

PAPER • OPEN ACCESS

An update to the genus *Bolboschoenus* in Bulgaria - species diversity, distribution and phytosociological affinities

To cite this article: G Kunev 2024 *IOP Conf. Ser.: Earth Environ. Sci.* **1305** 012002

View the [article online](#) for updates and enhancements.

You may also like

- [Sustainable development of destination Bulgaria through alternative forms of tourism](#)
M Bozhinova and K Georgieva
- [Phytotoxicological assessment of AMD affected river waters in "Sredna Gora", Bulgaria to *Lepidium sativum* L.](#)
Mariya Vladimirova, Lora Kirova and Ivan Traykov
- [Analysis of the opportunities for using energy from renewable sources in Bulgaria](#)
P Zlateva and N Mileva

An update to the genus *Bolboschoenus* in Bulgaria - species diversity, distribution and phytosociological affinities

G Kunev

Department of Botany, Faculty of Biology, Sofia University, Dragan Tzankov 8, 1164 Sofia, Bulgaria

gikunev@uni-sofia.bg

Abstract. The current study presents new data on the distribution of the representatives of the genus *Bolboschoenus* in Bulgaria and gives a brief description of their communities. It is based on revision of herbarium materials, field observations and phytosociological samples. Morphological characteristics and ecological traits of the studied taxa are commented. A synopsis of all collected chorological information is attached.

1. Introduction

The account of the genus *Bolboschoenus* (Asch.) Palla (*Cyperaceae*) for the Bulgarian flora [1] includes only *B. maritimus* (L.) Palla with seven varieties (*monostachys*, *polystachys*, *compactus*, *macrostachys*, *bornmulleri*, *maritimus*, and *laxiflorus*). These varieties were distinguished solely on the basis of differences in inflorescence structure. For the Flora Europaea, DeFilipps [2] had adopted broader concept including *Bolboschoenus* in *Scirpus* L. at section level, recognizing two subspecies *S. maritimus* L. subsp. *maritimus* and *S. maritimus* subsp. *affinis* (Roth) T. Norlindh for the territory of the Old World. Over the last 25 years, research on the genus has largely clarified its taxonomy and established species diversity of sixteen species worldwide [3], six of which are represented in Europe [4]. It became clear that carpological characters are most important in discrimination of species within the genus and inflorescence features are of lower significance since the latter being often affected by ecological conditions [5], [6], [7]. The accumulation of new taxonomic information and improvement of classification of *Bolboschoenus* induced many regional studies especially in Europe [6], [7], [8], [9], [10]. However, diversity, distribution and phytosociological affinities of *Bolboschoenus* spp. in Bulgaria have been not summarized according newly accepted taxonomy.

Among the European species, *Bolboschoenus glaucus* (Lam.) S. G. Smith and *B. planiculmis* (F.Schmidt) T.V. Egorova has been already reported to Bulgaria [11], [12], though without reference to representative material. Further extensive revision of herbarium collections at the indexed Bulgarian herbaria SO and SOM [13] raised the number of species in Bulgaria to four [5], adding *B. laticarpus* Marhold, Hroudová, Ducháček & Zák to already noted *B. planiculmis*, *B. glaucus* and *B. maritimus* s. str. Yet, in the most recent floristic synopses on the flora of Bulgaria [14], [15], [16], the novel data on the taxonomic and biogeographic limits of the species within *Bolboschoenus* were incompletely amended.

Data on the distribution of *Bolboschoenus maritimus* s. l. in Bulgaria could be traced in many published floristic and phytosociological works and several MSc or PhD theses. Most important of



these studies were summarized recently [17], [18]. However, these data is largely outdated being collected for the most part in the period 1950-2000.

Therefore, the main goal of the present study was to collect new chorological and phytosociological data for the representatives of the genus *Bolboschoenus* at a national scale.

2. Materials and Methods

Revision of herbarium materials from *Bolboschoenus* (incl. *Scirpus*) had been done at SO, SOM, SOA and BNHM herbaria [13]. Additional distributional data had been searched in various online databases and previous studies [5], [19], [20]. Data from the author's personal gatherings cumulated in the period 2019-2022 were also used to establish the distribution of the species subject to the present study. Field trips were planned and held during the vegetation seasons of 2022-2023. Samples of inflorescences and ripe fruits had been collected randomly, at a distance of at least 1 m between culms of each of the examined populations. Achenes cross-sections were studied under stereomicroscope Leica EZ4 (8x - 35x), and analysed by means of SEM Hitachi TM4000, at 15 kV and 25 pA. 27 phytosociological samples were taken according the Braun-Blanquet's phytosociological school [21], [22]. For each sample, data on complete species composition of the vascular plants, cover-abundance, GPS coordinates, anthropogenic influences, fragmentation, and soil moisture were recorded. A total number of 107 populations with participation of *Bolboschoenus* spp. were registered at the field and along with established herbarium records are supplemented to the present text (Appendices A and B). Only herbarium materials with reliable label information were used to compose a distribution map. An approximate geographic coordinates in WGS 84 system were extracted with Google Earth Pro application and had been referred to older herbarium records. The presented distribution map (Figure 1) was designed with the same application. The landowner provided permission for the field study conducted on private land.

3. Results and Discussion

The present study confirms the results of previous studies [5] on occurrence of four species of genus *Bolboschoenus* in Bulgaria. The most important characters used for discrimination of the individual taxa within the genus are indeed, those related to achene morphology and anatomy. The identification keys proposed by various authors [5], [6], [7], [16] has been proved useful and reliable for differentiation of *Bolboschoenus* taxa within Bulgarian populations.

3.1. Chorological data

Among the Bulgarian species, *B. glaucus* is the most widespread. It occupies 77 (10x10 km) UTM grid squares within the most of the floristic regions of the country, excluding Strandzha, The Rhodopes (West) and (Central), Rila, Pirin (North), Belasitsa, Slavyanka, Struma Valley (North), Znepole and Sofia Regions (Figure 1A). It is recognized by the inflorescence bearing many rays, and the achenes – smallest among all of the representatives of the genus in Bulgaria. The exocarp, visible in transverse section of achene made across upper 1/3 - very thin, outer surface smoot and glossy. The exocarp/mesocarp ratio is about 1:5 (1:8) (Figure 2A-A₁). Compared to the other representatives, the species is more thermo- and xerophilic. It is often seen in shallow, temporarily wet depressions that completely dry out in summer. The flowering period begins comparatively earlier of about 2 to 4 weeks, thus ripe fruits may be collected as early as mid-June. However, the letter observation need to be supported with additional phenological studies. The vertical limits of the species reaches 710 m a.s.l at 'Arkata' reservior (Appendix B).

