Available online at www.notulaebotanicae.ro

Print ISSN 0255-965X; Electronic 1842-4309

Not Bot Horti Agrobo, 2012, 40(1):29-34

Distribution and Phytocoenotic Context of *Kobresia simpliciuscula* (Wahlenb.) Mack. in South-Eastern Carpathians

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Abstract

This study proposes a critical analysis of the distribution and habitat requirements of the rare arctic-alpine plant species *Kobresia simpliciuscula* (Wahlenb.) Mack. in the South-Eastern Carpathians. The species was recorded in this part of Carpathians only from Romania, in Bucegi Mountains. The mention of *K. simpliciuscula* in Rodna Mountains (Eastern Carpathians) is considered to be erroneous. *K. simpliciuscula* was found in the Southern Carpathians in a different habitat type compared to the one characteristic for populations in the Arctic and the Alps. The species does not grow in the pioneer phytocoenoses of the *Caricion bicoloris-atrofuscae* alliance but, on the contrary, in dry calciphilous alpine vegetation included in *Oxytropido-Elynion.* The plant communities where *K. simpliciuscula* was found in Bucegi Mountains belong to *Achilleo schurii-Dryadetum* (Beldie 1967) Coldea 1984. These phytocoenoses are very similar to those described for the species in Belianske Tatra Mountains (Western Carpathians, Slovakia).

Keywords: alpine habitats, chorology, *Cyperaceae*, rare species, Romanian Flora

Introduction

Kobresia Willd. is a relatively small genus of *Cyperaceae* family, one of the largest and cosmopolite families of flowering plants (Ford *et al.*, 2006). This genus includes about 50 species (Starr and Ford, 2009), all of them being restricted to the Northern hemisphere. The highest *Kobresia* species diversity is located in Himalaya region, with only few species having a circumpolar distribution (Roalson *et al.*, 2001).

Kobresia, together with *Carex*, *Cymophyllus*, *Schoenoxiphium* and *Uncinia*, is a member of tribe *Cariceae* Kunth ex Dumort., a monophyletic and morphologically well defined group of *Cyperaceae* (Starr *et al.,* 2004). Of these, *Kobresia* and *Schoenoxiphium* are being distinguished from the other genera in *Cariceae* by the presence of open utricules, as compared to the closed perigynia found in *Carex* (Starr and Ford, 2009). Even though the flower structure clearly separates *Kobresia* within *Cariceae*, recent molecular phylogenetic studies have showed that this genus is in fact nested in *Carex* (Roalson *et al.*, 2001; Waterway *et al.*, 2009).

Two species of this genus are present in flora of Europe: *Kobresia simpliciuscula* (Wahlenb.) Mack. and *Kobresia myosuroides* (Vill.) Fiori (Chater, 1980). Both of them have an circum-arctic distribution, with scattered populations in several high mountains of Europe, Asia and North America (Meusel *et al.*, 1965; Pârvu *et al.*, 2009). These species are also occurring in the Romanian Carpathians, within few cited localities (Şerbănescu and Nyárády, 1966). The present study focuses on *Kobresia simpliciuscula*, one of the rarest plant species in the Carpathian Flora (Čeřovský *et al.*, 1999; Dihoru and Negrean, 2009).

