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Pohlia Hedw. and *Oleolophozia* L.Söderstr., De Roo & Hedd. species new to Turkey and South-West Asia

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ABSTRACT
Pohlia lescuriana (Sull.) Ochi and *Oleolophozia perssonii* (H.Buch & S.W.Arnell) L.Söderstr., De Roo & Hedd. have been identified as new to Turkey and South-west Asia, following a recent bryological excursion in Giresun province of Turkey. The genus *Oleolophozia* L.Söderstr., De Roo & Hedd. is also new to Turkey. In this paper, brief descriptions, illustrations, information about geographic distribution, ecology and comparisons with morphologically similar taxa are given. A key to *Pohlia* Hedw. taxa in Turkey is added.

KEY WORDS
Bryophyte,
Pohlia,
Oleolophozia,
Turkey,
new records.

RÉSUMÉ
Des espèces de Pohlia *Hedw. et* Oleolophozia *L.Söderstr., De Roo & Hedd. nouvelles pour la Turquie et l'Asie du Sud-Ouest.*
À la suite d'une récente excursion bryologique dans la province de Giresun (Turquie) *Pohlia lescuriana* (Sull.) Ochi et *Oleolophozia perssonii* (H.Buch & S.W.Arnell) L.Söderstr., De Roo & Hedd. sont identifiés comme nouveaux pour la Turquie et l'Asie du Sud-Ouest. Le genre *Oleolophozia* L.Söderstr., De Roo & Hedd. est aussi nouveau pour la Turquie. Ces taxons sont brièvement décrits et illustrés, leur distribution géographique, leur écologie, des comparaisons morphologiques avec des taxons proches sont donnés, ainsi qu'une clé des *Pohlia* Hedw. en Turquie.

MOTS CLÉS
Bryophyte,
Pohlia,
Oleolophozia,
Turquie,
signalements nouveaux.

INTRODUCTION

Recently, research on bryophytes (flora and vegetation) has increasingly been continuing in Turkey however, floristic research prevails. Lately, many bryophytes taxa have been recorded as new to Turkey (Alataş *et al.* 2017, 2019a, b; Uyar *et al.* 2018; Batan *et al.* 2019; Ursavaş & Keçeli 2019; Ursavaş & Işın 2019; Ellis *et al.* 2019; Erata & Batan 2020, Unan *et al.* 2020; Ursavaş *et al.* 2020). Up to now, approximately 1041 species of bryophytes (± 841 mosses, ± 195 liverworts and 4 hornworts) are known from Turkey (Özenoğlu-Kiremit & Keçeli 2009; Kürschner & Frey 2011; Ursavaş & Keçeli 2019; Ursavaş & Işın 2019; Ellis *et al.* 2019; Erata & Batan 2020; Kürschner & Frey 2020; Unan *et al.* 2020; Ursavaş *et al.* 2020).

Pohlia Hedw. and *Oleolophozia* L. Söderstr., De Roo & Hedd. specimens were collected from Kümbet Plateau of Giresun province (Turkey). Nineteen species and seven varieties of *Pohlia* have been reported from Turkey, making *Pohlia lescuriana* (Sull.) Ochi the 20th (Kürschner & Frey 2011; Ros *et al.* 2013; Uyar & Ören 2013; Ellis *et al.* 2015, 2017; Kürschner & Frey 2020). Both the genus *Oleolophozia* and *Oleolophozia perssonii* (H.Buch & S.W.Arnell) L.Söderstr., De Roo & Hedd. are new record for Turkey (Smith 1996; Paton 1999; Frey *et al.* 2006; Özenoğlu-Kiremit & Keçeli 2009; Söderström *et al.* 2010; Hodgetts 2015; Söderström *et al.* 2016, Kürschner & Frey 2020).

Kümbet Plateau, which is located within the borders of Dereli district of Giresun province, is located on the slopes of Giresun Mountains facing the Black Sea. Giresun province, which is located in the Euro-Siberian floristic region of Turkey, is located in the east of the Black Sea Region and surrounded by Trabzon and Gümüşhane in the East, Sivas and Erzincan in the South, and Ordu in the West (Fig. 1).

