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Three remarkable moss species new to Türkiye and Southwest Asia

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Three remarkable moss species new to Türkiye and Southwest Asia

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ABSTRACT

KEY WORDS

Andreaea,
Türkiye,
biodiversity,
bryophyte,
Iwatsukiella,
new records.

Iwatsukiella leucotricha (Mitt.) Buck & Crum., *Andreaea alpestris* (Thed.) Schimp., and *Andreaea mutabilis* Hook.f. & Wilson are newly recorded in Türkiye and Southwest Asia, following a recent bryological survey in the Artvin region. Additionally, the genus *Iwatsukiella* W.R.Buck & H.A.Crum. has been introduced as a new record for Türkiye's bryophyte flora. This study provides brief descriptions, illustrations, and data on the geographic distribution and ecological preferences of these species, along with comparisons to morphologically similar species.

RÉSUMÉ

MOTS CLÉS
Andreaea,
Turquie,
biodiversité,
bryophyte,
Iwatsukiella,
nouveaux signalements.

Trois espèces remarquables de mousses inédites en Turquie et en Asie du Sud-Ouest. *Iwatsukiella leucotricha* (Mitt.) Buck & Crum., *Andreaea alpestris* (Thed.) Schimp. et *Andreaea mutabilis* Hook.f. & Wilson ont été récemment répertoriées en Turquie et en Asie du Sud-Ouest, à la suite d'une étude bryologique menée récemment dans la région d'Artvin. De plus, le genre *Iwatsukiella* W.R.Buck & H.A.Crum. a été introduit comme nouveau genre dans la flore bryophyte de Turquie. Cette étude fournit de brèves descriptions, des illustrations et des données sur la répartition géographique et les préférences écologiques de ces espèces, ainsi que des comparaisons avec des espèces morphologiquement similaires.

