

Bryophytes of Frakto Forest (Rhodope Mountains, Greece), including *Syzygiella autumnalis* and the genus *Ulot* new to Greece

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Abstract – 155 bryophytes are reported from Frakto Forest, Greece, parts of which consist of old-growth mixed forest with spruce (*Picea abies*), fir (*Abies borisii-regis*) and beech (*Fagus sylvatica*). Many of the species recorded extend into the boreal zone in Europe, and are rare or unknown elsewhere in Greece. Three species, *Syzygiella autumnalis*, *Ulot crispula* and *Ulot crispula* are new to Greece, and there are second or confirmed records for *Dicranella subulata*, *Lewinskya breviseta*, *Mnium lycopodioides*, *Seligeria recurvata* and *Solenostoma obovatum*. Attention is drawn to a distinctive forest form of *Ctenidium molluscum* occurring on non-calcareous substrates.

***Ctenidium* / *Lewinskya breviseta* / lignicolous bryophytes / old-growth forest / The Balkan peninsula / Mediterranean**

INTRODUCTION

Bryological exploration in Greece during the nineteenth and much of the twentieth century was concentrated mainly in the lowland Mediterranean zone and in the islands. The mountains of northern mainland Greece were difficult of access, and during the Cold War era the border areas between northern Greece and its Balkan neighbours were under military control. However, during the past four decades improved access and free movement in these areas have led to a substantial increase in bryological exploration there, and numerous species have been added to the Greek flora. Among the more important contributions concerning the mountains of northern Greece have been those of Geissler (1977), Gamisans & Hébrard (1979, 1980), Lüth (2003), Tsakiri *et al.* (2006), Blockeel (2010), Papp *et al.* (2011) and Papp & Tsakiri (2017). Nevertheless, exploration of these areas remains very incomplete. In June 2016, with the help and permission of the Forest Service of Drama, I was able to spend several days at Frakto Forest in the Greek Rhodope Mountains, to record the forest bryophytes. This area, with tracts of mixed old-growth forest, is of great ecological interest in the Greek context, and there is little previous published information about the bryophyte flora. The results of the author's visit are therefore presented in this paper.

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STUDY AREA

Frakto Forest is a wildlife refuge in the Central Rhodope mountains in the Prefecture of Drama, Greece, adjoining the border with Bulgaria (Fig. 1). The refuge includes a zone of absolute protection that contains tracts of mixed old-growth forest of Spruce (*Picea abies* (L.) H.Karst.), Fir (*Abies alba* Mill. and *A. borisii-regis* Mattf.) and Beech (*Fagus sylvatica* L.), known as the Virgin Forest (Partheno Dasos). Frakto and the adjacent Elatia Forest are notable for the extensive occurrence of Norway Spruce (*Picea abies*) at its southernmost locality in the Balkans, but Scots Pine (*Pinus sylvestris* L.), Fir (*Abies borisii-regis*) and Beech (*Fagus sylvatica*) also occur widely and mixed stands are common. Other forest trees at Frakto include Silver Birch (*Betula pendula* Roth), Black Pine (*Pinus nigra* J.F.Arnold) and small numbers of Balkan Pine (*Pinus peuce* Griseb.) (Eleftheriadou & Raus, 1996). Athanasiadis *et al.* (1993) analysed the pollen profile of cores taken from a Flachmoor in nearby Elatia Forest. There was a strong expansion of beech (*Fagus sylvatica*) at around 1700 AD, possibly aided by favourable climatic conditions. A major source



Fig. 1. Map of Greece, showing the location of Frakto Forest.

of human influence within historical times was the transhumance grazing of the Sarakatsani, with the creation of forest clearings. The remains of former settlements are found widely in Elatia and Frakto Forest. However, the region was always remote and it became strongly depopulated after World War II. The first forest roads were built in the 1970s. However parts of the inner zone of Frakto Forest are thought to have experienced little or no human intervention and consist of old-growth forest with individual trees of 300-400 years age, and individual species reaching heights of 53 m (*Picea abies*), 43 m (*Abies alba* and *A. borisii-regis*) and 35 m (*Fagus sylvatica*) (Böhr, 1989).

Within Greece Frakto forest is outstanding for the large number of Central European and even boreal elements in both the fauna and flora, as noted by Eleftheriadou & Raus (1996). These authors give a detailed inventory of the vascular flora of the inner zone of the forest. They note that the area is formed largely from acid intrusive and igneous bedrocks, although there are some exposures of base-rich rocks at lower altitudes on the periphery of the inner zone. They characterise the climate as humid-continental with a cold winter and a short, hot summer period. Data extrapolated from the nearest meteorological stations of Skaloti and Livaditis imply an annual precipitation of 1500-2000 mm and an annual mean temperature of ca 6°C.

No comprehensive accounts of the bryophytes of Frakto Forest have been published. Moss and lichen associations in the Greek sector of the Rhodope mountains were studied by Geissler (1977) and Zoller *et al.* (1977), and one of the investigated sites was located in the vicinity of the Forest Station, for which they used the name Sagradenia (Zagradenia). Fourteen bryophytes are listed by Geissler (1977) from this part of the forest, sampled from rotting *Abies* logs and beech (*Fagus*) forest.

MATERIALS AND METHODS

Sites were investigated on 21-24 June 2016 and were located within the wildlife refuge, partly in the inner zone of the forest in the Likolaka and Delimposka areas, and partly in the outer zone to the south (Tzaki Rema and at the head of the Achladorema valley). The choice of sites was intended to cover the full range of altitudinal zones within the Forest, but was constrained by the logistics and practicalities of access. The inner zone (the zone of absolute protection) lies at higher altitudes than the outer zone, and is partly defined by a natural barrier of steep south-facing crags. These crags are difficult of access. However sampling of the higher levels in the inner zone was possible via the former forest road that leads close to Delimposka summit in the north-west of the protected area. Within these constraints, the choice of sites was random. The investigated sites are listed in Table 1.

The nomenclature of liverworts follows the World List (Söderström *et al.*, 2016), and for mosses Ros *et al.* (2013), with the following exceptions. *Bryum* is retained in a broad sense following Guerra *et al.* (2010), and the genus *Lewinskya* F. Lara, Garilleti & Goffinet is separated from *Orthotrichum*, following Lara *et al.* (2016). Phytogeographic designations are based on Hill & Preston (1998), except where otherwise stated. Voucher specimens are held in the author's personal herbarium.