Giresun Mountains are part of the eastern Black Sea mountain range and Kümbet plateau is located on the slopes of Giresun Mountains facing the Black Sea. The north side of the Black Sea mountain range has many streams in the deep valleys flowing down to the sea. Thanks to the humid climate, Giresun Mountains (e.g Kümbet plateau) have the largest parts of closed forest in Turkey (Papp 2004).

The research area has a typical Black Sea Region climate. The mild and damp oceanic climate with high and evenly distributed rainfall makes bryodiversity very rich. In Kümbet plateau, summers are warm and humid, whereas winters are cool, snowy, and damp (Sesli *et al.* 2015).

The average annual rainfall is 867 mm, and the average annual temperature is 12.7°C. The hottest month of the year is August, and the coldest month is January (URL 1).

The most common trees and shrubs are *Alnus glutinosa* (L.) Gaertn., *Carpinus betulus* L., *Carpinus orientalis* Mill., *Corylus avellana* Thunb., *Acer platanoides* L., *Fagus orientalis* Lipsky, *Picea orientalis* (L.) Peterm., *Rhododendron luteum* Sweet, *Rhododendron ponticum* L. and various *Quercus* L.

MATERIAL AND METHODS

Kümbet Plateau was chosen as the study area for the project. In the bryological survey conducted in Kümbet plateau, Dereli district, Giresun Province (Turkey), *Pohlia* specimens were collected by N. Batan, M. Alataş and H. Erata, whereas *Oleolophozia* specimen was collected by N. Batan and H. Erata. Identifications were made using various floras and keys (Nieuwkoop & Bisang 1993; Nyholm 1993; Smith 1996, 2004; Paton 1999; Pedrotti 2001; Guerra *et al.* 2006; Frey *et al.* 2006; Söderström *et al.* 2010; Bakalin 2011).

The status of these taxa was evaluated by reviewing the related literature for Turkey (Kürschner & Frey 2011; Ros *et al.* 2013), south-west Asia (Kürschner & Frey 2011), and later bryological publications (Ellis *et al.* 2017).

Voucher specimens are kept in a special collection at the Biology Department, Faculty of Science, Karadeniz Technical University, Turkey (KTUB).

RESULTS

Family Cephaloziellaceae Douin
Genus *Oleolophozia* L. Söderstr., De Roo & Hedd.

Oleolophozia perssonii (H.Buch & S.W.Arnell) L.Söderstr., De Roo & Hedd.
(Fig. 2)

Specimen examined. — **Turkey** (Giresun province). Dereli district, Kümbet plateau, Başoba, 40°31'48"N, 38°29'01"E, 2000-2050 m, 10.VII.2019, leg. H. Erata, M. Alataş and N. Batan, KTUB[KTUB 1606].

Ecology. — *Oleophozia perssonii* grows on chalk, limestone or basic soil in open habitats (Smith, 1990). In addition, it is found in green patches or mixed with other bryophytes on other calcareous substrates (Frey *et al.* 2006). Turkish specimens collected in Kümbet plateau, in alpine meadow vegetation, near a stream, on chalk and basic moist soil in open habitats, together with *Brachythecium rivulare* Schimp., *Calliergonella cuspidata* (Hedw.) Loeske, *Rhizomnium punctatum* (Bruch & Schimp.) T.J.Kop., *Climacium dendroides* (Hedw.) F. Weber & D. Mohr. and *Pellia epiphylla* (L.) Corda.

Distribution. — Europe (Denmark, Finland, Norway, Sweden, Britain, Ireland, Andorra, France, Italy, Austria, Belgium, Germany, Netherlands, Switzerland, Estonia, North Russia); America (Canada, Greenland and Alaska); Asia (Georgia, Siberia) (Smith 1996; Paton 1999; Frey *et al.* 2006; Bakalin & Tigishvili 2013; Dulin 2013; Hodgetts 2015; Söderström *et al.* 2015, 2016; Hodgetts *et al.* 2019).

