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RESEARCH PAPER

# Epiphytic bryophyte vegetation of *Fagus orientalis* trees in Hıdırnebi Plateau (Trabzon, Turkey)

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## ABSTRACT

In this study, the epiphytic bryophyte vegetation of *Fagus orientalis* forests in Hıdırnebi Plateau (Trabzon, Turkey) was investigated. A total of 34 relevés taken from living tree trunks in the different vegetation periods of 2020 were analysed according to the Braun-Blanquet methodology. As a result of the analyses, the *Leskeello nervosae–Pterigynandretum filiformis*, *Leskeello nervosae–Pterigynandretum filiformis lewinskyetosum rupestris* subass. nov., *Pseudoleskeello nervosae–Raduletum lindbergianae* ass. nov. and *Pseudoleskeello nervosae–Raduletum lindbergianae isothecietosum alopecuroidis* subass. nov. were described and characterised as a new epiphytic syntaxa. The *Leskeello nervosae–Pterigynandretum filiformis* is also new to Turkey. In addition, the ecological and floristical characteristics of the syntaxa were evaluated.

**Keywords:** Braun-Blanquet, bryophyte, epiphyte, phytosociology, vegetation

## РЕЗЮМЕ

**Алаташ М., Эзер Т., Эрата Х., Батан Н. Эпифитная бриофитная растительность на стволах деревьев *Fagus orientalis* на плато Хыдырнеби (Трабзон, Турция).** Изучена эпифитная бриофитная растительность лесов *Fagus orientalis* на плато Хыдырнеби (Трабзон, Турция). Всего было проанализировано 34 геоботанических описания, выполненных на стволах живых деревьев в разные периоды вегетации 2020 года в соответствии с методологией Браун-Бланке. В результате анализа были выделены и охарактеризованы как новые следующие эпифитные синтаксоны: *Leskeello nervosae–Pterigynandretum filiformis*, *Leskeello nervosae–Pterigynandretum filiformis lewinskyetosum rupestris* subass. nov., *Pseudoleskeello nervosae–Raduletum lindbergianae* ass. nov. и *Pseudoleskeello nervosae–Raduletum lindbergianae isothecietosum alopecuroidis* subass. nov. Ассоциация *Leskeello nervosae–Pterigynandretum filiformis* является новой для Турции. Кроме того, были охарактеризованы экологические и флористические особенности синтаксонов.

**Ключевые слова:** Браун-Бланке, бриофит, эпифит, фитосоциология, растительность

*Переведено редколлегией*

The mutual relationships between environmental factors (such as soil, temperature, light, humidity and precipitation) and plant species are the leading factors that enable plants to come together and keep them together. The communities formed by plant species with the same or close ecological requirements are called vegetation (Kılınç 2011). Bryophytes with the same or close ecological requirements, such as humidity, temperature, light and acidity, also come together to form bryophyte communities at different phytosociological levels.

A total of 51 syntaxa have been identified in studies carried out so far on epiphytic bryophyte vegetation in Turkey. Of these syntaxa, 44 are at the level of association and subassociation, and 7 are at the community level with an unclear syntaxonomic category (Alataş 2018, Alataş et al. 2019a, 2019b, 2021). These studies and the determined syntaxa are quite insufficient to determine the epiphytic bryosociological richness of Turkey. In Turkey, which has a rich bryodiversity due to the fact that it contains three phytogeographic regions (Euro-Siberian, Mediterranean and Iran-Turanian) with different climatic and geographical features (Erdağ & Kürschner 2017, Kürschner & Frey 2020), It is possible to reveal the bryosociological diversity of Turkey with new studies to be carried out.

Hıdırnebi Plateau (Trabzon) was chosen as the study area, since there has not been any study on bryophytes before and the area contains *Fagus orientalis* populations which is home to many different species rich in terms of epiphytic bryophytes. In the present study, in which the epiphytic bryophyte vegetation on the *F. orientalis* trunks in Hıdırnebi Plateau (Trabzon) was investigated, a total of four vegetation units, three of which are newly described, were determined. Therefore, the present study aims to contribute to epiphytic bryophyte vegetation of Turkey. With these records, the number of epiphytic bryophyte syntaxa in Turkey increases to 55.

## MATERIAL AND METHODS

### Study area

Established for the development of highland tourism in the Eastern Black Sea region, Hıdırnebi Plateau, is located in the A4 square according to the Henderson (1961) grid system and is in the Colchis zone of the Euro-Siberian phytogeographic region (Anşin 1983, Fig. 1). The plateau, located in the south of Hıdırnebi Hill, in the northeastern part of the Eastern Black Sea Mountain masses, is 23 km from Akçaabat and 35 km from Trabzon.