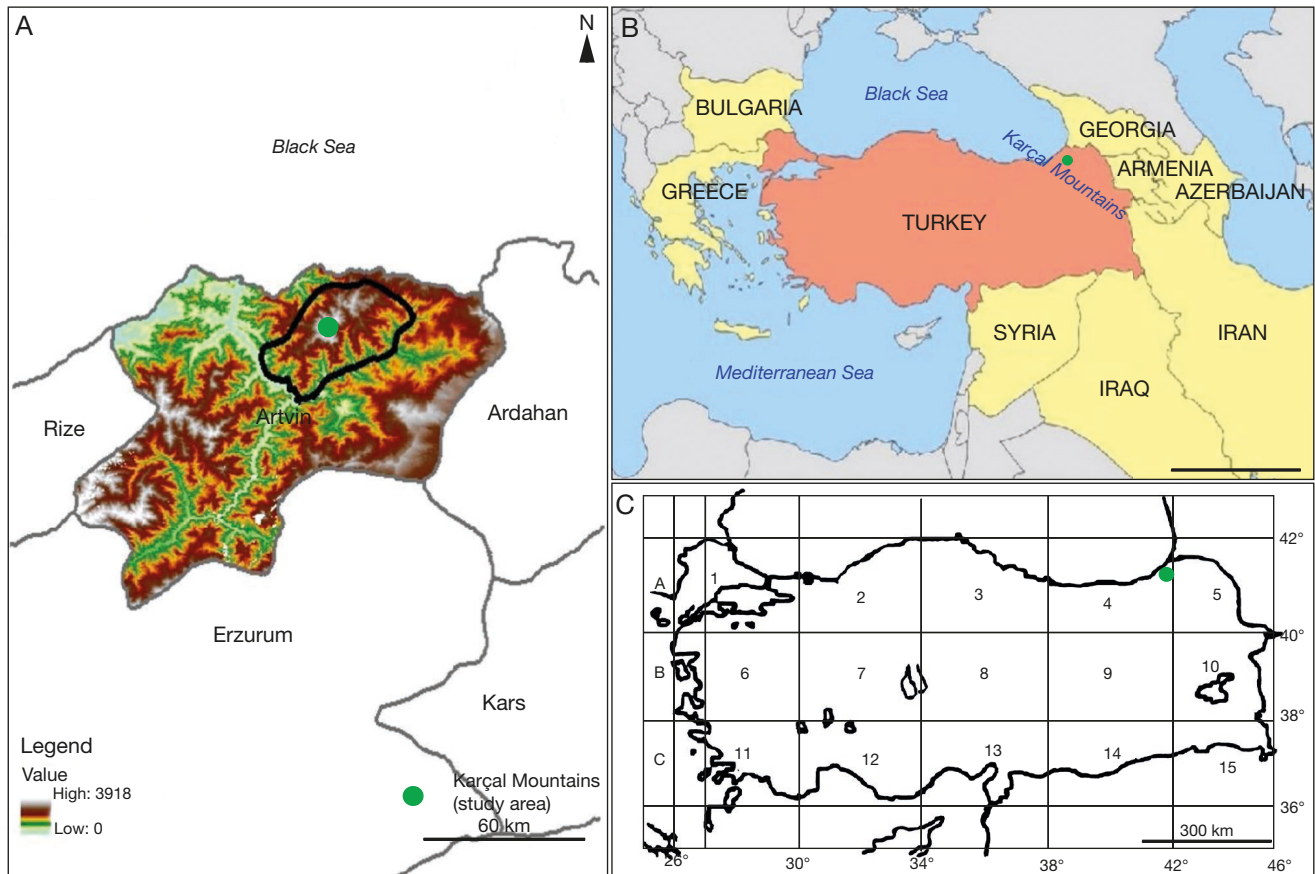


FIG. 1. — Location of research area. **A**, Location of the research area in the Karçal Mountains; **B**, Türkiye and neighboring countries; **C**, The geographical location of the study area (green dots) are determined within the grid system of Türkiye as delineated by Henderson (1961).

INTRODUCTION

The Karçal Mountains, a range extending from the Çoruh Valley to the Georgian border, rise from an altitude of 500 m to a peak of 3 545 m a.s.l. (Fig. 1). The region exhibits diverse climatic influences: the Çoruh Valley experiences a sub-Mediterranean climate, while the northern slopes of the Karçal Mountains are influenced by the Black Sea climate. In contrast, the southern slopes experience a mix of sub-Mediterranean and continental climates, shaped by the valley's influence. The eastern and higher elevations of the range are characterized by a more pronounced continental climate (Eminağaoğlu 2015; Fig. 1).

Studies on the bryophyte flora in Türkiye have predominantly focused on the Aegean, Mediterranean, Central Anatolia, Marmara, and Black Sea regions. Although some research has investigated bryophytes in Artvin province and its surrounding areas (Gökler & Öztürk 1992; Townsend 2005; Özdemir *et al.* 2008; Batan & Özdemir 2008, 2012, 2013a, b; Blockeel *et al.* 2009; Batan *et al.* 2014; Alataş *et al.* 2018), there remains a notable scarcity of studies specifically investigating the bryophyte flora of the Karçal Mountains.

The research area encompasses three distinct vegetation types: forest, subalpine, and alpine zones. The dominant vegetation is forest, characterized by mixed woodlands primarily

composed of *Abies nordmanniana* (Steven) Spach subsp. *nordmanniana*, *Picea orientalis* (L.) Link, *Ulmus glabra* Mill., *Castanea sativa* Mill., *Fagus orientalis* Lipsky, *Quercus petraea* subsp. *iberica* (Steven ex M.Bieb.) Krassiln., *Alnus glutinosa* (L.) Gaertn, *Populus tremula* L., *Salix caucasica* Andersson, *Carpinus betulus* L., *Corylus avellana* L., *Rhododendron luteum* Sweet, *R. ponticum* L., *Prunus laurocerasus* L., *Rubus platyphyllus* C. Koch., *Crataegus microphylla* K. Koch., *C. monogyna* subsp. *monogyna* Jacq., *Ilex colchica* Pojark., *Acer campestre* var. *campestre* L. and *Fraxinus angustifolia* subsp. *oxycarpa* (M. Bieb. ex Willd.) Franco & Rocha Afonso (Eminağaoğlu 2015; Yılmaz 2016).

MATERIAL AND METHODS

In 2022, c. 7500 bryophyte samples were collected from various localities across different habitats and substrates in the Karçal Mountains. The UTM WGS84 coordinate system was used to record the coordinates of each collection site. The moss samples were examined using both stereomicroscope and light microscope, and species identification was conducted by consulting key bryological references (Murray 1988; Noguchi *et al.* 1991; Gao & Crosby 1999; Wu *et al.* 2002; Smith 2004; Frey *et al.* 2006; Brugués *et al.* 2007;



FIG. 2. — *Iwatsukiella leucotricha* (Mitt.) Buck & Crum.: **A**, habit; **B**, shoot (Dry); **C-E**, leaves; **F**, alar cells; **G**, hair point; **H**, leaf tip; **I**, leaf margin cells. Scale bars: A, 2 cm; B, 1 cm; C-E, 200 µm; F, G, I, 50 µm; H, 100 µm.

