Korab Mt., stony grassland in stream borders, 41°47'13.08"N 20°32'29.42"E, 2350-2400 m a.s.l., 18 Jul 2019, C. Benítez-Benítez, M. Míguez, S. Martín-Bravo and P. Jiménez-Mejías 171CBB19, UPOS-13411; Ibidem, alpine meadows in the summit, 41°47'23.62"N 20°32'49.81"E, 2764 m a.s.l., 18 Jul 2019, C. Benítez-Benítez, M. Míguez, S. Martín-Bravo and P. Jiménez-Mejías 175CBB19, UPOS-13415, TIR-8962.

NORTH MACEDONIA. Polog region, Mavrovo and Rostusa, Mt. Korab, alpine meadows near the summit, 41°47'13"N 20°32'50"E, 2662 m a.s.l., 18 Jul 2019, C. Benítez-Benítez, M. Míguez, S. Martín-Bravo and P. Jiménez-Mejías 173CBB19, UPOS-13413.

MONTENEGRO. Kukës county, Prokletije (Albanian Alps), Valbonë valley, path from Valbonë valley to Kolata peak, international border at saddle, subalpine mesophilous grassland on limestone, 42°29'3.70"N 19°53'8.80"E, ca. 1950 m a.s.l., 12 Jul 2019, C. Benítez-Benítez, S. Martín-Bravo and P. Jiménez-Mejías 51CBB19, UPOS-13291.

***Carex* sect. *Rhynchocystis* Dumort. (*C. agastachys* L.f. and *C. pendula* Huds.)**

Only two species of this section were traditionally recognized to be present in the western Palearctic until recently: the central Mediterranean endemic *C. microcarpa* Bertol. ex Moris (Míguez et al. 2021a) and the widely distributed *C. pendula* (e.g. Jiménez-Mejías and Luceño 2011), a well-known large sedge commonly inhabiting riparian habitats and frequently used as an ornamental in European gardens. However, the detailed study of the systematics of section *Rhynchocystis*, based on morphological and molecular data, has initiated a revolution in the classification of this group (Míguez et al. 2017, 2018, 2021b). Two different species have been distinguished across the former *C. pendula* Palearctic mainland range (plus two additional Macaronesian endemic species; Míguez et al. 2021b): *C. pendula* s.s., from Europe and the Mediterranean basin, and *C. agastachys* L.f., from C, SE Europe and SW Asia (Míguez et al. 2018). The range of both species overlaps from C to SE Europe, including part of the Balkans. Although this contact area is still poorly known and in need of detailed delimitation, recent studies are making progress with this issue (Meierott 2019, Bergmeier 2020, Christians et al. 2020, Dimopoulos et al. 2020, Sutorý and Repka 2020). In the Balkans, *C. agastachys* has been confirmed from Bulgaria, Greece, European Turkey, Serbia and Slovenia, and *C. pendula* from Croatia, Greece, Montenegro and Slovenia (Míguez et al. 2018). Govaerts et al. (2021) added Albania for *C. agastachys* but did not clarify the distribution in the former Yugoslavian countries. Finally, recent Albanian checklists and floras include *C. pendula* s.l. without taking into account the potential presence of *C. agastachys* (Vangjeli 2015, Pils 2016, Barina et al. 2018). As a result of our field campaigns and study of TIR herbarium specimens, we can confirm the presence of both species in Albania.

Carex pendula: ALBANIA. Lezhë county, SH 34 road, between Rrëshen and Perlat, just before Perlat, degraded *Quercus cerris* forest, puddly roadsides, 41°44'3.3"N 19°58'21.1"E, ca. 285 m a.s.l., 9 Jul 2019, C. Benítez-Benítez, M. Míguez, S. Martín-Bravo and P. Jiménez-Mejías 1CBB19, UPOS-13241, TIR-8948; Vlorë county, Vlorë, depressions under *Pinus halepensis* coastal forest, 1-2 m, 40°27'34.70"N 19°27'57.78"E, 30 May 2021, M. Meco s.n., TIR-8964; Tirana county, Tirana, Parku i madh Kodrat e Liqenit, wet soils in mixed broadleaf forest, 41°18'35.64"N 19°49'39.84"E, ca. 135 m a.s.l., 29 Jun 2021, M. Meco s.n., TIR-8965.

