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Research article

A contribution to the vascular flora of Bulgaria: new species record and chorological update

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Abstract: The present paper discusses new data on the distribution of 15 plant taxa, native or alien to the vascular flora of Bulgaria. *Allium urusakiorum* is reported to Bulgaria for the first time. Five of the listed taxa, *Thelypteris palustris, Isolepis supina, Cladium mariscus, Carex punctata,* and *Avena eriantha* are of conservation significance at regional scale. The current invasive status of the alien to the Bulgarian vascular flora *Mollugo verticillata* is discussed. Additional nomenclature notes and comments on some neglected herbarium records distributed in the indexed Bulgarian herbaria were included to the text.

Keywords: alien species, Bulgarian flora, herbarium digitisation, new chorological data, threatened plants

Introduction

Floristic studies give an important information for plant biodiversity and are directly related to the protection of rare and threatened plant species, as well as their associated communities. In this regard, the Herbarium as an institution plays an important role for storing, managing, and distributing references for the chorology of plants of a certain geographic region. The Herbarium at the National Museum of Natural History at the Bulgarian Academy of Sciences, registered in the Index Herbariorum under the acronym BNHM is currently involved in the Distributed System of Scientific Collections – Bulgaria project (DiSSCo-BG; https://dissco-bg.eu/en). The vascular plant collection of the herbarium BNHM is registered in the Global Registry of Scientific Collections with the code BG-NMNHS-BOT: https://scientific-collections.gbif.org/. As part of the project up to now about 2000 herbarium exsiccates have been digitised through Specify 7 database management tool (https://www.specifysoftware.org/). Among them, about 300 exsiccates concern recently collected specimens by the author from the territory of Bulgaria and Greece. In the present paper new regional chorological information, regarding 15 plant taxa is extracted from the corresponding collection.

Materials and methods

The new chorological information have been collected during botanical trips taken in the vegetation seasons of 2023. The identity of the plant species was keyed out through Stoyanov et al. (2021), apart from *A. urusakiorum* being identified via Koçyiğit at al. (2016). The nomenclature follows POWO (2023), except for *Isolepis supina,* presented as in Kuzmanov & Kozhuharov (1964). Herbarium sheets from all of the listed species had been deposited to the BNHM herbarium. Duplicates for some of the taxa had been deposited also in SO and SOM herbaria (herbarium acronyms follows Thiers, 2023). All of the cited specimens were digitised as part of DiSSCo-BG project. The plant names are ordered as in multivolume edition of Flora Europaea (Tutin et al., 1964–1980). The species distribution is presented according accepted floristic regionalisation (Jordanov, 1966). The habitat notes were based on author's personal observations. The invasive status of

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Fig. 1. *Thelypteris palustris* Schott at Alepu marsh, 30 August 2023.

the species is given according to Richardson & al. (2000). All the images (Figs. 1–4) presented in the text were taken by the author during his field trips.

List of plants

1. *Thelypteris palustris* Schott (Thelypteridaceae) (Fig. 1)

Voucher specimens: 1) The Black Sea Coast (North): Novo Oryahovo Village, Dolni Chiflik Municipality, Varna Province, 0 m, 42.98189°N, 27.89025°E, coll. date: 8 Oct 2022; leg. & det. G. Kunev (BNHM–000000001178); 2) The Danubian Plain: Tarnene Village, Pleven Province, in the marshes near former Oil Refinery 'Plama', 68 m, 43.39187°N, 24.49965°E, coll. date: 6 Jun 2022, leg. & det. R. Tzonev (BNHM–000000001179); 3) The Black Sea Coast (South): Alepu Marsh, Sozopol Municipality, Burgas Province, 0 m, 42.357566°N, 27.714178°E, coll. date: 30 Aug 2023, leg. & det. G. Kunev (BNHM–000000001922; SO–108262; SOM–178820).