Lüth 2019). The taxonomic status of each species was assessed through a review of the relevant Turkish literature (Ros *et al.* 2013; Erdağ & Kürschner 2017; Hodgetts & Lockhart 2020; Kürschner & Frey 2020), with nomenclature and synonyms

aligned with the classification system established by Hodgetts *et al.* (2020) was followed in terms of nomenclature and synonyms. The voucher specimens are in the private bryophyte collections of the second author (Batan) (*Batan 1626*,

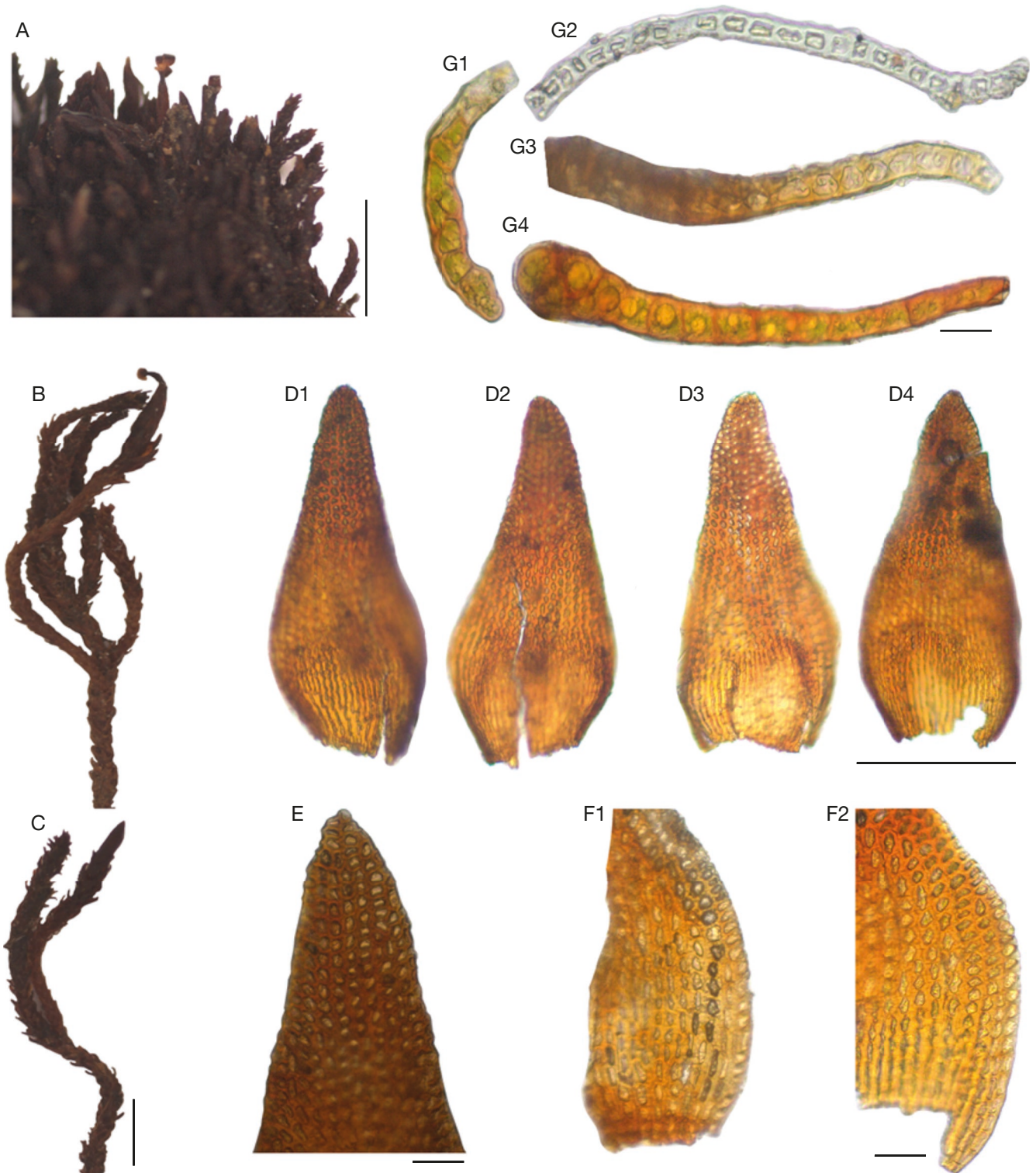


FIG. 3. — *Andreaea alpestris* (Thed.) Schimp.: **A**, habit; **B**, **C**, shoot (dry); **D1-D4**, leaves; **E**, leaf apex; **F1**, leaf base (alar cells); **F2**, leaf base (alar cells); **G1**, cross section of the upper part of the leaf; **G2**, cross section of the lower part of the leaf; **G3**, cross section of the lower part of the leaf; **G4**, cross section of the lower part of the leaf. Scale bars: A, 2 mm; B, C, 1 mm; D, 0.5 mm; E, F, 100 µm; G, 20 µm.

Batan 1627, *Batan 1628*) at the Department of Molecular Biology and Genetics, Faculty of Science, Karadeniz Technical University, Trabzon, and in the special collections of

the first author (Erata) (*Erata 1216*, *Erata 1217*, *Erata 1218* (Herb. Erata) at the Kürtün Vocational School, Gümüşhane University, Türkiye.