Description

Plants

Small, up to 5 mm long, pale green to bright yellow-green, sometimes brownish. Stems, simple or branched, green to reddish-brown.

Leaves

Yellowish-green or green, 1-1.2 mm long and 0.7-1 mm wide, bifid and asymmetrical.

Cells
20-32 ×30-70 µm, thin walled, trigones absent or small, oil bodies 4-10 per cell.

Underleaves
Lacking.

Shoots
With apical clusters of yellowish red gemmae, 1-2 celled with one cell larger than the other, one or both cells with 1-2 large and often several smaller oil bodies.

REMARKS
Since *Lophozia perssonii* H.Buch & S.W.Arnell is shown to be very different from other taxa belonging to the *Lophozia* genus, it was transferred to a new monotypic genus, *Oleolophozia* L.Söderstr., De Roo & Hedd. based on molecular evidence and persistent oil bodies in gemmae (Söderström *et al.* 2010).

The species resembles *Lophoziopsis excisa*, but differs in the gemmae, some cells of which contain one or two large persistent oil bodies. Similar oil globules occasionally develop in *Isopaches bicrenata* gemmae when the plants are dried. Besides, *O. perssonii* resembles *Mesoptychia badensis* and *M. turbinata,* but it differs from them by the presence of gemmae and the apex of the leaf lobes not being round (Smith 1996; Nieuwkoop & Bisang 1993; Paton 1999; Frey *et al.* 2006; Söderström *et al.* 2010).

Oleophozia perssonii is classified as least concern in the IUCN Red List of European bryophytes (Hodgetts *et al.* 2019).

Family BRYACEAE Rchb.
Genus *Pohlia* Hedw.

Pohlia lescuriana (Sull.) Ochi
(Fig. 3)

SPECIMEN EXAMINED. — **Turkey** (Giresun province): Dereli district, Kümbet plateau, streamside, on moist soil, in the forest (*Picea orientalis* (L.) Link), 40°33'04"N, 38°27'18"E, 1610-1630 m, 11.VII.2019, leg. H. Erata, M. Alataş and N. Batan, KTUB[KTUB 1607].

ECOLOGY. — *Pohlia lescuriana* usually grows on damp clayey soil on banks by streams, ditches, reservoirs, paths, on woodland rides and in fields (Smith 2004). In addition, *P. lescuriana* can be found on soil in exposed and disturbed habitats (Ireland 1982). Turkish specimens collected in Kümbet plateau, on damp soil, streamside in area of *Picea oritalis* forest. It was found together with *Mnium spinosum* (Voit) Schwägr, *Philonotis fontana* (Hedw.) Brid., *Brachythecium albicans* (Hedw.) Schimp., *Ptychostomum moravicum* (Podp.) Ros & Mazimpaka, *P. pseudotriquetrum* (Hedw.) J.R. Spence & H.P. Ramsay var. *pseudotriquetrum* and *Marchantia polymorpha* L.

DISTRIBUTION. — Europe (Denmark, Finland, Norway, Sweden, Britain, Ireland, Corsica, France, Italy, Portugal, Spain, Austria, Belgium, Czech Republic, Germany, Netherlands, Poland, Slovakia, Switzerland, Hungary, Romania, Serbia, Slovenia, Arctic Russia, Central Russia, NE Russia, NW Russia, Estonia, Latvia, Lithuania, Sub-polar & North Urals, Ukraine); North America; Asia (China, Japan) (Nyholm 1993; Smith 2004; Frey *et al.* 2006; Da-cheng *et al.* 2007; Ros *et al.* 2013; Hodgetts 2015; Hodgetts *et al.* 2019).

