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Bryophytes of the peatlands of Aubrac (Massif Central - France)

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Abstract – The major peatlands of Aubrac plateau have been bryofloristicaly investigated. A list of 141 taxa is provided, among which 32 taxa are considered of high conservation value. Emphasis is put on the most remarkable sites from the points of view of richness in overall bryophyte flora and in taxa of high conservation value.

Peatlands / Bryophyte survey / Massif Central / Aubrac / Aveyron / Cantal / Lozère / Chorology / Conservation

Résumé – Les principaux ensembles tourbeux du plateau de l'Aubrac ont fait l'objet d'un inventaire bryologique. Un total de141 taxa sont cités, dont 32 sont considérés comme possédant une forte valeur patrimoniale. Les sites les plus remarquables d'un point de vue de la richesse floristique et de la richesse en taxons à forte valeur patrimoniale sont mis en lumière.

Tourbières / Inventaire bryologique / Massif Central / Aubrac / Aveyron / Cantal / Lozère / Chorologie / Conservation

INTRODUCTION

The Massif Central of France has a rich and original bryoflora (Héribaud, 1899; ECCB, 1995; Schumacker & Sapaly, 1996) owing to the great variety of geologic substrata, wide array of climatic influences and altitudes, and historical factors. Yet, its bryological knowledge appears rather deficient, as comprehensive inventories are still totaly lacking. A great number of regions have only been surveyed very superficially, for example Margeride, Artense and Cézallier (Héribaud, 1899; Sarrassat, 1931; Vanden Berghen, 1951; Long & Daget, 1965; Souchon, 1965; Boudier, 1987). As underlined by Schumacker & Sapaly (1996), peatland habitats have been very under-explored since the beginning of bryophyte exploration of Auvergne, and the same applies to the region of Aubrac.

History of bryophyte recording in Aubrac is not an exception. Apart from the report of a bryological 1986 extraordinary session of the Société

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Botanique du Centre-Ouest (Boudier, 1987), the bryological publications are scarce. Allorge & Denis (1927) made only a brief mention on the bryophytes when monographing the vegetation of limnogenous peatlands of Aubrac. More recently, Pujos (1991) published the result of sphagnological investigations. Hugonnot *et al.* (2002), Hugonnot & Ully (2003) and Hugonnot (2004) respectively reported the discovery of the first locality of *Jamesoniella undulifolia*, *Bruchia vogesiaca* and *Sphagnum obtusum* in Aubrac. Surprisingly, there is no mention of Aubrac in the classic work of Boulay (1877), and very few data are given in the work of Héribaud (1899).

Because of the need of accurate and updated data on the species chorology and ecology to draw conservational schemes, a bryological survey was undertaken by the author from 2002 to 2008 that yielded a number of interesting records. Conservation schemes are more and more demanding the appropriate selection of sites of major bryological interest that can efficiently ensure the location and extent of potentially protected areas. In order to gain a more relevant picture of the pattern of bryological interest and to priorize conservational policies, hot-spots are designated.

STUDY AREA

Aubrac is a natural region extending over an area of nearly 450 km^2, mostly made of high volcanic and granitic plateau in the south-western part of Massif Central (Fig. 1). It lies in the departments of Cantal, Aveyron and Lozère, and exhibits a volcanic ridge 30 km long (orientated from NW to SE) dominating a vast granite plateau (Abrard, 1948).

The climate of Aubrac is highly affected by the altitude and the nakedness of the landscape (De Martonne, 1940). The plateau has a severe climate with rainfall averaging often more than 1200 mm per annum. The mean January temperatures are dropping below 0°C, and the temperature is liable to fall under O°C also in summer. Mean July temperatures are about 14°C. Fog is very frequent, and violent storms are common in summer.

Topographically, Aubrac is dominated by the Signal de Mailhebiau that rises to 1469 m (De Martonne, 1942). The mean altitude of the plateau is approximately 1200 m. The age of the volcanic assemblage is from 7 to 10 millions years. Pleistocene glacial activity impacted landscape and let a handful of marks, such as alluviums, erratic blocks and hollows, today filled with peat. Peatlands of Aubrac occupy large areas (more than 1000 ha, Brian, 1999) and are identified as ecosystems of high conservation value, from floristic and phytocoenologic points of view (De Puytorac, 1997; Antonetti *et al.*, 2006; Manneville, 2006).