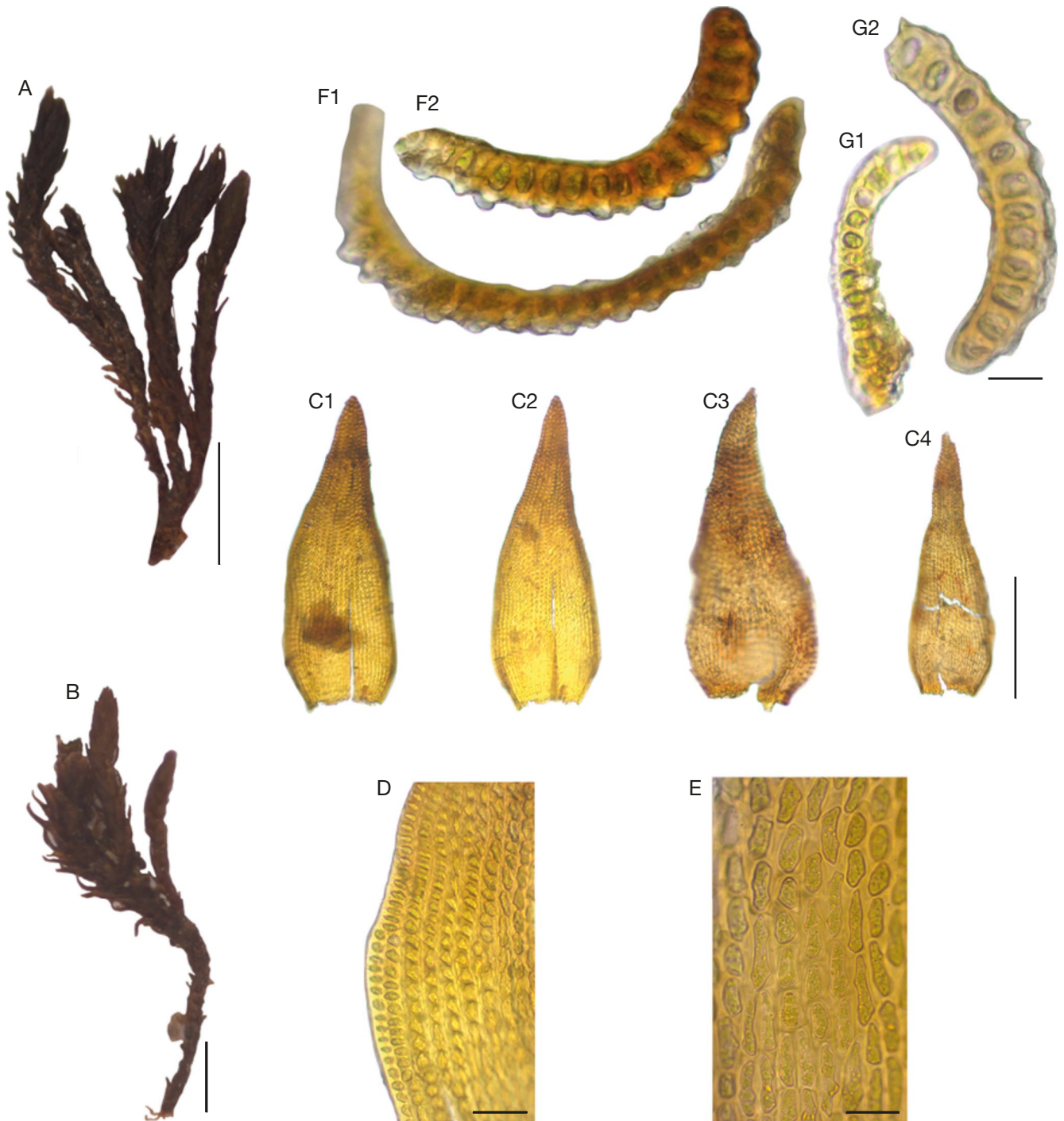


FIG. 4. — *Andreaea mutabilis* Hook.f. & Wilson: **A, B**, shoot (dry); **C1-C4**, leaves; **D**, leaf base (alar cells); **E**, basal cells; **F1, F2**, cross section of the lower part of the leaf; **G1, G2**, cross section of the upper part of the leaf. Scale bars: A, 2 mm; B, 1 mm; C, 0.5 mm; D, E, 200 μ m; F, G, 20 μ m.

RESULTS

Family NECKERACEAE Schimp.
Genus *Iwatsukiella* W.R.Buck & H.A.Crum.

**Iwatsukiella leucotricha* (Mitt.) W.R.Buck & H.A.Crum
(Fig. 2)

SPECIMEN EXAMINED. — Türkiye • Artvin province; Artvin, Irsa Plateau, on tree trunks (*Abies nordmanniana* (Stev.) Spach. subsp. *nordmanniana*); 2014 m alt.; 41°51'54.7"N, 41°15'47.7"E; 24.VIII.2022; leg. N. Batan, H. Erata, N. Batan, H. Erata, KTUB[KTUB1626]; duplicate in *Erata 1215* (Herb. Erata).

ECOLOGY. — *Iwatsukiella leucotricha* typically grows on tree trunks and fallen logs of *Abies* and *Picea*, and is occasionally on rock faces and in crevices (Dierßen 2001). In Türkiye, the specimens were collected

from tree trunks of *Abies nordmanniana* (Stev.) Spach. Subsp. *nordmanniana* on the İrsä Plateau, Karçal Mountains, in the Artvin region.

DISTRIBUTION. — *Iwatsukiella leucotricha* is distributed across Europe (notably in the European part of Russia); Asia (including Georgia, China, and Japan); and North America (in Canada, Alaska, and Oregon) (Ignatov *et al.