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THREE NEW RECORDS OF MOSSES FROM AZERBAIJAN

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Abstract

Splachnum ampullaceum Hedw., *Sphagnum capillifolium* (Ehrh.) Hedw., and *Plagiothecium cavifolium* (Brid.) Z. Iwats. have been reported as new for Azerbaijan, following a recent bryological expedition to the Tugay forest and Dilman forest of Azerbaijan. Of these, *Splachnum* has been recorded as new genus record for bryophyte flora of Azerbaijan. Brief descriptions, illustrations, geographic distribution, ecology and comparisons with morphologically similar species are presented.

Introduction

Zangilan District, located in southeastern Azerbaijan along the left bank of the Araz river, lies within the Lesser Caucasus Mountain range with an area 730 sq.km. It borders Gubadli to the north, Jabrayil to the east, Iran to the south (the Araz), and Armenia's Mehri and Gafan districts to the west. The area features a varied and rugged topography, consisting of mid- and low-elevation mountains. Geologically, both sedimentary and volcanic formations, particularly Jurassic and Cretaceous deposits, are widespread. Mineral resources include building stone, gold, black marble, raw lime, and limestone used in soda production (Fig. 1).

The region encompasses two climatic zones: temperate-warm and semi-desert with dry winters. Summers are hot, winters are mild and dry, with an average annual temperature of 13.3 °C (max. 41 °C, min. –21 °C). Annual rainfall averages 600 mm, while evaporation reaches 900 mm. The landscape alternates between plains, hills, and river valleys. Four major rivers, Araz, Okchuchay, Hakari, and Basitchay, flow through the district, making it the only region in Azerbaijan with four permanent rivers.

The Basitchay river basin hosts a large, ancient forest dominated by eastern plane trees (*Platanus orientalis* L.), considered the largest of its kind in Europe and second largest globally. The reserve has an asymmetrical structure: rugged terrain on the right bank and a hilly plateau (700–1000 m) on the left, underlain by alluvial deposits. Despite the dry climate, broadleaf forests are well established. The dominant plane tree species is tolerant of poor soils and extreme temperatures, including heat, frost, and drought.

Bryophytes, non-vascular plants including mosses, liverworts, and hornworts, thrive in diverse ecosystems ranging from deserts to polar regions (Cíhal, 2023). They grow on various substrates such as rocks (epilithic), soil (epigeic), water (submerged), and tree surfaces (epiphytic).

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Bryophytes include about 20,000 species in the world (Patiño and Vanderpoorten, 2018). In Azerbaijan, bryophytes are currently represented by approximately ± 504 taxa (belonging to 152 genera and 57 families (Ellis *et al*., 2021; Mammadova *et al*., 2021; Mammadova and Abiyev, 2023: Mammadova *et al*., 2024)). The bryophyte flora of Azerbaijan is little known.

