Notes on the Bulgarian wetland flora, including new national and regional records

Michal Hájek[1,2], Petra Hájková[1,2] & Iva Apostolova[3]

[1] Department of Botany, Faculty of Sciences, Masaryk University, 2 Kotlářská, CZ-61137 Brno, Czech Republic, e-mail hajek@sci.muni.cz (address for correspondence)

[2] Department of Ecology, Institute of Botany, Czech Academy of Sciences, 3b Poříčí, CZ-60300 Brno

[3] Department of Phytocoenology and Ecology, Institute of Botany, Bulgarian Academy of Sciences, Acad. G. Bonchev St., bl.23, 1113 Sofia, Bulgaria

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Abstract. Seven vascular plant species have been recently recorded or re-identified as new for the Bulgarian territory, namely *Carex hartmanii, C. lasiocarpa, Equisetum* x *moorei, Gymnadenia densiflora, Molinia horanzskyi, Montia hallii* and *Sesleria uliginosa*. New recent regional records and habitat characteristics of another 18 rare and endangered species (e.g. *Carex buxbaumii* s. str., *C. elata, C. lepidocarpa, C. punctata, Eriophorum gracile*) are also presented. In most cases the taxonomic and phytogeographical background is outlined. Detailed research of the Bulgarian mountain wetlands has shown that these habitats are still not sufficiently known. Several of the new records represent the southeastern limits of some rare relic species in Europe.

Keywords: the Balkans, bog, fen, mire, spring, vascular plants

Introduction

Bulgarian wetland flora is extraordinary rich owing to a mixture of Balkan, Central-European, Carpathian, Mediterranean and Boreal species, the latter occurring predominantly in refugia (e.g. Meshinev & Apostolova 1998; Natcheva & Cronberg 2003). This is due to a combination of the unique geographical position of the country, altering relief and varied postglacial history. In spite of this uniqueness, the flora of some wetland types has not been sufficiently explored. This is especially true for submontane fens and waterlogged meadows, apparently owing to their scarcity and small extent, as well as to the absence of detailed phytosociological research which often produces ample floristic records, especially in the case of small or not always fertile plants, such as the graminoids. During our phytosociological research of ca 400 springs, fens and waterlogged meadows we have encountered some species missing in the Bulgarian flora and determination keys (Andreev & al. 1992; Delipavlov & al. 2003). Some of them turned out as new species for the Bulgarian flora, others were re-identified as species present in the Bulgarian sources under different names. We have also found some species that were probably new to particular regions, including such known from single regions so far. The aim of this contribution is to present these important vascular plant records and to outline the taxonomic and phytogeographical background in the most important cases.

Material and methods

The field research was conducted during the years 2001–2005. Beside the authors, a number of other colleagues participated too, namely Martin Kočí (2002–2003, the Balkan Range 2004), Kateřina Kočí (2002–2003), Tenyo Meshinev (Vitosha and the Rhodopes 2001, Malyovitsa 2002, the Forebalkan and Kazanluk valley 2004), Anna

Ganeva (Vitosha 2001, Malyovitsa 2002), Marcela Havlová (the Forebalkan, Kazanluk valley, the Rhodopes and the Balkan Range 2004) and Zuzana Rozbrojová (SW Rila, Razlog valley and Kozyata Stena locality 2004).

All new species for the Bulgarian flora and the greatest part of the most important records were documented by herbarium specimens, which were deposited in SOM and BRNU, respectively. The herbarium collections of BRNU, SOM, SOA and SO were also checked for important chorological data. In some cases, e.g. when the number of herbarium findings was high, information from the herbaria was abbreviated (year-author-herbarium).

The presented records are given with coordinates (WGS84 system) and with the measured environmental factors, namely altitude (using calibrated GPS except for 2001), water pH and water conductivity (both measured in-field by portable instruments). When a larger number of localities are presented, only range of values is shown.

The species new to Bulgaria are presented with full names, including author citations. The nomenclature of other vascular plant species follows Andreev & al. (1992), the nomenclature of bryophytes follows Ganeva & Natcheva (2003) and Natcheva & Ganeva (2005). The categories of threat according to Velchev (1984) are presented in brackets.

Results

Species new to Bulgaria

Carex hartmanii Cajander

Field records:

Pirin Mts: Razlog valley, Krousheto locality near the Predela saddle, 1067–1125 m, 41° 51'–52' N, 23° 21'–22' E, water pH 6.0–7.4, water conductivity 63–231 µS/cm/20 °C, 13.08. 2004. Waterlogged and fen meadows with *Scirpus sylvaticus*.

Rila Mts: Samokovsko pole basin, 0.5 km S from the Prodanovtsi village, 930 m, 42° 20' 22" N, 23° 31' 52" E, water pH 5.9, water conductivity 200 µS/cm/20 °C, 04.07.2005.

Mt Sredna Gora (*Western*): 0.6 km from the hill Beliya Kamuk, near Koprivshtitsa town, 1298 m, 42° 38' 06" N, 24° 24' 07" E, water pH 5.5, water conductivity 48 µS/cm/20 °C, 2004, coll. Hájek & Hájková, BRNU 578931. Together with *Eriophorum angustifolium* and *Sphagnum contortum*.

Rhodopi Mts (*Western*): spring fens at S margin of Batak reservoir, 7 km W of Batak town, 1200 m, 41° 56'–57' N, 24° 10' E, water pH 6.0–6.3, water conductivity 120–230 µS/cm/20 °C, 27.06.2001 & 25.06.2004, coll. Hájek & Hájková, SOM 161686, BRNU 578933. Together with *Carex panicea, Eriophorum latifolium*, *Sphagnum subnitens* and *S. contortum*; Beglika, 2 km from the settlement near the road to Batak. 41°50' 27" N, 24°08' 47" E, pH 6.8, water conductivity 160 µS/cm/20 °C, 30.06.2005, coll. Hájek & Hájková, BRNU 578918.

Herbarium revisions:

Mt Vitosha: between Beli Bryag and Zlatnite Mostove, 1956, coll. N. Vichodcevski, SO 09401, 09402; Vitosha, 1881, coll. Pančić & Achtarov, SOM 19087; Dragalevtsi village, 1927, coll. N. Stoyanov, SOA 1587.

Rila Mts: Prodanovtsi village, 1987, coll. M. Stoeva, SOM 152846; Samokov, Iskur river, 2002, coll. A. Petrova, SOM 159136.

Mt Sredna Gora (*Western*): Beliya Kamak, 1991, coll. D. Stoyanov, SO 95750 & SOM 150725.