The species is rare in Bulgaria and thus of conservation significance. It is listed as 'Vulnerable' in the national Red List (Ivanova, 2009), and included in Annex 3 of the Bulgarian Biodiversity Act. Its distribution in the country has been recently reevaluated (Tzonev et al., 2022; Natcheva et al., 2023). The localities 1 and 2 in the header data of the present report had been already mentioned by Tzonev et. al (2022) and here additional reference to the herbarium records are given. The locality 3 is new for the respective taxon and its first for the floristic region of Black Sea Coast (South). Three subpopulations were recognised from a distance, looking from the road at the East margin of the Alepu Marsh, as they appear as large rusty coloured spots densely colonised by the species. The microsite population area varies between 200–500 m^2. The floristic composition includes *Solanum dulcamara* L., *Cyperus odoratus* L., *Typha angustifo-*

lia L., *Schoenoplectus* cf. *lacustris, Epilobium tetragonum* L., *Pulicaria dysenterica* (L.) Bernh., and *Lycopus europaeus* L.

2. *Mollugo verticillata* L. (Molluginaceae)

Voucher specimens: 1) The Struma Valley (South): Kulata Village, Petrich Municipality, on the left shore of the Struma River, abundant, 70 m, 41.386288°N, 23.343486°E, coll. date: 23 Jul 2023, leg. & det. G. Kunev (BNHM–000000001320); 2) The Struma Valley (South): Marikostinovo Village, Petrich Municipality, along the gravel bars at Struma River, 80 m, 41.428250°N, 23.314180°E, coll. date: 30 Sep 2023, leg. & det. G. Kunev (BNHM–000000001885).

Kunev (2019) reported this alien weed for the first time for Bulgarian flora following the find of only two specimens at the gravel bars of Struma River. The invasive status of the species in the country at that time was evaluated as 'casual alien' in the sense of Richardson et al. (2000). However, this particular section of the river was revisited each year since its report with attempts to collected additional data on population trends of the species. Furthermore, new localities were reported from Bulgaria and Greece (Kunev, 2020; Giannakis et al., 2022). The current report adds new localities at Struma River with numerous individuals unevenly spread over the gravel bars. This summarised information shows expansion of the species and increase in its population density in the region. Therefore, it could be concluded that there is persistent seed bank already established giving rise to many self-supported micro-populations, so the invasive status of the species should be reassess as 'naturalised alien'.

3. *Glinus lotoides* L. (Molluginaceae)

Voucher specimen: The Black Sea Coast (South): Velika Village, Tsarevo Municipality, along the shores of a small reservoir, 20 m, 42.191288°N, 27.805807°E, coll. date: 31 Aug 2023, leg. & det. G. Kunev (BNHM–000000001877; SO–108263; SOM–178819).

A new locality and first collection of the species from the Black Sea Coast (South) floristic region (Stoyanov et al., 2021).

4. *Stellaria cupaniana* (Jord. & Fourr.) Bég. (Caryophyllaceae)

Voucher specimen: The Rhodopes (East): Mezek Village, Svilengrad Municipality, side of a dirt road directing to Mt Sheinovets, 500 m, 41.716159°N, 26.051814°E, coll. date: 20 May 2023, leg. & det. G. Kunev (BNHM–000000001294; SO–108245, –108246).

The taxon was reported to Bulgarian flora under the combination *Stellaria media* subsp. *cupaniana* (Jord. & Fourr.) Nyman (Cheschmedzhiev, 1988). It was first collected at Borovets, a mountain resort at Rila Mts, at approximately 1200–1300 m. However, the material at SOM–144911 (16 Sep 1984, leg. & det. I. Cheschmedzhiev) (incorrectly cited in Cheschmedzhiev, 1988 as 144901), is certainly referable to *S. aquatica* (L.) Scop. since its flowers bear five styles (vs. three in *S. media* subsp. *cupaniana*).

Under the combination *Stellaria cupaniana* (Jord. & Fourr.) Bég., it has been reported also for the territory of 'Rila Monastery' Nature Park and 'Rilomanastirska Gora' Reserve (Tsoneva & Peev, 2003; Tonkov et al., 2006), although not supported with herbarium collections in any of the national herbaria. In Bulgaria, up to now it has been known only from Rila Mts. The current report gives information for a new locality and a new floristic region for the species in the country. Two microsites composed of not more than 20 ind. each were observed at ruderal place along a dirt road.

