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Original Scientific Paper

Three *Sphagnum* taxa new to Turkey and South-West Asia

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ABSTRACT:
Sphagnum jensenii, *S. fallax* var. *isoviitae*, and *S. pylaesii* were found as new to Turkey and Southwest Asia following a bryological field trip to the Giresun province of Turkey. *Sphagnum fallax* var. *isoviitae* was also new to Asia. Descriptions, illustrations, world distribution, ecology, and comparisons with related species are presented.

Keywords:
biodiversity, Bryophyte, peat mosses, new record

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INTRODUCTION

There are three floristic regions in Turkey: the Mediterranean, Irano-Turanian, and Euro-Siberian regions. Euro-Siberian floristic elements are particularly dominant in the north of Turkey, namely the Black Sea region (Akman 1995). Because of the moist climate, this region supports the largest parts of the expansive forest in Turkey (Papp 2004). There are numerous blanket bog and plane bog areas, thus providing opportunities for the diversity and growth of *Sphagnum* species. The eastern Black Sea region including the Giresun province (Fig. 1), where peatlands, bogs, blanket bogs, fens, swamps, and flushes are the most common, offers many possibilities for the growth of *Sphagnum* mosses.

The total number of *Sphagnum* species worldwide is estimated to be between 150 and 450 (Michaelis 2019). In Europe, the number of *Sphagnum* species is ± 60 (Laine *et al*. 2018). The number of taxa belonging to the genus *Sphagnum* in Turkey has increased to 27 with the most recent studies (Özdemir & Çetin 1999; Abay *et al*. 2009; Kirmaci & Kürschner 2013; Tonguç Yayintaş 2013; Abay & Keçeli 2014; Özdemir & Batan 2016; Abay 2017; Ellis *et al*. 2017, 2019a, b, 2021; Ören *et al*. 2017; Erata & Batan 2020; Erata *et al*. 2021). It is known that 26 of these taxa [namely *Sphagnum angustifolium* (Warnst.) C.E.O. Jensen, *S. auriculatum* Schimp., *S. capillifolium* (Ehrh.) Hedw., *S. centrale* C.E.O. Jensen, *S. compactum* Lam. & DC., *S. contortum* K.F. Schultz, *S. cuspidatum* Ehrh. ex Hoffm., *S. divinum* Flatberg & Hassel, *S. fallax* (H. Klinggr.) H. Klinggr., *S. fimbriatum* Wilson, *S. fuscum* (Schimp.) H. Klinggr., *S. girgensohnii* Russow, *S. inundatum* Russow, *S. medium* Limpr. *S. molle* Sull., *S. palustre* L., *S. papillosum* Lindb., *S. platyphyllum* (Lindb. ex Braithw.) Warnst., *S. rubellum* Wilson, *S. squarrosum* Crome, *S. subfulvum* Sjörs, *S. subsecundum* Nees, S. *tenellum* (Brid.) Brid., *S. teres* (Schimp.) Ångstr., *S. warnstorfii* Russow, and S. *quinquefarium* (Braithw.) Warnst] are distributed in the eastern Black Sea region of Turkey (Schiffner 1896; Handel-Mazzetti 1909; Robinson & Godfrey 1960; Henderson 1961a, b; Henderson & Prentice 1969; Özdemir & Çetin 1999; Payne *et al*. 2007; Abay *et al*. 2009, 2016; Özdemir 2009; Kirmaci & Kürschner 2013; Abay & Keçeli 2014; Özdemir & Batan 2016; Ellis *et al*. 2019a, b, 2021; Kirmaci *et al*. 2019; Erata *et al*. 2021).

MATERIAL AND METHODS

The field trip to the Giresun province was undertaken in different localities in 2019 and many *Sphagnum* samples were collected from this area by the authors. The *Sphagnum* specimens were examined with a stereomicroscope and light microscope. Some microscopic properties of the *Sphagnum* specimens were investigated using methylene blue water solution. The identification of the samples was made based on the relevant literature. (Crum & Anderson 1981; Ireland 1982; Chien *et al.* 1999; Smith 2004; Frey *et al.* 2006; Laine *et al.* 2018). The status of the new records for Southwest Asia and Turkey was evaluated using the relevant literature (Ros *et al.* 2013; Kürschner & Frey 2020).

The bryophyte voucher specimens were kept in the private bryophyte collections of the first author (Özen-Öztürk), in the Department of Biology, Karadeniz Technical University (Trabzon, Turkey).

