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Electronic Appendix 5. – Commented syntaxonomical synopsis.

Scheuchzerio-Caricetea fuscae Tx. 1931 class
Caricetalia davallianae Br.-Bl. 1950 order
Caricion davallianae Klika 1934 alliance

(1) *Caricetum davallianae* Dutoit 1924
Syn: *Eleocharitetum quinqueflorae* p.p. (see Discussion), *Seslerietum uliginosae* auct. slov. p.p., non Palmgren 1916

Distribution: Slovakia, Romania
Short-sedge brown-moss calcareous fens, differing from associations *Carici flavae-Cratoneuretum filicini* and *Valeriano simplicifoliae-Caricetum flavae* by a significant proportion of species associated with relict fen sites (Hájek et al. 2011), such as *Primula farinosa* or *Carex hostiana*. It frequently occurs in the rainy northern parts of the Alps and the Inner Western Carpathians (Slovakia). In the Western Carpathians, it occupies intermountain basins between core mountain ranges. The literature reports from Morariu et al. (1985) belong to this association as well, according to numerical analysis.

(2) *Glauco-Trichophoretum pumili* (Šmarda 1961) Vicherek 1973

Distribution: Slovakia
This association of relict travertine fens is confined to the intermountain basins of the Western Carpathians in Slovakia (the Liptov and Spiš basins; Dítě et al. 2013). Vicherek (1973) considered it to form the separate alliance *Halo-Trichophorion pumili* of the *Festuco-Puccinellietea* class (see Discussion in Dítě et al. 2007).

(3) *Orchido-Schoenetum nigricantis* Oberdorfer 1957

Distribution: Romania
The Romanian communities dominated by *Schoenus nigricans* (Prejmer and Harman villages in the Covasna region) are referred to *Orchido-Schoenetum nigricantis*, a likely younger synonym of *Junco subnodulosi-Schoenetum nigricantis* Allorge 1921, as proposed by Hájek & Hájková (2011). The numerical analyses merged these communities with *S. ferrugineus* communities from Slovakia (close to Mošovce, Spišská Teplica, Stankovany and Šuja villages) that otherwise show species composition very similar to *Caricetum davallianae* (cluster 2 in the synoptic table, Table 3). Further research at the European scale is needed.

(4) *Carici flavae-Cratoneuretum filicini* Kovács et Felföldy 1960
Syn: *Carici flavae-Eriophoretum* Soó 1944 p.p. (see Discussion), *Carici-Blysmetum compressi* auct. rom. p.p (see Discussion), *Eleocharitetum quinqueflorae* p.p. (see Discussion)

Distribution: Czech Republic, Slovakia, Poland, Ukraine, Romania
This association comprises vegetation of short-sedge brown-moss tufa-forming (petrifying) spring fens at developmentally young, non-relict sites, with a significant proportion of grassland and reed-bed species. Spring bryophytes (*Palustriella commutata*, *Cratoneuron filicinum*) frequently dominate instead of fen mosses. The relict tufa-forming fens belong to

associations *Glauco-Trichophoretum pumili* and, partially, *Caricetum davallianae*. It was previously identified in Hungary, Slovakia and the Czech Republic; here, we demonstrate it also occurs in other Carpathian countries, especially in Romania, where it has been reported under different names such as *Carici flavae-Eriophoretum latifolii* (e.g., Pop et al. 1960, 1962). In our study, the lowland fens with reed-bed species assigned by the last name as well (e.g., Soó 1947, Petránová 1967) showed the high similarity to *Carici flavae-Cratoneuretum filicini* Kovács et Felföldy 1960, although being without dominant *Palustriella* and *Cratoneuron* mosses. Further research is needed to conclude whether these lowland fens belong to a separate association.