Rhodopi Mts (*Western*): Beglika, 1940, coll. D. Jordanov, SO 09403; 1987, coll. M. Stoeva, SOM 152845; Dospat, 1940, coll. D. Jordanov, SOM 156571.

Carex hartmanii is a distinctly separated species from the allied and earlier described *C. buxbaumii* Wahlenb. (Syn.: *C. polygama* Schkur) according to a combination of several morphological characters. It is characterised by a cylindrical terminal spike, female flowers forming upper 1/2–3/4 of the terminal spike, acuminate but not (!) aristate female glumes not forming a collar below female flowers, and by unequal in size and shape marginal spikes that occur primarily in threes or fours. We have found this characteristic combination in the majority of populations of *C. buxbaumii – hartmanii* group in the Bulgarian wetlands, in spite the fact that Chater (1980) distinguishing both allied species, reports only the occurrence of *C. buxbaumii* in Bulgaria. Herbarium revisions confirmed this fact. Hence, *C. buxbaumii* should be re-identified as *C. hartmanii* in the most of Bulgarian localities. There is only one confirmed locality of *C. buxbaumii* s. str. in Bulgaria, near the Batak damp (see below).

The European distribution of *C. hartmanii* spans approximately from 61° N at the north, to Montenegro at the south (Rohlena 1942; Chater 1980). The Bulgarian populations are the south-easternmost ones and more or less isolated from the others. According to Jovanović-Dunjić (1976), no species from *C. buxbaumii – hartmanii* group occurs in neighbouring Serbia. Only six recent Bulgarian localities in four phytogeographical regions imply the endangerment of the species in Bulgaria.

C. lasiocarpa Ehrh.

Rhodopi Mts (*Western*): Koupena Nature Reserve, 1360 m, 41° 59' 09" N, 24° 18' 58" E, water pH 5.3, water conductivity 30 μS/cm/20 °C. 24.06.2004, coll. Hájek, Hájková, Apostolova & Havlová, SOM 161687; Tsigov Chark settlement, spring fens at S margin of the Batak damp, 7 km W of Batak town, 1100 m, 41° 56' 53" N, 24° 09' 31" E, water pH 6.6, water conductivity 66 μS/cm/20 °C, 30.06.2005, coll. Hájek & Hájková, BRNU 578919.

C. lasiocarpa is a distinct sedge species and a boreal element in the Central- and Southern European flora. Most probably it is a glacial relic here, witnessing rapid extinction accelerated by the destruction of fen habitats. Its distribution range becomes more fragmented south-eastwards and consists only of scarce localities in Serbia (Jovanović-Dunjić 1976) and Montenegro (Rohlena 1942). The Rhodopean localities probably represent the species southeastern limit in Europe. *C. lasiocarpa* occupies here one of the oldest peat sediments in Bulgaria, accumulated in a waterlogged depression in the Koupena Reserve (Huttunen & al. 1992) and the fen near the Batak damp rich in relic mire species with a boreal distribution range. The species locality in the Koupena Reserve, the treeless depression surrounded by virgin forests, has withstood tree succession owing to a high water level. It implies a relic character of the habitat. The peculiar hydrology has determined specific, species-poor vegetation dominated by the fen species *C. lasiocarpa*, swamp species *C. elata* and inundation-tolerating mire species *Sphagnum platyphyllum*. The uppermost peat layer and mosses are separated from the old dense peat and drift on the surface during wet periods of the year. Tall sedges root in the deeper peat layer. At the second locality, Tsigov Chark, *C. lasiocarpa* populates the most waterlogged place where the litter accumulation due to management cessation is the weakest. It is accompanied by the other relic species such are *C. buxbaumii* s. str., *Menyanthes trifoliata* and moss *Calliergon giganteum*.

Both populations of *C. lasiocarpa* were not fertile in the year of finding. Nevertheless, the species is very easily recognisable even without any spikes. It creates conspicuous, up to 1.5 m high growths of regularly distributed long, but only 1–2 mm wide greyish-green leaves with unrolled margins. The next important and marked character of infertile *C. lasiocarpa* is yellowish- to reddish-brown basal sheaths slightly disintegrating net-like during senescence.

Equisetum x *moorei* Newman

Field records:

Danubian Plane: Pleven district, Chernelka Protected area, along the trail towards Kartozhablene village, undocumented (noted at the Botanical Excursion of the Masaryk University Brno in Bulgaria, 2004)

Forebalkan (*East*): Devetashko Plato, travertines near Gradina village, 425 m, 42° 58' 06" N, 24° 58' 24" E, water pH 7.2, water conductivity 530 μS/cm/20 °C, 21.06.2004.

Pirin Mts (*North*): between Predela saddle and Razlog village, 1010 m, 41° 51' 44" N, 23° 23' 41" E, water pH 7.2–7.8, water conductivity 308–380 μS/cm/20 °C, abundant, 13.08.2004, coll. Hájek, Hájková & Rozbrojová, SOM 161683.

Mt Sredna Gora (*Western*): Mt. Lozenska, above Lozen village. 850 m, 42° 35' 37" N, 23° 29' 00" E, 27.06.2005, coll. Hájek & Hájková, BRNU 578930.

Toundzha Hilly Country: Kazanluk valley, eastern margin of Dounavtsi village, 425 m, 42° 39' 34" N, 25° 16' 37" E, water pH 7.4, water conductivity 572 μS/cm/20 °C, 21.06.2004, coll. Hájek, Hájková, Havlová, Apostolova & Meshinev, SOM 161681, 161682.

Herbarium excerption (the most typical specimens):

Valley of Strouma River: Blagoevgrad district, sandy places along the railway between state frontier and Kulata village, 24.05.1994, coll. P. Gerginov, SOM 156244 [sub. *E. hiemale* L. var. *moorei* (Newm.) Hook].

Rhodopi Mts (*Western*): brook margins and mires in Longurlii and Turna-Chair, 8.07.1930, coll. B. Stefanov & D. Jordanov, SO 1167 (sub. *E. hiemale* L. var. *rabenhorsti* Milde).

Toundzha Hilly Country: Sakar Mt., moist depressions E from Kostour village, Svilengrad district, 09.07.1974, coll. D. Jordanov, SO 01257 (sub. *E. ramossissimum* Desf.).

