

The bryophyte flora of the Montseny massif (northeastern Iberian Peninsula): conservation issues and an updated check-list

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*On the occasion of the 10th anniversary of the death of Dr. Creu Casas,
the authors present this study in appreciation of her outstanding contribution
to the knowledge of the Bryophyte flora of the Iberian Peninsula.
She began her scientific career studying the bryoflora of the Montseny massif*

Abstract – An annotated check-list of the bryophytes of the Montseny massif (northeastern Iberian Peninsula) is presented, based on literature and herbarium records revision as well as collections made by the authors. A total of 352 taxa were recorded, out of which three were hornworts, 80 liverworts and 269 mosses. Intensive surveys of original locations of threatened, extinct and protected species in the massif were carried out. Species whose local populations became extinct were those with a strong preference for wet and oligotrophic habitats, such habitats have been severely damaged in recent decades. We discuss possible strategies for effective conservation of those bryophytes whose local population have suffered a decline, like targeted legislation and establishing specific protected areas.

Biodiversity / conservation / hornworts / liverworts / mosses / Mediterranean

INTRODUCTION

The Montseny massif is located in the northeastern Iberian Peninsula, Catalonia, Spain, 41°43'-41°51'N latitude, 2°14'-2°33'E longitude. This isolated mountain near the Mediterranean coastline has historically attracted scientists and naturalists because of its diverse habitats, altitudinal range (from 200 m to 1706 m a.s.l.) and proximity to the city of Barcelona (50-60 km to the north, on present-day roads). Bryophyte records for the massif from the late 19th century consist of a few

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collections by P.A. Pourrett and J. Texidor (Colmeiro, 1889). In his compilation on bryophytes of the Iberian Peninsula Casares Gil (1915) includes 39 species. Later, P. and V. Allorge collected 76 bryophyte species during a 3-day foray (Allorge & Allorge, 1946). The first thorough exploration of the mountain was carried out by Casas Sicart (1959, 1960) as part of her doctoral thesis, resulting in a list of 315 taxa that showcased the remarkable bryophyte diversity of the Montseny massif. Subsequently, Casas (1986) produced an updated catalogue of 311 taxa, providing detailed information from the bryological surveys carried out in the massif. Since that last catalogue of bryophytes of Montseny, several floristic novelties have been published. Also, rather important ecological changes have taken place in the mountain that may have affected populations of rare bryophytes, especially those associated with Montseny's fragile hydromorphic habitats that were already highlighted by Casas i Sicart (1999). We are now at a juncture where such impacts can be better assessed. All relevant information related to bryophyte occurrences in the massif and their respective habitats have been revised in order to: 1) update the catalogue of bryophytes of Montseny, 2) study the importance of the massif in the conservation of particularly vulnerable bryophyte species, and 3) analyse possible changes in the bryophyte flora of the massif, focusing on the local extinction of some species.

MATERIAL AND METHODS

Study area

The c. 355 km² of the Montseny massif considered in this study (Fig. 1) falls for the most part within the boundaries of the Natural Park that bears its name, which was created in 1977. Montseny Natural Park became a UNESCO Man and Biosphere (MaB) Programme Reserve in 1978. It includes the Turó de l'Home summit, the highest elevation in the northeastern Iberian Peninsula's Pre-littoral range that runs parallel to the Mediterranean coast. The massif is mostly siliceous throughout (granites and schists) except for some limestone intrusions in its westernmost end (Sáez *et al.*, 2017). The Montseny massif is situated between two macrobioclimates: the Mediterranean and the Temperate (Rivas-Martínez, 1996, Rivas-Martínez *et al.*, 2004). The annual precipitation amount in the studied area is 651-1217.5 mm (maximum in Santa Fe, at 1100 m a.s.l., and minimum in Seva at 660 m) (Bolòs, 1983). Mean annual temperatures are between 6.5°C in Turó de l'Home (at 1706 m a.s.l.) and 15.1°C in la Garriga (at 248 m a.s.l.) (Bolòs, 1983, Climate-Data.org, 2017). In the massif is well represented the Mediterranean vegetation, as well as the medio-European and the Boreo-Alpine (Bolòs, 1983, Sáez *et al.*, 2017). Plant cover consists mainly of *Quercus ilex* L. forests with a fair presence of *Q. suber* L. Also common are forests dominated by *Q. pubescens* Sw. and *Q. petraea* (Matt.) Liebl., as well as large forest stands dominated by *Fagus sylvatica* L. that contain small but dense, practically monospecific patches of *Abies alba* Mill. Mountain tops are covered either by prostrate mats of *Juniperus communis* subsp. *nana* Syme or by herbaceous subalpine vegetation (Sáez *et al.*, 2017).

Three well-defined sectors can be recognised: E sector, made of the Turó de l'Home and Les Agudes summits (the former, at 1706 m a.s.l., is the highest elevation in the massif); NW sector, consisting of the Matagalls sub-massif (summit at 1697 m); and SW sector, including Pla de la Calma and Puig Drau (1344 m). The E sector was given special attention as it contains various key habitats, including the

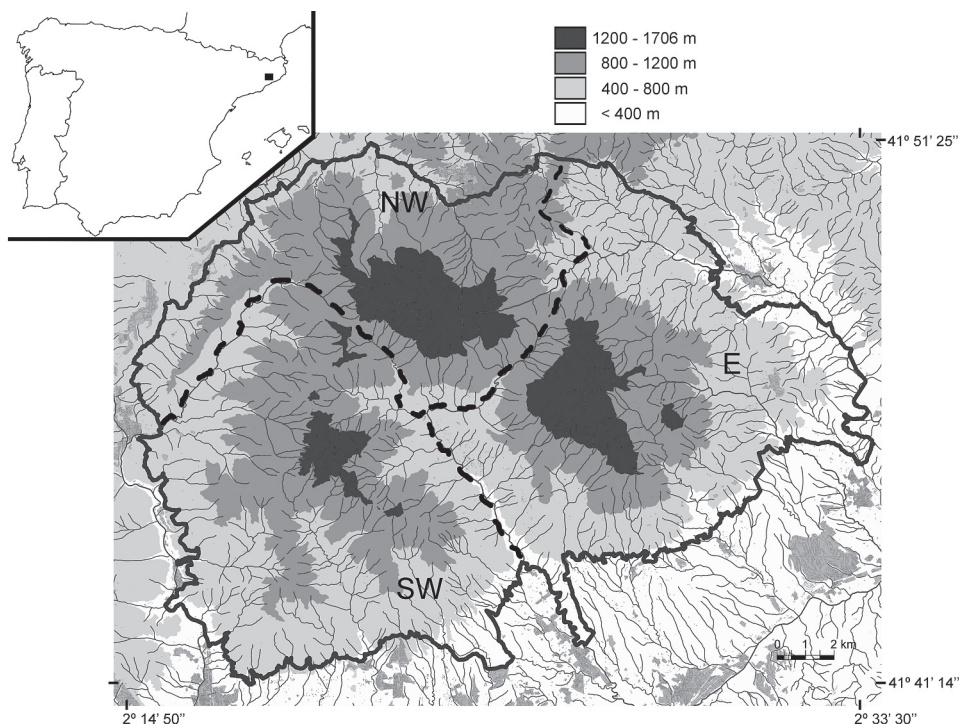


Fig. 1. Map of the Montseny massif divided in its main three geographic sectors (E = Turó de l'Home and Les Agudes, NW = Matagalls, SW = Pla de la Calma and Puig Drau). In the upper left corner the situation of Montseny massif in the northeastern Iberian Peninsula is shown.

ca 12 ha fir (*Abies alba*) stand of Passavets (ca 41°46.4'N 2°26.4'E), and the quasi-permanently flooded areas (hydromorphic soil habitats) of Santa Fe (ca 41°46.3'N 2°27.5'E). Due to their relative uniqueness, these two sites have attracted most attention from botanists, but also from visitors, making bryophyte populations that dwell in the Santa Fe hydromorphic habitats particularly vulnerable. Most of the local extinctions and threatened species come from these localities (Casas i Sicart, 1999) so we thoroughly surveyed these and other sites throughout Montseny known to harbour hydromorphic habitats.

Conservation and threats

In order to determine the current status of the most threatened species in the massif, including those that in her review Casas i Sicart (1999) regarded as disappeared and those that are now under some kind of legal protection, we conducted twelve surveys between April 2011 and July 2017. In these surveys we focused on species that 1) were considered threatened or regionally extinct in the massif and had at least one record with an acceptably reliable and precise georeference, or 2) were under strict protection by at least one of the following pieces of European, Spanish or Catalan regional legislation, respectively:

HD-II: Annex II in Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.

HD-V: Annex V in Directive 92/43/EEC of 21 May 1992.

CEEA: *Real Decreto 139/2011, de 4 de febrero para el desarrollo del Listado de Especies Silvestres en Régimen de Protección Especial y del Catálogo Español de Especies Amenazadas. Boletín Oficial de España B.O.E. 46, 23 February 2011, pp. 20912-20951.* [Spanish Catalogue of Threatened Species (CEEA, in Spanish).]

PEIN: *Pla d'Espais d'Interès Natural de Catalunya) Decret 328/1992 (D.O.G.C. 1714 1 March 1993), modified by Decree 172/2008, de 26 d'agost, de creació del Catàleg de flora amenaçada de Catalunya (D.O.G.C. 5204 – 28.8.2008), pp. 65881-65895.* [Plan for Interesting Natural Areas in Catalonia (PEIN in Catalan)].

PEM: *Edicte de 21 de gener de 2009, sobre una resolució del conseller de Política Territorial i Obres Públiques referent al Pla especial de protecció del medi natural i del paisatge del Parc del Montseny. (D.O.G.C. 5308 30 January 2009), pp. 6583-6683.* [Special Plan for protection of the environment and landscape in Montseny Natural Park (PEM in Catalan)].

Sixteen species satisfied these conditions (Table 1). These taxa were searched for exhaustively and monitored at greater detail by surveying sites where any of them had been recorded historically. Such sites include those with hydromorphic habitats around Santa Fe (E sector) and Pla de la Calma (SW sector) as well as the *Abies alba* stand of Passavets (E sector). Specific historical and current information was gathered for each species in the Montseny massif: 1) year of the last confirmed record, 2) number of historical localities, 3) number of localities at present and 4) current cover area. This information is summarized in Table 1, where 1) and 2) were sourced from Casas (1986), Casas *et al.* (1989), García-Pausas & Canalis (1992) and Casas i Sicart (1999), so historical local occurrences can be contrasted with those resulting from our surveys.

Bryophyte catalogue

The basis for the catalogue is all published literature on bryophytes from the Montseny massif in addition to herbarium material revision (mainly from BCB, for some records also MA and PC). Nomenclature follows Söderström *et al.* (2016) for liverworts and hornworts, and Ros *et al.* (2013) for mosses, updated by Müller (2014) and Lara *et al.* (2016) for *Bartramia aprica* Müll. Hal. and the genus *Lewinskya* F. Lara, Garilleti & Goffinet, respectively. Taxa are arranged alphabetically within each phylum: hornworts, liverworts and mosses. Names of accepted taxa are shown in bold face. Those in plain italics correspond to taxa that should be excluded from the Montseny flora. Names preceded by an asterisk (*) correspond to the 16 target taxa (in Table 1) that were closely monitored. For each accepted taxon we provide information on: 1) Distribution within the Montseny massif, specifying the geographic sector (Fig. 1) where recorded from; 2) Altitudinal range in the studied area; 3) The 10×10 km square(s) in the UTM grid (31T zone) where recorded from; 4) Literature references and/or herbarium specimen for the whole territory studied (herbarium specimens are provided when no literature records exist for some of the three sectors); 5) Estimated abundance following the Rams *et al.* (2014) scale: very rare (present only in one locality), rare (present in 2-10 localities), frequent (present in 11-25 localities), common (present in 26-50 localities), and very common (present in more than 50 localities). For those taxa that are new to the studied area, data are provided for: locality, year of collection [“s.d.” if unknown], collector and herbarium number of specimen.

RESULTS

Checklist

In the present checklist a total of 352 taxa are recognized: three hornworts, 80 liverworts and 269 mosses. Comparatively, Casas (1986) listed 311 species of bryophytes: three hornworts, 73 liverworts and 235 mosses. Considering also the records published after the Casas's work and the exclusions we propose, this catalogue represents a net increase of 41 taxa, of which 28 are here regarded as novelties for the study area.

ANTHOCEROTOPHYTA

Anthoceros punctatus L.

E, NW. 325-925 m. DG42, 52. Casas Sicart (1960), Casas (1986). Rare.

Phaeoceros laevis (L.) Prosk.

E. 300-500 m. DG51, 52. Casas Sicart (1960), Casas (1986). Rare.

Phymatoceros bulbiculosus (Brot.) Stotler, W.T. Doyle & Crand.-Stotl.

E, SW. 300-1140 m. DG42, 51. Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1996). Rare.

MARCHANTIOPHYTA

Aneura pinguis (L.) Dumort.

E. 1000 m. DG52. Allorge & Allorge (1946), Casas Sicart (1960), Panareda i Clopès *et al.* (1981), Casas *et al.* (1985a), Casas (1986). Very rare.

