Cryptogamie, Bryologie, 2008, 29 (1): 49-73

The bryophyte flora of the natural park of Serra da Estrela (Portugal): Conservation and Biogeographical approaches

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(Received 1 March 2005, accepted 30 December 2006)

Abstract – A synthesis of the current knowledge on the bryophyte flora of the Natural Park of Serra da Estrela (PNSE) is presented. This study is based on 7500 specimens, from old records since 1804 but mainly on material collected recently. Three hundred and eighty three taxa (284 mosses and 99 hepatics) are reported from the area. Thirty three taxa are first reports to Beira Alta province, and eighteen species are new to the Natural Park. Data on the distribution of bryophyte species are updated, and distributional patterns of bryophytes in the Park are analysed. PNSE is the exclusive area of occurrence for 37 taxa in Portugal, which evidences the importance of the bryophyte flora in this area.
Seven phytogeographical elements are recognized, among which the most represented ones are the oceanic, temperate and boreal elements. Potential threats to the bryoflora in this area are discussed.

Mosses / Hepatics / Central Range / Iberian Peninsula / Natural Park

INTRODUCTION

The Serra da Estrela is one of the major granitic mountain ranges in southwestern Europe. It holds the highest peak (1993 m) of Portugal's mainland and is the meeting point of two climatic regions: Atlantic and Mediterranean. As noted by Henriques (1883, 1889) and Tavares (1945), the floristic studies of the Serra da Estrela started with Carolus Clusius in the sixteenth century, followed by Tournefort in the seventeenth century. The references to bryophyte species are more recent, starting in the eighteenth century with Felix Brotero, Friedrich Welwitsch, Emile Levier and Júlio Henriques in 1881 with the "Expedição Scientifica á Serra da Estrella" (Henriques, 1883).

The Serra da Estrela is considered to be a centre of endemic and narrowly distributed taxa (Moreno Saiz & Sainz Ollero, 1992; Davis *et al.*, 1994; Médail & Quézel, 1997). Numerous plant species reach their southwestern range limits here (Jansen, 2002). A large number of plants and animals listed in the

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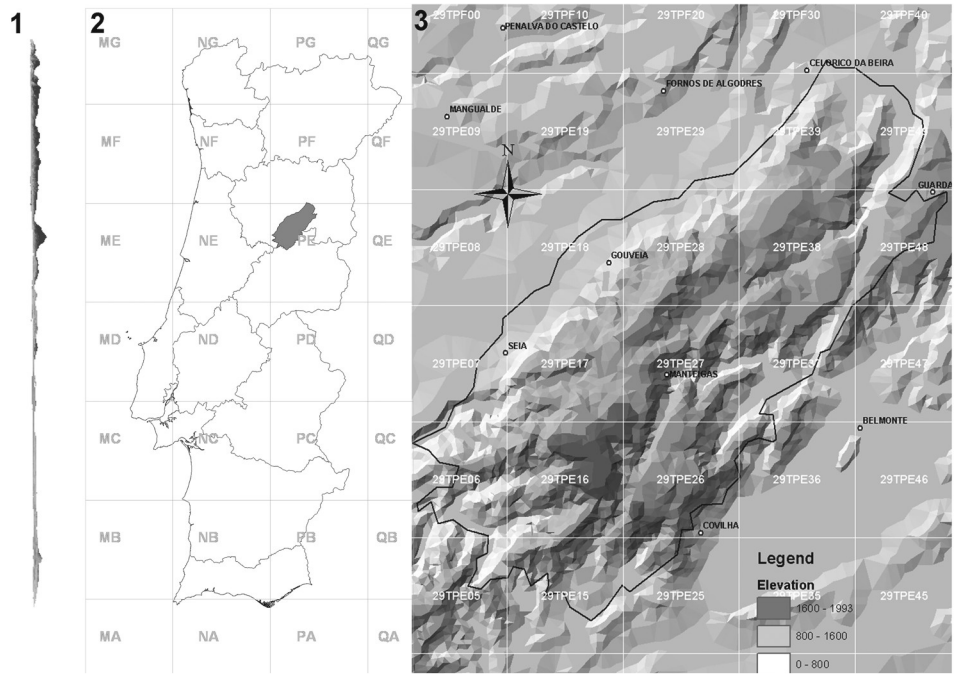
annexes of the EU "Habitats Directive" occur there, and the Park area contains well over 30 habitats of this Directive (Jansen, 2002). For various reasons, investigations have been intensified during the last fifteen years, resulting in new findings of vascular plant species, plant associations, cryptogams and even a new bird species (most references in Garcia, 2001; Jansen, 2002; van den Boom & Jansen, 2002). Despite its national and international importance, the bryophyte diversity of PNSE was, until this study, inadequately recorded.

THE STUDY AREA

The largest part of the study area is located within the limits of the Parque Natural da Serra da Estrela (PNSE, established in 1976). The PNSE is located in the central-east of the country, and has an extension of 1000 km^2 (Figs 1-3). It covers a mountainous region whose altitude ranges from 300 m to 1993 m (Fig. 3). The geological structure is mainly composed of granite and schist. Most of the high plateau was glaciated during the last glacial maximum and is dominated by glacial erosion forms (Daveau, 1971; Daveau *et al.*, 1997). Bare-rock outcrops and moraines dominate the glaciated area. Outside, typical tor and bornhardt morphology with regolith prevails (Vieira, 2004; Vieira *et al.*, 2004). The soil-types include lithosols, rankers, cambisols and fluvisols.



Figs 1-3. **1.** Longitudinal N-S view from the shoreline of Portugal. The highest peak corresponds to the Natural Park of Serra da Estrela (PNSE). **2.** Location of PNSE area in Portugal (UTM 100 × 100 km). **3.** PNSE area with contourlines (UTM 10 × 10 km). Based on Atlas do Ambiente Digital – Instituto do Ambiente, Portugal.

The Serra da Estrela is subject to both Oceanic and Mediterranean influences (Vieira & Mora, 1998). The climate variety is expressed by the mosaic of the biotopes joining mainly Mediterranean and Atlantic, but also Continental, Alpine and Boreal phytogeographic elements (Jansen & Sequeira, 1999b). Mean monthly air temperatures ranges from 1.2ºC in February (Penhas da Saúde, alt. 1510 m), the coldest month, to 18.8ºC in July (Guarda, alt. 1019), the warmest one, over the period 1951-1980 (Instituto Nacional de Meteorologia e Geofísica, 1991).

The mean annual precipitation is about 2500 mm in the higher parts of the mountain (Daveau *et al.*, 1977). In general terms the Atlantic climate is expressed in the high precipitation with mean annual precipitation varying from about 1000 mm in Guarda to over 2600 mm in Penhas da Saúde (Anonymous, 1987) and the Mediterranean climate in the high annual insolation (> 2500h at Penhas Douradas). The annual rainfall distribution consists of a dry period in summer and a wet season in autumn and winter (Fig. 4).

The distribution of the vegetation in the Serra da Estrela reveals the presence of 5-6 altitudinal levels (Jansen, 2002). The Temperate macrobioclimate is assumed to cover a larger part of the massif including the meso-, supra-, oro- (and perhaps) cryoro-temperate belt; the Mediterranean one includes the meso- and supra-mediterranean belt (see also Pinto da Silva & Teles, 1980; Rivas-Martinez, 1981). According to Jansen (2002) the following concise description can be given:

– The lower belts stretch from the foot of the mountain to *ca*. 800 m a.s.l. The potential natural vegetation is mainly formed by evergreen or mixed evergreen and deciduous oak forests dominated by *Quercus suber*, or by *Q. rotundifolia* under dryer conditions.

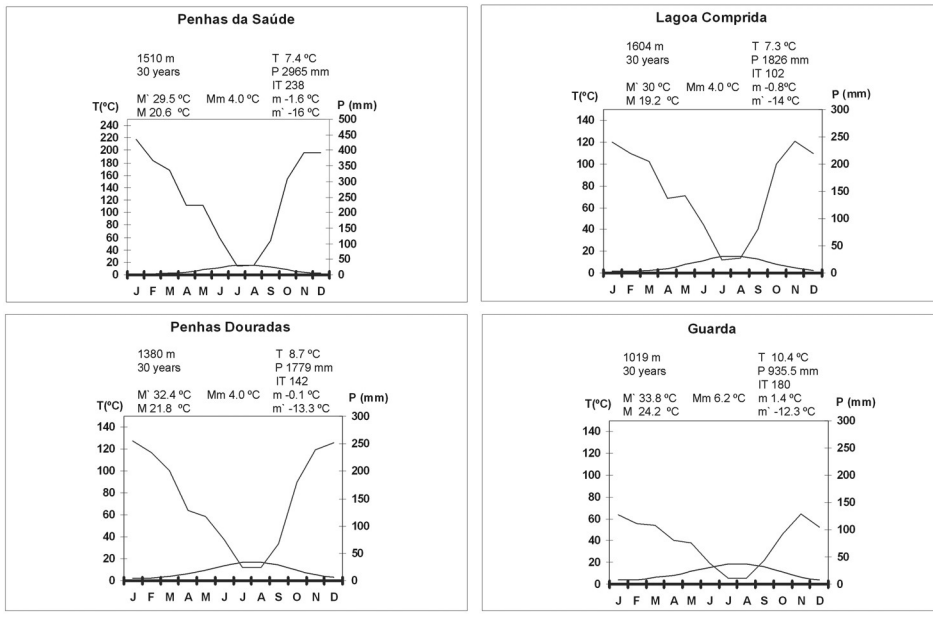


Fig. 4. Climatograms of the main stations in the study area, based on data of the period 1951-1980 (Instituto Nacional de Meteorologia e Geofísica, 1991).

– In the middle belt, from *ca*. 800 to *ca*. 1600 m, there are only very small and incomplete fragments of semi-natural forests. The potential natural vegetation corresponds to mixed deciduous evergreen oak forests with *Quercus pyrenaica* and *Q. rotundifolia.* Under special climatic and edaphic conditions, both *Betula celtiberica* and *Taxus baccata* woods, sometimes mixed with *Ilex aquifolium*, represent the final stage. Degraded phases include small areas covering thickets and large areas covered by dwarf-shrub.

– In the uppermost belt from *ca*. 1600 m to the top, the potential natural vegetation is mainly formed by dwarf juniper formations (*Juniperus communis* subsp. *alpina*), with or without *Cytisus oromediterraneus* or *Pinus sylvestris* and thorn-cushion scrub of *Echinospartum ibericum* subsp. *pulviniformis*.

The majority of the habitats have been affected by human activities such as burning, cutting, grazing, ploughing, afforestation and cultivation.

MATERIALS AND METHODS

This study is based on herbarium specimens (LISU, COI, PO, LISFA and LISE) as well as on new field data and floristic studies (Garcia, 2001). It is also supported by collections from more recent studies, mainly those on bryophytes recolonisation after fire (Sim-Sim *et al.*, 2004a) and bryophyte diversity surveys in semi-natural grasslands (Sérgio *et al.*, 2003b). About 7500 specimens have been studied and more than 200 UTM grids (1×1 km) have been explored (Fig. 3). A list of taxa reported from Serra da Estrela is presented in alphabetic order. The organization and abbreviations used are those included in Appendix 1. The nomenclature generally follows Corley *et al.* (1981) and Corley & Crundwell (1991) for mosses, and Grolle (1983) and Grolle & Long (2000) for liverworts as well as Sérgio & Carvalho (2003) for some taxa. The bibliography concerning Serra da Estrela bryophytes contains approximately 2250 entries. The erroneous or dubious species are also listed, printed in plain instead of bold format.

Notes are provided on the habitat occupied by each species in Serra da Estrela so far as these are known. Based on altitudinal and geographic origin of each collected specimen, the altitudinal range of each taxon is specified. Data on the distribution are presented based on a UTM grid (10×10 km), together with the number of squares (1×1 km) where the species have been recorded. Detailed information for most of the species can be found in Garcia (2001). Finally, four classes of collection periods have been established and indicated with different symbols: ≤ 1899 (98 taxa); 1900-1949 (153 taxa); 1950-1989 (134 taxa); and ≥ 1990 (372 taxa).

The biogeographic considerations on the main chorological elements represented in the study area, were made through the percentage analysis of the different chorological types, which were grouped in seven main categories for statistical and graphical treatment (see Figs 6-15). Reports without a precise indication of locality but referred to Serra da Estrela, were indicated but not included in this phytogeographic analysis.

The characterization of biogeographic elements follows Düll (1983, 1984 and 1985). The Red List categories are those of the Red List of Bryophytes of the Iberian Peninsula (Sérgio *et al.*, 1994) and the European Red Data Book (ECCB, 1995).

RESULTS AND DISCUSSION

Bryoflora

Bryophyte species can be considered to be good indicators of natural environmental conditions (Hallingbäck & Hodgetts, 2000). Studies of bryofloristic composition are important and provide useful insights on species distribution and abundance at the regional and national scale. The knowledge of the relationships of the total bryophyte species and the diversity of some other groups of organisms (Sérgio *et al.*, 2000), evidences the importance of the investigation on bryophytes for the evaluation of biodiversity richness.

In this paper, 402 bryophyte taxa are listed for Serra da Estrela, based on a critical assessment of literature data and herbarium material. The PNSE comprises a diverse bryoflora, consisting of 383 taxa, of which 284 are mosses and 99 are liverworts (see Appendix 1). The rich bryoflora clearly contributes to the high biodiversity of the area. About 65% of the total Portuguese bryoflora occurs in the area and close to 40% of the total Iberian bryoflora (Garcia, 2001) is also represented in the area. Thirty three taxa are first reported to Beira Alta province, and eighteen species are new to the Natural Park. So, the Serra da Estrela is one of the places that exhibits the richest and most diverse bryoflora in Portugal (Sérgio *et al*., 2000; Draper *et al*., 2003).

Conservation

The Natural Park of Serra da Estrela is an important area in both the Iberian and European context, with numerous species that have a high conservation value.

The conservation importance of bryophyte species in this natural park can be clearly inferred from the high number of exclusive or rare and threatened species occurring there (see Appendix 1). Several bryophytes are listed in the Red Data Book of European Bryophytes (ECCB, 1995). The mosses: *Andreaea frigida* (R), *Andreaea heinemannii* (R), *Brachythecium dieckii* (K), *Bruchia vogesiaca* (E), *Campylostelium strictum* (V), *Grimmia caespiticia* (R), *G. pilosissima* (RT), *Orthotrichum ibericum* (K), *O. scanicum* (E), *Racomitrium lamprocarpum* (R), *R. lusitanicum* (R), *Schizymenium pontevedrensis* (R), *Thamnobryum maderense* (R) and the hepatics: *Anthoceros caucasicus* (R), *Asterella africana* (V), *Cephaloziella elachista* (K), *Marsupella adusta* (K), *M. profunda* (V) and *Pallavicinia lyellii* (V). Also *Orthotrichum scanicum* is present in the 2003 IUCN World Red List of Threatened Species.