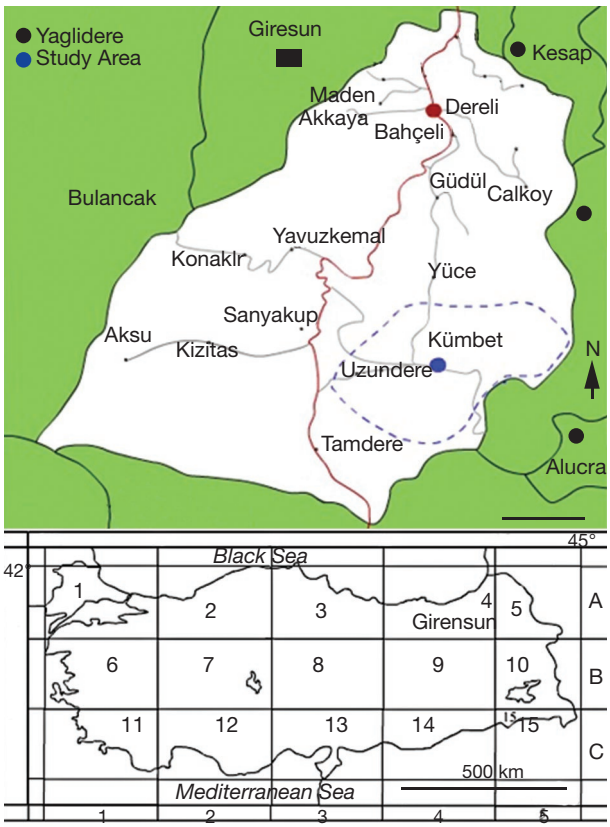

FIG. 1. — Map of the Study area

DESCRIPTION
Plants
Small, 0.3-1.2 cm, dull green, pale green or green to yellowish green, lacking metallic sheen; stems brownish.

Leaves
1-3 mm long, flexuose when dry, erect to erect-spreading when moist. Leaves ovate-lanceolate, margin denticulate in upper part, slightly recurved below; costa green to brownish green, ending in or below apex; cells thin walled, narrowly rhomboidal to linear-rhomboidal.

Gemmae
Present on rhizoids, pale brown, spherical, ellipsoid or pyriform.

Capsules
With superficial stomata, brownish, neck short or capsules lacking; outer peristome teeth yellow, inner peristome thin and hyaline; spores 12-16 µm.

REMARKS
This species is similar to *Pohlia lutescens* (Limpr.) H. Lindb. but differs in the morphology of the rhizoidal gemmae (Ireland 1982; Nyholm 1993; Smith 2004; Guerra *et al.* 2006).