Barbilophozia barbata (Schmidel *ex* Schreb.) Loeske

E, NW, SW. 300-1200 m. DG32, 42, 51. Casas Sicart (1959, 1960), Casas (1986). Rare.

Barbilophozia hatcheri (A. Evans) Loeske

SW. 1140 m. DG42. Casas Sicart (1960, 1999), Casas (1986). Very rare.

Bazzania flaccida (Dumort.) Grolle

E. 900-1200 m. DG52. Casas *et al.* (1996), Casas i Sicart (1999). Rare.

Bazzania tricrenata (Wahlenb.) Lindb.

Reported from Santa Fe de Montseny and Turó de Morou (E sector) by Casas Sicart (1959, 1960) and Casas (1986), the voucher specimens on which reports were based (BCB27304 and BCB27305) belong to *B. flaccida*.

Blepharostoma trichophyllum (L.) Dumort.

E. 1200 m. DG52. Casas Sicart (1960), Casas (1986), Casas i Sicart (1999). Very rare.

Calypogeia azurea Stotler & Crotz

The report from E sector (Breda, font Nova) by Barnola (1919) is not supported by herbarium material and there is no evidence of *C. azurea* occurrence in the studied area.

***Calypogeia fissa* (L.) Raddi**

E, SW. 300-1250 m. DG32, 42, 51, 52. Casares Gil (1915), Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1998). Frequent.

****Calypogeia muelleriana* (Shiffn.) Müll. Frib.**

SW. 1280 m. DG42. García-Pausas & Canalis (1992). Very rare. Three surveys between 2011 and 2017 failed to reveal any specimen, thus can now be regarded as regionally extinct from Montseny.

***Cephalozia bicuspidata* (L.) Dumort.**

E. 450 m. DG51. Casas Sicart (1959, 1960), Casas (1986). Very rare.

***Cephaloziella baumgartneri* Schifffn.**

E. 325 m. DG51. Casas Sicart (1960), Casas (1986). Very rare.

***Cephaloziella calyculata* (Durieu & Mont.) Müll. Frib.**

E. 325 m. DG51. Casas Sicart (1960), Casas (1986), Casas i Sicart (1999). Very rare.

***Cephaloziella divaricata* (Sm.) Schifffn.**

E, NW, SW. 400-1480 m. DG32, 42, 43, 51, 52. Casas Sicart (1959, 1960), Casas (1986). Frequent.

***Cephaloziella hampeana* (Nees) Schifffn. ex Loeske**

Reports of this species from Arbucies (E sector), Campins (E sector) and Sant Marçal (NW sector) by Casas Sicart (1960) are not supported by herbarium material and there is no evidence of this species in the studied area.

***Cephaloziella turneri* (Hook.) Müll. Frib.**

E, SW. 300-500 m. DG42, 51, 52. Casas Sicart (1959, 1960), Casas (1986). Rare

***Chiloscyphus polyanthos* (L.) Corda**

E, SW. 400-1200 m. DG42, 51, 52. Allorge (1929), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1998), BCB1312, BCB29590. Frequent.

***Cololejeunea rossettiana* (C. Massal.) Schifffn.**

E. 400-500 m. DG52, 53. Casas (1986), Calleja *et al.* (2014). Rare.

***Conocephalum conicum* (L.) Dumort.**

E, NW, SW. 200-950 m. DG41, 43, 52, 62. Barnola (1916, 1919), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Panareda i Clopès *et al.* (1981), Casas (1986), Casas *et al.* (1998), Casas i Sicart (1993). Frequent.

***Conocephalum salebrosum* Szweyk., Buczk. & Odrzyk.**

E. 700-975 m. DG52. Cros & Buczkowska (2009). Very rare.

***Corsinia coriandrina* (Spreng.) Lindb.**

SW. 500 m. DG32. Casas Sicart (1960), Casas (1986). Very rare.

***Diplophyllum albicans* (L.) Dumort.**

E, NW. 1200 m. DG42, 52. Casares Gil (1915), Allorge (1929), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986). Rare.

***Fossombronia angulosa* (Dicks.) Raddi**

E, NW, SW. 400 m. DG32, 42, 51, 52. Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986). Rare.

Fossombronia caespitiformis* (Raddi) De Not. ex Rabenh. subsp. *caespitiformis

NW. 400-900 m. DG42. Casas Sicart (1959, 1960), Casas (1986). Rare.

***Fossombronia caespitiformis* subsp. *multispira* (Schiffn.) J.R. Bray & Cargill**

E. 550 m. DG51. Casas Sicart (1959, 1960), Casas (1986). Very rare.

***Fossombronia pusilla* (L.) Nees**

E. 350 m. DG51. New for Montseny massif (Campins, 1951, *C. Casas s.n.*, BCB16230). Very rare.

***Fossombronia wondraczekii* (Corda) Dumort. ex Lindb.**

E. 1000 m. DG52. Casas *et al.* (1985b), Casas (1986). Very rare.

***Frullania dilatata* (L.) Dumort.**

E, NW, SW. 200-1550 m. DG32, 41, 42, 43, 51, 52, 62. Barnola (1918, 1919), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas *et al.* (1985a), Casas (1986), Calleja *et al.* (2001). Very common.

***Frullania fragilifolia* (Taylor) Gottsche, Lindenb. & Nees**

E. 1100 m. DG52. Casas *et al.* (1985b), Casas (1986), Casas *et al.* (1996), Casas i Sicart (1999). Very rare.

***Frullania microphylla* (Gottsche) Pearson**

Reported from eastern Montseny by Casas *et al.* (1996), the voucher specimen (Turó de Morou, sobre Riells, La Grapissa, BCB27581) belongs to *F. tamarisci*.

***Frullania tamarisci* (L.) Dumort.**

E, NW, SW. 250-1200 m. DG31, 32, 42, 51, 52. Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Lloret (1986), Calleja *et al.* (2001, 2014). Common.

***Gongylanthus ericetorum* (Raddi) Nees**

E. 450 m. DG51. Casas Sicart (1959, 1960), Casas (1986). Very rare.

***Gymnomitrium alpinum* (Gottsche ex Husn.) Schiffn.**

Reported from Santa Fe de Montseny (E sector) and Sant Marçal (NW sector) by Casas (1986). The voucher specimens (BCB17174, BCB17189 and BCB17177) belong to *Marsupella funckii*.

Isopaches bicrenatus (Schmidel ex Hoffm.) H. Buch

A report from Mosqueroles (E sector) by Casas Sicart (1960) is not supported by herbarium material and there is no evidence of this species in the studied area.

Jungermannia atrovirens Dumort.

E, NW. 300-1100 m. DG42, 51. Casas Sicart (1959, 1960), Casas (1986). Rare.

Jungermannia sphaerocarpa Hook.

Listed (without a locality) by Casas (1986), the voucher specimen (Montseny, Santa Fe, BCB16436) belongs to *Solenostoma hyalinum*.

Lejeunea cavifolia (Ehrh.) Lindb.

E, NW, SW. 300-1500 m. DG32, 42, 51, 52. Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Lloret (1986), Casas *et al.* (1998), Calleja *et al.* (2014). Common.

Lophocolea bidentata (L.) Dumort.

E, NW, SW. 300-1200 m. DG32, 42, 43, 51, 52. Barnola (1918), Casas Sicart (1959, 1960), Brugués (1978), Casas (1986), Casas *et al.* (1998). Common.

Lophocolea heterophylla (Schrad.) Dumort.

E. 300-400 m. DG51. Casas Sicart (1959, 1960), Casas (1986). Rare.

Lophocolea minor Nees

E, NW. 300-1200 m. DG42, 43, 51, 52. Casas Sicart (1959, 1960), Casas (1986), Casas i Sicart (1993). Frequent.

Lophozipsis excisa (Dicks.) Konstant. & Vilnet

E, SW. 1000-1200 m. DG42, 52. Casas Sicart (1959, 1960), Casas (1986), Casas i Sicart (1999). Rare.

Lunularia cruciata (L.) Dumort. ex Lindb.

E. 200-500 m. DG51, 52. Barnola (1918), Casas Sicart (1959, 1960), Polo Albertí (1982), Casas (1986). Common.

Mannia androgyna (L.) A. Evans

E, NW. 300-650 m. DG43, 51, 52. Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1996). Rare.

Marchantia paleacea Bertol.

E. 350 m. DG51, 52. Barnola (1916, 1918), Casas Sicart (1960), Casas (1986). Very rare.

Marchantia polymorpha L.

E, SW. 450 m. DG32, 52. Casas Sicart (1960), Casas (1986). Rare.

Marsupella emarginata (Ehrh.) Dumort.

E, NW. 900-1230 m. DG42, 52. Casas Sicart (1959, 1960), Casas (1986). Rare.

Marsupella funckii (F. Weber & D. Mohr) Dumort.

E. 1100 m. DG52. Casas (1992a), Casas i Sicart (1999). Very rare.

Mesoptychia bantriensis (Hook.) L. Söderstr. & Váňa

E, NW. 670-1200 m. DG42, 43, 52. Casas Sicart (1959, 1960), Casas (1986), Casas i Sicart (1999). Rare.

Mesoptychia turbinata (Raddi) L. Söderstr. & Váňa

NW, SW. 450-700 m. DG42, 43. Casas Sicart (1959, 1960), Casas (1986), BCB3441. Rare.

Metzgeria conjugata Lindb.

E. 600-1200 m. DG52. Casas *et al.* (1985b), Casas (1986), Casas i Sicart (1999). Rare.

Metzgeria furcata (L.) Corda

E, NW, SW. 200-1600 m. DG32, 42, 43, 51, 52, 53, 62. Barnola (1919), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Lloret (1986), Casas *et al.* (1998), Calleja *et al.* (2001, 2014). Very common.

Metzgeria pubescens (Schrank) Raddi

E. 1500 m. DG52. Casas *et al.* (1985b); Casas (1986). Very rare.

Microlejeunea ulicina (Taylor) Steph.

E. 500-650 m. DG52, 53. Casas *et al.* (1985b), Casas (1986), Casas i Sicart (1999), Calleja *et al.* (2001, 2014). Rare.

Myriocoleopsis minutissima (Sm.) R.L. Zhu, Y. Yu & Pócs

E. 750 m. DG52. Calleja *et al.* (2014). Very rare.

Oxymitra incrassata (Broth.) Sérgio & Sim-Sim

NW. 650 m. DG43. Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1989). Very rare.

Pedinophyllum interruptum (Nees) Kaal.

Reports of this species by Casares Gil (1915) and Casas Sicart (1959, 1960) are not supported by herbarium material and there is no evidence of *P. interruptum* in the studied area.

Pellia endiviifolia (Dicks.) Dumort.

E, NW. 250-1250 m. DG42, 43, 51, 52. Casas (1986). Frequent.

Pellia epiphylla (L.) Corda

E. 1000-1100 m. DG52. New for Montseny massif (Santa Fe, 1972, *J. Vives s.n.*, BCB40571; *idem*, 1973, *J. Vives s.n.*, BCB40613). Rare. Reports of this species from Campins, Arbúcies and Mosqueroles (Casas Sicart, 1960) are not supported by herbarium material.

Pellia neesiana (Gottsche) Limpr.

E. 750-1100 m. DG52. Casas *et al.* (1998). Rare.

Plagiochila asplenoides (L.) Dumort.

Reports of this species by Casares Gil (1915), Casas Sicart (1960) and Polo Albertí (1982) are not supported by herbarium material and there is no evidence of *P. asplenoides* in the studied area. A specimen collected by J. Vives in Tagament (SW sector) (BCB53385), labelled as *P. asplenoides* belongs to *P. porelloides*.

Plagiochila porelloides (Torr ex Nees) Lindenb.

E, NW, SW. 300-1350 m. DG32, 42, 43, 51, 52. Casas Sicart (1959, 1960), Casas (1986), Lloret (1986), Casas i Sicart (1993), Casas *et al.* (1998). Common.

Porella arboris-vitae (With.) Grolle

E, NW, SW. 250-1400 m. DG32, 42, 51, 52. Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1998). Frequent.

Porella cordaeana (Huebener) Moore

E, NW, SW. 700-1450 m. DG42, 52, 62. Barnola (1919), Casas Sicart (1959, 1960), Casas (1986). Frequent.

Porella obtusata (Taylor) Trevis.

E, NW, SW. 400-1100 m. DG32, 42, 43, 51, 52. Casas Sicart (1959, 1960), Casas (1986). Frequent.

Porella platyphylla (L.) Pfeiff.

E, NW, SW. 400-1250 m. DG32, 42, 43, 51, 52. Barnola (1916), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Brugués (1978), Casas (1986), Casas i Sicart (1993). Common.

Preissia quadrata (Scop.) Nees

NW. 1060 m. DG52. Casas Sicart (1960), Casas *et al.* (1992). Very rare.

Radula complanata (L.) Dumort.

E, NW, SW. 200-1550 m. DG32, 42, 43, 51, 52, 53. Barnola (1916, 1922), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Lloret (1986), Casas *et al.* (1998), Calleja *et al.* (2014). Very common.