Carex agastachys: ALBANIA. Tirana county, Tirana, 17 May 1958, Xh. Qosja s.n, TIR-00706, 00707, 00708.

***Carex* sect. *Aulocystis* Dumort. (*C. ferruginea* Scop., *C. kitaibeliana* Degen ex Bech., *C. lazarei Jac.Koopman, Niketic, Wieclaw and Govaerts*) (Fig. 1D,E,G)**

Within sect. *Aulocystis*, the *C. sempervirens* and *C. ferruginea* aggregates or complexes are two groups of closely related taxa of complex taxonomy, disjunctly distributed in the mountains of southern and central Europe, with Balkan

mountains as the centre of diversity of both groups. During our field work in Albania, we observed that *C. ferruginea*, *C. kitaibeliana* and *C. lazarei* are sometimes sympatric, but there is apparently a certain degree of habitat differentiation and frequent ecological turnover between them. The three species may be easily distinguished using the identification key provided by Flora Europaea (Chater 1980).

In the Balkans, the distribution and ecology of *C. ferruginea* are obscure and debated. While it has been reported from all the countries except for Montenegro and North Macedonia (Jiménez-Mejías et al. 2011, Govaerts et al. 2021), Barina et al. (2015) newly reported it for Albania and considered it a very rare species in the Balkans only known from Albania, Bosnia-Hercegovina, Kosovo, Montenegro and Serbia. Most Albanian records have been attributed to misidentifications, especially involving the similar *C. kitaibeliana* (Barina et al. 2015, Pils 2016). In Albania it is known only from two populations in Dibër county (Mali i Bardhë and Mali i Dejës in NE Albania), where it grows along mountain streams on serpentine and evaporitic substrates (Barina et al. 2015). We found additional populations of this rare species on Mt. Korab (NE Albania) and in the Albanian Alps (Çerem, N Albania), also along flushes.

Carex kitaibeliana is widely distributed from SE Europe to Turkey (Govaerts et al. 2021) and has been reported for all Balkan countries (Jiménez-Mejías and Luceño 2011). In Albania, the species is widespread in mountain areas throughout the country (Barina 2017b), and we have found numerous populations, mostly growing in fissures of limestone rocks.

Finally, *C. lazarei* (formerly known as *C. bulgarica* (Domin) Lazare) is a Balkan endemic (Jiménez-Mejías and Luceño 2011, Govaerts et al. 2021) reported from mountain acid soils (Koopman et al. 2019). In Albania, it has frequently been subsumed under the highly variable *C. sempervirens* Vill. (Pils 2016, Barina 2017b, Barina et al. 2018). We have found populations of *C. lazarei* in mountain grasslands of two different ranges in N and NE Albania (Çerem and Mt. Korab, respectively).

C. ferruginea Scop.

ALBANIA. Kukës county, Çerem, Qafa e Kunji i Armeves pass, borders of streams on serpentines, 42°28'49.26"N 20°0'10.22"E, ca. 1920 m a.s.l., 14 Jul 2019, C. Benítez-Benítez, M. Míguez, S. Martín-Bravo and P. Jiménez-Mejías 93CBB19, UPOS-13333, TIR-8958. Ibidem, Qafa e Kunji i Armeves pass, borders of stream, 42°30'11.44"N 19°59'48.08"E, ca. 1660 m a.s.l., 14 Jul 2019, C. Benítez-Benítez, M. Míguez, S. Martín-Bravo and P. Jiménez-Mejías 89CBB19, UPOS-13329, TIR-8966; Dibër county, Radomirë, Korab Mt., stream borders in *Pinus nigra* forest, 41°48'43"N 20°29'48"E, ca. 1450 m a.s.l., 18 Jul 2019, C. Benítez-Benítez, M. Míguez, S. Martín-Bravo and P. Jiménez-Mejías 161CBB19, UPOS-13401, TIR-8967.