Equisetum x *moorei* is a taxon originating from hybridization of the parent species *E. ramosissimum* Desf. and *E. hiemale* L. It is presented in the checklists and determination keys of most floras, including *Flora Europaea* (Tutin 1964), owing to its ability to bring germinating spores and to reproduce itself (Krahulec & al. 1995). It is also able to grow in habitats unoccupied by any of its parents (Hrouda & Krahulec 1982).

Stefanoff & Jordanoff (1931) already recognised the horsetails of conspicuous morphology, growing in mires and belonging to the subgenera *Hippochaete*, and assigned them as *E. hiemale* var. *rabenhorstii*. This name corre-

sponds to the present *Equisetum* x *moorei*. The Bulgarian populations markedly differ in both morphology and habitat preferences. The typical plants occupy dry, pioneer granular substrates. This ruderal tendency is a typical trait of *E.* x *moorei* in Europe (Hrouda & Krahulec 1982; Loiseau & Felzines 1991; Zlinská 1995). Such populations were observed or collected, e.g. along the trails in the Chernelka gorge near Pleven and on the disturbed ground along drainage canals at the rich fen margins near Dounavtsi village. The same ecotype was collected by Gerginov (SOM) along the rail tracks at Kulata. The second specific ecotype populates the central parts of calcium-rich alkaline fens of the *Caricion davallianae* alliance. We collected its specimens in *Schoenus nigricans* fens near Dounavtsi village and in the extremely-rich spring fens in the Krousheto locality, below the marble section of the Pirin Mts. These populations differ from the rest not only by their peculiar ecology that has no analogue in Europe, but also by the morphology of individuals: the plants are slender, relatively low, branched in the lowermost parts of the stem, with an always narrow to broad scarious border on the sheath teeth. This morphological characteristic makes them resemble the rich fen species *E. variegatum* Schleich. Bulgarian populations differ from *E. variegatum* and its hybrids by the presence of transverse tubercles on stem ribs and by convex to mildly convex shape of the ribs. This morphological and ecological exclusivity could be explained by the extraordinary ability of *Equisetum* subgen. *Hippochaete* species to hybridize. Furthermore, the gametophytes of hybrid origin can cross-breed with the parents thus making the species of this subgenus less distinctly delimited than in the subgenus *Equisetum* (Krahulec & al. 1995). Bulgarian rich fen populations may originate from the hybridization of *E.* x *moorei* with its parent *E. ramosissimum*.

Gymnadenia densiflora (Wahlenb.) A. Dietr.

Field records:

Rhodopi Mts (*Western*): Tsigov Chark settlement, spring fens at S margin of the Batak damp, 7 km W from Batak town, 1110 m, 41° 56' 48" N, 24° 09' 27" E, water pH 6.3, water conductivity 64 µS/cm/20 °C, 30.06.2005, coll. Hájek & Hájková, BRNU 578925.

Rhodopi Mts (*Central*): Mugla, spring fens near the path from Mugla village towards Lednitsata challet, below the Prevala saddle, 41° 37' 43" N, 24° 31' 08" E, pH 7.2, water conductivity 340 µS/cm/20 °C and on moist places along the whole marked path to the Mugla village. 01.07.2005, coll. Hájek & Hájková, BRNU 578927.

Herbarium records:

Balkan Range (*Central*): Troyanski Balkan, Kozyata Stena, 1898, coll. Urumov, SOM 15087; Gabrovo, Sokolski Monastery, 22.05.1899, coll. Neichev, SOM 15090.

Pirin Mts: Bayuvi Dupki, 07.07.1918, coll. Tzar Ferdinand I, SOM 15084.

G. densiflora, a taxon from *G. conopsea* group was recently either misinterpreted or not accepted as a distinct taxon by various authors and Floras including *Flora Europaea* (for detailed overview see Marhold & al. 2005). Nevertheless, the detailed morphometric analysis conducted by Marhold & al. (2005) clearly showed that the species is well separated from *G. conopsea*. In addition, it differs from *G. conopsea* also by invariable chromosome number 2n=40 and by specific habitat requirements. As compared to *G. conopsea*, *G. densiflora* grows in calcareous fens and moist calcareous clayey soils, has wider second lowermost leaf (about 2.3 cm), more flowers in denser inflorescence (very often above 70), more sheathless leaves (about 6), wider labellum, larger flowers, smells very intensively and is higher especially when the height of plant is related to the distance from the stem base to the base of uppermost sheathed leaf (Marhold & al. 2005).

In the Rhodopean localities, the species grows together with *Eriophorum latifolium, Carex flava, C. panicea, Eleocharis quinqueflora, Cratoneuron commutatum* (Mugla) and *Sphagnum contortum* (Tsigov Chark). The population near the Mugla village was very abundant in 2005.

Molinia horanzskyi Milk.

Sofia region: Plana Mt, Zheleznitsa village, spring fen and moist meadows 1 km E from the village, 980 m, 42° 32' 12" N, 23° 22' 44" E, water pH 6.9, water conductivity 324 µS/cm/20 °C, 04.07.2005, coll. Hájek, Hájková & Apostolova, BRNU 578921.

Balkan Range (*Central*): 3.6 km SE from peak Vezhen (2198 m), Ravna Reka mire, 42° 43' 41" N, 24° 26' 09" E, 2002; Anton village, close to the path to Bolovan peak, 1040 m, 42° 44' 48" N, 24° 16' 51" E, water pH 7.1, water conductivity 146 µS/cm/20 °C, 06.07.2005, coll. Hájek & Hájková, BRNU 578920.

Rhodopi Mts (*Western*): Tsigov Chark settlement, spring fens at S margin of the Batak damp, 7 km W of Batak town, 1100 m, 41° 56' 53" N, 24°09' 31" E, water pH 6.6, water conductivity 66 µS/cm/20 °C, 30.06.2005.

Rhodopi Mts (*Central*): Chairski lakes, 1500 m, 41° 38' N, 24° 28' E, (2001); Smolyan lakes, 1173 m, 2.3 km SSW from peak Snezhanka (1926 m), 41° 37 N, 24° 41' E (2001).

Mt Sredna Gora (*Western*): 0.6 km SE from peak Golyam Bogdan, in the direction to peak Mali Bogdan, 42° 36"08"N, 24° 28' 11" E, (2002).