MATERIAL AND METHODS

The bark and rock inhabiting species have not been included in the present study. Only species more or less linked to peaty habitats have been recorded.

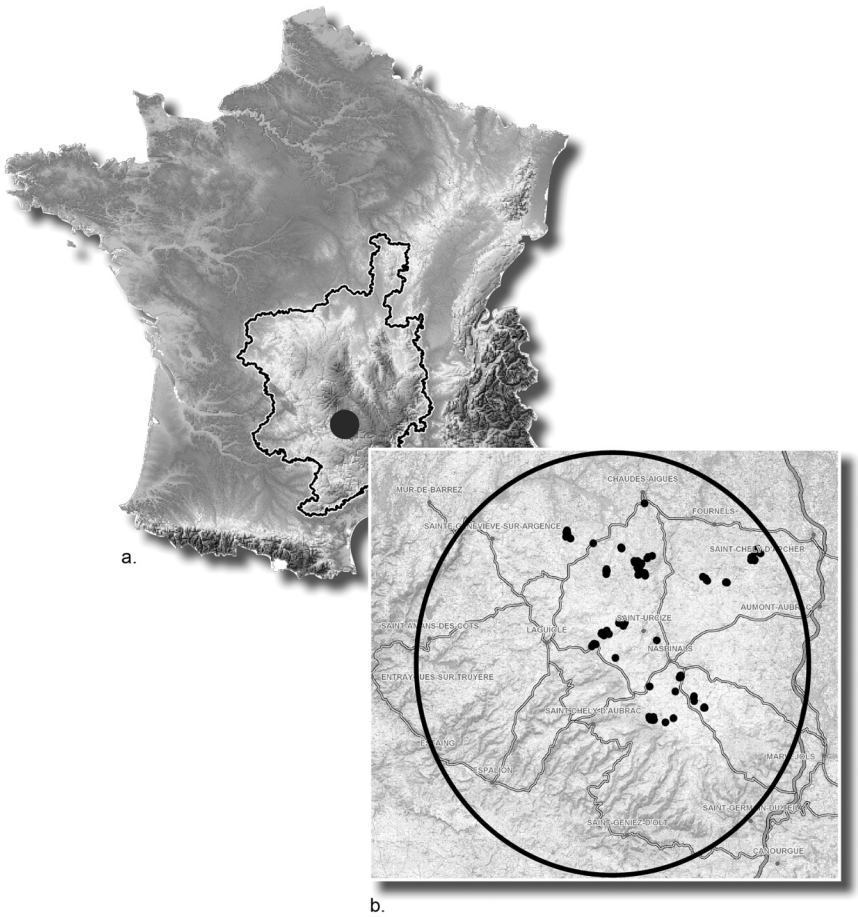


Fig. 1. Location of the Massif Central (black line), Aubrac (black dot) (a), and the investigated sites (b).

The taxonomy and nomenclature of Hill *et al.* (2006) for mosses and Ros *et al.* (2007) for hepatics has been followed, except for the following taxa:

– *Racomitrium* s. l. is considered polyphyletic; hence segregates are recognized following Ochyra *et al.* (2003), notably the genus *Niphotrichum* (Bednarek-Ochyra) Bednarek-Ochyra & Ochyra,

– *Cryptothallus mirabilis* Malmb. is considered to be a member of the genus *Aneura, Aneura mirabilis* (Malmb.) Wickett & Goffinet (Wickett & Goffinet 2008).

Nomenclature of flowering plants follows Kerguélen (1993) whereas the synnomenclature follows Bardat *et al.* (2004).

Geographic coordinates of localities are provided as latitude/longitude, degrees projection WGS 84. The concept of Massif Central used on the maps is defined on the basis of the decree n° 2006-249 of the 27 February 2006 (Journal Officiel de la République Française).

For denomination of habitats and peatland environments, we follow Rydin & Jeglum (2006).