RESULTS

Sphagnum jensenii H. Lind. (Fig. 2)

Specimens examined: TURKEY, Giresun: Dereli district, Şıh high plateau-2, mesotrophic mire, wet hollows and near the water table level, N 40°31'45", E 38°29'07", 1980 m, 13 September 2019, leg. N. Batan and H. Erata, Özen-Öztürk 512, det. Ö. Özen Öztürk and N. Batan, conf. Dr. Harri Vasander.

Plant medium-sized, robust, 10–15 cm tall, whitish green, green-brown, but generally brownish. The capitula is often brown. The terminal bud is variably visible. The stem is pale and quite thin, yellowish. The stem leaves are small, concave, lingulate-triangular, their apex obtuse to rounded. The hyaline cells of the stem leaves are not divided and are fibrillose at the leaf apex. The fascicle has branches, of which two are divergent and two pendent. The two divergent branches are long, and thick. The branch leaves are imbricate, narrowly ovate-lanceolate, and twice as long as the stem dentate apex. The hyaline cells are linear-rhomboidal, and densely fibrillose.

Sphagnum jensenii belongs to the section *Cuspidata*. *Sphagnum jensenii* and is somewhat similar to *S. annulatum* H. Lindb. ex Warnst. and *S. balticum* (Russow) C.E.O.Jensen, but differs in terms of longer spreading branches, and the branch leaves. Also, in *S. jensenii* the stem cortex is differentiated, and the small pores on the convex side of the leaf are more likely to be distributed in 1 rather than in 2 rows (Laine *et al.* 2018).

Ecology: *Sphagnum jensenii* grows in open wet, and mesotrophic mires floating or partially submerged in the ponds or hollows of string fens (Dierssen 2001). This species is a widespread fen species and is abundant in the north (Laine *et al.* 2011). It prefers open habitats and commonly occurs in association with *S. majus*. It may also be found with *S. lindbergii* Schimp., *S. riparium* Ångstr. or *S. annulatum* (Daniels & Eddy 1985).

Sphagnum jensenii was collected in the eastern Black Sea region, in alpine meadows, and open, wet, and carpet habitats together with *S. fallax*.

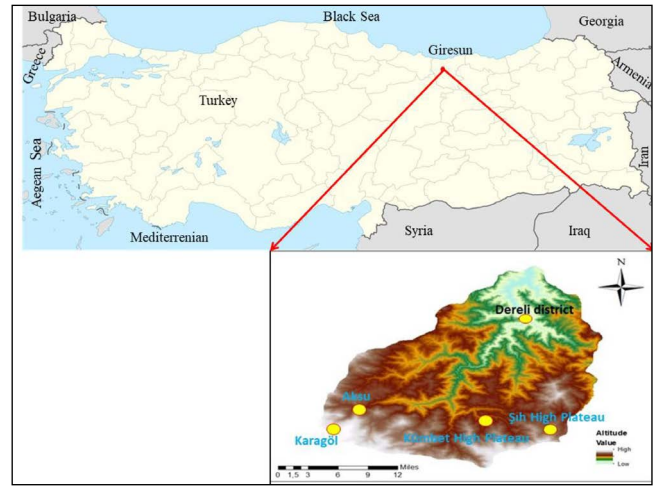

Fig. 1 Map of the research area.

Distribution: Asia (the Philippines, China, Yakutia, Siberia, the Russian Far East, Arctic Russia, Central Russia, Middle NE Russia, the Southern Urals, the Sub-polar & Northern Urals, Eastern Asia and North Asia), Europe (Finland, Norway, Sweden, Poland, Romania, Belarus, Estonia, Latvia, Lithuania, Macaronesia, W. Russia, East Europe, and the Baltic countries), and the Americas (Subarctic America, Western Canada, Eastern Canada, North-western USA, North-eastern USA) (Bastien & Garneau 1997; Hill *et al.* 2006; Ignatov *et al.* 2006; Sabovljević *et al.* 2008; Séneca & Söderström 2009; Hodgetts 2015; Tan *et al.* 2018; Hodgetts *et al.* 2020).

Sphagnum fallax* var. *isoviitae (Flatberg) Lönnell & Hassel (Syn: ***Sphagnum isoviitae*** Flatberg) (Fig. 3)

Specimens examined: TURKEY, Giresun: Dereli district, Şıh high plateau-3, alpine meadow, in the water, N 40°31'17", E 38°29'29", 2050 m, 13 September 2019, leg. N. Batan and H. Erata, Özen-Öztürk 513, det. Ö. Özen Öztürk and N. Batan, conf. Dr. Harri Vasander.

