

THREE LIVERWORT TAXA NEW TO AZERBAIJAN

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Abstract

The liverwort taxa *Scapania calcicola*, *Barbilophozia hatcheri*, and *Porella cordaeana*, are reported as new for Azerbaijan, following a recent bryological expedition to the Zagatala, Shabran and Astara of Azerbaijan. Brief descriptions, illustrations, geographic distribution, ecology and comparisons with morphologically similar species are presented.

Introduction

Bryophytes are a diverse group of early land plants that occupy a wide range of ecological niches, from arid environments to humid forests and alpine zones. Among them, liverworts are of particular interest due to their pronounced morphological variability, ecological specialization, and sensitivity to microhabitat conditions, which make them valuable indicators in floristic and biodiversity studies (Patiño and Vanderpoorten, 2018; Cihal, 2023).

The Caucasus region is widely recognized as one of the major centers of plant diversity in Eurasia, shaped by a complex geological history, strong altitudinal gradients, and diverse climatic regimes. Azerbaijan, located at the intersection of Europe and Western Asia, encompasses multiple biogeographical zones and provides a wide range of suitable habitats for bryophytes. Despite this favorable setting, bryophytes particularly liverworts have historically received less attention than vascular plants, and the national bryophyte flora remains incompletely documented (Ignatov *et al.*, 2006; Hodgetts and Lockhart, 2020).

Recent studies have contributed significantly to the knowledge of bryophyte diversity in Azerbaijan, reporting numerous new national and regional records and highlighting the floristic richness of the country (Ellis *et al.*, 2021; Mammadova *et al.*, 2021; Mammadova and Abiyev, 2023; Erata *et al.*, 2025). Nevertheless, liverwort records are still comparatively scarce, and many regions of Azerbaijan remain insufficiently explored from a bryological perspective. This suggests that additional taxa are likely to be discovered through continued field investigations.

During recent bryological surveys conducted in different localities of Azerbaijan, several liverwort specimens were collected that could not be assigned to taxa previously reported from the country. Detailed morphological examination and comparison with relevant taxonomic literature (Smith, 1996; Paton, 1999; Damsholt, 2002; Frey *et al.*, 2006) confirmed that these specimens represent taxa new to the bryophyte flora of Azerbaijan.

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In the present study, three liverwort taxa are reported as new records for Azerbaijan. For each species, diagnostic morphological characters, ecological preferences, geographic distribution, and comparisons with morphologically similar taxa are provided. These new records contribute to a more comprehensive understanding of liverwort diversity in Azerbaijan and emphasize the importance of continued bryological exploration in the Caucasus region.

In Azerbaijan, bryophytes are currently represented by approximately 507 taxa belonging to 152 genera and 57 families (Ellis *et al.*, 2021; Mammadova *et al.*, 2021; Mammadova and Abiyev, 2023; Mammadova *et al.*, 2024). However, despite this recorded diversity, the bryophyte flora of Azerbaijan remains insufficiently studied.

Materials and Methods

The bryophyte samples were collected from different localities from Zagatala, Shabran and Astara of Azerbaijan in 2025 (Fig. 1). The bryophytes were identified by consulting keys (Smith, 1996; Paton, 1999; Damsholt, 2002; Frey *et al.*, 2006; Hugonnot and Chavoutier, 2021; Unan *et al.*, 2021). The distributional status of the identified taxa in Azerbaijan was assessed through relevant national references (Ignatov and Afonina, 1992; Ignatov *et al.*, 2006; Gasimov and Novruzov, 2017; Hodgetts and Lockhart, 2020; Hodgetts *et al.*, 2020; Mammadova *et al.*, 2021; Ellis *et al.*, 2021; Mammadova and Abiyev, 2023; Erata *et al.*, 2025). The study of Hodgetts *et al.* (2020) was followed in terms of nomenclature and synonyms. Voucher specimens are deposited in the Herbarium 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).