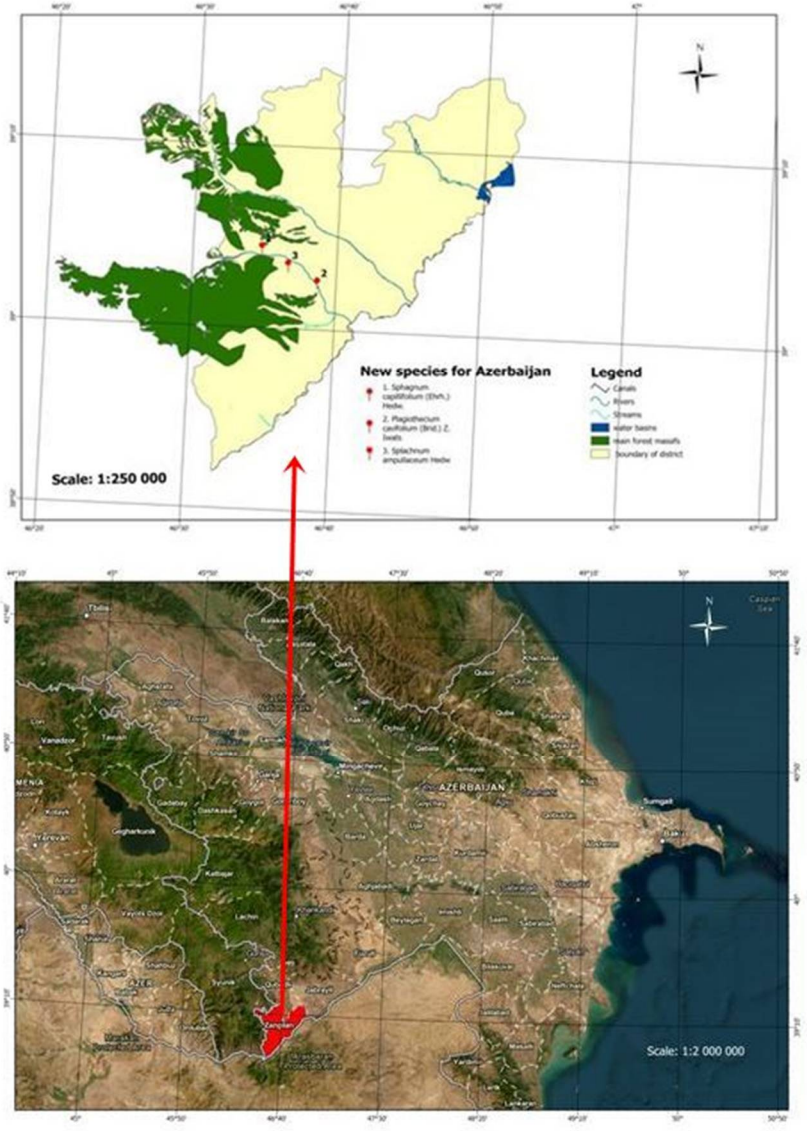

Fig. 1. Map of Reserach Area.

Material and Methods

Numerous bryophyte specimens were collected from the study area in 2024 during a bryological survey conducted in the Tugay and Dilman forests of Azerbaijan by A. Mammadova, S. Ibadullayeva and N. Sadıgova. The collected samples were examined using a Carl Zeiss Stemi 2000-C stereomicroscope and a Carl Zeiss Axio Imager A2 light microscope.

Species identification was carried out using standard literature sources (Smith, 2004; Frey *et al*., 2006; Brugués *et al*., 2007; Guerra *et al*., 2010, 2018; Lüth, 2019). The distributional status of the identified taxa in Azerbaijan was assessed through relevant national references (Ignatov *et al*., 2006; Gasimov and Novruzov, 2017; Mammadova *et al*., 2021; Mammadova and Abiyev, 2023; Hodgetts and Lockhart, 2020). Taxonomic nomenclature and synonymy follow the treatment of Hodgetts and Lockhart (2020).

Voucher specimens are deposited in the private bryophyte collection of A. Mammadova at the Institute of Botany, Azerbaijan National Academy of Sciences (Baku, Azerbaijan), and in the private collection of N. Batan at the Department of Molecular Biology and Genetics, Faculty of Science, Karadeniz Technical University (Trabzon, Türkiye).

Results

Splachnum ampullaceum Hedw. (**Fig. 2**)

Specimens examined: Azerbaijan (Baku province): Zangilan district, Tugay forest, edge of Besit stream, on wet soil 39º3'11.07" E, 46º37'14.33" N, Altitude: 652 m a. s. l., 24 June, 2022, leg. A. Mammadova, S. Ibadullayeva, det. A. Mammadova, Z.G. Köroğlu, H. Erata, N. Batan, Batan 1628.