The land structure becomes steeper towards the south in Hıdırnebi Plateau, which is located at an altitude of approximately 1450 m above sea level. The highest peaks in the area, where the elevation continuously increases towards the south, are Hıdırnebi Hill (1402 m), Kuruçam Hill (1702 m), and Koru Hill (1477 m). As a lithological structure, volcanic formations consisting of Upper Cretaceous-aged andesite, basalt lava, and pyroclasts are common in and around the plateau (Zaman 2001).

Hıdırnebi Plateau, like the north-facing slopes of the Eastern Black Sea Mountains, has a lush forest formation due to sufficient precipitation and temperature conditions and precipitation in all seasons.

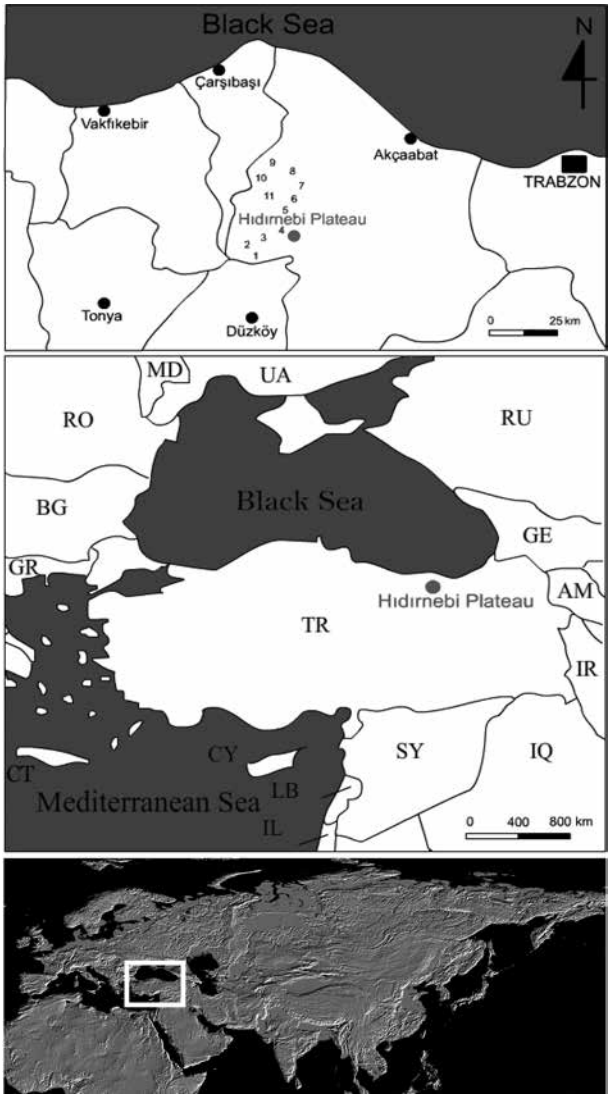


**Figure 1** Study area and locations of sample plots

*Picea orientalis* (L.) Link, *Abies nordmanniana* (Stev.) Spach., *Fagus orientalis* Lipsky., *Carpinus betulus* L. and *Alnus glutinosa* (L.) Gaertner are the main tree species in the area, which is located in the mixed forest zone. *Rhododendron luteum* Sweet, *R. ponticum* L., *Corylus avellana* L., *Cornus sanguinea* L., *Vaccinium* spp., *Rubus caucasicus* Focke, *Urtica dioica* L., and *Euphorbia* spp. are the most common species found in the forests.

Considering the altitude difference of approximately 1450 m between the coast and the area, where the plateau is located, it is certain that there will be significant climatic differences. Depending on the increasing altitude, there is a decrease in temperature values and an increase in precipitation. According to Ardel (1973), where the slope is steeper, precipitation increases accordingly. However, this increase does not continue continuously and finds its highest value at a certain altitude. Based on these data, the climate of the area can be better revealed by examining the temperature and precipitation values of the Akçaabat Meteorological Station (10 m) closest to the study area.

Considering the Akchaabat area (URL 1), where the annual precipitation is 1,466 mm and the mean annual temperature is 12.1 ºC, thus the average annual temperature in the area is lower and the precipitation is higher with increasing altitude. In addition, the fact that the annual precipitation regime type is AuWiSpSu and that there is no dry season shows that the area is under the influence of the Oceanic climate (Akman 2011).

### Sampling and measurements

The materials of the present study consist of a total 31 species within the total 34 relevés. The relevés were taken from the lower (0–0.5 m) and middle (0.5–2m) parts of the trunks of *F. orientalis* trees which exist in the different localities of Hıdırnebi Plateau in the year 2020 (Table 1).