Kobresia simpliciuscula (*K. caricina*, *K. bipartita*, *Carex simpliciuscula*-simple bog sedge) is a typical arctic-alpine biogeographical element, found in the arctic and sub-arctic regions of Europe (including Svalbard, Eastern Greenland), Asia (tundra of Lena Delta, Chukotka) and North America (Alaska, Northern Canada)-(Bressoud, 1989; Meusel *et al.*, 1965). South of the arctic regions it has a disjunct distribution, with populations centered in alpine areas of some high mountains as Rocky Mountains and Wallowa Mountains from North America (Decker *et al.*, 2006) and in the mountains of Anatolia (Jiménez-Mejías and Luceño, 2011) or Central Asia (Bressoud, 1989). In Europe, the species is present in the Scandes, the Scottish Mountains, the Alps, the Carpathians and the Pyrenees (Bressoud, 1989; Meusel *et al.*, 1965). In the arctic region, *K. simpliciuscula* grows in mesic to wet tundra, in almost exclusively open biotopes, on wet places along springs, rivulets, glacial torrents, glacier forelands, on calcareous substrates (Ball, 2002; Bressoud, 1989; Decker *et al.*, 2006). It is considered a character species for the pioneer formations of the *Caricion bicoloris-atrofuscae* alliance (Aeschimann *et al.*, 2004; Gafta *et al.*, 2008) or, in North America, an indicator of rich or extreme rich fens (Johnson and Steingraeber, 2003). The species was also recorded in these types of habitats in the temperate mountains of Europe: the Alps (Bressoud, 1989) and the Pyrenees (Benito Alonso, 2006). In the Carpathians, the suitable ecological conditions for *K. simpliciuscula* are well documented only in Belianske Tatras (Western Carpathians, Slovakia; Petrík *et al.*, 2005;

Šibík *et al*., 2007). In this mountain range, the species can be found in a different habitat type than described above, characterized by dry, wind-exposed ridges and edges of the highest summits on limestone bedrock (the class *Carici rupestris-Kobresietea bellardi*). For the South-Eastern Carpathians (Romania) few and inconsistent data exists; *K. simpliciuscula* was reported to grow on basophilous alpine vegetation (on limestone), developed on windswept rocky ridges (Beldie, 1967) or as being character element for the alpine acidophilous grasslands (on siliceous bedrock) from *Caricetalia curvulae* (Popescu and Sanda, 1998). There are no published vegetation relevés from the Romanian Carpathians containing this species (Dihoru and Negrean, 2009).

The main goal of this study was to characterize the phytocoenotic context of *Kobresia simpliciuscula* in Romanian Carpathians, based on original field data. Additionally, a critical analysis of the data concerning its distribution in Romania was carried out.

Materials and methods

The existing herbarium material was revised and all available information from botanical literature was critically compiled in order to clarify the distribution of *K. simpliciuscula* in the South-Eastern Carpathians For this purpose, the following herbaria were consulted (acronyms according to Thiers, 2012): BUAG (University of Agronomical Sciences and Veterinary Medicine, Bucharest), BUC (D. Brandza Botanical Garden, Bucharest), BVS (Transylvania University of Braşov), CL (Babeş-Bolyai University, Cluj-Napoca), CLA (University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca), CRAI (University of Craiova), I (Faculty of Biology, Alexandru Ioan Cuza University, Iaşi), IAGB (Botanical Garden, Alexandru Ioan Cuza University, Iaşi), IASI (University of Agricultural Sciences and Veterinary Medicine, Iaşi) and SIB (Natural History Museum, Sibiu). Several field surveys were made between 2009 and 2011 in localities from Bucegi Mountains (Southern Carpathians) and Rodna Mountains (Eastern Carpathians), where the species was reported. To describe the plant communities where the species is growing, phytosociological relevés were performed according to the Central European Phytosociological School (Cristea *et al*., 2004). Nomenclature of the species follows Flora Europaea (Tutin *et al.*, 1964-1980).

Results and discussion

Distribution in the Carpathians

Western Carpathians: The presence of *K. simpliciuscula* in the Western Carpathians is well known and documented by both bibliographical and herbarium records. It occurs only in the small range of Belianske Tatras, on several localities in the eastern part of this massif (Čeřovský *et al.*, 1999). This species was erroneously reported from the Polish Tatra Mts., environs of the Morskie Oko Lake (Mirek *et al.*, 2002).

South-Eastern Carpathians: *K. simpliciuscula* populations from this part of the Carpathians (namely Romania) represent the South-Eastern edge of its European distribution (Fig. 1). The species was not recorded from the Balkans (Stevanović *et al*., 2009).