Table 1. Collecting localities

<i>Site Number</i>	<i>Locality Detail</i>	<i>Habitat</i>
1	Afchenas, 1 km west of Frakto Forest Station, ca 1400-1420 m alt.	Light woodland of mixed deciduous trees, on south-facing slope below forest road
2	A little to the N and NW of Frakto Forest Station, ca 1320-1410 m alt.	Mixed forest with <i>Fagus sylvatica</i> and <i>Betula pendula</i> on north-facing slopes
3	At and near the «Symplegades» rocks, ca 1 km N of Frakto Forest Station, ca 1280-1310 m alt.	Mixed forest with rock chasm, on north-facing slopes
4	A little to the NW of Frakto Forest Station, ca 1370 m alt.	Edge of forest road
5	Side stream in upper part of Likolaka Rema, ca 1630-1680 m alt.	Mixed forest with <i>Fagus sylvatica</i> , <i>Picea abies</i> and <i>Abies borisii-regis</i> , along stream running in north-easterly direction
6	Southern slopes of Delimposka summit, ca 1780-1910 m alt.	Open grassy slopes facing S to SE, with small rock outcrops
7	Upper part of Likolaka Rema, ca 1710-1740 m alt.	Mixed forest with <i>Fagus sylvatica</i> , <i>Picea abies</i> and <i>Abies borisii-regis</i> , along stream running in easterly direction
8	North-east side of Makroulo ridge, ca 1600-1660 m alt.	Edge of forest road, and adjacent forest with <i>Fagus sylvatica</i> and <i>Abies borisii-regis</i>
9	Tzaki Rema, south of Makroulo ridge, ca 1380 m alt.	<i>Fagus sylvatica</i> forest in deep stream valley
10	South side of Tzaki Rema valley, ca 1280-1290 m alt.	Edge of forest road on north-facing slope with <i>Fagus sylvatica</i> and <i>Picea abies</i>
11	Ca 1.75 km north of Frakto Forest Station, on slopes above the Tzaki stream, ca 1140-1250 m alt.	Mixed forest with <i>Pinus sylvestris</i> and <i>Fagus sylvatica</i> , on slopes facing north to north-west
12	Ca 2 km NNE of Frakto Forest Station, on banks near the Tzaki stream, ca 1070-1120 m alt.	Mixed forest and stream banks with low crags
13	Ca 2.25 km NNE of Frakto Forest Station, north of the junction of the Tzaki and Achladorema streams, ca 1020-1040 m alt.	Base-rich conglomerate rocks and slopes, facing east, by forest road and under <i>Fagus sylvatica</i>
14	Ca 2.5-3.25 km NNE of Frakto Forest Station, in the Achladorema valley, ca 1050-1180 m alt.	Forest with <i>Fagus sylvatica</i> , stream banks and waterfalls, and area of open scree
15	Ca 2-2.25 km NNE of Frakto Forest Station, north of Tzaki Rema, on west side of Achladorema valley, ca 1100-1150 m alt.	Mixed forest on south-facing slope, and area of boulder scree on east-facing slope
16	Likolaka Rema valley, ca 2.5-3 km north of Frakto Forest Station, ca 1140-1200 m alt.	Mixed forest on slopes facing north-east, with <i>Fagus sylvatica</i> and occasional trees of <i>Betula pendula</i> and <i>Pinus peuce</i>
17	Ca 2 km N of Frakto Forest Station, on banks of the Tzaki stream, ca 1110-1140 m alt.	<i>Fagus sylvatica</i> forest with low crags
18	Ca 0.6 km NNW of Frakto Forest Station, ca 1370 m alt.	Edge of forest road

RESULTS AND DISCUSSION

The collections from Frakto include 155 bryophyte taxa, excluding a small number of specimens not yet satisfactorily named. In the following citations, the first number of each entry indicates the collecting site for the species, as described in Table 1, which documents the general characteristics of each collecting site. This is followed by details that are specific to each individual collection, i.e. the substrate on which the specimen was found, the geographical co-ordinates of the collection, and the reference number of the specimen(s) in the author's herbarium. The abbreviation p.p. (*pro parte*) indicates that the specimen is part of a mixed gathering. Species new to Greece are indicated by an asterisk (*).

Liverworts

- Barbilophozia hatcheri* (A.Evans) Loeske: 3, among lightly shaded boulders at base of crag, 41°30'58"N, 24°30'06"E, 45/432.
- Blasia pusilla* L.: 10, on log in ditch by forest road, 41°30'53"N, 24°29'33"E, 45/507.
- Blepharostoma trichophyllum* (L.) Dumort.: 2, on rotting log in mixed forest, 41°30'27"N, 24°30'13"E, 45/417; 5, on old log by stream in mixed forest, 41°32'33"N, 24°28'57"E, 45/442 p.p.
- Calypogeia fissa* (L.) Raddi: 6, seepage on lightly shaded bank by forest road, 41°33'00"N, 24°29'33"E, 45/474.
- Calypogeia suecica* (Arnell & J.Perss.) Müll.Frib.: 5, on old log by stream in mixed forest, 41°32'33"N, 24°28'57"E, 45/442 p.p.
- Chiloscyphus polyanthos* (L.) Corda: 14, rock at edge of stream below waterfall, 41°31'47"N, 24°30'48"E, 45/548.
- Cololejeunea calcarea* (Lib.) Steph.: 17, on north-facing crag in beech (*Fagus*) forest, 41°31'21"N, 24°30'21"E, 45/598.
- Conocephalum conicum* (L.) Dumort., s.str.: 12, seepage on steep slope in mixed forest, 41°31'22"N, 24°30'35"E, 45/527.
- Frullania dilatata* (L.) Dumort.: 1, on deciduous tree, 41°30'29"N, 24°29'42"E, 45/394; 14, on *Fagus*, 41°31'51"N, 24°30'48"E, 45/549.
- Fuscocephaloziopsis catenulata* (Huebener) Váňa & L.Söderstr.: 5, on old log by stream in mixed forest, 41°32'33"N, 24°28'57"E, 45/440 p.p.
- Lejeunea cavifolia* (Ehrh.) Lindb.: 3, in recess on lightly shaded crag in mixed forest, 41°30'59"N, 24°30'07"E, 45/429; 5, on wet rock face by stream in mixed forest, 41°32'27"N, 24°28'50"E, 45/471.
- Lepidozia reptans* (L.) Dumort.: 5, on old log by stream in mixed forest, 41°32'33"N, 24°28'57"E, 45/439 p.p.
- Liochlaena lanceolata* Nees: 5, a few stems on old log by stream in mixed forest, 41°32'33"N, 24°28'57"E, 45/439 p.p.
- Lophocolea bidentata* (L.) Dumort.: 14, on moist rock face in beech (*Fagus*) forest, 41°32'01"N, 24°30'55"E, 45/555.
- Lophocolea heterophylla* (Schrad.) Dumort.: 2, under *Fagus* on bank by forest road, 41°30'27"N, 24°30'14"E, 45/416; 2, on old tree stump in mixed forest, 41°30'27"N, 24°30'13"E, 45/421.

