

# Contribution to the bryological knowledge of the Tuscan-Emilian Apennines (Northern Italy)

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## Abstract

The inventory of the bryophytes collected during the annual excursion of the Working Group for Bryology of the Italian Botanical Society is reported. This excursion was held in 2018 on the northern slope of the Tuscan-Emilian Apennines National Park, in the Administrative Region of Emilia-Romagna. The field work led to the finding of 113 taxa (24 liverworts and 89 mosses), including eight new records and seven confirmations for this Region. The occurrence of rare taxa for Italy (*Scapania uliginosa*, *Rhizomnium pseudopunctatum*, *Racomitrium fasciculare*, *Scorpidium cossonii*, *Grimmia lisae*, *Orthotrichum pulchellum*) is highlighted.

## Keywords

Bryophytes, new floristic records, northern Apennines, regional flora

## Introduction

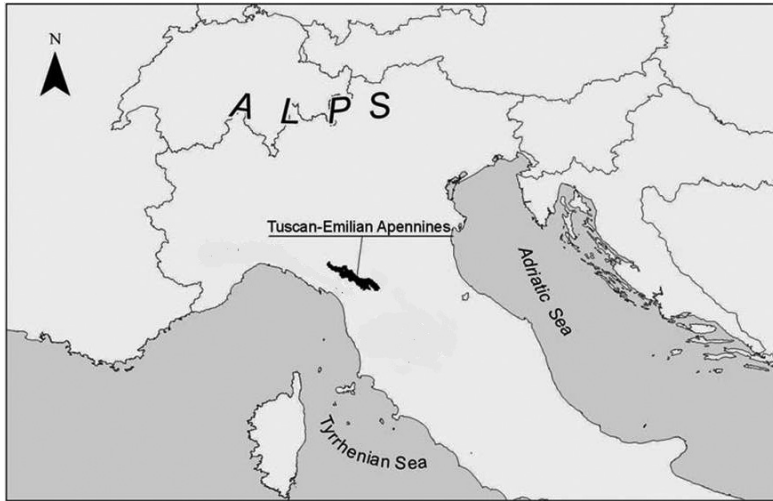
The Tuscan-Emilian Apennines constitute the central sector of the northern Apennines, a mountain chain that crosses the Italian peninsula along the border between the Administrative Regions of Emilia-Romagna and Toscana.

The first knowledge on the bryophyte flora of the Tuscan-Emilian Apennines dates back to the end of the 19<sup>th</sup> century with the floristic contributions of Fiori (1886, 1892a, 1892b), Avetta (1897), Casali (1899a, 1899b), and Provasi (1938), regarding the moss and liverwort flora of the provinces of Modena, Reggio Emilia, and Parma. Other information is found in the papers published by Barsali (1907, 1914) and Bottini (1913, 1914, 1919); later, Raffaelli (1976) published a paper on the genus *Sphagnum* for the Tuscan-Emilian territory. More data can be drawn from the phytogeographic and phytosociological papers of Tomaselli and Gerdol (1984), Gerdol and Tomaselli (1988, 1993), Tomaselli (1991), and Petraglia and Tomaselli (2007). Recently, a study on the bryoflora of the gypsum outcrops (Aleffi et al. 2014) and a checklist of the bryophytes of Emilia-Romagna (Fariselli et al. 2019) were published. Nevertheless, knowledge on the bryophyte flora of the northern Apennines is not yet comprehensive; therefore, the annual excursion of the Working Group for Bryology of the Italian Botanical Society was organized in July 2018 in the National Park of the Tuscan-Emilian Apennines, where many different types of mountain habitats with an interesting bryophyte flora were investigated.