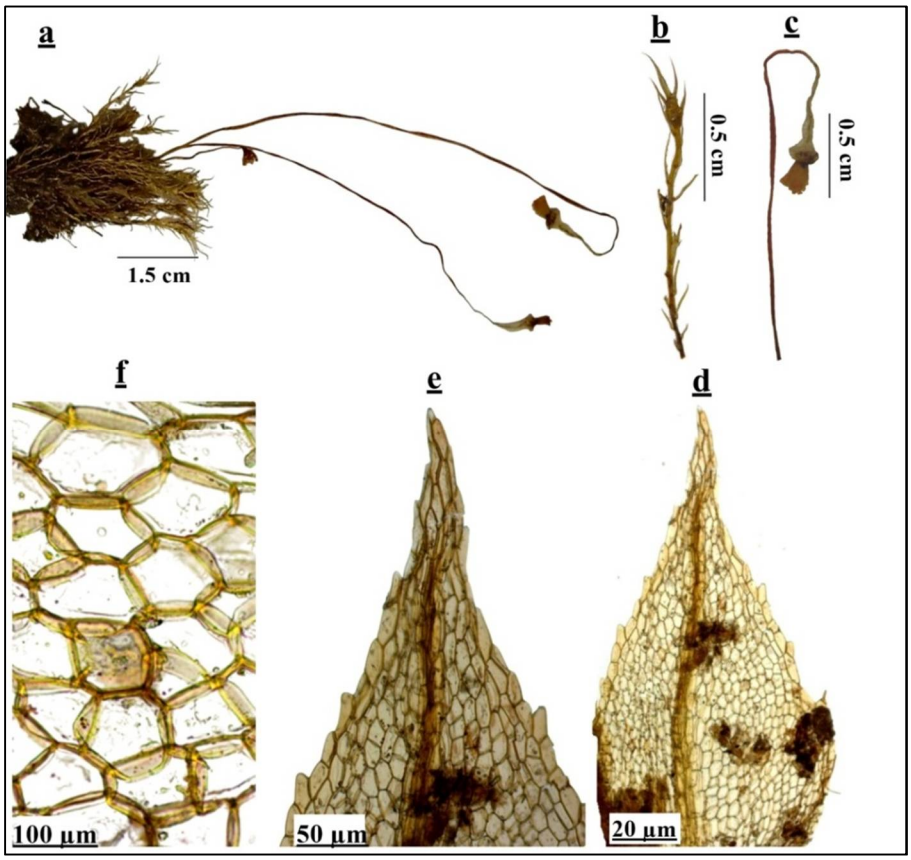

Fig. 2. *Splachnum ampullaceum* Hedw. a) Habit, b) Shoots (dry), c) Capsule, d-e) Leaves, f) Mid-leaf cells.

Plants tufts, light green or yellow-green, to 4.6 cm high. Shoots 0.8–1.24 cm long and with toothed. Leaves crowded at stem apices, 3.0 mm long and 1.1 mm wide, long-lanceolate to narrowly oblong-obovate, Leaf margins are plane at the below and roughly toothed at the upper part of the leaves. Costa ending in or below apex. Cells in mid-leaf ± hexagonal. Hypophysis (neck of capsule) yellow or pink, pyriform, 3 times as wider as urn.

Splachnum ampullaceum is similar to *Splachnum sphaericum* Hedw. but different in terms of having hypophysis pyriform, 3 times as wider as urn, and Leaf margins are plane at the below and roughly toothed at the upper part of the leaves. In contrast, *Splachnum sphaericum* has the leaves are entire or only obscurely toothed and the capsule of does not have an inflated neck. *Splachnum ampullaceum* resembles *Splachnum vasculosum* Hedw., however, the former can be distinguished from the latter by its hypophysis pyriform. The latter has hypophysis rounded.

Ecology: Splachnum ampullaceum grows on bogs on dung on wet heaths, moorland and in wet areas (Dierben, 2001; Smith, 2004). Azerbaijan specimens was collected on wet soil, Tugay forest, edge of Besit stream in Bakü province. It is associated with *Diplophyllum taxifolium* (Wahlenb.) Dumort., *Solenostoma sphaerocarpum* (Hook.) Steph., *Plagiothecium succulentum* (Wilson) Lindb., *Philonotis seriata* Mitt., *Imbribryum alpinum* (Huds. ex With.) N.Pedersen.

Distribution: Denmark, Faroe Islands, Finland, Norway, Sweden, Great Britain, Ireland, Northern Ireland, France, Italy, Spain, Austria, Belgium, Czech Republic, Germany, Netherlands, Poland, Slovakia, Switzerland, Montenegro, Romenia, Slovenia, Belarus, Estonia, Kaliningrad, Latvia, Lithuania, Central Russia, RE Russia, RW Russia, South Urals, Ukranie (Frey *et al*., 2006; Hodgetts and Lockhart, 2020), New to Azerbaijan.