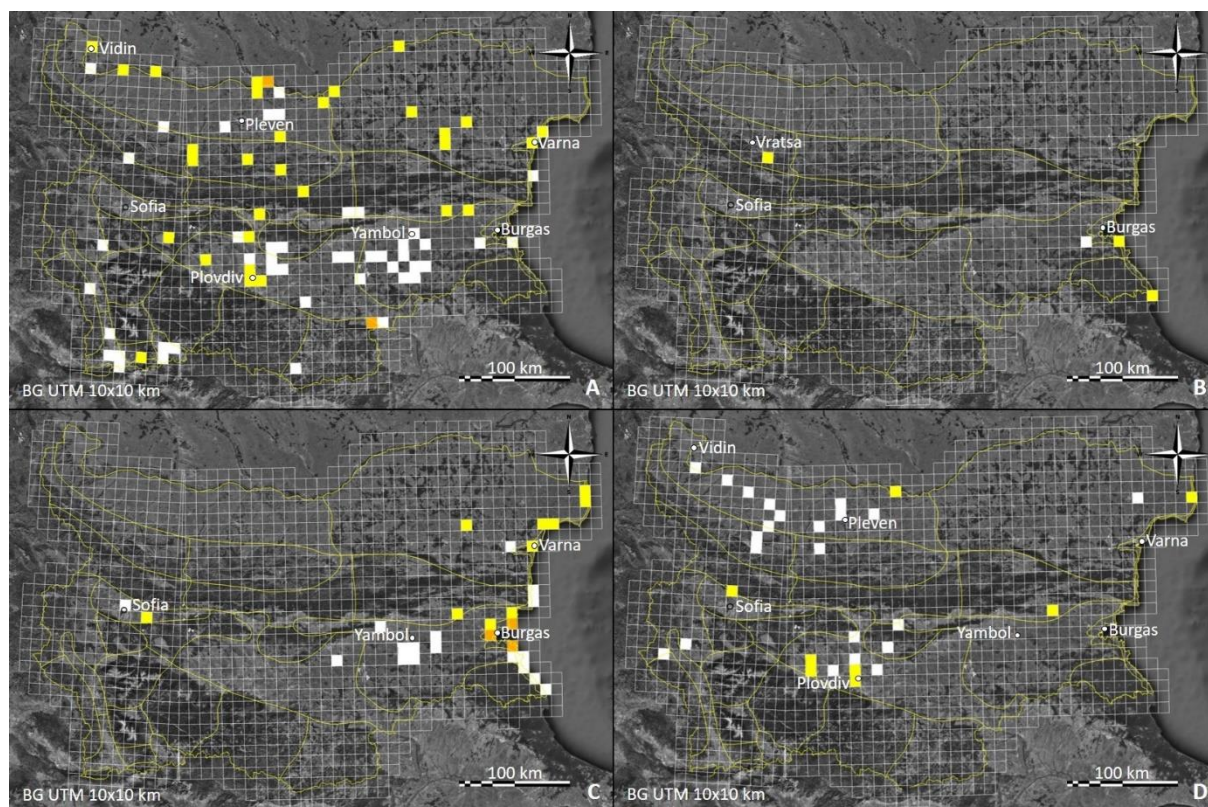


Figure 1. Distribution map of *Bolboschoenus* spp. in Bulgaria: A) *B. glaucus*; B) *B. laticarpus*; C) *B. maritimus*; D) *B. planiculmis*. Yellow grid squares indicate localities extracted from herbarium records; white grid squares show localities registered at the field; orange grid squares display both respectively.

In Europe *B. laticarpus* is most frequent in its central region, while it is restricted on South [5], [19], which is the reason it is the most rare representative of the genus in Bulgaria - lack of optimal conditions at the periphery of its range limits its distribution in the country. It has been confirmed to Bulgaria from four locations only, three of which are known only from herbarium records (Appendix A). It is registered at four UTM grid squares and the floristic regions Black Sea coast (South), Tundzha Hilly Country, and Forebalkan (West) (Figure 1B). A single population has been registered at the field during the present study (Appendix B). The species is most similar to *B. glaucus* and it is hardly distinguished from the latter at *in situ* environment based only on general morphology. The achene length/width ratio is ca. 3x2 mm, achene surface somewhat dull, a bit larger than and not as shiny as in *B. glaucus*. The exocarp/mesocarp ratio is mostly 1:3 (1:2) (Figure 2B-B₁). The observed population consisted of several groups of individuals each covering an area of 1-2 m², distributed in about 50 m section of a small river. At the locality, the species was associated with *Phragmites australis*, *Schoenoplectus lacustris*, *Typha latifolia*, *Iris pseudacorus*, *Paspalum distichum*, *Cyperus longus*, *Calamagrostis epigejos*, *Xanthium orientale* subsp. *italicum*, *Sonchus arvensis* subsp. *uliginosus*, *Stachys palustris*, *Lycopus exaltatus*, and *Urtica dioica*.

B. maritimus was found frequently and with high population density mostly along the Black Sea coast and to a certain extent in SE Bulgaria, while in the remaining regions, explored during present study it was found significantly less frequently and with low abundance. The area of occupancy includes 30 UTM grid squares and the floristic regions of the Black Sea coast, Northeast Bulgaria, The Balkan Mts (East), Tundzha Hilly Country, Thracian Lowland, and Sofia (Figure 1C). It has been found mainly on the shores of brackish water bodies, which shows its higher salt tolerance comparing

with the rest of the Bulgarian species of the genus, which is in line with previous studies [5], [7]. Beside the exhibit salinity tolerance the species is recognized by its (sub-)sessile inflorescence, occasionally bearing 1-3 rays, each with 1-3(-4) spikelets. The achenes are relatively large, surface more or less dull, with conspicuous smooth polygonal reticulation, exocarp/mesocarp ratio usually 2:1 (Figure 2C-C₁).

In Bulgaria *B. planiculmis* has been registered at 30 UTM grid squares and Struma Valley (North), Znepole, Sofia, Thracian Lowland, Sredna gora Mts (West), Balkan Mts (East), Northeast Bulgaria, The Black Sea coast (North), Forebalkan, and The Danubian plain floristic regions (Figure 1D). It is recognized by its slender habit, inflorescence often (sub-) sessile with predominantly bifid styles, often formed by a single spikelet. Achenes length/width 3-3.5 x 2-2.5 mm, usually broader in comparison to the rest *Bolboschoenus* spp. in Bulgaria, biconcave or flat-concave in cross section, exocarp/mesocarp ratio 1:1 (Figure 2D-D₁). It is more common and abundant in Northwest and South-central Bulgaria. It is often found along with *B. glaucus* at the peripheries of artificial ponds, e.g. reservoirs, gravel pits, fishponds, or ricefields. However, in such cases both species usually colonize different parts of littoral zone. *B. glaucus*, being more xerophilous, colonize the upper littoral zone that drains earlier in the season, while *B. planiculmis* is commonly observed in the lower littoral zone, often semi-submerged in shallow (0.05-0.20 cm) water.

3.2. Phytosociological affinities

Representatives of the genus on the territory of Bulgaria often dominate a wide range of wet habitats, including coastal and inland salt marshes, coastal zones of freshwater bodies and temporarily wet pools on the periphery of arable land. They inhabit mostly disturbed sites with considerable silt accumulation. The preliminary analysis, based only on differences in floristic composition and ecological traits of 27 phytocenological samples collected during the present study shows differentiation of four groups of communities with dominance or high abundance of *Bolboschoenus* spp.

The communities with *B. maritimus* develop on sandy or sand-mud substrates mainly along the Black Sea coast and along Tundzha River. The species composition of these communities varies significantly even in neighbouring stands. It is mostly poor, including many typical hygrophytes and (sub-) halophilic species, as well as ruderals, such as *Phragmites australis*, *Typha* spp., *Tripolium pannonicum*, *Symphyotrichum squamatum*, *Polypogon monspeliensis*, *Artemisia santonicum*, *Xanthium orientale* subsp. *italicum*, *Pulicaria dysenterica*, *Elymus elongatus*, *Suaeda maritima*, *Samolus valerandi*, *Centaureum spicatum*, *Equisetum ramosissimum*, *Bromus diandrus*, *Solanum dulcamara*, etc. According to the recent classification of inland *Bolboschoenus*-dominated vegetation [23], saline *Bolboschoenus* associations of coastal areas are classified to the alliance *Scirpion maritimi* Dahl et Hadač 1941, while inland freshwater communities dominated by *Bolboschoenus* spp. were grouped into *Meliloto dentati-Bolboschoenion maritimi* Hroudová, Hrivnák & Chytrý 2009. Two type of communities with *B. maritimus* could be recognized also in Bulgaria. However, the species composition of the Bulgarian communities is somewhat different from those in Central Europe, therefore at present assignment to a lower syntaxonomic units is not considered due to insufficient data set.