The taxonomy of the genus *Molinia* is rather complicated, due to an extensive nomenclatural confusion and a small number of reliable morphological characters. Generally, *M. arundinacea* Schrank differs from *M. caerulea* (L.) Moench by the hairs on the spike rhachis, high plants and luxuriant inflorescence, and by the stomata size. Yet, chromosome numbers can reliably confirm or reject the occurrence of any species, because the aggregate is a polyploid complex of several taxa not overlapping in their chromosome numbers. Therefore, we sampled living plant material from several populations of *Molinia* occurring in the wetlands under study. It was analysed by Martin Dančák (Palacký University, Olomouc, Czech Republic) using flow-cytometry. Seven populations were found to be octoploid and hence corresponding to *M. horanszkyi* Milk. (Milkovits & Borhidi 1986; Dančák 2002). Since this species has a discrete distribution range, clearly segregated from that of Central-European *M. arundinacea* (Syn.: *M. litoralis* Host., see Kozhuharov 1963), differs mostly by quantitative characters (shorter lemmas, caryopses, anthers and stomata) and displays very similar ecology, its treatment on the subspecies level is more appropriate (Dančák 2004). The occurrence of tetraploid or hexaploid cytotypes, both corresponding to *M. caerulea*, was confirmed only in four, mostly calcium-rich, fen localities during our research: in the Krousheto locality (Razlog valley), Balkan Range – near Vasil Levski village (BRNU 578932), in rich fens near Dounavtsi and Yasenovo villages (Kazanluk valley) and in the Rhodopes – at Smolyanski ezera and along the road Smolyan – Devin. The herbarium specimens (SO, SOM, SOA) sampled from other than the above-mentioned localities belong to *M. horanszkyi*. *M. caerulea* seems to be more rare species in the Bulgarian flora.

Montia hallii (A. Gray) Greene (= *Montia fontana* L. subsp. *amporitana* Sennen)

Field records:

Balkan Range (*Central*): 2.9 km NW from Klisoura village, Haidoutski Dol valley, 1367 m, 42° 43' 04" N, 24° 25' 58" E, water pH 5.9, water conductivity 59 µS/cm/20 °C, 03.07.2002, coll. Hájek, Hájková & Kočií, SOM 161675. Together with *Carex echinata, Eriophorum latifolium, Warnstorfia exannulata* and *Philonotis seriata*.

Rila Mts: SW margins, Blagoevgrad, Prashka hill, spring in the saddle below Mt. Fakiro, 1407 m, 42° 05' 42" N, 23° 11'07"E, water pH 7.1, water conductivity 47 µS/cm/20 °C, 07.08.2004, coll. Hájek, Hájková, & Rozbrojová, SOM 161678. Together with *Veronica beccabunga* and *Philonotis caespitosa*; springs 2.2 km WSW from Govedartsi village in the of Cherni Iskur river, 1213 m, 42° 15' 08" N, 23° 26' 47" E, water pH 5.6, water conductivity 72 µS/cm/20 °C, 23.06.2002, coll. Hájek, Hájková, Apostolova, Meshinev & Kočí, SOM 161674. Together with *Equisetum sylvaticum*, *Cardamine amara* subsp. *balcanica*, *Philonotis caespitosa* and *Warnstorfia exannulata*; southern foothills of the Kostenets divide, between Cherna Mesta and Vulcha Polyana, 1403 m, 42° 04' 16" N, 23° 45' 31" E, water pH 7.0, water conductivity 90 µS/cm/20 °C, 06.07.2003, coll. Hájek, Hájková & Kočí, SOM 161677. Together with *Calliergonella cuspidata* and *Juncus effussus*.

Herbarium revisions:

Black Sea Coast (*South*): Sozopol, Ropotamo, 1929, coll. Jordanov, SO 18793.

Balkan Range (*Central*): Gabrovo, 1897, coll. Neichev, SOM 19663; Klisoura, coll. Baev, SO 18788; Selska loc., close to Shipka village, 1930, coll. Shiryaev, BRNU 210349. Sofia region: Mt. Lyulin, in rivulet in front of Sveta Petka Monastery, 1994, coll. D. Stoyanov, SO 96951.

Mt Slavyanka: between Petrovo and Goleshevo villages, 1994, coll. I. Pashaliev, SOM 152787.

Rila Mts: Beli Iskur, 1917, coll. B. Davidov, SOM 21449.

Rhodopi Mts (*Western*): NE from Dospat town, 1997, coll. D. Stoyanov, SO 98951.

Rhodopi Mts (*Central*): Smolyan lakes, 1939, coll. Jordanov, SO 18786; 1972, coll. Andreev, SOM 132341; 1968, coll. Vichodsevski, SO 18785.

Thracian Lowlands: margin of river Kruk Dere, Mezek village, Svilengrad distr., 1940, coll. B. Kitanov, SO 29467.

Tundzha Hilly Country: Dervishka Mogila (Sakar planina), 1937, coll. D. Jordanov, SO 18791.

Mt Strandzha: between Zvezdets and Evrenozovo villages, 1933, coll. D. Jordanov, SO 18789.

Not clear region: Karluk, 1887, coll. S. Georgiev, SO 18790.

There are three clear taxonomic entities within genus *Montia* in Europe, namely *M. fontana* s. str., *M. halii* [= *M. fontana* subsp. *amporitana* Sennen; *M. fontana* subsp. *variabilis* (Walters) Kozhevn.; *M. rivularis* C. C. Gmel.] and *M. arvensis* Wallr. [= *M. fontana* L. subsp. *chondrosperma* (Fenzl) Walters; Syn.: *M. verna* Neck]. These taxa are morphologically well differentiated by the structure of seed surface. *M. fontana* has shiny seed surface without tubercles. The other two taxa have both seed surface with tubercles of rather low glossiness, separated by grooves with apertures at the juncture of the grooves. *M. hallii* has more or less conspicuously acute nipple-like tubercles at least at seed keel while *M. arvensis* has sphaerical tubercles across the seed surface, i.e. the structure of the seed surface resembles a fruit of *Morus* or *Rubus* under microscope (Moore 1963; Bureš & Dvořák 1988; Stace 1989: 72; Bureš 1990). A minute difference in the seed morphology has led to differentiating two subspecies or varieties within *M. hallii* (*amporitana* and *variabilis*), but these two taxa still strongly overlap and manifest many transitions in morphology and ecology.

There is a principal ecological difference between *M. arvensis* and the two other species. *M. arvensis* is a weed occurring on sandy arable land in lowlands and flowering in early spring from April to May, while *M. hallii* occupies nutrient-poor heliophilic springs, especially in the mountains and most frequently flowers from June to July. This difference underlies the distinct species differentiation within *M. fontana* agg.