Splachnum ampullaceum has most recently been assessed for *The IUCN Red List of Threatened Species* in 2017. *Splachnum ampullaceum* is listed as Near Threatened (NT) (Baisheva and Ignatov, 2019. *Splachnum ampullaceum* (Europe assessment). The IUCN Red List of Threatened Species 2019: e.T87569778A87761065. Accessed on 20 January 2025).

Sphagnum capillifolium (Ehrh.) Hedw. (Syn: *Sphagnum capillifolium* subsp. *capillifolium*)

(**Fig. 3**)

Specimens examined: Azerbaijan (Baku province): Zangilan district, Tugay forest, edge of Besit stream, on wet soil, 39º3'57.72" E, 46º34'33.42"N, Altitude: 705 m a. s. l., 24 June, 2022, leg. A. Mammadova, S. Ibadullayeva, det. A. Mammadova, H. Erata, N. Batan, Batan 1629.

Plant medium-sized up to 15 cm tall, yellowish-green, pale red. Capitulum roundish. Stems green to red. Stem leaves appressed, erect, triangular, 1.1-1.7 mm long, obtuse or acute apex, hyaline cells S-shapedand fibrils usually with conspicuous, occasionally fibrils weak or absent. Branches has fascicle with 2-3 spreading and 1-2 pendent. Branch leaves, imbricate, ovate-lanceolate, 1-1.3 mm long apex narrow. Branch leaves usually not markedly 5-ranked.

Sphagnum capillifolium belongs to the section Acutifolia. *S. capillifolium* is morphologically similar to *Sphagnum warnstorfii* Russow, but different in having branch leaves 5-ranked or not and fibrils of stem leaves usually conspicuous. In contrast, *Sphagnum warnstorfii* branch leaves more markedly 5-rankedwith narrower apices, and stem leaves without fibrils. Also, *S. capillifolium* resembles *Sphagnum girgensohnii Russow* however, but differs in that it is stem leaves appressed, erect, triangular, obtuse or acute apex.

Ecology: Sphagnum capillifolium grows on high hummocks in bogs, in wet heath lands, at the edge of flushes, on sheltered and somewhat drained banks in woodland and on boulder fields in mountain areas. Also it occurs in oligotrophic to weakly mesotrophic drier acid peatlands (blanket bogs), with rather acid, organic soils (Daniels and Eddy, 1985; Dierben, 2001; Smith, 2004).

Azerbaijan specimens was collected on wet soil in bogs in wet habitats, Tugay forest, edge of Besit stream in Bakü province. It is associated with *Chiloscyphus polyanthos* (L.) Corda., *Solenostoma sphaerocarpum* (Hook.) Steph., (Wilson) Lindb., *Philonotis seriata* Mitt.