- Metzgeria conjugata* Lindb.: 12, forming lax patches on moist north-facing crag in mixed forest, 41°31'23"N, 24°30'26"E, 45/517.
- Metzgeria furcata* (L.) Corda: 5, on trunk of *Fagus*, 41°32'31"N, 24°28'56"E, 45/447.
- Nowellia curvifolia* (Dicks.) Mitt.: 5, on old log by stream in mixed forest, 41°32'33"N, 24°28'57"E, 45/440 p.p., 45/442 p.p.
- Obtusifolium obtusum* (Lindb.) S.W.Arnell: 12, among rocks on bank in mixed forest, 41°31'23"N, 24°30'29"E, 45/520.
- Pellia endiviifolia* (Dicks.) Dumort.: 18, in seepage by forest road, 41°30'38"N, 24°30'08"E, 45/609.
- Plagiochila porelloides* (Torr. ex Nees) Lindenb.: 2, under *Fagus* on bank by forest road, 41°30'27"N, 24°30'14"E, 45/409.
- Porella arboris-vitae* (With.) Grolle: 17, on north-facing crag in beech forest, 41°31'22"N, 24°30'23"E, 45/593.
- Porella cordaeana* (Huebener) Moore: 5, on wet rock face by stream in mixed forest, 41°32'27"N, 24°28'50"E, 45/470.
- Porella platyphylla* (L.) Pfeiff.: 1, on trunk of *Fagus*, 41°30'29"N, 24°29'34"E, 45/407; 14, on steep crag in beech (*Fagus*) forest, 41°32'04"N, 24°31'00"E, 45/566.
- Radula complanata* (L.) Dumort.: 7, on *Fagus* in mixed forest, 41°33'08"N, 24°29'13"E, 45/491.
- Radula lindenbiana* Gottsche ex C.Hartm.: 5, on wet rock face by stream in mixed forest, 41°32'27"N, 24°28'50"E, 45/469. This collection is abundantly fertile with numerous sporophytes, but completely lacking antheridial bracts subtending the perianths, and evidently dioicous. No male shoots were detected.
- Reboulia hemisphaerica* (L.) Raddi: 17, sparsely on north-facing crag in beech (*Fagus*) forest, 41°31'21"N, 24°30'21"E, 45/597.
- Riccardia latifrons* (Spruce) Schiffn.: 5, on old log by stream in mixed forest, 41°32'31"N, 24°28'53"E, 45/462.
- Riccardia palmata* (Hedw.) Carruth.: 10, on log in ditch by forest road, 41°30'53"N, 24°29'33"E, 45/506.
- Scapania nemorea* (L.) Grolle: 5, on small boulder in mixed forest, 41°32'32"N, 24°28'55"E, 45/455.
- Scapania umbrosa* (Schrad.) Dumort.: 5, on old log by stream in mixed forest, 41°32'33"N, 24°28'57"E, 45/441, 45/442 p.p.
- Scapania undulata* (L.) Dumort.: 5, on rocks in stream in mixed forest, 41°32'32"N, 24°28'54"E, 45/459.
- Schistochilopsis incisa* (Schrad.) Konstant.: 5, on side of log by stream in mixed forest, 41°32'29"N, 24°28'51"E, 45/468.
- Solenostoma hyalinum* (Lyell) Mitt.: 8, on wet mineral soil on bank by forest road, 41°31'54"N, 24°29'00"E, 45/497.
- Solenostoma obovatum* (Nees) C.Massal.: 5, on rocks in stream in mixed forest, 41°32'32"N, 24°28'54"E, 45/458. Paroicous inflorescences are present.
- **Syzygiella autumnalis* (DC.) K.Feldberg, Vaňa, Hentschel & Heinrichs: 15, among boulders in hollow in scree, 41°31'31"N, 24°30'41"E, 45/572.

Mosses

- Abietinella abietina* (Hedw.) M.Fleisch.: 14, in light shade under beech, 41°32'00"N, 24°30'57"E, 45/567.
- Alleniella besseri* (Lobarz.) S.Olsson, Enroth & D.Quandt: 13, on shaded calcareous conglomerate rocks, 41°31'35"N, 24°30'54"E, 45/538; 17, underside of boulder in beech (*Fagus*) forest, 41°31'19"N, 24°30'19"E, 45/606.
- Alleniella complanata* (Hedw.) S.Olsson, Enroth & D.Quandt: 12, base of old beech (*Fagus*) tree in mixed forest, 41°31'23"N, 24°30'35"E, 45/521.
- Amphidium mougeotii* (Schimp.) Schimp.: 12, on moist north-facing crag in mixed forest, 41°31'22"N, 24°30'26"E, 45/515; 16, on moist silty rocks by small waterfall in forest stream, 41°32'02"N, 24°30'25"E, 45/586.
- Anomodon attenuatus* (Hedw.) Huebener: 3, on small rock outcrop in mixed forest, 41°30'58"N, 24°30'06"E, 45/436; 12, on boulder in mixed forest, 41°31'22"N, 24°30'35"E, 45/522.
- Anomodon viticulosus* (Hedw.) Hook. & Taylor: 13, on small boulder under beech (*Fagus*), 41°31'35"N, 24°30'53"E, 45/540.
- Antitrichia curtispindula* (Hedw.) Brid.: 3, on lightly shaded crag in mixed forest, 41°30'58"N, 24°30'06"E, 45/431; 14, on lightly shaded boulder in scree, 41°31'59"N, 24°30'56"E, 45/556.
- Atrichum undulatum* (Hedw.) P.Beauv.: 5, on soil on tree stump in mixed forest, 41°32'32"N, 24°28'54"E, 45/457.
- Bartramia pomiformis* Hedw.: 12, in rock crevice on bank in mixed forest, 41°31'23"N, 24°30'29"E, 45/519.
- Blindia acuta* (Hedw.) Bruch & Schimp.: 5, stone by stream in mixed forest, 41°32'32"N, 24°28'57"E, 45/444.
- Brachytheciastrum velutinum* (Hedw.) Ignatov & Huttunen (*sensu* Orgaz *et al.*, 2013): 5, on roots of beech (*Fagus*) in mixed forest, 41°32'30"N, 24°28'52"E, 45/465; 11, on forest bank in mixed forest, 41°31'06"N, 24°30'16"E, 45/511. These plants are fertile with rough setae.
- Brachytheciastrum olympicum* (Jur.) Vanderp., Ignatov, Huttunen & Goffinet: 6, on the ground under scattered *Abies*, 41°33'03"N, 24°29'36"E, 45/475. The status of *B. olympicum* is rather problematic. Orgaz *et al.* (2013) recognise *B. olympicum* and *B. salicinum* as distinct species, differing from *B. velutinum* by reason of their smooth setae, and from each other in the presence or absence of prorate cells on the dorsal lamina of the stem leaves, and in the size of the alar groups. The Frakto plants are fertile with smooth setae and have large alar groups (the ascending marginal row mostly composed of 5–10 cells), thus agreeing with *B. olympicum*. However Orgaz *et al.* (2013) state that *B. olympicum* also differs from *B. salicinum* in the presence of prorate cells in the stem leaves, but this could not be confirmed in the Frakto specimen.
- Brachythecium glareosum* (Bruch *ex* Spruce) Schimp.: 2, under *Fagus* on bank by forest road, 41°30'27"N, 24°30'14"E, 45/408.
- Brachythecium rivulare* Schimp.: 5, on stones in seepage in mixed forest, 41°32'29"N, 24°28'53"E, 45/463; 18, in seepage by forest road, 41°30'39"N, 24°30'07"E, 45/611.