* 2006; Hodgetts & Lockhart 2020; GBIF 2024: <https://www.gbif.org/species/2681265>). This record demonstrates that the *Iwatsukiella leucotricha*, previously known from North America and eastern Asia, has extended its distribution further within Asia, marking a new location. The majority of records for *Iwatsukiella leucotricha* are from Russia. In the European part of Russia, it has been documented in the Republic of Bashkortostan (Bashkiria) and the Perm Territory. In Asiatic Russia, occurrences span across numerous regions, including the Chukotka Autonomous Area, Khanty-Mansi Autonomous Area-Yugra, Republic of Sakha (Yakutia), Magadan Region, Irkutsk Region, Khabarovsk Territory, Kamchatka Territory, Commander Islands, Republic of Altai, Kemerovo Region, Republic of Buryatia, Trans-Baikal Territory, Amur Region, Primorye Territory, and Sakhalin Region (encompassing Sakhalin Island and the Kuril Islands). (Ignatov 1994; Ignatova *et al.* 1995, 1996, 2013; Ignatov *et al.* 2001; Czernyadjeva & Potemkin 2003; Zolotov & Baisheva 2003; Bakalin *et al.* 2009a; b; Pisarenko 2014; Fedosov *et al.* 2016; Afonina *et al.* 2018; Pisarenko & Bakalin 2018; Dudov *et al.* 2018; Pisarenko *et al.* 2022). This new record represents the westernmost and southernmost points of *Iwatsukiella leucotricha*'s global distribution. Additionally, this locality establishes it as both the southernmost occurrence of the species worldwide and the closest point to Europe within its distribution range.