Radula lindenbergiana Gottsche ex C. Hartm.

E. 1100 m. DG52. Allorge & Allorge (1946), Casas Sicart (1960), Casas (1986). Very rare.

Reboulia hemisphaerica (L.) Raddi

E, NW. 300-900 m. DG42, 51, 52. Barnola (1918), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986). Frequent.

Riccardia chamedryfolia (With.) Grolle

E, NW. 600-1100 m. DG42, 52. Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1998). Rare.

Riccardia multifida (L.) Gray

E. DG52. Casares Gil (1915), Casas Sicart (1960), Casas (1986). Very rare.

***Riccia bifurca* Hoffm.**

E, NW. 300-1100. DG43, 51, 52. Casas Sicart (1959, 1960), Casas (1986), Casas i Sicart (1999). Rare.

***Riccia ciliata* Hoffm.**

E, NW. 300-900 m. DG42, 52. Casas Sicart (1959, 1960), Casas (1986). Rare.

***Riccia glauca* L.**

E. 1050 m. DG52. New for Montseny massif (Santa Fe, 1967, *C. Casas s.n.*, BCB26578). Very rare.

***Riccia lamellosa* Raddi**

E. 450 m. DG51. Casas Sicart (1960), Casas (1986). Very rare.

***Riccia nigrella* DC.**

E, NW. 300-650 m. DG43, 51, 52. Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1992). Rare.

***Riccia sorocarpa* Bisch.**

E, NW, SW. 450-800 m. DG32, 42, 52. Casas Sicart (1959, 1960), Casas (1986), Casas i Sicart (1999). Rare.

***Riccia warnstorffii* Limpr. ex Warnst.**

SW. 1140 m. DG42. Casas Sicart (1960), Casas (1986). Very rare.

***Scapania aequiloba* (Schwägr.) Dumort.**

Reported from Aiguafreda, Barranc de l'Avencó (SW sector) by Casas Sicart (1960) and Casas (1986). This report is referable to *S. compacta* (Casas *et al.*, 1992).

***Scapania aspera* M. Bernet & Bernet**

E, NW. 400-670 m. DG43, 51. Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1992). Frequent.

***Scapania compacta* (Roth) Dumort.**

E, SW. 200-1000 m. DG32, 51, 52, 62. Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1992), BCB40800. Rare.

***Scapania curta* (Mart.) Dumort.**

Reports by Casas Sicart (1959, 1960) for Mosqueroles (E sector), are due to confusion with *S. nemorea* (BCB18465).

***Scapania nemorea* (L.) Grolle**

E. 400-1200 m. DG52. Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1998). Rare.

***Scapania praetervisa* Meyl.**

E, NW. 1000-1230 m. DG42, 52. New for Montseny massif (El Brull vers Collformic, 1951, *C. Casas s.n.*, BCB18431; Santa Fe de Montseny, cerca de Coll de Santa Elena, 1951, *C. Casas s.n.*, BCB18463). Rare.

***Scapania undulata* (L.) Dumort.**

E, NW. 900-1200 m. DG43, 52. Allorge (1928), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1998). Rare.

***Schistochilopsis opacifolia* (Culm. ex Meyl.) Konstant.**

E. 1200 m. DG52. Casas & Infante (1998). Very rare.

***Solenostoma gracillimum* (Sm.) R.M. Schust.**

Reports by Casas Sicart (1959, 1960) from Santa Fe de Montseny (E sector), are due to confusion with *Solenostoma hyalinum* (BCB33365).

***Solenostoma hyalinum* (Lyell) Mitt.**

E. 1100-1200 m. DG52. Casas (1986), Casas i Sicart (1999). Rare. See comments under *Jungermannia sphaerocarpa*.

***Solenostoma obovatum* (Nees) C. Massal.**

The report from Santa Fe by Casas Sicart (1960) is not supported by herbarium material and there is no evidence of *S. obovatum* in the studied area.

***Southbya tophacea* (Spruce) Spruce**

NW, SW. 400-700 m. DG31, 42, 43. Casas Sicart (1959, 1960), Casas (1986). Rare.

***Sphenolobus minutus* (Schreb. ex D. Crantz) Berggr.**

E. 900-1250 m. DG52. Casas Sicart (1959, 1960), Casas (1986). Rare.

***Targionia hypophylla* L.**

E, SW. 300-600 m. DG32, 51, 52. Casas Sicart (1960), Casas (1986), Zamora *et al.* (1989). Frequent.

****Trichocolea tomentella* (Ehrh.) Dumort.**

E. 1100-1200 m. DG52. Casas Sicart (1959, 1960), Vives (1974), Sanz i Magrané & Casas i Sicart (1983), Casas (1986), Casas i Sicart (1999). Very rare. Regarded as endangered by Casas i Sicart (1999); a declining population from a single site has been found in our surveys.

***Trilophozia quinquedentata* (Huds.) Bakalin**

E, NW, SW. 450-1200 m. DG32, 42, 52. Casas Sicart (1959, 1960), Casas (1986). Rare.

BRYOPHYTA***Abietinella abietina* (Hedw.) M. Fleisch.**

E, NW, SW. 650-1200 m. DG42, 43, 52. Brugués (1978), Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1992), BCB39987. Frequent.

***Alleniella complanata* (Hedw.) S. Olsson, Enroth & D. Quandt**

E, NW, SW. 400-1450 m. DG32, 42, 43, 51, 52. Casas Sicart (1959, 1960), Casas (1986), Lloret (1986), Casas *et al.* (1998), Calleja *et al.* (2001), BCB53349. Common.

***Aloina aloides* (Schultz) Kindb.**

E, NW. 325-670 m. DG43, 51, 52. Casas Sicart (1959, 1960), Casas (1986).
Rare.

***Amblystegium serpens* (Hedw.) Schimp.**

E, NW. 300-650 m. DG43, 51, 52. Casas Sicart (1959, 1960), Casas (1986).
Rare.

***Amphidium mougeotii* (Schimp.) Schimp.**

E, NW, SW. 450-1500 m. DG32, 42, 52. Casares Gil (1915), Civit (1918), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1989). Frequent.

***Andreaea rupestris* Hedw.**

E. 1530 m. DG52. Entre Turó de l'Home i Puig Sesolles, 2017, *L. Sáez s.n.*, BCB59298. A very imprecise record from Passavets (E sector) was reported by Casas i Sicart (1999); it lacked coordinates, altitude, description of site or indication of habitat and the record was not supported by any herbarium specimen. The Passavets area has been thoroughly explored but the species has never been found there.

***Anomobryum julaceum* (Schrad. ex P. Gaertn. *et al.*) Schimp.**

E. 500-700 m. DG52. Casas Sicart (1960), Casas (1986), Casas i Sicart (1999). Rare.

***Anomodon attenuatus* (Hedw.) Huebener**

E, NW. 450-1100 m. DG43, 51, 52. Casas Sicart (1959, 1960), Casas (1986), Granzow de la Cerda (1988). Rare.

***Anomodon viticulosus* (Hedw.) Hook. & Taylor**

E, SW. 400-1050 m. DG32, 42, 51, 52. Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Sanz i Magrané (1987), Granzow de la Cerda (1988). Frequent.

***Antitrichia curtipendula* (Hedw.) Brid.**

E. 1000-1200 m. DG52. Casares Gil (1915), Casas Sicart (1960), Casas (1986), Casas *et al.* (1985b, 1989). Very rare.

***Archidium alternifolium* (Hedw.) Mitt.**

E, NW. 800-1100 m. DG42, 52. Casas Sicart (1960), Casas (1986), Casas *et al.* (1992), Casas i Sicart (1999). Rare.

***Atrichum angustatum* (Brid.) Bruch & Schimp.**

E. 450-1200 m. DG42, 51, 52. Casares Gil (1915), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Brugués (1978), Casas (1986), Casas *et al.* (1998). Rare.

***Atrichum undulatum* (Hedw.) P. Beauv.**

E, NW. 300-1450 m. DG42, 43, 51, 52. Casares Gil (1915), Casas Sicart (1959, 1960), Brugués (1978), Polo Albertí (1982), Casas (1986), Casas i Sicart (1993), Casas *et al.* (1998). Common.

Aulacomnium androgynum (Hedw.) Schwägr.

E. DG52. Casares Gil (1915), Casas Sicart (1960), Casas (1986). Very rare.

****Aulacomnium palustre*** (Hedw.) Schwägr.

E, SW. 1100-1280 m. DG42, 52. Allorge (1928), Allorge & Allorge (1946), Casas Sicart (1960), Casas (1986, 1992b), Casas *et al.* (1989), García-Pausas & Canalis (1992), Casas i Sicart (1999). Rare (currently regionally extinct from Montseny).

Barbula convoluta Hedw.

E, NW. 300-1000 m. DG42, 43, 51, 52. Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Casas i Sicart (1993, 1999). Frequent.

Barbula unguiculata Hedw.

E, NW, SW. 200-1000 m. DG32, 43, 51, 52, 62. Casas Sicart (1959, 1960), Casas (1986), BCB25811. Frequent.

Bartramia aprica Müll. Hal.

E. 300 m. DG51. Casas Sicart (1960), Casas (1986, 1992b). Very rare.

Bartramia halleriana Hedw.

E, NW. 1100-1500 m. DG42, 52. Casares Gil (1915), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986). Rare.

Bartramia ithyphylla Brid.

E, NW, SW. 700-1700 m. DG42, 43, 52. Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1992), Casas i Sicart (1993, 1999). Frequent.

Bartramia pomiformis Hedw.

E, NW, SW. 700-1300 m. DG32, 42, 43, 52. Civit (1918), Allorge (1929), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Lloret (1986), Casas *et al.* (1992). Common.

Blindia acuta (Hedw.) Bruch & Schimp.

E, NW. 1100-1450 m. DG42, 52. Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1996), Casas i Sicart (1999). BCB14779. Rare.

Brachytheciastrum velutinum (Hedw.) Ignatov & Huttunen

E, NW, SW. 300-1500 m. DG42, 51, 52, 53. Casares Gil (1915), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Lloret (1986), Casas i Sicart (1993). Calleja *et al.* (2014). Common.

Brachythecium albicans (Hedw.) Schimp.

E. 700-1100 m. DG52, 53. Casas Sicart (1959, 1960), Casas (1986). Rare.

Brachythecium glareosum (Bruch ex Spruce) Schimp.

E, NW, SW. 280-1200 m. DG32, 42, 43, 51, 52. Casas Sicart (1959, 1960), Casas (1986). Frequent.

Brachythecium rivulare Schimp.

E, NW, SW. 550-1600 m. DG42, 43, 52. Allorge (1928, 1929), Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1998). Rare.

Brachythecium rutabulum (Hedw.) Schimp.

E, NW, SW. 300-1400 m. DG32, 42, 51, 52. Allorge & Allorge (1946), Casas Sicart (1959, 1960), Polo Albertí (1982), Casas (1986). Frequent.

Brachythecium salebrosum (Hoffm. ex F. Weber & D. Mohr) Schimp.

Reported from Arbúcies (E sector) by Casas Sicart (1959, 1960), the voucher specimen (BCB14887) belongs to *B. glareosum*.

Bryoerythrophyllum recurvirostrum (Hedw.) P.C. Chen var. ***recurvirostrum***

SW. DG32, 450 m. New for Montseny massif (Aiguafreda, Avencó, 1951, C. Casas *s.n.*, BCB27336). Very rare.

Bryum argenteum Hedw.

E, NW, SW. 200-1706 m. DG42, 43, 51, 52. Casas Sicart (1959, 1960), Casas (1986). Common.

Bryum canariense Brid.

SW. 500 m. DG32. Casas Sicart (1960), Casas (1986). Very rare.

Bryum dichotomum Hedw.

E, NW. 280-1700 m. DG51, 52. Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986). Frequent.

Bryum gemmiparum De Not.

NW. 600 m. DG43. Casas Sicart (1959, 1960), Casas (1986). Very rare.

Bryum sauteri Bruch & Schimp.

E. 700 m. DG52. Casas (2000), Guerra *et al.* (2010). Very rare.

****Buxbaumia viridis*** (Moug. ex Lam. & DC.) Brid. ex Moug. & Nestl.

E. 1300-1380 m. DG52. Casas *et al.* (1985b), Casas (1986), Casas i Sicart (1999), Sáez *et al.* (2014). Very rare. Restricted to a single locality in Passavets *Abies alba* stand.

Calliergonella cuspidata (Hedw.) Loeske

E, NW, SW. 250-1200 m. DG42, 43, 51, 52. Allorge (1928, 1929), Casas Sicart (1959, 1960), Panareda i Clopès *et al.* (1981), Casas (1986, 1992b), García-Pausas & Canalis (1992), Casas *et al.* (1998). Frequent.

Calliergonella lindbergii (Mitt.) Hedenäs

E. DG52. Allorge & Allorge (1946), Casas Sicart (1960), Casas (1986). Very rare.

Campyliadelphus chrysophyllus (Brid.) Kanda

E, NW. 250-750 m. DG43, 52, 62. Casas Sicart (1959, 1960), Casas (1986). Rare.

