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DOI: 10.26672.anatolianbryology.936553

Anatolian Bryology  
Anadolu Briyoloji Dergisi  
**Research Article**  
e-ISSN:2458-8474 Online



## ***Asterella saccata* (Wahlenb.) A. Evans a new genus and liverwort (Aytoniaceae, Hepaticae) species from Turkey**

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Received: 12 May 2021

Revised: 10 June 2021

Accepted: 18 June 2021

### Abstract

*Asterella saccata*, which belongs to the Aytoniaceae family, was added to the bryophyte flora of Turkey for the first time. With this study, the number of genera represented in the family is increased to four with *Mannia*, *Plagiochasma* and *Reboulia*. In addition, this study highlights the importance of investigating poorly researched study areas such as Eastern Anatolia Region in terms of bryophytes so as to fully reveal the flora of Turkish bryophytes.

**Key words.** Bryophyte, *Mannia*, *Reboulia*, *Plagiochasma*, Conservation, Red List

## **Türkiye'den yeni bir cins ve ciğerotu (Aytoniaceae, Hepaticae) türü *Asterella saccata* (Wahlenb.) A. Evans**

### Öz

Aytoniaceae ailesine ait olan *Asterella saccata*, Türkiye karayosunları florasına ilk kez eklenmiştir. Bu çalışmayla, ailede temsil edilen cins sayısı *Mannia*, *Plagiochasma* ve *Reboulia* ile birlikte dörde çıkmıştır. Ayrıca, bu çalışma Türkiye karayosunları florasının tam olarak ortaya çıkarılması için Doğu Anadolu Bölgesi gibi karayosunları açısından nispeten az araştırılmış alanların çalışılmasının önemli olduğunu göstermiştir.

**Anahtar kelimeler:** Karayosunları, *Mannia*, *Reboulia*, *Plagiochasma*, Koruma, Kırmızı Liste

### 1. Introduction

The number of studies conducted on Turkish bryophytes, which constitute an important part of biodiversity, is increasing day by day. Up to now, approximately 520 studies have been carried out recording 974 species (Bryophyta 775, Marchantiophyta 194 and Anthocerotophyta 4) from Turkey (Özenoğlu et al., 2016; 2019; Erdağ

and Kürschner, 2017; Unan et al., 2020; Ursavaş et al., 2020, Erata et al., 2021; Unan and Ören, 2021). These floristic studies have, however, concentrated on the Black Sea, Mediterranean, West Anatolia and Southwest Anatolia regions. Records from Eastern and Southeastern Anatolia are limited (Schiffner, 1913; Papp, 2007; Alataş and Batan, 2016; Batan et al., 2013; 2017; Batan and Özdemir,

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To cite this article: Kırmacı M. Armağan M. Özenoğlu H. 2021. *Asterella saccata* (Wahlenb.) A. Evans a new genus and liverwort (Aytoniaceae, Hepaticae) species from Turkey. *Anatolian Bryology*. 7:2, 90-95.



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2013; 2016; Özenoğlu et al., 2019; Kürschner and Erdağ, 2020).

The bryophyte records given from the Eastern Anatolia Region, which includes the area where new records have been determined, are individual records by researchers visiting the Anatolia for different reasons and not extensive studies aimed at determining the flora of such areas. These records are *Lunularia cruciata* (L.) Dumort. ex Lindb., *Marchantia polymorpha* var. *alpestris* (synonym of *Marchantia polymorpha* subsp. *montivagans* Bischl. & Boissel. - Dub.), *Apopellia endiviifolia* (Dicks.) Nebel & D. Quandt (synonym of *Pellia endiviifolia* (Dicks.) Dumort.) and *Riccia bifurca* Hoffm. (Schiffner, 1913; Papp, 2007; Özenoğlu et al., 2019; Kürschner and Erdağ, 2020).

*Asterella* P. Beauv. is one of the largest genera of the order Marchantiales. It includes 57 species found worldwide (Söderström, 2016) with 15 taxa occurring in Eurasia (Long, 2006), 4 taxa occurring in Russia (Konstantinova et al., 2009) and 3 taxa in Near and Middle East (Kürschner and Erdağ, 2020).