Plant middle-sized, erect, capitulum flat, brown, 5-radiate. The stem is yellowish-green, differentiated. The stem leaves are acute apiculate, wider than long. The hyaline cells of the stem leaves are non-septate and mostly without fibrils. The branches are in fascicles of 4–5, of which 2 are divergent and 2–3 pendent. The branch leaves are

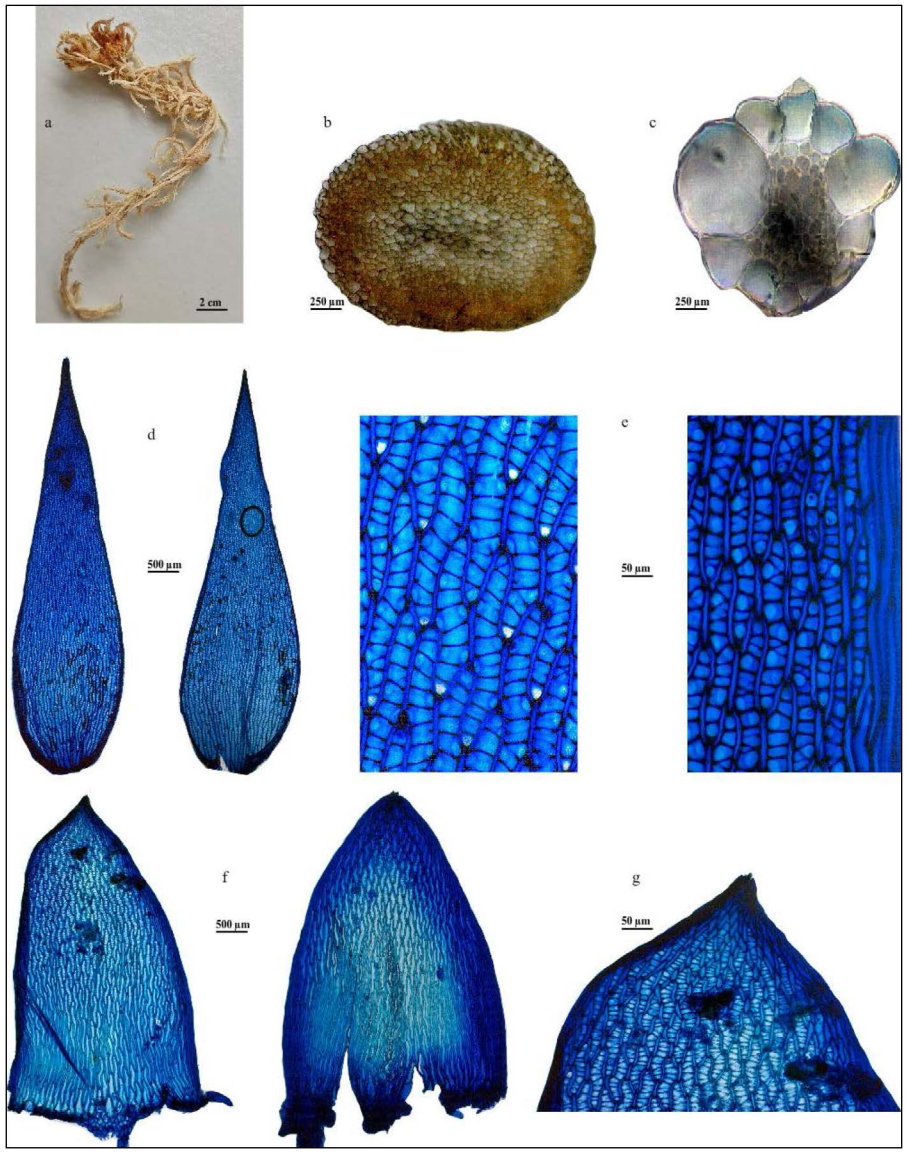

Fig. 2 *Sphagnum jensenii* H. Lind.: (a) Gametophyte; (b) Cross section of the stem; (c) Cross section of the branch stem; (d) Branch leaves; (e) Branch leaf cells from the convex surface; (f) Stem leaves; (g) Stem leaf; the hyaline cells are fibrillous at the apex.

straight and strongly 5-ranked, narrowly ovate-lanceolate, not recurved.