## Study area

The Tuscan-Emilian Apennines represent the core district of the northern Apennines, a 250 km-long mountain barrier running in a NW-SE direction and separating the Po plain in the north from the rest of the Italian peninsula in the south (Fig. 1). The geological framework of the Tuscan-Emilian Apennines is mainly given by sandstones belonging to the Macigno Formation and by the Ligurian units, represented by successions characterized by helminthoid flysch deposits and sedimentary mélanges with blocks of ophiolite rocks (Bruni et al. 1994). Climatic features of the study area were obtained from the thermo-pluviometric data of six stations located above 1,000 m a.s.l. The mean annual precipitation is around 1500 mm, the mean annual temperature is about 5 °C with the mean monthly temperature ranging between 7 °C and 13 °C. July is the warmest month with a mean daily maximum of about 16 °C; February is the coldest one with a mean daily minimum of -2 °C.

The study area is located in the Emilian slope of the northern Apennines. It is characterized by a sub-Mediterranean vegetation belt dominated by xerophilous or mesophilous deciduous woodlands extending up to about 1,000 m a.s.l.; the montane belt is represented by different types of beech woodlands (Ubaldi et al. 1993). Its upper limit ranges between 1,600 and 1,700 m a.s.l., where it is strongly dependent upon geomorphological and land use conditions.



**Figure 1.** Schematic map of the study area.

Subalpine vegetation above the treeline is characterized by heathlands dominated by *Vaccinium* species (*V. myrtillus* L., *V. gaultherioides* Bigelow and *V. vitis-idaea* L.) and by *Empetrum hermaphroditum* Hagerup; they represent the most widespread vegetation type in the summit areas (Ferrari and Piccoli 1997). Intermixed with shrub heathlands and above the ridges and summits, a patchy mosaic of snow-beds (Petraglia and Tomaselli 2007), cryoxerophytic and mesophytic primary grasslands (Tomaselli et al. 2000), secondary grasslands (Gennai et al. 2014) and vegetation on rock faces and cliffs (Tomaselli et al. 2019) compose the landscape of the Tuscan-Emilian Apennines.

## Materials and methods

The field work was carried out on 21–23 July, 2018 in areas falling in the Emilia-Romagna in the localities Passo della Scalucchia, Buca del Moro, Mt. Cavalbianco, Lago della Bargetana, and Mt. Prado, at altitudes between 1,350 and 2,056 m a.s.l. The collections were made from soil, rocks, rocky crevices, tree bark, and rotting stumps in different habitats (beech woods, heathlands with *Vaccinium* sp. pl., snow-beds, peat bogs, stream banks). The following 13 sites were investigated and sampled:

- 1 Passo della Scalucchia, beech wood, 1,350 m a.s.l., 44°21'25"N, 10°13'44"E
- 2 Buca del Moro, beech wood, 1,450 m a.s.l., 44°20'32"N, 10°12'59"E
- 3 Mt. Cavalbianco, beech wood, 1,575 m a.s.l., 44°17'10"N, 10°17'59"E
- 4 Mt. Cavalbianco, beech wood, 1,590 m a.s.l., 44°17'27"N, 10°17'55"E
- 5 Mt. Cavalbianco, beech wood, 1,600 m a.s.l., 44°17'38"N, 10°18'00"E
- 6 Mt. Cavalbianco, heathland, 1,650 m a.s.l., 44°18'05"N, 10°17'50"E

- 7 Mt. Cavalbianco, streams in the beech wood beyond the heathland, 1,450 m a.s.l., 44°18'24"N, 10°18'31"E
- 8 Lago della Bargetana, 1,740 m a.s.l., 44°15'28.9"N, 10°24'06.5"E
- 9 Lago della Bargetana, 1,750 m a.s.l., 44°15'18"N, 10°24'16"E
- 10 Lago della Bargetana, peat bog, 1,770 m a.s.l., 44°15'18"N, 10°24'17"E
- 11 Lago della Bargetana, peat bog, 1,780 m a.s.l., 44°15'18.6"N, 10°24'20"E
- 12 Lago della Bargetana, heathland, 1,820 m a.s.l., 44°15'09"N, 10°24'22"E
- 13 Mt. Prado, snow-beds, 2,056 m a.s.l., 44°14'58"N, 10°24'26"E

Taxa (genera and species) are arranged in alphabetical order mainly following the classification proposed by Goffinet et al. (2009). The nomenclature follows Ros et al. (2013), Plášek et al. (2015), and Lara et al. (2016) for mosses and Söderström et al. (2016) for liverworts.