The first mentions of *K. simpliciuscula* from the Southern Carpathians date back to XIXth century, the period of

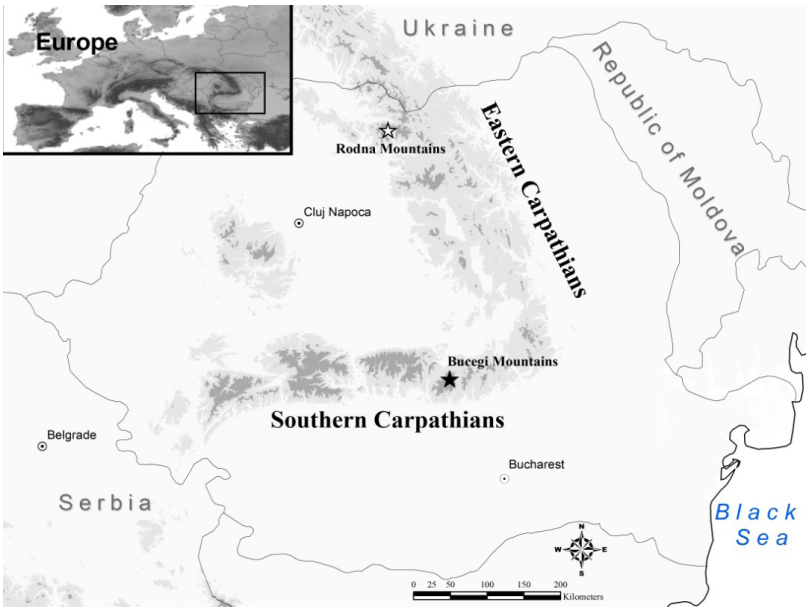

Fig. 1. Distribution of *Kobresia simpliciuscula* (black star) in South-Eastern Carpathians. Erroneous indications of *K. simpliciuscula* in Rodna Mountains is represented by white star. Left insert indicates the location of South-Eastern Carpathians in Europe

the first explorations of Transylvanian flora. Schur quoted this taxon in 1866 as present in the alpine belt of Bucegi Mountains. Subsequently, the species was recorded from Romania only in this massif by Prodan (1923, 1939), Jávorka (1925) or Borza (1947). Beldie (1967), in his comprehensive monograph dealing with the flora and vegetation of Bucegi Mountains, offered a detailed list with all the places where *K. simpliciuscula* was indicated in this range: Baba Mare (CL), Brâna Mică (Caraiman), Valea Albă (1920 m alt.), Coştila (IAGB) on Valea Colţilor, Valea Mălinului (2150-2250 m alt.), Valea Seacă, Valea Urzicii and Valea Priponului (1980 m alt.), Podul Coştilelor, Colţii Obârşiei (BUC, CL, BVS, I, IASI), Omu Peak, Bucşoiu (BVS, CLA), Doamnele (in the brackets there are highlighted the localities certified by herbarium material).

Ştefureac reported in 1952 the second locality with *K. simpliciuscula* in Romanian Carpathians, namely on the northern slope of Pietrosul Borşei (Rodnei) Peak (Rodna Mountains, Eastern Carpathians). In that paper, the author just enumerated the species in a list of cormophytes growing as companions of the rare bryophyte *Aulacomnium turgidum*, without highlighting this important finding. Only in 1968 Ştefureac published a new study with a detailed description of the new locality for *K. simpliciuscula*, including as well a photo with a voucher of the plants collected in 1948. The specimens in the picture had a label of BUC herbarium, but without an inventory number. Carefully examining this photo, I concluded that definitely the plants presented there have not the habitus of *K. simpliciuscula*, but, on the contrary, they show a typical morphology of *Carex curvula*. It especially has to be pointed out the very long and curved leaves, a character that can never be found for *K. simpliciuscula*, neither in living plants that I saw in their natural habitat in the Alps and Carpathians (Bucegi Mts.), nor verifying the specimens from Carpathians, Alps, Northern Europe or Chukotka deposited in CL Herbarium. Unfortunately, it seems that the plants collected in 1948 and published in 1968 were in fact never deposited in BUC, as the label would indicate (Petronela Comănescu, BUC curator, personal communication) or in other public herbarium. In consequence, I had no possibility to verify the vouchers. Recently, *K. simpliciuscula* was indicated by mistake from Ineu Peak in Rodna Mountains by Dihoru and Negrean (2009), but this quoted locality is in fact an erroneous citation of Ştefureac (1967).