- Brachythecium salebrosum* (Hoffm. ex F.Weber & D.Mohr) Schimp.: 5, on fallen log on stream bank in mixed forest, 41°32'32"N, 24°28'55"E, 45/453.
- Brachythecium tommasinii* (Sendtn. ex Boulay) Ignatov & Huttunen: 17, on massive boulder in beech (*Fagus*) forest, 41°31'20"N, 24°30'19"E, 45/605.
- Bryoerythrophyllum recurvirostrum* (Hedw.) P.C.Chen: 2, soil on bank by forest road, 41°30'31"N, 24°30'13"E, 45/422.
- Bryum argenteum* Hedw.: 6, dry soil on stony ground on grassy slope, 41°33'02"N, 24°29'36"E, 45/486.
- Bryum pseudotriquetrum* (Hedw.) G. Gaertn., B. Mey. & Scherb.: 14, sterile plants, not assignable to subspecies, in wet recess under rocks by stream near waterfall, 41°31'46"N, 24°30'48"E, 45/546.
- Calliergonella cuspidata* (Hedw.) Loeske: 4, seepage by forest road, 41°30'38"N, 24°30'08"E, 45/438.
- Campyliadelphus chrysophyllus* (Brid.) R.S.Chopra: 13, on calcareous conglomerate rocks by forest road, 41°31'33"N, 24°30'53"E, 45/535.
- Ceratodon purpureus* (Hedw.) Brid.: 6, among rocks on grassy slope, 41°33'05"N, 24°29'30"E, 45/479.
- Cirriphyllum crassinervium* (Taylor) Loeske & M.Fleisch.: 16, on moist rocks by small waterfall in forest stream, 41°32'02"N, 24°30'25"E, 45/585.
- Cratoneuron filicinum* (Hedw.) Spruce: 18, in seepage by forest road, 41°30'38"N, 24°30'08"E, 45/610.
- Ctenidium molluscum* (Hedw.) Mitt. var. *molluscum*: 13, on calcareous conglomerate rocks by forest road, 41°31'31"N, 24°30'54"E, 45/530.
- Ctenidium molluscum* "forest taxon": 5, on moist stone in mixed forest, 41°32'32"N, 24°28'55"E, 45/456; 5, on rocks on stream bank in mixed forest, 41°32'32"N, 24°28'53"E, 45/460; 5, on roots of beech (*Fagus*) in mixed forest, 41°32'30"N, 24°28'52"E, 45/464; 12, base of beech (*Fagus*) tree in mixed forest, 41°31'23"N, 24°30'27"E, 45/518. This moss is very distinct from the normal forms of *C. molluscum*, and appears to be a neglected or undescribed taxon. It is larger and laxer than var. *molluscum*, and the leaves are only slightly curved. It occurs on substrates that are mildly acidic. Further investigation into its status is ongoing.
- Cynodontium bruntonii* (Sm.) Bruch & Schimp.: 3, on lightly shaded crag in mixed forest, 41°30'59"N, 24°30'07"E, 45/427.
- Dicranella heteromalla* (Hedw.) Schimp.: 5, on the ground under beech (*Fagus*) in mixed forest, 41°32'31"N, 24°28'56"E, 45/446.
- Dicranella subulata* (Hedw.) Schimp.: 8, with sporophytes, on wet mineral soil on bank by forest road, 41°31'54"N, 24°29'00"E, 45/499.
- Dicranella varia* (Hedw.) Schimp.: 13, on moist soil on slump by forest road, 41°31'39"N, 24°30'54"E, 45/539.
- Dicranum scoparium* Hedw.: 3, on tree stump in mixed forest, 41°30'54"N, 24°30'04"E, 45/426; 3, on lightly shaded crag in mixed forest, 41°30'58"N, 24°30'06"E, 45/434, and 41°30'59"N, 24°30'08"E, 45/435; 15, in hollow in scree, 41°31'31"N, 24°30'42"E, 45/576.
- Dicranum tauricum* Sapjegin: 2, on old tree stump in mixed forest, 41°30'27"N, 24°30'13"E, 45/420.

- Didymodon fallax* (Hedw.) R.H.Zander: 13, on calcareous conglomerate rocks by forest road, 41°31'33"N, 24°30'53"E, 45/536.
- Ditrichum pusillum* (Hedw.) Hampe: 8, on wet mineral soil on bank by forest road, 41°31'54"N, 24°29'00"E, 45/498.
- Encalypta ciliata* Hedw.: 2, sparsely under *Fagus* on bank by forest road, 41°30'27"N, 24°30'14"E, 45/413.
- Encalypta streptocarpa* Hedw.: 13, on conglomerate boulder by forest road, 41°31'30"N, 24°30'54"E, 45/529.
- Eucladium verticillatum* (With.) Bruch & Schimp.: 17, on wet face of vertical crag in beech (*Fagus*) forest, 41°31'21"N, 24°30'18"E, 45/600.
- Eurhynchiastrium pulchellum* (Hedw.) Ignatov & Huttunen var. *diversifolium* (Schimp.) Ochyra & Żarnowiec: 11, on forest bank in mixed forest, 41°31'18"N, 24°30'29"E, 45/512.
- Eurhynchium angustirete* (Broth.) T.J.Kop.: 9, on slope in mixed forest, 41°31'11"N, 24°28'59"E, 45/503; 17, on rocky north-facing bank in beech (*Fagus*) forest, 41°31'22"N, 24°30'22"E, 45/594.
- Fissidens dubius* P.Beauv.: 2, under *Fagus* on bank by forest road, 41°30'27"N, 24°30'14"E, 45/414 p.p.
- Fissidens taxifolius* Hedw.: 14, under beech (*Fagus*) on bank by stream, 41°31'45"N, 24°30'53"E, 45/545.
- Fontinalis antipyretica* Hedw. subsp. *antipyretica*: 7, in stream in mixed forest, 41°33'06"N, 24°29'12"E, 45/488.
- Funaria hygrometrica* Hedw.: 6, on disturbed ground on grassy slope, 41°33'09"N, 24°29'33"E, 45/485.
- Grimmia hartmanii* Schimp.: 5, on boulders in mixed forest, 41°32'32"N, 24°28'57"E, 45/443; 14, on boulders in scree, 41°32'02"N, 24°30'58"E, 45/563; 15, on boulders in hollow in scree, 41°31'31"N, 24°30'41"E, 45/571; 15, lightly shaded rocks at edge of scree, 41°31'31"N, 24°30'42"E, 45/578.
- Grimmia muehlenbeckii* Schimp.: 6, in small area of scree on grassy slope, 41°33'06"N, 24°29'31"E, 45/483; 15, on boulders in hollow in scree, 41°31'31"N, 24°30'41"E, 45/574. These specimens lack sporophytes but agree well with *G. muehlenbeckii* in having a central strand in the stem and a nerve which is angled to slightly winged dorsally (Fig. 2). Stalked gemmae are present near the base of the leaf on the dorsal surface in no. 45/483 (Fig. 3).
- Grimmia ovalis* (Hedw.) Lindb.: 3, on lightly shaded boulder at base of crag, 41°30'58"N, 24°30'06"E, 45/433; 6, on small rock outcrop on grassy slope, 41°33'05"N, 24°29'30"E, 45/476; 14, on boulders in scree, 41°32'00"N, 24°30'56"E, 45/560; 15, lightly shaded rocks at edge of scree, 41°31'31"N, 24°30'42"E, 45/579.
- Grimmia torquata* Drumm.: 17, on moist crag by forest stream, with *Amphidium mougeotii*, 41°31'22"N, 24°30'23"E, 45/592.
- Hedwigia ciliata* (Hedw.) P.Beauv. var. *ciliata*: 14, on lightly shaded boulder in scree, 41°31'59"N, 24°30'56"E, 45/557; 15, on boulders in hollow in scree, 41°31'31"N, 24°30'41"E, 45/573.