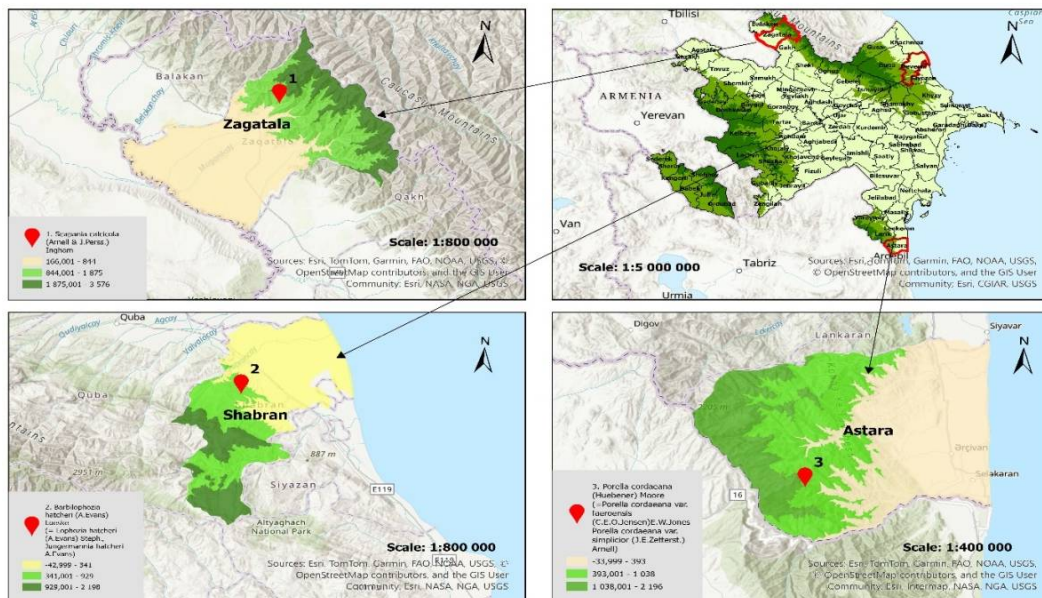


Fig. 1 The map of research area.

Results**Scapania calcicola** (Arnell & J.Perss.) Ingham

(Fig. 2).

Specimens examined: Azerbaijan, Zaqatala region, on wet soil, 40° 19' 11.0" N, 046° 19' 00.8" E, Altitude: 581 m a. s. l., July 5, 2025, leg. A. Mammadova, S. Ibadullayeva, det. A. Mammadova, H. Erata, N. Batan, NBAK 7025.