B. glaucus dominated communities in Bulgaria were noted mostly in the periphery of freshwater basins in the interior of the country, often observed over the shallow banks and at the inflow zone of artificial ponds, in wet depressions of alluvial terraces at lower course of many rivers, roadside ditches, and at the margins of arable land. *B. glaucus* was noted at the margins of rice paddy fields, although it is rarely abundant in such communities. The substrates were often clayey, retaining moisture even during dry period. The colonies are often dense and monospecific. In the hot months of the year *B. glaucus* stands are often grazed, since it is nearly the only fresh source of fodder available in the lowlands during dry period. This explain why these communities are influenced by many ruderal species. The species composition includes *Phragmites australis*, *Typha* spp., *Schoenoplectus* spp., *Mentha aquatica*, *M. pulegium*, *Pulicaria dysenterica*, *Cyperus longus*, *Agrostis stolonifera*,

Rumex spp., *Epilobium tetragonum*, *E. hirsutum*, *Carex cuprina*, *C. muricata* aggr., *Lythrum salicaria*, *L. virgatum*, *Xanthium orientale* subsp. *italicum*, *Eleocharis palustris*, *E. uniglumis*, *Cirsium vulgare*, *C. arvense*, *C. creticum*, *Sonchus arvensis* subsp. *uliginosus*, *Phacelurus digitatus*, *Beckmannia eruciformis*, *Sparganium erectum*, *Bidens* spp., *Oxybasis rubra*, *Jacobaea aquatica*, *Amaranthus blitum* aggr., *Erigeron canadensis*, etc. The preliminary data indicate that described communities correspond to ass. *Bolboschoenetum glauci* Grechushkina, Sorokin et Golub 2011 of the all. *Eleocharito palustris*-*Sagittarion sagittifoliae* Passarge 1964 [24], [25].

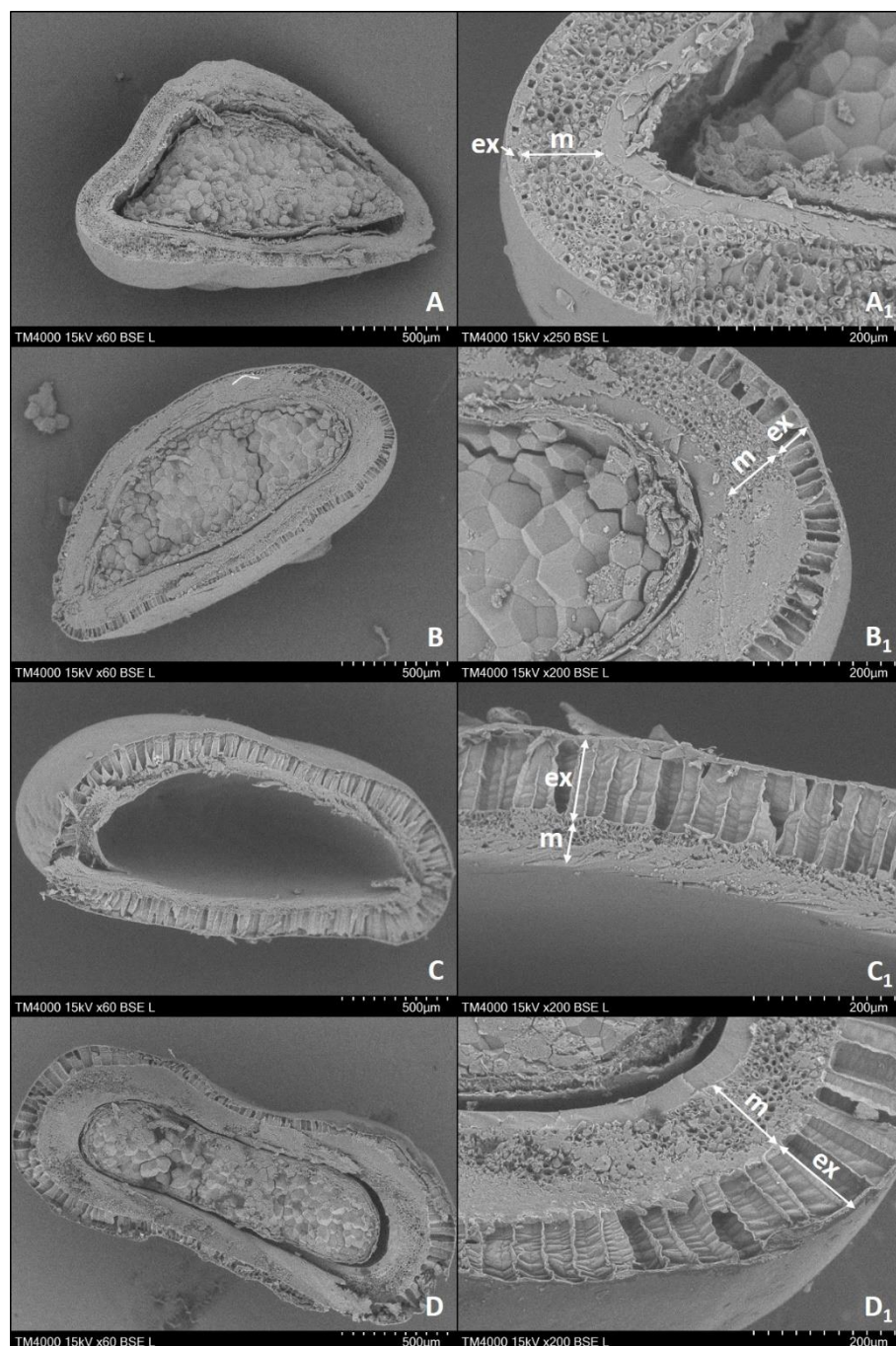


Figure 2. Cross-section of achenes from A-A₁) *B. glaucus*; B-B₁) *B. laticarpus*; C-C₁) *B. maritimus*; D-D₁) *B. planiculmis*, showing exocarp (ex)/mesocarp (m) proportions.

Communities with *B. planiculmis* develop in the periphery of freshwater basins in the interior of the country, more often in North-West Bulgaria. As it was already pointed, the optimum of these communities is displayed at flooded conditions and water layer with depth of 0.05-0.2 m [26], so to form helophytic coenoses. The substrates are mostly sand-loamy. The species composition includes many of the representatives characteristic of *B. glaucus* communities. In contrast, phytocoenoses with *B. planiculmis* are relatively open, which allows entering of some annual ephemeral vascular plants and mosses, such as *Cyperus fuscus*, *C. glaber*, *Crypsis alopecuroides*, *C. schoenoides*, *Persicaria* spp., *Lindernia dubia*, *Riccia cavernosa*, *R. frostii*, and *Physcomitrella patens*.

The collected phytosociological data is insufficient for conclusive syntaxonomic decision. However, the studied communities with *B. planiculmis* most probably, belong also to all. *Eleocharito palustris-Sagittarion sagittifoliae* Passarge 1964, as they share similar species pool with the communities of *B. glaucus* and often both species co-occur at the field. Though, at community level the ass. *Tripleurospermo inodori-Bolboschoenetum planiculmis* Hroudová et al. 2009, from Central Europe is sufficiently ecologically and floristically different to encompass the Bulgarian communities with *B. planiculmis* [23].