DESCRIPTION

Plants small, slender 0.7–1.7 cm high, pale to yellowish-green. Stem creeping, densely pinnately branched. Branch 1–4 mm high and densely leaved. Leaves reflexed when moist and imbricate when dry. Leaves 1–2 mm tall and 0.2–1.3 mm wide, rounded or rounded ovate at base, and long, clear, hairpoint on the tip. Alar cells not clearly differentiated. Median leaf cells oblong or rhomboidal. Costa absent, or short and double.

Iwatsukiella leucotricha bears resemblance to *Habrodon perpusillus* (De Not.) Lindb., yet it can be differentiated by its long, transparent hairpoint at the leaf tip and its undifferentiated alar cells. *Iwatsukiella leucotricha* is also morphologically close to *Heterocladia dimorpha* (Brid.) Ignatov & Fedosov, from which it is distinguished by similar features: a long, clear hairpoint at the leaf tip and undifferentiated alar cells. Additionally, *Heterocladia dimorpha* differs by its denticulate leaf margins and papillose cell surfaces, further setting it apart from *Iwatsukiella leucotricha*.

REMARKS

Iwatsukiella leucotricha was most recently assessed for the IUCN Red List of Threatened Species in 2017, where it is categorized as Least Concern (LC) (Baisheva *et al.* 2019). This assessment, documented under the Europe region, is accessible in the IUCN Red List of Threatened Species (2019: e.T87468107A87758253), with data available as of March 26, 2024.

Family ANDREAEACEAE Dumort.
Genus *Andreaea* Hedw.

**Andreaea alpestris* (Thed.) Schimp.
(Synonymous; *Andreaea rupestris*
var. *alpestris* (Thed.) Sharp) (Fig. 3).

SPECIMEN EXAMINED. — **Türkiye** • Artvin province, Borçka district, exit of Beyazsu Plateau, Road to Yıldız Lake, valley interior, on rock; 2459 m alt.; 41°57'59.3"N, 41°21'38.0"E; 23.VI.2022 • Borçka district, Beyazsu Plateau, road to Yıldız Lake, on rock; 2496 m alt.; 41°57'47.7"N, 41°22'10.1"E; 24.VI.2022 • Borçka district, above Kuyruklu Lake, rocky area, on rock; 2720 m alt.; 42°3'32.6"N, 41°24'57.1"E; 23.VIII.2022 • Borçka district, between Çikunet Plateau and Saymiye ridge, on rock; 2760 m alt.; 42°1'6.4"N, 41°22'36.8"E; 23.VIII.2022; *leg.* N. Batan, H. Erata, N. Batan, H. Erata, KTUB[KTUB1627]; duplicate in *Erata 1216* (Herb. Erata).

ECOLOGY. — *Andreaea alpestris* typically grows on periodically wet rocks and lithosols often near snow beds. Also grows on rocks in subalpine and alpine habitats (Dierßen 2001; Smith 2004; Frey *et al.* 2006).

DISTRIBUTION. — *Andreaea alpestris* has a broad distribution, found in Europe (Finland, Norway, Sweden, Great Britain, Andorra, Corsica, France, Italy, Madeira, Spain, Austria, Poland, Switzerland, Bulgaria, North Macedonia, Romania, Caucasus (in Europe); Arctic Russia (NW Russia); Ukraine; Asia (China); America (Subarctic America, EW America, Canada, Guatemala, Honduras, Costa Rica); (Murray 1988; Allen 1994; Smith 2004; Hodgetts & Lockhart 2020).

DESCRIPTION

Plants small, 1.0–3.4 cm high, reddish black, black or greenish brown cushions. Shoots 1.4–1.8 cm high. Leaves 0.4–0.8 mm long, usually straight, imbricate, lanceolate, widest above the base. Leaf margins entire, plane or slightly incurved. Costa absent; basal cells short rectangular. Upper cells of leaf almost quadrate. Papillae on the dorsal surface of the leaves low or absent. Perichaetial leaves differentiated, sheathing, convolute and 1.1–1 mm long and 0.5–0.6 mm wide (Murray 1988; Smith 2004; Frey *et al.* 2006).