The taxonomic treatment of genus *Montia* in *Flora Europaea* (Walters 1993) emphasises the differences in seed morphology and ecology of diverse populations on the subspecies level. This conception is practical because it allows determination of plants without ripe seeds at least on the species level. Accordingly, it was adopted in many of European Floras. On the other hand, the more appropriate differentiation on the species level has sometimes also been applied (see Slavnić 1972 for Serbia; Skalický & Sutorý 1990 for Czech Republic; Tan 1997 for Greece). The latter author differentiates only *M. arvensis* on the species level and refers two other species to *M. fontana* as subspecies.

Only *M. fontana* subsp. *chodrosperma* (*M. arvensis*) has been reported so far from Bulgaria (Georgiev 1966; Andreev & al. 1992; Delipavlov & al. 2003), as well as from neighbouring Macedonia (Micevski 1995). This taxonomic identity of the populations contradicts the presented habitat requirements. According to Georgiev (1966) *M. fontana* subsp. *chodrosperma* grows in wet places and springs. During our research on spring and mire vegetation in Bulgaria, we have found four populations growing in submontane springs that doubtlessly belonged to *M. fontana* subsp. *amporitana* (*M. hallii*). The herbarium excerption has shown another 12 mostly historical localities of *M. hallii* in Bulgaria. Some of them represent very typical morphotypes of *M. hallii* (Smolyan lakes), others have spherical tubercles across the whole seed surface and nipple-like tubercles only at seed keel. The causes of occurrence of these transitional populations deserve further study. Anyway, both typical *M. fontana* subsp. *amporitana* (*M. hallii*) and typical *M. fontana* subsp. *chondrosperma* (*M. arvensis*) doubtlessly occur in Bulgaria. The typical specimens of *M. arvensis* (revised by us and by Petr Bureš, Brno) have been collected, for instance, in the Eastern Rhodopes (Momchilgrad, 1937, coll. Stoyanov, SO 18792), in the Thracian Lowland (Plovdiv, 1894, coll. Stříbrný, SO 18794 & SOM 19664), Mt. Lyulin (1951, coll. Ganchev, SOM 19662) and in Vitosha (coll. Mrkvička, SOM 19666).

Sesleria uliginosa Opiz

Field records:

Toundzha Hilly Country: Kazanluk valley, eastern margin of Dounavtsi village, 412 m, 42° 39' N, 25°16'–17' E, water pH 6.8–7.4, water conductivity 672–996 µS/cm/20 °C, 21.06.2004, coll. Hájek, Hájková, Havlová, Apostolova & Meshinev, SOM 161688; Kazanluk valley, between Dounavtsi and Dolno Sachrane villages, 420 m, 42°38' 56'' N, 25° 16' 16'' E, 22.06.2004.

Herbarium revisions:

Toundzha Hilly Country: Kazanluk valley, Yasenovo village., 05.05.1971, coll. Denchev & N. Nikolov, SO 67589 & SOM 130316 [sub *Sesleria caerulea* (L.) Ard.].

This species is one of the major indicators of rich fens. It is clearly differentiated from the allied species *S. caerulea* by different morphology (e.g. a dense, ovate panicle, glumes ciliate on margins and veins, lemma with about 1 mm awn), and especially by different environmental requirements. *S. caerulea* prefers dry calcareous grasslands, while *S. uliginosa* populates rich calcareous fens. Owing to some confusion in the nomenclature within genus *Sesleria,* there have been certain ambiguity about the name *S. caerulea*. According to Deyl (1980), rich fen populations belong to *S. caerulea,* while dry grassland populations belong to *S. albicans* Kit. ex Schult [Syn.: *S.*

varia (Jacq.) Wettst., *S. calcarea* Pers.]. A detailed analysis of the nomenclature conducted by Foggi & al. (2001) confirmed the validity of *S. uliginosa* for rich fen populations and *S. caerulea* for dry grassland ones.

So far only *S. caerulea* has been reported from Bulgaria. Its local habitat requirements presented in the *Flora of PR Bulgaria* (Hinkova 1963) and in the more recent identification keys (Delipavlov & al. 2003) confirm that this name is used correctly for dry grassland plants. Therefore, the fen populations found by us in the Kazanluk valley, corresponding morphologically and ecologically to *S. uliginosa*, represent the second species. *S. uliginosa* occupies the rich fens and adjacent meadows in Serbia (Tatić 1976), Bosnia (Horvat & al. 1974) and conceivably also in Montenegro (Deyl 1980). Its occurrence in Bulgaria was expected by Meusel & al. (1965: 38), who mapped its distribution range deeply into the Central Bulgaria. It is unclear whether Meusel's map did only reflect the misleading identification of Bulgarian reports of *S. caerulea*, or whether it was based on exsiccate of *S. caerulea* from Yasenovo (see above).

New regional records of extremely rare or insufficiently known species

Carex buxbaumii Wahlenb. s. str.

Rhodopi Mts (*Western*): Tsigov Chark settlement, spring fens at S margin of the Batak damp, 7 km W of Batak town, 1100 m, 41° 56' 53" N, 24° 09' 31" E, water pH 6.6, water conductivity 66 µS/cm/20 °C, 30.06.2005, coll. Hájek & Hájková, BRNU 578917.

The occurrence of *C. buxbaumii* s. str. in Bulgaria was confirmed recently in the relic fens close to Batak damp. The other populations of the *C. buxbaumii* group belong to *C. hartmanii* (see above). In entire Central and Southern Europe, *C. buxbaumii* s. str. is very rare, threatened and strongly confined to relic habitats including fens. Its locality in Bulgaria is therefore important from phytogeographical point of view and deserves a protection. The species is accompanied here by other relic mire species such are *Carex lasiocarpa, Menynanthes trifoliata* and *Calliergon giganteum*.

C. elata All.

Rhodopi Mts (*Central*): Koupena Nature Reserve, 1360 m, 41° 59' 09" N, 24° 18' 58" E, water pH 5.3, water conductivity 30 µS/cm/20 °C, 24.06.2004.

Toundzha Hilly Country: Kazanluk valley, eastern margin of Dounavtsi village, 425 m, 42° 39' 34" N, 25° 16' 37" E, water pH 7.4, water conductivity 572 µS/cm/20 °C, 21.06.2004.

A single mention of *C. elata* occurrence in Bulgaria in the Kazichene marsh near Sofia is hidden in the chromosome number report of the Mediterranean plants (Stoeva 1994). This is probably the reason why this species has not been included in the new determination key to Bulgarian flora (Delipavlov & al. 2003). We have found this wetland species in the Koupena Reserve in the Rhodopes, where it accompanied *C. lasiocarpa* (see above). Contrary to the latter species, however, it grows here to more terrestrialized mire margin. The second new locality is the rich fen near Dunavtsi village dominated by *Schoenus nigricans*. *C. elata* occupied the wettest places of the fen. In the Balkans the species occurs in Macedonia, Serbia, Croatia, Romania and Greece (Horvat & al. 1974; Jovanović-Dunjić 1976; Chater 1980).