In Europe, *Sphagnum fallax* var. *isoviitae* Flatberg has recently been described as an additional member of the *S. recurvum* complex (Flatberg 1992). *Sphagnum fallax* var. *isoviitae* belongs to the section *Cuspidata* and the *S. recurvum* complex along with *S. fallax* var. *brevifolium* (Lindb. ex Braithw.) Lönnell & Hassel. *S. fallax* var. *isoviitae* is quite similar to *S. fallax* var. *fallax* and *S. fallax* var. *brevifolium* (Lindb. ex Braithw.) Lönnell & Hassel. *S. fallax* var. *isoviitae* has a differentiated stem cortex, whereas *S. fallax* var. *fallax* has an undifferentiated cortex. Also, *S. fallax* var. *isoviitae* has a flat and brown capitulum, whereas that of *S. fallax* var. *fallax* is pale and convex. The capitulum of *S. fallax* var. *isoviitae* is 5-radiate, while in *S. fallax* var. *brevifolium* it is absent (Laine *et al.* 2018).

Ecology: *S. fallax* var. *isoviitae* grows in carpets in a wide variety of poor to medium rich fen habitats (Laine *et al.* 2018). It also grows in mesotrophic, and usually soligenous mires (Frey *et al.* 2006).

Sphagnum fallax var. *isoviitae* was collected in the eastern Black Sea region, in alpine meadows, carpet habitats, and on mire edges. The accompanying species were *Sphagnum fallax* var. *fallax*, *S. subsecundum* Ness and *Chiloscyphus polyanthos* (L.) Corda.

Distribution: Europe (France, Norway, Sweden, Finland, Ireland, Wales, Scotland, England, southwestern and southern Fennoscandia, Estonia, Macaronesia, and Cyprus) (Frey *et al.* 2006; Hill *et al.* 2006; Garrett 2015; Laine *et al.* 2018; Hodgetts *et al.* 2020). New to Asia.