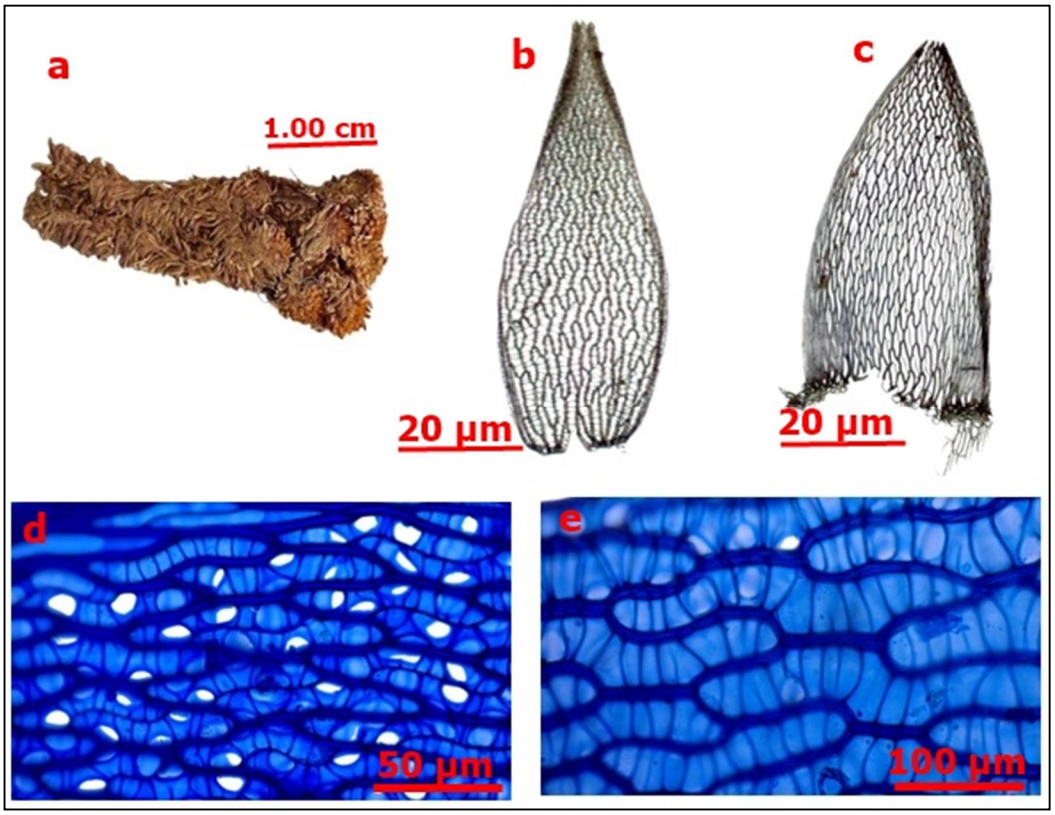

Fig. 3. *Sphagnum capillifolium* (Ehrh.) Hedw. a) Gametophyte, b) Branch leaves, c) Stem leaves, d) Stem leaf cells from the convex surface, e) Branch leaf cells from the concave surface.

Distribution: Denmark, Faroe Islands, Finland, Iceland, Norway, Sweden, Great Britain, Ireland, Northern Ireland, Andorre, Azores, Corsica, France, Italy, Prortugal, Sardinia, Spain, Austria, Belgium, Czech Republic, Germany, Liechtenstein, Luxembourg, Netherlands, Poland, Slovakia, Switzerland, Bosnia-Herzegovina, Bulgaria, Croatia, Hungary, Kosovo, Montenegro, North Macedonia, Romenia, Serbia, Slovenia, Türkiye, Belarus, Caucasus (in Europe), Estonia, Kaliningrad, Latvia, Lithuania, Arctic Russia, Central Russia, RE Russia, RW Russia, South Urals, Ukranie (Frey *et al*., 2006; Hodgetts and Lockhart, 2020). New to Azerbaijan.

Sphagnum capillifolium has most recently been assessed for The IUCN Red List of Threatened Species in 2017. *Sphagnum capillifolium* is listed as Least Concern (LC) (Schröck 2019. *Sphagnum capillifolium (Europe assessment). The IUCN Red List of Threatened Species* 2019: e.T87567451A87741728. Accessed on 21 January 2025)

Plagiothecium cavifolium (Brid.) Z. Iwats. (**Fig. 4**)

Specimens examined: Azerbaijan (Baku province): Zangilan district, Tugay forest, edge of Besit stream, on wet soil, 39º2'23.03" E, 46º38'26.02" N, Altitude: 756 m a. s. l., 01 July, 2024, leg. A. Mammadova, , S. Ibadullayeva, det. A. Mammadova, H. Erata, N. Batan, Batan 1630.

Plants dense mats, in glossy green to yellowish. Shoots julaceous, Leaves erect or some times spreading imbricate, concave, longitudinally plicate, more or less symmetrical, ovate or oblong-ovate, shortly tapering to acute or apiculate apex. Margins plane, usually entire. Costa double and very short. Alar cells enlarged, rectangular, other cells linear-rhomboidal.