5. *Silene heuffelii* Soó (Caryophyllaceae)

Voucher specimen: West Frontier Mountains: Osogovo Mts, Garlyano Village, Kyustendil Municipality, under hazel shrubs, on the right shore of Bistritsa River, 1185 m, 42.230674°N, 22.555482°E, coll. date: 9 Jul 2023, leg. & det. G. Kunev (BNHM–000000001322; SO–108244).

New species for Osogovo Mts, not previously mentioned from West Frontier Mountains floristic region (Assyov & Petrova, 2012; Stoyanov et al., 2021).

6. *Radiola linoides* Roth (Linaceae)

Voucher specimen: The Rhodopes (East): Dobromirtsi Village, Kirkovo Municipality, damp

terrace along stream, 350, 41.380799°N, 25.228683°E, coll. date: 2 Jul 2023, leg. & det. G. Kunev (BNHM–000000001556).

This is a hardly noticeable dwarf annual species, seldom collected in Bulgaria. It is characteristic species for *Isoëto-Nanojuncetea* communities, an ephemeral cyperaceous vegetation developed on silt depositions of temporary flooded stream sides and pond shores (Mucina et al., 2016). It has not been reported from East Rhodope Mts up to now (Stoyanov et al., 2021). In the present locality *R. linoides* was associate with *Cyperus flavescens* L., *Juncus tenageia* Ehrh. ex L.f., *J. articulatus* L., *J. bufonius* L., *Trifolium micranthum* Viv., *T. campestre* Schreb., *T. glomeratum* L., *T. lappaceum* L., *Mentha arvensis* L., *M. pulegium* L., *Ranunculus sardous* Crantz, *Lotus angustissimus* L., *Anagallis minima* (L.) E.H.L.Krause, *Persicaria hydropiper* (L.) Delarbre, *Allium sardoum* Moris, and *Carex* sp. This particular population consisted of several tens of individuals over an area of 2 m^2.

7. *Pyrola minor* L. (Ericaceae)

Voucher specimen: West Frontier Mountains: Osogovo Mts, Garlyano Village, Kyustendil Municipality, in a mixed forest near stream, right slopes over Bistritsa River, 1280 m, 42.215476°N, 22.549052°E, coll. date: 9 Jul 2023, leg. & det. G. Kunev (BNHM–000000001321).

The species has been reported from Osogovo Mts (Ančev, 1982), thought without representative material deposited in any of the national herbaria. Probably, this was the reason for its omission in the latest floristic summaries from Bulgaria (Assyov & Petrova, 2012; Stoyanov et al., 2021). The above-cited material confirms the species for Osogovo Mts. The observed population consisted of about 30 individuals over 10 m^2 at the lowest point of a dry ravine, at its side slopes, under mixed beech-pine forest.

8. *Allium urusakiorum* Özhatay, Seregin & N.Friesen (Amaryllidaceae) (Fig. 2a–b)

Voucher specimens: 1) Strandzha Mts: North from Malko Tarnovo, over open eroded slopes and calcareous substrates, 290 m, 42.014889°N, 27.495488°E, coll. date: 1 Aug 2023, leg. & det. G. Kunev (BNHM–000000001926; SO–108257; SOM–178821); 2) Strandzha Mts: West from Mladezhko Village, Malko Tarnovo Municipality, on open calcareous slopes over the source of Mladezka River, 250 m, 42.152534°N, 27.357281°E, coll. date: 1 Aug 2023, leg. & det. G. Kunev (BNHM–000000001927; SO–108256).

The taxon is new to Bulgarian flora. It belongs to the taxonomically intricate *Allium saxatile* group, recently resolved by morphological and molecular analyses (Seregin at al., 2015). Two species of this group has been described from Bulgaria so far. These are *Allium austrodanubiense* N. Friesen & Seregin (Fig. 2c) and *A. rubriflorum* (Adamovic) Anackov, N. Friesen & Seregin, both of which having white-purplish tepals and anthers shifting from yellowish to purplish-brown during different phenophases (Seregin et al., 2015). A specimen of *A. austrodanubiense* can be seen under catalog number BNHM–000000000872 (26 Aug 2022, leg. & det. G. Kunev).