The specimens are kept in CAME, CAG, SIENA, and in the personal herbaria of the authors.

## Results

### Floristic list

The bryophyte taxa collected in the investigated areas are listed below. The taxa followed by \*\* are new reports for Emilia-Romagna; the taxa followed by \* are confirmations for the Region. For each taxon, the localities and habitat within the study area are reported.

### MARCHANTIIDAE JUNGERMANNIALES

#### Cephaloziaceae

*Cephalozia bicuspidata* (L.) Dumort. – Site 11: in the peat bog.

#### Cephaloziellaceae

*Cephaloziella baumgartneri* Schiffn. – Site 5: on soil and in rocky crevices in the beech wood.

#### Jungermanniaceae

*Jungermannia atrovirens* Dumort. – Site 5: on soil and in rocky crevices.

#### Lophocoleaceae

*Chiloscyphus pallescens* (Ehrh.) Dumort. – Site 12: on soil.

\**Chiloscyphus polyanthos* (L.) Corda – Site 8: on damp soil along a stream; site 10: in the peat bog.

*Lophocolea heterophylla* (Schrad.) Dumort. – Sites 1, 5: on rotting stumps in the beech wood.

## Plagiochilaceae

*Plagiochila asplenoides* (L.) Dumort. – Site 1: on rocks.

*Plagiochila porelloides* (Torr. ex Nees) Lindenb. – Sites 3, 4: on soil in the beech wood, on bark of *Fagus sylvatica*; site 8: on peaty soil, along a stream.

## Pseudolepicoleaceae

*Blepharostoma trichophyllum* (L.) Dumort. – Site 9: along a stream.

## Scapaniaceae

*Barbilophozia barbata* (Schmidel ex Schreb.) Loeske – Site 6: on humus among boulders in the heathlands with *Vaccinium* sp. pl.

*Barbilophozia hatcheri* (A. Evans) Loeske – Site 8: in rocky crevices.

*Barbilophozia lycopodioides* (Wallr.) Loeske – Site 1: on rocks in the beech wood; site 6: on humus among boulders in the heathlands with *Vaccinium* sp. pl.

*Lophozia ventricosa* (Dicks.) Dumort. – Site 11: on peaty soil; Site 13: on soil in a snow-bed.

*Lophozia wenzelii* (Nees) Steph. – Site 8: on peaty soil.

*Mesoptychia turbinata* (Raddi) L.Söderstr. et Váša – Sites 1,2: on soil; site 4: on humus among boulders in the heathlands with *Vaccinium* sp. pl.

\**Scapania irrigua* (Nees) Nees – Site 5: on soil and rotting stumps in the beech wood.

\*\**Scapania uliginosa* (Lindenb.) Dumort. – Site 8: on peaty soil.

*Trilophozia quinquedentata* (Huds.) Bakalin – Site 12: on soil.

## PORELLALES

## Frullaniaceae

*Frullania dilatata* (L.) Dumort. – Site 4: on rotting stumps.

\**Frullania tamarisci* (L.) Dumort. var. *tamarisci* – Site 4: on soil.

## Porellaceae

*Porella platyphylla* (L.) Pfeiff. – Site 1: on soil at the edge of the beech wood; site 2: on rocks in the beech wood; site 3: on bark of *Fagus sylvatica*.

## Radulaceae

*Radula complanata* (L.) Dumort. – Site 1: on bark of *Fagus sylvatica*; sites 3,4: on bark of *Fagus sylvatica*; site 7: along a stream.

*Radula lindbergiana* Gottschs ex C. Hartm. – Site 2: on rotting stumps in the beech wood.

## METZGERIALES

## Aneuraceae

*Aneura pinguis* (L.) Dumort. – Site 10: in the peat bog.

## BRYIDAE

### SPHAGNALES

Sphagnaceae

*Sphagnum capillifolium* (Ehrh.) Hedw. – Site 8,10: in the peat bog.