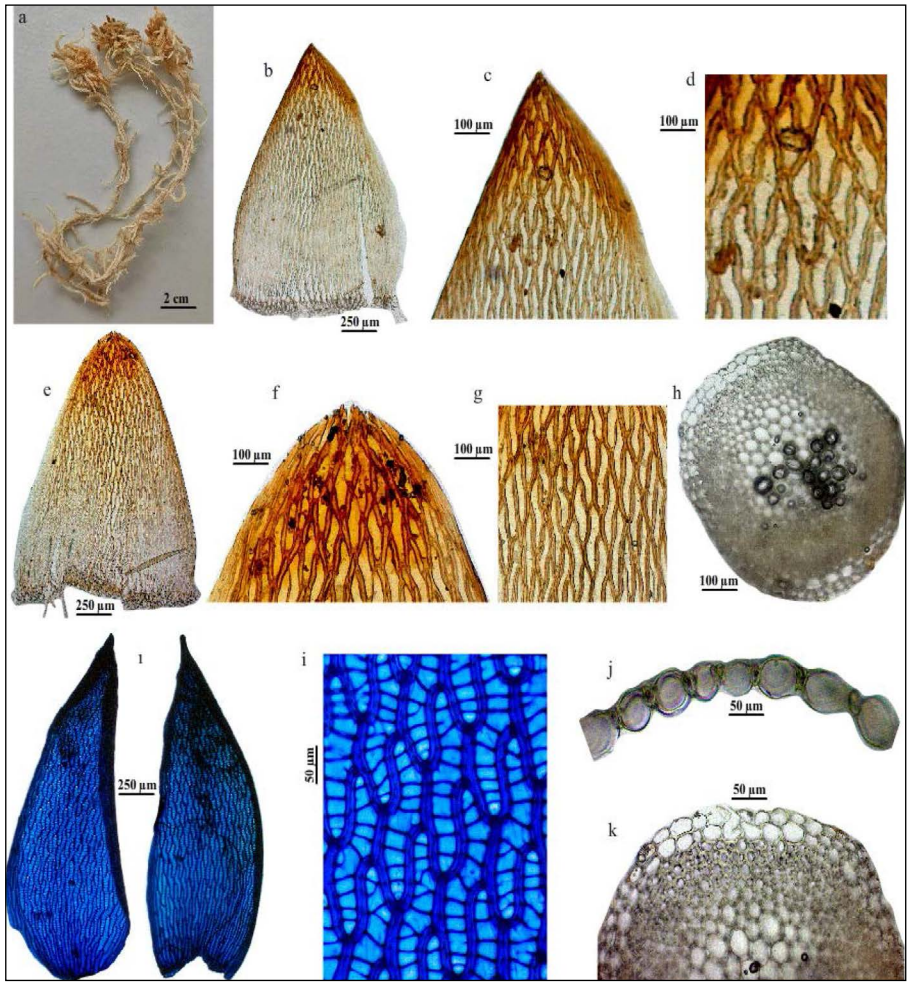

Fig. 3 *Sphagnum fallax* var. *isoviitae* (Flatberg) Lönnell & Hassel: (a) Gametophyte; (b,e) Stem leaves; (c,f) Stem leaves apex; (d) Stem leaf apex cells; (g) Stem leaf middle cells; (h,k) Cross sections of the stem; (ı) Branch leaves; (i) Branch leaf cells from the convex surface; (j) Cross section of the branch leaf.

Sphagnum pylaesii Brid. (Fig. 4)

Specimens examined: TURKEY, Giresun: Dereli district, Karagöl Mountain, Çatlak plateau, alpine meadow, in the water, N 40°31'59", E 38°11'12", 2350 m, 14 September 2019, leg. N. Batan and H. Erata, Özen-Öztürk 514, det. Ö. Özen Öztürk and N. Batan.

Plant relatively short and thin, blackish, dark brown, without capitula. The stem is almost simple, pale green to brown. The stem leaves are imbricate, large, and overlapping. Fascicles are absent or with 1 spreading branch. Branch leaves exist, on 1–2 short branches. The branch leaves lack pores and are quite similar to the stem leaves.

Sphagnum pylaesii (previously the only species in the section *Hemitheca*) is included in the section *Subsecunda* although it differs both morphologically and anatomically from the others. In the field, this species is more likely to be unobserved as a pleurocarpous moss than to be mistaken for any other species of *Sphagnum* (Daniels & Eddy 1985; Laine *et al*. 2018). It is morphologically similar to the genus *Pseudocalliergon,* but anatomically resembles *S. auriculatum* Schimp. with only a few branches. *S. pylaesii* is similar to *S. platyphyllum* (Lindb. ex Braithw.) Warnst. and *S. subsecundum* Nees. *Sphagnum pylaesii* differs from *S. platyphyllum* and *S. subsecundum* in terms of the lack of pores on the branch leaves and its colour.

Ecology: *Sphagnum pylaesii* is found in hollows subject to periodic flooding by weakly mineotrophic water or on damp marginal areas receiving runoff from moderately oligotrophic peatlands (Daniels & Eddy 1985). It also grows in weakly mineotrophic sloping fens and dry blanket mires in Europe (Laine *et al*. 2018). It was found together with the other species of the same section (Frey *et al*. 2006).

Sphagnum pylaesii was collected in the eastern Black Sea region, in alpine meadows, in bogs or poor fens, in wet habitats. The accompanying species were *Sphagnum contortum* Schultz.