According to the minimal area concept of Braun-Blanquet (1964), the sizes of the vegetation plots were determined depending on the species richness and species distribution. For the relevés, abundance-coverage scale of Frey & Kürschner (1991) was used (Table 2).

The relevés were evaluated using the classical Braun-Blanquet (1964) method. Newly identified syntaxa in the present study were proposed according to the International Code of Phytosociological Nomenclature (Theurillat et al. 2020). While distinguishing and ranking the syntaxonomical units, the works of Marstaller (2006) and Hübschmann (1984) were taken into account. For the identification of the bryophyte specimens, different floras, monographs and revisions were used. The moss specimens were identified using Nyholm (1981), Hedenäs (1992), Zander (1993), Cortini Pedrotti (2001, 2006), Smith (2004), Heyn & Herrnstadt (2004), Frey et al. (2006), Kürschner & Frey (2011), Plášek et al. (2015), and Lara et al. (2016), and the liverwort specimens were identified using Paton (1999), Heyn & Herrnstadt (2004), Frey et al. (2006), Casas et al. (2009) and Kürschner & Frey (2020).

The bryophyte specimens collected from the area were stored in the Herbarium of the Karadeniz Technical University (KATO) in Turkey.

**Table 1.** List of localities of the relevés on the *Fagus orientalis* trunks

| Releyé numbers | Localities | Altitude (m) | Date | GPS Coordinates |
|---|---|---|---|---|
| 1–3 | 1 | 1410 | 28.04.2020 | 40°56'46.39"N 39°25'24.20"E |
| 4–6 | 2 | 1439 | 29.04.2020 | 40°56'54.00"N 39°25'30.10"E |
| 7–9 | 3 | 1427 | 29.04.2020 | 40°57'09.05"N 39°25'40.96"E |
| 10–12 | 4 | 1398 | 25.06.2020 | 40°57'45.49"N 39°26'04.79"E |
| 13–15 | 5 | 1384 | 25.06.2020 | 40°57'45.53"N 39°25'59.46"E |
| 16–18 | 6 | 1401 | 26.06.2020 | 40°57'39.32"N 39°25'49.17"E |
| 19–21 | 7 | 1416 | 24.08.2020 | 40°57'33.53"N 39°25'43.85"E |
| 22–24 | 8 | 1449 | 24.08.2020 | 40°57'31.48"N 39°25'33.28"E |
| 25–27 | 9 | 1424 | 25.10.2020 | 40°57'23.96"N 39°25'30.80"E |
| 28–30 | 10 | 1430 | 26.10.2020 | 40°57'19.27"N 39°25'31.97"E |
| 31–34 | 11 | 1440 | 26.10.2020 | 40°57'10.35"N 39°25'38.02"E |

**Table 2.** Abundance-coverage scale used for bryophytes.

| Scale | Abundance-coverage |
|---|---|
| + | < 1 % |
| 1 | 1.1 – 6.0 % |
| 2 | 6.1 – 12.0 % |
| 3 | 12.1 – 25.0 % |
| 4 | 25.1 – 50.0 % |
| 5 | 50.1 – 100 % |

## RESULTS

As a result of the evaluation of the phytosociological data obtained from 34 relevés taken from *F. orientalis* trunks in the study area with the classical Braun-Blanquet methodology, a total of four communities, three of which were new, were determined. Among them, *Leskeello nervosae-Pterigynandretum filiformis* was recorded for the first time from Turkey (Alataş 2018; Alataş et al. 2019a, b, 2021).

*Leskeello nervosae–Pterigynandretum filiformis lewinskyetosum rupestris* **subass. nov.**, *Pseudoleskeello nervosae–Raduletum lindbergianae* **ass. nov.** and *Pseudoleskeello nervosae–Raduletum lindbergianae isothecietosum alopecuroidis* **subass. nov.** were described as new syntaxa. With these records, the number of epiphytic bryophyte syntaxa in Turkey has reached 55.

The floristic and ecological features of these syntaxa are given below in accordance with Marstaller's (2006) sequence.

Class *Frullanio dilatatae–Leucodontetea sciuroidis* Mohan 1978
Order *Orthotrichetalia* Had. in Kl. and Had. 1944
Alliance *Ulotion crispae* Barkm. 1958
Association *Leskeello nervosae–Pterigynandretum filiformis* Phil. 1983
Subassociation *Leskeello nervosae–Pterigynandretum filiformis typicum*
Subassociation *Leskeello nervosae–Pterigynandretum filiformis lewinskyetosum rupestris* **subass. nov.**
Association *Pseudoleskeello nervosae–Raduletum lindbergianae* **ass. nov.**
Subassociation *Pseudoleskeello nervosae–Raduletum lindbergianae typicum*
Subassociation *Pseudoleskeello nervosae–Raduletum lindbergianae isothecietosum alopecuroidis* **subass. nov. hoc loco**