Based on the published or preliminary red data books (Deperiers-Robbe, 2000; ECCB, 1995; Tan *et al.*, 2000) and the the Annex II of EU Directive on Habitats, a selection of high conservation value taxa was made. Additionally, taxa not mentioned in any of the references cited in the preceding but with a national or restricted range at national or local level are added to the list. The publications of Augier (1966), Héribaud (1899) and Schumacker & Sapaly (1996) were consulted to draw the list.

Conservation hot-spots have been selected among all the sites investigated. The sites have been agglomerated to a certain extent in the hot-spot analysis. The 78 localities surveyed have been combined into 24 peatlands complexes. The selection criteria and the method followed in Draper *et al.* (2007) resulted difficult to use in the present case because of the rather low number of peatland complexes and the lack of quantitative data. The species richness of an individudal site is the number of taxa of specific rank. The best sites as regards species richness and species of high conservation value are here considered as local hot-spots. For rarity, those sites that are known to accommodate at least 10 taxa considered of high conservation value are selected. Taxa occuring in only one peatland complex are considered unique and reinforce the local value of hot-spots.

The concepts of Lecointe (1979; 1981a, b) and Düll (1983; 1984; 1985; 1992) have been followed to draw the biogeographic profile of the Aubrac peatland bryoflora.

The vouchers are deposited in the herbarium of Conservatoire Botanique National du Massif Central and in the private herbarium of the author.

The list of visited localities is given in the appendix 1. The communes, localities, altitudes, geographic coordinates, and dates are provided in a geographic sequence roughly from north to south. In all cases, collections were made by the author.

RESULTS AND DISCUSSION

A total of 141 bryophyte taxa have been recorded in the peatlands of Aubrac, including 45 liverworts and 96 mosses. All of them are alphabetically listed below.

Liverworts

Aneura pinguis (L.) Dumort. – 15, 31, 44, 46, 49, 50. In a wide variety of fens.
Aneura mirabilis (Malmb.) Wickett *et* Goffinet – 13. Beneath *Sphagnum palustre*, *S. teres*, *Thuidium tamariscinum*… in *Salix* stands
Barbilophozia kunzeana (Huebener) Müll. Frib. – 18, 56. At the summit of small hummocks in bogs.
Calypogeia fissa (L.) Raddi – 2, 3, 4, 5, 18, 24, 31, 41. In bogs.
Calypogeia muelleriana (Schiffn.) Müll. Frib. – 35, 38, 54. In bogs.
Calypogeia neesiana (C. Massal. *et* Carestia) Müll. Frib. – 54, 67. In bogs.