Campylophyllum calcareum (Crundw. & Nyholm) Hedenäs

E, NW, SW. 300-1000 m. DG42, 43, 51, 52. Casas Sicart (1959), Casas (1986), Casas i Sicart (1993). BCB1118. Rare.

Campylopus fragilis (Brid.) Bruch & Schimp.

E. 875-1000 m. DG52. Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Casas i Sicart (1999). Rare.

Campylopus pilifer Brid.

E. 500 m. DG52. Casas (1986), Casas *et al.* (1989), Casas i Sicart (1999). Very rare.

Ceratodon purpureus (Hedw.) Brid.

E, NW, SW. 250-1700 m. DG42, 43, 51, 52. Casas Sicart (1960), Casas (1986). Common.

Cinclidotus fontinaloides (Hedw.) P. Beauv.

E. 500 m. DG52. New for Montseny massif (Gorg Negre, 1973, *J. Vives s.n.*, BCB1318, BCB35177). Very rare.

Cirriphyllum crassinervium (Taylor) Loeske & M. Fleisch

E, NW, SW. 400-800 m. DG32, 42, 51, 52. Casas Sicart (1959, 1960), Casas (1986). Frequent.

Clasmatodon parvulus (Hampe) Sull. & Lesq.

Reported by Casas de Puig (1954), Casas Sicart (1960), Casas i Sicart (1999) and Casas *et al.* (2001). The voucher specimen (Seva, BCB31756) belongs to *Pseudoleskeella tectorum* (Heras *et al.*, 2006).

Climacium dendroides (Hedw.) F. Weber & D. Mohr

E. 1100 m. DG52. Allorge (1929), Allorge & Allorge (1946), Casas Sicart (1960), Casas (1986, 1992b), Casas i Sicart (1999). Very rare.

Coscinodon cribrosus (Hedw.) Spruce

NW, SW. 450-900 m. DG32, 42, 43. Casas Sicart (1959, 1960), Casas (1986). Rare.

Cratoneuron filicinum (Hedw.) Spruce

E, NW. 400-650 m. DG43. Casas Sicart (1959, 1960), Casas (1986), Fuertes *et al.* (2007), BCB16550. Rare.

Crossidium crassinervium (De Not.) Jur.

E. 400 m. DG51. Casas (1986). Very rare.

Crossidium squamiferum (Viv.) Jur.

E, NW. 400-600 m. DG43, 51. Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986). Rare.

***Cryphaea heteromalla* (Hedw.) D. Mohr**

NW, SW. 800-1200 m. DG42, 43. Casas Sicart (1960), Vives (1979), Casas (1986), Casas i Sicart (1999). Rare.

***Ctenidium molluscum* (Hedw.) Mitt.**

E, NW, SW. 300-1200 m. DG32, 42, 43, 51, 52. Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1998). Common.

***Cynodontium bruntonii* (Sm.) Bruch. & Schimp.**

A report from Gualba (Allorge, 1929; Allorge & Allorge, 1946; Casas, 1986) is not supported by herbarium specimens, and there is no evidence of *Cynodontium bruntonii* occurrence in the studied area.

***Dialytrichia mucronata* (Brid.) Broth.**

SW. 450 m. DG32. Casas Sicart (1960), Casas (1986). Very rare.

****Dichodontium palustre* (Dicks.) M. Stech**

E. 960-1100 m. DG52. Gutiérrez Perarnau (1993), Casas i Sicart (1999). Rare. This species was regarded as endangered in the Montseny massif (Casas i Sicart, 1999); a single population persists in the Santa Fe area.

***Dichodontium pellucidum* (Hedw.) Schimp.**

E, NW. 700-1200 m. DG42, 52. Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Casas i Sicart (1993). Rare.

***Dicranella heteromalla* (Hedw.) Schimp.**

E, SW. 200-1150 m. DG32, 52. Casas Sicart (1960), Casas (1986). Rare.

***Dicranella howei* Renauld & Cardot**

E. 200-900 m. DG51, 52. Brugués (1978), Casas *et al.* (1985b), Casas (1986). Frequent.

***Dicranella varia* (Hedw.) Schimp.**

E. 600-1200 m. DG43, 52. Casas Sicart (1960), Casas i Sicart (1993). Rare.

****Dicranum bonjeanii* De Not.**

E. 1100 m. DG52. Casas Sicart (1960), Casas (1986, 1992b), Casas i Sicart (1999). Very rare (currently regionally extinct from Montseny).

***Dicranum polysetum* Sw ex Anon.**

Reported from Collformic (SW sector) by Casas (1986) and Casas i Sicart (1999). The voucher specimen that served as the basis for these reports (BCB35451) belongs to *D. scoparium*.

***Dicranum scoparium* Hedw.**

E, NW, SW. 300-1650 m. DG31, 32, 42, 43, 51, 52, 62. Casas Sicart (1959, 1960), Brugués (1978), Panareda i Clopès *et al.* (1981), Casas (1986), Lloret (1986), Casas i Sicart (1993). Very common.

Dicranum undulatum Schrad. ex Brid.

Reported from NW sector (between Font Pomareta and Coll Formic) by Casas Sicart (1960). This record is not supported by herbarium specimens, and there is no evidence that this species exists in the studied area.

Didymodon acutus (Brid.) K. Saito

NW. 600-750 m. DG43. Casas Sicart (1959, 1960), Casas (1986). Rare.

Didymodon fallax (Hedw.) R.H. Zander

E, NW, SW. 250-1100 m. DG32, 43, 52, 62. Casas Sicart (1960), Casas (1986), Casas i Sicart (1993), Jiménez *et al.* (2005), BCB26929. Rare.

Didymodon insulanus (De Not.) M.O. Hill

NW. 800 m. DG43. Casas i Sicart (1993). Very rare.

Didymodon luridus Hornsch.

E, NW, SW. 250-650 m. DG32, 43, 52. Casas (1986), BCB27300, BCB50796, BCB1787. Rare.

Didymodon rigidulus Hedw.

E. 1100 m. DG52. Casas (1986). Very rare.

Didymodon sinuosus (Mitt.) Delogne

Reported from Aiguafreda (NW sector) by Casas Sicart (1960). This record is not supported by herbarium specimens, and there is no evidence that this species exists in the studied area.

Didymodon tophaceus (Brid.) Lisa

NW, SW. 450-650 m. DG42, 43. Casas Sicart (1960), Casas (1986), BCB53317. Rare.

Didymodon vinealis (Brid.) R.H. Zander

NW, SW. 400-750 m. DG32, 43. Casas Sicart (1960), Casas (1986). Rare.

**Diphyscium foliosum* (Hedw.) D. Mohr

E. 1000-1250 m. DG52. Allorge (1929), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986). Rare. This species remains rare but has been found in at least three localities during our surveys.

Ditrichum flexicaule (Schwägr.) Hampe

NW. 600-750 m. DG43. Casas Sicart (1959, 1960), Casas (1986). Rare.

Ditrichum gracile (Mitt.) Kuntze

NW, SW. 500-1050 m. DG32, 42, 43. Casas *et al.* (1992). Rare.

Ditrichum subulatum Hampe

E. 300 m. DG51. Casas Sicart (1959, 1960), Casas (1986). Very rare.

Drepanocladus aduncus (Hedw.) Warnst.

E. 250 m. DG62. Gutiérrez Perarnau (1998), Fuertes *et al.* (2010). Rare.

***Encalypta ciliata* Hedw.**

E, NW, SW. 1000-1450 m. DG42, 52. Casas Sicart (1959, 1960), Casas (1986), Casas i Sicart (1993, 1999). Rare.

***Encalypta microstoma* Bals.-Criv. & De Not.**

E. 1700 m. DG52. New for Montseny massif (Turó de l'Home, 1972, J. Vives s.n., BCB35733). Very rare.

***Encalypta streptocarpa* Hedw.**

E, NW, SW. 600-1100 m. DG31, 42, 43, 52. Casas Sicart (1959, 1960), Casas (1986). Common.

***Encalypta vulgaris* Hedw.**

E, NW. 600-800 m. DG42, 43, 51. Casas Sicart (1960), Brugués (1978), Casas (1986), BCB35750. Rare.

***Entosthodon attenuatus* (Dicks.) Bryhn**

E. 300-500 m. DG51, 52. Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1996). Rare.

***Entosthodon convexus* (Spruce) Brugués**

E, NW. 250-400 m. DG42, 43, 51, 52. Allorge & Allorge (1946), Casas Sicart (1960), Casas (1986), Casas *et al.* (1996), Brugués & Ruiz (2010). Rare.

***Entosthodon fascicularis* (Hedw.) Müll. Hal.**

E. 350-600 m. DG51. Casas (1986), Casas *et al.* (1996), Brugués & Ruiz (2010). Rare.

***Entosthodon muhlenbergii* (Turner) Fife**

Reported from E and NW sectors by Casas Sicart (1959) and Casas (1986). The voucher specimens that served as the basis for these reports belong to *E. convexus* (BCB30085, Mosquerols) and *E. pulchellus* (BCB30086, Seva).

***Entosthodon obtusus* (Hedw.) Lindb.**

Reported from Campins by Casas Sicart (1959, 1960) and Casas (1986). The voucher specimens that served as the basis for these reports (BCB12509 and BCB27590) belong to *E. fascicularis*.

***Entosthodon pulchellus* (H. Philib.) Brugués**

E, NW. 300-650 m. DG43, 52. Casas *et al.* (1985b, 1996), Casas (1986), Brugués & Ruiz (2010). Rare.

****Ephemerum serratum* (Hedw.) Hampe**

E. 1085 m. DG52. Casas *et al.* (1985b), Casas (1986), Casas i Sicart (1999), Infante *et al.* (2010). Very rare (currently regionally extinct from Montseny).

***Epipterygium tozeri* (Grev.) Lindb.**

E, NW. 200-500 m. DG42, 51, 52. Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1996). Rare.

***Eucladium verticillatum* (With.) Bruch & Schimp.**

E, NW. 250-1100 m. DG32, 42, 51, 52. Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986). Common.

***Eurhynchiastrum pulchellum* (Hedw.) Ignatov & Huttunen**

E, NW. 1000-1100 m. DG52. Casas *et al.* (1985b), Casas (1986), Casas i Sicart (1993). Rare.

***Eurhynchium striatum* (Hedw.) Schimp.**

E, NW, SW. 350-1100 m. DG32, 42, 51, 52. Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1998). Frequent.

***Exsertotheca crispa* (Hedw.) S. Olsson, Enroth & D. Quandt**

E, NW, SW. 600-1200 m. DG42, 43, 52. Casares Gil (1915), Allorge & Allorge (1946), Casas Sicart (1960), Casas (1986), BCB58999. Frequent.

***Fabronia ciliaris* (Brid.) Brid.**

E. 320 m. DG52. Casas Sicart (1960), Casas (1986). Very rare.

***Fabronia pusilla* Raddi**

NW. 850 m. DG42. New for Montseny massif (El Brull, 1990, *R.M. Cros s.n.*, BCB28524). Very rare.

***Fissidens adianthoides* Hedw.**

E. 500-600 m. DG52. Casas Sicart (1959, 1960), Casas (1986). Rare. Confirmed only for Gorg Negre (BCB11754) and Gualba (BCB16083). The record from Sant Marçal (BCB16084) should be referred to *F. dubius*.

***Fissidens bryoides* Hedw.**

E, NW, SW. 300-700 m. DG42, 52. Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Casas i Sicart (1999). BCB2078. Rare.

***Fissidens crassipes* Wilson ex Bruch & Schimp.**

NW. 750 m. DG43. Casas Sicart (1959, 1960), Casas (1986). Very rare.

***Fissidens curvatus* Hornsch.**

E, NW. 320-850 m. DG42, 51. Casas Sicart (1960), Casas *et al.* (1985a), Casas (1986). Rare.

***Fissidens dubius* P. Beauv.**

E, NW, SW. 300-1200 m. DG42, 43, 51, 52, 62. Potier de la Varde (1945), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Brugués (1978), Casas (1986), Lloret (1986), Casas i Sicart (1993, 1999), Casas *et al.* (1998). Frequent.

***Fissidens grandifrons* Brid.**

E. 200-1200 m. DG52. Casas Sicart (1959, 1960), Casas (1986), Casas i Sicart (1993). Rare.

***Fissidens rivularis* (Spruce) Schimp.**

E. 400 m. DG51. Casas Sicart (1960), Casas (1986). Very rare.

***Fissidens taxifolius* Hedw.**

E, NW. 250-1500 m. DG42, 51, 52. Potier de la Varde (1945), Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1998). Common.

***Fissidens viridulus* var. *incurvus* (Starke ex Röhl.) Waldh.**

E, NW. 350-1200 m. DG42, 51, 52. Casas Sicart (1959, 1960), Casas (1986). Frequent.

Fissidens viridulus* (Sw. ex anon.) Wahlenb. var. *viridulus

E. 350 m. DG51. Casas Sicart (1960), Casas (1986). Very rare.

***Fontinalis antipyretica* Hedw.**

E, NW. 700-1200 m. DG42, 43, 52. Civit (1918), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Panareda i Clopès *et al.* (1981), Casas (1986), Casas i Sicart (1999). Frequent.