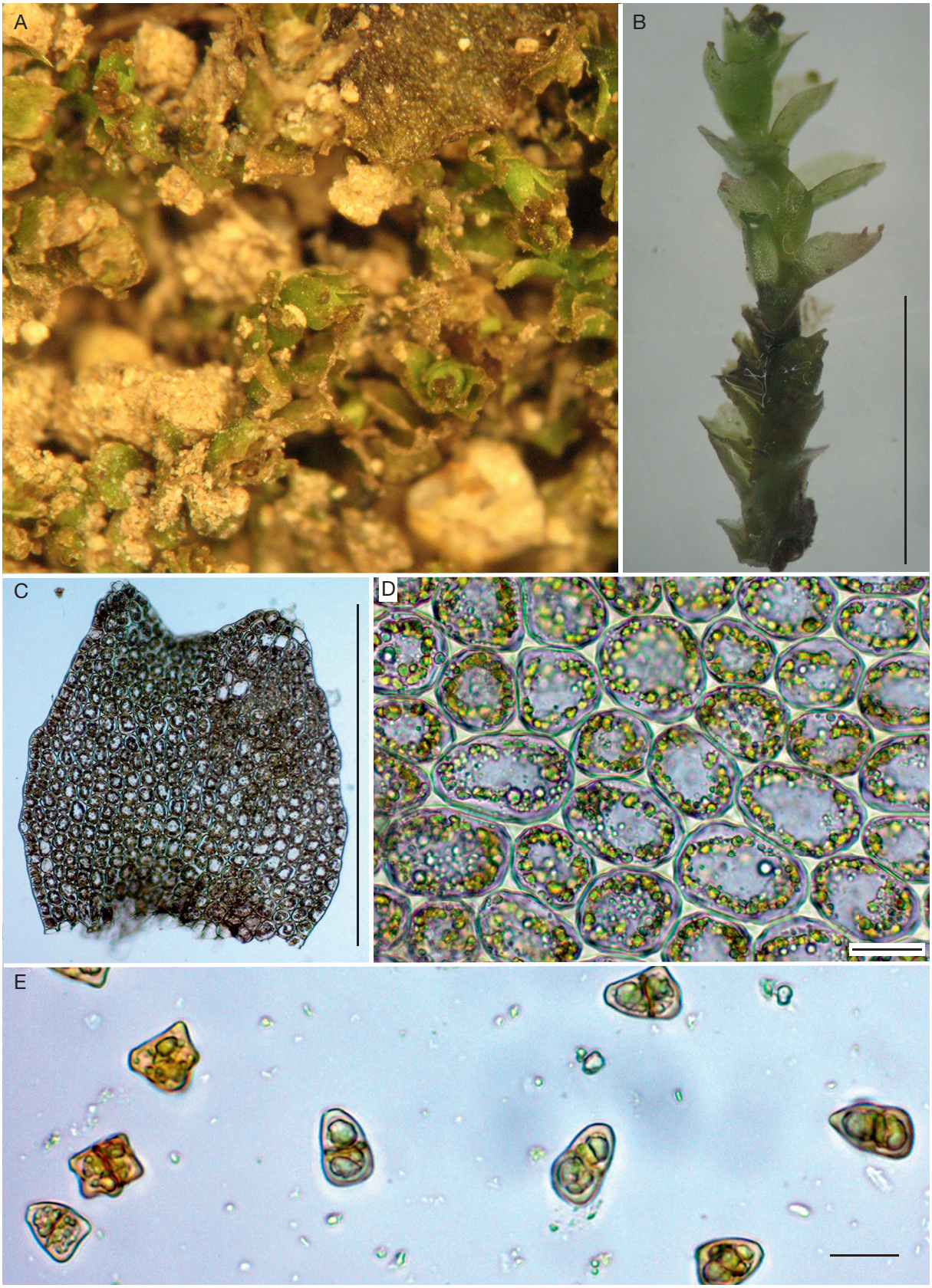

Fig. 2. — *Oleolophozia perssonii* (H.Buch & S.W.Arnell) L.Söderstr., De Roo & Hedd., KTUB 1606: **A**, habit, **B**, shoot (wet), **C**, leaf, **D**, mid-leaf cells, **E**, gemmae. Scale bars: B, 2 mm; C, 1 mm; D, E, 20 µm.