At the Iberian and National scale (Sérgio *et al.*, 1994) a significant number of species are red listed in the Iberian Peninsula (more or less 50) and in Portugal (near 100). Four bryophytes, *Cynodontium jenneri*, *Grimmia pilosissima*, *Pohlia longicollis* and *Rhizomnium magnifolium*, belong to the category of endangered especies (E) in Iberian Peninsula. *Cephalozia connivens*, *Bruchia vogesiaca*, *Schistostega pennata*, *Sphagnum angustifolium*, *S. squarrosum*, *S. molle* and *S. centrale* are included in the vulnerable category (V). Some species have been considered extinct (Ex) in Portugal: *Andreaea frigida*, *Brachythecium starkei*, *Dicranella rufescens*, *D. subulata*, *Encalypta ciliata*, *E. streptocarpa*, *Plagiomnium rostratum*, *Pogonatum urnigerum*, *Schistidium rivulare* and *Scapania curta*, but this category must change, due to their record in this Natural Park. On the other hand *Cynodontium gracilescens*, *Sphagnum centrale* and *Frullania azorica* have not been refound. Five species are considered endangered (E): *Grimmia pilosissima*, *Pohlia longicollis*, *Plagiothecium cavifolium*, *Sphagnum molle* and *Lophozia*

longiflora. In addition, 4 species are endemic to the Iberian Peninsula: *Racomitrium hespericum*, *R. lusitanicum* and *Schizymenium pontevedrensis*, and *Fissidens jansenii* which, at present, is also considered to be endemic to Portugal. Finally, two species are present in the Habitat Directive and Bern Convention: *Marsupella profunda* and *Bruchia vogesiaca*.

This area is the only locality for 37 species in Portugal (almost 10%) and some taxa are present only in 1 UTM grid (1×1 km) in the Natural Park. The majority of them are species with high conservation value, with a scattered distribution in the country. This is the case of *Bryum subapiculatum*, *Fissidens jansenii*, *Orthotrichum shawii*, *Plagiothecium laetum*, *Plagiothecium latebricola*, *P. piliferum*, *Schistidium brunnescens*, *Sphagnum fallax*, *S. girgensohnii*, *Asterella africana, Cephaloziella elachista* and *Diplophyllum taxifolium.*

Selecting areas with a higher number of threatened species (Sérgio *et al.*, 1994; ECCB, 1995) such as taxa considered endangered, vulnerable, as well as bryophytes from Habitat Directive, Bern Convention and Iberian endemics, could be a good tool for conservation actions in the PNSE. Examples of these areas are the Central plateau located in the upper belt (above 1600 m) and the Casal do Rei valley. With over 100 taxa, these areas have the highest numbers of taxa (Fig. 5), many of which are redlisted (Sérgio *et al.*, 2001a).

These data can help to make sustainable management choices and to set up appropriate conservation actions, since only with this information it is possible to know and apply different methods to halt species decline (Hallingbäck & Hodgetts, 2000). The PNSE presents numerous problems common to several areas, which not only affect the bryoflora, but also the conservation of biodiversity in general. The anthropogenic factors are responsible for most of the changes in Estrela habitats (Jansen & Diemont, 2005) and the largest impact today is due to changes in forestry and agriculture, urbanization and water and air pollution. Intensive forestry, with commercial species such as *Pinus pinaster* and *Eucalyptus globulus* are a major threat in PNSE, being repeatedly correlated with fires (Jansen *et al.*, 1997). The main reasons for bryophyte decline are the lack of a vegetation cover and the disruption of organic matter by burning (Soler & Sala, 1992; Jansen, 2002) as well as the disruption of the bryophyte and lichens layer, related to post-fire erosion.

Recently intensive artificial snowing has been applied in the summit area. The impact has not been studied but it is expected that the additional inputs of water and ions in the nutrient-poor system will promote taxa from mesic habitats. The recent decline of the *Sphagnum* communities is attributed to human disturbance (Kelly *et al.*, 2003) and bogs in Estrela are vulnerable due to deterioration of habitats, particularly by pollution and rubbish dumping. Another threat is the alien bryophyte *Campylopus introflexus*, an acidophytic species with a recent strong expansion in Portugal (Sérgio *et al.*, 2004b), related to pine plantations and anthropogenic pressure.

The abandonment of the agro-pastoral system in Serra da Estrela, is also a risk for some species. The decline of traditional practices leads to a negative impact on some communities (Sérgio *et al.*, 2003b). One example is *Bruchia vogesiaca* that needs an environment with a certain degree of disturbance. Such disturbance is related to the natural process of cryoturbation, but also to moderate grazing and trampling by cattle (Sérgio *et al.*, 1998; Garcia & Sérgio, 2004).

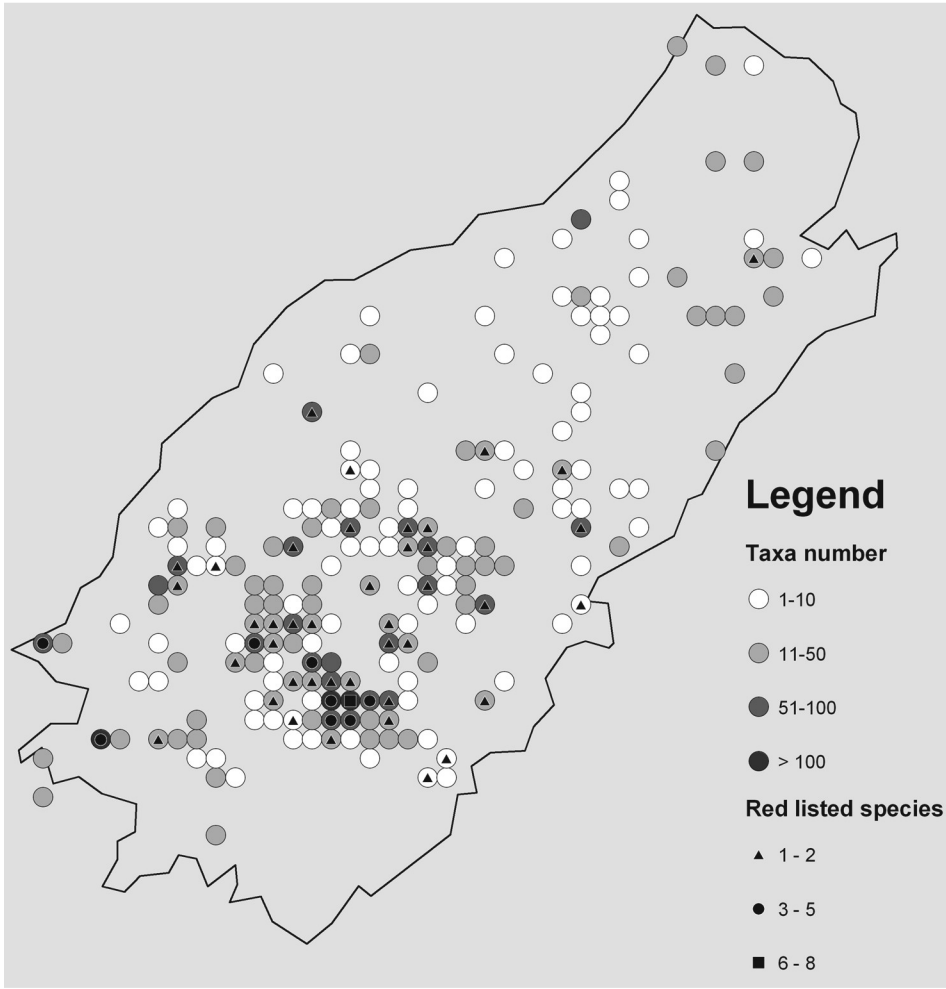
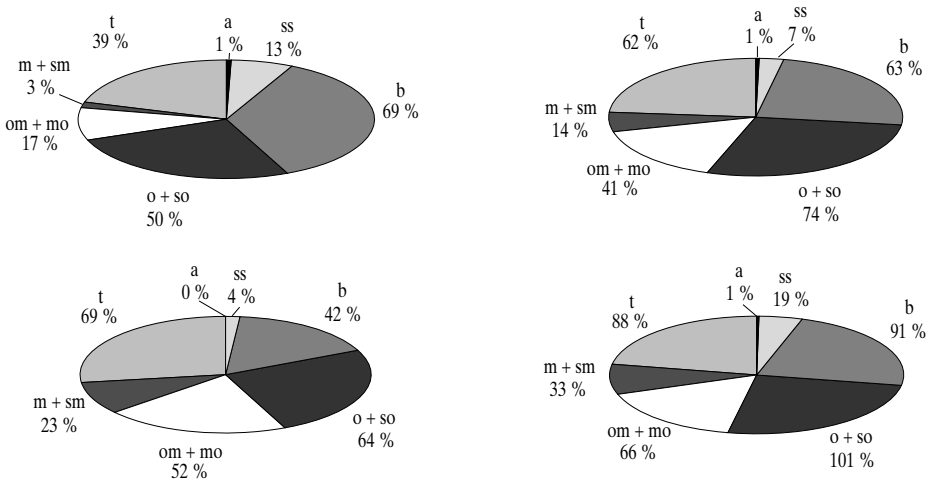


Fig. 5. Classes of species diversity in each grid-square (UTM 1 × 1 km) 1) 0-10; 2) 11-50; 3) 51-100; 4) over 100 species. The hot spots of species with high conservation value in PNSE are also represented. Compare with a background cover of steep slopes at the landscape and UTM grid represented in Fig. 1A, UTM Grids (1 × 1 km).

Biogeography

The geomorphology of Serra da Estrela creates a range of contrasting ecological conditions that are related to species diversity and rarity patterns at the landscape scale (Jansen, 2002). The phytogeographic elements occur in close relation to factors such as altitude, temperature, precipitation, etc. The followign phytogeographical elements have been recognized (Figs 6-9): **arctic-alpine**; **subarctic-subalpine** (subarctic-alpine, dealpine, subarctic); **suboceanic**; **boreal** (subboreal, subcosmopolite-boreal, subcosmopolite-subboreal); **oceanic** (euoceanic, oceanic-subtemperate, oceanic-subalpine); **oceanic-mediterranean** (suboceanic-mediterranean, suboceanic-submediterranean); **mediterranean**; **submediterranean-**

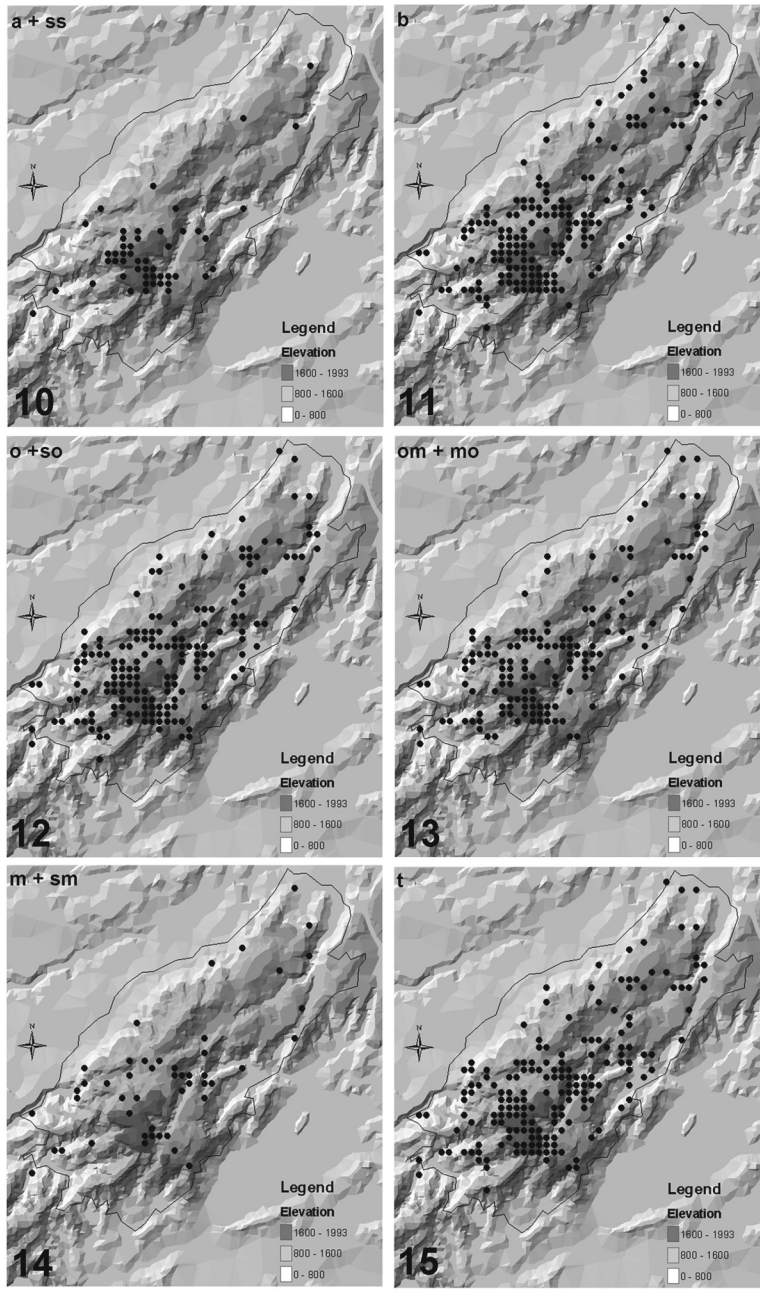


Figs 6-9. **6.** Bryogeographical elements represented in PNSE; **7.** In lower belt (below 800/900 m). **8.** In the middle belt (900 to 1600 m). **9.** In upper belt (above 1600 m).
Abbreviations: **a**– artic-alpine; **ss**– subarctic-subalpine (subarctic-alpine, dealpine, subarctic); **so**– suboceanic (subalpine, suboceanic-alpine); **b**– boreal (subboreal, subcosmopolite-boreal, subcosmopolite-subboreal); **o**– oceanic (euoceanic, oceanic-subtemperate, oceanic-subalpine); **om**– oceanic-mediterranean (suboceanic-mediterranean, suboceanic-submediterranean), **m**– mediterranean; **mo**– submediterranean-suboceanic; **sm**– submediterranean; **t**– temperate (temperate-subalpine); **c**– continental (subcontinental, subcontinental-mediterranean). Chorological elements are those of Düll (1983, 1984, 1985).