***Fontinalis squamosa* Hedw.**

E, NW. 600-1100 m. DG42, 52. Allorge (1928), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Casas i Sicart (1999). Rare.

***Funaria hygrometrica* Hedw.**

E, NW, SW. 200-1200 m. DG42, 51, 52. Casas Sicart (1959, 1960), Casas (1986). Common.

***Grimmia crinitoleucophaea* Cardot**

NW. 1100 m. DG52. Casas (1986, 1993), Casas i Sicart (1999). Very rare. See comments under *G. tergestina*.

***Grimmia decipiens* (Schultz) Lindb.**

E, SW. 450-1100 m. DG32, 43, 51. Casas Sicart (1959, 1960), Casas (1986), Zafra (1982). Rare.

***Grimmia funalis* (Schwaegr.) Bruch & Schimp.**

NW. 1400 m. DG42. Casas Sicart (1960), Casas (1986), Casas i Sicart (1999). Very rare.

***Grimmia hartmanii* Schimp.**

E. 1000 m. DG52. Casas *et al.* (1985b), Casas (1986), Casas i Sicart (1999). Very rare.

***Grimmia laevigata* (Brid.) Brid.**

E, NW, SW. 200-1700 m. DG32, 42, 43, 52. Casas Sicart (1959, 1960), Brugués (1978), Casas (1986). Common.

***Grimmia lisae* De Not.**

E, SW. 400-500 m. DG32, 52. New for Montseny massif (Arbúcies, 1952, C. Casas *s.n.*, BCB16372; El Figaró, 1973, M. Brugués *s.n.*, BCB2568). Rare.

***Grimmia orbicularis* Bruch ex Wilson**

E, NW, SW. 500-1200 m. DG32, 43, 52. Casares Gil (1915), Casas Sicart (1960), Casas (1986), BCB36086. Common.

***Grimmia ovalis* (Hedw.) Lindb.**

NW. 1300 m. DG42. Casas Sicart (1960), Casas *et al.* (1985b), Casas (1986). Very rare.

***Grimmia pulvinata* (Hedw.) Sm.**

E, NW, SW. 200-1350 m. DG32, 42, 43, 51, 52. Casas Sicart (1959, 1960), Brugués (1978), Casas (1986), Casas i Sicart (1993). Very common.

***Grimmia tergestina* Tømm. ex Bruch & Schimp.**

Reported from Sant Marçal (NW sector) by Casas Sicart (1960), Casas (1986) and Zafra (1982). The single voucher specimen that served as the basis for these reports (BCB20597) belongs to *G. crinitoleucophaea*.

***Grimmia trichophylla* Grev.**

E NW. 800-1100 m. DG42, 52. Casas Sicart (1959, 1960), Casas (1986), Lloret (1986). Rare.

***Gymnostomum calcareum* Nees & Hornsch.**

NW. 650 m. DG43 Casas Sicart (1960). Very rare.

***Gymnostomum viridulum* Brid.**

NW. 700 m. DG43. Sérgio (1984), Casas (1986). Very rare.

***Habrodon perpusillus* (De Not.) Lindb.**

E. 700 m. DG52. Casas Sicart (1959, 1960), Casas (1986), Casas i Sicart (1999). Very rare.

Hedwigia ciliata* (Hedw.) P. Beauv. var. *ciliata

E, NW, SW. 320-1600 m. DG42, 43, 51, 52. Casas Sicart (1959, 1960), Brugués (1978), Lloret (1986), Casas (1986), Casas i Sicart (1993), Casas *et al.* (1996). Common.

***Hedwigia ciliata* var. *leucophaea* Bruch & Schimp.**

E. DG52, 700-975 m. New for Montseny massif (Riells, Camí del sot del Pla de Saba, 1997, R.M. Cros *et al. s.n.*, BCB49112). Very rare.

***Hedwigia stellata* Hedenäs**

E. 600 m. DG52. Casas *et al.* (1996). Very rare.

****Herzogiella seligeri* (Brid.) Z. Iwats.**

E. 1290-1380 m. DG52. Casas *et al.* (1985b), Casas (1986), Casas i Sicart (1999), Sáez *et al.* (2014). Very rare. Although regarded as locally extinct by Casas i Sicart (1999), one population from a single site, showing no signs of decline, was found during our 2013-2017 surveys.

Heterocladium dimorphum (Brid.) Schimp.

E, NW. 1100-1500 m. DG42, 52. Casas Sicart (1959, 1960), Casas (1986), Casas i Sicart (1999). Rare.

Heterocladium heteropterum (Brid.) Schimp.

Reported from Santa Fe (E sector) by Allorge (1929), Allorge & Allorge (1946) and Casas Sicart (1960). The single voucher specimen that served as the basis for these reports (PC) belongs to *Pseudoleskeella nervosa*.

Homalothecium lutescens (Hedw.) H. Rob.

E, NW, SW. 400-1000 m. DG32, 42, 43 51. Casas Sicart (1959, 1960), Casas (1986), BCB37655. Frequent.

Homalothecium sericeum (Hedw.) Schimp.

E, NW, SW. 350-1500 m. DG32, 42, 43, 52. Casas Sicart (1959, 1960), Casas (1986). Common.

Homomallium incurvatum (Schrader ex Brid.) Loeske

E. 850-1100 m. DG52. Casas *et al.* (1985b, 1998), Casas (1986). Rare.

****Hookeria lucens*** (Hedw.) Sm.

E. 750-1080 m. DG52. Vives (1974), Casas (1986), Casas *et al.* (1992), Casas i Sicart (1999). Rare. Regarded as endangered by Casas i Sicart (1999). A single declining population still remains in Santa Fe area.

Hygroamblystegium varium var. *humile* (P. Beauv.) Vanderp. & Hedenäs

E, NW. 300-650 m. DG43, 51, 52. Allorge & Allorge (1946), Casas Sicart (1960), Casas (1986). Rare.

Hygroamblystegium varium (Hedw.) Mönk. var. *varium*

E. 250-1100 m. DG52, 62. Casas (1986), BCB33763. Rare.

Hygrohypnum duriusculum (De Not.) D.W. Jamieson

E. DG52, 500 m. Casas *et al.* (1985b, 1989), Casas (1986), Casas i Sicart (1999). Very rare.

Hygrohypnum luridum (Hedw.) Jenn.

E, NW. 700-1100 m. DG43, 52. Casas Sicart (1959, 1960), Casas (1986), Casas i Sicart (1993). Rare.

Hylocomium splendens (Hedw.) Schimp.

E, NW, SW. 300-1650 m. DG32, 42, 43, 51, 52. Casares Gil (1915), Casas Sicart (1959, 1960), Polo Alberti (1982), Casas (1986), Casas i Sicart (1993). Very common.

Hypnum andoi A.J.E. Sm.

E. 800-1110 m. DG52. Calleja *et al.* (2001), (Santa Fe, BCB47323). Rare.

Hypnum cupressiforme* Hedw. var. *cupressiforme

E, NW, SW. 200-1680 m. DG32, 41, 42, 43, 51, 52, 53, 62. Casas Sicart (1959, 1960); Brugués (1978), Polo Albertí (1982), Casas (1986), Lloret (1986), Casas *et al.* (1998), Casas i Sicart (1993), Calleja *et al.* (2014). Very common.

***Hypnum cupressiforme* var. *filiforme* Brid.**

E, NW, SW. 300-1600 m. DG42, 51, 52. Casas (1986). Common.

***Hypnum cupressiforme* var. *lacunosum* Brid.**

E, NW, SW. 400-1100 m. DG32, 42, 43, 52. Casas (1986). Rare.

***Hypnum cupressiforme* var. *resupinatum* (Taylor) Schimp.**

NW. 700-1000 m. DG32, 42. New for Montseny massif (Seva, El Montanyà, 1987, C. Casas *s.n.*, BCB23512; Sant Marçal, *s.d.*, C. Casas *s.n.*, BCB39881). Rare.

***Hypnum cupressiforme* var. *subjulaceum* Molendo**

E. DG52, 1100 m. New for Montseny massif (Santa Fe, 1975, C. Casas *s.n.*, BCB47347). Very rare.

***Hypnum vaucheri* Lesq.**

NW. 600 m. DG43. Casas Sicart (1959, 1960), Casas (1986), Ruiz & Brugués (2011). Very rare.

***Imbriobryum alpinum* (Huds. ex With.) N. Pedersen**

E, NW, SW. 500-1700 m. DG42, 43, 52. Allorge (1929), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986). Frequent.

***Imbriobryum mildeanum* (Jur.) J.R. Spence**

E, NW. 500-600 m. DG43, 52. Casas Sicart (1960), Casas (1986), Casas i Sicart (1999), Guerra *et al.* (2008). Rare.

***Isopterygiopsis muelleriana* (Schimp.) Z. Iwats.**

E. 1000-1200 m. DG52. Casas Sicart (1960), Casas (1986). Very rare.

***Isothecium alopecuroides* (Lam. ex Dubois) Isov.**

E, NW, SW. 450-1450 m. DG32, 42, 52. Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Lloret (1986), Casas *et al.* (1998). Frequent.

***Isothecium myosuroides* Brid.**

E, NW. 1000-1300 m. DG42, 52. Casas Sicart (1959, 1960), Casas (1986), Lloret (1986). Rare.

***Kindbergia praelonga* (Hedw.) Ochyra**

E, NW, SW. 250-1100 m. DG41, 51, 52, 62. Casares Gil (1915), Allorge (1929), Allorge & Allorge (1946), Casas Sicart (1960), Casas (1986), Casas i Sicart (1993), Casas *et al.* (1998), BCB35696, BCB31531. Frequent.

***Leptodictyum riparium* (Hedw.) Warnst.**

E, NW, SW. 600-1050 m. DG42, 43, 52. Casas Sicart (1959, 1960), Peñuelas & Comelles (1984), Casas (1986). Rare.

Leptodon smithii (Hedw.) F. Weber & D. Mohr

E, NW, SW. 300-1050 m. DG32, 42, 43, 51, 52. Casares Gil (1915), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1992), Calleja *et al.* (2001). Common.

****Leucobryum glaucum*** (Hedw.) Ångstr.

E. 1000-1100 m. DG52. Casas Sicart (1960), Panareda i Clopès *et al.* (1981), Casas (1986), Casas i Sicart (1999). Very rare. Regarded as vulnerable by Casas i Sicart (1999), a single declining population still remains in Santa Fe area.

Leucobryum juniperoideum (Brid.) Müll. Hal.

E. 850-1100 m. DG52. Casas *et al.* (1985b, 1996, 1998), Casas (1986), Casas i Sicart (1999). Rare.

Leucodon sciuiroides (Hedw.) Schwägr.

E, NW, SW. 400-1650 m. DG32, 42, 43, 51, 52. Casas Sicart (1959, 1960), Brugués (1978), Polo Albertí (1982), Casas (1986), Casas i Sicart (1993), Fuertes *et al.* (1997). Very common.

Lewinskya acuminata (H. Philib.) F. Lara, Garilleti & Goffinet

E, NW. 400-800 m. DG42, 52. Casas (1994), BCB37426. Rare.

Lewinskya affinis (Brid.) F. Lara, Garilleti & Goffinet

E, NW. 250-1200 m. DG42, 51, 52. Casas Sicart (1959, 1960), Casas (1986), Calleja *et al.* (2001). Rare.

Lewinskya rupestris (Schleich. ex Schwägr.) F. Lara, Garilleti & Goffinet

E, NW, SW. 500-1600 m. DG42, 43, 51, 52. Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), BCB4014. Very common.

Lewinskya striata (Hedw.) F. Lara, Garilleti & Goffinet

E, NW, SW. 400-1600 m. DG42, 51, 52. Casas Sicart (1959, 1960), Casas (1986), BCB56864, BCB4033. Rare.

Loeskeobryum brevirostre (Brid.) M. Fleisch.

E. 1100 m. DG52. Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1992), Casas i Sicart (1999). Very rare.

Microeurhynchium pumilum (Wilson) Ignatov & Vanderp

E. 300-500 m. DG51, 52. Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986). Rare.

Mnium hornum Hedw.

E. 850-1100 m. DG52. Casares Gil (1915), Allorge (1929), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Panareda i Clopès *et al.* (1981), Casas (1986), Casas i Sicart (1993), Casas *et al.* (1998), Fuertes & Acón (1999). Rare.

Mnium lycopodioides Schwägr.

E. 1100 m. DG52. Fuertes & Acón (1999). Very rare.

Mnium marginatum (Dicks.) P. Beauv.

E, NW. 250-700 m. DG43, 51. Casas Sicart (1959, 1960), Casas (1986). Rare.

Mnium stellare Hedw.

E, NW. 300-1450 m. DG43, 52. Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1989), Casas i Sicart (1999), Fuertes & Acón (1999). Rare.

Nogopterium gracile (Hedw.) Crosby & W.R. Buck

E, NW, SW. 300-1300 m. DG32, 42, 43, 51, 52. Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Lloret (1986), Casas i Sicart (1993). Common.