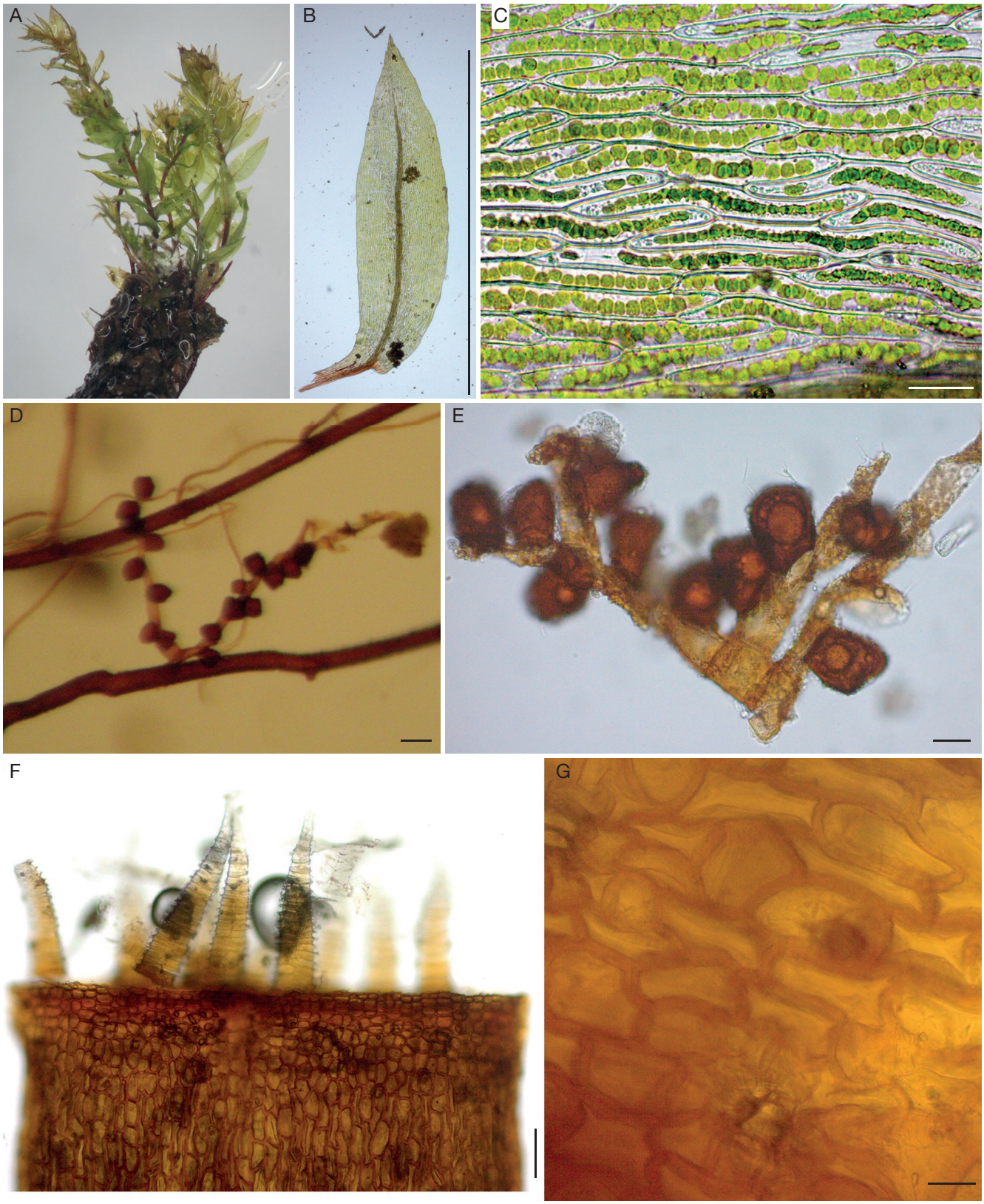

Fig. 3. — *Pohlia lescuriana* (Sull.) Ochi, KTUB 1607: **A**, habit; **B**, leaf; **C**, mid-leaf cells; **D**, **E**, rhizoidal gemmae; **F**, capsule; **G**, stoma. Scale bars: B, 2 mm; C-F, 20 µm.

Fig. 4. — *Pohlia lutescens* (Limpr.) H. Lindb., KTUB 1608: **A**, habit, **B**, shoot (wet), **C**, leaf, **D**-**F**, rhizoidal gemmae. Scale bars: B, 2 mm; C, 1.8 µm; D-F, 20 µm.

Pohlia lutescens (Limpr.) H. Lindb.
(Fig. 4)

SPECIMENS EXAMINED. — **Turkey** (Giresun province). Dereli district, Kümbet plateau, on soil, 40°35'28"N, 38°26'59"E, 1230-1260 m, 08.VII.2019 leg. H. Erata & N. Batan, M. Alataş, KTUB[KTUB 1608].