Herzogiella seligeri (Brid.) Z.Iwats.: 2, on old tree stump in mixed forest, 41°30'27"N, 24°30'13"E, 45/419.

Homalothecium lutescens (Hedw.) H.Rob.: 13, on calcareous conglomerate rocks by forest road, 41°31'32"N, 24°30'52"E, 45/531.



Fig. 2. Leaf section of *Grimmia muehlenbeckii*, showing angled to slightly winged nerve, from Blockeel 45/483.

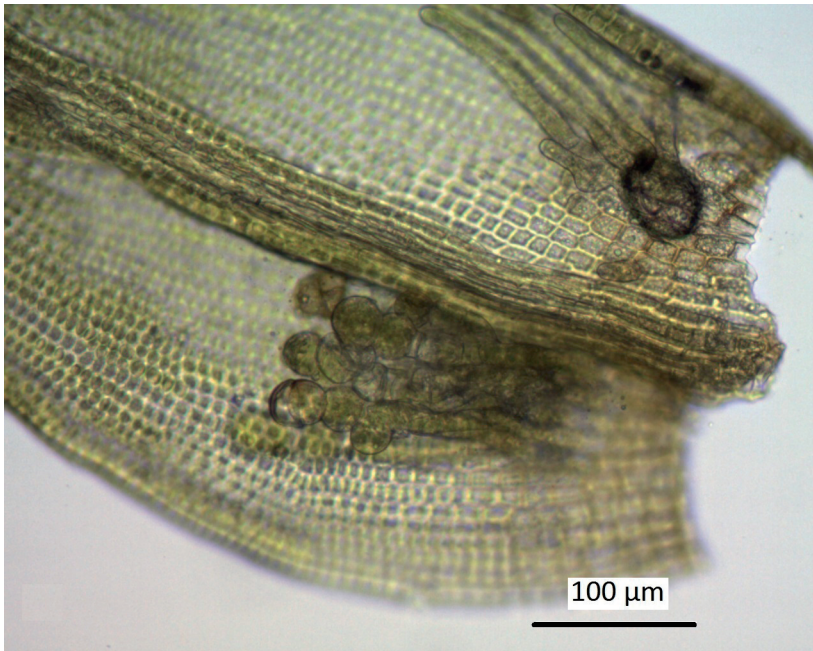


Fig. 3. Stalked gemmae of *Grimmia muehlenbeckii*, arising from the dorsal leaf base, from Blockeel 45/483.

- Homalothecium philippeanum*** (Spruce) Schimp.: 12, on small boulder under beech (*Fagus*), 41°31'21"N, 24°30'25"E, 45/514; 13, on small boulder under beech (*Fagus*), 41°31'35"N, 24°30'53"E, 45/541.
- Homomallium incurvatum*** (Schrad. ex Brid.) Loeske: 14, on small stone under beech (*Fagus*), 41°31'44"N, 24°30'53"E, 45/543; 15, with *Sciuro-hypnum populeum* on boulder in mixed forest, 41°31'24"N, 24°30'28"E, 45/568.
- Hylocomium splendens*** (Hedw.) Schimp.: 17, on rocky north-facing bank in beech (*Fagus*) forest, 41°31'22"N, 24°30'22"E, 45/595.
- Hymenoloma crispulum*** (Hedw.) Ochyra: 6, in small area of scree on grassy slope, 41°33'06"N, 24°29'31"E, 45/484; 8, on lightly shaded rocks under *Abies*, 41°31'46"N, 24°29'20"E, 45/500.
- Hypnum cupressiforme*** Hedw. var. *cupressiforme*: 14, on boulders in scree, 41°32'02"N, 24°30'58"E, 45/564 and 45/565; 15, on boulders in hollow in scree, 41°31'31"N, 24°30'41"E, 45/575. Specimens 45/564 and 45/565 occurred together in the field, behaving as distinct taxa. No. 45/564 is close to var. *tectorum* Brid., but this variety is not recognised by Ros *et al.* (2013).
- Isothecium alopecuroides*** (Lam. ex Dubois) Isov.: 3, on lightly shaded crag in mixed forest, 41°30'58"N, 24°30'06"E, 45/430.
- Leptodon smithii*** (Hedw.) F.Weber & D.Mohr: 17, sparsely on *Fagus*, 41°31'23"N, 24°30'23"E, 45/590.
- Lescuraea saviana*** (De Not.) E.Lawton: 5, on base of *Fagus* trunk, 41°32'31"N, 24°28'56"E, 45/451; 6, on rock in small area of scree on grassy slope, 41°33'06"N, 24°29'31"E, 45/482; 7, on base of *Fagus* in mixed forest, 41°33'09"N, 24°29'14"E, 45/495.
- Leucodon sciuroides*** (Hedw.) Schwägr.: 1, on small thorn tree, 41°30'29"N, 24°29'34"E, 45/405; 7, on *Abies* in mixed forest, 41°33'08"N, 24°29'15"E, 45/493.
- Lewinskya acuminata*** (H.Philib.) F.Lara, Garilleti & Goffinet: 1, on deciduous tree, 41°30'29"N, 24°29'37"E, 45/397 p.p.
- Lewinskya affinis*** (Brid.) F.Lara, Garilleti & Goffinet: 1, on deciduous trees, 41°30'29"N, 24°29'42"E and near vicinity, 45/390 p.p., 45/392 p.p., 45/393 p.p., 45/396 p.p., 45/397 p.p., 45/398, 45/400; 14, on deciduous tree in scree, 41°32'01"N, 24°30'56"E, 45/561 p.p.; 15, on small deciduous tree, 41°31'25"N, 24°30'29"E, 45/569a p.p., 45/569b p.p.
- Lewinskya breviseta*** (F.Lara, Garilleti & Mazimpaka) F.Lara, Garilleti & Goffinet: 1, on small thorn tree, 41°30'29"N, 24°29'34"E, 45/406 p.p., *det.* F. Lara.
- Lewinskya rupestris*** (Schleich. ex Schwägr.) F.Lara, Garilleti & Goffinet: 2, on *Betula pendula*, 41°30'47"N, 24°30'10"E, 45/425; 14, on *Fagus*, 41°31'44"N, 24°30'53"E, 45/542 and 41°31'51"N, 24°30'48"E, 45/550.
- Lewinskya shawii*** (Wilson) F.Lara, Garilleti & Goffinet: 1, on deciduous tree, 41°30'29"N, 24°29'42"E, 45/393 p.p. and 41°30'29"N, 24°29'39"E, 45/396 p.p.; 8, on *Fagus*, 41°31'16"N, 24°29'30"E, 45/502.
- Lewinskya speciosa*** (Nees) F.Lara, Garilleti & Goffinet: 1, on deciduous tree, 41°30'29"N, 24°29'39"E, 45/395 and 41°30'29"N, 24°29'37"E, 45/399 p.p.; 8, on *Fagus*, 41°31'46"N, 24°29'20"E, 45/501; 15, on small deciduous tree, 41°31'25"N, 24°30'29"E, 45/569b p.p.; 16, on small deciduous tree in mixed forest, 41°32'01"N, 24°30'26"E, 45/582 p.p.