A. urusakiorum belongs to the sub-group of white-yellowish flowered members of the *A. saxatile* group. It was first reported from Strandzha Mts in European Turkey as *A. saxatile* M. Bieb. (Özhatay et al., 2012). However, further reevaluation proved the species as new to science (Koçyiğit at al., 2016). It is clearly separated from the above-mentioned taxa by its white-yellowish tepals, yellow anthers, which do not change colour over maturation, and longer filaments (Fig. 2a–b).

White-yellowish forms of *A. saxatile* were reported from Bulgarian parts of Strandzha Mts by Jordanoff (1934, 1935). His materials were collected approximately 20 km from locus classicus of *A. urusakiorum* in Turkey and deposited at SO–11910 (15 Jul 1935, leg. & det. D. Jordanoff), –11911 (13 Aug 1933, leg. & det. D. Jordanoff). In August 2023, some of the localities reported by Jordanoff were revisited by the present author for observations and new samples to be made. The collected material were compared following the morphological description and the identification key in Koçyiğit at al. (2016), leading to the conclusion that the Bulgarian samples are undistinguishable from those described from Turkey, thus the name *A. urusakiorum* must be applied to the Bulgarian populations (sub *A. saxatile*) know from Strandzha Mts.

Additional localities of *A. saxatile* in Strandzha Mts were reported at ‘Petrova niva’ (Jordanoff, 1935)