*Sphagnum teres* (Schimp.) Ångstr. – Site 8: in a swamp.

### POLYTRICHALES

Polytrichaceae

*Atrichum undulatum* (Hedw.) P. Beauv. – Sites 3,4: on soil in the beech wood.

*Pogonatum aloides* (Hedw.) P.Beauv. – Site 4: on soil in the beech wood (forest path escarpment); site 13: in a snow-bed.

*Pogonatum urnigerum* P. Beauv. – Site 2: on soil in the beech wood.

*Polytrichastrum alpinum* (Hedw.) G.L.Sm. – Sites 1,2: on rocks and soil in the beech wood; site 3,4: on soil and rocky crevices in the beech wood; site 6: on humus among boulders in the heathlands with *Vaccinium* sp. pl.; site 8,9: in rocky crevices.

*Polytrichum formosum* Hedw. – Site 4: on soil in the beech wood; site 6: on humus among boulders in the heathlands with *Vaccinium* sp. pl.; site 9: on soil.

*Polytrichum juniperinum* Hedw. – Sites 5,6: on humus among boulders in the heathlands with *Vaccinium* sp. pl.

*Polytrichum piliferum* Hedw. – Site 1,5: on soil; site 4: on soil in the beech wood; site 6: on soil and humus among boulders in the heathlands with *Vaccinium* sp. pl.; site 13: on soil in a snow-bed.

### BARTRAMIALES

Bartramiaceae

*Philonotis calcarea* (Bruch & Schimp.) Schimp. – Sites 8,9: on peaty soil; site 12: on soil in the heathland.

*Philonotis fontana* (Hedw.) Brid. – Site 8: along a stream edge; site 10: in the peat bog.

\*\**Philonotis rigida* Brid. – Site 12: on soil in the heathland.

*Philonotis seriata* Mitt. – Sites 8: on peaty soil; site 10: along a streamlet in the bog.

### BRYALES

Bryaceae

*Bryum schleicheri* DC. – Site 10: along a streamlet in the bog; site 12: on soil in the heathland.

*Bryum tenuisetum* Limpr. – Site 13: on soil in a snow-bed.

*Imbribryum mildeanum* (Jur.) J.R. Spence – Site 13: on soil in a snow-bed.

*Ptychostomum pallens* (Sw.) J.R. Spence – Site 8: on peaty soil.

*Ptychostomum pseudotriquetrum* (Hedw.) J.R. Spence & H.P.Ramsay var. *pseudotriquetrum* – Site 8: on peaty soil.

#### Mniaceae

*Mnium marginatum* (Dicks.) P.Beauv. var. *marginatum* – Site 7: on damp soil.

*Mnium spinulosum* Bruch & Schimp. – Site 1: on soil; site 6: on humus among boulders in the heathlands with *Vaccinium* sp. pl.

*Plagiomnium undulatum* (Hedw.) T.J.Kop. var. *undulatum* – Site 7: on moist soil along streams.

*Pohlia cruda* (Hedw.) Lindb. – Site 7: on moist soil along streams.

\*\**Rhizomnium pseudopunctatum* (Bruch & Schimp.) T.J.Kop. – Site 9: on moist soil.

*Rhizomnium punctatum* (Hedw.) T.J.Kop. – Site 5: on soil in the beech wood; site 7: on moist soil along streams.

### DICRANALES

#### Dicranaceae

*Dicranella heteromalla* (Hedw.) Schimp. – Site 6: on humus among boulders in the heathlands with *Vaccinium* sp. pl.

*Dicranella subulata* (Hedw.) Schimp. – Site 9: in rocky crevices.

*Dicranum majus* Sm. – Site 9: on soil in the beech wood.

*Dicranum scoparium* Hedw. – Site 1: on soil; site 6: on humus among boulders in the heathlands with *Vaccinium* sp. pl.

*Dicranum* cfr. *tauricum* Sapjegin – Site 8: in rocky crevices.