Pietrosul Rodnei and its surroundings represent maybe the most intensively investigated region by the botanists, considering the whole range of Rodna Mountains. Starting from the XIXth century and continuing to present, many remarkable botanical works contributed to the knowledge of the flora of this area (reviewed by Coldea *et al.*, 1983). It seems that only Ştefureac (1952, 1968) listed *K. simpliciuscula* in Pietrosul Rodnei as being seen in the field. Afterwards, even this author was not able to find the species again in that place (Gh. Coldea, personal communication). Moreover, the habitat described by Ştefureac (1968) for *K. simpliciuscula* in Rodna Mts. is very different from the typical ecological preferences of the species, recorded elsewhere. *K. simpliciuscula* was reported in that article to be growing on acidic soil, on crystalline schists, in association with *Aulacomnium turgidum* (which is

Fig. 2. *Kobresia simpliciuscula* in Bucegi Mountains (Baba Mare, 2261 msm)

obligatory calcifuge, Ştefureac, 1952) and other typical acidophilous species characteristic for *Caricetalia curvulae* (*Primula minima*, *Festuca airoides*, *Oreochloa disticha*) or *Salicetalia herbaceae* (*Salix herbacea*). Notably, *Carex curvula* is missing from that list, even if it is the most frequent and abundant species around the summit, at that altitude (2280 msm). Besides the publication of Ştefureac (1968), *K. simpliciuscula* was characterized as calcicole in all the regions where this species was recorded: North America (Ball, 2002; Decker *et al.*, 2006; Johnson and Steingraeber, 2003), Alps (Aeschimann *et al.*, 2004; Konrad and Gerhart, 2000), Pyrenees (Villar *et al.*, 2001), Western Carpathians (Čeřovský *et al.*, 1999) and Southern Carpathians (Beldie, 1967). In addition, Bressoud (1989) emphasized that *K. simpliciuscula* is the most calcicole element among all 8 character species for *Caricion bicoloris-atrofuscae*. Thus, it can be concluded that the mention of *K. simpliciuscula* in Rodna Mountains is very likely to be a mistake (possible confusion with *Carex curvula*) and until a new, well documented record, the presence of the species in the Eastern Carpathians should be regarded as an error.

Habitat description in Southern Carpathians

K. simpliciuscula was found in Bucegi Mountains (Fig. 2) growing in very similar ecological conditions to those presented by Beldie (1967). It occupies wind-exposed rocky ridges near summits and extremely steep slopes, in the alpine belt. The species has poorly developed populations in each place that has been checked. The plants are growing on shallow soil, in the crevices of the stones. During the hot summer days the soil is often dry. From the geological point of view, the bedrock was represented only by limestone.

The phytocoenoses where *K. simpliciuscula* was recorded belong to *Achilleo schurii-Dryadetum* (Beldie 1967) Coldea 1984 (Tab. 1). The ground cover of the vegetation is moderate to low, typical for the windswept *Dryas*-mats in South-Eastern Carpathians. The dominant species is *Dryas octopetala*, seconded by *Carex rupestris* and *Festuca versicolor*. Of the diagnostic calciphilous species of the alliance *Oxytropido-Elynion* and higher syntaxa, several species are well represented: *Kobresia myosuroides*, *Achillea oxyloba* subsp. *schurii, Minuartia sedoides* and *Silene acaulis*. Besides *K. simpliciuscula*, other rare species found in the same communities are *Draba kotschyi*, *Eritrichium nanum*, *Lomatogonium carinthiacum* and *Ranunculus alpestris*.