### Epiphytic bryophyte communities

***Leskeello nervosae–Pterigynandretum filiformis*** Phil. 1983 (Table 3, syntaxon A)

The *Leskeello nervosae–Pterigynandretum filiformis* is determined by 4 relevés at elevation 1398–1439 m a.s.l. in the study area. The association was found on northern parts of *F. orientalis* trunks in the northern slopes of the Hıdırnebi Plateau. While the general coverage of the taxa within the association varies between 81 and 96 %, the canopy cover varies between 70 and 80 %. The *Leskeello nervosae–Pterigynandretum filiformis* is represented by 16 species. Among them one is liverwort and 15 are mosses, of which 8 are pleurocarpous and 7 are acrocarpous. The members of the pleurocarpous mosses are more sensitive to drought than acrocarpous (Schofield 2001), but acrocarpous members of the association were usually found on the upper parts of trunks. Upper parts of the trunks are periodically exposed to higher insolation and desiccation (Moe & Botnen 2000).

The main diagnostic species of the association are the mesophytic *Pseudoleskeella nervosa* and *Pterigynandrum filiforme* with the highest constancy, and their frequency within the relevés is 100 %. *Pseudoleskeella nervosa* and *Pterigynandrum filiforme* grow as epiphytes on tree trunks or epilytes on rock surfaces in semi-neutral and semi-arid environments that defines this association as cortico-saxicolous. The average number of species in the association is 8.

The characteristic species of the class *Frullanio dilatatae-Leucodontetea sciuroidis* and the order *Orthotrichetalia*, such as *Leucodon sciuroides*, *L. immersus*, *Frullania dilatata*, *Pulvigera lyellii*, *Hypnum andoi*, *Lewinskya striata* and *Ulota crispa*, are highly represented in the association. The association was classified to the alliance *Ulotion crispae* (Table 3). Moreover, the association is similar to the association detected by Marstaller (2006) in Germany in terms of floristic composition and ecological characteristics.

In this study, we present new subassociation that reflect the variation within this association.

***Leskeello nervosae–Pterigynandretum filiformis lewinskyetosum rupestris*** **subass. nov.** (Table 3, Syntaxon B)

**Holotypus:** relevé no 1 (Table 3, Syntaxon B), Prov. Trabzon, Hıdırnebi Plateau, 1439 m a.s.l., *Fagus orientalis* forest.

**Differential species:** *Lewinskya rupestris*

The new subassociation was represented by 20 species, four of which are liverworts, within the total of 9 relevés between 1398 and 1440 m a.s.l. in the study area. The community was mostly found in the northern face of the trunks of beech trees. The general bryophyte cover in the subassociation varies between 83 and 98 %, the canopy cover varies between 60 and 90 %. The number of species in the relevés ranges from 6 to 11. Among the mosses, 9 are acrocarpous and 7 are pleurocarpous.

**Description:** *Lewinskya rupestris*, diagnostic and characteristic species of the new subassociation, has the highest frequency, and the species is 100 % constant in the relevés (Table 3b). Acrocarpous *L. rupestris* is a species that grows as epiphyte on tree trunks and as epilyte on rock surfaces, preferring semi-neutral and shade habitats. The general physiognomy of the new subassociation is dominated by pleurocarpous species due to the high coverage of members of large strong competitor mosses within the subassociation such as *Pterigynandrum filiforme*, *Pseudoleskeella nervosa*, *Leucodon immersus*, and *L. sciuroides*. However, acrocarpous Orthotrichaceae members such as *Ulota crispa* and *Lewinskya rupestris* which is the diagnostic species of the subassociation, have also mixed as small pads among these pleurocarpous species, especially upper parts of beechwood trunks.

The subassociation described as cortico-saxicolous strongly overlaps with the association it belongs to in terms of substrate, habitat and ecological characteristics.

Synhierarchically, due to the fact that the new subassociation contains the characteristic species of the classis *Frullanio dilatatae–Leucodontetea sciuroidis*, order *Orthotrichetalia*, and the

**Table 3.** Association *Leskeello nervosae–Pterigynandretum filiformis* Phil. 1983: subassociation *typicum* (A), and subassociation *lewinskyetosum rupestris* subass. nov. (B) on the *Fagus orientalis* trunks.