C. lazarei Jac.Koopman, Niketic, Wieclaw and Govaerts

ALBANIA. Kukës county, Çerem, Qafa e Kunji i Armeves pass, grasslands on serpentines, 42°28'49.26"N 20°0'10.22"E, c. 1920 m, 14 Jul 2019, C. Benítez-Benítez, M. Míguez, S. Martín-Bravo and P. Jiménez-Mejías 94CBB19, UPOS-13334, TIR-8957; Ibidem, subalpine grasslands with *Vaccinium uliginosum*, 42°29'12"N 19°59'56"E, 2010 m a.s.l., 14 Jul 2019, C. Benítez-Benítez, M. Míguez, S. Martín-Bravo and P. Jiménez-Mejías 75CBB19, UPOS-13315, TIR-8956; Dibër county, Radomirë, Mt. Korab, stony grasslands, c. 1800 m, 18 Jul 2019, C. Benítez-Benítez, M. Míguez, S. Martín-Bravo and P. Jiménez-Mejías 166CBB19, UPOS-13406, TIR-8968.

C. kitaibeliana Degen ex Bech.

ALBANIA. Dibër county, Fushë Lurë, Lura lakes, clearings in *Pinus peuce* forest, 41°47'13,41"N 20°11'40,56"E, 1735 m a.s.l., 10 Jul 2019, C. Benítez-Benítez, M. Míguez, S. Martín-Bravo and P. Jiménez-Mejías 34CBB19, UPOS-13274, TIR-8969; Dibër county, Radomirë, Korab Mt., stream borders in *Pinus nigra* forest, 41°48'43"N 20°29'48"E, ca. 1450 m a.s.l., 18 Jul 2019, C. Benítez-Benítez, M. Míguez, S. Martín-Bravo and P. Jiménez-Mejías 162CBB19, UPOS-13402, TIR-8970.

Author contributions

SMB, CBB, MM (Mónica Míguez) and PJM conducted the main field campaign in Albania. MM (Mariol Meco) performed additional collections. All authors contributed to the study of herbarium specimens. SMB drafted the manuscript and all authors contributed to the writing of the final version.

Acknowledgements

The authors thank Professor A. Mullaj (University of Tirana) for essential help for the organization of the field campaign and facilitating work at TIR herbarium. We are particularly indebted to G. Pils and Z. Barina for their very useful advice on fieldwork in Albania. C. Barciela from UPOS herbarium provided technical help with processing of specimens. Thanks are also due to E. von Raab-Straube, S. Gebauer, and M. Luceño for providing critical comments or relevant information. Projects CGL2016-77401-P and PID2020-113897GB-I00 from the Spanish Ministries of Economy and Competitiveness, and Science and Innovation, respectively, are acknowledged for funding.

References

Barina, Z., 2017a: Number 46 (*Carex atrata* subsp. *aterrima*). In: Csiky, J., Kovács, D., Deme, J., Takács, A., Óvári, M., Molnár V., Malatinszky, Á., Nagy, J., Barina, Z. (eds.), Taxonomical and chorological notes 4 (38–58). Studia Botanica Hungarica 48, 133–144.

Barina, Z., 2017b: Revision of F. K. Meyer's herbarium from Albania. Phytotaxa 331, 213–223.

Barina, Z., Mullaj, A., Pifkó, D., Somogyi, G., Meco, M., Rakaj, M., 2017: Distribution Atlas of vascular plants in Albania. Hungarian Natural History Museum, Budapest.

Barina, Z., Pifkó, D., Mesterhazy, A., 2011: Contributions to the flora of Albania, 3. Willdenowia 41, 329–339.

Barina, Z., Pifkó, D., Rakaj, M., 2015: Contributions to the flora of Albania, 5. Studia Botanica Hungarica 46, 119–140.