(5) *Valeriano simplicifoliae-Caricetum flavae* Pawłovski et al. 1960
Syn: *Carici flavae-Eriophoretum* Soó 1944 p.p. (see Discussion), *Carici-Blysmetum compressi* auct. rom. p.p (see Discussion), *Eleocharitetum quinqueflorae* p.p. (Discussion), *Valeriano simplicifoliae-Caricetum davallianae* Moravec 1966

Distribution: Czech Republic, Slovakia, Poland, Ukraine, Romania
This association comprises vegetation of short-sedge brown-moss peat-forming alkaline spring fens at developmentally young, non-relict sites, with a significant proportion of grassland species. Fen brown mosses, usually *Scorpidium cossonii*, frequently dominate. The relict peat-forming brown-moss fens belong to associations *Campylio-Caricetum lasiocarpae*, *Drepanoclado adunci-Ligularietum sibiricae*, and, partially, *Caricetum davalianae*. The association has been previously identified in Poland, Slovakia and Czech Republic. Here we demonstrate it also occurs in Eastern-Carpathian countries, especially Romania, where it has been reported under different names such as *Carici flavae-Eriophoretum latifolii* or *Carici flavae-Blysmetum compressi* (see Discussion), rarely also the name *Valeriano simplicifoliae-Caricetum* flavae was used (Raţiu 1972). We report the occurrence of this association in the Retezatul Mic Mts (Câmpul Mielului), Obcina Feredeului Mts and Apuseni Mts (close to the village of Sfoartea). It further occurs in the Călimani Mts (Coldea 1973). Some of our records from the Obcina Mestecănișului (Benia village), Călimani and Gurghiului (Voșlobeni village) Mts stay close to this association. They were, however, assigned to *Sphagno warnstorfii-Eriophoretum latifolii* by the k-means clustering even if they lack *Sphagnum* species.

(6) *Campylio-Caricetum lasiocarpae* Klötzli 1969
Syn.: *Drepanoclado revolventis-Caricetum lasiocarpae* (Koch 1926) Rybníček in Rybníček et al. 1984, *Drepanoclado revolventis-Caricetum diandrae* (Kopecký 1960) Rybníček in Rybníček et al. 1984, *Scorpidio-Caricetum diandrae* sensu auct. non Osvald 1923 (pseudonym)

Distribution: Slovakia, Poland
This association of tall-sedge brown-moss alkaline fens contains relict species of the boreal-continental distribution range (Dítě et al. 2018) and is associated with relict fens combining spring and topogenic hydrology. It occurs in Slovak and Polish Western Carpathians, the most frequently in the Orawa-Nowy Targ basin. When peatmosses (*Sphagnum*) occur, the vegetation belongs already to the association *Menyantho-Sphagnetum teretis*. In Romania, this association is replaced by a physiognomically similar association *Drepanoclado adunci-Ligularietum sibiricae*, which differs from *Campylio-Caricetum lasiocarpae* especially by nitrogen instead of a phosphorus limitation (Peterka et al. 2017) and, as evidenced by our study, by a more continental climate.

Sphagno warnstorfii-Tomentypnetalia Lapshina 2010 order
Stygio-Caricion limosae Nordhagen 1943 alliance

(7) *Swertio perennis-Caricetum chordorrhizae* Coldea (1986) 1990 and *Amblystegio scorpioidis-Caricetum limosae* Osvald 1925

Distribution: Romania (*Swertio perennis-Caricetum chordorrhizae*); Slovakia (*Amblystegio scorpioidis-Caricetum limosae*), Poland (*Amblystegio scorpioidis-Caricetum limosae*).
These two associations of calcareous quaking fens were merged into cluster 7 in our analysis. The association *Swertio perennis-Caricetum chordorrhizae* was described by Coldea (1990) from the Ştiol fen in the Rodnei Mts. We resampled it, yielding specific differences in the moss layer. In line with previous continental-scale syntheses (Peterka et al. 2017, 2018), we place it to the *Stygio-Caricion limosae* alliance of calcareous quaking fens (the EUNIS habitat, Chytrý et al. 2020), which are characterised, among others, by *Drepanocladus trifarius* and *Carex chordorrhiza.* Coldea (1990) placed this association to the *Caricion lasiocarpae*, the alliance that has been rejected by the EuroVeg checklist (Mucina et al. 2016) as well as Peterka et al. (2017).

The association *Amblystegio scorpioidis-Caricetum limosae* Osvald 1925 (Syn.: *Amblystegio scorpioidis-Caricetum chordorrhizae* Osvald 1925, *Eleocharitetum quinqueflorae* p.p.) occurs in the Western Carpathians in Slovakia (Belanské lúky Nature Reserve, Kubínska hoľa Mts) and also in Polish Carpathians (Peterka et al. 2018). Dítě et al. (2007) used the name *Amblystegio scorpioidis-Caricetum limosae* Osvald 1925 for this association. According to the Code of the Phytosociological Nomenclature principles, this name must be suggested for conserving because it is the name of the Upsalla School.