The Aytoniaceae family is represented with 3 genera which are *Mannia* Opiz (3 taxa), *Plagiochasma* Lehm. & Lindenb. (1 taxon) and *Reboulia* Raddi (1 taxon) in Turkey. *Asterella elegans* (Spreng.) Trevis., *A. gracilis* (F. Weber) Underw. and *A. lindenbergiana* (Corda ex Nees) Arnell have been recorded in our country (Özenoğlu Kiremit and Keçeli, 2009). But, *Asterella elegans* was recorded from grid-square C12 of Turkey by Wettstein (1889) and Bornmüller (1931); but Frey et al. (1991) reported that this was a

misidentification and that this species was supposed to be *Mannia androgyna* (L.) A. Evans. Likewise, Kürshner (1996) reported that *A. lindenbergiana*, recorded from grid-square C11 of Turkey by Gökler and Öztürk (1991), was also a misidentification that should have been identified as *Corsinia coriandrina* (Spreng.) Lindb. (Özenoğlu Kiremit and Keçeli, 2009). The last one, *Asterella gracilis* was transferred to *Mannia* genus, based on some molecular studies on the phylogeny of the family Aytoniaceae (Long et al., 2000; Schill et al., 2010; Borovichev et al., 2015). For this reason, the *Asterella* and *Asterella saccata* are new for Turkey. With this study, the genus *Asterella* was added to the Turkish bryophyte flora again.

## 2. Taxonomic Treatment

*Asterella saccata* (Wahlenb.) A. Evans, Contr. U.S. Natl. Herb. 20: 276. 1920 (Fig. 2).

**Synonyms:** – *Marchantia saccata* Wahlenb., – *Fimbraria saccata* (Wahlenb.) Nees, – *Hypenantron saccatum* (Wahlenb.) Trevis., – *Marchantia fragrans* Schleich., – *Hypenantron ciliatum* Corda, – *Marchantia umbonata* Wallr., – *Fimbraria umbonata* (Wallr.) Wallr., – *Hypenantron umbonatum* (Wallr.) Trevis., – *Fimbraria fragrans* Nees, – *Hypenantron fragrans* Trevis., – *Asterella fragrans* Trevis.

**Turkish name:** Sakallı mantarbaş

**Locality:** Bitlis, between Ahlat and Tatvan, N 38° 33' 55", E 42° 21' 18.4", 1750 m. coll: M. KIRMACI and M. ARMAĞAN, Det: H. ÖZENOĞLU and M. KIRMACI. AYDN 4001 (Fig 1).