| Syntaxon | A | | | | | B | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of relevé | 5 | 6 | 11 | 21 | Constancy Class | 7 | 1 | 3 | 12 | 18 | 19 | 20 | 30 | 31 | Constancy Class |
| Altitude (m, a.s.l.) | 1439 | 1439 | 1398 | 1416 | | 1427 | 1410 | 1410 | 1398 | 1401 | 1416 | 1416 | 1430 | 1440 | |
| Size of relevés (dm²) | 99 | 99 | 130 | 77 | | 99 | 84 | 117 | 96 | 85 | 96 | 88 | 99 | 104 | |
| Trunk (m, above ground) | 2.9 | 1.8 | 2.4 | 1.3 | | 1.8 | 2.7 | 2.7 | 3.4 | 3.8 | 2.1 | 2.6 | 2.7 | 2.3 | |
| Exposition | N | N | N | N | | N | N | N | N | N | N | N | N | N | |
| Position of relevés | N | N | N | N | | N | N | NE | N | N | N | N | N | N | |
| Covering (%) | 70 | 80 | 80 | 80 | | 90 | 70 | 70 | 60 | 80 | 80 | 80 | 80 | 80 | |
| Canopy cover (%) | 88 | 96 | 86 | 81 | | 83 | 93 | 94 | 88 | 94 | 87 | 91 | 98 | 92 | |
| Base (B) / Trunk (T) | T | T | T | B | | T | T | T | B | T | B | T | B | T | |
| Number of species | 10 | 8 | 10 | 6 | | 6 | 10 | 9 | 9 | 8 | 11 | 11 | 9 | 10 | |
| **Characteristic and differential species of the association and subassociations** | | | | | | | | | | | | | | | |
| *Pseudoleskeella nervosa* | 2 | 2 | 2 | 3 | V | 1 | 3 | 1 | 2 | 3 | 1 | 1 | 1 | 3 | V |
| *Pterigynandrum filiforme* | 2 | 2 | 2 | 2 | V | 1 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | V |
| *Lewinskya rupestris* | · | · | · | · | · | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | V |
| **Characteristic and differential species of the *Ulotion crispae*** | | | | | | | | | | | | | | | |
| *Ulota crispa* | 2 | 2 | 2 | · | IV | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 1 | V |
| *Hypnum andoi* | 2 | · | · | · | II | · | 2 | 3 | · | · | 3 | 4 | 4 | · | III |
| *Lewinskya striata* | 1 | · | · | · | II | · | · | · | · | · | · | · | · | · | · |
| **Characteristic and differential species of the *Syntrichion laevipilae*** | | | | | | | | | | | | | | | |
| *Orthotrichum pumilum* | · | · | · | 1 | II | · | · | · | · | · | · | · | · | · | · |
| **Characteristic and differential species of the *Orthotrichetalia* and *Frullanio dilatatae-Leucodontetea sciuroidis*** | | | | | | | | | | | | | | | |
| *Leucodon immersus* | · | 4 | · | 4 | III | 3 | · | · | · | 4 | 3 | 2 | 2 | 4 | IV |
| *Leucodon sciuroides* | 3 | · | 1 | · | III | · | 2 | 4 | 4 | · | · | · | · | · | II |
| *Frullania dilatata* | 2 | 2 | 2 | | IV | 4 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | V |
| *Radula complanata* | · | · | · | · | · | · | 1 | · | · | · | · | 1 | · | 1 | II |
| *Pulvigera lyellii* | · | 1 | 1 | · | III | · | · | · | 1 | · | · | · | · | · | I |
| *Ptychostomum moravicum* | · | 1 | · | 2 | III | · | 1 | · | · | 2 | 1 | 1 | · | 2 | III |
| *Isothecium alopecuroides* | 3 | 3 | 1 | · | IV | · | · | · | · | · | 2 | · | · | · | I |
| **Other species** | | | | | | | | | | | | | | | |
| *Dicranum tauricum* | · | · | · | · | · | · | · | · | · | · | · | 1 | 1 | · | II |
| *Hypnum cupressiforme* | · | · | 3 | · | II | · | · | · | · | · | · | · | · | · | |
| *Hypnum resupinatum* | · | · | 2 | 1 | III | · | · | · | 2 | · | · | · | · | · | I |
| *Hedwigia ciliata* | 1 | · | 1 | · | III | · | · | · | 1 | · | · | · | · | · | I |
| *Plagiochila porelloides* | · | · | · | · | · | · | · | · | · | · | · | · | 2 | · | I |
| *Plagiomnium cuspidatum* | · | · | · | · | · | · | · | 2 | · | · | · | · | · | · | I |
| *Porella platyphylla* | · | · | · | · | · | · | · | 1 | · | · | · | · | · | 2 | II |
| *Schistidium apocarpum* | 1 | · | · | · | II | · | 1 | · | 1 | · | 1 | 1 | · | 1 | III |
| *Tortella tortuosa* | · | · | · | · | · | · | · | · | · | 1 | 1 | · | · | · | II |

alliance *Ulotion crispae*, it was classified within these upper syntaxonomical units (Table 3b).