4. Conclusion

The occurrence of four species of the genus *Bolboschoenus* in Bulgaria has been confirmed. *B. glaucus* is the most widespread, thermophilous and dry tolerant. It is the earliest flowering and fruiting amongst all studied taxa. In contrast, *B. paniculmis* is less dry tolerant, and it is flowering/fruiting latter in the season. On the territory of the country the latter is mostly found in flooded habitats. *B. maritimus* has been found mostly at the coastal regions while it is relatively scattered inland. *B. laticarpus* has been registered in a single site with small numbers of individuals, so it is the rarest representative of the genus. The preliminary analysis of 27 phytocenological samples shows the differentiation of four groups of communities of *Bolboschoenus* spp. in Bulgaria, belonging to cl. *Phragmito-Magnocaricetea* Klika in Klika et Novák 1941. However, more samples should be collected prior final analysis and classification of these communities in Bulgaria, which will be subject of a further study.

Acknowledgements

This study was funded by the “Young Scientists and Postdoctoral Researchers National Programme 2” of the Ministry of Education and Science of Bulgaria.

Appendix A

List of herbarium records of *Bolboschoenus* spp. collected in Bulgaria. For all listed records herbarium acronym, collection date, collector/reviewer, locality, coordinates, altitude, and UTM quadrant code are given.

B. glaucus

1. BP 34337, BRNU 147701, n.d. 1908, 1909, I. Urumov (rev.: n.d. Z. Hroudová), Lom town, Montana Province, 43.8202°, 23.2386°, 40 m, FP85
2. SO 08954, 08955, 08961, 23 Jun 1947, N. Stoyanov (rev.: 2002, Z. Hroudová), Kozloduy Isl., Danube River, Kozloduy Municipality, 43.7931°, 23.7302°, 28 m, GP15
3. BP 35075, n.d. 1925, I. Urumov (rev.: n.d. Z. Hroudová), Lukovit town, Lovech Province, 43.2053°, 24.1643°, 125 m, KH68
4. SOM 95487, 13 Jul 1949, B. Achtarov (rev.: 2002, Z. Hroudová), Zlatna Panega village, Yablanitsa Municipality, 43.0948°, 24.1613°, 185 m, KH67
5. SO 8969, 18 Jun 1946, N. Stoyanov (rev.: 2002, Z. Hroudová), Cherkovica village, Nikopol Municipality, 43.7030°, 24.8474°, 25 m, LJ24
6. SO 8970, 18 Jun 1946, N. Stoyanov (rev.: 2002, Z. Hroudová), Somovit village, Gulyantsi Municipality, 43.6893°, 24.7690°, 25 m, LJ23

7. SOM 8662, n.d. 1899, A. Yavashev & B. Davidov (rev.: 2002, Z. Hroudová), Novgrad village, Tsenovo Municipality, 43.6105°, 25.5709°, 26 m, LJ82
8. SOM 8651, 21 Aug 1901, A. Yavashev & B. Davidov (rev.: 2002, Z. Hroudová), Batin village, Borovo Municipality, 43.6716°, 25.6871°, 22 m, LJ93
9. SO 8968, 30 Jul 1924, D. Yordanov (rev.: 2002, Z. Hroudová), Brashlen village, Slivo Pole Municipality, 44.0231°, 26.4377°, 15 m, MJ57
10. PRC, n.d. 1890, I. Urumov (rev.: n.d. Z. Hroudová), Letnitsa town, Letnitsa Municipality, 43.3038°, 25.0649°, 75 m, LH49
11. GLM 115468, Sep 1874 (<https://www.gbif.org/occurrence/3900919043>), Plovdiv town, 42.1438°, 24.7495°, 160 m, LG16
12. KRAM 465467, n.d. 1963, J. Mądaliski (rev.: n.d. Z. Hroudová), Gabrovo town, 42.8801°, 25.3186°, 380 m, LH64
13. SOM 8641, n.d. 1900, I. Urumov (rev.: 2002, Z. Hroudová), Ichtiman town, Sofia Province, 42.4635°, 23.8068°, 670 m, GN30
14. SO 8967 (mixed with *B. planiculmis*), 8 Jul 1961, G. Ganchev (rev.: 2002, Z. Hroudová), Velichkovo village, Pazardzhik Municipality, 42.2696°, 24.2455°, 235 m, KG78
15. LI 308090, n.d. 1986, C. M. Denchev (rev.: n.d. Z. Hroudová), Plovdiv town, 42.1528°, 24.7444°, 155 m, LG16
16. B, BRNM 544158, KRAM 21415, SOM 111878 (mixed with *B. planiculmis*), 8 Nov 1954, N. Vihodtsevski (rev.: 2002-2004, Z. Hroudová), Ribarnika locality, Plovdiv town, 42.2370°, 24.7616°, 175 m, LG17
17. BP 35074, n.d., I. Urumov (rev.: n.d. Z. Hroudová), Hisarya town, Plovdiv Province, 42.5138°, 24.6993°, 395 m, LH10
18. BRA, n.d. 1972, Fr. Černoch (rev.: Z. Hroudová), Karlovo town, Plovdiv Province, 42.6319°, 24.8341°, 470 m, LH22
19. SOM 90433, 7 Aug 1940, B. Kitanov (rev.: 2002, Z. Hroudová), Mezek village, Svilengrad Municipality, 41.7362°, 26.0877°, 160 m, MG22
20. SOM 8650, n.d. 1886, A. Yavashev & B. Davidov (rev.: 2002, Z. Hroudová), Razgrad town, 43.5226°, 26.5414°, 200 m, MJ61
21. PRC, n.d. 1890, Fr. Mild (rev.: n.d. Z. Hroudová), Shumen town, 43.2480°, 26.9455°, 145 m, MH98
22. SOM 8655 (mixed with *B. maritimus*), 1 Jun 1901, B. Davidov (rev.: 2002, Z. Hroudová), Novi Pazar town, Shumen Province, 43.3838°, 27.1803°, 135 m, NJ10
23. W, n.d. 1930, K. Ronniger (rev.: n.d. Z. Hroudová), Varna town, 43.2171°, 27.8953°, 40 m, NH78
24. B, BP, BRNM 598367, JE, KRAM 63258, PR, SO 8966, SOM 125446, SOA 27228, 18 Sep 1963, Sl. Petrov & B. Kuzmanov (rev.: 2002, Z. Hroudová), Aytos town, Burgas Province, 42.7033°, 27.2339°, 70 m, NH12
25. SO 8952, n.d. V. Stribrny (rev.: 2002, Z. Hroudová), Sadovo town, Plovdiv Province, 42.1417°, 24.9361°, 145 m, LG26
26. SO 8956, 28 Aug 1923, D. Yordanov (rev.: 25 Mar 2023, G. Kunev), Aladzha Monastery, Varna Province, 43.2715°, 28.0199°, 120 m, NH89
27. SO 94474, 1 Oct 1989, D. Stoyanov (rev.: 25 Mar 2023, G. Kunev), Belyovo village, Sandanski Municipality, 41.4805°, 23.5498°, 715 m, GL19
28. SO 8963 (mixed with *B. planiculmis*), 25 Jul 1929, D. Yordanov (rev.: 2002-2004, Z. Hroudová), Karnobat town, Burgas Province, 42.6696°, 26.9678°, 170 m, MH92
29. SOA 1433, 09 Sep 1928, N. Stoyanov & T. Georgiev (rev.: 26 Sep 2023, G. Kunev), Vidin town, 43.9941°, 22.8880°, 35 m, FP57
30. SOA 3328, n.d. 1954, (rev.: 26 Sep 2023, G. Kunev), Nikopol town, Pleven Province, 43.7072°, 24.8954°, 23 m, LJ34
31. SOM 8609, 4 Jun 1938, A. Yurkovsky (rev.: Jan 2006, S. Stoyanov), Plovdiv town, 42.1441°, 24.7055°, 160 m, LG16