- Lewinskya striata* (Hedw.) F.Lara, Garilleti & Goffinet: 1, on deciduous trees, 41°30'29"N, 24°29'42"E, 45/392 p.p., 45/393 p.p., and 41°30'29"N, 24°29'37"E, 45/399 p.p.; 15, on small deciduous tree, 41°31'25"N, 24°30'29"E, 45/569a p.p.; 16, on small deciduous tree in mixed forest, 41°32'01"N, 24°30'26"E, 45/583.
- Mnium lycopodioides* Schwägr.: 14, damp recess under boulder by stream below waterfall, 41°31'46"N, 24°30'48"E, 45/547; 16, on moist silty rocks among *Amphidium* by small waterfall, 41°32'02"N, 24°30'25"E, 45/587; 17, on stony/soily bank in beech (*Fagus*) forest, 41°31'20"N, 24°30'21"E, 45/599.
- Mnium stellare* Hedw.: 11, among roots of beech (*Fagus*) tree, 41°31'05"N, 24°30'14"E, 45/509; 12, base of moist crag near waterfall in mixed forest, 41°31'21"N, 24°30'35"E, 45/525.
- Neckera menziesii* Drumm.: 17, on massive boulder in beech (*Fagus*) forest, 41°31'20"N, 24°30'19"E, 45/604.
- Neckera pumila* Hedw.: 3, on face of lightly shaded crag in mixed forest, 41°30'59"N, 24°30'07"E, 45/428; 17, on trunk of *Fagus*, 41°31'20"N, 24°30'20"E, 45/602.
- Orthotrichum cupulatum* Hoffm. ex Brid. var. *cupulatum*: 16, on small boulder on bank of forest stream, 41°32'02"N, 24°30'25"E, 45/584.
- Orthotrichum pallens* Bruch ex Brid.: 1, on deciduous tree, 41°30'29"N, 24°29'42"E, 45/391 p.p.; 1, on small thorn tree, 41°30'29"N, 24°29'34"E, 45/404.
- Orthotrichum scanicum* Gronvall: 1, on deciduous tree, 41°30'29"N, 24°29'42"E, 45/391 p.p. and 41°30'29"N, 24°29'35"E, 45/402.
- Orthotrichum stramineum* Hornsch. ex Brid.: 1, on deciduous tree, 41°30'29"N, 24°29'42"E, 45/390 p.p.; 2, on *Betula pendula*, 41°30'47"N, 24°30'10"E, 45/424; 5, on trunk of *Fagus*, 41°32'31"N, 24°28'56"E, 45/449; 14, on deciduous tree in scree, 41°32'01"N, 24°30'56"E, 45/561 p.p.; 15, on small deciduous tree, 41°31'25"N, 24°30'29"E, 45/569a p.p.; 16, on small deciduous tree in mixed forest, 41°32'01"N, 24°30'26"E, 45/582 p.p.
- Oxyrrhynchium hians* (Hedw.) Loeske: 16, on wet rocks by forest stream, 41°32'03"N, 24°30'25"E, 45/589.
- Oxystegus tenuirostris* (Hook. & Taylor) A.J.E.Sm. var. *tenuirostris*: 7, on rocks at edge of stream in mixed forest, 41°33'07"N, 24°29'12"E, 45/490.
- Paraleucobryum longifolium* (Hedw.) Loeske: 15, in hollow in scree, 41°31'31"N, 24°30'42"E, 45/577.
- Philonotis tomentella* Molendo: 6, seepage on lightly shaded bank by forest road, 41°33'00"N, 24°29'33"E, 45/472. This is a rather critical species. The specimen from Frakto has acute inner perigonal bracts. The cells of the leaf lamina have proximal papillae on the dorsal surface, but in addition some distal papillae are present on the ventral surface, especially in the upper part of the leaf.
- Plagiomnium affine* (Blandow ex Funck) T.J.Kop.: 17, among rocks in beech (*Fagus*) forest, 41°31'19"N, 24°30'19"E, 45/607.
- Plagiomnium cuspidatum* (Hedw.) T.J.Kop.: 14, top of boulder in beech (*Fagus*) forest, 41°31'57"N, 24°30'50"E, 45/552.
- Plagiomnium rostratum* (Schrad.) T.J.Kop.: 2, under *Fagus* on bank by forest road, 41°30'27"N, 24°30'14"E, 45/412.