***Pseudoleskeello nervosae–Raduletum lindbergianae* ass. nov.** (Table 4, Syntaxon A)

**Holotypus:** relevé no 4 in the Table 4; Prov. Trabzon, Hıdırnebi Plateau at elevation of 1439 m a.s.l., *Fagus orientalis* forest.

**Differential species:** *Pseudoleskeella nervosa*, *Radula lindenbergiana.*

**Description:** the *Pseudoleskeello nervosae–Raduletum lindbergianae* is represented by a total 6 relevés taken from the beechwood trunks between 1398 and 1440 m a.s.l. in the northern parts of the study area. While the general bryophyte coverage of the association varies between 85 % and 91 %, the canopy cover in the area, varies between 60 % and 90 %. The association consists of a total of 18 species (15 mosses, 3 liverworts). Among the mosses, 7 are pleurocarpous and 8 acrocarpous. The average number of species in the community is 8. The coverage percentages and species numbers of acrocarpous and pleurocarpous suggest that the community is a meso-hygrophytic and spreading in humid and semi-arid environments.

The mesophytic moss *Pseudoleskeella nervosa* and the hygrophytic liverwort *Radula lindenbergiana*, which are main characteristics species of the association, have the highest frequency, and their constancy are 83 % within the relevés. The pleurocarpous *P. nervosa*, which occurs in semi-arid and open areas, grows epiphytically on trunks and epilithically on rock surfaces, while *R. lindenbergiana*, which occurs in semi-neutral, moist and shaded conditions, is cortico-saxicolous, and commonly grows on tree trunks. Therefore, the new association comprises mainly cortico-saxicolous bryophytes. Physiognomically, the association is dominated by large and strong competitors of *Leucodon*, and also acrocarpous species (e.g. *Ulota crispa*, *Orthotrichum pumilum*, *Lewinskya rupestris*, and *Syntrichia virescens*) mixed with the pleurocarpous as small cushions.

Characteristic species of the higher syntaxonomic units, such as *Leucodon sciuroides*, *L. immersus*, *Frullania dilatata*, and *Ulota crispa* support the classification of the new association within the class *Frullanio dilatatae–Leucodontetea sciuroidis*, the order *Orthotrichetalia*, and the alliance *Ulotion crispae* (Table 4).

In this study, we present new subassociations that reflect the variation within this association.

***Pseudoleskeello nervosae–Raduletum lindbergianae isothecietosum alopecuroidis* subass. nov.** (Table 4b)

**Holotypus:** relevé no 29 (Table 4, Syntaxon B), Prov. Trabzon, Hıdırnebi Plateau, 1430 m a.s.l., *Fagus orientalis* forest

**Differential species:** *Isothecium alopecuroides*

The subassociation *isothecitosum alopecuroidis* is represented by a total of 15 relevés from basal zones of the beechwood trunks. It was found between 1384 and 1449 m a.s.l. in the study area, especially in the northern part. The general bryophyte cover of the subassociation varies between 81 and 98 %, the canopy cover varies between 60 and 100 %. The number of species within the relevés ranges from 7 to 12. The subassociation consist of a total of 27 species. Among them, 7 are liverworts, and 20 are mosses, 10 of which are acrocarpous and 10 of which are pleurocarpous. The prominent proportion of liverworts and the equal number of acrocarpous and pleurocarpous species in the relevés indicate that the subassociation occurs on humid and semi-arid habitats in the study area. Because, acrocarpous moss members indicate the presence of arid environments, especially open areas where forest vegetation is interrupted in the study area, while pleurocarpous moss members which are more sensitive than acrocapous to drought indicate the presence of moist and shaded habitats (Schofield 2001).

The pleurocarpous moss *Isothecium alopecuroides* differentiates the subassociation from the *Pseudoleskeello nervosae–Raduletum lindbergianae typicum*. It has the highest frequency, and its constancy is 100 % within the relevés (Table 4b). *Isothecium alopecuroides* grows on tree trunks and on rock surfaces and also prefers semi-neutral shade habitats. Therefore, it can be said that the new subassociation is cortico-saxicolous and it is found especially in the base parts of the trunks where have more humid and more nutrient-rich due to soil proximity.