- 32.SOM 8654, Jul 1912, *I. Neychev & B. Davidov* (rev.: Jan 2006, *S. Stoyanov*), Sevlievo town, 43.0177°, 25.0691°, 240 m, LH46
- 33.SOM 96224, 16 Jun 1951, *N. Stoyanov & I. Ganev* (rev.: 2002, *Z. Hroudova*), Belokopitovo village, Shumen Province, 43.3137°, 26.8963°, 240 m, MH99
- 34.SOM 94331, n.d., rev.: 18 May 2023, *G. Kunev*, Slivek village, Lovech town, 43.0975°, 24.7440°, 200 m, LH17
- 35.SOA 58564, 06 Jul 2002, *I. Cheschmedzhiev* (rev.: 26 Sep 2023, *G. Kunev*), Maritsa river, Plovdiv town, 42.1553°, 24.7581°, 155 m, LG16
- 36.BNHN 1907, 14 Oct 2023, *G. Kunev*, Brezovo town, Plovdiv Province, along the shores of 'Brezovo' Reservoir, abundant, 42.3641°, 25.0621°, 260 m, LG49 37.
- 37.BNHN 1908, 02 Jul 2023, *G. Kunev*, Dobromiritsi village, Kardzhali Province, stream side, 41.3758°, 25.2151°, 360 m, LF58
- 38.BNHN 1909, 14 Oct 2023, *G. Kunev*, Nikolaevo town, Stara Zagora Province, on the left shore of Tundzha River, at the floodgates of abandoned fishponds, 42.6324°, 25.8228°, 270 m, MH02

B. laticarpus

1. SO 8974, 6 Aug 1961, *N. Vihodtsevski* (rev.: 1 Apr 2023, *G. Kunev*), Kavatsite beach, Sozopol town, 42.3931°, 27.7029°, 8 m, NG59
2. SO 8972, 25 Jun 1960, *I. Penev* (rev.: 2004, *Z. Hroudova*), Mezdra town, Vratsa Province, 43.1351°, 23.7250°, 205 m, GN27
3. SOM 8627, 8661, 27 Jul 1921, *B. Achtarov* (rev.: 2004, *Z. Hroudova*), Rezovo village, Tsarevo Municipality, 41.9830°, 28.0239°, 8 m, NG84

B. maritimus

1. SO 8950, 1 Aug 1928, *D. Yordanov* (rev.: 2002, *Z. Hroudová*), Burgasko (Vayakyoysko) lake, Burgas Province, 42.4844°, 27.4095°, 1 m, NH30
2. SO 8977, Aug 1967, *E. Bozhilova* (rev.: 2002, *Z. Hroudová*), Pomorie town, Burgas Province, 42.5664°, 27.6262°, 1 m, NH51
3. SO 8965, 26 Jul 1928, *D. Jordanov* (rev.: 25 Mar 2023, *G. Kunev*), Atanasovsko ezero, Burgas Province, 42.5516°, 27.4772°, 1 m, NH31
4. SO 8959, 28 Jul 1928, *D. Yordanov* (rev.: 2002, *Z. Hroudová*), Atanasovsko ezero, Burgas Province, 42.5516°, 27.4772°, 1 m, NH31
5. SOM 8595, 03 Jul 1901, *B. Davidov* (rev.: 2002, *Z. Hroudová*), Varna town, 43.1742°, 27.9148°, 2 m, NH78
6. SOM 8601, 20 Jul 1907, *B. Davidov* (rev.: 2002, *Z. Hroudová*), Tuzlata (Solnitsata) locality, Balchik town, 43.4000°, 28.2168°, 3 m, NJ90
7. SOM 8653, 09 Jul 1906, *B. Davidov* (rev.: 2002, *Z. Hroudová*), Nesebar town, Burgas Province, 42.6753°, 27.7111°, 1 m, NH52
8. SOM 8655 (mixed with *B. glaucus*), 1 Jun 1901, *B. Davidov* (rev.: 2002, *Z. Hroudová*), Novi Pazar town, Shumen Province, 43.3838°, 27.1803°, 135 m, NJ10
9. SOM 8605, 09 Jul 1920, *B. Davidov* (rev.: 2002, *Z. Hroudová*), Shabla town, Dobrich Province, 43.5625°, 28.5906°, 2 m, PJ22
- 10.SOM 8622, 08 Jul 1922, *B. Davidov* (rev.: 2002, *Z. Hroudová*), Varna town, 43.1742°, 27.9148°, 2 m, NH78
- 11.BRNU 291950, n.d. 1936, *J. Berger* (rev.: n.d. *Z. Hroudová*), no distributional data!
- 12.BRNM 544180, n.d., 1971, *O. Jakeš* (rev.: n.d. *Z. Hroudová*), Albena beach, Black Sea coast, 43.3522°, 28.0751°, 2 m, NJ80
- 13.BRNU 297507, n.d. 1938, *G. Brižický* (rev.: n.d. *Z. Hroudová*), Sozopol town, Burgas Province, 42.4178°, 27.6898°, 3 m, NG59
- 14.BRNM 544161, 544177, n.d. 1963, *J. Šmarda* (rev.: n.d. *Z. Hroudová*), Atanasovsko lake Burgas Province, 42.5297°, 27.4707°, 1 m, NH30

- 15.BRA, n.d. 1965, *Vicherek* (rev.: n.d. Z. Hroudová), Durankulak (Blatnitsa) village, Shabla Municipality, 43.6774°, 28.5376°, 2 m, PJ23
- 16.SOA 14248, Jul 1927 (rev.: 26 Sep 2023, G. Kunev), Karnobat town, Burgas Province, 42.6533°, 27.0621°, 230 m, NH02
- 17.SOA 14249, 19 Aug 1921, D. Yordanov (rev.: 26 Sep 2023, G. Kunev), Musachevo village, Sofia Province, 42.6770°, 23.5826°, 540 m, GN12
- 18.SOM 152502, 31 May 1992, A. Petrova (rev.: Sep 2003, S. Stoyanov), Hadzhiyska River, Synny Beach, Nesebar Municipality, 42.6753°, 27.7111°, 1 m, NH52
- 19.SOM 8626, 8664, n.d. 1906, I. Urumov & B. Davidov (rev.: 2002, Z. Hroudová), Burgas town, 42.4844°, 27.4095°, 1 m, NH30