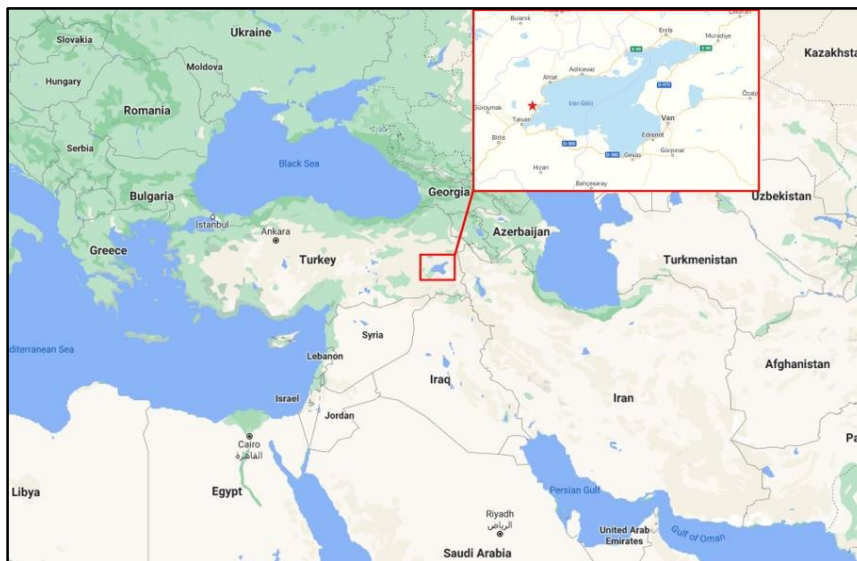


Figure 1: Distribution of *Asterella saccata*

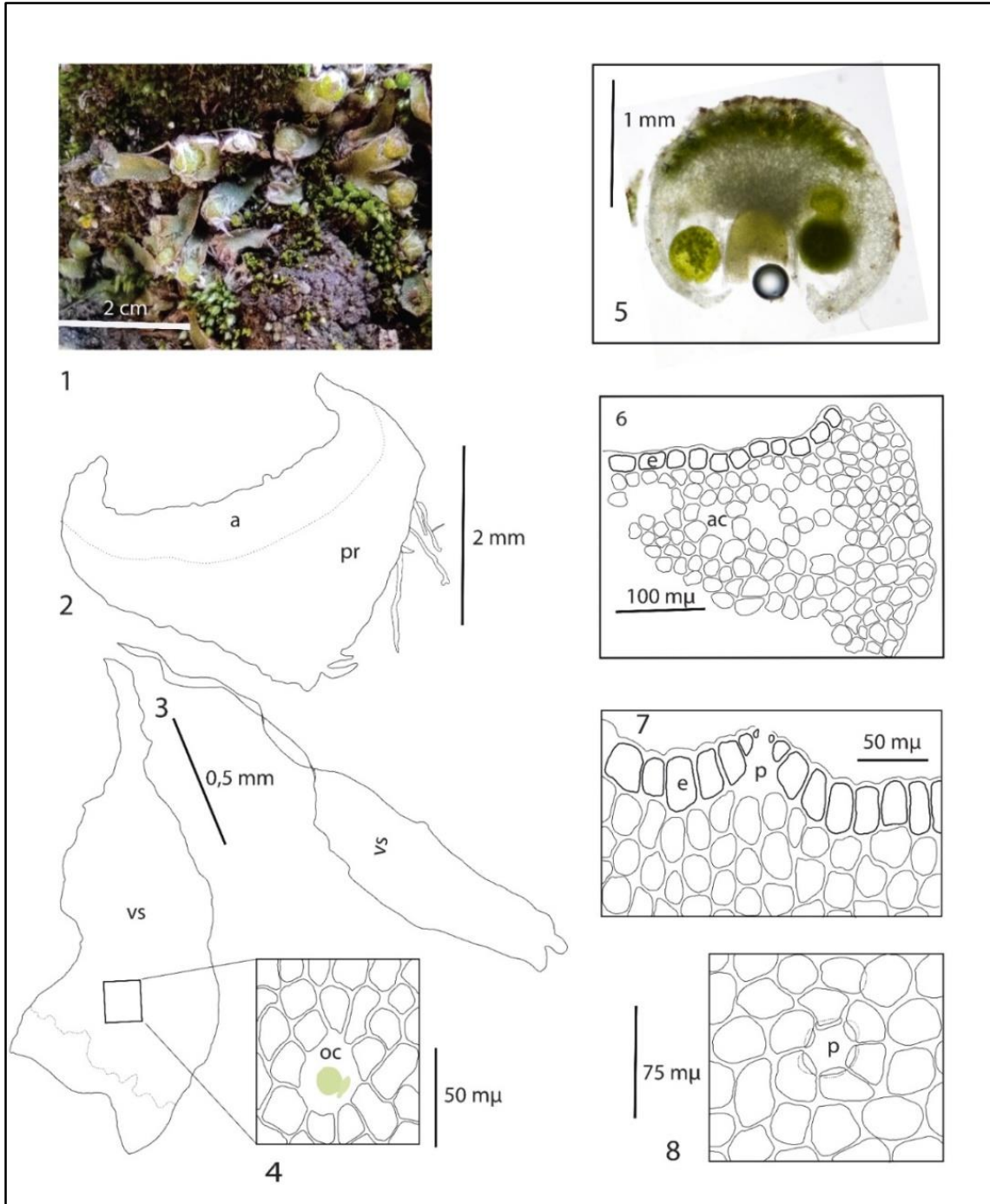


Figure 2: *Asterella saccata*; 1- General view of *A. saccata*; 2- cross-section of lobe; 3 and 4- ventral scales; 5- carpocephalum; 6- epidermis and air chambers; 7- pore and epidermis cells cross-section of lobe; 8- pore from above. Drawn by M.Kırmacı