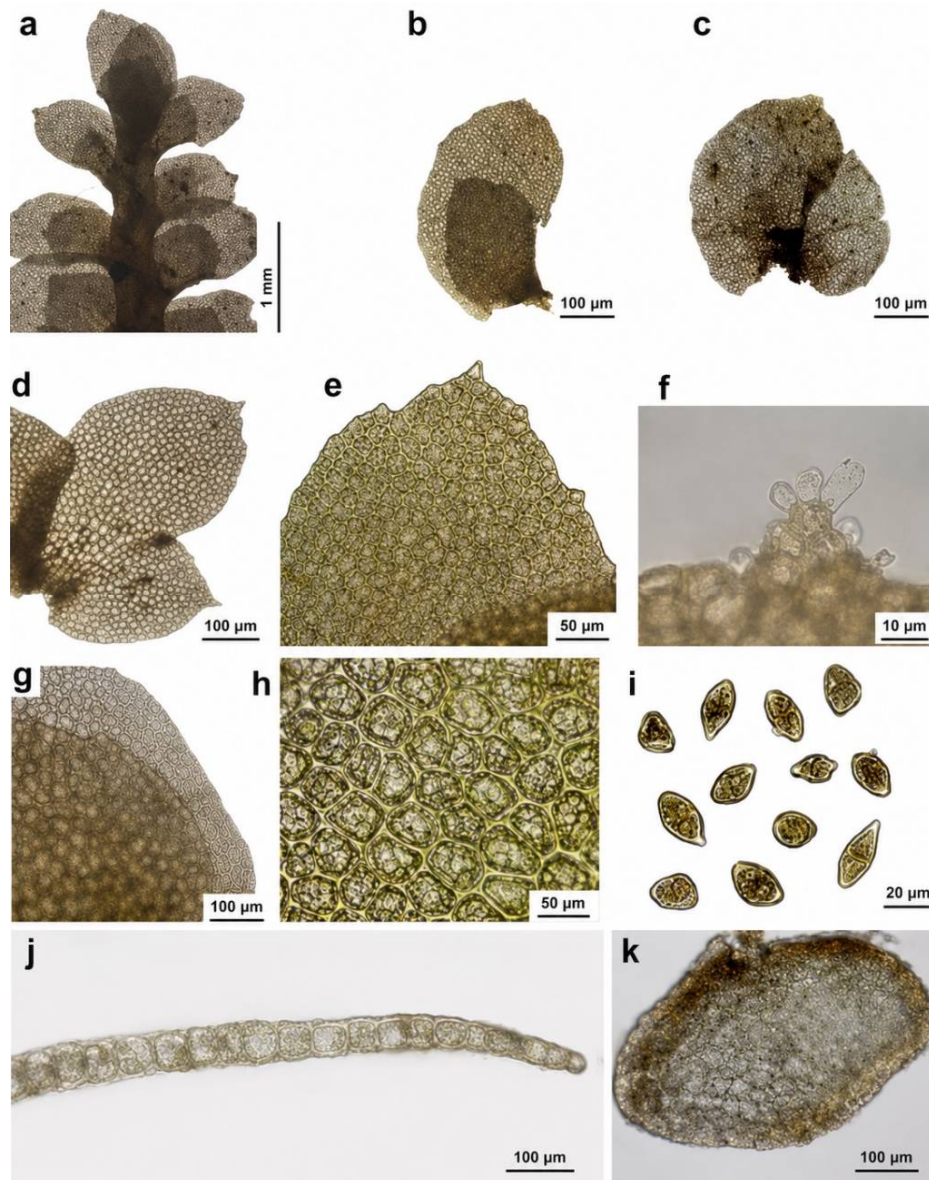


Fig. 2. *Scapania calcicola*; (a) shoot, (b-d) leaves, (e-f) leaf apex, (g) leaf margin, (h) median cells and oil bodies, (i) gemmae, (j) leaf cross-section, (k) stem cross-section.

Plants small, yellowish-green. Shoots ascending, up to 0.8–2.7 cm long. Leaves imbricate, unequally bilobed and antical lobe patent and postical lobe patent or squarrose. Antical lobe about 0.4–0.6 as large as postical lobe and lobes dentate, keel ± acute. Leaf cells thick-walled. Mid-leaf cells of postical lobe 14–22 × 17–24 µm and with brownish trigones. Marginal cells 17–22 µm, equally thick-walled, not differentiated. Oil bodies brownish 2–4 (6) per cell, spherical to ellipsoidal. Gemmae common, yellow-brown to dark brown ellipsoidal to pyriform, ovoid or ellipsoid.

Scapania calcicola is similar to *S. cuspiduligera* (Nees) Müll. Frib., but *S. calcicola* differs from *S. cuspiduligera* in the pale green gemmae and smaller in size brownish oil bodies. Also, *Scapania calcicola* resembles *Scapania aequiloba* (Schwägr.) Dumort., however, the former can be distinguished from the latter by its unequally bilobed undecurrent leaves, persistent oil-bodies, and yellow-brown to dark brown gemmae.

Ecology: *S. calcicola* grows on moist limestones and other basic rocks, loes and calcareous soil, and montane habitats (Dierßen, 2001; Damsholt, 2002; Smith, 2004; Frey *et al.*, 2006; Unan *et al.*, 2021; Hugonnot and Chavoutier, 2021). Azerbaijan specimens were collected on calcareous rock, Zakatala province. It is associated with *Blepharostoma trichophyllum* (L.) Dumort., *Plagiochila asplenioides* (L.) Dumort., *Jungermannia borealis* Damsh. & Vána, *Amphidium mougeotii* (Bruch & Schimp.) Schimp., *Anoetangium aestivum* (Hedw.) Mitt. and *Grimmia anodon* Bruch & Schimp.

Distribution: Denmark, Faroe Islands, Finland, Iceland, Norway, Svalbard, Sweden, Great Britain, Andorra, France, Italy, Spain, Austria, Belgium, Czech Republic, Germany, Liechtenstein, Poland, Slovakia, Switzerland, Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Greece, Hungary, Montenegro, North Macedonia, Romania, Serbia, Türkiye, Caucasus (in Europe), Crimea, Estonia, Latvia, Arctic Russia, RW Russia, Greenland, N. America, Colombia, Argentina, Siberia, Japan, Congo, Lesotho (Paton, 1999; Frey *et al.*, 2006; Bakalin *et al.*, 2016; Hodgetts and Lockhart, 2020; Hugonnot and Chavoutier, 2021; Unan *et al.*, 2021; Url 1, in <https://www.gbif.org/species/4277184>). New to Azerbaijan.