Nyholmiella obtusifolia (Brid.) Holmen & E. Warncke

E, NW, SW. 450-700 m. DG32, 42, 52. Casas Sicart (1959, 1960), Casas (1986). Rare.

Orthotrichum anomalum Hedw.

E, NW, SW. 500-1200 m. DG42, 43, 52. Casares Gil (1915), Casas Sicart (1960), Casas (1986), Casas i Sicart (1993). BCB53351, BCB17530, BCB17532. Rare.

Orthotrichum diaphanum Brid.

E, NW, SW. 200-700 m. DG32, 42, 43, 51, 52. Casas Sicart (1959, 1960), Casas (1986). Rare.

Orthotrichum lyellii Hook. & Taylor

E, NW. 700-800 m. DG42, 53. Casas Sicart (1960), Casas (1986), BCB33019. Rare.

Orthotrichum philibertii Venturi

NW. 700 m. DG32. New for Montseny massif (El Muntanyà, 1987, C. Casas *s.n.*, BCB37489, mixed with *O. schimperi*). Very rare.

Orthotrichum schimperi Hammar

E, NW. 400-800 m. DG32, 42, 52. New for Montseny massif (Moscaroles, 1951, C. Casas *s.n.*, BCB17559, mixed with *O. tenellum*; El Brull, 1952, C. Casas *s.n.*, BCB18779; El Muntanyà, 1987, C. Casas *s.n.*, BCB37489, mixed with *O. philibertii*). Rare.

Orthotrichum tenellum Bruch *ex* Brid.

E, NW. 300-1100 m. DG43, 51, 52. Casas Sicart (1959, 1960), Casas (1986). Rare.

Oxyrrhynchium hians (Hedw.) Loeske

E. 300-400 m. DG51, 52. New for Montseny massif (Campins, 1950, C. Casas *s.n.*, BCB46308; Mosqueroles, 1972, J. Vives *s.n.*, BCB36878). Rare.

Oxyrrhynchium speciosum (Brid.) Warnst.

E. 200-500 m. DG42, 51, 52. Casas Sicart (1959, 1960), Casas (1986). Rare.

***Palustriella commutata* (Hedw.) Ochyra**

E, NW. 200-1100 m. DG52. Casares Gil (1915), Panareda i Clopès *et al.* (1981), Casas (1986), Casas *et al.* (1998), BCB15494, BCB15496. Rare.

***Philonotis caespitosa* Jur.**

Reported by Casas Sicart (1960) from Arbúcies and Gualba (E sector). These records are not supported by herbarium specimens, and there is no evidence that the species exists in the studied area.

***Philonotis calcarea* (Bruch & Schimp.) Schimp.**

E, NW. 660-700 m. DG43, 52. Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986). Rare.

***Philonotis capillaris* Lindb.**

NW. 1000 m. DG52. New for Montseny massif (Sant Marçal, s.d., C. Casas *s.n.*, BCB27786). Very rare.

***Philonotis fontana* (Hedw.) Brid.**

E, NW, SW. 450-1400 m. DG32, 42, 43, 52. Allorge (1929), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Casas i Sicart (1993). Rare.

***Philonotis marchica* (Hedw.) Brid.**

E, NW, SW. 250-1100 m. DG32, 41, 42, 52. Allorge (1929), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Casas i Sicart (1993). BCB33357. Rare.

***Philonotis rigida* Brid.**

NW. 800 m. DG42. Casas (1986), Casas *et al.* (1989), Casas i Sicart (1999). Very rare.

***Plagiomnium affine* (Blandow ex Funck) T.J. Kop.**

E, NW, SW. 300-1100 m. DG32, 42, 51, 52, 62. Allorge & Allorge (1946), Casas Sicart (1960), Casas (1986), Casas *et al.* (1998), Gómez-Menor *et al.* (1999), BCB38920. Rare. See comments under *P. ellipticum*.

***Plagiomnium cuspidatum* (Hedw.) T.J. Kop.**

E. 350 m. DG52. Casas Sicart (1959, 1960), Gómez-Menor *et al.* (1999). Very rare.

***Plagiomnium elatum* (Bruch & Schimp.) T.J. Kop.**

A report from Santa Fe (E sector) by Gómez-Menor *et al.* (1999), based on BCB17280 should be referred to *P. undulatum*. Reports from Sant Climent (Allorge, 1929) and Santa Fe (Panareda i Clopès *et al.*, 1981) are not supported by any herbarium specimens.

***Plagiomnium ellipticum* (Brid.) T.J. Kop.**

E. 1100 m. DG52. Gómez-Menor *et al.* (1999). Very rare. A report from Mosqueroles (Casas, 1986; BCB42266) is due to confusion with *P. affine*.

Plagiomnium medium (Bruch & Schimp.) T.J. Kop.

E. 1100 m. DG52. Gómez-Menor *et al.* (1999). Very rare.

Plagiomnium rostratum (Schrad.) T.J. Kop.

E. 1100 m. DG52. Allorge & Allorge (1946), Casas Sicart (1960), Casas (1986). Very rare.

Plagiomnium undulatum (Hedw.) T.J. Kop.

E, NW, SW. 200-1530 m. DG32, 41, 42, 43, 51, 52, 62. Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), García-Pausas & Canalis (1992), Casas i Sicart (1993), Casas *et al.* (1998), Gómez-Menor *et al.* (1999). Common.

Plagiopus oederianus (Sw.) H.A. Crum & L.E. Anderson

NW. 800 m. DG43. Casas i Sicart (1993). Very rare.

Plagiothecium cavifolium (Brid.) Z. Iwats.

E, NW, SW. 400-1200 m. DG42, 52. Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986). Frequent.

Plagiothecium nemorale (Mitt.) A. Jaeger

E, SW. 900-1300 m. DG42, 52. Casares Gil (1915), Civit (1918), Allorge & Allorge (1946), Casas Sicart (1960), Casas (1986), Lloret (1986), Casas *et al.* (1998), BCB59146. Rare.

Plagiothecium succulentum (Wilson) Lindb.

E. 1450 m. DG52. New for Montseny massif (Montllovar, 1972, *J. Vives s.n.*, BCB39861). Very rare. This species was reported from Santa Fe de Montseny (E sector) by Casas Sicart (1959). The voucher specimen that served as base for this report (BCB30279) belongs to *P. cavifolium*.

Plasteurhynchium meridionale (Schimp.) M. Fleisch.

NW, SW. 400-700 m. DG32, 43. Casas Sicart (1959, 1960), Casas (1986). Rare.

Plasteurhynchium striatulum (Spruce) M. Fleisch.

SW. 500 m. DG32. New for Montseny massif (Aiguafreda, Avencó, 1950, C. Casas *s.n.*, BCB33342). Very rare.

Pleuridium acuminatum Lindb.

NW. 1100 m. DG42. Casas i Sicart & Belmonte i Soler (1983), Casas (1986). Very rare.

Pleuridium subulatum (Hedw.) Rabenh.

E, SW. 380-1100 m. DG42, 51, 52. Casas Sicart (1959, 1960), Casas i Sicart & Belmonte i Soler (1983), Casas (1986). Rare.

Pleurozium schreberi (Willd. ex Brid.) Mitt.

E, NW. 1000-1500 m. DG42, 52. Casares Gil (1915), Casas Sicart (1959, 1960), Casas (1986). Rare.

***Pogonatum aloides* (Hedw.) P. Beauv.**

E, NW, SW. 350-1400 m. DG41, 42, 43, 51, 52. Casares Gil (1915), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Brugués (1978), Polo Albertí (1982), Casas (1986), Casas *et al.* (1992), Casas i Sicart (1993). Common.

***Pogonatum nanum* (Hedw.) P. Beauv.**

E. 1200 m. DG52. Brugués (1978), Casas *et al.* (1985b, 1992), Casas (1986), Casas i Sicart (1999). Very rare.

****Pogonatum urnigerum* (Hedw.) P. Beauv.**

E. 1100 m. DG52. Allorge & Allorge (1946), Casas Sicart (1959, 1960), Brugués (1978), Casas (1986), Casas *et al.* (1992). Very rare (currently regionally extinct from Montseny).

***Pohlia camptotrachela* (Renauld & Cardot) Broth.**

E. 1100 m. DG52. New for Montseny massif (Santa Fe, 1974, C. Casas *s.n.*, BCB4413). Very rare.

***Pohlia cruda* (Hedw.) Lindb.**

E, NW. 1000-1200 m. DG42, 52. Allorge & Allorge (1946), Casas Sicart (1959, 1960), Polo Albertí (1982), Casas (1986). Rare.

***Pohlia proligera* (Kindb.) Lindb. *ex* Broth.**

E. 1100 m. DG52. Casas *et al.* (1985b), Casas (1986). Very rare.

***Pohlia wahlenbergii* (F. Weber & D. Mohr) A.L. Andrews**

E. 450 m. DG52. Casas (1986). Very rare.

***Polytrichum commune* Hedw.**

A report provided by Casas Sicart (1960) is not supported by herbarium specimens, and there is no evidence that this species exists in the studied area.

***Polytrichum formosum* Hedw.**

E, NW, SW. 300-1600 m. DG32, 42, 51, 52, 62. Casares Gil (1915), Casas Sicart (1959, 1960), Brugués (1978), Panareda i Clopès *et al.* (1981), Polo Albertí (1982), Casas (1986), Lloret (1986), Casas i Sicart (1993), Casas *et al.* (1998). Common.

***Polytrichum juniperinum* Hedw.**

E. 300-1600 m. DG42, 51, 52. Casas Sicart (1960), Brugués (1978), Polo Albertí (1982), Casas (1986), Casas i Sicart (1993). Rare.

***Polytrichum piliferum* Hedw.**

E, NW. 400-1700 m. DG42, 43, 51, 52. Civit (1918), Casas Sicart (1959, 1960), Casas (1986). Rare.

***Pseudoamblystegium subtile* (Hedw.) Vanderp. & Hedenäs**

Reports from Montseny (E sector) by Casares Gil (1915) and Avencó (SW sector) by Casas Sicart (1960) are not supported by herbarium specimens, and there is no evidence that this species exists in the studied area.

****Pseudephemerum nitidum*** (Hedw.) Loeske

E. 1000 m. DG52. Casas *et al.* (1985b), Casas (1986), Casas i Sicart (1999). Very rare (currently regionally extinct from Montseny).

Pseudocrossidium revolutum (Brid.) R.H. Zander

NW. 650 m. DG43. Casas Sicart (1960), Casas (1986). Very rare.

Pseudoleskea incurvata (Hedw.) Loeske

E. 1100-1500 m. DG52. New for Montseny massif (Les Agudes, 1950, C. Casas *s.n.*, BCB27699, Santa Fe, 1986, C. Casas *s.n.*, BCB29572). Very rare.

Pseudoleskeella nervosa (Brid.) Nyholm

E. 800-1600 m. DG52. Casas (1986), Casas *et al.* (1998). Rare.

Pseudoleskeella tectorum (Funck *ex* Brid.) Kindb. *ex* Broth.

NW. 650 m. DG43. Casas (1986). Very rare.

Pseudoscleropodium purum (Hedw.) M. Fleisch.

E, NW, SW. 300-1100 m. DG31, 41, 42, 43, 51, 52, 62. Casares Gil (1915), Casas Sicart (1959, 1960), Brugués (1978), Pérez-Obiol (1984), Casas (1986), Casas i Sicart (1993), Casas *et al.* (1998). Very common.

Pseudotaxiphyllum elegans (Brid.) Z. Iwats.

E. DG52, 900-1150 m. Casas *et al.* (1985b), Casas (1986), Casas i Sicart (1999). Rare.

Pterigynandrum filiforme Hedw.

E, NW, SW. 450-1670 m. DG42, 51, 52. Casares Gil (1915), Casas Sicart (1959, 1960), Casas (1986), Lloret (1986), Casas i Sicart (1993), Casas *et al.* (1998). Common.

Pterygoneurum ovatum (Hedw.) Dixon

E. DG51, 450 m. Casas *et al.* (1989). Very rare.

Ptychomitrium polyphyllum (Dicks. *ex* Sw.) Bruch & Schimp.

E, NW, SW. 900-1200 m. DG43, 52. Allorge (1937), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1989), Casas i Sicart (1993, 1999). Rare.

Ptychostomum boreale (F. Weber & D. Mohr) Ochrya & Bednarek-Ochrya

Reports provided by Casares Gil (1915), Allorge & Allorge (1946) and Casas Sicart (1959, 1960) are not supported by herbarium specimens, and there is no evidence that *P. boreale* exists in the studied area.

Ptychostomum bornholmense (Wink. & R. Ruthe) Holyoak & N. Pedersen

E. 400 m. DG52. Casas Sicart (1960), Casas *et al.* (1985b), Casas (1986). Very rare.

***Ptychostomum capillare* (Hedw.) Holyoak & N. Pedersen**

E, NW, SW. 200-1704 m. DG32, 42, 43, 51, 52. Casares Gil (1915), Casas Sicart (1959, 1960), Casas (1986), Casas i Sicart (1993). Common.