Calypogeia sphagnicola (Arnell *et* J. Perss.) Warnst. *et* Loeske – 23, 28, 34, 64. In bogs, at the summit of sphagna hummocks.
*Calypogeia suecica (*Arnell *et* J. Perss.) Müll. Frib. – 36. In bogs.
Cephalozia bicuspidata (L.) Dumort. – 4, 6, 17, 18, 22, 31, 37, 47, 52, 54, 55, 56. In fens or bogs.
Cephalozia connivens (Dicks.) Lindb. – 2, 9, 16, 19, 28, 34, 41, 45, 52, 53, 54, 55, 56. In bogs.
Cephalozia loitlesbergeri Schiffn. – 22, 31. In bogs, amidst sphagna.
Cephalozia macrostachya Kaal. – 41. In bogs.
Cephalozia pleniceps (Austin) Lindb. – 46. In bogs.
Cephaloziella divaricata (Sm.) Schiffn. – 43. In bog.
Cephaloziella hampeana (Nees) Schiffn. – 18, 19, 40, 41, 44, 52, 53, 56, 58, 62, 72. In bogs, on hummocks of *Sphagnum.*
Cephaloziella rubella (Nees) Warnst. – 52. Wet heath.
Chiloscyphus pallescens (Ehrh. *ex* Hoffm.) Dumort. – 1, 13, 17, 26, 31, 41, 48, 50, 53, 67. In fens and *Phragmites communis* marshes.
Chiloscyphus polyanthos (L.) Corda – 62. At the margins of small rivulets in bogs.
Cladopodiella francisci (Hook.) Jörg. – 31. On bare peat in bog.
Diplophyllum albicans (L.) Dumort. – 33. On the banks of drainage ditches.
Gymnocolea inflata (Huds.) Dumort. – 47, 59. On bare peat in bogs.
Jamesoniella undulifolia (Nees) Müll. Frib. – 3, 4, 6, 7, 9, 16, 19, 22, 23, 41, 47, 48, 52, 53, 54, 55, 60, 62, 66, 67, 70, 72, 73. On living sphagna in bogs.
Jungermannia gracillima Sm. – 4, 15, 46. On the banks of drainage ditches.
Jungermannia hyalina Lyell – 62. On the banks of drainage ditches.
Kurzia pauciflora (Dicks.) Grolle – 9, 47, 67. On living sphagna in bogs.
Lophocolea bidentata (L.) Dumort. – 11, 13, 33, 53. On dry peat in bogs.
Lophocolea heterophylla (Schrad.) Dumort. – 13, 32, 33, 36. On dry peat in bogs.
Lophozia incisa (Schrad.) Dumort. – 18, 24, 53, 64. On peat and dying sphagna in bogs.
Lophozia longiflora (Nees) Schiffn. – 6, 9, 16, 22, 23, 26, 28, 52, 53, 54, 56, 58. On peat and dying sphagna in bogs.
Lophozia silvicola H. Buch – 18. On peat and dying sphagna in bogs.
Lophozia ventricosa (Dicks.) Dumort. – 33, 47. On peat and dying sphagna in bogs.
Marchantia polymorpha L. subsp. *montivagans* Bischl. *et* Boisselier – 1. In a *Phragmites communis* marsh.
Marchantia polymorpha L. subsp. *polymorpha* – 27, 31, 44, 46, 48, 51, 55, 57. In fens and *Phragmites communis* marshes.
Mylia anomala (Hook.) Gray – 6, 7, 9, 17, 20, 23, 24, 31, 47, 52, 53, 54, 58, 62, 67, 68. On peat, dying and living sphagna in bogs.
Nardia insecta Lindb. – 62. On the banks of drainage ditches.
Pellia epiphylla (L.) Corda – 13, 77. In fens.
Pellia neesiana (Gottsche) Limpr. – 1, 2, 27, 31, 46, 52, 57, 62, 67. In fens.
Ptilidium ciliare (L.) Hampe – 76. In bogs.
Riccardia chamaedryfolia (With.) Grolle – 42, 78. In fens.
Riccardia incurvata Lindb. – 1, 39, 41, 46, 61, 62, 67, 70. In fens.
Riccardia multifida (L.) Gray – 47. In fens.
Riccardia palmata (Hedw.) Carruth. – 55, 65. In bogs.
Riccia canaliculata Hoffm. – 67. In a *Carex vesicaria* marsh.
Scapania irrigua (Nees) Nees – 1, 2, 3, 4, 6, 9, 15, 18, 26, 27, 31, 40, 41, 44, 46, 47, 52, 53, 56, 59. In fens and bogs.
Scapania undulata (L.) Dumort. – 13, 40. At the margins of small rivulets.