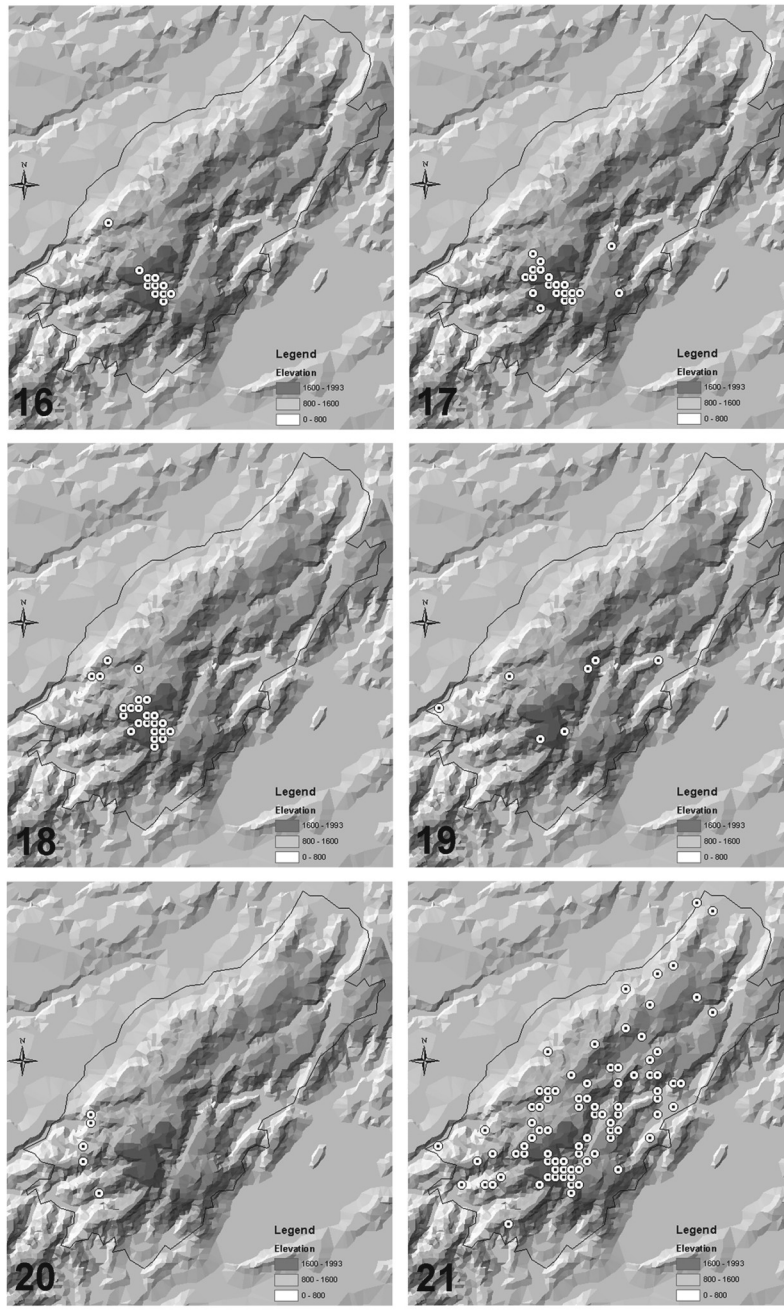
suboceanic; **submediterranean**; **temperate** (temperate-subalpine). The authentic continental and subcosmopolitan elements are not present in PNSE.

With 23.9% (Fig. 6) the most represented elements are the oceanic ones (including euoceanic, oceanic-subtemperate, oceanic-subalpine). Conversely, the least represented elements are the alpine ones, with only 0.3%. As could be expected, these elements present distinct values in the 3 belts (Figs 7-9). In the lower belt (below 800/900 m) the temperate elements are dominant (27.2%). In the middle belt the oceanic element (28.2%), dominates together with the boreal one (24.0%). In the uppermost belt (above 1600 m) the boreal element (35.8%) is the dominant one. The temperate elements are similar in the different altitudinal zones (20% to 27%), as well as the oceanic ones. The most divergent data correspond to the boreal and subarctic-subalpine elements, which are significantly higher in the upper belt and less in lower areas. On the other hand the oceanic-mediterranean elements become dominant from the upper to the lower belt. From these results (Figs 7-9), it can be inferred that there is a close relationship between the altitudinal border of species ranges and the floristic elements to which they belong.

Figures 10-15 shows the distribution patterns of the floristic elements in PNSE. Some elements, such as the oceanic and oceanic-mediterranean ones have similar distribution in the studied area. However, others such the artic-alpine/ subarctic-subalpine and boreal elements present a distribution area more restricted to the upper belt. Conversely, the mediterranean/submediterranean elements are more confined to the lower belt and on the PNSE boundaries, or confined to some areas such as river and stream valleys. Finally, the temperate



Figs 10-15. Species distribution in PNSE according the different floristic elements. **10.** Artic-alpine (a) and subarctic-subalpine (ss) taxa. **11.** Boreal (b) taxa. **12.** Oceanic (o) and suboceanic (so) taxa. **13.** Oceanic-mediterranean (om) and submediterranean-suboceanic (mo) taxa. **14.** Mediterranean (m) and submediterranean (sm) taxa. **15.** Temperate (t) taxa.
Maps created from the recognized distribution elements of 6654 bryophyte specimens. From the 7500 studied specimens only 6654 can be well georeferenced.



Figs 16-21. Distributions patterns in Serra da Estrela of different species. **16.** *Kiaeria starkei* (F. Weber & D. Mohr) I. Hagen (subarctic-subalpine). **17.** *Polytrichum alpinum* Hedw. (subarctic-subalpine). **18.** *Grimmia curvata* (Brid.) De Sloover (boreal). **19.** *Marsupella profunda* Lindb. (oceanic). **20.** *Schistostega pennata* (Hedw.) F. Weber & D. Mohr (suboceanic). **21.** *Ceratodon purpureus* (Hedw.) Brid. (temperate).

elements are dominant and exhibit a widespread distribution in the Serra da Estrela mountains.

Bryophytes are much more sensitive to microclimatic conditions than to macroclimatic ones, and their distributional areas do not always coincide with "classical" bioclimatic-floristic regions. This is well evidenced by the distribution patterns of some examples showed in Figures 16-21. Some subarctic-subalpine or boreal bryophytes such as *Kiaeria starkei* (Fig. 16), *Polytrichum alpinum* (Fig. 17) and *Grimmia curvata* (Fig. 18), prefer high altitude areas (above 1600 m). In addition, *Marsupella profunda* (Fig. 19) an oceanic liverwort, and *Schistostega pennata* (Fig. 20), a suboceanic moss, occur in areas subject to a strong oceanic influence, mainly in the western areas of Serra da Estrela. Finally, *Ceratodon purpureus* (Fig. 21) is largely distributed in the area, not only due to its temperate tendency, but also due to the high number of fires in the area.

Acknowledgements. Special thanks are extended to the ICN (Instituto da Conservação da Natureza), Natural Park of Serra da Estrela, in particular António Coimbra and Angelina Barbosa and to the Natural Park guards for the support and company in some field trips. Vicente Mazimpaka, Francisco Lara and Ricardo Garilleti determined or confirmed specimens of *Orthotrichum genus*; Creu Casas, Monserrat Brugués and Rosa Maria Cros helped with the revision of material. Huub van Melick and Henk Greven provided material collected in Serra da Estrela. The Curators and Directors of the herbaria COI, PO, LISFA and LISE kindly allowed us to study their collections. Finally, Rosa Mª Ros, Brian O'Shea and Vicente Mazimpaka made constructive comments on earlier versions of the manuscript. All of them are gratefully acknowledged.

The research was partly funded by ICN, PAMAF-IED (Programa de Apoio À Modernização Agrícola e Florestal n.º 8178) and FCT (Fundação para a Ciência e a Tecnologia PNAT/1999/BIA/15056/C and BD/2949/2000).

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APPENDIX 1 – Floristic catalogue of serra da estrela

The following abbreviations are used:

Taxon in bold	Taxon confirmed by herbarium material, with ecology included.
Not in bold	Taxon not confirmed by herbarium material, only bibliographic reference. Ecology not included.
◊	PNSE is the only area of occurrence of the taxon in Portugal.
●●	First report to Beira Alta province.
●	New species to the Natural Park (PNSE).
○	Report with a very improbable occurrence.
✶✶	Endemic species in the Iberian Peninsula.
✶	Endemic species in Portugal.
HD	Species included in the Habitat Directive and Bern Convention.
IUCN	Species from IUCN (The 2003 IUCN World Red List of Bryophytes http://www.iucn.org/).
PE--	UTM (10 × 10 km) squares were the taxa are present.
(n)	Number of UTM squares (1 × 1 km).
[ ]	Date in bibliographic references.

Classes of collection dates: ≤ 1899 – □; 1900-1949 – □; 1950-1989 – ■; ≥ 1990 – ■

Mosses

Aloina aloides (Koch. ex Schultz) Kindb. ○ – Only reported by Greven & van Melick (1994) without locality. [□].

***Amblystegium riparium* (Hedw.) Schimp.** ● – Wet rocks, water. 870 m. **PE27** (1). ■.

Amblystegium serpens (Hedw.) Schimp. ○ – Only reported by Greven & van Melick (1994) without locality. This is the only repor from Portugal. [□].

***Amblystegium varium* (Hedw.) Lindb.** ◊ – Wet rocks and water. 550 m. **PE07** (1). ■.

***Amphidium mougeotii* (Bruch & Schimp.) Schimp.** – Rock crevices, wet rocky banks, slowly dripping water in shade of cliff. 400-1850 m. **PE06**, **PE16** (8). ■.

***Andreaea frigida* Huebener** ◊ – Exposed and humid rocks. 1150-1900 m. **PE16** (2). □, ■.

Andreaea heinemannii* Hampe & Müll. subsp. *heinemannii – Exposed and humid granite rocks. 1150-1900 m. **PE16**, **PE17**, **PE26** (3). ■.

***Andreaea heinemannii* subsp. *crassifolia* (Luisier) Sérgio** – Exposed and humid granite rocks, rarely on soil. 1150-1900 m. **PE16**, **PE17**, **PE26**, **PE27** (11). □, ■.

Andreaea rothii* F. Weber & D. Mohr subsp. *rothii – Exposed and humid granite rocks, rarely in walls. 925-1900 m. **PE16**, **PE17**, **PE26**, **PE27** (3). ■.

***Andreaea rothii* subsp. *falcata* (Schimp.) Lindb.** – Exposed granite rocks, vertical rocks. 925-1900 m. **PE16**, **PE17**, **PE27** (8). □, □, ■.

***Andreaea rupestris* Hedw.** – Exposed and humid rocks, rock crevices. 1590-1850 m. **PE16**, **PE26**, **PE27** (5). □, ■, ■.

***Anomobryum julaceum* (P. Gaertn., B. Mey. & Scherb.) Schimp.** – Rocky banks, walls. 760-1060 m. **PE17**, **PE39** (3). □, □, [■], ■.

***Antitrichia californica* Sull.** – Tree trunks, dry exposed rock crevices. 350-1900 m. **PE06**, **PE16**, **PE27**, **PE29** (4). ■.

***Antitrichia curtipendula* (Hedw.) Brid.** – Tree trunks, shaded rocky banks, base of shrubs, rock crevices. 650-1900 m. **PE07**, **PE16**, **PE17**, **PE26**, **PE27**, **PE37**, **PE38** (31). □, □, ■, ■.

***Archidium alternifolium* (Hedw.) Mitt.** – Humid and wet soil. 1900 m. **PE16** (1). ■.

***Atrichum angustatum* (Brid.) Bruch & Schimp.** ●● – Wet soil. 300-450 m. **PE06** (1). ■.

***Atrichum undulatum* (Hedw.) P. Beauv.** – Humid and wet rocks, on soil. 450-970 m. **PE07**, **PE17**, **PE27**, **PE39** (4). □, ■, ■.

***Aulacomnium androgynum* (Hedw.) Schwägr.** – Among granite blocks, on humid soil, rocky banks, tree trunks and base of trees. 300-1870 m. **PE06**, **PE16**, **PE17**, **PE18**, **PE26**, **PE27**, **PE28**, **PE37**, **PE38**, **PE39**, **PE48** (37). ■, ■.

***Aulacomnium palustre* (Hedw.) Schwägr.** – Wet soil with *Sphagnum*, river and stream banks. 1000-1860 m. **PE15**, **PE16**, **PE17**, **PE26**, **PE27**, **PE38** (32). □, □, ■, ■.

***Barbula convoluta* Hedw.** – Soil and walls. 300-700 m. **PE06**, **PE48** (2). ■, ■.

***Barbula unguiculata* Hedw.** ●● – Soil. 970 m. **PE27** (1). ■.

***Bartramia ithyphylla* Brid.** – Wet rocky banks, dripping water, rock crevices. 770-1890 m. **PE16**, **PE17**, **PE18**, **PE26**, **PE27** (16). □, □, ■, ■.

***Bartramia pomiformis* Hedw.** – Soil, rocky banks and rock fissure. 300-1890 m. **PE06**, **PE07**, **PE16**, **PE17**, **PE18**, **PE26**, **PE27**, **PE37**, **PE38**, **PE39**, **PE48**, **PE49** (64). □, □, ■, ■.

***Bartramia stricta* Brid.** – Banks in roadsides or tracks, stone walls, concrete on man-made substrata. 425-790 m. **PE27**, **PE39**, **PE49** (5). [□], ■.

***Brachythecium albicans* (Hedw.) Schimp.** – Banks in roadsides, dripping water rocks, base of shrubs, rarely as epiphyte. 300-1865 m. **PE06**, **PE16**, **PE17**, **PE26**, **PE27**, **PE38**, **PE39**, **PE48** (21). ■, ■.

***Brachythecium dieckei* Roll** – Banks in roadsides, rocky crevices, soil shallow with gravel and a little humus. 750-1900 m. **PE07**, **PE16**, **PE26**, **PE27**, **PE38**, **PE39** (18). □, □, ■.

***Brachythecium glareosum* (Spruce) Schimp.** – Rocky banks, walls, tree trunks. 760-1000 m. **PE18**, **PE27**, **PE39** (4). [■], ■.

***Brachythecium plumosum* (Hedw.) Schimp.** – Humid rocks in a river bank. 1700 m. **PE27** (1). ■.

Brachythecium populeum (Hedw.) Schimp. – Only reported by Machado (1933) from one locality (Sanatório, Manteigas). [□].

***Brachythecium rivulare* Schimp.** – Softly flowing and dripping rocks, humid soil in river bank. 300-1000 m. **PE06**, **PE07**, **PE16**, **PE17**, **PE18**, **PE26**, **PE27** (28). □, □, ■.