#### Ditrichaceae

*Ceratodon purpureus* (Hedw.) Brid. – Site 1: on dry soil; site 2: on soil at the edge of the beech wood.

#### Fissidentaceae

\* *Fissidens pusillus* (Wilson) Milde – Site 7: on soil along streams.

#### Rhabdoweisiaceae

*Dicranoweisia cirrata* (Hedw.) Lindb. – Site 6: on soil among boulders in the heathlands with *Vaccinium* sp. pl.

*Hymenoloma crispulum* (Hedw.) Ochyra – Site 6: on soil among boulders in the heathlands with *Vaccinium* sp. pl.

*Kiaeria starkei* (F.Weber & D.Mohr) I. Hagen – Site 9: in rocky crevices.

### DIPHYSCIALES

#### Diphysciaceae

*Diphyscium foliosum* (Hedw.) D.Mohr – Sites 3,4: on soil in the beech wood.

## GRIMMIALES

## Grimmiaceae

\*\**Grimmia lisae* De Not. – Site 1: on rocks in the beech wood.

*Racomitrium elongatum* Ehrh. ex Frisvoll – Site 1: on soil in the beech wood.

\*\**Racomitrium fasciculare* (Hedw.) Brid. – Site 6: on humus among boulders in the heathlands with *Vaccinium* sp. pl.; site 13: on soil in a snow-bed.

*Racomitrium lanuginosum* (Hedw.) Brid. – Site 6: on humus among boulders and rocks in the heathlands with *Vaccinium* spp; site 9: on soil.

*Schistidium apocarpum* (Hedw.) Bruch & Schimp. – Site 1: on rocks; site 6: among boulders in the heathlands with *Vaccinium* sp. pl.

## HYPNALES

## Amblystegiaceae

*Campylium protensum* (Brid.) Kindb. – Site 12: on soil.

*Campylium stellatum* (Hedw.) Lange & C.E.O. Jensen – Site 8: along a streamlet in the bog, on peaty soil; site 11: on peaty soil.

*Hygrohypnum luridum* (Hedw.) Jenn. – Site 8: on peaty soil.

*Palustriella commutata* (Hedw.) Ochyra – Site 7: along a stream.

*Palustriella falcata* (Brid.) Hedenäs – Site 11: in a peat bog.

*Sanionia uncinata* (Hedw.) Loeske – Site 8: on peaty soil.

\*\**Scorpidium cossonii* (Schimp.) Hedenäs – Site 8: on peaty soil.

## Anomodontaceae

*Anomodon attenuatus* (Hedw.) Huebener – Site 1: on soil in the beech wood.

## Brachytheciaceae

*Brachytheciastrum velutinum* (Hedw.) Ignatov & Huttunen var. *velutinum* – Site 1: on soil in the beech wood.

*Brachythecium campestre* (Müll. Hal.) Schimp. – Site 4: on soil in the beech wood.

*Brachythecium rutabulum* (Hedw.) Schimp. – Site 4: on rotting stumps in the beech wood.

\**Brachythecium cirrosum* (Schwägr.) Schimp. – Site 6: on humus among boulders in the heathlands with *Vaccinium* sp. pl.

*Homalothecium sericeum* (Hedw.) Schimp. – Sites 1,3,4,5: on bark of *Fagus sylvatica*; Site 2: on soil in beech wood.

*Kindbergia praelonga* (Hedw.) Ochyra – Sites 3,4: along streams.

*Rhynchostegium confertum* (Dicks) Schimp. – Site 2: on bark at the base of *Fagus sylvatica*.

*Rhynchostegium riparioides* (Hedw.) Cardot – Site 7: in a stream.

*Scorpiurium circinatum* (Bruch) M.Fleisch. & Loeske – Site 4: on soil.

## Calliergonaceae

*Sarmentypnum exannulatum* (Schimp.) Hedenäs – Site 8: on peaty soil.

*Straminergon stramineum* (Dicks. ex Brid.) Hedenäs – Site 8: in a bog.