Epilithic bryophytes, which grow on rock surfaces, usually settle on tree trunks in continental humid conditions. Espe-

**Table 4.** Association *Pseudoleskeello nervosae–Raduletum lindbergianae* ass. nov.: subassociations *typicum* (A) and *Pseudoleskeello nervosae–Raduletum lindbergianae isothecietosum alopecuroidis* subass. nov. (B) on the *Fagus orientalis* trunks.

| Syntaxon | A | | | | | | | B | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of relevé | **4** | **8** | **10** | **13** | **17** | **34** | | **2** | **15** | **16** | **24** | **25** | **26** | **27** | **28** | **29** | **32** | **33** | **14** | **23** | **9** | **22** | |
| Altitude (m) | 1439 | 1427 | 1398 | 1384 | 1401 | 1440 | Constancy Class | 1410 | 1384 | 1401 | 1449 | 1424 | 1424 | 1424 | 1430 | 1430 | 1440 | 1440 | 1384 | 1449 | 1427 | 1449 | Constancy Class |
| Size of relevés (dm²) | 88 | 81 | 96 | 77 | 120 | 88 | | 88 | 99 | 63 | 80 | 96 | 120 | 80 | 77 | 99 | 108 | 99 | 60 | 108 | 108 | 108 | |
| Trunk (m) | 2.3 | 3.1 | 2.6 | 1.5 | 2.1 | 2.2 | | 3.0 | 2.2 | 1.8 | 2.3 | 2.7 | 2.1 | 2.1 | 1.4 | 1.9 | 2.7 | 2.7 | 2.2 | 2.8 | 2.4 | 2.2 | |
| Exposition | N | N | N | N | N | N | | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | |
| Position of relevés | N | N | N | N | NE | N | | N | N | NE | N | N | N | NE | N | N | N | N | N | N | N | N | |
| Covering (%) | 60 | 90 | 70 | 90 | 90 | 90 | | 60 | 100 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 80 | 90 | 90 | 80 | 80 | 80 | |
| Canopy cover (%) | 91 | 85 | 89 | 90 | 88 | 88 | | 96 | 81 | 92 | 84 | 99 | 95 | 86 | 85 | 95 | 95 | 98 | 86 | 86 | 95 | 98 | |
| Base (B) / Trunk (T) | T | B | T | T | T | B | | B | B | B | B | B | B | B | B | T | T | T | B | T | B | T | |
| Number of species | 9 | 9 | 10 | 6 | 10 | 6 | | 12 | 8 | 11 | 7 | 11 | 10 | 8 | 9 | 12 | 11 | 10 | 8 | 10 | 10 | 10 | |
| **Characteristic and differential species of the association and subassociations** | | | | | | | | | | | | | | | | | | | | | | | |
| *Pseudoleskeella nervosa* | 3 | 3 | · | 2 | 2 | 3 | V | 2 | 1 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 3 | 2 | 3 | 4 | 2 | 1 | V |
| *Radula lindenbergiana* | 1 | 1 | 1 | 1 | 1 | · | V | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | · | · | 1 | 1 | V |
| *Isothecium alopecuroides* | · | · | · | · | · | · | · | 2 | 2 | 2 | 4 | 4 | 4 | 4 | 3 | 4 | 2 | 2 | 3 | 1 | 3 | 1 | V |
| **Characteristic and differential species of the *Ulotion crispae*** | | | | | | | | | | | | | | | | | | | | | | | |
| *Ulota crispa* | 1 | · | 2 | 1 | 1 | 1 | V | 1 | · | 1 | · | 1 | 1 | 2 | 2 | 2 | 1 | 2 | · | · | · | 2 | IV |
| *Hypnum andoi* | 3 | · | · | · | · | · | I | 1 | · | · | · | 2 | · | · | 2 | 2 | 2 | 2 | · | · | · | 3 | III |
| *Lewinskya striata* | · | · | · | · | · | · | · | · | · | · | · | · | · | · | 1 | 1 | · | · | · | · | · | · | I |
| *Metzgeria furcata* | · | · | · | · | · | · | · | · | · | · | · | · | · | · | · | 1 | · | · | · | · | · | · | I |
| **Characteristic and differential species of the suballiance *Pterigynandrenion filiformis*** | | | | | | | | | | | | | | | | | | | | | | | |
| *Pterigynandrum filiforme* | 3 | 4 | 3 | · | 1 | · | IV | 2 | · | 1 | · | 2 | 1 | 1 | 1 | 2 | · | 3 | 3 | 2 | 1 | 1 | IV |
| **Characteristic and differential species of the *Syntrichion laevipilae*** | | | | | | | | | | | | | | | | | | | | | | | |
| *Orthotrichum pumilum* | · | · | · | 1 | · | 1 | II | · | 1 | · | · | 1 | 1 | · | · | · | 1 | 1 | · | · | · | · | II |
| *Syntrichia virescens* | · | 1 | · | · | · | · | I | · | · | · | · | · | · | · | · | · | · | · | · | · | · | · | · |
| **Characteristic and differential species of the *Orthotrichetalia* and *Frullanio dilatatae–Leucodontetea sciuroidis*** | | | | | | | | | | | | | | | | | | | | | | | |
| *Leucodon immersus* | · | · | 4 | 4 | · | · | II | 4 | 4 | 2 | 3 | 3 | 2 | · | · | · | 4 | 4 | · | 3 | 3 | 4 | IV |
| *Leucodon sciuroides* | 2 | 3 | · | · | 4 | 4 | IV | · | · | · | · | · | · | · | 3 | · | · | · | 2 | · | · | · | I |
| *Frullania dilatata* | 2 | · | 2 | 3 | · | 1 | IV | 2 | 1 | · | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | · | 1 | 3 | 2 | V |
| *Pulvigera lyellii* | · | · | · | · | · | · | · | · | · | · | · | · | · | 1 | · | · | · | · | · | · | · | · | I |
| *Ptychostomum moravicum* | 1 | 1 | 1 | · | 1 | · | IV | · | · | · | · | · | · | · | · | · | 1 | 1 | · | 1 | 1 | · | II |
| *Lewinskya rupestris* | 1 | · | 1 | · | 1 | · | IV | 1 | · | 1 | · | · | · | · | · | · | · | · | 1 | 1 | 1 | 1 | II |
| **Other species** | | | | | | | | | | | | | | | | | | | | | | | |
| *Hypnum cupressiforme* | · | · | 2 | · | · | · | I | · | · | · | · | · | · | · | · | · | · | · | · | · | · | · | · |
| *Hypnum resupinatum* | · | · | · | · | 2 | · | I | · | · | 4 | · | · | · | · | · | · | · | · | · | · | · | · | I |
| *Hedwigia ciliata* | · | 2 | 1 | · | · | · | II | 1 | · | · | · | · | · | · | · | · | · | · | · | · | 2 | · | I |
| *Lophocolea heterophylla* | · | · | · | · | · | · | · | · | · | · | 1 | · | 1 | · | · | 1 | · | · | · | · | · | · | I |
| *Plagiochila asplenioides* | · | · | · | · | · | · | · | · | · | · | · | · | 2 | · | · | · | · | · | · | · | · | · | I |
| *Plagiochila porelloides* | · | · | · | · | · | · | · | · | · | · | · | 1 | · | · | · | 2 | · | · | · | · | · | · | I |
| *Plagiomnium cuspidatum* | · | · | · | · | · | · | · | 2 | · | · | · | · | · | · | · | · | · | · | · | · | · | · | I |
| *Plagiothecium succulentum* | · | · | · | · | · | · | · | · | · | · | · | · | · | 1 | · | · | · | · | · | · | · | · | I |
| *Porella platyphylla* | · | · | · | · | · | 2 | I | · | · | · | · | · | · | · | · | 1 | · | · | · | 1 | · | · | I |
| *Sanionia uncinata* | · | · | · | · | · | · | · | · | · | · | · | 1 | · | · | · | · | · | · | · | · | · | · | I |
| *Schistidium apocarpum* | · | 1 | · | · | 1 | · | II | 1 | 2 | 1 | · | · | · | · | · | · | 1 | · | 1 | 1 | 1 | · | III |
| *Sciuro-hypnum populeum* | · | · | · | · | · | · | · | · | · | · | · | · | · | · | · | · | · | · | 2 | · | · | 1 | I |
| *Tortella tortuosa* | | | 1 | | 2 | | II | | 3 | 1 | 1 | | | | | | 1 | | 2 | 1 | | | II |