C. lepidocarpa Tausch

Balkan Range (*Central*): Kalofer district, Panitsite settlement, 500 m SSE from the farm buildings, 769 m, 42° 39' 31" N, 24° 59' 10" E, water pH 6.1, water conductivity 84 µS/cm/20 °C, 02.07.2004; Vasil Levski village, Vezhdata site, 2 km NNW from the village (towards Soushitsa village), calcareous springs above a small pond, 598 m, 42° 37' 52"N, 24° 53' 18" E, water pH 6.3, water conductivity 286 µS/cm/20 °C, 03.07.2004; 5.5 km NNE from the train station, along the trail towards Kaloferski Monastery, before the crossing with Gavrashtitsa brook, calcareous spring fens, 720 m, 42° 38' 18" N, 24° 55' 25" E, water pH 6.3–6.7, water conductivity 220–295 µS/cm/20 °C, 03.07.2004; Anton village, near the green path to Bolovan peak, 1040 m, 42° 44' 48" N, 24° 16' 51" E, water pH 7.1, water conductivity 146 µS/cm/20 °C, 06.07.2005.

Toundzha Hilly Country: Yasenovo village, limestone valley NW from the village 525 m, 42° 41' 40' N, 25° 13' 46" E, water pH 7.6, water conductivity 495 µS/cm/20 °C, 29.06.2005, coll. Hájek & Hájková, BRNU 578924.

Pirin Mts: between the Predela saddle and Razlog village, 1010 m, 41° 51' 44" N, 23° 23' 41" E, water pH 7.2–7.8, water conductivity 308–380 µS/cm/20 °C, abundant, 13.08.2004, coll. Hájek & Hájková, BRNU 578922.

Rila Mts.: Samokovsko pole basin, 0.5 km S from the Prodanovtsi village, 930 m, 42° 20' 22" N, 23° 31' 52" E, water pH 5.9, water conductivity 200 µS/cm/20 °C, 04.07.2005.

Rhodopi Mts (*Western*): spring fens at S margin of Batak reservoir, 7 km W from Batak town,

1150–1200 m, 41° 56'–57' N, 24°09'–10' E, water pH 5.3–6.3, water conductivity 42–230 µS/cm/20 °C, 25.06.2001 & 27.06.2004. Together with *Carex panicea, Eriophorum latifolium*, *Sphagnum subnitens* and *S. contortum*.

Rhodopi Mts (*Central*): Smolyan, spring fen near the road Smolyan–Devin, 1 km ahead of the juction to Smolyanski lakes, 1370 m, 41°36' 23" N, 24° 40' 05" E, water pH 6.2, water conductivity 165 µS/cm/20 °C, 02.07.2005; Smolyanski lakes, spring fen, 1495 m, 41° 36' 58" N, 24° 40' 08" E, water pH 6.2, water conductivity 220 µS/cm/20 °C, 02.07.2005.

Toundzha hilly Country: Kazanluk valley, E margin of Dounavtsi village, 425 m, 42° 39' 19" N, 25° 16' 25" E, water pH 6.8–7.4, water conductivity 572–996 µS/cm/20 °C, 21.06.2004.

Herbarium excerptions (after *1990*):

Balkan Range (*Western*): a fen in the Srebarna Reka valley, 2 km NW from Komshtitsa village, limestone, 1990, coll. Štěpánková, Markova & Goranova, SOM 149259.

This calcicole rich-fen species was characterised as widespread by Ahtarov (1957) and Vulev & Kitanov (1964). Nevertheless, Stoeva & Štěpánková (1990) revised its distribution in Bulgaria and confirmed only four reliably documented localities (near Sofia, Shipka, Samokov, and Razlog) that they did not found recently in the field. The recent confirmation of *C. lepidocarpa* occurrence was done by Štěpánková in 1990 (see herbarium reference above).

Our detailed phytosociological research of springs and mires was a good opportunity to enlarge the knowledge about this potentially endangered species. We have carefully distinguished *C. lepidocarpa* from the allied *C. flava* and have found several recent localities in the Rhodopes, basins below the Pirin and Rila Mts and at the foothills of the Balkan Range. It has predominantly occupied calcium-rich fens of the *Caricion davallianae* alliance. The populations from fens at the southern margin of the Batak reservoir surprisingly grew in a moderately to slightly acid environment, but the concentration of calcium was still rather high, as indicated by the high water conductivity. This occurrence could be explained by the occurrence of more alkaline fens in the region of Batak in the past. *C. lepidocarpa* was not a single calcicole fen species growing there. We also recorded occasionally there the moss *Scorpidium cossonii*, another indicator of extremely rich fens.

C. punctata Gaudin

Balkan Range (*Central*): Kalofer district, Panitsite settlement, 500 m SSE from the farm buildings, 769 m, 42° 39' 31" N, 24° 59' 10" E, water pH 6.1, water conductivity 84 µS/cm/20 °C, 02.07.2004, coll. Hájek, Hájková, Kočí & Havlová, SOM 161680, Hájek & Hájková, BRNU 578935; Vasil Levski village, spring wetlands between the village and the Gavrashtitsa brook, 42° 37' 57" N, 24° 54' 43" E, pH 6.2, conductivity 165 µS/cm/20 °C, 27.06.2005, coll. Hájek & Hájková, BRNU 578929.

Rhodopi Mts. (*Central*): Smolyan, spring fen near the road Smolyan–Devin, 1 km ahead of the juction to Smolyanski lakes. 1370 m, 41° 36' 23" N, 24° 40' 05" E, water pH 6.2, water conductivity 165 µS/cm/20 °C, 02.07.2005, coll. Hájek & Hájková, BRNU 578928.

This species represents a Suboceanic-Submediterrean element in the Balkan flora (Horvat & al. 1974). It is one of the rarest Bulgarian sedges so far known from sporadic wet localities on the northern margin of the Rhodopes (Bachkovo, 1894, coll. Stříbrný, SOM 79598). The locality from the Toundzha Hilly Country (Aitos, Trite Bratya, 1930, coll. Stříbrný SOM 79597, SOA 367) has been erroneously reported. The specimen labelled as *C. punctata* represents *C. distans* L.