Saxifrago hirculi-Tomentypnion nitentis Lapshina 2010 alliance

(8) *Drepanoclado adunci-Ligularietum sibiricae*, assoc. nova
Syn.: *Carici flavae-Eriophoretum* Soó 1944 p.p. (see Discussion)

Distribution: Romania
These tall-sedge brown-moss N-limited fens show the boreal-continental distribution and often occur under high iron concentration (Peterka et al. 2017). The association represents the first association of the *Saxifrago hirculi-Tomentypnion nitentis* alliance, recognised as late as 2010 in Western Siberia (Lapshina 2010) and in 2017 in Europe (Peterka et al. 2017). In Romania it occurs in well-known fen sites of the Harghita Mts (Dumbrava Harghitei close to Vlăhiţa pass), Ciuc Basin (Tuşnadu Nou, Nadăş, Sâncrăieni, Sânsimion, Vrabia), where it is associated with iron- and phosphorus-rich volcanic beds. A less distinct species composition occurs in the Călimani Mts (Bilbor) and Obcina Feredeului Mts (the village of Botuş).

Sphagno warnstorfii-Tomentypnion nitentis Dahl 1957 alliance

(9) *Menyantho-Sphagnetum teretis Warén* 1926
Syn.: *Sphagno-Caricetum lasiocarpae* Steffen 1931*; Carici limosae-Sphagnetum contorti* Warén 1926

Distribution: Slovakia, Poland, Romania (one record only)
The association comprises tall-sedge rich fens with calcium-tolerant sphagna, often coexisting with brown mosses, and species with a boreal-continental distribution range (*Carex lasiocarpa*, *C. diandra*, *C. chordorrhiza*, *C. limosa*). It occurs primarily in the Western

Carpathians (Slovakia, Poland), the most frequently in the Orawa-Nowy Targ basin. In Romania, one vegetation plot record from the Dumbrava Harghitei fen (the locality of the *Drepanoclado adunci-Ligularietum sibiricae* association) was assigned to the cluster of the *Menyantho-Sphagnetum teretis* association. It came from the place where peat moss species dominate instead of brown mosses. Because this is a single report of this community in Romania, further research is needed to verify the occurrence of *Menyantho-Sphagnetum teretis* using the data set from a wider geographical area.

(10) *Sphagno warnstorfii-Eriophoretum latifolii* Rybníček 1971
Syn.: *Carici flavae-Eriophoretum* Soó 1944 p.p. (see Discussion), *Carici-Blysmetum compressi* auct. rom., non Eggler 1933 p.p., *Eleocharitetum quinqueflorae* p.p. (see Discussion), *Sphagno warnstorfii-Caricetum davallianae* Rybníček 1984; *Sphagno-Caricetum appropinquatae* (Šmarda 1948) Rybníček 1984

Distribution: Czech Republic, Slovakia, Poland, Ukraine, Romania
This community occurs in short-sedge and cotton-grass rich fens and rich-fen grasslands. It is characterised by co-existing calcium-tolerant sphagna and calcicole species of both bryophytes and vascular plants. It contained a group of wet-grassland species, making it similar to calcareous fen grasslands, especially those of association *Valeriano simplicifoliae-Caricetum flavae*. It occurs on only moderately calcium-rich bedrock of the Western and Eastern Carpathians (non-calcareous flysch sandstones, crystalline and volcanic rocks), being previously reported from Slovakia and Czech Republic (Rybníček 1984, Dítě et al. 2007, Hájek & Hájková 2011) and Poland (Hájek & Hájková 2002). Here we report it for the first time from Romania, where corresponding vegetation had been assigned to many other associations, often again *Carici flavae-Eriophoretum latifolii*, because of insufficient focus on the moss layer. We recorded this association in the Lotrului Mts, Cindrel Mts, Şureanu Mts, Maramureş Mts, Gutâi Mts, Harghita Mts, Făgăraș depression, Apuseni (Padiş) and Călimani Mts.

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