- Plagiomnium undulatum* (Hedw.) T.J.Kop.: 16, on moist rocks by small waterfall in forest stream, 41°32'02"N, 24°30'25"E, 45/588.
- Plagiopus oederianus* (Sw.) H.A.Crum & L.E.Anderson: 17, on north-facing crag in beech (*Fagus*) forest, 41°31'20"N, 24°30'22"E, 45/596.
- Plagiothecium cavifolium* (Brid.) Z.Iwats.: 11, on forest bank in mixed forest, 41°31'06"N, 24°30'14"E, 45/510.
- Plagiothecium nemorale* (Mitt.) A.Jaeger: 5, on the ground under beech (*Fagus*) in mixed forest, 41°32'32"N, 24°28'56"E, 45/454; 17, on boulder in beech (*Fagus*) forest, 41°31'19"N, 24°30'19"E, 45/608.
- Plagiothecium succulentum* (Wilson) Lindb.: 5, among rocks on stream bank in mixed forest, 41°32'32"N, 24°28'55"E, 45/452.
- Plasteurhynchium striatulum* (Spruce) M.Fleisch.: 13, on shaded calcareous conglomerate rocks, 41°31'35"N, 24°30'54"E, 45/537.
- Pleurozium schreberi* (Willd. ex Brid.) Mitt.: 11, on bank in *Fagus/Pinus* forest, 41°31'19"N, 24°30'28"E, 45/513.
- Pogonatum aloides* (Hedw.) P.Beauv.: 5, on root plate of fallen tree in mixed forest, 41°32'33"N, 24°28'55"E, 45/461.
- Pohlia cruda* (Hedw.) Lindb.: 2, under *Fagus* on bank by forest road, 41°30'27"N, 24°30'14"E, 45/411.
- Polytrichum formosum* Hedw.: 5, on the ground under beech (*Fagus*) in mixed forest, 41°32'31"N, 24°28'56"E, 45/445.
- Polytrichum piliferum* Hedw.: 6, among rocks on grassy slope, 41°33'05"N, 24°29'30"E, 45/478.
- Pseudoamblystegium subtile* (Hedw.) Vanderp. & Hedenäs: 5, on trunk of *Fagus*, 41°32'31"N, 24°28'52"E, 45/467; 7, on *Fagus* in mixed forest, 41°33'08"N, 24°29'13"E, 45/492.
- Pseudoleskeella nervosa* (Brid.) Nyholm: 7, on *Fagus* in mixed forest, 41°33'08"N, 24°29'16"E, 45/494.
- Pseudoscleropodium purum* (Hedw.) M.Fleisch.: 10, under *Picea* on bank by forest road, 41°30'52"N, 24°29'40"E, 45/508.
- Pterigynandrum filiforme* Hedw.: 1, on trunk of *Fagus*, 41°30'29"N, 24°29'34"E, 45/403; 12, on boulder in mixed forest, 41°31'22"N, 24°30'35"E, 45/524.
- Racomitrium aciculare* (Hedw.) Brid.: 7, on small boulder in stream in mixed forest, 41°33'06"N, 24°29'11"E, 45/487.
- Rhabdoweisia fugax* (Hedw.) Bruch & Schimp.: 6, among rocks on grassy slope, 41°33'05"N, 24°29'30"E, 45/480. These plants are sterile, but agree fully with *R. fugax* on vegetative characters. In particular the leaf cells are ornamented with fine striae, as is usual for this species.
- Rhizomnium punctatum* (Hedw.) T.J.Kop.: 6, seepage on lightly shaded bank by forest road, 41°33'00"N, 24°29'33"E, 45/473; 17, edge of seepage in beech (*Fagus*) forest, 41°31'20"N, 24°30'18"E, 45/601.
- Rhynchostegium riparioides* (Hedw.) Cardot: 16, on rocks in small forest stream, 41°31'50"N, 24°30'35"E, 45/580.
- Rhytidium rugosum* (Hedw.) Kindb.: 14, among lightly shaded boulders in scree, 41°32'00"N, 24°30'56"E, 45/558; 14, among boulders in scree, 41°32'01"N, 24°30'58"E, 45/562.

- Sanionia uncinata* (Hedw.) Loeske: 5, on trunk of *Fagus*, 41°32'31"N, 24°28'56"E, 45/448.
- Schistidium apocarpum* (Hedw.) Bruch & Schimp.: 3, on small rock outcrop in mixed forest, 41°30'58"N, 24°30'06"E, 45/437; 7, on rocks at edge of stream in mixed forest, 41°33'07"N, 24°29'12"E, 45/489.
- Schistidium confertum* (Funck) Bruch & Schimp.: 6, on small rock outcrop on grassy slope, 41°33'05"N, 24°29'30"E, 45/477, *conf.* R. Ochyra.
- Schistidium crassipilum* H.H.Blom: 13, on calcareous conglomerate rocks by forest road, 41°31'32"N, 24°30'53"E, 45/532.
- Sciuro-hypnum populeum* (Hedw.) Ignatov & Huttunen: 14, on small boulder under beech (*Fagus*), 41°31'44"N, 24°30'54"E, 45/544, and 41°31'56"N, 24°30'49"E, 45/551.
- Seligeria acutifolia* Lindb.: 17, on side of massive boulder in beech (*Fagus*) forest, 41°31'20"N, 24°30'20"E, 45/603.
- Seligeria donniana* (Sm.) Müll.Hal.: 14, on wet rock face behind waterfall, 41°32'02"N, 24°30'57"E, 45/554 p.p.
- Seligeria recurvata* (Hedw.) Bruch & Schimp.: 14, on wet rock face behind waterfall, 41°32'02"N, 24°30'57"E, 45/554 p.p.
- Syntrichia ruralis* (Hedw.) F.Weber & D.Mohr var. *ruralis*: 1, on trunk of *Fagus*, 41°30'29"N, 24°29'35"E, 45/401; 6, among rocks on grassy slope, 41°33'05"N, 24°29'29"E, 45/481.
- Thamnobryum alopecurum* (Hedw.) Gangulee: 12, boulder by stream below waterfall, 41°31'21"N, 24°30'35"E, 45/526.
- Thuidium recognitum* (Hedw.) Lindb.: 2, crest of bank by forest road, 41°30'31"N, 24°30'13"E, 45/423; 14, over rocks in beech (*Fagus*) forest, 41°31'57"N, 24°30'50"E, 45/553.
- Tortella squarrosa* (Brid.) Limpr.: 15, in grassy vegetation on open sunny bank, 41°31'26"N, 24°30'39"E, 45/570.
- Tortella tortuosa* (Hedw.) Limpr. var. *tortuosa*: 2, under *Fagus* on bank by forest road, 41°30'27"N, 24°30'14"E, 45/410; 12, on moist north-facing crag in mixed forest, 41°31'22"N, 24°30'27"E, 45/516.
- Tortula muralis* Hedw.: 13, on calcareous conglomerate rocks by forest road, 41°31'32"N, 24°30'53"E, 45/533.
- Tortula subulata* Hedw.: 2, under *Fagus* on bank by forest road, 41°30'27"N, 24°30'14"E, 45/415; 12, bank under beech (*Fagus*) in mixed forest, 41°31'23"N, 24°30'36"E, 45/528.
- Trichostomum crispulum* Bruch: 13, on calcareous conglomerate rocks by forest road, 41°31'32"N, 24°30'53"E, 45/534.
- **Ulota crispa* (Hedw.) Brid.: 5, on trunk of *Fagus*, 41°32'31"N, 24°28'56"E, 45/450, *conf.* F. Lara; 5, on trunk of *Fagus*, 41°32'31"N, 24°28'52"E, 45/466; 9, on *Fagus* in sheltered forest valley, 41°31'12"N, 24°28'58"E, 45/505, *conf.* F. Lara; 16, on *Betula pendula*, 41°32'01"N, 24°30'27"E, 45/581, *conf.* F. Lara. The taxonomy of *Ulota crispa* used here follows Caparrós *et al.* (2016).
- **Ulota crispula* Bruch: 9, on *Fagus* in sheltered forest valley, 41°31'12"N, 24°28'58"E, *conf.* F. Lara. 45/504.