Barina, Z., Somogyi, G., Pifkó, D., Rakaj, M., 2018: Checklist of vascular plants of Albania. Phytotaxa 378, 1–339.

Bergmeier, E., Sakellarakis, F.-N., Strid, A., Swinkels, C., 2020: New additions to the flora of Prespa, Greece. Phytologia Balcanica 26(1), 103–130.

Chater, A.O., 1980: *Carex* L. In: Tutin, T.G., Heywood, V.H.,Burges, N.A., Moore, D.M., Valentine, D.H., Walters, S.M., Webb, D.A. (eds.), Flora Europaea, vol. 5, 290–323. Cambridge University Press, Cambridge.

Christians, J.F., Ferrez, Y., Hennequin, C., Philippe, M., Thiery, F., Tinguy, H., Tison, J.M., 2020: *Carex agastachys* L.f. une nouvelle espèce pour la Flore de France. Les Nouvelles Archives de la Flore jurassienne et du nord-est de la France 18, 47–50.

Dimopoulos, P., Raus, Th., Bergmeier, E., Constantinidis, Th., Iatrou, G., Kokkini, S., Strid, A., Tzanoudakis, D., 2020: Flora of Greece web. Vascular plants of Greece: An annotated checklist. Retrieved October 2, 2020 from http://portal.cybertaxonomy.org/flora-greece

Govaerts, R., Jiménez-Mejías, P., Koopman, J., Simpson, D., Goetghebeur, P., Wilson, K., Egorova, T., Bruhl, J., 2021: World Checklist of Cyperaceae, Royal Botanic Gardens, Kew. Retrieved July 12, 2021 in http://wcsp.science.kew.org/

IUCN, 2012a. IUCN red list categories and criteria, version 3.1. Ed. 2. IUCN, Gland, Switzerland and Cambridge, UK.

IUCN, 2012b. Guidelines for Application of IUCN Red List Criteria at regional and national levels: version 4.0. IUCN, Gland, Switzerland and Cambridge, UK.

Jiménez-Mejías, P., Benítez-Benítez, C., Fernández-Mazuecos, M., Martín-Bravo, S., 2017: Cut from the same cloth: convergent evolution of dwarf morphotypes in the *Carex flava* group (Cyperaceae) in Circum-Mediterranean mountains. PLoS One 12(12), e0189769.

Jiménez-Mejías, P., Hahn, M., Lueders, K., Starr, J.R., Brown, B.H., Chouinard, B.N., Chung, K.-S., Escudero, M., Ford, B.A., Ford, K.A., Gebauer, S., Gehrke, B., Hoffmann, M.H., Jin, X.-F., Jung, J., Kim, S., Luceño, M., Maguilla, E., Martín-Bravo, S., Míguez, M., Molina, A., Naczi, R.F.C., Pender, J.E., Reznicek, A.A., Villaverde, T., Waterway, M.J., Wilson, K.L., Yang, J.-C., Zhang, S., Hipp, A.L., Roalson, E.H., 2016: Megaphylogenetic specimen-level approaches to the *Carex* (Cyperaceae) phylogeny using ITS, ETS, and matK sequences: implications for classification. Systematic Botany 41(3), 500–518.

Jiménez-Mejías, P., Luceño, M., 2009: *Carex castroviejoi* Luceño and Jiménez Mejías (Cyperaceae), a new species from North Greek mountains. Acta Botanica Malacitana 34, 231–233.

Jiménez-Mejías, P., Luceño, M., 2011: Cyperaceae. In: Euro+Med Plantbase - the information resource for Euro-Mediterranean plant diversity. Retrieved October 12, 2020 from https://www.emplantbase.org/home.html

Jiménez-Mejías, P., Luceño, M., Martín-Bravo, S., 2014: Species boundaries within the southwest Old World populations of the *Carex flava* group (Cyperaceae). Systematic Botany 39, 117–131.