S. calcicola has most recently been assessed for *The IUCN Red List of Threatened Species* in 2017. *Scapania calcicola* is listed as Least Concern (LC) (Konstantinova, 2019. *S. calcicola* (Europe assessment). The IUCN Red List of Threatened Species 2019: e.T87523397A87758932. Accessed on 10 December 2025)

Barbilophozia hatcheri (A.Evans) Loeske [Synonym: *Lophozia hatcheri* (A.Evans) Steph., *Jungermannia hatcheri* A.Evans] (Fig. 3).

Specimens examined: Azerbaijan, Astarra region, on wet soil, 38° 27' 68" N, 48° 58' 26" E, Altitude: 180 m a. s. l., July 7, 2025, leg. A. Mammadova, S. Ibadullayeva, det. A. Mammadova, H. Erata, N. Batan, NBAK 522.

Plants turfs or patches, yellowish green to brownish. Shoots 2–4 cm high, 0.9–2.3 mm wide. Leaves imbricate, horizontal, concave to convex. Leaves 3–4 lobed, each lobe ovate triangular, apex acute to obtuse, ± asymmetrical. Ventral base 1–8 mostly long celled cilia. Underleaves bifid into lanceolate lobes, and ciliate at base. Cells 18–24 × 20–26 µm, quadrate-hexagonal, thin-walled, trigones small. Gemmae common on young leaves, reddish 1–2 celled. Oil-bodies 2–8 per cell.

Barbilophozia hatcheri is closely related to *B. lycopodioides* (Wallr.) Loeske. However, *Barbilophozia hatcheri* differs from *Barbilophozia lycopodioides* in presence of gemmae, small size, and underleaves with less ciliate. Also, *Barbilophozia hatcheri* is similar to *B. barbata*

(Schmidel ex Schreb.) Loeske, but differs in having reddish gemmae on young leaves, and underleaves bifid into lanceolate lobes, ciliate at base. In addition to, *B. hatcheri* is confusable with *Trilophozia quinquedentata* (Huds.) Bakalin, but the former differs always from the latter in having underleaves bifid into lanceolate lobes, ciliate at base, whereas. *T. quinquedentata* lacking underleaves.

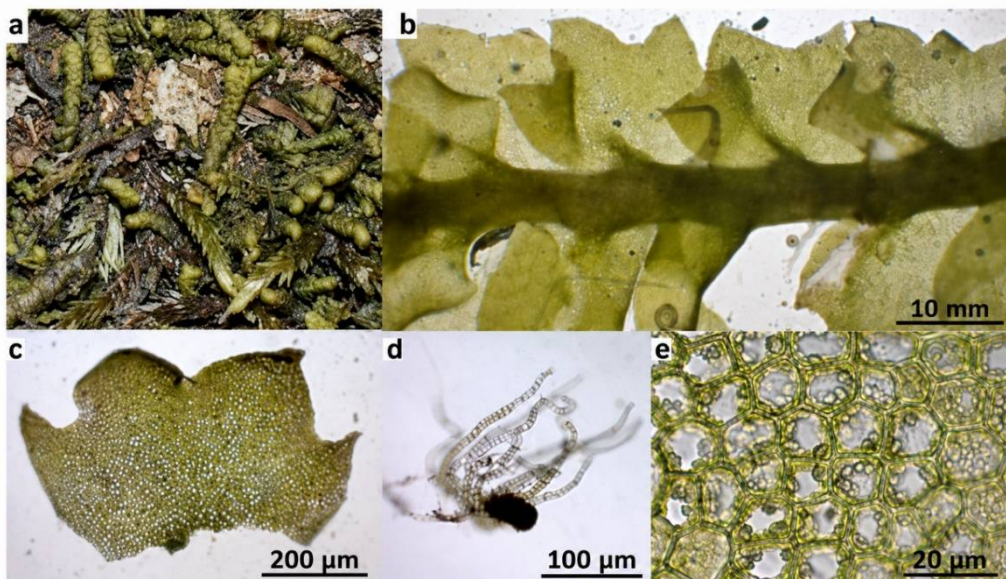


Fig. 3. *Barbilophozia hatcheri*; a) habitus, b) shoot, c) leaf, d) underleaf, e) mid-leaf cells.