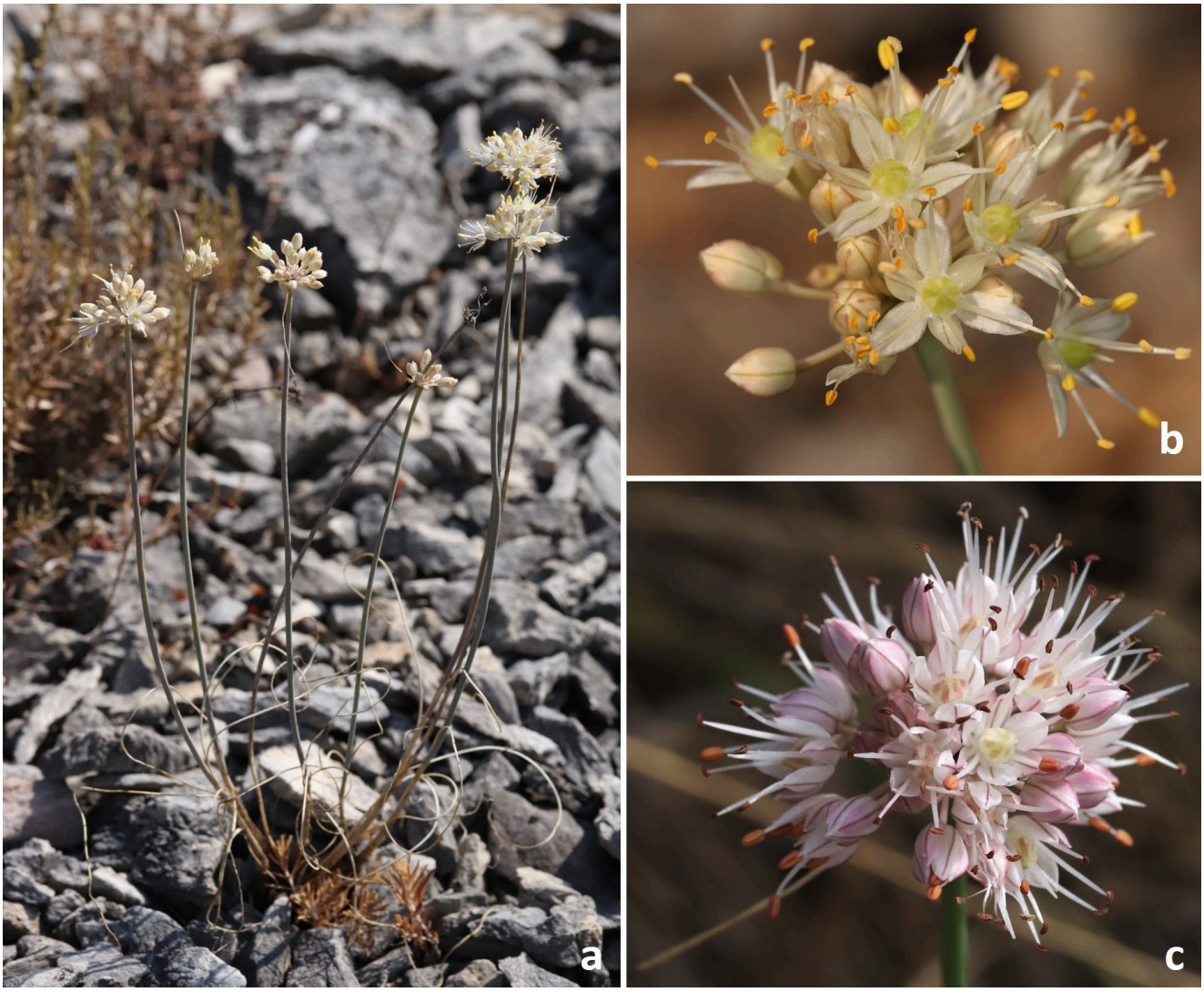

Fig. 2. *Allium urusakiorum* Özhatay, Seregin & N.Friesen at Malko Tarnovo, 1 August 2023 a) habitus; b) inflorescence; c) inflorescence of *Allium austrodanubiense* N. Friesen & Seregin at Tri Ushi heights, 26 August 2022.

and for the 'Malak Budzhak' on the left slopes over Rezovska River within 'Uzunbudzhak' ('Lopushna') Reserve (Gussev et al., 2004). The plants related to those field registrations most probably also represent *A. urusakiorum*.

It must be mentioned that the tepals of *A. urusakiorum* collected in Bulgaria turned pinkish during the course of preservation, therefore their typical colour should be observed on fresh material.

9. *Juncus capitatus* Weigel (Juncaceae)

Voucher specimen: The Mesta Valley: Ilinden Village, Hadzhidimovo Municipality, on the moist shores of a small reservoir, 630 m, 41.460340°N, 23.830110°E, coll. date: 24 Jul 2023, lLeg. & det. G. Kunev (BNHM–000000001880).

New location and new floristic region for this dwarf annual species (Goranova et al., 2013), observed on sandy alluvium at the shores of a small pond. The communities in which the species participates could be referred as *Isoëto-Nanojuncetea* vegetation type. It was observed along the shores of the pond in four microsites with several tens of individuals.

10. *Avena eriantha* Durieu (Poaceae)

Voucher specimen: The Rhodopes (East): Likana Protected area, Ivaylovgrad Municipality, in forest

opening, calcareous substrate, 223 m, 41.452884°N, 26.137993°E, coll. date: 21 May 2023, leg. & det.: G. Kunev (BNHM–000000001303; SO–108243).

The species has been reported to Bulgaria for the first time from the region of Cape Kaliakra, on the Black Sea coast by Delipavlov (1999). Since it has been known from this single region, the species was evaluated as 'Criticaly Endangered' for the national Red Data Book (Tzonev, 2015a) and included in Annex 2a of the Bulgarian Biodiversity Act.

A single population of several hundreds of individuals were observed at Likana locality, over open, shallow, skeletal substrates, on slopes of low inclination and SE exposition. This represents the first observation of the species from the region of East Rhodope Mts (Stoyanov et al., 2021). The species is closely related with *Avena clauda* Durieu, the latter being reported from Belopolyane Village (Velchev & Petrova, 2011), very close to the here reported locality of *A. eriantha*. The latter can be distinguished by the spike with 2(-3) florets (vs. 3(-5) in *A. clauda*) and the type of dispersal unit, being the spike (rachilla disarticulates at the base), but the floret in *A. clauda* (rachilla disarticulates between florets) (Delipavlov, 1999).