ECOLOGY. — *Pohlia lutescens* usually grows on wet soil and bare soil in open conditions on streamside. (Atherton *et al.* 2010). Additionally, this species grows on paths and on ditches (Bezgodov & Ignatova 2013). Turkish specimens collected in Kümbet plateau, in area of mix forest (*Picea orientalis* (L.) Link, *Alnus glutinosa* (L.) Gaertner, *Castanea Sativa* Mill, *Fagus orienntalis* Lipsky.). It was found together with *Polytrichum commune* Hedw., *Ptychostomum moravicum* (Podp.) Ros & Mazimpaka, *Pohlia wahlenbergii* (F.Weber & D.Mohr) A.L.Andrews, *Brachythecium rivulare* Schimp., *Sanionia uncinata* (Hedw.) Loeske, *Calliergonella cuspidata* (Hedw.) Loeske, *Dichodontium pellucidum* (Hedw.) Schimp. and *Oxyrrhynchium hians* (Hedw.) Loeske.

DISTRIBUTION. — Europe (Italy, Britain, Ireland, Northern Ireland, Corsica, Sicily, Poland, Channel Islands, Sweden, Denmark, Bulgaria, Austria, Belgium, Czech Republic, Germany, Luxemburg, Netherlands, Slovakia, Switzerland, Hungary, Macedonia, Slovenia, Yugoslavia, France, Serbia, Russia, Middle and South Urals); Asia (Mongolia, China, and Turkey) (Smith 2004; Frey *et al.* 2006; Bezgodov & Ignatova 2013; Ros *et al.* 2013; Hodgetts 2015; Ellis *et al.* 2017; Hodgetts *et al.* 2019).

DESCRIPTION

Plants

Small, thin, pale yellow-green.

Leaves

Narrow lanceolate to linear-lanceolate, acuminate towards apex, margins plane and denticulate upper part of leaves. Pale yellow-green leaves 1-3 mm long. Costa excurrent in upper leaves and ending below apex in stem leaves, percurrent.

Cells

Narrowly rhomboidal in leaves. Pale yellow, brownish, ellipsoid to ovoid knobbly rhizoidal gemmae.

REMARKS

This species is similar to *Pohlia lescuriana*, but different in terms of having brownish, ellipsoid to ovoid knobbly rhizoidal gemmae. *P. lutescens* is close to *P. melanodon* (Brid.) A.J.Shaw, but can easily be distinguished from latter by knobbly rhizoidal gemmae (Smith 2004; Atherton *et al.* 2010; Bezgodov & Ignatova 2013; Ellis *et al.* 2017).

Pohlia lutescens was first reported from Sakarya province, Samanlı Mountain, Kartepe district, on soil by Ellis *et al.* (2017) in Turkey. This record, which is about 1000 km away from the first locality, extends its distribution range to the Eastern Black Sea Region in Turkey.

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A key to *Pohlia* Hedw. taxa in Turkey

1. Axillary bulbil present 2
— Axillary bulbil absent..... 9

2. Bulbil single in axils in upper part of stems 3
— Bulbils numerous axils in upper part of stems..... 4

3. Bulbils reddish brown, plant glossy and dark green to reddish.....
..... *Pohlia drummondii* (Müll.Hal.) A.L.Andrews
— Bulbils yellowish, bulbil oblong or elliptic..... *Pohlia filum* (Schimp.) Mårtensson

4. Bulbils 2-8 per leaf axil, narrowly elongate, oblong, obconic 5
— Bulbils numerous per axil in upper part of stems, yellowish green or orange, ovoid or vermiform 6

5. Bulbils yellowish green, spheroid to obovate..... *Pohlia bulbifera* (Warnst.) Warnst.
— Bulbils ovoid, oblong or obconic sessile..... *Pohlia annotina* (Hedw.) Lindb.

6. Bulbils oblong, knobby in outline ..... *Pohlia flexuosa* Harv.
— Bulbils opaque not knobby in outline 7

7. Bulbils spheroid, stalked, obconic or linear..... *Pohlia camptotrachela* (Renauld & Cardot) Broth.
— Bulbils oblong- linear, not lked 8

8. Plants dull, bulbils ovoid, oblong, sessile ..... *Pohlia annotina* (Hedw.) Lindb.
— Plants glossy, bulbils linear-vermicular..... *Pohlia proligera* (Kindb.) Lindb. ex Broth.