Surprisingly, we have found this low sedge in the spring fen meadows close to the Panitsite settlement in the Balkan Range and close to the town of Smolyan in the Rhodopes.

Eleocharis uniglumis (Link) Schultes

Mt Vitosha: Popovyane, southern margin of the village, alluvial meadow, 930 m, 42° 24' 02" N, 23°21' 43" E, 04.06.2005.

Balkan Range (*Central*): between Zlatitsa and Chelopech, 42° 42' 23" N, 24° 06' 42" E (2004); Vasil Levski village, fens not far from Gavrashtitsa brook, 42° 38' 18" N, 24° 55' 25" E (2004); Vasil Levski village, Roshava Mogila locality, 42° 37' 49" N, 24° 52' 50" E (2004); Kalofer district, S part of Panitsite settlement, left-hand bank of the brook, 42° 38' 59" N, 24° 58' 55" E (2004).

Pirin Mts: NE foothills, wet meadows between Dobrinishte town and Gotse Delchev challet, 41° 46' 28" N, 23° 33' 01" E (2003); Razlog valley, Krousheto locality, near the Predela saddle, 41° 52' 31" N, 23° 21'37" E (2004); between the Predela saddle and Razlog town, 41° 51' 53" N, 23° 22' 44" E (2004).

Mt Sredna Gora (*Western*): Lozenska Mt, 1 km E from Lalina Mogila hill, 42° 34' 42" N, 23° 30' 09" E (2004).

Rhodopi Mts (*Western*): above Bratsigovo village, 42° 00' 16" N, 24° 23' 07" E (2004).

Toundzha Hilly Country: Kazanluk valley, E margin of Dounavtsi village, 42° 39' 34" N, 25° 16' 38" E (2004).

The presented localities of *E. uniglumis* from the Pirin Mt, the Balkan Range, Kazanluk valley, Mt. Lozenska, and the Rhodopes are also new for the particular regions. The locality at the foothills of Pirin probably represents the maximum altitude known for *E. uniglumis* distribution in Bulgaria (1248 m). The water pH of the occupied springs ranges between 5.7 and 7.4, and water conductivity is between 63 µS/cm/20 °C and 671 µS/cm/20 °C.

Eriophorum gracile Koch ex Roth

Rhodopi Mts (*Western*): spring fens at S margin of Batak reservoir, 7 km W from Batak town, 1173 m, 41° 56' 08" N, 24° 09' 57" E, water pH 5.8, water conductivity 64 µS/cm/20 °C, 25.06.2004, coll. Hájek & Hájková, BRNU 578934. Together with *Carex serotina, C. echinata, Sphagnum contortum* and *S. teres*.

Herbarium revisions:

Rhodopi Mts (*Western*): Loungourli, 1950, coll. D. Jordanov & N. Stoyanoff, SOA 1389; Zmeitsa village, 1952, SOA 03235.

Erroneously reported localitiy:

Mt Vitosha, 1922; Mt Belasitsa, Eleshnitsa village, 1950, coll. Stoyanov & Ahtarov, SOM 92073. The specimens represent *E. latifolium* Hoppe.

This is one of the most endangered species in the temperate part of Europe. Similarly, it belongs to the recently becoming rare species in Bulgaria. Despite our intensive research, we have found it only in a single recent locality. This is probably due to its extremely low competitiveness and sensitivity to habitat changes, such as drainage, eutrophication and acidification.

Juncus acutiflorus Ehrh. ex Hoffm.

Balkan Range (*Western*): NW from Klisoura Monastery, rivulet alluvium, 413 m, 42° 12' 21" N, 23° 11' 01" E, 27.06.2003, coll. Hájek & Hájková, SOM 161676.

Herbarium revisions and excerptions:

Sofia region: Aldomirovtsi marsh, 1996, coll. Ts. Petrova, SOM 154003.

Rila Mts: Samokov, 1909, coll. Davidov, SOM 10686, 10690; 1911, coll. Davidov, SOM 10666, 10677, 10678; Samokov-Mussinskoto, 1909, coll. Davidov, SOM 10665; Palakarya, coll. Davidov, SOM 10667 (sub *J. atratus* Krock).

Mt Sredna Gora (*Western*): Klisoura, 1922, coll. Jordanov, SOA 14357 (sub *J. atratus*).

The Suboceanic-Submediterean species *J. acutiflorus* is very rare in the subcontinental areas, including Bulgaria. The Flora of Bulgaria presents only one region of its occurrence, in the surrounding of Svilengrad town, where the species occupies river margins and (wet?) pastures. Besides this locality, Šmarda (1970) reported *J. acutiflorus* from the Rhodopes. The literature data, however, deserve a revision due to frequent confusions, especially with *J. articulatus* L., but also with *J. subnodulosus* Schrank and *J. atratus* Krock. *J. acutiflorus* differs from the similar species by all tepals long and acuminate, inner tepals markedly longer than outer, outer tepals having crooked back tips, and by an elliptical stem section.

We have documented this species from the seasonally dry meadows over-flooded in spring, not far from Klisoura Monastery (Western Balkan Range). Nikolić (1976) reported its occurrence in the Serbian part of this mountain range. Randjelović & Zlatković (1994) frequently recorded it in *Calthion* meadows in the south-eastern Serbia.

In the Central and Western Europe, this species is diagnostic for the permanently wet meadows of the *Calthion* alliance (e.g. Hájek & Hájková 2004). The locality below the Balkan Range has different vegetation determined by seasonal drying-out and dominated by *Holcus lanatus* and *Agrostis stolonifera* agg. Most probably it belongs to the *Deschampsion caespitosae* alliance (see Botta-Dukát & al. 2005). However, the occurrence of some species that constantly grow in the Bulgarian *Calthion* meadows (i.e., *Juncus thomasii, Gratiola officinalis, Lychnis flos-cuculi, Trifolium micranthum,* and *Brachythecium rivulare*) suggests that this habitat is not contradictory to the effective niche of the species, but rather represents its margin. The species is not common here like in the West European *Calthion* meadows where it often dominates.

New distribution and ecological data on other red-listed species

Drosera rotundifolia L. (Rare)

Mt Sredna Gora (*Western*): Debeli Del, two spring fens 2 km SEE from the Beliya Kamuk locality (6 km E from Koprivshtitsa town) 42° 38' 25"–34" N, 24° 24' 12"–49" E (2002); 0.6 km SE from peak Golyam Bogdan, in the direction to peak Mali Bogdan, 42° 36' 08" N, 24° 28' 11" E (2002). We report this species as new for Mt. Sredna Gora.