In the present report, the two taxa are considered at specific level. However, the taxonomic significance of the above-mentioned discrimination characters were not universally accepted. Some authors prefer merging *A. eriantha* and *A. clauda,* and treating them as different subunits of a single species, since both often co-occur across their range, interbreed, and produce viable offspring (Ladizinsky, 2012).

11. *Isolepis supina* (L.) R.Br. (Cyperaceae)

Voucher specimens: 1) The Thracian Lowland: Staro Zhelezare Village, Hissarya Municipality, at the inflow area of a small reservoir, 290m, 42.454262°N, 24.661796°E, coll. date: 26 Sep 2023, leg. & det. G. Kunev (BNHM–000000001918; SO-108269); 2) Vitosha Region: Gorna Dikanya Village, Radomir Municipality, on the shores of Arkata Reservoir, 710 m, 42.432395°N, 23.149835°E, coll. date: 11 Oct 2023, leg. & det. G. Kunev (BNHM–000000001919); 3) Sredna Gora (East): Brezovo Town, Plovdiv Province, at the West shore of Brezovo Reservoir, 260 m, 42.364106°N, 25.062169°E, coll. date: 14 Oct 2023, leg. & det. G. Kunev (BNHM–000000001920); 4) The Rhodopes (East): Maglene Village, Kirkovo Municipality, on the desiccating shores of Maglene Reservoir, 415 m, 41.409698°N, 25.245892°E, coll. date: 16 Oct 2023, leg. & det. G. Kunev (SOM–178822).

The species is seldom collected in the country, as it is confirmed by the low number of herbarium records kept at the SO, SOM and SOA herbaria. For this reason, it was included in the first edition of the Red Data Book of Bulgaria (Markova, 1984), as 'Endangered', and it is currently listed in the Annex 2a of the Biodiversity Act of Bulgaria. Most of the species records were documented before 1941 (Markova, 1984), with a single recent collection from the old riverbeds of Osam River at Balgarene Village, Pleven Province (Tzonev et al., 2010). Distribution notes on four new localities are here provided. The populations of *I. supina* at the reservoir at Staro Zhelezare Village, at the W shore of Brezevo Reservoir, and Maglene Reservoir consist of several tens to more than a hundred of individuals, while at the shores of Arkata Reservoir only one specimen has been noticed. Following the present and the historical records (Markova, 1984; Tzonev et al., 2010; Stoyanov et al., 2021) the species is now documented from seven floristic regions of Bulgaria: The Danubian Plain, North-Eastern Bulgaria, Sredna Gora (East), The Thracian Lowland, Tundzha Hilly Country, Vitosha Region, and The Rhodopes (East). The vertical limits of the species in the country is also significantly extended and exceeds 700 m at Arkata Reservoir.

12. *Eleocharis acicularis* (L.) Roem. & Schult. (Cyperaceae)

Voucher specimen: Vitosha Region: Verila Mts, Gorna Dikanya Village, Radomir Municipality, on the shores of Arkata Reservoir, 710 m, 42.433768°N, 23.157591°E, coll. date: 11 Oct 2023, leg. & det. G. Kunev (BNHM–000000001840).

The species is widespread in the country, however no materials from Verila Mts has been collected up to now (Assyov & Petrova, 2012; Stoyanov et al., 2021). It is typical for the desiccating shores of shallow water bodies and characteristic species for *Isoëto-Nanojuncetea* communities. At this particular site *E. acicularis* co-occurs with rarely collected *Limosella aquatica* L. (11 Oct 2023, leg. & det. G. Kunev,

Fig. 3. *Carex pendula* Huds. near Bonsovi Polyani locality, 8 May 2023.

BNHM–000000001883). Second specimen of *E. acicularis* deposited in BNHM was gathered at Drenov dol Reservoir, Kyustendil Municipality (5 Oct 2020, leg. & det. G. Kunev BNHM–000000001012).