B. planiculmis

1. SO 8957, 14 Jul 1929, D. Yordanov (rev.: 2002, Z. Hroudová), Gnilyane village, Novi Iskar town, Sofia Province, 42.8085°, 23.3663°, 500 m, FN94
2. SO 8967 (mixed with *B. glaucus*), 8 Jul 1961, G. Ganchev (rev.: 2002-2004, Z. Hroudová), Velichkovo village, Pazardzhik Municipality, 42.2696°, 24.2455°, 235 m, KG78
3. SO 32514, 9 Jul 1960, N. Vihodtsevski (rev.: 2003, Z. Hroudová), Pazardzhik town, 42.1967°, 24.2728°, 210 m, KG77
4. BP 491983, BRNM 544158, JE, PRC, SO 8973, W; mixed with *B. glaucus*: B, KRAM 21415, SOM 111878, 08 Nov 1954, N. Vihodtsevski (rev.: n.d., Z. Hroudová), Ribarnika locality, Plovdiv Province, 42.2370°, 24.7616°, 175 m, LG17
5. SO 8963 (mixed with *B. glaucus*), 25 Jul 1929, D. Yordanov (rev.: 2002-2004, Z. Hroudová), Karnobat town, Burgas Province, 42.6696°, 26.9678°, 170 m, MH92
6. SOM 8594, 09 Jul 1901, A. Yavashev (rev.: 2004, Z. Hroudová), Shabla town, Dobrich Province, 43.5625°, 28.5906°, 2 m, PJ22
7. SOA 58680, 14 Oct 2001, I. Cheschmedzhiev (rev.: 26 Sep 2023, G. Kunev), Maritsa river, Plovdiv town, 42.1553°, 24.7581°, 155 m, LG16
8. SOA 58685, 06 Jul 2002, I. Cheschmedzhiev (rev.: 26 Sep 2023, G. Kunev), Maritsa river, Plovdiv town, 42.1553°, 24.7581°, 155 m, LG16
9. SOA 43391; 43392, 26 Aug 1985, I. Cheschmedzhiev (rev.: 26 Sep 2023, G. Kunev), ricefields at Graf Ignatievo village, Maritsa Municipality, 42.2942°, 24.7621°, 190 m, LG18
- 10.SOM 159873, 02 Jun 1984, M. Stoeva (rev.: 18 May 2023, G. Kunev), Chernilica marsh, Dekov village, Belene Municipality, 43.6099°, 25.1476°, 21 m, LJ53
- 11.BNHM 1910, 14 Oct 2023, G. Kunev, Brezovo town, along the West shores of Brezovo Reservoir, 42.3641°, 25.0621°, 260 m, LG49
- 12.BNHM 1911, 14 Oct 2023, G. Kunev, Viden village, Pavel Banya Municipality, along Tundzha River, floodplain near the village, 42.6088°, 25.2411°, 385 m, LH51

Appendix B

List of field samples of *Bolboschoenus* spp. collected in Bulgaria. For all listed records sample No (e.g. S1, S15, etc.), collection date, locality, habitat notes, coordinates, altitude, and UTM quadrant code are given.

B. glaucus

- S1: 24 Nov 2022, Sadovo village, Hadzhidimovo Municipality, reservoir, 41.4975°, 23.8080°, 570 m, GL39
- S3: 20 Aug 2022, Hisarlaka locality, Belene Municipality, river bank, 43.6815°, 25.0976°, 18 m, LJ43

- S4:** 30 Dec 2022, 03 Jul 2021, Strumyani village, Blagoevgrad Province, river bank, 41.6255°, 23.2138°, 125 m, FM81
- S5:** 05 Oct 2021, Tatarevo village, Mineralni bani Municipality, reservoir, 41.9314°, 25.4091°, 240 m, LG64
- S12:** 09 Oct 2022, 26 Sep 2023, Trud village, Maritsa Municipality, ricefield, 42.2534°, 24.7444°, 185 m, LG18
- S14:** 09 Oct 2022, 07 Aug 2023, Belozem village, Rakovski Municipality, floodplain near ricefields, 42.1809°, 25.0307°, 140 m, LG37
- S15:** 28 Sep 2021, 23 Sep 2023, Damyanitsa village, Sandanski Municipality, river bank, 41.5163°, 23.2583°, 100 m, FL89
- S17:** 20 Nov 2022, 15 Oct 2023, Svilengrad town, damp depression, 41.7627°, 26.1651°, 50 m, MG32
- S19:** 22 Nov 2022, Obnova village, Levski Municipality, reservoir, 43.4407°, 24.9677°, 60 m, LJ31
- S23:** 24 Jul 2023, Hadzhidimovo town, Blagoevgrad Province, gravel pit, 41.5277°, 23.8665°, 460 m, GM30
- S24:** 24 Jul 2023, Ablanitsa village, Hadzhidimovo Municipality, reservoir, 41.5475°, 23.9241°, 690 m, GM40
- S25:** 23 Jul 2023, Ribnik village, Petrich Municipality, river bank, 41.4890°, 23.2641°, 90 m, FL89
- S26:** 23 Jul 2023, Marikostinovo village, Petrich Municipality, salt marsh, 41.4378°, 23.3173°, 80 m, FL98
- S27:** 28 Sep 2023, Marikostinovo village, Petrich Municipality, reservoir, 41.4453°, 23.3126°, 100 m, FL99
- S28:** 03 Aug 2023, Nivyanin village, Borovan Municipality, reservoir, 43.3914°, 23.7935°, 190 m, GP20
- S36:** 04 Aug 2023, Archar village, Dimovo Municipality, Danube River, 43.8203°, 22.9131°, 33 m, FP55
- S40:** 01 Aug 2023, Balgarene village, Levski Municipality, moist depression next to crop-field, 43.4448°, 25.0560°, 45 m, LJ41
- S41:** 01 Aug 2023, Hisarlaka locality, Belene Municipality, Danube River, 43.6810°, 25.1001°, 18 m, LJ43
- S42:** 01 Aug 2023, Nikopol town, Danube River, 43.7075°, 24.8954°, 22 m, LJ34
- S43:** 08 Aug 2023, Shkorpilovtsi village, Dolni Chiflik Municipality, 42.9594°, 27.8962°, 1 m, NH75
- S44:** 07 Aug 2023, 'Bezdannata yama' reservoir, Rakovski Municipality, 42.2196°, 25.0782°, 150 m, LG47
- S45:** 07 Aug 2023, Rakovski Municipality, salt meadows near Belozem village, 42.2171°, 25.0603°, 150 m, LG37
- S46:** 07 Aug 2023, Rakovski Municipality, 'Bolyarino' Reservoir, 42.2568°, 25.0499°, 170 m, LG38
- S47:** 07 Aug 2023, Rakovski Municipality, depression next to crop-fields, 42.2560°, 25.0585°, 170 m, LG38
- S48:** 07 Aug 2023, Yastrebovo village, Opan Municipality, reservoir, 42.2710°, 25.6676°, 165 m, LG98
- S50:** 07 Aug 2023, Mednikarovo village, Galabovo Municipality, floodplain at Sokolitsa River, next to crop-fields, 42.1330°, 25.9858°, 125 m, MG16
- S51:** 07 Aug 2023, close to Radetski village, Nova Zagora Municipality, temporary wet depression between crop-fields, 42.2800°, 26.1257°, 138 m, MG28
- S52:** 07 Aug 2023, Roza village, Tundzha Municipality, reservoir, 42.3875°, 26.3956°, 135 m, MG59
- S56:** 12 Aug 2023, Disevitsa village, Pleven Municipality, gravel pits, 43.4054°, 24.5145°, 60 m, KJ90