***Brachythecium rutabulum* (Hedw.) Schimp.** – Rocky banks, humid soil in river banks. 400-1420 m. **PE06**, **PE07**, **PE16**, **PE17**, **PE26**, **PE39** (6). □, ■.

***Brachythecium salebrosum* (F. Weber & D. Mohr) Schimp.** – Rocky and soil banks. 400-1740 m. **PE06**, **PE16**, **PE27** (3). ■.

***Brachythecium starkei* (Brid.) Schimp.** – Spring in cave of granite wall, 1310 m. **PE26** (2). □, ■.

***Brachythecium velutinum* (Schimp.) Mönk.** – Tree trunks and shaded banks. 550-1500 m. **PE17**, **PE26**, **PE27**, **PE37**, **PE39** (8). □, □, ■, ■.

***Bruchia vogesiaca* Schwägr. HD** – Soil with *Sphagnum*, moist soil over rock debris created by breaking up of grassland. 1800-1870 m. **PE16** (3). ■.

***Bryum alpinum* With.** – Exposed wet rocks in banks, moist soil, rock crevices. 550-1500 m. **PE06**, **PE16**, **PE17**, **PE25**, **PE26**, **PE27**, **PE28**, **PE37**, **PE38**, **PE48** (61). □, □, ■, ■.

***Bryum argenteum* Hedw.** – Rocky banks, wall vegetation with granite and soil. 425-1500 m. **PE15**, **PE16**, **PE17**, **PE27**, **PE39** (11). □, ■, ■.

***Bryum caespiticium* Hedw.** – Banks, exposed soil. 600-1000 m. **PE27**, **PE49** (2). □, □, ■.

***Bryum capillare* Hedw.** – Rocky banks, soil and walls, tree trunks. 300-1890 m. **PE06**, **PE07**, **PE16**, **PE17**, **PE26**, **PE27**, **PE37**, **PE38**, **PE39**, **PE48** (49). [□], □, ■, ■.

***Bryum dichotomum* Hedw.** – Soil, stone walls, concrete on man-made substrata. 700-1220 m. **PE17**, **PE27** (2). ■.

***Bryum donianum* Grev.** – Rocky banks, soil. 400-1330 m. **PE06**, **PE16**, **PE18**, **PE27** (5). ■.

***Bryum elegans* Nees** – Rocky banks, walls stone on man-made substrata, grassland, 1020-1790 m. **PE16**, **PE17**, **PE27**, **PE39** (5). [□], ■.

***Bryum gemmiferum* R. Wilczek & Demaret ●●** – Exposed rocks in banks, 530-970 m. **PE27**, **PE48** (2). ■.

***Bryum gemmiparum* De Not. ●●** – Crevices among granite blocks, 1700 m. **PE16** (1). ■.

***Bryum mildeanum* Jur. ●●** – Rocks and soil. 1800 m. **PE16** (1). ■.

***Bryum minii* Podp.** – Banks in roadsides, crevices among granite blocks. 400-1420 m. **PE06**, **PE17**, **PE26**, **PE39**, **PE48** (7). ■.

***Bryum muehlenbeckii* Bruch & Schimp.** – River banks. 600-650 m. **PE49** (2). [□], ■.

***Bryum pallescens* Schwägr.** – Humid soil banks, river banks. 1480-1700 m. **PE16**, **PE26**, **PE27** (5). □, ■, ■.

***Bryum pseudotriquetrum* (Hedw.) P. Gaertn., B. Mey. & Scherb.** – Border of oligotrophic meadow, humid soil banks and crevices among granite blocks. 300-1880 m. **PE06**, **PE16**, **PE17**, **PE26**, **PE27**, **PE38**, **PE39** (30). □, □, ■, ■.

***Bryum radiculosum* Brid. ●●** – Soil in open grassland. 1300-1400 m. **PE17** (1). ■.

***Bryum rubens* Mitt. ●●** – Soil in open grassland. 650-660 m. **PE16** (1). ■.

***Bryum subapiculatum* Hampe ◊** – Soil banks. 700-800 m. **PE17** (1). ■.

***Bryum torquescens* De Not.** – Rocky banks, soil in open grassland. 1300-1450 m. **PE16**, **PE17** (3). □, ■.

***Calliergonella cuspidata* (Hedw.) Loeske** – Humid soil banks, border of oligotrophic meadow. 800-1800 m. **PE16**, **PE26**, **PE27**, **PE38** (9). □, ■.

***Campylopus brevipilus* Bruch & Schimp.** – Humid rock crevices. 540-1310 m. **PE15**, **PE27** (2). ■. Also reported by Greven & van Melick (1994).

Campylopus flexuosus (Hedw.) Brid. – Only reported by Greven & van Melick (1994) without locality. [□].

***Campylopus fragilis* (Brid.) Bruch & Schimp. ●** – Soil and exposed rocks. 550-900 m. **PE06**, **PE37** (2). ■.

***Campylopus introflexus* (Hedw.) Brid.** – Humid soil banks in roadsides. 350 m. **PE06** (1). ■.

***Campylopus pilifer* Brid.** – Rocks, banks in roadsides, soil. 400-1855 m. **PE06**, **PE16**, **PE17**, **PE36**, **PE48** (7). [□], ■.

***Campylostelium strictum* Solms ●** – Rocky banks and crevices. 450-1400 m. **PE09**, **PE18**, **PE26** (2). ■.

***Ceratodon purpureus* (Hedw.) Brid.** – Soil of grasslands and soil banks. 300-1950 m. **PE06**, **PE07**, **PE15**, **PE16**, **PE17**, **PE18**, **PE25**, **PE26**, **PE27**, **PE28**, **PE36**, **PE37**, **PE38**, **PE39** (86). □, □, ■, ■.

***Claopodium whippleanum* (Sull.) Renauld & Cardot** – Soil of shaded banks and rocky crevices. 300-1100 m. **PE06**, **PE07**, **PE16**, **PE18**, **PE27**, **PE38**, **PE39**, **PE49** (17). □, [■], ■.

Climacium dendroides (Hedw.) F. Weber & D. Mohr – Only reported by Greven & van Melick (1994) without locality. [□].

Cratoneuron filicinum (Hedw.) Spruce – Only reported in Greven & van Melick (1994) without locality. [□].

***Cryphaea heteromalla* (Hedw.) D. Mohr** – Tree trunks and branches. 300-950 m. **PE06**, **PE17** (2). ■.

***Cynodontium bruntonii* (Sm.) Bruch & Schimp.** – Rocky banks and crevices, walls and soil, rarely on tree trunks. 300-1991 m. **PE06**, **PE15**, **PE16**, **PE17**, **PE26**, **PE27**, **PE37**, **PE38**, **PE39** (46). ■, ■.

***Cynodontium gracilescens* (F. Weber & D. Mohr) Schimp.** – Rock crevices. 1800 m. **PE26** (1). ■.

***Cynodontium jenneri* (Schimp.) Stirt.** ◊ – Rocky banks and crevices, walls and soil. 300-1860 m. **PE06**, **PE16**, **PE26**, **PE37** (5). ■.

Dialytrichia mucronata (Brid.) Broth. – Only reported by Greven & van Melick (1994) without locality. [□].

***Dicranella heteromalla* (Hedw.) Schimp.** – Granitic blocks, soil in banks by rivers. 700-1870 m. **PE16**, **PE17** (8). □, ■.

***Dicranella rufescens* (With.) Schimp.** ●● – Humid soil in river banks. 1800 m. **PE16** (1). ■.

***Dicranella subulata* (Hedw.) Schimp.** ●● – Humid soil in banks. 1410 m. **PE06**, **PE17** (2). ■, ■.

***Dicranoweisia cirrata* (Hedw.) Milde** – Tree trunks, rarely on rocks. 760-1500 m. **PE17**, **PE27**, **PE28**, **PE38, PE39** (10). ■.

***Dicranum crassifolium* Sérgio, Ochyra & Séneca** – Rock crevices, on soil with much humus. 400-1860 m. **PE06**, **PE16**, **PE17**, **PE26**, **PE27** (13). □, ■, ■.

***Dicranum scoparium* Hedw.** – Soil and rocks. Rock crevices, banks and tree trunks. 300-1900 m. **PE06**, **PE07**, **PE15**, **PE16**, **PE17**, **PE25**, **PE26**, **PE27**, **PE37**, **PE38**, **PE39**, **PE48** (58). □, □, ■, ■.

***Dicranum tauricum* Sapjegin** – Normally epiphytic on *Castanea sativa*. 400-700 m. **PE06**, **PE27** (2). ■.

***Didymodon fallax* (Hedw.) R. H. Zander** ●● – Stone walls, concrete on man-made substrata. 770 m. **PE27** (1). ■.

***Didymodon insulanus* (De Not.) M. Hill** – Humid rocks and stone walls, or on man-made substrata. 450-950 m. **PE06**, **PE17**, **PE27**, **PE48** (6). □, ■, ■.

***Didymodon luridus* Hornsch.** ●● – Exposed rocks. 760-790 m. **PE39** (1). ■.

***Didymodon nicholsonii* Culm.** ●● – Epiphytic in *Castanea sativa*, wall vegetation (granite). 670-700 m. **PE27**, **PE48** (3). ■.

***Didymodon rigidulus* Hedw.** ● – Wall with some concrete. 700 m. **PE17** (1). ■.

Didymodon tophaceus (Brid.) Lisa. – Only reported by Greven & van Melick (1994) without locality. [□].

***Diphyscium foliosum* (Hedw.) D. Mohr** – Soil, entrances to caves, in humid shaded rock banks. 400-1990 m. **PE06**, **PE16**, **PE17**, **PE26** (11). □, ■.

***Ditrichum cylindricum* (Hedw.) Grout** – Wet banks. 400-1300 m. **PE06**, **PE27** (2). ■.

***Ditrichum heteromallum* (Hedw.) Britton** – Rocky and soil banks, 550-1410 m. **PE16**, **PE17**, **PE37** (3). [□], □, ■.

***Ditrichum subulatum* Hampe** – River banks. 300-1620 m. **PE06**, **PE16**, **PE17** (3). ■.

***Drepanocladus aduncus* (Hedw.) Warnst.** ●● – Water. 1750-1800 m. **PE16** (2). ■.

***Encalypta ciliata* Hedw.** – Rocks and soil. 1855 m. **PE16** (1). ■.

Encalypta streptocarpa Hedw. ○ – Only reported by Greven & van Melick (1994) without locality. [□].

***Encalypta vulgaris* Hedw.** ● – In wall vegetation. 970 m. **PE27** (1). ■.

***Entosthodon attenuatus* (Dicks.) Bryhn** – Soil banks. 400-450 m. **PE06**, **PE27** (2). ■, ■.

***Entosthodon convexus* (Spruce) Brugués** – Humid banks and rock crevices. 450 m. **PE06** (1). ■.

***Epipterygium tozeri* (Grev.) Lindb.** – Soil banks, entrance to caves. 300-790 m. **PE06**, **PE17**, **PE18**, **PE37**, **PE39** (6). ■, ■.

***Eurhynchium hians* (Hedw.) Sande Lac.** ● – River banks, humid rocks and walls with concrete. 770-1450 m. **PE16**, **PE17**, **PE18**, **PE27** (4). ■.

***Eurhynchium praelongum* var. *stokesii* (Turner) Dixon** – Humid soil banks, crevices, humid rocks and walls with concrete. 300-1870 m. **PE06**, **PE07**, **PE16**, **PE17**, **PE18**, **PE26**, **PE27**, **PE28**, **PE37**, **PE38**, **PE39**, **PE48**, **PE49**, **PE48** (54). □, □, ■, ■.

***Eurhynchium pulchellum* (Hedw.) Jenn.** – River banks, soil and rocks, waterfalls. 870-1800 m. **PE06**, **PE16**, **PE18**, **PE27**, **PE39** (11). ■, ■.

***Eurhynchium pumilum* (Wilson) Schimp.** – Shaded rocks and soil. Tree trunks. 650-1590 m. **PE07**, **PE16**, **PE18** (3). ■.

***Eurhynchium schleicheri* (F. Weber & D. Mohr) Milde** ●● – Rocks. 760-790 m. **PE39** (1). ■.

***Eurhynchium speciosum* (Brid.) Jur.** ●● – Rocks and soil. 870-1800 m. **PE17**, **PE27** (2). ■.

***Eurhynchium striatum* (Hedw.) Schimp.** – Wet rocks, walls near springs, tree trunks. 300-1835 m. 300-1835 m. **PE06**, **PE07**, **PE16**, **PE17**, **PE48** (10). □, ▪, ■.

***Fabronia pusilla* Raddi** ● – Epiphytic. 350 m. **PE29** (1). ■.

***Fissidens bryoides* Hedw.** – Soil in banks. 400-1160 m. **PE06**, **PE38** (3). □, ■.

***Fissidens bryoides* var. *caespitans* Schimp.** ●● – Soil in banks, rock crevices. 540-1420 m. **PE16**, **PE18**, **PE26**, **PE27**, **PE38**, **PE48** (12). □, ■.

***Fissidens dubius* P. Beauv.** ● – Soil banks, rock crevices. 435 m. **PE06** (1). ■.

***Fissidens incurvus* Starke ex Röhl.** – Rocky banks. 450 m. **PE06** (1). ■.

***Fissidens jansenii* Sérgio & Pursell** ◊ ✳ – Submerged in water on hornfels rocks. 1100 m. **PE27** (1). ■.

***Fissidens polyphyllus* Wilson ex Bruch & Schimp.** – River banks, wet rocks near springs. 650 m. **PE16**, **PE17** (2). □, ▪, ■.

***Fissidens pusillus* (Wilson) Milde** – Rocks and soil. 700-800 m. **PE17** (1). ■.

***Fissidens serrulatus* Brid.** – Entrance to caves, humid banks and rock crevices. 300-650 m. **PE06**, **PE16**, **PE48** (5). ■.

***Fissidens taxifolius* Hedw.** – 800 m. **PE17** (1). [□], □. The first reference seems to be of Casares (1932) corresponding to a Brotero collection.

***Fissidens viridulus* (Sw.) Wahlenb.** – Soil banks, walls. 400-1520 m. **PE06**, **PE17**, **PE27**, **PE49** (4). ■.

***Fontinalis antipyretica* Hedw.** (including also *Fontinalis antipyretica* var. *gracilis* (Lindb.) Schimp.) – Water, river banks, intermitent rivulet. 550-1950 m. **PE16**, PE17, **PE26**, **PE27**, **PE37**, **PE38** (16). □, □, ■.