## Climaciaceae

*Climacium dendroides* (Hedw.) F.Weber & D.Mohr – Site 8: on peaty soil.

## Hylocomiaceae

*Hylocomium splendens* (Hedw.) Schimp. – Site 8: on soil.

*Rhytidiadelphus squarrosus* (Hedw.) Warnst. – Site 6: on humus among boulders in the heathlands with *Vaccinium* sp.pl.

*Rhytidiadelphus triquetrus* (Hedw.) Warnst. – Site 6: on humus among boulders in the heathlands with *Vaccinium* sp. pl.

## Hypnaceae

*Campylophyllum halleri* (Hedw.) M.Fleisch. – Sites 1,2: on rocks in the beech wood.

*Herzogiella seligeri* (Brid.) Z. Iwats – Site 4: on soil in the beech wood.

*Hypnum cupressiforme* Hedw. var. *cupressiforme* – Site 1: on bark of *Fagus sylvatica*, on soil and rocks in the beech wood; sites 3,4,5: on bark of *Fagus sylvatica*.

## Leskeaceae

*Lescuraea incurvata* (Hedw.) E.Lawton – Site 5: on soil in the beech wood.

*Lescuraea radicata* (Mitt.) Mönk. – Site 4: on rotting stumps.

\**Lescuraea saxicola* (Schimp.) Molendo – Site 5: on rocks in the beech wood.

*Pseudoleskeella nervosa* (Brid.) Nyholm – Site 5: on soil in the beech wood.

## Leucodontaceae

*Leucodon sciuroides* (Hedw.) Schwägr. – Sites 1,2: on bark of *Fagus sylvatica*.

## Plagiotheciaceae

*Plagiothecium denticulaum* (Hedw.) Schimp. var. *denticulatum* – Sites 1,4,5: on rotting stumps in the beech wood.

*Plagiothecium laetum* Schimp. – Site 5: on rocks in the beech wood.

## Pterigynandraceae

\*\**Habrodon perpusillus* (De Not.) Lindb. – Site 2: on rotting stumps in beech wood.

\**Heterocladium dimorphum* (Brid.) Schimp. – Site 2: on humus among boulders in the heathlands with *Vaccinium* sp. pl.

*Myurella julacea* (Schwägr.) Schimp. – Site 6: on humus among boulders in the heathlands with *Vaccinium myrtillus*.

*Myurella tenerrima* (Brid.) Lindb. – Site 4: on soil in beech wood.

*Pterigynandrum filiforme* Hedw. – Site 1: on bark of *Fagus sylvatica*, on rotting stumps; sites 3,4,7: on bark of *Fagus sylvatica*, on soil; site 13: on soil in a snow-bed.

## Thuidiaceae

*Abietinella abietina* (Hedw.) M.Fleisch. var. *abietina* – Sites 1,2: on soil in the beech wood.

*Thuidium delicatulum* (Hedw.) Schimp. – Site 7: on soil along streams.

*Thuidium tamariscinum* (Hedw.) Schimp. – Site 7: on soil.

## ORTHOTRICHALES

Orthotrichaceae

*Lewinskya affinis* (Schrad. ex Brid.) F.Lara, Garilleti & Goffinet – Sites 3,4: on bark of *Fagus sylvatica*.

*Pulviger a lyellii* (Hook. & Taylor) Plášek, Sawicki & Ochrya – Sites 3,4: on bark of *Fagus sylvatica*.

\*\**Orthotrichum pulchellum* Brunt. – Sites 3,4: on bark of *Fagus sylvatica*.

*Orthotrichum striatum* Hedw. – Sites 1,3,4: on bark of *Fagus sylvatica*.

*Ortotrichum* cfr. *tenellum* Bruch ex Brid. – Sites 3,5: on bark of *Fagus sylvatica*.

## POTTIALES

Pottiaceae

*Didymodon acutus* (Brid.) K.Saito – Site 6: on humus among boulders in the heathlands with *Vaccinium myrtillus*.