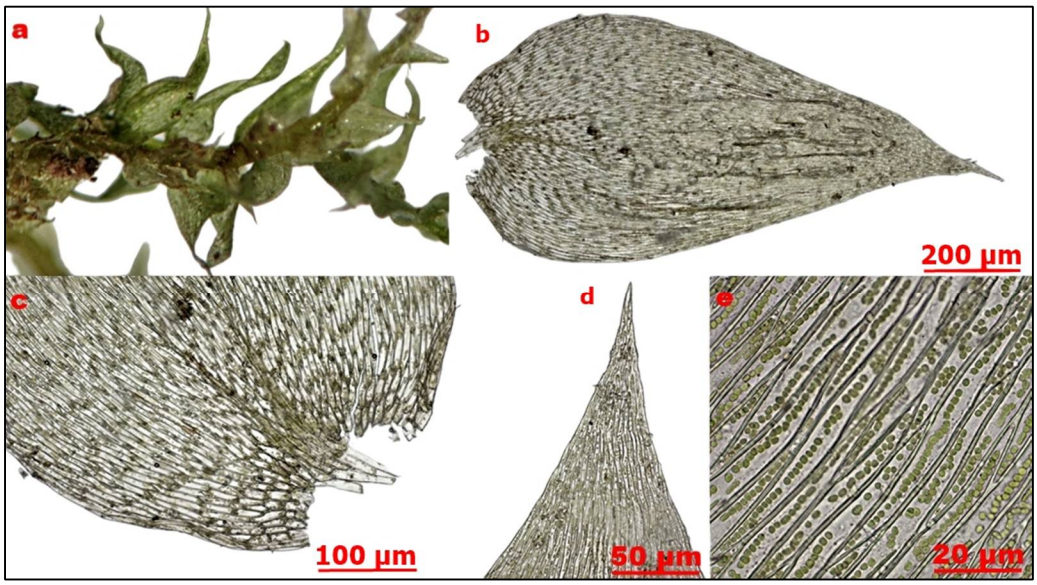

Fig. 4. *Plagiothecium cavifolium* (Brid.) Z.Iwats. a) Habit, b) Leaf, c) Lower part of leaf (leaf base and alar cells), d) Leaf apex, f) Mid-leaf cells.

Plagiothecium cavifolium is similar to *Plagiothecium succulentum* (Wilson) Lindb. but different in having leaves concave, longitudinally plicate and the shoots are not or are hardly arranged in one plane. Also, this species is distinguished from other *Plagiothecium* species in having shoots julaceous with very concave leaves and narrowly decurrent alar cells distinct.

Ecology: Plagiothecium cavifolium grows on moist usually basic rock ledges in montane area. Also it occurs shaded soil or humus overlying boulders and cliffs, rotten logs, stumps, base of trees, on loamy and sandy soil, low to high elevations (Dierben, 2001; Smith, 2004). Azerbaijan specimens was collectedon soil, Dilman forest, edge of Besit stream in Bakü province. It is associated with *Chiloscyphus polyanthos* (L.) Corda., *Mnium spinosum* (Voit) Schwägr., *Philonotis marchica* (Hedw.) Brid, and *Amblystegium serpens* (Hedw.) Schimp.

Distribution: Denmark, Faroe Islands, Finland, Iceland, Norway, Sweden, Great Britain, Ireland, Andorre, Azores, Corsica, France, Italy, Prortugal, Sicily, Spain, Austria, Belgium, Czech Republic, Germany, Liechtenstein, Luxembourg, Netherlands, Poland, Slovakia, Switzerland, Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Greece, Hungary, Montenegro, North Macedonia, Romenia, Serbia, Slovenia, Türkiye, Belarus, Caucasus (in Europe), Estonia, Kaliningrad, Latvia, Lithuania, Moldova, Arctic Russia, Central Russia, RE Russia, RW Russia,

SE Russia, South Urals, Ukranie, N. America, Japan (Smith, 2004; Frey*et al.*, 2006; Hodgetts and Lockhart, 2020).

Plagiothecium cavifolium has most recently been assessed for The IUCN Red List of Threatened Species in 2017. *Plagiothecium cavifolium* is listed as Least Concern (LC)(Sabovljevic, 2019. *Plagiothecium cavifolium (Europe assessment). The IUCN Red List of Threatened Species* 2019: e.T87467954A87782311. Accessed on 21 January 2025).

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