***Fontinalis hypnoides* Hartm.** – Water and river banks. 1450 m. **PE26**, **PE27** (2). [□], ■.

***Fontinalis squamosa* Hedw.** – Water and river banks, rocky substrate, very slowly flowing 300-1620 m. **PE06**, **PE17**, **PE26**, **PE27** (11). □, □, ▪, ■. We have included also plants of var. *curnowii* Cardot.

***Funaria hygrometrica* Hedw.** – Soil of grasslands and soil banks after fire, rock crevices. 540-1590 m. **PE07**, **PE16**, **PE17**, **PE27**, **PE38**, **PE39**, **PE48** (10). ▪, ■.

***Grimmia caespiticia* (Brid.) Jur.** ◊ – Rock crevices. 1840-1900 m. **PE16** (1). ■.

***Grimmia curvata* (Brid.) De Sloover** – Moist rock crevices, near dripping water and stream. 800-1900 m. **PE16**, **PE17**, **PE26** (23). □, □, ▪, ■.

***Grimmia decipiens* (Schultz) Lindb.** – Rocks in exposed banks or shaded rock crevices 530-1600 m. **PE16**, **PE17**, **PE18**, **PE26**, **PE27**, **PE38**, **PE39**, **PE48** (17). □, □, ▪, ■.

Grimmia donniana Sm. ○? – Most of old material corresponds to *Grimmia montana.*

***Grimmia laevigata* (Brid.) Brid.** – Rocky banks, stone walls, on man-made substrata. 425-1600 m. **PE06**, **PE17**, **PE26**, **PE27**, **PE37**, **PE39** (14). □, □, ▪, ■.

***Grimmia montana* Bruch & Schimp.** – Soil and rocky banks, rock surface with little gravel, rarely epiphytic. 425-1990 m. **PE06**, **PE16**, **PE17**, **PE26**, **PE27**, **PE28**, **PE37**, **PE39** (31). □, □, ▪, ■.

***Grimmia orbicularis* Wilson** – Rock stream in medium-sized blocks. 1720 m. **PE16** (1). ■.

***Grimmia ovalis* (Hedw.) Lindb.** – Rocky banks. **PE17** (1). □. Only reported based in old collection (Machado, 1930).

***Grimmia pilosissima* Herzog** – Granitic rock. 1500 m. **PE27** (1). ■.

***Grimmia pulvinata* (Hedw.) Sm.** – Rocky banks and walls, tree trunks. 425-1580 m. **PE16**, **PE17**, **PE27**, **PE38**, **PE39** (10). □, ▪, ■.

***Grimmia trichophylla* Grev.** – Granitic rock, wall rock fissures, tree trunks. 300-1900 m. **PE06**, **PE16**, **PE17**, **PE18**, **PE26**, **PE27**, **PE29**, **PE36**, **PE37**, **PE38**, **PE39** (37). □, □, ■.

***Gymnostomum calcareum* Nees & Hornsch.** – Stone walls, concrete on man-made substrata. 700 m. **PE17**, **PE27** (3). [▪], ■.

***Gymnostomum viridulum* Brid.** – Walls with some concrete. 700-780 m. **PE17**, **PE28** (2). ■.

***Habrodon perpusillus* (De Not.) Lindb.** – Epiphytic. 400-1100 m. **PE06**, **PE27**, **PE28**, **PE39**, **PE49** (9). [▪], ■.

***Hedwigia ciliata* (Hedw.) P. Beauv.** – Rocky banks and crevices, walls and tree trunks. 425-1610 m. **PE06**, **PE16**, **PE18**, **PE26**, **PE27**, **PE28**, **PE37**, **PE38**, **PE39** (15). ■.

***Hedwigia stellata* Hedenäs** – Rocky banks and crevices, walls. Epiphytic. 400-1860 m. **PE06**, **PE15**, **PE16**, **PE17**, **PE25**, **PE26**, **PE26**, **PE27**, **PE28**, **PE37**, **PE38**, **PE39**, **PE48** (63). □, □, ▪, ■.

***Heterocladium heteropterum* Bruch & Schimp.** – Rocky shaded banks and crevices, in slowly dripping water. 400-1950 m. **PE06**, **PE16**, **PE17**, **PE26**, **PE38** (22). ▪, ■.

***Homalothecium aureum* (Spruce) H. Rob.** – Rocky banks and soil. 425-1120 m. **PE27**, **PE37**, **PE39** (7). □, ■.

***Homalothecium lutescens* (Hedw.) H. Rob.** – Shaded boulders along a rivulet. 1500-1700 m. **PE26**, **PE27** (2). ■.

***Homalothecium sericeum* (Hedw.) Schimp.** – Rocky banks, walls and tree trunks. 450-1800 m. **PE06**, **PE07**, **PE16**, **PE17**, **PE18**, **PE27**, **PE29**, **PE37**, **PE38**, **PE39**, **PE49** (26). □, ▪, ■.

***Hookeria lucens* (Hedw.) Sm.** – Humid soil of river banks. 1400 m. **PE26** (3). □, □, ■.

***Hygrohypnum ochraceum* (Wilson) Loeske** – Humid rocky banks and springs. 540-1950 m. **PE16**, **PE48** (3). □, ■.

***Hylocomium splendens* (Hedw.) Schimp.** – Rocky banks, crevices among granite blocks with humus. 650-1850 m. **PE07**, **PE16**, **PE17**, **PE26** (8). ▪, ■.

***Hyocomium armoricum* (Brid.) Wijk & Margad.** ● – Dripping rocks, intermittent rivulet banks. 800-1250 m. **PE17** (2). ▪, ■.

***Hypnum andoi* A. J. E. Smith** – Soil, tree trunks. 400-1550 m. **PE06**, **PE16**, **PE17**, **PE26**, **PE27**, **PE39** (9). ■.

***Hypnum cupressiforme* Hedw.** – Rocks, soil, epiphytic. 300-1890 m. **PE07**, **PE15**, **PE16**, **PE17**, **PE18**, **PE25**, **PE26**, **PE27**, **PE28**, **PE29**, **PE37**, **PE38**, **PE39**, **PE48** (84). [□], □, ▪, ■.

***Hypnum cupressiforme* var. *filiforme* Brid.** – Soil, tree trunks. 1550-1890 m. **PE16**, **PE26 (4).** ■.

***Hypnum cupressiforme* var. *lacunosum* Brid.** – Soil, rocky banks, tree trunks. 550-1800 m. **PE06**, **PE16**, **PE17**, **PE26**, **PE28**, **PE36**, **PE37**, **PE38**, **PE39**, **PE48** (39). ▪, ■.

***Hypnum resupinatum* Taylor** – Rocks and tree trunks. 400-1780 m. **PE06**, **PE16**, **PE26**, **PE27**, **PE28**, **PE38**, **PE39** (8). ■.

***Hypnum imponens* Hedw.** – Crevices in granite blocks. 400-1840 m. **PE06**, **PE07**, **PE16**, **PE17**, **PE26**, **PE27** (13). [□], ■.

***Hypnum jutlandicum* Holmen & E. Warncke** – Soil and rocky banks, rocky crevices, tree trunks. 400-1550 m. **PE06**, **PE16**, **PE17**, **PE23**, **PE26** (8). □, [□], ▪, ■.

***Isothecium alopecuroides* (Dubois) Isov.** – Rocky banks, tree trunks. 400-790 m. **PE06**, **PE07**, **PE39** (3). ■.

***Isothecium holtii* Kindb.** – River rocks, intermittent rivulet banks. 300-1900 m. **PE06**, **PE07**, **PE16**, **PE17**, **PE26**, **PE27** (23). ■.

***Isothecium myosuroides* Brid.** – Rocky banks, crevices among rocks. 400-1900 m. **PE06**, **PE07**, **PE16**, **PE17**, **PE26**, **PE27**, **PE38**, **PE39**, **PE48** (21). □, □, ■.

***Isothecium striatulum* (Spruce) Kindb.** – Rocks and soil. 1810 m. **PE16** (2). [□], ■.

***Kiaeria blyttii* (Bruch & Schimp.) Broth.** ◊ – Rocky banks, rock fissures. 1700-1900 m. **PE16** (4). [□], ■.

***Kiaeria falcata* (Hedw.) I. Hagen** ◊ – Rocky banks, rock stream with small quantity of humus. 1720-1830 m. **PE16** (4). [□], ■.

***Kiaeria starkei* (F. Weber & D. Mohr) I. Hagen** ◊ – Rocky banks, large boulders and soil with gravel and humus. 925-1900 m. **PE16**, **PE17**, **PE26** (11). □, □, ▪, ■.

***Leptodon smithii* (Hedw.) F. Weber & D. Mohr** – Epiphytic. 400-1100 m. **PE06**, **PE07**, **PE27** (3). ■.

***Leucodon sciuroides* (Hedw.) Schwägr.** (including **var. *morensis* (Schwägr.) De Not.**) – Epiphytic. 300-900 m. **PE06**, **PE06**, **PE07**, **PE27**, **PE28**, **PE29**, **PE37**, **PE38**, **PE39** (12), □, ■.

***Mnium hornum* Hedw.** – Wet rocks, rock fissures with dripping water. 300-1850 m. **PE17**, **PE26**, **PE27**, **PE38**, **PE48** (22). □, □, ▪, ■.

***Neckera complanata* (Hedw.) Huebener** – Rocky banks and tree base. 650 m. **PE07** (1). ■.

***Neckera pumila* Hedw.** – Epiphytic. 400-1500 m. **PE06**, **PE26**, **PE26**, **PE27** (5). ■.

***Orthotrichum acuminatum* H. Philib.** – Epiphytic. 550-1439 m. **PE16**, **PE26**, **PE27**, **PE37**, **PE38** (13). ▪, ■.

***Orthotrichum affine* Brid.** – Epiphytic. 300-1500 m. **PE06**, **PE07**, **PE16**, **PE17**, **PE18**, **PE26**, **PE27**, **PE28**, **PE37**, **PE38**, **PE39**, **PE49** (32). [□], ▪, ■.

***Orthotrichum anomalum* Hedw.** – Rocky bank and walls. 950-1450 m. **PE17**, **PE26 (2).** ■.

***Orthotrichum cupulatum* Brid.** ●● – Rocky wall with some concrete. 1500 m. **PE27** (1). ■.

***Orthotrichum diaphanum* Brid.** – Tree trunks, 550-1860 m. **PE06**, **PE16**, **PE17**, **PE18**, **PE37**, **PE39**, **PE49** (10). ▪, ■.

***Orthotrichum ibericum* Lara & Mazimpaka** – Tree trunks 550-1860 m. **PE17**, **PE26**, **PE27**, **PE38** (10). ■.

***Orthotrichum lyellii* Hook. & Taylor** – Tree trunks 300-1500 m. **PE06**, **PE07**, **PE17**, **PE18**, **PE26**, **PE27**, **PE28**, **PE29**, **PE37**, **PE38**, **PE39** (34). [□], ■.

***Orthotrichum rupestre* Schwägr.** – Shaded wet rocks, tree trunks. 350-1880 m. **PE06**, **PE07**, **PE16**, **PE17**, **PE26**, **PE27**, **PE29**, **PE37**, **PE38**, **PE39**, **PE48** (49). [□], ▪, ■.

***Orthotrichum scanicum* Gronvall IUCN** – Tree trunks. 970-1430 m. **PE26**, **PE27** (3). ■.

***Orthotrichum shawii* Wilson** ◊ – Tree trunks 1200 m. **PE27** (1). ■. The only locality in Portugal corresponds to this report (Garcia *et al.*, 2005).

***Orthotrichum speciosum* Nees** – Tree trunks. 780-1650 m. **PE16**, **PE17**, **PE26**, **PE27**, **PE28**, **PE38** (11). ▪, ■.

***Orthotrichum stramineum* Brid.** ◊ – Tree trunks 650-1430 m. **PE07**, **PE26** (2). ■.

***Orthotrichum striatum* Hedw.** – Tree trunks, 300-1500 m. **PE06**, **PE07**, **PE16**, **PE17**, **PE18**, **PE26**, **PE27**, **PE37**, **PE38**, **PE39** (33). ▪, ■.

***Orthotrichum tenellum* Brid.** – Tree trunks, 350-1470 m. **PE06**, **PE17**, **PE26**, **PE27**, **PE28**, **PE29**, **PE37**, **PE39** (12). ▪, ■.

***Philonotis arnellii* Husn.** – Wet rocks, loamy soil. 350-1470 m. **PE06**, **PE27**, **PE16**, **PE37**, **PE39** (9). □, ■.

***Philonotis caespitosa* Jur.** – Wet rocky banks, entrance to caves. **PE16**, **PE17**, **PE18**, **PE26**, **PE27**, **PE38**, **PE39**, **PE49** (13). ■.

***Philonotis fontana* (Hedw.) Brid.** – Wet soil and rocks, shade rocks with slowly dripping water. **PE16**, **PE17**, **PE25**, **PE26**, **PE27**, **PE38**, **PE48** (41). □, □, ▪, ■.

***Philonotis marchica* (Hedw.) Brid.** – Wet rocky banks, wet exposed soil. 400-1450 m. **PE06**, **PE17**, **PE18**, **PE26**, **PE27** (5). ■.

***Philonotis rigida* Brid.** – Humid rocks with dripping water. 400-450 m. **PE06**, **PE27** (2). □, □, ■.

***Philonotis seriata* Mitt.** – River banks, moist soil with *Sphagnum*, crevices among blocks. **PE16**, **PE17**, **PE26**, **PE27**, **PE37**, **PE39**, **PE48** (24). □, □, ■.

***Philonotis tomentella* Molendo** – River banks, slowly dripping water, crevices among blocks, grasslands. 400-1870 m. **PE06**, **PE16**, **PE26**, **PE27**, **PE38** (10). □, ▪, ■.

***Physcomitrium pyriforme* (Hedw.) Hampe** – Wet exposed soil. 580 m. **PE28** (1). 1990.

***Plagiomnium affine* (Blandow) T. J. Kop.** – River banks. Wet shaded soil. 400-1870 m. **PE06**, **PE07**, **PE16**, **PE17**, **PE26**, **PE27**, **PE28**, **PE37**, **PE38**, **PE38**, **PE48** (14). □, ■.

***Plagiomnium medium* (Bruch & Schimp.) T. J. Kop.** ◊ – Banks in roadsites, moist soil. 1000-1400 m. **PE26**, **PE38** (2). □, ■.

***Plagiomnium rostratum* (Schrad.) T. J. Kop.** – River banks, shaded soil. 770-970 m. **PE18**, **PE27** (2). ■.

***Plagiomnium undulatum* (Hedw.) T. J. Kop.** – Humid and wet soil banks, shaded rocks. 300-1100 m. **PE06**, **PE07**, **PE15**, **PE17**, **PE27**, **PE38**, **PE39**, **PE49** (12). □, ■.