This species closely resembles *Andreaea rupestris* Hedw., but it differs by having straight leaves and low or absent papillae on the dorsal leaf surface. Additionally, *A. alpestris* is distinct from *A. rupestris* due to its smaller, imbricate, obtuse leaves and the non-porose nature of the upper leaf cells. *Andreaea alpestris* also bears similarities to *Andreaea mutabilis* Hook.f. & Wilson; however, it can be differentiated by its typically straight leaves and the low or absent papillae on the leaf surface (Murray 1988; Smith 2004; Frey *et al.* 2006; Zander 2007).

REMARKS

The species was last assessed for the IUCN Red List in 2017 and is currently classified as Data Deficient (DD) (Hallingbäck *et al.* 2019; IUCN Red List of Threatened Species, 2019: e.T83659776A87832177, accessed on July 8, 2024).

Family ANDREAEACEAE Dumort.
Genus *Andreaea* Hedw.

**Andreaea mutabilis* Hook.f. & Wilson
(Fig. 4)

SPECIMEN EXAMINED. — **Türkiye** • Artvin province, Borçka district, Balçıköy Plateau, power plant surroundings on rock; 2095–2150 m alt.; 41°56'36.2"N, 41°20'35.7"E; 22.VI.2022 • Borçka district, Beyazsu Plateau, on rock; 2356 m alt.; 41°57'36.1"N, 41°21'18.4"E;

23.VI.2022; *leg.* N. Batan, H. Erata, *det.* N. Batan, H. Erata, KTUB[KTUB1628]; duplicate in *Erata 1217* (Herb. Erata).

ECOLOGY. — *Andreaea mutabilis* typically grows on dry to wet, exposed acidic rocks. It is also found on periodically wet acid boulders crags or rubble, rarely on thin soil over rocks (Dierßen 2001; Smith 2004; Frey *et al.* 2006).

DISTRIBUTION. — *Andreaea mutabilis* is distributed across various regions, including Europe (Faro Islands, Great Britain, Andorra, France, Spain); Asia (Taiwan, China, and Malaysia); the Americas (North and South America); Oceania (New Guinea, Australia, Tasmania, and New Zealand); (Chiang 1998; Gao & Crosby 1999; Smith 2004; Hodgetts & Lockhart 2020).

DESCRIPTION

Plants small, 1.0–1.2 cm high, reddish to black cushions. Shoots 0.4–1 cm high. Leaves 0.4–0.7 mm long, erect-spreading and straight, lanceolate, widest above the base, acuminate to acute apex. Costa absent. Leaf margins entire, incurved. Basal laminal cells rectangular, basal marginal cells isodiametric, median laminal cells rounded-quadrate or rhomboid. Perichaetial leaves oblong-lingulate, acuminate (Murray 1988; Smith 2004; Frey *et al.* 2006).

Andreaea mutabilis closely resembles *Andreaea sinuosa* B.M. Murray but can be distinguished by its quadrate basal laminal cells and non-sinuose basal cells. Additionally, *A. mutabilis* differs from *Andreaea rupestris* Hedw. by having isodiametric basal marginal cells, less pitted basal cell walls, and quadrate basal laminal cells, whereas *A. rupestris* has rectangular basal laminal cells and laminal papillae. *Andreaea mutabilis* also bears similarity to *Andreaea alpestris*, but differs in its minimally sheathing leaf bases, often displaying a patch of yellow cells at the base, with basal cells that are scarcely pitted. Its basal laminal cells are rectangular, and marginal cells are quadrate, measuring 0.8–1 mm in length and 0.3–0.4 mm in width (Chiang 1998; Murray 1988; Smith 2004; Frey *et al.* 2006; Zander 2007).

REMARKS

Andreaea mutabilis was last assessed for The IUCN Red List of Threatened Species in 2016, where it is classified as Least Concern (LC) (Hodgetts *et al.* 2019; The IUCN Red List of Threatened Species 2019: e.T83659827A87792052 accessed on 11 July 2024).

CONCLUSION

The discovery of *Iwatsukiella leucotricha*, *Andreaea alpestris*, and *Andreaea mutabilis* in the Karçal Mountains extends the known distribution of these species and represents the first records for Türkiye and Southwest Asia. These findings highlight the biogeographical importance of the Karçal Mountains (Artvin, Türkiye), a poorly explored region with high potential for cryptogamic flora. The area emerges as an important reservoir of bryophyte diversity. Continued floristic surveys in this and other under-investigated regions are likely

to yield additional noteworthy records, thereby enhancing our understanding of regional moss diversity.

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