cially the Black Sea Region, which is considered to be the rainforests ecosystems of Turkey, is under the influence of the oceanic climate and the dry season is almost never seen. For this reason, epilithic species such as *Pseudoleskeella nervosa*, *Isothecium alopecuroides*, *Pterigynandrum filiforme*, *Radula lindenbergiana* and *Lewinskya rupestris* are also successful on colonizing tree trunks.

Synhierarchically, the new subassociation was classified to the alliance *Ulotion crispae* of the order *Orthotrichetalia* of the class *Frullanio dilatatae–Leucodontetea sciuroidis* (Table 4b).

## CONCLUSION

In the present study, the epiphytic bryophyte vegetation of *Fagus orientalis* forests in Hıdırnebi Plateau (Trabzon, Turkey) was described. As a result of the study, four syntaxonomic units were identified; the *Leskeello nervosae–Pterigynandretum filiformis*, *Leskeello nervosae–Pterigynandretum filiformis lewinskyetosum rupestris* subass. nov., *Pseudoleskeello nervosae–Raduletum lindbergianae* ass. nov. and *Pseudoleskeello nervosae–Raduletum lindbergianae isothecietosum alopecuroidis* subass. nov. The data obtained show that the epiphytic bryological diversity of the area is high, and it reflects the climatic characteristics of the Black Sea Region of Turkey, which is rainy all seasons.

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