***Plagiothecium cavifolium* (Brid.) Z. Iwats.** – Rocks and soil banks. 1000-1890 m. **PE16**, **PE26**, **PE27** (4). ■.

***Plagiothecium denticulatum* (Hedw.) Schimp.** – Crevices among rocks, soil with humus. 1000-1890 m. **PE16** (5). [□], ■.

***Plagiothecium denticulatum* var. *obtusifolium* (Turner) Moore** – Rock crevices. 1720-1790 m. **PE16** (2). ■.

***Plagiothecium latebricola* Schimp.** ◊ – Base of *Genista florida*. 1470 m. **PE26** (1). ■.

***Plagiothecium laetum* Schimp.** ◊ – Shaded rocks, base of trees. 1000 m. **PE27** (1). ■.

***Plagiothecium nemorale* (Mitt.) A. Jaeger** – Humid soil and rocky banks. 400-1820 m. **PE06**, **PE07**, **PE16**, **PE18**, **PE38**, **PE49** (7). □, □, ■.

***Plagiothecium piliferum* (Hartm.) Schimp.** ◊ – Wet dark cave under overhanging rock. 1500 m. **PE26** (1). ■.

***Plagiothecium succulentum* (Wilson) Lindb.** – Entrance to caves, on humid and wet soil and rocks, dripping cliff, tree trunks. 300-1950 m. **PE06**, **PE07**, **PE17**, **PE16**, **PE17**, **PE18**, **PE26**, **PE27**, **PE39**, **PE48** (19). □, ▪, ■.

***Platyhypnidium lusitanicum* (Schimp.) Ochyra & Bednarek-Ochyra** – Shaded rocks, lowly dripping water, humid and wet banks. 540-1950 m. **PE16**, **PE17**, **PE26**, **PE27**, **PE37**, **PE39**, **PE48** (33). □, □, ■.

***Pleuridium acuminatum* Lindb.** – Dry soil, rocks, banks in roadsides, base of *Castanea sativa*. 425-1640 m. **PE06**, **PE15**, **PE17**, **PE18**, **PE26**, **PE27**, **PE37**, **PE38**, **PE39** (21). ■.

***Pleuridium subulatum* (Hedw.) Rabenh.** – Rocky bank, slowly dripping water. 450 m. **PE06** (3). [□, □], ■.

***Pleurochaete squarrosa* (Brid.) Lindb.** ● – Banks in roadsides, temporary wet soil. 525-790 m. **PE39**, **PE48** (3). ■.

***Pleurozium schreberi* (Brid.) Mitt.** – Crevices in granite blocks, grassland with *Gentiana lutea*, river banks, on humid soil. 1550-1900 m. **PE16**, **PE27** (9). □, ■.

***Pogonatum aloides* (Hedw.) P. Beauv.** – Banks in roadsides, walls. 300-1950 m. **PE06**, **PE07**, **PE17**, **PE18**, **PE26**, **PE27**, **PE37**, **PE38**, **PE39** (28). □, □, ▪, ■.

***Pogonatum nanum* (Hedw.) P. Beauv.** – Banks in roadsides, soil and rocky banks. 550-1700 m. **PE16**, **PE26**, **PE27**, **PE37**, **PE38** (7). [□], ■.

***Pogonatum urnigerum* (Hedw.) P. Beauv.** – Humid soil amongst boulders. 1100-1750 m. **PE16**, **PE17**, **PE27** (3). ■.

***Pohlia* aff. *andalusica* (Höhn.) Broth.** ◊ – Soil and rock banks, rock fissures. 550-1700 m. **PE16**, **PE17**, **PE26** (7). ■.

***Pohlia annotina* Lindb.** – Soil and rock banks, moist soil over rock debris created by breaking up of grassland. 300-1950 m. **PE06**, **PE16**, **PE17**, **PE26**, **PE27**, **PE28** (20). □, ■.

***Pohlia camptotrachela* (Ren. et Card.) Broth.** – Soil of grasslands. 1000 m. **PE38** (1). ■.

***Pohlia cruda* (Hedw.) Lindb.** – Soil and rock banks, soil with humus among granite blocks. 800-1890 m. **PE16**, **PE17**, **PE26**, **PE27** (11). [□], □, ■.

***Pohlia elongata* Hedw.** – Soil and rock banks, crevices among granite blocks. 400-1950 m. **PE06**, **PE16**, **PE17**, **PE26**, **PE27** (17). □, □, ▪, ■.

***Pohlia longicollis* (Hedw.) Lindb.** – Soil and rock banks, crevices among granite blocks 1500-1880 m. **PE16**, **PE26** (7). [□, □], ■.

***Pohlia nutans* (Hedw.) Lindb.** – Soil and rock banks. Crevices among granite blocks 700-1900 m. **PE16**, **PE17** (4). [□], □, ▪, ■.

***Pohlia proligera* (Kindb.) Broth. ●●** – On a wall of a bridge. 1340 m. **PE17** (1). ■.

***Polytrichum alpinum* Hedw.** – Soil and rock of river banks and grasslands. 1050-1950 m. **PE16**, **PE26**, **PE27** (20). □, □, ■, ■.

***Polytrichum commune* Hedw.** – Soil and rocky banks, very slowly streaming through bogs, mineral soil. 540-1910 m. **PE16**, **PE17**, **PE26**, **PE27**, **PE28**, **PE38**, **PE39**, **PE48** (61). □, □, ■, ■.

***Polytrichum formosum* Hedw.** – Rocky banks, soil, base of trees. 400-1835 m. **PE06**, **PE07**, **PE16**, **PE17**, **PE26**, **PE28**, **PE39** (12). □, □, ■, ■.

***Polytrichum juniperinum* Hedw.** – Soil, rocky banks, gaps in grasslands, tree trunks. 400-1835 m. **PE06**, **PE15**, **PE16**, **PE17**, **PE26**, **PE27**, **PE28**, **PE37**, **PE38**, **PE39**, **PE48** (62). □, ■, ■.

***Polytrichum piliferum* Hedw.** – Rocky banks, soil shallow with gravel and little humus, base of trees. 300-1920 m. **PE06**, **PE16**, **PE17**, **PE18**, **PE26**, **PE27**, **PE36**, **PE37**, **PE38**, **PE39**, **PE48**, **PE49** (93). □, □, ■, ■.

***Pottia intermedia* (Turner) Fuernr. ●●** – Soil banks. 600-650 m. **PE49** (1). ■.

***Pottia truncata* (Hedw.) Bruch & Schimp. ●●** – Grassland on soil. 760-790 m. **PE39** (1). ■.

***Pseudephemerum nitidum* (Hedw.) Reimers ●●** – In a river bank. 1160 m. **PE38** (1). ■.

***Pseudocrossidium hornschuchianum* (Schultz) R. H. Zander** – Rocky banks, stone walls with concrete, on man-made substrata. 700-950 m. **PE17**, **PE27**, **PE48** (3). ■.

***Pseudoleskea incurvata* (Hedw.) Loeske ◊** – Crevices among rocks, on soil. 600-1900 m. **PE16**, **PE27** (5). [□], □, ■.

***Pseudoleskea patens* (Lindb.) Kindb. ◊** – Crevices among rocks, base of *Juniperus* species, soil with humus among stones. 300-1900 m. **PE06**, **PE16** (11). □, ■.

***Pseudotaxiphyllum elegans* (Brid.) Z. Iwats.** – Crevices among granite blocks, wet shaded rocks, rarely tree trunks. 700-1900 m. **PE16**, **PE17**, **PE26**, **PE27** (28). □, □, ■.

***Pterigynandrum filiforme* Hedw.** – Soil, on small slope among boulders. 1100-1900 m. **PE16**, **PE17**, **PE26**, **PE27** (21). □, □, ■.

***Pterogonium gracile* (Hedw.) Sm.** – Trees, rocky banks. 300-1470 m. **PE06**, **PE07**, **PE17**, **PE18**, **PE26**, **PE27**, **PE28**, **PE37**, **PE38**, **PE39**, **PE49** (24). □, [□], ■, ■.

***Racomitrium aciculare* (Hedw.) Brid.** – Crevices among wet granite blocks, shaded rocks in river banks near water. 400-1950 m. **PE06**, **PE16**, **PE17**, **PE26**, **PE27**, **PE37**, **PE48** (33). [□], □, ■, ■.

***Racomitrium affine* (F. Weber & D. Mohr) Lindb.** – Humid banks in roadsides, slowly dripping water. 300-1850 m. **PE06**, **PE16**, **PE17**, **PE26**, **PE27**, **PE48** (12). □, [□, ■], ■.

***Racomitrium aquaticum* (Schrad.) Brid** – Shaded rocks in river banks near water, dripping cliff. 400-1950 m. **PE06**, **PE16**, **PE17**, **PE26**, **PE27**, **PE48** (14). [□], ■.

***Racomitrium elongatum* Frisvoll** – Dry rocks, crevices, dry soil, wall on granite. 300-1920 m. **PE06**, **PE16**, **PE17**, **PE26**, **PE27**, **PE27**, **PE28**, **PE37**, **PE38**, **PE48** (44). □, □, ■, ■.

***Racomitrium hespericum* Sérgio, Muñoz & Ochyra ✶✶** – Shaded rocks in river banks near water, slowly dripping water, rarely tree trunks. 400-1950 m. **PE06**, **PE16**, **PE17**, **PE26**, **PE27** (35). □, □, ■, ■.

***Racomitrium heterostichum* (Hedw.) Brid.** – Dry rocks, soil, rarely tree trunks. 400-1990 m. **PE06**, **PE15**, **PE16**, **PE17**, **PE26**, **PE27**, **PE36**, **PE37**, **PE38**, **PE48** (58). □, □, ■, ■.

***Racomitrium lamprocarpum* (Müll. Hal.) A. Jaeger** – Shaded rocks in river banks near water, slowly dripping water. 700-1950 m. **PE06**, **PE16**, **PE17**, **PE26**, **PE27**, **PE38** (17). □, ■, ■.

***Racomitrium lanuginosum* (Hedw.) Brid.** – Crevices among granite blocks, on soil, rock outcrop. 700-1825 m. **PE06**, **PE15**, **PE16**, **PE17**, **PE26**, **PE27 (19)**. □, □, ■, ■.

***Racomitrium lusitanicum* Ochyra & Sérgio ✶✶** – Rocky banks, mineral soil mixed with gravel, shaded rocks in springs. 400-1880 m. **PE06**, **PE16**, **PE17**, **PE26 (10)**. □, ■.

***Racomitrium macounii* Kindb. subsp. *macounii* ◊** – Crevices among granite blocks, wet soil. 450-1950 m. **PE06**, **PE16**, **PE17**, **PE26**, **PE27**, **PE38** (22). □, ■, ■.

Racomitrium macounii* subsp. *alpinum (E. Lawton) Frisvoll ◊ – Rocks under softly flowing water. 800-1500 m. **PE16**, **PE26** (5). □, ■.

***Racomitrium obtusum* (Brid.) Brid.** – Rocks and soil. 800-1500 m. **PE17**, **PE26**, **PE27** (3). □, ■.

***Racomitrium sudeticum* (Funck) Bruch & Schimp.** – Rocks and soil. 1420-1850 m. **PE16**, **PE17**, **PE26** (5). [□, □], ■.

***Rhabdoweisia fugax* (Hedw.) Bruch & Schimp.** – Shaded rocks and caves, large boulders in rock fissures. 650-1990 m. **PE16**, **PE17**, **PE26**, **PE27**, **PE48** (11). ■.

***Rhizomnium magnifolium* (Horik.) T. J. Kop.** – River banks, dripping rocks, wet soil. 1590-1850 m. **PE16** (3). ■.

***Rhizomnium punctatum* (Hedw.) T. J. Kop.** – Wet rocky banks, wet soil, dripping water. 530-1950 m. **PE16**, **PE17**, **PE26**, **PE27**, **PE48** (28). □, □, ■, ■.

***Rhynchostegium confertum* (Dicks.) Schimp.** – Humid rocks and soil, shade of woodland fringe, rarely tree trunks. 400-1600 m. **PE06**, **PE17**, **PE26**, **PE27** (7). ■.

***Rhynchostegium megapolitanum* (F. Weber & D. Mohr) Schimp. ●●** – Rocky banks with soil, grassland. 300-1880 m. **PE06**, **PE16**, **PE17** (6). ■.

***Rhynchostegium murale* (Hedw.) Schimp.** – River banks on soil. 300-320 m. **PE06** (1). ■.

***Rhynchostegium riparioides* (Hedw.) Cardot** – Rocks and soil, wet rocky banks, rarely tree trunks. 400-1950 m. **PE06**, **PE16**, **PE17**, **PE26**, **PE27**, **PE37**, **PE39**, **PE49** (21). □, □, ■, ■.

***Rhytidiadelphus loreus* (Hedw.) Warnst.** – Humid rocks and soil, crevices among granite blocks. 1460-1800 m. **PE16**, **PE26** (8). □, □, ■, ■.

***Rhytidiadelphus squarrosus* (Hedw.) Warnst.** – Humid rocky banks. 1550-1810 m. **PE16**, **PE17**, **PE27** (4). ■, ■.

***Rhytidiadelphus triquetrus* (Hedw.) Warnst.** – Humid rocky banks, soil in grasslands. 400-1800 m. **PE07**, **PE16**, **PE17** (8). □, □, ■, ■.

***Sanionia uncinata* (Hedw.) Loeske** – Humid rocky banks, soil with *Sphagnum.* 1650-1930 m. **PE16** (11). □, ■.

***Schistidium apocarpum* (Hedw.) Bruch & Schimp.** – Rocks, walls with concrete. 1650-1930 m. **PE17** (2). ■.

***Schistidium brunnescens* Limpr. ◊** – Walls with some concrete in an artificial channel. 950 m. **PE17** (1). ■.

***Schistidium rivulare* (Brid.) Podp.** – Rocks in river banks. 400-450 m. **PE06** (1). ■.

***Schistostega pennata* (Hedw.) F. Weber & D. Mohr** – Granitic caves. 700-1000 m. **PE06**, **PE16**, **PE17** (5). □, ■, ■.

***Schizymenium pontevedrensis* (Luis.) Sérgio, Casas, Cros & Brugués** ✶✶ – Shaded banks. 300-550 m. **PE06**, **PE37**, **PE48** (3). [■], ■.

***Scleropodium purum* (Hedw.) Limpr.** – Rocky banks, soil in grasslands. 300-1800 m. **PE06**, **PE07**, **PE16**, **PE17**, **PE18**, **PE26**, **PE27**, **PE37**, **PE38**, **PE39**, **PE48** (26). [□], ■, ■.