***Ptychostomum donianum* (Grev.) Holyoak & N. Pedersen**

Reports provided by Allorge & Allorge (1946) and Casas Sicart (1959, 1960) are not supported by herbarium specimens, and there is no evidence that *P. donianum* exists in the studied area.

***Ptychostomum imbricatum* (Müll. Hal.) Holyoak & N. Pedersen**

E, NW. 700-1700 m. DG43, 52. Casas Sicart (1960), BCB34655. Rare.

***Ptychostomum moravicum* (Podp.) Ros & Mazimpaka**

E, SW. 1100-1150 m. DG42, 52. Casas *et al.* (1985b), Casas (1986), BCB59147. Rare.

***Ptychostomum pseudotriquetrum* (Hedw.) J.R. Spence & H.P. Ramsay**

E, NW. 350-1480 m. DG52. Panareda i Clopès *et al.* (1981), Casas (1986), Casas *et al.* (1998), BCB15053. Rare.

***Ptychostomum torquescens* (Bruch & Schimp.) Ros & Mazimpaka**

E, NW, SW. 200-1200 m. DG42, 43, 51, 52. Casas Sicart (1959, 1960), Casas (1986). Common.

***Pylaisia polyantha* (Hedw.) Schimp.**

Listed without a specific locality by Casas (1986). The voucher specimen (Montseny, El Brull, Seva, BCB32883) belongs to *Hypnum cupressiforme*.

***Racomitrium aciculare* (Hedw.) Brid.**

E, SW. 450-1200 m. DG32, 52. Allorge (1928), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1992), Casas i Sicart (1999). Rare.

***Racomitrium affine* (F. Weber & D. Mohr) Lindb.**

E, NW, SW. 500-1300 m. DG32, 42, 52. Casas Sicart (1959, 1960), Casas *et al.* (1992). Frequent.

***Racomitrium aquaticum* (Brid. ex Schrad.) Brid.**

A report from Santa Fe (E sector) by Casas *et al.* (1985b) and Casas (1986) is not supported by any herbarium specimen.

***Racomitrium canescens* (Hedw.) Brid.**

E, NW. 300-1600 m. DG42, 43, 52. Casares Gil (1915), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1992). Frequent.

***Racomitrium heterostichum* (Hedw.) Brid.**

Reported by Casas (1986), the vouchers specimens on which they were based (BCB18180, BCB18181) belong to *R. affine*.

***Racomitrium lanuginosum* (Hedw.) Brid.**

E. 900-1200 m. DG52. Casas Sicart (1959, 1960), Casas (1986), Casas i Sicart (1999). Rare.

***Rhabdoweisia fugax* (Hedw.) Bruch & Schimp.**

E. 1000 m. DG52. Casas *et al.* (1985b), Casas (1986), Casas i Sicart (1999). Very rare.

***Rhizomnium pseudopunctatum* (Bruch & Schimp.) T.J. Kop.**

Reported by Casas Sicart (1960) and Casas (1986), but not supported by herbarium specimens. Reports of this species in Spain ought to be referred as *R. magnifolium* or *R. punctatum* (Marcos *et al.*, 1999).

***Rhizomnium punctatum* (Hedw.) T.J. Kop.**

E, NW. 900-1200 m. DG43, 52. Casares Gil (1915), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1998), Fuertes *et al.* (2010). Rare.

***Rhodobryum roseum* (Hedw.) Limpr.**

E, NW, SW. 450-1100 m. DG32, 43, 52. Casas Sicart (1959, 1960), Casas (1986), Casas i Sicart (1999). Rare.

***Rhynchostegiella tenella* (Dicks.) Limpr.**

E, NW, SW. 400-650 m. DG32, 43, 51, 52. Casas Sicart (1959, 1960), Casas (1986). Common.

***Rhynchostegium confertum* (Dicks.) Schimp.**

E, NW, SW. 300-1450 m. DG32, 42, 43, 51, 52, 53. Casas Sicart (1959, 1960), Brugués (1978), Casas (1986), Casas i Sicart (1993), Casas *et al.* (1998), Calleja *et al.* (2014). Common.

***Rhynchostegium megapolitanum* (Blandow ex F. Weber & D. Mohr) Schimp.**

E. 300-500 m. DG51, 52. Casas Sicart (1959, 1960), Casas (1986). Rare.

***Rhynchostegium riparioides* (Hedw.) Cardot**

E, NW, SW. 200-1480 m. DG32, 42, 43, 51, 52. Casas Sicart (1959, 1960), Panareda i Clopès *et al.* (1981), Casas (1986), Casas i Sicart (1993), Casas *et al.* (1998). Common.

***Rhytidiadelphus loreus* (Hedw.) Warnst.**

E. 1200 m. DG52. New for Montseny massif (Santa Fe, 1969, C. Casas *s.n.*, BCB5105). Very rare.

***Rhytidiadelphus triquetrus* (Hedw.) Warnst.**

E, NW, SW. 800-1550 m. DG42, 43, 52. Civit (1918), Casas Sicart (1959, 1960), Casas (1986), Casas i Sicart (1993). Common.

***Rhytidium rugosum* (Hedw.) Kindb.**

E, NW, SW. 600-1700 m. DG42, 43, 52. Casares Gil (1915), Casas Sicart (1959, 1960), Casas (1986), Casas i Sicart (1993). Common.

***Saelania glaucescens* (Hedw.) Broth.**

E, NW, SW. 800-1200 m. DG42, 43, 52. Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1989), Casas i Sicart (1993). BCB32313. Rare.

***Schistidium apocarpum* (Hedw.) Bruch. & Schimp.**

E, NW, SW. 300-1200 m. DG32, 42, 52. Casas Sicart (1959, 1960), Brugués (1978), Casas (1986, 2001), Lloret (1986), Casas *et al.* (1998). Frequent.

***Schistidium confertum* (Funck) Bruch & Schimp.**

E. 350-900 m. DG51, 52. Casas (2001). Rare.

***Schistidium crassipilum* H.H. Blom**

NW. 650 m. DG42, 43. Casas (2001). Rare.

***Schistidium helveticum* (Schkuhr) Deguchi**

NW. 650 m. DG43. Casas (2001), BCB27073. Very rare.

***Sciuro-hypnum flotowianum* (Sendtn.) Ignatov & Huttunen**

A report from Gualba, Gorg Negre (E sector) by Casas (1986) is not supported by herbarium material, so there is no evidence of this species occurring in the studied area.

***Sciuro-hypnum plumosum* (Hedw.) Ignatov & Huttunen**

E. 850-1100 m. DG52. Casas Sicart (1959, 1960), Casas (1986). Rare.

***Sciuro-hypnum populeum* (Hedw.) Ignatov & Huttunen**

E, NW, SW. 350-1200 m. DG42, 43, 52. Casas Sicart (1959, 1960), Casas (1986), BCB29601. Frequent.

***Scleropodium touretii* (Brid.) L.F. Koch.**

E, NW, SW. 250-1100 m. DG31, 32, 42, 51, 52. Allorge & Allorge (1946), Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1989). Rare.

***Scopelophila ligulata* (Spruce) Spruce**

SW. 500 m. DG32. Ederra (2006). Very rare.

***Scorpiurium circinatum* (Bruch) M. Fleisch. & Loeske**

E, NW, SW. 250-600 m. DG31, 32, 42, 43, 51, 52. Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1989). Common.

***Sphagnum capillifolium* (Ehrh.) Hedw.**

The report from Santa Fe (Allorge, 1928) that was accepted by subsequent authors (Casas Sicart, 1960; Panareda i Clopés *et al.*, 1981; Casas, 1986, 1992b; Sáez *et al.*, 2014) is erroneous. The herbarium specimen that served as a basis for this record (BCB29884) consists of *S. subnitens*.

***Sphagnum palustre* L.**

Reports from Montseny massif (Barnola, 1921) are mistaken with *S. papillosum* (Casas, 1992b).

****Sphagnum papillosum* Lindb.**

E. 1100 m. DG52. Casas *et al.* (1992). This species was collected once in Santa Fe. Very rare (currently regionally extinct from Montseny).

****Sphagnum subnitens* Russow & Warnst.**

E, SW. 1080-1280 m. DG42, 52. Casas de Puig (1962), Panareda i Clopés *et al.* (1981), Casas (1986, 1992b), García-Pausas & Canalís (1992), Fuertes & Munín (1994), Casas i Sicart (1999). Rare (currently regionally extinct from Montseny).

***Syntrichia calcicola* J.J.Amann**

NW. 670 m. DG43. New for Montseny massif (Seva, vers Can Sans, 1952, *C. Casas s.n.*, BCB26820). Very rare.

***Syntrichia laevipila* Brid.**

E, NW, SW. 300-700 m. DG32, 42, 43, 51, 52. Casas Sicart (1959, 1960), Casas (1986). Common.

***Syntrichia montana* Nees**

NW. 850 m. DG42. New for Montseny massif (El Brull, 1994, *C. Casas s.n.*, BCB33022). Very rare. A report from Aiguafreda (SW sector) (Casas Sicart, 1960) based on BCB10009, should be referred to *S. princeps*.

***Syntrichia papillosa* (Wilson) Jur.**

E, NW. 300-800 m. DG43, 51. Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1989). Rare.

***Syntrichia princeps* (De Not.) Mitt.**

SW. 450 m. DG32. New for Montseny massif (Aiguafreda, s.d., *C. Casas s.n.*, BCB19009). Very rare.

***Syntrichia ruralis* var. *ruraliformis* (Besch.) Delogne**

SW. 1150 m. DG42. New for Montseny massif (Collformic, 1952, *C. Casas s.n.*, BCB26819). Very rare.

Syntrichia ruralis* (Hedw.) F. Weber & D. Mohr var. *ruralis

E, NW, SW. 400-1700 m. DG32, 42, 51, 52. Casas Sicart (1959, 1960), Brugués (1978), Casas (1986). Common.

***Taxiphyllum wissgrillii* (Garov.) Wijk & Margad.**

E. 1000 m. DG52. New for Montseny massif (Barranc del Turó de l'Home, a Font Martina, 1986, *C. Casas s.n.*, BCB25996). Very rare.

****Tetraphis pellucida* Hedw.**

E. 1300-1350 m. DG52. Casas (1986), Casas *et al.* (1985b, 1989), Casas i Sicart (1999), Sáez *et al.* (2014). Very rare. Although regarded as locally extinct by Casas i Sicart (1999), a single site population was found during our 2013-2017 surveys that shows no signs of decline.

***Thamnobryum alopecurum* (Hedw.) Gangulee**

E, NW, SW. 250-1400 m. DG32, 43, 52. Casares Gil (1915), Allorge & Allorge (1946), Casas Sicart (1959, 1960), Brugués (1978), Casas (1986), Casas *et al.* (1998). Common.

***Thuidium assimile* (Mitt.) A.Jaeger**

E, NW, SW. 1000-1200 m. DG42, 43, 52. Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1992), BCB29491. Rare.

***Thuidium delicatulum* (Hedw.) Schimp.**

E, NW. 1000-1100 m. DG42, 43. Casares Gil (1915), Casas Sicart (1960), Casas (1986), Casas *et al.* (1992). Rare.

***Thuidium recognitum* (Hedw.) Lindb.**

E, NW, SW. 430-1100 m. DG31, 42, 52. Casares Gil (1915), Casas Sicart (1959, 1960), Casas (1986), Casas *et al.* (1992). Rare.

***Thuidium tamariscinum* (Hedw.) Schimp.**

E, NW, SW. 250-1350 m. DG32, 42, 51, 52, 62. Casas Sicart (1959, 1960), Panareda i Clopès *et al.* (1981), Polo Albertí (1982), Casas (1986), Casas *et al.* (1992), Casas i Sicart (1993), Casas *et al.* (1998). Common.

***Tortella flavovirens* (Bruch) Broth.**

Reported from El Brull (NW sector) by Brugués (1978). This record is not supported by herbarium specimens, and there is no evidence that this species exists in the studied area.

***Tortella humilis* (Hedw.) Jenn.**

E. DG52. Allorge & Allorge (1946), Casas Sicart (1960), Casas (1986). Very rare.

***Tortella inclinata* (R. Hedw.) Limpr.**

NW. 650 m. DG43. Casas Sicart (1960), Casas (1986). Very rare.

***Tortella inflexa* (Bruch) Broth.**

E. 200 m. DG62. New for Montseny Massif (Breda, 1973, *J. Vives s.n.*, BCB39419). Very rare.

***Tortella nitida* (Lindb.) Broth.**

Reported from El Brull (NW sector) by Brugués (1978). This record is not supported by herbarium specimens, and there is no evidence that this species exists in the studied area.

***Tortella squarrosa* (Brid.) Limpr.**

E, NW, SW. 200-900 m. DG32, 42, 43, 51, 52, 62. Casas Sicart (1959, 1960), Brugués (1978), Casas (1986). Very common.

***Tortella tortuosa* (Hedw.) Limpr.**

E, NW, SW. 400-1700 m. DG32, 42, 51, 52. Casas Sicart (1959, 1960), Casas (1986). Common.

Tortula acaulon (With.) R.H. Zander var. ***schreberiana*** (Dicks.) R.H. Zander
E. 400 m. DG51. Guerra *et al.*, (1991). Very rare.