Ecology: *B. hatcheri* grows on peat and soil, among rocks, and on walls in sheltered habitats. Also, it grows on boulders in woodland ravines, and open slopes, and cliff ledges (Smith, 1996; Paton, 1999; Dierßen, 2001; Damsholt, 2002; Frey *et al.*, 2006; Hugonnot and Chavoutier, 2021). Azerbaijan specimens were collected on rock, Şabran province. It is associated with *Cephaloziella divaricata* (Sm.) Schiffn. *Scapania irrigua* (Nees) Nees, *Plagiochila porelloides* (Torr. ex Nees) Lindenb., *Jungermannia atrovirens* Dumort, *Polytrichum piliferum* Hedw., *Hymenoloma crispulum* (Hedw.) Ochyra, *Racomitrium affine* (F.Weber & D.Mohr) Lindb, and *Grimmia alpestris* (F.Weber & D.Mohr) Schleich

Distribution: Denmark, Faroe Islands, Finland, Iceland, Norway, Svalbard, Sweden, Great Britain, Andorra, Corsica, France, Italy, Portugal, Sardinia, Sicily, Spain, Austria, Belgium, Czech Republic, Germany, Luxembourg, Netherlands, Poland, Slovakia, Switzerland, Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Greece, Hungary, Kosovo, Montenegro, North Macedonia, Romania, Serbia, Türkiye, Caucasus (in Europe), Arctic Russia, Central Russia, RE Russia, RW Russia, South Urals, Ukraine, South Georgia, Greenland, N. America, Asia, S. America, Falklands, Siberia, Japan, Taiwan, Himalayas, Antarctica (Smith, 1996; Paton, 1999; Frey *et al.*, 2006; Bakalin *et al.*, 2016; Hodgetts and Lockhart, 2020; Hugonnot and Chavoutier, 2021; Url 2, in <https://www.gbif.org/species/2689433>). New to Azerbaijan.

B. hatcheri has most recently been assessed for The IUCN Red List of Threatened Species in 2016. *Barbilophozia hatcheri* is listed as Least Concern (LC) (Hodgetts, 2019. *B. hatcheri* (Europe assessment). The IUCN Red List of Threatened Species 2019: e.T87485997A87825483. Accessed on 10 December 2025).

Porella cordaeana (Huebener) Moore [Synonym: *Porella cordaeana* var. *faeroensis* (C.E.O. Jensen) E.W.Jones, *Porella cordaeana* var. *simplicior* (J.E.Zetterst.) Arnell] (Fig. 4).

Specimens examined: Azerbaijan, Zaqatala region, on the tree trunk, 41° 6' 48.30" N, 046° 6' 53.25" E, Altitude: 950 m a. s. l., August 8, 2025, leg. A. Mammadova, , S. Ibadullayeva, det. A. Mammadova, H. Erata, N. Batan, NBAK 6071.