K. simpliciuscula was found in the Southern Carpathians in a very similar habitat to the one described from Belianske Tatra Mts (Western Carpathians, Petrík *et al*., 2005; Šibík *et al*., 2007). It is certainly not a character element for the *Caricetalia curvulae* plant communities, as considered before in some Romanian botanical works (Popescu and Sanda, 1998). It does not grow either in moist habitats from *Caricion bicoloris-atrofuscae*, as in the Alps or Northern Europe. In fact, the existence of these alpine pioneer formations belonging to the alliance mentioned before was regarded as doubtful by Gafta *et al*. (2008). Nevertheless, more recently, based on the occurrence of several character species of *Caricion bicoloris-atrofuscae* in the Carpathian Flora, Schneider-Binder (2010) argued that this alpine habitat could be considered as present in Rodna Mountains and maybe in other parts of the Carpathians. It has to

Tab. 1. *Achilleo schurii-Dryadetum* (Beldie 1967) Coldea 1984 in Bucegi Mountains (Romania)

Relevé no.	1	2
Altitude (msm)	2261	2363
Surface (m^2)	20	10
Cover (%)	80	35
Char. ass.		
Achillea oxyloba subsp. *schurii*	+	+
Oxytropido-Elynion et Elinetalia		
Kobresia myosuroides	+-1	+
Carex atrata	+	-
Cerastium alpinum var. *lanatum*	-	+
Minuartia sedoides	+	+
Carici rupestris-Kobresietea		
Dryas octopetala	3-4	1
Carex rupestris	1-2	2-3
Silene acaulis	1	+
Gentiana nivalis	+	-
Gypsophilion et Potentilletalia		
Draba kotschyi	-	+
Eritrichium nanum	-	+
Saxifraga luteoviridis	-	+
Seslerietalia		
Festuca versicolor	1-2	-
Carex capillaris	1	-
Carex sempervirens var. *pumila*	1	+
Androsace chamaejasme	+	+
Euphrasia salisburgensis	+	+
Polygonum viviparum	+	+
Caricetalia curvulae		
Primula minima	+	+
Varia		
Kobresia simpliciuscula	+-1	+
Salix reticulata	1	-
Armeria maritima subsp. *alpina*	-	+
Lomatogonium carinthiacum	+	-
Minuartia recurva	-	+
Poa alpina	-	+
Ranunculus alpestris	+	+
Saxifraga aizoides	+	-
Saxifraga oppositifolia	+	+
Saxifraga paniculata	+	-
Viola alpina	+	+

Place and date and of relevés: 1. Baba Mare (N: 45,413°/E: 25,467°, 27.08.2010); 2. Between Obârşia and Doamnele (N: 45.434°/E: 25.453°, 11.09.2010)

be emphasized that the presence of only one species does not necessarily indicate the presence of its characteristic habitat. The ecological behavior of range margin populations can be sometimes different comparing with the range center populations (Choler and Michalet, 2002). All these arctic-alpine species of *Caricion bicoloris-atrofuscae* are in Carpathians at the southern periphery of their distribution. Supplementary field data is required to confirm or infirm the existence of *Caricion bicoloris-atrofuscae* alliance in South-Eastern Carpathians.

Conclusions

Kobresia simpliciuscula is a typical arctic-alpine species, that has in the Romanian Carpathians the most South-Eastern populations of its entire European distribution range. This study showed that the occurrence of *K. simpliciuscula* in South-Eastern Carpathians is restricted to Bucegi Mountains, where it grows in dry alpine vegetation, on limestone bedrock. In older botanical literature, it was erroneously indicated from Rodna Mountains (Eastern Carpathians). Due to the very low number of localities where the species was certainly recorded, the reduced size of the populations and the restricted range of suitable alpine habitat, this species should be treated as vulnerable (VU) in Romania, following the IUCN criteria (Coldea *et al.*, 2009).

Acknowledgements

This study was founded by Romanian Ministry of Education, Research and Innovation (CNCSIS-UEFISCSU, project PNII-Resurse Umane, PD_405/2010).

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