Besides this region, we also recorded *D. rotundifolia* in the Central Rhodopes, the Balkan Range and at the foothills of the Rila Mt, but outside the National Park. The altitudes ranged from 1172 m (Batak) to 1632 m (Mali Kom), water pH was between 4.4 and 6.8 and water conductivity between 9 and 294 µS/cm/20 °C. This implies that the species occupies a wide range of calcium gradient in Bulgaria, but avoids alkaline environment.

Menyanthes trifoliata L. (Threatened)

Balkan Range (*Central*): Kalofer district, Panitsite settlement, 300 m S from the farm buildings, 776 m, 42° 39' 33" N, 24° 59' 01" E, water pH 6.4, water conductivity 151 µS/cm/20 °C.

Potentilla palustris (L.) Scop. (Rare)

Rila Mts: at the Rhodopes – Rila border, southern slopes of Kostenets divide, between Cherna Mesta village and Vulcha Polyana settlement, Bukata locality, 42° 05' 08" N, 23° 47' 09" E, (2003).

This species, so far known from the Rhodopes, was found at the biogeographical border between Rila and the Rhodopes.

Utricularia minor L. (Threatened)

Balkan Range (*Central*): Anton village, near the green path to Bolovan peak, 1040 m, 42° 44' 48" N, 24° 16' 51" E, water pH 7.1, water conductivity 146 µS/cm/20 °C, 6.07.2005.

Pirin Mts: Krousheto locality, between Predela saddle and Razlog town, 1012 m, 23° 23' 48" E, 41° 51' 43" N (2004, 2005).

Rila Mts: at the Rhodopes – Rila border, S slopes of Kostenets divide, between Cherna Mesta village and Vulcha Polyana settlement, Bukata locality, 23° 47' 09" E, 42° 05' 08" N (2003).

This species has been known primarily from the sub-alpine belt of the Rila and Pirin Mts. Our three localities are from lower altitudes. The locality above Cherna Mesta lies at the biogeographical border between Rila and the Rhodopes. The species has been not known so far from the latter region. The same holds for the locality in the Balkan Range.

Viola palustris L. (Rare)

Pirin Mts: E part, Ribni lakes, 41° 42' 60" N, 23° 31' 12" E, (2003); Izvorite site, an isle of sub-alpine meadows along the blue trail from Ribni lakes to N slopes of peak Choveko (2333 m), 41° 42' 55" N, 23° 32' 36" E (2003).

We have reported this species as new for the Pirin Mts. We have found *V. palustris* in the eastern part of this mountain massif, where its distribution range from the Rhodopes continues. The measurements of environmental data in the Pirin Mts have shown that the species markedly avoids any mineral richer fens and is restricted to low conductivity values of merely 14 to 18 µS/cm/20 °C. The water was moderately acid (pH 5.4–5.8). The altitude was about 2150 m.

Other new regional records

This section briefly presents the floristic records of wetland plants that could be new to particular regions as compared to the *Bulgarian Flora*, determination keys and herbarium collections:

***Blysmus compressus* (L.) Panz ex Link** – new to Mt Sredna Gora (Lozenska Mt, Lalina Mogila and above Lozen village).

***Carex paniculata* L.** – new to Balkan Range (*Central*) – 3.6 km SW from peak Vezhen and new to Pirin Mts (Popovi livadi pass in the South Pirin).

***Eleocharis quinqueflora* (Hartm.) Schw.** – new to Pirin Mts – between Dobrinishte town and Gotse Delchev challet; Popovi livadi pass in the South Pirin; spring above the right bank of Bunderitsa rivulet on W slopes of the Pouknatiya Kamuk site. Bunderitsa locality represents the altitudinal maximum of the species in Bulgaria (2079 m). This species has been collected in the Krousheto locality (Pirin Mts) already by H. Kochev (1978, SOM 152328), but the specimen was labelled as *E. palustris*.

***Hieracium caespitosum* Dumort.** – new to Mt Sredna Gora (*Western*) – Beliya Kamuk; Debeli Del; Golyam Bogdan).

***Ophioglossum vulgatum* L.** – new to Toundzha Hilly Country (Kazanluk valley – village Dounavtsi).

***Stellaria palustris* Retz.** – new to the Rhodopi Mts. (Beglika and Shiroka Polyana settlements, BRNU 578926).

Discussion and conclusion

The new national and regional records of mire vascular plants and of bryophytes have directed the attention to the fact that Bulgarian wetland flora is still not entirely known. The incomplete exploration on wet habitats is also evident from the fact that the results of the recent studies of genus *Cardamine* (Marhold & al. 1996; Marhold & Ančev 1999) are not included in the new determination key to the Bulgarian flora (Delipavlov & al. 2003). In order to reduce the risk of biodiversity loss, a special attention should be paid to the detailed monitoring of sub-montane fen vegetation, which harbours a great number of endangered plants.

Furthermore, we propose to include more fen species into the Red List of Bulgarian plants. *Carex lasiocarpa*, first reported from Bulgaria in this paper, is the most serious candidate for inclusion among the endangered species. The same applies to the formerly neglected species *Sesleria uliginosa* and to the generally extremely rare relic species *Carex buxbaumii* s. str. not separated from *C. hartmanii* in Bulgarian literature sources so far. There are also grave apprehensions about the fate of another, formerly possibly more common species of the sub-montane nutrient-limited wetlands. *Eriophorum gracile* has been found only in single recent locality and, therefore, is a hot candidate to be red-listed, along with the scattered but sensitive species *C. lepidocarpa, C. hartmanii* and both taxa of *Montia fontana* agg. We have recently recorded all these species in a lesser number of localities than some other mire and wet meadow species already included in the Red Data Book (Velchev 1984). They also occur in nearly all red lists of Central and West European countries thus suggesting that their extinction would be accelerated with intensification of agriculture and building activities and with increasing transport-mediated deposition of nitrogen in the atmosphere.

Our study gives rise to several unsolved questions, which could stimulate further floristic and taxonomic research: (i) Does the species *Carex buxbaumii* occur only in the single locality? (ii) Is the species *Molinia caerulea* confined only to the relic fens? (iii) Which is the entire distribution of tall sedges *Carex elata* and *C. lasiocarpa*? (iv) What is the cause of *Equisetum* x *moorei* occurrence in the rich fens? and finally (v) Are the two subspecies of *Montia fontana* clearly delimited in Bulgaria?

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