*Syntrichia ruralis* (Hedw.) F.Weber & D.Mohr var. *ruralis* – Site 1: on rocks in the beech wood.

*Tortula muralis* Hedw. – Site 13: on soil in a snow-bed.

## RHIZOGONIALES

Aulacomniaceae

*Aulacomnium palustre* (Hedw.) Schwägr. – Site 12: in a peat bog.

## Discussion

The result of this survey is a checklist of 113 taxa (24 liverworts and 89 mosses), including eight records that, on the basis of data reported by Fariselli et al. (2019), are new for the Emilia-Romagna Region. Some of them are of phytogeographical interest and deserve a special protection over time. In particular, *Scapania uliginosa*, which is a circumpolar Arctic montane species very rare in Europe (Ros et al. 2007), is reported here for the first time in Emilia-Romagna. The new moss records for this Region are *Grimmia lisae*, *Harbrodon perpusillus*, *Orthotrichum pulchellum*, *Philonotis rigida*, *Racomitrium fasciculare*, *Rhizomnium pseudopunctatum*, and *Scorpidium cossonii*. Amongst these, we highlight, for their rarity in Italy, *Rhizomnium pseudopunctatum*, *Racomitrium fasciculare*, and *Scorpidium cossonii*, reported only for few northern Regions (Aleffi et al. 2008). Particularly interesting is the finding of *Orthotrichum pulchellum*, which has been reported in Italy only from Lombardia, Calabria, and Sicilia (Aleffi et al. 2008). In addition to these in-

teresting new records, the occurrence of seven species is confirmed for Emilia-Romagna: *Chiloscyphus polyanthos*, *Scapania irrigua*, and *Frullania tamarisci* among the liverworts, *Brachythecium cirrosum*, *Fissidens pusillus*, *Heterocladium dimorphum*, and *Lescurea saxicola*, among the mosses. In particular, *Brachythecium cirrosum* deserves to be mentioned because it is an European bryophyte that is probably threatened by climate change; although it is not actually at risk, conservation measures for this taxon are recommended (Schnyder 2019). Overall, the most widespread species recorded by us are: *Plagiochila porelloides*, *Homalothecium sericeum*, *Hypnum cupressiforme* var. *cupressiforme*, *Polytrichastrum alpinum*, *Polytrichum piliferum*, and *Pterigynandrum filiforme*.

Based on the results of this survey, the bryophyte flora in the investigated area shows a liverwort/moss ratio of 0.269, with a scarce liverwort component, comparable with that of Monte Bondone (Trentino-Alto Adige), which is 0.256 (Privitera et al. 2010). Within mosses, the pleurocarpous/acrocarpous ratio is 0.87, a very high value considering the numerical superiority of the acrocarpous mosses. This is likely due to the occurrence, in the investigated sites (most of them within beech woods), of species that are well adapted to the forest ecosystem. Liverworts belong to 11 families, and mosses to 26; in particular, the most represented moss families are Brachytheciaceae (10.3%) Amblystegiaceae and Polytrichaceae (9.0% each one), followed by Mniaceae (6.8%) and then by Dicranaceae, Grimmiaceae, Orthotrichaceae and Pteryginandraceae (5.7% each). The scarce presence of the Pottiaceae (3.4%) is not surprising, since the family is widespread in Mediterranean territories (Privitera et al. 2015; Puglisi et al. 2015; Puglisi and Cataldo 2019).

As regards the phytogeographical analysis (Hill and Preston 1998), the boreal-temperate species prevail (30.7%), followed at a distance by boreal-arctic montane (16.2%), boreal-montane (11.7%), and temperate species (10.8%); the least represented categories are the Mediterranean (5.4%) and wide-temperate (2.7%).

In conclusion, this study reveals a rich bryophyte diversity in the investigated area, with a significant number of species that are rare for Italy. For this reason, and as previously highlighted for other mountain areas (Puglisi et al. 2013; Ellis et al. 2017), the Apennines can be considered an important site for biodiversity conservation, surely less affected by human disturbance, one of the most dangerous causes of biodiversity loss.

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