Mosses

Atrichum undulatum (Hedw.) P.Beauv. – 2, 9, 15. At the base of desintegrated hummocks, and on the banks of drainage ditches.
Aulacomnium palustre (Hedw.) Schwägr. – 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 24, 28, 29, 30, 32, 35, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59. From fens to bogs.
Brachythecium rivulare Schimp. – 8, 17, 39, 41, 46, 48, 50, 51, 57. A the edge of small rivulets in fens.
Brachythecium rutabulum (Hedw.) Schimp. var. *rutabulum* – 33. In heaths.
Bruchia vogesiaca Nestl. *ex* Schwägr. – 65, 71. In over-grazed *Juncus effusus* stands, at the base of tussocks, and on the banks of drainage ditches.
Bryum alpinum Huds. *ex* With. – 2, 39, 49, 50. On a layer of peat at the base of granite rocks.
Bryum archangelicum Bruch *et* Schimp. – 22, 39. On overturned peat in disturbed bogs.
Bryum bimum (Schreb.) Turn. – 41. In a fen.
Bryum cyclophyllum (Schwägr.) Bruch *et* Schimp. – 21, 27, 51, 72. In intermitently exposed bare peats, at the margin of lakes or at the base of sedge tussocks.
Bryum pallens Sw. *ex* anon. – 5, 60. In bogs and fens, on the banks of drainage ditches.
Bryum pseudotriquetrum (Hedw.) P. Gaertn., B. Mey. *et* Scherb. – 1, 9, 24, 26, 27, 41, 44, 45, 46, 47, 48, 49, 50, 56. In a wide variety of fens.
Bryum tenuisetum Limpr. – 2, 45, 51. On overturned peat in grazed bogs.
Bryum torquescens Bruch *et* Schimp. – 22. In a fen.
Bryum weigelii Spreng. – 24. In a fen.
Calliergon cordifolium (Hedw.) Kindb. – 1, 42, 44, 46, 48, 70, 75. In fens.
Calliergon giganteum (Schimp.) Kindb. – 5, 40, 41, 42, 50, 61, 67, 70, 75, 78. In fens.
Calliergonella cuspidata (Hedw.) Loeske – 1, 2, 4, 5, 6, 7, 8, 13, 15, 17, 18, 19, 22, 24, 25, 26, 32, 33, 34, 39, 40, 41, 42, 43, 44, 45, 46, 48, 49, 50, 51, 53, 55, 56, 57, 58, 59. In a wide variety of grazed fens and humid grasslands.
Campylium stellatum (Hedw.) Lange *et* C.E.O. Jensen – 4, 5, 6, 39, 40, 41, 42, 44, 46, 49, 50. In a wide variety of fens.
Campylopus introflexus (Hedw.) Brid. – 4, 9, 14, 17, 34, 36, 41, 43, 46, 47, 57. In all types of fens and bogs, mostly in disturbed places.
Campylopus pyriformis (Schultz) Brid. – 47. In bogs.
Ceratodon purpureus (Hedw.) Brid. subsp. *purpureus* – 1, 5, 9, 14, 15, 16, 17, 44, 46, 47, 48, 51, 52, 54. In fens and bogs, in disturbed places, rarely on dung.
Climacium dendroides (Hedw.) F. Weber & D. Mohr – 1, 2, 6, 8, 24, 25, 39, 40, 41, 44, 46, 48, 49, 50, 51, 56, 57. In a wide variety of fens and carrs.
Dichodontium palustre (Dicks.) M. Stech – 1. In a poor fen and at the margins of rivulets.
Dicranella heteromalla (Hedw.) Schimp. – 9, 15, 17, 38, 45, 52, 57. On the banks of drainage ditches.
Dicranella rufescens (Dicks.) Schimp. – 15. On the banks of drainage ditches.
Dicranodontium denudatum (Brid.) E. Britton – 6, 47. At the base of hummocks in bogs.
Dicranum bonjeanii De Not. – 18, 20, 22, 41, 45, 46, 49, 50, 51, 52, 56, 57. Amidst sphagna in bogs and fens.
Dicranum scoparium Hedw. – 11, 13, 33, 48, 54, 55. At the summit of sphagna hummocks in bogs.