Tortula atrovirens (Sm.) Lindb.
E, NW. 500-800 m. DG42, 52. Casas Sicart (1960), Casas (1986), BCB1599.
Rare.

Tortula canescens Mont.
E. 280-320 m. DG51. Casas Sicart (1960), Casas (1986). Rare.

Tortula caucasica Broth.
NW. 600 m. DG53. Casas Sicart (1959, 1960), Casas (1986). Very rare.

Tortula cuneifolia (Dicks.) Turner
E, NW. 400-800 m. DG42, 51. Casas Sicart (1960), Casas (1986), BCB9537.
Rare.

Tortula inermis (Brid.) Mont.
A report from Aiguafreda (NW sector) by Casas Sicart (1960) is not supported by any herbarium specimen.

Tortula lindbergii Broth.
NW, SW. 600-620 m. DG42, 43. Casas (1986), BCB4629. Rare.

Tortula mucronifolia Schwägr.
Reports from Santa Fe (E sector) and Collformic (SW sector) by Casas Sicart (1960) are not supported by herbarium specimens, and there is no evidence that *T. mucronifolia* exists in the studied area.

Tortula muralis Hedw.
E, NW. 200-1200 m. DG43, 51, 52. Casas Sicart (1959, 1960), Casas (1986). Common.

Tortula schimperi M.J. Cano, Werner & J. Guerra
SW. 1200 m. DG42. New for Montseny massif (Collformic, talus fageda, 1978, C. Casas *s.n.*, BCB13392). Very rare.

Tortula subulata Hedw.
E, NW, SW. 350-1200 m. DG42, 43, 51, 52. Casas Sicart (1959, 1960), Casas (1986), Casas i Sicart (1993). Frequent.

Trichostomum brachydontium Bruch
E, NW, SW. 300-850 m. DG42, 51, 52. Casas Sicart (1959, 1960), Casas (1986), Lloret (1986), Casas *et al.* (1998), BCB28568. Frequent.

Trichostomum crispulum Bruch
E, NW, SW. 300-800 m. DG32, 42, 43, 51, 62. Casas Sicart (1959, 1960), Brugués (1978), Casas (1986), Casas i Sicart (1993). Common.

***Weissia controversa* Hedw.**

E, NW, SW. 200-1600 m. DG32, 43, 51, 52. Casas Sicart (1959, 1960), Casas (1986), Casas i Sicart (1993). Common.

***Zygodon forsteri* (Dicks. ex With.) Mitt.**

E, NW, SW. 200-650 m. DG32, 42, 43, 52, 53. Casas Sicart (1959, 1960), Cros Matas (1983), Casas (1986), Calleja *et al.* (2001). Common.

Conservation and threats

Of the sixteen bryophyte species selected for this study, because of being threatened (Table 1), eight are to be considered as regionally extinct at present. Four

Table 1. Protection and conservation status and IUCN category for Spain of regionally extinct or threatened species within Montseny massif. Protection: a, HD-II (Annex II in Directive 92/43/EEC of 21 May 1992); b, HD-V (Annex V in Directive 92/43/EEC of 21 May 1992); c, CEEA (Spanish Catalogue of Threatened Species); d, PEIN (Plan for Interesting Natural Areas in Catalonia); e, PEM (Special Plan for protection of the environment and landscape in Montseny Natural Park). Conservation status: E, endangered; RE, regionally extinct; VU: vulnerable. T(+): threatened but populations not declining; T(-): threatened and populations declining; Yr: year of the last confirmed record; H: number of historical localities; N: number of current localities; C: current cover area (in m²). Note that conservation status categories, especially those used by Casas i Sicart (1999), are on a locally explicit basis for the area studied and they do not reflect true global or regional conservation status. *Data provided only for the Santa Fe area. IUCN category for Spain follows Brugués & González-Mancebo (2012)

Species	Protection	Conservation status		IUCN category for Spain
		Casas i Sicart (1999)	Current status: Yr / H / N / C	
<i>Aulacomnium palustre</i>	–	RE	RE: 1992 / 2 / – / –	–
<i>Buxbaumia viridis</i>	a, c	RE	T(+): – /1/ 1 / 0.5	VU
<i>Calypogeia muelleriana</i>	–	–	RE: 1995 / 1 / – / –	–
<i>Dichodontium palustre</i>	–	E	T(–): – /2/ 1 / 1.5	–
<i>Dicranum bonjeanii</i>	–	RE	RE: 1956 / 1 / – / –	–
<i>Diphyscium foliosum</i>	–	VU	T(–): – /3/ 2 / 2.5	–
<i>Ephemerum serratum</i>	–	E	RE: 1980 / 1 / – / –	LC–att
<i>Herzogiella seligeri</i>	–	RE	T(+): – /1/ 1 / 4	–
<i>Hookeria lucens</i> *	e	E	T(–): – /2/ 1 / 1	–
<i>Leucobryum glaucum</i> *	b, e	VU	T(–): – /2/ 1 / 0.1	LC
<i>Pogonatum urnigerum</i>	–	E	RE: 1917 / 1 / – / –	–
<i>Pseudephemerum nitidum</i>	–	E	RE: 1974 / 2 / – / –	–
<i>Sphagnum papillosum</i>	b, d	RE	RE: 1918 / 1 / – / –	–
<i>Sphagnum subnitens</i>	b, d	RE	RE: 1995 / 3 / – / –	–
<i>Tetraphis pellucida</i>	–	RE	T(+): – /1/ 1 / 0.5	–
<i>Trichocolea tomentella</i>	–	E	T(–): – /2/ 1 / 0.5	–

of them were among the seven species regarded by Casas i Sicart (1999) as such (*Aulacomnium palustre*, *Dicranum bonjeanum*, *Sphagnum papillosum* and *S. subnitens*); their disappearance from Montseny is here corroborated. And the other four are here proposed (*Calypogeia muelleriana*, *Ephemerum serratum*, *Pogonatum urnigerinum* and *Pseudoepherum nitidum*). Five species have declining populations (*Dichodontium palustre*, *Diphyscium foliosum*, *Hookeria lucens*, *Leucobryum glaucum* and *Trichocolea tomentella*). And three species, although still scarce and regionally threatened, do not show obvious signs of decline (*Buxbaumia viridis*, *Herzogiella selligeri* and *Tetraphis pellucida*).

DISCUSSION

Biodiversity characterisation

In spite of its small area (ca 355 km²) and the relatively low elevation of its highest summit (barely exceeding 1700 m a.s.l.), the bryophyte flora of the Montseny massif is surprisingly rich. According to Brugués & Ruiz (2017), peninsular Spain contain 1138 bryophyte taxa (857 mosses, 5 hornworts, 276 liverworts), so the Montseny, with its 352 taxa, contains 30.9% of the peninsular Spain flora. Montseny’s bryophyte richness is slightly lower than that of Sierra Nevada (395 taxa), another mountain range in the southern Iberian Peninsula recently studied bryologically by Rams *et al.* (2014). Sierra Nevada, however comprises an area of 2000 km², almost six times the surface of the Montseny massif and twice its elevation (ca 3500 m a.s.l.).

An analysis of Montseny floristic composition reveals that the proportion of hornworts (0.9%), liverworts (22.7%) and mosses (76.4%) taxa is very similar to that throughout the Mediterranean basin as a whole: 0.4% of hornworts, 24.5% of liverworts, and 75.1% of mosses (Ros *et al.*, 2007, 2013).

In terms of their relative abundance within the area of study, 109 taxa (31.0%) are regarded as *very rare*, 147 taxa (41.8%) as *rare*, 40 (11.3%) as *frequent*, 45 (12.8%) as *common*, and only 11 (3.1%) as *very common*. This adds up to 73.6% of the taxa being *rare* or *very rare* and 26.4% *frequent*, *common* or *very common* in the massif.

The species richness within the studied area is rather uneven: the E sector contains the highest species richness (301 taxa, 85.5% over total) and the SW sector the lowest (139 taxa, 39.5%) (Table 2). The E sector includes a larger area with greater altitudinal range and wetter climate conditions; it also harbours more diverse and unique habitats, including the majority of wetland patches and a continuous

Table 2. Characterization of the three sectors in the study area (E: Turó de l’Home and Les Agudes; NW: Matagalls; SW: Pla de la Calma and Puig Drau)

Sector	Area (km ²)	Elevation range (max. elev., m)	Number of taxa	% species over total
E	142	1500 (1706)	301	85.5
NW	93	1200 (1697)	207	58.8
SW	120	1150 (1344)	139	39.5

12 ha fir stand. These factors are likely to explain the higher species richness of the E sector. But perhaps because of this greater habitat diversity, it may have disproportionately enabled more collecting, thus contributing to a greater species count compared to the other sectors.

Conservation and threats

Human-caused habitat changes seems to be the main cause of species loss: the disappearance of wetlands and hydromorphic soil habitats has most likely led to the loss of at least five species in the massif: *Aulacomnium palustre*, *Calypogeia muelleriana*, *Dicranum bonjeanii*, *Sphagnum papillosum* and *S. subnitens*. The small fragments of wetland remnants in the Santa Fe site (not larger than half ha, all combined) did subsist until the 1990's, but they have now been gravely altered. The intense human visitation of the Santa Fe reservoir and surroundings has led to its habitats degradation. Signs of nitrification, trampling and alteration of the hydric regime are strikingly evident especially in hydromorphic soils. The loss of species of *Ephemerum serratum*, *Pseudephemerum nitidum* and *Sphagnum*, that were reported by Casas (1999) as growing in wet or seasonally flooded soils, is most likely associated with the great damage inflicted to these hydromorphic habitats. The other hydromorphic soil fragment, in Pla de la Calma (SW sector), has been destroyed sometime in this decade by the construction of a concrete trough for livestock, despite the reported presence of the strictly protected *Sphagnum subnitens* (García-Pausas & Canalis, 1992).

Several species have undergone a decline in number of populations since the publication of the paper of Casas i Sicart (1999). For *Hookeria lucens* and *Leucobryum glaucum*, specifically, their decline could be attributed to trampling and rooting by wild boar (*Sus scrofa* Linnaeus, 1758). The population of wild boar has increased noticeably in recent years (Guinart *et al.*, 2014), encroaching on wetlands that are habitat for these two mosses.

Three species that grow on logs in advanced stages of decay, namely *Buxbaumia viridis*, *Herzogiella seligeri* and *Tetraphis pellucida*, were regarded as regionally extinct by Casas i Sicart (1999). However, our surveys have shown their presence in the *Abies alba* stand in eastern Montseny since 2011, with no evidence of population decline for any of them, but rather suggesting that, although extremely small, populations are fairly stable. With its mere 12 ha, the Passavets white fir forest fragment seems to suffice in providing adequate habitat for these three species. The practices recently adopted by the Park's management to foster the regeneration of *A. alba* and discontinue the removal of fallen fir logs will probably result in population increase for these mosses specific of decaying *A. alba* logs.

Increased pressure by visitors, whether traveling trails, in the case of *Diphyscium foliosum*, or the trampling around hydromorphic soils occupied by *Dichodontium palustre* and *Trichocolea tomentella*, are likely to have decimated the already scant populations of these species. Public works for widening paths have caused the disruption of the *Pogonatum urnigerum* population.

Montseny's mountainous areas with a healthy forest cover have benefited from adequate conservation conditions. In contrast, the much more fragile hydromorphic habitats have been subjected to greater neglect and are thus severely disturbed, in some cases irreversibly so. The designation of the Montseny massif as a Natural Park and Biosphere Reserve in the late 1970s did little to prevent the disappearance of species such as *Aulacomnium palustre*, *Calypogeia muelleriana*

and *Sphagnum subnitens* by the end of the 1990s. Neither did those designations provide effective protection for other threatened bryophytes. Many species of bryophytes have been under strict protection (nominally) in Catalonia for the least 25 years, including those within the Montseny Natural Park and other natural reserves. However, despite the relatively large overall number of protected species in the region, the conservation actions toward protected bryophytes in the Montseny Natural Park, extrapolable to Catalonia as a whole, are practically nil.

Available information on the conservation status of high elevation (> 1500 m) bryophytes in the Montseny massif is surprisingly scarce. It is therefore essential to establish the conservation status for species from these habitats, since a large proportion of threatened bryophytes in Spain are restricted to subalpine and alpine habitats e.g. *Encalypta microstoma* and *Schistochilopsis opacifolia* (Brugués & González-Mancebo, 2012). Bergamini *et al.* (2009) documented upward displacement of bryophytes in the Alps, so it is not unlikely that other mountain systems in the Mediterranean basin would undergo similar shifts and replacements in response to climate warming, similar to what has already been suggested for woody species in Montseny (Peñuelas *et al.*, 2007).

Most taxa that Casas i Sicart (1999) considered threatened, besides those regionally extinct at the time, were the ones growing in particularly vulnerable habitats such as hydromorphic soils and wet hollows. All these species have now become or remain regionally extinct. On the other hand, three rare species thought to be regionally extinct by Casas i Sicart (1999) because of their stenoicous substrate preferences (decaying *Abies alba* stumps and logs), have now “reappeared”.

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