Jiménez-Mejías, P., Martín-Bravo, S., Luceño, M., 2012a: Systematics and taxonomy of *Carex* sect. *Ceratocystis* (Cyperaceae) in Europe: a molecular and cytogenetic approach. Systematic Botany 37, 382–398.

Jiménez-Mejías, P., Martín-Bravo, S., Rat, M., Anackov, G., Luceño, M., 2012b: New records of southeast European *Carex* L. (Cyperaceae). Biologia Serbica 34, 100–102.

Koopman, J., Niketić, M., Wieclaw, H., Govaerts, R., 2019: Nomenclatural and taxonomic notes on *Carex lazarei* nom. nov. (Cyperaceae). Phytotaxa 422(3), 295–297.

Médail, F., Diadema, K., 2009: Glacial refugia influence plant diversity patterns in the Mediterranean Basin. Journal of Biogeography 36, 1333–1345.

Médail, F., Quézel, P., 1999: Biodiversity hotspots in the Mediterranean Basin: setting global conservation priorities. Conservation Biology 13, 1510–1513.

Meierott, L., 2019: *Carex agastachys* L. fil. und *Carex pendula* Huds. s.str. Berichte der Bayerischen Botanischen Gesellschaft 89, 256–260.

Meyer, F.K., 2011: Beiträge zur Flora von Albanien. Haussknechtia suppl. 15, 1–220.

Mittermeier, R.A., Turner, W.R., Larsen, F.W., Brooks, T.M., Gascon, C., 2011: Global biodiversity conservation: the critical role of hotspots. In: Zachos, F.E., Habel, J.C. (eds.), Biodiversity hotspots, 3–22. Springer Publishers, London.

Míguez, M., Bartolucci, F., Jiménez-Mejías, P., Martín-Bravo, S,. 2021a: Re-evaluating the presence of *Carex microcarpa* (Cyperaceae) in Italy based on herbarium material and DNA barcoding. Plant Biosystems

Míguez, M., Jiménez-Mejías, P., Benítez-Benítez, C., Schaefer, H., Martín-Bravo, S., 2021b: Systematics of the giant sedges of *Carex* section *Rhynchocystis* (Cyperaceae) in Macaronesia with description of two new species. Systematic Botany 46(2), 304–320.

Míguez, M., Gehrke, B., Maguilla, E., Jiménez-Mejías, P., Martín-Bravo, S., 2017: *Carex* sect. *Rhynchocystis* (Cyperaceae): a Miocene subtropical relict in the Western Palearctic showing a dispersal-derived rand flora pattern. Journal of Biogeography 44, 2211–2224.

Míguez, M., Martín-Bravo, S., Jiménez-Mejías, P., 2018: Reconciling morphology and phylogeny allows an integrative taxonomic revision of the giant sedges of *Carex* section *Rhynchocystis* (Cyperaceae). Botanical Journal of the Linnean Society 188, 34–58.

Myers, N., Mittermeier, R.A., Mittermeier, C.G. da Fonseca, G.A.B., Kent, J., 2000: Biodiversity hotspots for conservation priorities. Nature 403, 853–858.

Nelmes, E., 1952: Notes on Cyperaceae: XXVIII. Kew Bulletin 7(1), 67–68.

Pils, G., 2016: Illustrated flora of Albania. Christian Theiss GmbH, St. Stefan, Austria.

POWO, 2020: Plants of the World online. Royal Botanic Gardens, Kew. Retrieved October 9, 2020 from http://www.plantsoftheworldonline.org

Stevanovic, V., Vukojicic, S., Šinžar-Sekulić, J., Lazarevic, M., Tomović, G., Tan, K., 2009: Distribution and diversity of Arctic-Alpine species in the Balkans. Plant Systematics and Evolution 283, 219–235.

Sutorý, K., Repka, R., 2020: *Carex agastachys* L.fil. In: Vladimirov., V., Aybeke, M., Tan, K., New floristic records in the Balkans: 43. Phytologia Balcanica 26(3), 537–572.

Vangjeli, J., 2015: Excursion flora of Albania. Koeltz Botanical Books, Oberreifenberg.