- S57:** 12 Aug 2023, Chelnik village, Tundzha Municipality, reservoir, 42.4038°, 26.6873°, 180 m, MG79
- S61:** 09 Aug 2023, 'Mandra' Reservoir, Kameno Municipality, 42.4187°, 27.3391°, 5 m, NG29
- S65:** 09 Aug 2023, Mogila village, Tundzha Municipality, 42.4954°, 26.6006°, 160 m, MH60
- S69:** 30 Aug 2023, Ravadinovo village, Sozopol Municipality, reservoir, 42.4218°, 27.6260°, 22 m, NG59
- S74:** 02 Sep 2023, Trankovo village, Radnevo Municipality, floodplain at Dunda River, 42.2896°, 25.8260°, 130 m, MG08
- S76:** 02 Sep 2023, Kirilovo village, Elhovo Municipality, reservoir, 42.2205°, 26.6409°, 130 m, MG77
- S77:** 02 Sep 2023, Kirilovo village, Elhovo Municipality, reservoir, 42.2187°, 26.6267°, 140 m, MG67
- S82:** 02 Sep 2023, 'Ovcharica' Reservoir, Tundzha Municipality, 42.2740°, 26.2212°, 135 m, MG38
- S83:** 02 Sep 2023. General Toshevo village, Tundzha Municipality, 42.2419°, 26.2972°, 225 m, MG47
- S84:** 02 Sep 2023, Izgrev village, Elhovo Municipality, 42.1722°, 26.5032°, 120 m, MG56
- S85:** 02 Sep 2023, Elhovo town, near Tundzha river, 42.1783°, 26.5539°, 100 m, MG66
- S86:** 02 Sep 2023, Elhovo town, near Tundzha river, 42.1744°, 26.5558°, 95 m, MG66
- S87:** 26 Sep 2023, Staro Zhelezare village, Hisarya Municipality, 42.4544°, 24.6614°, 290 m, LH00
- S88:** 30 Sep 2023, 'Logodazh' reservoir, Blagoevgrad Municipality, 41.9896°, 22.9556°, 610 m, FM65
- S89:** 07 Oct 2023, Svrazhen HPP, Iskar River, Svoge Municipality, 43.0957°, 23.4232°, 350 m, FN97
- S90:** 11 Oct 2023, 'Arkata' reservoir, Gorna Dikanya village, Radomir Municipality, 42.4277°, 23.1476°, 710 m, FM79
- S91:** 15 Oct 2023, Mezek village, Svilengrad Municipality, reservoir, 41.7586°, 26.0984°, 105 m, MG22
- S92:** 15 Oct 2023, Mezek village, Svilengrad Municipality, reservoir, 41.7514°, 26.0870°, 125 m, MG22
- S93:** 15 Oct 2023, Svilengrad town, reservoir, 41.7817°, 26.1283°, 65 m, MG22
- S94:** 15 Oct 2023, Trankovo village, Elhovo Municipality, reservoir, 42.2253°, 26.5442°, 130 m, MG67
- S95:** 15 Oct 2023, Trankovo village, Elhovo Municipality, roadside ditch, 42.2052°, 26.5517°, 105 m, MG67
- S97:** 14 Oct 2023, Tvarditsa town, reservoir, 42.6840°, 25.9155°, 325 m, MH12
- S100:** 14 Oct 2023, 'Brezovo' Reservoir, Brezovo town, 42.3647°, 25.0615°, 260 m, LG49
- S101:** 14 Oct 2023, W from Brezovo town, temporary wet depression between crop-fields, 42.3543°, 25.0555°, 255 m, LG39
- S102:** 14 Oct 2023, W from Brezovo town, reservoir, 42.3535°, 25.0425°, 230 m, LG39
- S103:** 14 Oct 2023, Otets Kirilovo village, Brezovo Municipality, reservoir, 42.3311°, 25.0027°, 223 m, LG38
- S104:** 15 Oct 2023, General Inzovo village, Tundzha Municipality, Kalnitsa River, 42.3306°, 26.4242°, 130 m, MG58
- S108:** 14 Oct 2023, Nikolaevo town, Stara Zagora Province, fishponds, 42.6311°, 25.8191°, 265 m, MH02
- S109:** 14 Oct 2023, Nikolaevo town, under the floodgates at Tundzha River, 42.6323°, 25.8229°, 265 m, MH02

B. laticarpus

S59: 09 Aug 2023, Konstantinovo vilage, Kameno Municipality, Rusokastrenska River, 42.4075°, 27.3094°, 5 m, NG29

B. maritimus

S13: 09 Sep 2022, Obzor town, at the mouth of Dvoynitsa River, 42.8275°, 27.8827°, 1 m, NH74

S16: 05 Oct 2022, Pomorie salt pans, 42.6173°, 27.6253°, 2 m, NH51

S21: 11 Dec 2022, Negovan vilage, Lesnovska River, 42.7674°, 23.4016°, 510 m, FN93

S49: 07 Aug 2023, Yastrebovo village, Opan Municipality, reservoir, 42.2710°, 25.6676°, 165 m, LG98

S53: 07 Aug 2023, Roza village, Tundzha Municipality, reservoir, 42.3875°, 26.3956°, 135 m, MG59

S58: 12 Aug 2023, Voynika village, Straldzha Municipality, reservoir, 42.3871°, 26.8014°, 200 m, MG89

S60: 09 Aug 2023, Atanasovsko ezero, Burgas Province, 42.5298°, 27.4708°, 0 m, NH30

S62: 08 Aug 2023, BG0002046 'Yatata' PA, Beloslav town, 43.1912°, 27.7302°, 0 m, NH58

S63: 09 Aug 2023, Irakli locality, mouth of Vaya River, 42.7502°, 27.8885°, 1 m, NH73

S67: 30 Aug 2023, 'Gradina' Camping, Sozopol Municipality, 42.4088°, 27.6685°, 1 m, NG59

S68: 30 Aug 2023, Ravadinovo village, Sozopol Municipality, reservoir, 42.4218°, 27.6260°, 22 m, NG59

S70: 31 Aug 2023, Ravadinovo village, Sozopol Municipality, reservoir, 42.3597°, 27.6856°, 25 m, NG58

S71: 31 Aug 2023, Primorsko town, Burgas Province, 42.2814°, 27.7449°, 5 m, NG68

S72: 31 Aug 2023, Primorsko town, Dyavolska River, 42.2588°, 27.7311°, 5 m, NG67

S73: 31 Aug 2023, Kiten town, Uzunchairska River, 42.2243°, 27.7424°, 8 m, NG67

S75: 01 Sep 2023, Nedyalsko village, Straldzha Municipality, reservoir, 42.4704°, 26.8194°, 215 m, MH80

S78: 31 Aug 2023, Butamyata Beach, Sinemorets village, 42.0537°, 27.9860°, 1 m, NG85

S79: 31 Aug 2023, Sinemorets village, mouth of Veleka River, 42.0653°, 27.9734°, 3 m, NG85

S80: 31 Aug 2023, Stavro Bay, Varvara village, 42.1347°, 27.8978°, 1 m, NG76

S81: 31 Aug 2023, Velika village, Tsarevo Municipality, reservoir, 42.1896°, 27.8063°, 24 m, NG67

S96: 14 Oct 2023, Slivenski Mineralni Bani balneology resort, 42.6074°, 26.2338°, 160 m, MH31

S105: 15 Oct 2023, General Inzovo village, Tundzha Municipality, Kalnitsa River, 42.3306°, 26.4242°, 130 m, MG58

S106: 15 Oct 2023, Tenevo village, Tundzha River, oxbol lake, 42.3702°, 26.5233°, 115 m, MG69

S107: 15 Oct 2023, Tenevo village, Tundzha Municipality, 42.3541°, 26.5306°, 115 m, MG68

B. planiculmis

S6: 18 Aug 2020, Trud village, Maritsa Municipality, fish pond, 42.2538°, 24.7501°, 180 m, LG18

S7: 18 Aug 2020, Belozem village, Rakovski Municipality, floodplain near ricefields, 42.1809°, 25.0307°, 140 m, LG37