***Scleropodium touretii* (Brid.) L. F. Koch.** – Banks, rocks and exposed soil, tree trunks. 300-1800 m. **PE06**, **PE07**, **PE17**, **PE18**, **PE27**, **PE37**, **PE39**, **PE48**, **PE49** (19). □, ■, ■.

***Scorpiurium circinatum* (Brid.) M. Fleisch. & Loeske** – Rocky banks. Tree trunks. 600-1100 m. **PE18**, **PE27**, **PE38**, **PE49** (5). ■.

***Sphagnum angustifolium* (Russow) C.E.O. Jensen** – Permanently wet soils. 1670 m. **PE16** (2). □, □, ■.

***Sphagnum auriculatum* Schimp.** – Permanently wet soils. 800-1850 m. **PE16**, **PE17**, **PE26**, **PE27**, **PE38** (32). □, □, ■, ■.

***Sphagnum capillifolium* (Ehrh.) Hedw.** – Permanently wet soils. 1400-1900 m. **PE16**, **PE17**, **PE27** (14). [□], □, ■, ■.

***Sphagnum centrale* C.E.O. Jensen ◊** – Reported by Séneca & Daniels (1994) and Séneca (2003) from one locality but based on old herbarium material. It is considered to be an extinct species in Portugal (Sérgio *et al.,* 2001b).

***Sphagnum compactum* Lam. & DC.** – Permanently wet soils in *Nardus* grasslands. 1440-1990 m. **PE16**, **PE17**, **PE16**, **PE26** (13). □, □, ■, ■.

***Sphagnum cuspidatum* Hoffm.** – Permanently wet soils, wet granitic rocks near grasslands. 1420-1695 m. **PE16**, **PE17**, **PE27** (7). [□], □, ■. *Sphagnum viride* Flatberg is likely present in Serra da Estrela but according to Séneca (2003), it could be better included in *S. cuspidatum.*

***Sphagnum fallax* (H. Klinggr.) H. Klinggr. ◊** – Permanently wet soils. 1605 m. **PE16** (1). ■. (Sérgio *et al.*, 2003a).

***Sphagnum flexuosum* Dozy & Molk.** – Permanently wet soils, rivulet with *Ranunculus* flowing through bog. 1695-1950 m. **PE16** (6). □, ■, ■.

***Sphagnum girgensohnii* Russow ◊ PE16** (1). [■]. – Only one locality reported by Séneca & Daniels (1994) and Séneca (2003).

***Sphagnum molle* Sull. PE16** (2). ■. – Reported to Serra da Estrela by Séneca & Daniels, 1994; Séneca, 2003.

***Sphagnum palustre* L.** – Permanently wet soils, fringe of *Nardus* grasslands. 1150-1850 m. **PE16**, **PE17**, **PE26**, **PE38** (8). □, □, ■, ■.

***Sphagnum papillosum* Lindb. var. *laeve* Warnst.** – Permanently wet soils, wet granitic rocks. 1580-1695 m. **PE16** (2). □, ■.

Sphagnum platyphyllum (Lindb. ex Braithw.) Sull. ex Warnst. ○ – Collected by Levier and reported by Warnstorf (1911). Séneca (2003) has concluded that most of the herbarium material of this taxon corresponds to *Sphagnum auriculatum.*

***Sphagnum rubellum* Wilson** – Permanently wet soils. 1600-1850 m. **PE16** (2). ■.

***Sphagnum russowii* Warnst.** – Reported by Séneca & Daniels (1994), Séneca (2003). From two localities (**PE16**) [■].

***Sphagnum squarrosum* Crome** – Permanently wet soils. 1580-1695 m. **PE16**, **PE17** (3). ■, ■.

***Sphagnum subnitens* Russow & Warnst.** – Permanently wet soils in grasslands. 895-1900 m. **PE16**, **PE17**, **PE27**, **PE38** (10). □, ■.

***Sphagnum subsecundum* Nees** (including **subsp. *inundatum* (Russ.) A. Eddy**) – Wet river banks and rivulet with *Ranunculus* flowing through bog. 895-1950 m. **PE16**, **PE26**, **PE27** (6). □, ■.

***Sphagnum tenellum* (Brid.) Brid.** – Permanently wet soils in *Nardus* grasslands, wet river banks. 1430-1800 m. **PE16**, **PE17** (5). ■.

***Straminergon stramineum* (Dicks. ex Brid.) Hedenäs ◊** – Humid soil banks. 1440-1900 m. **PE16**, **PE17**, **PE26** (11). □, □, ■.
***Syntrichia laevipila* Brid.** – Tree trunks. 300-700 m. **PE06**, **PE17**, **PE27**, **PE37** (4). ■.
***Syntrichia latifolia* (Bruch ex Hartm.) Huebener** – Tree trunks, 300-700 m. **PE27**, **PE28** (2). ■.
***Syntrichia papillosa* (Wilson) Jur.** – Tree trunks. 400-500 m. **PE06** (1). ■.
***Syntrichia princeps* (De Not.) Mitt.** – Soil and rocks. 770-1285 m. **PE17**, **PE27**, **PE37**, **PE38** (5). ▪, ■. Also reported from Serra da Estrela by Greven & van Melick (1994) as *Syntrichia virescens* (De Not.) Ochyra. However, revision of the material confirms that it corresponds to this taxon.
***Syntrichia ruralis* (Hedw.) F. Weber & D. Mohr** – Soil and rocks, exposed rock outcrop. 300-1900 m. **PE06**, **PE17**, **PE18**, **PE27**, **PE28**, **PE39**, **PE48** (19). [□], □, ▪, ■.
***Syntrichia subpapillosissima* (Bizot & R. B. Pierrot) M. T. Gallego & J. Guerra** – Epiphytic. 550-600 m. **PE37** (1). ■.
Tetraphis pellucida Hedw. ○ – Only reported by Greven & van Melick (1994) without locality. [□].
***Thamnobryum alopecurum* (Hedw.) Gangulee** – Wet river banks, rocks of springs and caves. 1430-1800 m. **PE06**, **PE07**, **PE16**, **PE17**, **PE18**, **PE26**, **PE27**, **PE38**, **PE39**, **PE49** (19). ■.
***Thamnobryum maderense* (Kindb.) Hedenäs** – Entrance to caves. 400-650 m. **PE06**, **PE16** (2). ■.
***Thuidium tamariscinum* (Hedw.) Schimp.** – Shaded rocky banks. 650 m. **PE07** (1). ■.
***Timmiella barbuloides* (Brid.) Mönk.** – Rock outcrop by side of the roads (schists). 690 m. **PE27** (1). ■.
***Tortula atrovirens* (Sm.) Lindb. ●●** – Rocky banks in roadsides. 750-790 m. **PE27**, **PE39** (2). ■.
***Tortula canescens* Mont. ●●** – Banks in roadsides. 600-790 m. **PE39**, **PE49** (2). ■.
***Tortula cuneifolia* (Dicks.) Turner** – Stone walls, concrete on man-made substrata. 450-700 m. **PE07**, **PE17**, **PE49** (3). ■.
***Tortula muralis* Hedw.** – Exposed rocks, walls with some concrete. 300-1450 m. **PE06**, **PE17**, **PE27**, **PE28**, **PE39**, **PE48**, **PE49** (11). ▪, ■.
***Tortula subulata* Hedw.** – Soil and rocks. 300-1805 m. **PE06**, **PE16**, **PE17**, **PE18**, **PE27**, **PE38**, **PE39** (8). ■.
***Trichostomum brachydontium* Bruch** – Soil and rocks, banks in roadsides. 300-1805 m. **PE06**, **PE17**, **PE27**, **PE39** (7). ■.
***Warnstorfia exannulata* (Schimp.) Loeske** – Soil in bank of rivulet. 1485-1950 m. **PE16** (8). □, □, ▪, ■.
***Warnstorfia fluitans* (Hedw.) Loeske** – In water or on humid and wet soil. 1480-1900 m. **PE16**, **PE17**, **PE26** (17). □, □, ■.
***Weissia controversa* Hedw.** – Walls with soil. 400-450 m. **PE06** (1). ■.
***Zygodon rupestris* Lorentz** – Tree trunks. 300-1650 m. **PE06**, **PE07**, **PE18**, **PE27**, **PE29**, **PE37**, **PE38**, **PE39**, **PE49** (14). ■.
***Zygodon viridissimus* (Dicks.) Brid.** – Epiphytic. 1076 m. **PE38** (1). ■.

Hepatics

***Aneura pinguis* (L.) Dumort.** – Wet granitic rocks, springs and river banks. 400-1430 m. **PE06**, **PE07**, **PE17**, **PE27**, **PE49** (9). ■.
***Anthoceros caucasicus* Steph. in Woronow** – Wet and humid banks, dripping rocks. 580-1330 m. **PE16**, **PE17**, **PE26**, **PE27**, **PE28**, **PE39** (7). □, ▪, ■.
***Anthoceros punctatus* L.** – Wet and humid banks, dripping rocks. 600-1220 m. **PE16**, **PE17**, **PE27**, **PE38**, **PE39**, **PE49** (9). ■.
***Asterella africana* (Mont.) A. Evans ◊** – River bank. 400-450 m. **PE06** (1). ■.
***Barbilophozia barbata* (Schmidel ex Schreb.) Loeske** – Shaded rock crevices. (Allorge, 1950). **PE27** (1). □. The only report from this locality (Manteigas, material in PC) is hereby confirmed.
***Barbilophozia floerkei* (F. Weber & D. Mohr) Loeske ◊** – Wet shaded banks and rock crevices with humus. 1000-1900 m. **PE16**, **PE27** (7). ■.
***Barbilophozia hatcheri* (A. Evans) Loeske** – Rock fissures, with fine humus soil. 1100-1890 m. **PE16**, **PE26**, **PE27** (18). □, ▪, ■.
***Barbilophozia lycopodioides* (Wallr.) Loeske ◊** – Wet shaded rocks. 1100-1890 m. **PE16** (2). ■.
***Calypogeia arguta* Nees & Mont. ●** – Shaded rivulets, caves and humid soil banks. 300-1300 m. **PE06**, **PE18**, **PE17**, **PE27** (5). ■.
***Calypogeia azurea* Stotler & Crotz** – Caves and deep crevices among granite blocks, humid soil banks. 700-1800 m. **PE16**, **PE17**, **PE27**, **PE38** (8). ■.
***Calypogeia fissa* (L.) Raddi** – Soil banks, wet grassland. 400-1870 m. **PE06**, **PE16**, **PE17**, **PE26**, **PE27**, **PE38**, **PE48** (17). □, ▪, ■.
***Calypogeia muelleriana* (Schiffn.) Müll. Frib.** – Moist soil in *Sphagnum* grasslands. 1440-1870 m. **PE16**, **PE17** (4). ■.
***Calypogeia sphagnicola* (Arnell & J. Perss.) Warnst. & Loeske ●** – Wet soil banks. 1100-1850 m. **PE16**, **PE38** (2). ■.

***Cephalozia bicuspidata* (L.) Dumort.** (Include also the subsp. *lammersiana* (Huebener) R. M. Schust.). (**PE16**) – Soil and rock banks in heathlands. 770-1870 m. **PE16**, **PE17**, **PE18**, **PE26**, **PE27** (13). □, ■, ■.

***Cephalozia connivens* (Dicks.) Lindb.** ●● – Soil with *Sphagnum.* 1440 m. **PE17** (1). ■.

Cephaloziella baumgartneri Schiffn. – **PE27** [□]. Reported from one locality only, Manteigas (Allorge, 1974).

***Cephaloziella divaricata* (Sm.) Schiffn.** – Soil and rock banks and fissures, rarely tree trunks. 550-1900 m. **PE06**, **PE16**, **PE17**, **PE18**, **PE26**, **PE27**, **PE28**, **PE37**, **PE38**, **PE39**, **PE38**, **PE39** (41). □, ■, ■.

***Cephaloziella elachista* (J.B. Jack ex Gottsche & Rabenh.) Schiffn.** ◊ **–** Soil with *Sphagnum*. 1400-1850 m. **PE16**, **PE17**, **PE27** (3). ■.

***Cephaloziella rubella* (Nees) Warnst.** – Soil in rock fissures. 925-1500 m. **PE27**, **PE39** (2). ■. Only sterile material.

***Cephaloziella stellulifera* (Taylor ex Spruce) Schiffn.** – Soil with *Sphagnum*, turf in rock fissures and tree trunks. 760-1590 m. **PE06**, **PE16**, **PE27**, **PE38**, **PE39** (6). ■.

***Cephaloziella turneri* (Hook.) Müll. Frib.** – Soil and rock banks in shaded places. 400-1900 m. **PE06**, **PE16**, **PE17**, **PE18**, **PE26**, **PE27**, **PE37**, **PE38**, **PE48** (26). □, ■, ■.

***Chiloscyphus pallescens* (Ehrh. ex Hoffm.) Dumort.** ● – Dripping cliff and springs. 1835-1950 m. **PE16** (1). ■.

***Chiloscyphus polyanthos* (L.) Corda** – River banks and wet rocks. 550-1950 m. **PE06**, **PE07**, **PE16**, **PE18**, **PE26**, **PE27**, **PE37** (10). □.

***Conocephalum conicum* (L.) Dumort.** – Humid soil and rocks, rivers banks and springs. 300-1050 m. **PE06**, **PE07**, **PE17**, **PE27**, **PE39**, **PE38** (9). □, ■, ■.

***Corsinia coriandrina* (Spreng.) Lindb.** – Banks in roadsides or tracks and rocky slopes. 450-1120 m. **PE06**, **PE27**, **PE39** (3). ■.

***Diplophyllum albicans* (L.) Dumort.** – Soil banks in roadsides, in shade cliffs. 300-1850 m. **PE06**, **PE16**, **PE17**, **PE18**, **PE27** (39). □, ■, ■.

Diphophyllum obtusifolium (Hook.) Dumort. ○ – Only reported in phytosociological relevés (Jansen, 1998), to be considered as an uncertain species.

***Diplophyllum taxifolium* (Wahlenb.) Dumort.** ◊ – Rocky slopes or peaty banks. 1750-1890 m. **PE16** (4). ■.

***Douinia ovata* (Dicks.) H. Buch** – Soil and rock banks, shaded granite blocks. **PE16**, **PE17**, **PE26**, **PE27**, **PE38** (8). □, ■, ■.

***Fossombronia angulosa* (Dicks.) Raddi** – Banks in roadsides and rocky wet slopes or walls. 300-1400 m. **PE06**, **PE16**, **PE17**, **PE18**, **PE26**, **PE27**, **PE39**, **PE48**, **PE49** (11). [□], ■, ■.