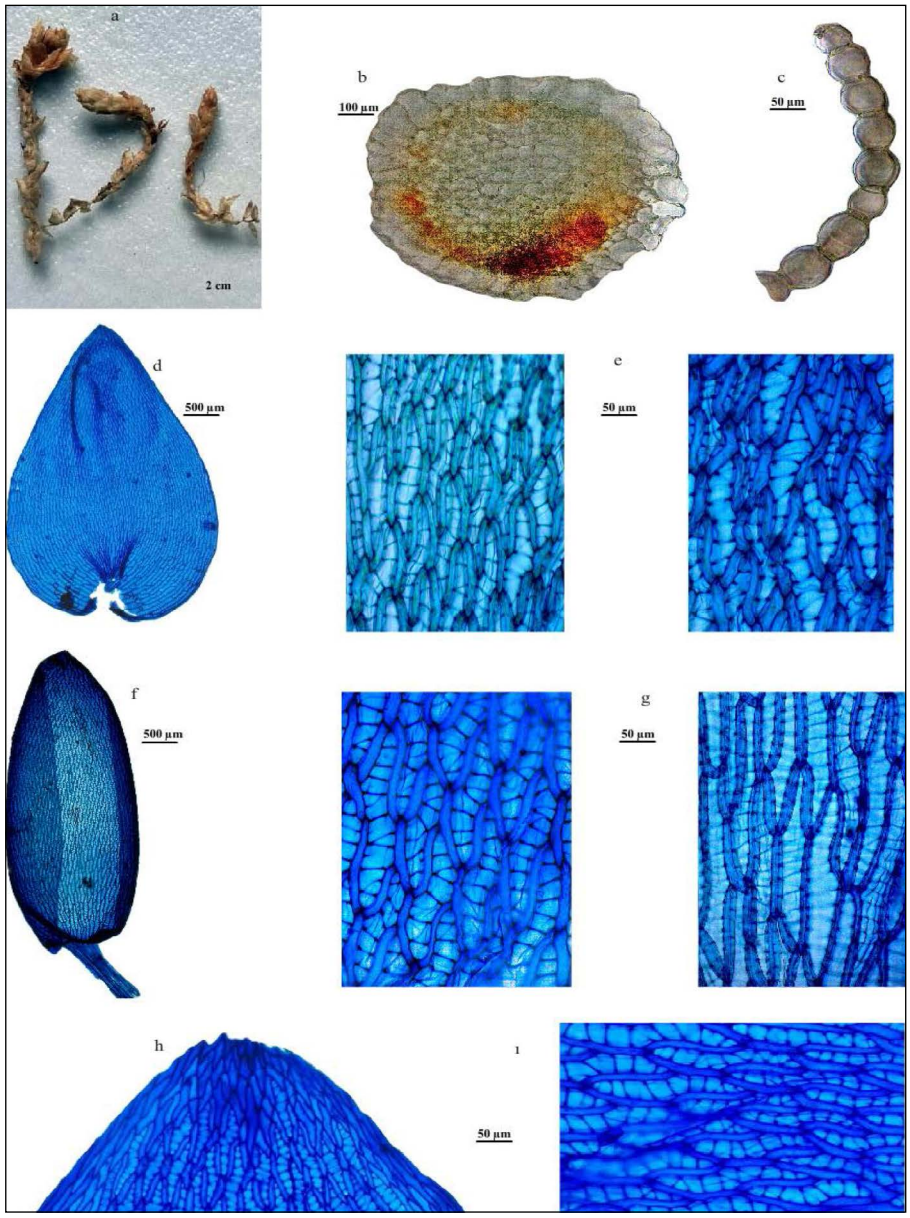

Fig. 4 *Sphagnum pylaesii* Brid.: (a) Gametophyte; (b) Cross section of stem; (c) Cross section of the stem leaf; (d,f) Stem leaves; (e) Stem leaf cells from the convex surface; (g) Stem leaf cells from the concave surface; (h) Stem leaf apex; (ı) Stem leaf apex cells.

Distribution: Europe (southwestern distribution in Europe in Portugal, Andorra, France, Spain, Brittany, Macaronesia, Cyprus, and Southern Greenland), the Americas (Eastern Canada, Northern America, and Southern America in Colombia, Ecuador, Peru, and Bolivia), and Asia (the Philippines) (Bastien & Garneau 1997; Frey *et al.* 2006; Hill *et al.* 2006; Séneca & Söderström 2009; Hodgetts 2015; Laine *et al.* 2018; Tan *et al.* 2018; Hodgetts *et al.* 2020).

The number of taxa belonging to the *Sphagnum* genus in Turkey had increased to 27 with the most recent studies. With this study, the number of taxa of the genus *Sphagnum* in Turkey rose to 30. In addition, this study makes a total of 30 taxa of *Sphagnum* found in Turkey, 29 of which were determined in the eastern Black Sea region (Kirmaci *et al.* 2022). This means that approximately 97% of the total number of *Sphagnum* taxa found in Turkey are located in this region. The genus is especially diverse in this region where it grows and actually creates peatlands, bogs, and fens in many wetland habitats.

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REZIME

Botanica SERBICA

Tri *Sphagnum* taksona nova za Tursku i jugozapadnu Aziju

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Tokom brioloških istraživanja u Giresun provinciji u Turskoj konstatovana su tri taskona nova za Tursku i jugozapadnu Aziju - *Sphagnum jensenii*, *S. fallax* var. *isoviitae*, i *S. pylaesii*. *Sphagnum fallax* var. *isoviitae* je istovremeno nov i za Aziju. Prikazani su opisi, ilustracije, distribucija u svetu, ekologija i poređenje sa srodnim vrstama.

Ključne reči: biodiverzitet, briofite, tresetne mahovine, novi nalaz