S8: 05 Oct 2020, Drenov dol village, Kyustendil Municipality, reservoir, 42.3034°, 22.6834°, 540 m, FM38

S9: 12 Oct 2019, Tsalapitsa village, Rodopi Municipality, ricefield margin, 42.2130°, 24.5309°, 195 m, KG97

S10: 27 Nov 2022, Gorni Dabnik Reservoir, Dolni Dabnik Municipality, 43.3488°, 24.3375°, 170 m, KJ80

S11: Oct 2022, 'Izvor' Reservoir, Radomir Municipality, 42.4196°, 22.8713°, 690 m, FM59

- S18:** 19 Nov 2022, 'Sinyata reka' Reservoir near Hisarya town, 42.4759°, 24.7055°, 300 m, LH10
- S20:** 22 Nov 2022, Obnova village, Levski Municipality, reservoir, 43.4407°, 24.9677°, 60 m, LJ31
- S22:** 27 Nov 2022, Aglen village, Lukovit Municipality, 'Vit' River, 43.1689°, 24.2955°, 175 m, KH88
- S29:** 03 Aug 2023, Nivyanin village, Borovan Municipality, reservoir, 43.3914°, 23.7935°, 190 m, GP20
- S30:** 03 Aug 2023, Mramoren village, Vratsa Municipality, 'Mramorchitsa' Reservoir, 43.2956°, 23.6895°, 250 m, GN19
- S31:** 03 Aug 2023, Varbeshnitsa village, Mezdra Municipality, reservoir, 43.1862°, 23.6860°, 280 m, GN18
- S32:** 03 Aug 2023, 'Dabnika' Reservoir, Vratsa town, 43.1988°, 23.5921°, 340 m, GN18
- S33:** 03 Aug 2023, Tarnava village, Byala Slatina Municipality, fish ponds, 43.4942°, 23.8848°, 110 m, GP31
- S34:** 03 Aug 2023, Rogozen village, Hayredin Municipality, reservoir, 43.5239°, 23.7248°, 125 m, GP22
- S35:** 03 Aug 2023, Septemvriyski village, Valchedram Municipality, reservoir, 43.5988°, 23.5480°, 90 m, GP03
- S37:** 04 Aug 2023, Archar village, Dimovo Municipality, Danube River, 43.8212°, 22.9117°, 29 m, FP55
- S38:** 04 Aug 2023, Rasovo village, Medkovets Municipality, 'Yaza' Reservoir, 43.7131°, 23.2464°, 125 m, FP84
- S39:** 04 Aug 2023, Rasovo village, Medkovets Municipality, reservoir, 43.7075°, 23.2363°, 130 m, FP84
- S54:** 12 Aug 2023, Bivolare village, Dolna Mitropoliya Municipality, gravel pit, 43.4814°, 24.5505°, 45 m, LJ01
- S55:** 12 Aug 2023, Riben village, Dolna Mitropoliya Municipality, banks of 'Vit' River, 43.5343°, 24.6161°, 35 m, LJ02
- S64:** 08 Aug 2023, Plachidol village, Dobrichka Municipality, reservoir, 43.5513°, 27.8848°, 240 m, NJ72
- S98:** 14 Oct 2023, Viden village, Pavel Banya Municipality, river bank, 42.6089°, 25.2409°, 385 m, LH51
- S99:** 14 Oct 2023, 'Brezovo' Reservoir, Brezovo town, 42.3665°, 25.0604°, 260 m, LG49

References

- [1] Kuzmanov B and Kozhuharov S 1964 *Bolboshoenus* Palla *Flora Reipublicae Popularis Bulgaricae* (vol 2) ed D Jordanov (Serdicae: In Aedibus Academiae Scientiarum Bulgaricae) pp 54–57
- [2] DeFilipps R A 1980 *Scirpus* L *Flora Europaea* (vol 5) eds Tutin et al (Cambridge: Cambridge University Press) pp 277–280
- [3] POWO Plants of the World Online Facilitated by the Royal Botanic Gardens Kew <http://www.plantsoftheworldonline.org/> Accessed December 2023
- [4] Jiménez-Mejías P and Luceño M 2023 *Cyperaceae* Euro+Med Plantbase the information resource for Euro-Mediterranean plant diversity <https://euoplusmed.org/> Accessed December 2023
- [5] Hroudová Z, Zákravský P, Ducháček M and Marhold K 2007 *Ann. Bot. Fennici* **44** 81102
- [6] Nikolić D, Gocić D J, Jušković M and Randelović V 2020 *Plant Biosystems* **154** 488502
- [7] Di Natale S, Lastrucci L, Hroudová Z and Viciani D 2022 *Plant Biosystems* **156** 261270
- [8] Simons E, Haveman R and Kleyheeg E 2016 *Gorteria* **38** 189223
- [9] Amini Rad M, Hroudová Z and Marhold K 2010 *Nord. J. Bot.* **28** 588602
- [10] Rumsey F J, Crouch H J, Lansdown R V and Spencer M A 2019 *British & Irish Botany* **1** 91106

- [11] Browning J, Gordon-Gray K D, Smith S G and van Staden J 1998 *Nord. J. Bot.* **18** 475482
- [12] Egorova T V and Tatanov I V 2003 *Bot. Zhurn.* **88** 131142
- [13] Thiers B 2023 Index Herbariorum A Global Directory of Public Herbaria and Associated Staff New York Botanical Garden's Virtual Herbarium <https://sweetgum.nybg.org/science/ih/> Accessed December 2023
- [14] Assyov B, Petrova A, Dimitrov D and Vassilev R 2012 *Conspectus of the Bulgarian Vascular Flora Distribution Maps and Floristic Elements* ed 4 (Sofia: Bulgarian Biodiversity Foundation) p 489
- [15] Petrova A and Vladimirov V 2018 *Bot. Serb.* **42** 3569
- [16] Stoyanov K, Raycheva Ts and Cheschmedzhiev I 2022 *Key to the native and foreign vascular plants in Bulgaria Interactive extended and supplemented edition* (Plovdiv: Academic Publishing House of the Agrarian University) <https://botanica.gallery/wp/archives/21117>
- [17] Tzonev R and Gushev C 2021 *Halophytic Vegetation in Bulgaria* ed M N Grigore Handbook of Halophytes (Cham: Springer) chapter pp 239–261 https://doi.org/10.1007/978-3-030-57635-6_8
- [18] Apostolova I 2023 *Phytologia Balcanica* **29** 225258
- [19] *Bolboschoenus* (Asch.) Palla in GBIF Secretariat 2023 GBIF Backbone Taxonomy Checklist dataset <https://doi.org/10.15468/39omei> Accessed December 2023
- [20] JACQ database <https://www.jacq.org/#database> Accessed December 2023
- [21] Braun-Blanquet J 1964 *Pflanzensoziologie Grundzüge der Vegetationskunde* 3 ed (Verlag, Wien: Springer) p 865
- [22] Westhoff V and van der Maarel E 1980 *The Braun-Blanquet Approach* eds R H Whittaker *Classification of Plant Communities* vol 5 (Dordrecht: Springer) chapter pp 289–399 https://doi.org/10.1007/978-94-009-9183-5_9
- [23] Hroudová Z, Hrivnák R and Chytrý M 2009 *Phytocoenologia* **39** 205215
- [24] Lastrucci L, Ferretti G, Mantarano N and Foggi B 2019 *Plant Sociology* **56** 1930
- [25] Nowak A, Nowak S and Nobis M 2014 *Pak. J. Bot.* **46** 2764
- [26] An Y, Gao Y and Tong S 2018 *Aquatic Botany* **148** 1014