13. *Cladium mariscus* (L.) Pohl (Cyperaceae)

Voucher specimen: The Struma Valley (South): Marikostinovo Village, Petrich Municipality, at the bridge at balneological center, 83 m, 41.438516°N, 23.315926°E, coll. date: 30 Sep 2023, leg. & det. G. Kunev (BNHM–000000001828).

The species is scattered and of conservation significance in Bulgaria being included in Annex 2a of the Bulgarian Biodiversity Act and in the Red Data Book of Bulgaria with the status of 'Endangered' (Stoeva, 2015). Additionally, the fens with *Cladium mariscus* are ascribed to the habitat 7210* of the Habitats Directive, and as an extremely rare communities in Bulgaria (Tzonev, 2015b) were included in Annex 1 of the Bulgarian Biodiversity Act. Therefore, this new locality at Marikostinovo is of great importance for the protection of the species in the country.

The present population has been observed in 2020 by Zhivko Barzov (an advanced nonprofessional naturalist), who shared his observation by a personal communication with the author. At the reported locality, the species forms dense patches at the source of the mineral spring, with monodominant stands covering at least 200 m^2. The total area occupied by the species is most probably larger however, it was not fully assessed during current field study due to the restricted access to some of the zones of the balneological centre.

14. *Carex pendula* Huds. (Cyperaceae) (Fig. 3)

Voucher specimen: Sofia Region: Lyulin Mts, Bonsovi Polyani locality, observed in few microsites along stream, 910 m, 42.653845°N, 23.189032°E, coll. date: 8 May 2023, leg. & det. G. Kunev (BNHM–000000001211; SO–108241).

The species is documented mostly from East Bulgaria (Valev, 1964). Here, a new locality and first

Fig. 4. *Carex punctata* Gaudin at Dobromirtsi Village, 18 June 2023, a) habitus; b) perigynium.

collection of the species from Sofia region is presented (Stoyanov et al., 2021).

15. *Carex punctata* Gaudin (Cyperaceae) (Fig. 4)

Voucher specimen: The Rhodopes (East): Dobromirtsi Village, Kirkovo Municipality, along stream, 350 m, 41.376966°N, 25.224861°E, coll. date: 18 Jun 2023, leg. & det. G. Kunev (BNHM–000000001220; SO–108240).

This is rare sedge in Bulgaria, since it was reported from only few localities. It was included in the first edition of the Red Data Book of Bulgaria as 'Rare' (Meshinev, 1984), and currently it is listed in Annex 2a of the Bulgarian Biodiversity Act. Up to now, observations of the species has been made at the following regions of the country: Balkan Range (Central) – SOM–161680 (2 Jul 2004, leg. & det. M. Hajek et al.); Rhodopes Mts (Central) – SOM–79598 (Jul 1894, leg. V. Stribrny & det. B. Achtaroff), SO–10258 (22 May 1893, leg. V. Stribrny); Valley of Struma River (South) – SOM–163638 (24 Jun 2007, leg. M. Hajek et al. & det. M. Hajek); Sofia region and Vitosha Mts (Hájek et al., 2005; Hájek et al., 2007; Tzonev et al., 2013; Stoyanov et al., 2021). An additional collection of the species from Slavyanka Mts – SOM–151060 (9 Aug 1991, leg. I. Pashaliev, sub *C. helodes* Link., rev.: P. Jiménez-Mejias) was apparently neglected in the main floristic sources from Bulgaria, and as far as it is known was not reported elsewhere.

At the new locality at East Rhodopes Mts, the species occupies sides of temporary streamlet along with *Anthoxanthum odoratum* L., *Ranunculus sardous, Trifolium nigrescens* Viv., *Juncus articulatus, Cynosurus cristatus* L., *Mentha aquatica, Persicaria hydropiper, Eleocharis uniglumis* (Link) Schult., and *Isolepis setacea* (L.) R.Br. The population is particularly vulnerable since it is composed of less than hundred individuals and it is subject of grazing.

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