9. Mid leaf cells large, more than 12 µm wide 10
— Mid-leaf cells narrow, less than 12 µm narrow..... 12

10. Leaf bases long-decurrent ..... *Pohlia ludwigii* (Spreng. ex Schwägr.) Broth.
— Leaf bases not long-decurrente 11

11. Plants brightly colored, leaves ovoid lanceolate or short lanceolate .....
..... *Pohlia wahlenbergii* (F.Weber & D.Mohr) A.L.Andrews
11/1 Plants whitish green, up to 6 cm tall; leaves ovate to ovate-lanceolate.....
.....*Pohlia* (F.Weber & D.Mohr) A.L.Andrews var. *wahlenbergii*
11/2 Plants pale green, robust, up to 15 cm tall; leaves ovate.....
..... *Pohlia* (F.Weber & D.Mohr) A.L.Andrews var. *glacialis* (Brid.) E.F.Warb.
11/3 Plants small, up to 1.5 cm tall; leaves lanceolate.....
..... *Pohlia* (F.Weber & D.Mohr) A.L.Andrews var. *calcarea* (Warnst.) E.F.Warb.
— Plant dark green, leaves narrow lanceolate and 1,5 -2 cm tall..... *Pohlia melanodon*

12. Plants bright and smooth, leaves ovoid, lanceolate..... *Pohlia cruda* (Hedw.) Lindb.
— The plant is dull and not smooth, very few rhizoids..... 13

13. Plants small, up to 3 mm tall, leaves lanceolate to ovate-lanceolate, capsule small.....
..... *Pohlia atropurpurea* (Wahlenb.) H.Lindb.
— Mid-leaf cells of upper leaves 10-14 µm wide or if less then costa ending in or below apex of upper lees.....
..... 14

14. Plants autoicous or paroicous, capsule with long neck, leaves same size narrowly lanceolate .....
..... *Pohlia elongata* Hedw.
14/1 Upper part of leaves 2-4 mm long, mid-leaf cells of leaves 60-110 µm..... *Pohlia* Hedw. var. *elongata*
14/2 Upper part of leaves 1-2.5 mm long; mid-leaf cells of leaves 40 µm long .....
..... *Pohlia* Hedw. var. *greenii* (Brid.) A.J.Shaw
— Plants dioicous; capsule with neck shorter or capsules absent 15

15. Plants pale green, up to 2.5 tall, capsule brownish, stem reddish .....
..... *Pohlia obtusifolia* (Vill. ex Brid.) L.F.Koch
— Plants dioicous, capsule with neck shorter or capsules absent 16

16. Plants shorter than 1 cm tall, rhizoidal gemmae present 17
— Plants up to 1 cm or more tall, rhizoidal gemmae absent..... 18

17. Plants bright yellow green, rhizoidal gemmae yellowish, rounded, knobby in outline ..... *Pohlia lutescens* (Limpr.) H. Lindb.
— Plant small, some glosyy, rhizoidal gemmae brownish, elliptical to pyriform, not knobbly in outline ..... *Pohlia lescuriana* (Sull.) Ochi

18. Plants yellowish-green, smoth, leaf cells thin-walled ..... *Pohlia longicolla* (Hedw.) Lindb.
— Plants dull dark gren 19

19. Spores 20-25 µm in diameter; capsules yellowish-brown, elongate pyriform to elliptical, plant up to 7.5 cm tall, leaves lanceolate, costa percurrent leaf cells thick-walled ..... *Pohlia nutans* (Hedw.) Lindb.
19/1 Capsule almost ellipsoid, perichaetial leaves narrowly lanceolate ..... *Pohlia* var. *nutans* (Hedw.) Lindb. var. *nutans*
19/2 Capsule ovate-ellipsoid, perichaetial leaves shorter, crowded..... *Pohlia nutans* (Hedw.) Lindb. var. *bicolor* (Hoppe & Homsch.) Hult.
— Spores 12-15 µm in diameter; setae longer than in *P. nutans*, in bogs amongst Sphagna ..... *Pohlia sphagnicola* (Bruch & Schimp.) Broth.

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