This catalogue cannot be considered to be a complete account of the bryophytes of Frakto Forest. In particular it was not possible during the present survey to sample the tract of old-growth forest in the north-eastern part of the inner zone, and the crags separating the inner and outer zones were not visited. However these crags are south-facing and might not be expected to contribute significant numbers of northern and boreal taxa.

The bryophyte flora of the forest incorporates a wide range of phytogeographical elements. A few species with Mediterranean-Atlantic or Sub-Mediterranean distributions extend into warmer sites at lower altitudes in the south of the protected area (at *ca* 1000-1100 m), e.g. *Leptodon smithii*, *Plasteurhynchium striatulum* and *Tortella squarrosa*. Similarly, a significant proportion of species in the forest are characteristic of Temperate zones (in the Wide-temperate, Temperate and Southern-temperate categories, as defined by Hill & Preston, 1998). However the majority of species in the forest have distributions that extend into the Boreal zone in Europe (in the Boreo-arctic montane, Wide-Boreal, Boreal-Montane and Boreo-temperate categories of Hill & Preston, 1998), and many of these are rare or unknown elsewhere in Greece.

Among species that, in Greece, are confined to the Rhodope Mountains are a number of lignicolous liverworts of rotting (especially softwood) logs. The rich flora of this habitat in the Rhodope Mountains has already been noted by Zoller *et al.* (1977) and Blockeel (2010). Of these *Blepharostoma trichophyllum*, *Calypogeia suecica*, *Fuscocephaloziopsis catenulata*, *Lepidozia reptans*, *Riccardia latifrons* and *Scapania umbrosa* are known from Frakto and the wider Rhodope area (including Mt Vrontous) but not elsewhere in Greece. *Fuscocephaloziopsis lunulifolia* (Dumort.) Vána & L.Söderstr., recorded by Geissler (1977) from Zagradenia also falls into this category. Other lignicolous species (*Liochlaena lanceolata*, *Nowellia curvifolia* and *Riccardia palmata*) have isolated sites elsewhere in the mountains of northern mainland Greece.

Three species recorded during the present survey (*Syzygiella autumnalis*, *Ulota crispa* and *U. crispula*) are new for Greece. The liverwort *Syzygiella autumnalis* (*Jamesoniella autumnalis* (DC.) Steph.) has a Circumpolar Boreo-temperate distribution. It is known from several Balkan countries (Hodgetts, 2015), but the only previous report from Greece, by Ade and Reching (1938) on Samothraki, has proved to be an error, and was re-identified as *Nardia geoscyphus* (De Not.) Lindb. by Müller (1947). In Frakto Forest it occurs among small boulders in an area of open scree. The genus *Ulota*, which is represented by 12 species in Europe and is primarily restricted to temperate regions with oceanic environments (Garilleti *et al.*, 2015). The occurrence of two species in Frakto Forest may be attributed to the humidity provided by summer rainfall. Eleftheriadou & Raus (1996) characterise the climate of the forest as 'axeric, montane and hyperhumid'.

The following species from Frakto are also noteworthy in a Greek context: *Solenostoma obovatum* is reported for Greece (Mt Voras) without full details by Blockeel (2013), and from Samothraki by Biel & Tan (2014), although the latter record, at 830 m alt., requires confirmation. It is a boreal-montane liverwort, very rare in the southern part of the Balkan Peninsula, recorded from Bulgaria, and further north from Romania, Serbia and Slovenia.

Dicranella subulata has a Circumpolar Boreo-arctic Montane distribution, and is known from most of the Balkan countries (Hodgetts, 2015). There is a single previous report from Greece (Ganiatsas, 1937), from sandy ground along a road in the Forest of Polighiros. This presumably refers to the Cholomondas mountains in the Chalkidiki Peninsula, with a maximum altitude of 1163 m, and therefore at a

relatively low altitude. In Frakto Forest fertile plants were found in a similar habitat at the edge of a forest road at ca 1650 m altitude, and its presence in Greece is confirmed.

Lewinskya breviseta has been reported once previously from Greece, on the Lasithi Plateau in Crete, as *Orthotrichum speciosum* var. *brevisetum* (Lara *et al.*, 2015). As a recently recognised taxon, it is surely under-recorded. It is a Mediterranean species (Draper *et al.*, 2003), apparently favouring mountains with relatively high precipitation but also experiencing summer drought. The record from Frakto is somewhat unusual in that the site is located in a sub-Mediterranean environment, though with a southerly aspect. The record is the first from mainland Greece.

Mnium lycopodioides has been reported for Greece previously only in the Doctoral Thesis of Tsakiri (2009), at a site on the Ladopotamos river near Andartiko in NW Macedonia. It is a Boreal-Montane species. The sites at Frakto are in beech (*Fagus sylvatica*) forest at ca 1050-1200 m alt., and two of the three collections are from humid niches on rocky stream banks.

Seligeria recurvata is a Boreo-temperate species that has been reported once previously in Greece, from a locality a little east of Eptachori in Western Macedonia (municipality of Nestorio), growing on sandstone (“cailloux gréseux”) in a dark ravine (Gamisans & Hébrard, 1980). A report from Crete published as *S. recurvata* var. *pumila* C.Hart. (Düll & Düll-Hermanns, 1973) was subsequently corrected to *Seligeria calycina* Mitt. ex Lindb. (Düll, 1995). *S. recurvata* is recorded from most of the Balkan countries (Hodgetts, 2015); as noted in many floras and atlases (e.g. Blockeel *et al.*, 2014), it avoids limestone rocks and is therefore absent from large areas.

Acknowledgements. My thanks are due to Dr Georgios Fotiadis (Aristotle University of Thessaloniki) for advice on my visit to Frakto, and to Alexandros Tsiridis (Forest Service of Drama) for permission to visit the forest and his generous assistance at the Forest Worksite. I am also very grateful to Dr F. Lara for checking specimens of the *Ulotia crisper* group and *Lewinskya breviseta*, and to Dr R. Ochyra likewise for *Schistidium confertum*. Dr Thomas Raus kindly helped with some literature references.

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