**Description** (Fig 2):

Plant xeromorphous habit, non-aromatic; thalli thick, leathery, 1–4 (5) mm wide, dichotomously branched, segments oblong to lingulate; whitish ventral scale appendages overtopping margins and forming a conspicuous white tuft at thallus apex; upper surface green to grayish-green; thallus margins undulate, reddish to dark purplish, inrolled in dry condition. Dorsal epidermis cells 22–26×10–

18 μm; cell walls thickened; pores simple, slightly raised above the epidermis, 18–30 μm in diameter, surrounded by 2(–3) concentric rings of 6–7 cells in each, cell walls thin. Aerenchyma well-developed, compact; air chambers narrow, 1(–2)-layered in the middle of thallus. Parenchyma consisting of thin-walled cells; with scattered oil-cells both in aerenchyma and parenchyma tissue; oil-cells

yellow-purple, 20–24 µm in diameter. Rhizoids smooth and tubercular, hyaline, covering ventral surface of midrib of thallus. Ventral scales semicircular, with dark red-purple body with broad hyaline curved median side; body 1300–2000 µm long and 550–800 µm wide; body cells 60–80 µm long and 16–26 µm wide, with numerous scattered pale oil-cells; oil cells 20–30 µm in diameter; appendage 1–2 per scale, hyaline; quickly tapering above broad base; papillae absent.

Plant parocious. Antheridia arising behind the female receptacle, greenish to purplish, without scales. Female receptacle arising in apical notch of thallus. Archegonial scales at base numerous, forming conspicuous dense cushion of hyaline scales and a few at apex. Carpocephalum conical-hemispheric, green to yellowish-green; disc convex, 2-4-lobed, each with a single sporophyte; involucre margin free, with broad bluntly V-shaped median incisures; pseudoperianth white, compressed laterally when young and with strongly connate apical part of lobes when mature, with free margins recurved when dry. Spores yellow-brown, globose, 90–100 µm in diameter, on distal surface with weak primary wavy lamellae with minute reticulations. Elaters 2-spiral, yellowish, 150–200 µm long.

*Asterella*, *Mannia*, *Plagiochasma* and *Reboulia* similar genus and all of them belongs to the Aytoniaceae family, but *Asterella* differs strikingly in its female gametophores, which have a cage-like pseudoperianth surrounding each sporogonium, borne within an involucre under the lobes of the carpocephalum. *Asterella saccata* differs from *Mannia fragrans* in not having fragrant thalli in fresh conditions, thickened cell walls of dorsal epidermis, margin of ventral scales without slime papillae.

**Study area and Ecology.** The new record was collected from the northern part of Van Lake which is largest soda lake in the world, between Nemrut Stratovolcano (2948 m) and Süphan (4058), an inactive volcanic mountain. The closest settlement is Tatvan, which has a cold and temperate climate. There is more rainfall in the winter than in the summer. It can be called Dsa according to the Köppen-Geiger climate classification. The temperature here averages 8.3 °C | 46.9 °F. In a year, the rainfall is 839 mm | 33.0 inch. With an average temperature of 22.0 °C | 71.6 °F, August is the hottest month of the year. In January, the average temperature is -4.3 °C, the lowest average of the year. There is a dry period between June and September (Anonym, 2021).

General vegetation is very poor and some steppe plants such as *Astragalus* sp., *Trifolium* sp., *Verbascum* sp., *Onopordum* sp., *Centaurea* sp., *Parietaria* sp., *Eryngium* sp., *Graminea* sp. and shrubs like *Sorbus* sp., *Rhamnus* sp., *Frangula* sp., *Quercus* sp., *Cerasus* sp., *Cotoneaster* sp., *Salix* sp., *Crataegus* sp., *Rosa* sp., and *Rhus coriaria* L. can be infrequently seen around the area.