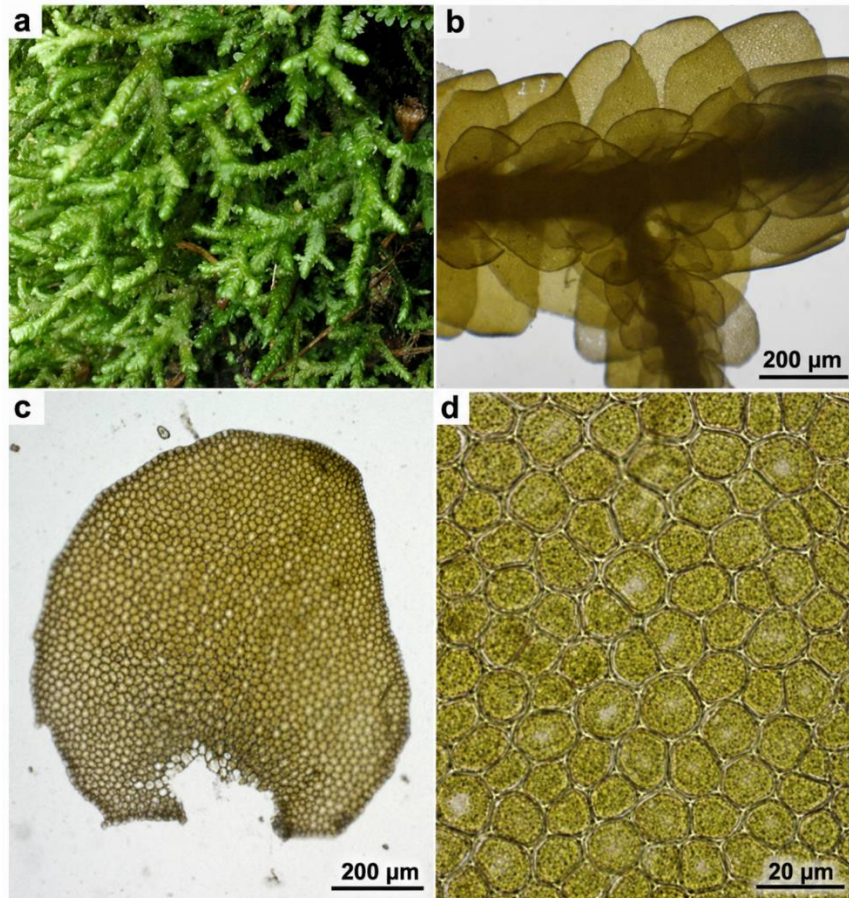


Fig. 4. *Porella cordaeana*; a) habitus, b) shoot, c) leaf, d) mid-leaf cells.

Plants robust, dull dark green, yellowish green. strongly aromatic and not acrid to the taste. Shoots up to 10 cm, 3-4 cm mm wide, procumbent irregularly 1-2 pinnately branched. Leaves approximate to imbricate, dorsal lobe broadly ovate to ovate-orbiular with cordate at base, apex rounded, margins entire or 1-3 spinose teeth. Ventral lobe very small oblong to lanceolate, undulate, longly decurrent, apex acute, entire recurved margin. Underleaves distant ovate quadrate and entire recurved margin and very long decurrent, undulate. Cells 25-38 x 16-40 µm, thin-walled, and more or less well-developed triangular lobes; the edges of the lobes are lined with undifferentiated cells. Gemmae lacking.

P. cordaeana is closely related to *P. platyphylla* (L.) Pfeiff., but differs in having distant, very long-decurrent underlaves and lobes tapering to acute apex whereas *P. platyphylla* has imbricate,

long decurrent underleaves and lobes rounded at apex. In addition, the former can be distinguished from the latter by its small acute ventral lobes.

Ecology: *P. cordaeana* grows on rocks (moist acidic, calcareous), tree roots and boles in damp shaded habitats. It grows among other bryophytes rock walls and on stones along streams and on the roots or trees. (Smith, 1996; Paton, 1999; Dierßen, 2001; Damsholt, 2002; Frey *et al.*, 2006; Bukvicki *et al.*, 2012; Tan *et al.*, 2016; Hugonnot and Chavoutier, 2021; Klimova *et al.*, 2025). It is associated with *Plogiochila asplenioides* (L.) Dumort., *Sanionia uncinata* (Hedw.) Loeske, and *Pterigynandrum filiforme* Hedw.

Distribution: Denmark, Faroe Islands, Finland, Iceland, Norway, Sweden, Great Britain, Ireland, Northern Ireland, Andorra, Corsica, Cyprus, France, Italy, Madeira, Portugal, Sardinia, Sicily, Spain, Madeira, Austria, Belgium, Czech Republic, Germany, Liechtenstein, Luxembourg, Netherlands, Poland, Slovakia, Switzerland, , Albia, Bosnia-Herzegovina, Bulgaria, Crete, Croatia, Greece, Hungary, Montenegro, North Macedonia, Romenia, Serbia, Slovenia, Turkey, Caucasus (in Europe), Crimea, Estonia, Latvia, NW Russia, Ukraine, Lebanon, Algaria, Morocco, N. Africa, Western N. America (Smith, 1996; Paton, 1999; Damsholt, 2002; Frey *et al.*, 2006; Tan *et al.*, 2016; Bakalin *et al.*, 2016; Hodgetts and Lockhart, 2020; Hugonnot and Chavoutier, 2021; Url 3, in <https://www.gbif.org/species/5710210>). New to Azerbaijan.

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