***Fossombronia husnotii* Corb.** – Banks in roadsides and walls. 400-790 m. **PE06**, **PE39** (2). ■.

***Fossombronia pusilla* (L.) Nees** – Banks and soil with ephemeral vegetation. 450-1830 m. **PE06**, **PE16** (2). ■.

***Fossombronia wondraczekii* (Corda) Lindb.** – Banks and open grasslands. 500-1050 m. **PE37**, **PE38** (2). ■.

Frullania azorica* Sim-Sim *et al. ◊ – Only one record to Serra da Estrela without locality. This species is certainly an extinct species (Sérgio *& al.,* 2001b).

***Frullania dilatata* (L.) Dumort.** – Epiphytic and in shaded or exposed rocks. 400-1500 m. **PE06**, **PE07**, **PE16**, **PE17**, **PE18**, **PE26**, **PE27**, **PE28**, **PE37**, **PE38**, **PE39**, **PE49** (36). □, ■, ■.

Frullania fragilifolia* (Taylor) Gottsche *et al. – Shaded rocks and tree trunks or in dead wood. 400-1500 m. **PE06**, **PE16**, **PE17**, **PE27** (7). □, ■, ■.

***Frullania tamarisci* (L.) Dumort.** – Wet rocks and tree trunks in shaded sites. 300-1600 m. **PE06**, **PE07**, **PE17**, **PE27**, **PE37**, **PE38**, **PE39** (11). □, ■, ■.

Frullania tamarisci* var. *mediterranea* (De Not.) Nees in Gottsche *et al. – Epiphytic on *Viburnum*. 400-450 m. **PE06** (1). ■.

***Frullania tamarisci* var. *sardoa* De Not.** – Shaded granite rocks. 700-800 m. **PE06**, **PE17** (2). □, ■.

***Gongylanthus ericetorum* (Raddi) Nees** – Banks in roadsides and rocky wet slopes. 400-970 m. **PE06**, **PE27**, **PE37** (3). [□], ■.

***Gymnocolea inflata* (Huds.) Dumort.** – Soil with *Sphagnum*, on dripping rocks. 1440-1900 m. **PE16**, **PE17** (8). ■, ■.

***Jungermannia gracillima* Sm.** – Soil with *Sphagnum* on dripping rocks, banks of flows. 550-1900 m. **PE06**, **PE16**, **PE17**, **PE26**, **PE27**, **PE37** (24). □, □, ■, ■.

***Jungermannia hyalina* Lyell** – Soil near streams, loamy and clay banks. 540-1870 m. **PE16**, **PE17**, **PE26**, **PE48** (5). □, ■, ■.

***Jungermannia pumila* With.** ● – Soil bank in moist place. 300-320 m. **PE06** (1). ■.

***Jungermannia sphaerocarpa* Hook.** – Soil with *Sphagnum* and wet banks. 550-1950 m. **PE16**, **PE17**, **PE26**, **PE27**, **PE37** (12). □, □, ■, ■.

***Lejeunea* aff. *eckloniana* Lindenb.** ● – Shaded banks of stream. 400-450 m. **PE06** (1). ■.

***Lejeunea cavifolia* (Ehrh.) Lindb.** – Trees, shaded banks rocks and walls. 435-1310 m. **PE06**, **PE07**, **PE15**, **PE27**, **PE49** (6). ■.

***Lejeunea lamacerina* (Steph.) Schiffn. ●●** – Shaded cave and epiphyllous on *Thamnobryum maderense.* 650 m. **PE16** (1). ■.

***Lophocolea bidentata* (L.) Dumort.** – Slowly dripping water, in shade of cliff, tree trunks. 300-1950 m. **PE06**, **PE07**, **PE16**, **PE17**, **PE18**, **PE27**, **PE28**, **PE38**, **PE39**, **PE49** (27). [□], □, ▪, ■.

***Lophocolea heterophylla* (Schrad.) Dumort. ●●** – Soil in shade of *Sorbus aucuparia*. 1370 m. **PE26** (1). ■.

***Lophozia bicrenata* (Schmidel ex Hoffm.) Dumort.** – Granitic rocks, soil banks. 770-1900 m. **PE16**, **PE17**, **PE18**, **PE26**, **PE27**, **PE37** (12). □, ■.

***Lophozia excisa* (Dicks.) Dumort. ●●** – Soil of small slope with rocks. 1640 m. **PE16** (1). ■.

***Lophozia longiflora* (Nees) Schiffn. ●●** – Banks of flows and soil near streams. 1650-1850 m. **PE16** (4). ■.

***Lophozia sudetica* (Nees ex Huebener) Grolle ◊** – Wet fissures and rock-faces and boulders. 1620-1900 m. **PE16** (7). [□], ■.

***Lophozia ventricosa* (Dicks.) Dumort.** – Soil among granite rocks, soil banks slowly dripping. 650-1880 m. **PE07**, **PE16**, **PE17**, **PE26**, **PE27** (10). ■.

***Lophozia wenzelii* (Nees) Steph. ◊** – Shaded granitic rock, rock fissures with soil and gravel and humus. 1650-1900 m. **PE16** (9). □, ■.

***Lunularia cruciata* (L.) Lindb.** – Trampled soil and deep crevices, in base of walls, banks of streams and rivers. 300-1185 m. **PE06**, **PE16**, **PE17**, **PE27**, **PE39**, **PE48** (17). □, ▪, ■.

***Mannia androgyna* (L.) A. Evans** – Rock crevices, walls. 400-450 m. **PE06** (1). ■.

***Marchantia polymorpha* L.** – Granitic rocks and banks of rivers and canals. 550-1310 m. **PE07**, **PE17**, **PE26**, **PE27**, **PE39**, **PE49** (10). □, □, ▪, ■.

***Marchantia polymorpha* subsp. *ruderalis* Bischl. et Boisselier ◊ –** Granitic rocks and soil. 700-800 m. **PE07**, **PE17** (2). □, □. The specimen reported as *M. paleaceae* (Serra da Estrela, *leg.* R. da Cunha, 1881, LISU!) corresponds to *M. polymorpha* subsp. *ruderalis*.

***Marsupella adusta* (Nees emend. Limpr.) Spruce ◊** – Small rock crevices and soil formed by decomposition of granite. 1380-1900 m. **PE16**, **PE17** (2). ■.

Marsupella alpina (Gottsche ex Husn.) Bernet. ○ – Only recorded by Müller without locality or date (see Sérgio & Carvalho, 2003). So, not being supported by herbarium specimens is to be considered an uncertain species.

***Marsupella emarginata* (Ehrh.) Dumort.** – Soil covered rocks, rock walls and rocky wet slopes, rarely tree trunks. 300-1950 m. **PE06**, **PE17**, **PE18**, **PE26**, **PE27**, **PE37**, **PE38**, **PE48** (54). □, □, ▪, ■.

***Marsupella funckii* (F. Weber & D. Mohr) Dumort.** – Rock cervices, dry exposed soil. 800-1900 m. **PE16**, **PE17**, **PE26**, **PE27** (15). □, ▪, ■.

***Marsupella profunda* Lindb. HD** – Gravel of decomposed granite rocks, banks in roadsides and rock-crevices. 300-1900 m. **PE06**, **PE16**, **PE17**, **PE27**, **PE37** (7). ■.

***Marsupella sphacelata* (Gieseke ex Lindenb.) Dumort.** – Granitic rocks, dripping cliff with humid rock crevices and wet soil. 670-1991 m. **PE16**, **PE17**, **PE26**, **PE27**, **PE37** (23). □, □, ▪, ■.

***Marsupella sprucei* (Limpr.) Bernet ◊** – Soil in granitic rock crevices. 1140-1800 m. **PE16**, **PE17**, **PE27** (3). ■.

***Metzgeria furcata* (L.) Dumort.** – Tree trunks, granitic shaded rocks. 400-1550 m. **PE06**, **PE07**, **PE17**, **PE26**, **PE27**, **PE39** (10). □, ▪, ■.

***Nardia scalaris* Gray** – River banks and wet soil. 710-1550 m. **PE16**, **PE17**, **PE27** (10). ▪, ■.

***Oxymitra incrassata* (Brot.) Sérgio & Sim-Sim** – Dry exposed banks. 450 m. **PE06** (1). ■.

***Pallavicinia lyellii* (Hook.) Carruth.** – Wet rock in a cave. 1850 m. **PE16** (1). ■.

Pellia endiviifolia (Dicks.) Dumort. ○ – The only record to Serra da Estrela not being supported by herbarium specimens is to be considered uncertain in this area.

***Pellia epiphylla* (L.) Corda** – Banks in rivers, waterfalls, cascades, in slowly dripping water. 300-1850 m. **PE06**, **PE07**, **PE16**, **PE17**, **PE18**, **PE26**, **PE27**, **PE38**, **PE39**, **PE48** (23). □, ▪, ■.

***Pellia neesiana* (Gottsche) Limpr. ●●** – Banks in rivers and small rivulets in grasslands. 770-1950 m. **PE16**, **PE18** (2). ■.

***Phaeoceros bulbiculosus* (Brot.) Prosk.** – Shaded banks. 300-450 m. **PE06** (2). ■.

***Phaeoceros laevis* (L.) Prosk. ●** – Banks in rivers. 300-1050 m. **PE16**, **PE18**, **PE27**, **PE39** (4). ■.

***Phaeoceros laevis* subsp. *carolinianus* (Michx.) Prosk. ●** – Banks of *Alnus glutinosa* gallery. 300-450 m. **PE06** (1). ■.

***Plagiochasma rupestre* (J. R. Forst. & G. Forst.) Steph.** – Banks in roadsides. 450 m. **PE06** (1). ■.

Plagiochila asplenioides (L. emend. Taylor) Dumort. ○ – Reported by Machado (1925). All these reports are considered to be erroneous and belong to *P. porelloides* (Sim-Sim *et al.*, 2004b).

***Plagiochila porelloides* (Torrey ex Nees) Lindenb.** – Wet rocks, shaded rock crevices, in banks, walls and in wooded soil. 650-1950 m. **PE07**, **PE16**, **PE17**, **PE18**, **PE27**, **PE38**, **PE39** (13). ▪, ■.

***Porella cordaeana* (Huebener) Moore** – Rocky banks and deep crevices among granite blocks, shaded humid rocks and slowly dripping water. 750-1950 m. **PE16**, **PE26**, **PE27**, **PE37**, **PE39**, **PE49** (13). □, ▪, ■.

***Porella obtusata* (Taylor) Trevis.** – Shaded rocks, wet banks, wet shaded stone, tree trunks. 400-900 m. **PE06**, **PE07**, **PE27**, **PE37**, **PE38**, **PE39** (7). ■.

Porella platyphylla (L.) Pfeiff. ○ – Only reported by Greven & van Melick (1994) without locality. [□].

***Radula complanata* (L.) Dumort.** – Rock banks, tree trunks. 400-780 m. **PE06**, **PE07**, **PE28** (3). [□], ■.

***Radula lindenbergiana* Gottsche ex C. Hartm.** – Epiphytic and shaded rocks. 400-650 m. **PE06**, **PE49** (2). ■.

***Reboulia hemisphaerica* (L.) Raddi** – Rocky banks, shaded rocks and soil. 300-1500 m. **PE06**, **PE07**, **PE16**, **PE18**, **PE26**, **PE27**, **PE38**, **PE39**, **PE49** (21). [□], ■, ■.

***Riccardia multifida* (L.) S. Gray** ● – Wet granite rock. **PE17** (1). ■.

***Riccia beyrichiana* Hampe ex Lehm.** – Soil in rocks crevices. 580 m. **PE28** (1). ■.

***Riccia bifurca* Hoffm.** ●● – Base of wall. 700 m. **PE17**. (1). ■.

***Riccia ciliifera* Link ex Lindenb** – Soil among rocks, on small slope with boulders. 960-1640 m. **PE16**, **PE27**, **PE38** (3). ■.

***Riccia gougetiana* Durieu & Mont.** ● – Soil. 1120 m. **PE27** (1). ■.

***Riccia michelii* Raddi** – Soil in base of walls. 400-450 m. **PE06** (1). ■.

***Riccia nigrella* DC.** – Banks in roadsides, walls. 400-790 m. **PE06**, **PE39** (2). ■.

***Riccia sorocarpa* Bisch.** ●● – Soil among rocks. 960-970 m. **PE27** (1). ■.

***Riccia warnstorfii* Limpr. ex Warnst.** ●● – Base of walls. 400-450 m. **PE06** (1). ■.

***Saccogyna viticulosa* (L.) Dumort.** – Shaded rocks and wet soil banks. 400-450 m. **PE06** (1). ■.

***Scapania compacta* (A. Roth) Dumort.** – Rocky banks, rock crevices, banks by rivers. 300-1900 m. **PE06**, **PE16**, **PE17**, **PE25**, **PE26**, **PE27**, **PE28**, **PE37**, **PE38**, **PE48**, **PE49** (43). □, ■, ■.

***Scapania curta* (Mart.) Dumort.** – Rock crevices, soil, banks. 1590-1860 m. **PE16**, **PE26** (6). ■.

Scapania gracilis Lindb. ○ – Only recorded by Machado (1925) without locality of Serra da Estrela. So, not being supported by herbarium specimens is to be considered an uncertain species in Serra da Estrela.

***Scapania scandica* (Arnell et H. Buch) Macvicar ◊ –** Shaded rocks, small rock crevices (Sérgio *et al.*, 2004a). 1600-1900 m. **PE16** (2). ■.

***Scapania subalpina* (Nees ex Lindenb.) Dumort.** – Shaded wet rocks, rock crevices. 550-1950 m. **PE16**, **PE17**, **PE26**, **PE27**, **PE37** (20). [□], □, ■, ■.

***Scapania undulata* (L.) Dumort.** – Shaded wet rocks, rocks in water, rarely tree trunks. 550-1990 m. **PE06**, **PE16**, **PE17**, **PE26**, **PE27**, **PE37**, **PE38** (45). □, □, ■, ■.

***Sphaerocarpos texanus* Austin** – Arable soil. 600-700 m. **PE17**, **PE49** (2). ■, ■.

***Targionia hypophylla* L.** – Walls, soil and dry rocks. 600-800 m. **PE06**, **PE16**, **PE17**, **PE18**, **PE27**, **PE39**, **PE49** (9). ■, ■.

***Targionia lorbeeriana* Müll. Frib.** – Walls and banks in roadsides. 400-650 m. **PE06**, **PE16** (2). ■.

***Tritomaria quinquedentata* (Huds.) H. Buch** – Banks on soil, shaded wet rocks, rarely tree trunks. 400-1820 m. **PE06**, **PE17**, **PE26**, **PE27**, **PE39** (7). ■, ■.