The northern part of the Lake Van is a relatively young volcanic area and the bedrock formation is basalt. While rocks such as basalt containing a small amount of silica easily decompose, it provides plenty of nutrients to the soil and the decomposed soil is alkali in character. Calciphilous xerophyte, growing in open to full sun places in South faced of soil bank. Very poor bryophyte taxa are associated with the new species and *Dicranella heteromalla* (Hedw.) Schimp., *Didymodon umbrosus* (Müll. Hal.) R.H. Zander, *D. luridus* Hornsch. ex Spreng., *D. insulanus* (De Not.) M.O. Hill, *Weissia breutelii* Müll. Hal., and *Bryum* sp. are commonly seen moss taxa in the collection area.

**Distribution.** Records of *Asterella saccata* in Europe are from Austria, Switzerland, Czech Republic, Slovakia, Italy, Makedonia, Montenegro, Hungary, Germany, Spain, France, Romania, Finland, Norway, Poland, Scandinavia, Sweden, Iceland, Corsica, Greece; eastward to Russia and China (Xinjing). *Asterella saccata* was known in the Russia from European part, Siberia, Altay Republic, Yakutia, Chukotka Autonomous District, Kamchatka, Amur and Ukraine (Bory, 1832; Zerov, 1964; Söderström et al., 2002; Long, 2006; Ross et al., 2007; Borovichev, 2015). This species has not been recorded from Near and Middle East (Kürschner and Erdağ, 2020).

**Conservation status:** The new record is known from only one locality yet. In order to comment on the redlist category of the species, it is necessary to study all areas that it is likely to be found in. In this sense, there are many areas that add to working in Eastern Anatolia. For this reason, the redlist category of the taxon was given as DD. It has been listed as endangered (EN) on the European red list (Hogetts et al., 2019).

### 3. Discussion

The family Aytoniaceae is represented with 3 genera, *Reboulia*, *Mannia* and *Plagiochasma*, in Turkey. Among them, the *Reboulia* is the most common; it is also recorded from Van and environs too. The genus *Asterella* which was added to this family with this study as a new genus raises the represented number of the family to four. *Asterella* differs from other Aytoniaceae members primarily

in the presence of a pseudoperianth. When sterile, *Asterella* recognition can be problematic as its gametophytes show close resemblance to *Mannia* species. Furthermore, *Asterella* species almost always have a pungent fishy smell whereas the odour of *Mannia* is aromatic. The hemispheric female receptacles in *Asterella* are different from the more star-like ones in *Reboulia* or the subspherical ones in *Plagiochasma*. The female receptacles in mid thallus also differentiate *Plagiochasma* from *Asterella*.

The new taxon was collected during the project entitled 'The Bryophyte Flora of Van Lake and Environs'. Very few liverwort taxa were collected during this study performed between 2018 and 2021. The main reasons for this are that there are limited habitats and water sources that would allow for the survival of liverworts, except for the south and south-east of the study area. Additionally, rapid evaporation due to low vegetation is another reason. Lastly, although bryophytes have a suite of photo protective strategies, high ultraviolet may affect liverworts.

The study that recently described *Orthotrichum cupulatum* var. *fuscum* (Venturi) Boulay as a new record from the region (Ellis et al., 2021) and our current study show the importance to investigate poorly researched areas such as Eastern Anatolia in terms of bryophytes so as to fully understand the flora of Turkish bryophytes. It is obvious that Turkish liverwort flora will be increased with more detailed studies.

This study is also important in terms of adding a new genus to our country's liverwort flora. We hope that it will be useful for future bryophyte studies.

#### Acknowledgements:

Many thanks to Aydın Adnan Menderes University Scientific Research Projects department (BAP) which was supported our project (FEF-18018) as financial. And also many thanks to Gözde ASLAN and Uğur ÇATAK for helping during field and laboratory studies.

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