Dicranum undulatum Schrad. *ex* Brid. – 6, 18, 19, 20, 41, 43, 45, 47, 48, 62, 67, 68, 70, 73. At the summit of sphagna hummocks in bogs.
Drepanocladus aduncus (Hedw.) Warnst. – 1, 44, 48. In fens.
Ephemerum minutissimum Lindb. – 2. In overgrazed fens.
Ephemerum serratum (Hedw.) Hampe – 64. In overgrazed fens.
Fissidens adianthoides Hedw. – 40, 42, 44, 49, 50. In fens.
Fissidens osmundoides Hedw. – 40, 45, 62, 77. In fens.
Fontinalis antipyretica Hedw. var. *antipyretica* – 2, 6, 13, 39, 40, 41, 50, 51. Immersed in small rivulets.
Funaria hygrometrica Hedw. – 47, 54. In disturbed fens and bogs.
Hamatocaulis vernicosus (Mitt.) Hedenäs – 4, 5, 6, 7, 19, 25, 26, 34, 40, 41, 43, 44, 46, 50, 59, 62, 64, 67, 69, 70, 74, 75, 78. In fens.
Herzogiella seligeri (Brid.) Z. Iwats. – 33, 36. In dry bogs.
Hylocomium splendens (Hedw.) Schimp. – 1, 6, 11, 13, 14, 17, 18, 19, 22, 30, 33, 36, 38, 40, 41, 47, 48, 52, 55. In fens and bogs.
Hypnum cupressiforme Hedw. var. *cupressiforme* – 6, 13, 19, 33, 38, 40, 55. In bogs.
Hypnum jutlandicum Holmen *et* E. Warncke – 6, 17, 18, 19, 30, 48, 54, 59. In bogs and wet heathlands.
Leucobryum glaucum (Hedw.) Ångstr. – 3, 4, 6, 20, 39, 47, 48. In bogs.
Niphotrichum elongatum (Frisvoll) Bednarek-Ochyra *et* Ochyra – 2, 40, 43. In dry parts of heaths.
Philonotis caespitosa Jur. – 8, 51. In fens.
Philonotis fontana (Hedw.) Brid. – 1, 6, 25, 26, 27, 40, 41, 46, 49, 50. In fens.
Philonotis tomentella Molendo – 46, 61, 70, 75. In fens.
Plagiomnium elatum (Bruch *et* Schimp.) T.J. Kop. – 40, 41, 42, 44, 46, 49, 50. In sedge marshes and fens.
Plagiomnium ellipticum (Brid.) T.J. Kop. – 1, 26, 27, 34, 48, 49, 50, 51, 67. In sedge marshes and fens.
Plagiothecium curvifolium Schlieph. *ex* Limpr. – 22. In bogs.
Platyhypnidium riparioides (Hedw.) Dixon – 50. Immersed in small rivulets.
Pleuridium acuminatum Lindb. – 4. In disturbed fens.
Pleurozium schreberi (Willd. *ex* Brid.) Mitt. – 1, 2, 3, 4, 6, 8, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20, 22, 23, 28, 30, 32, 33, 34, 36, 37, 38, 41, 43, 45, 46, 47, 48, 52, 54, 55, 56, 58. In dry bogs and heathlands.
Pogonatum aloides (Hedw.) P. Beauv. – 14. In a bog, at the base of a disturbed sphagna hummock.
Pohlia annotina (Hedw.) Lindb. – 2, 51, 63. On the banks of drainage ditches.
Pohlia camptotrachela (Renauld *et* Cardot) Broth. – 51, 62. On the banks of drainage ditches.
Pohlia nutans (Hedw.) Lindb. subsp. *nutans* – 9, 18, 22, 23, 43, 47, 52, 53, 54, 55, 58. On sphagna hummocks in bogs.
Pohlia sphagnicola (Bruch *et* Schimp.) Broth. – 45. Amidst sphagna in bogs.
Polytrichastrum longisetum (Sw. *ex* Brid.) G.L. Sm. – 6, 45, 49, 50. In disturbed fens and bogs.
Polytrichum commune Hedw. – 1, 3, 4, 9, 10, 11, 13, 14, 15, 16, 17, 18, 22, 29, 30, 32, 34, 36, 37, 38, 46, 51, 52, 54, 55, 56, 57, 58, 59. In sedge marshes and fens.
Polytrichum strictum Menzies *ex* Brid. – 2, 3, 4, 6, 8, 9, 11, 12, 14, 15, 16, 17, 18, 19, 20, 22, 23, 24, 30, 34, 36, 37, 38, 41, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 58, 59. At the summit of hummocks in bogs.
Pseudephemerum nitidum (Hedw.) Loeske – 51. In disturbed fens.
Pseudobryum cinclidioides (Huebener) T.J. Kop. – 51, 57, 59. In fens.
Pseudoscleropodium purum (Hedw.) M. Fleisch. – 13, 15. In dry heaths.

Rhizomnium pseudopunctatum (Bruch *et* Schimp.) T.J. Kop. – 6, 49, 50, 53, 67, 69, 70. In fens.
Rhizomnium punctatum (Hedw.) T.J. Kop. – 2, 33, 46, 49, 50. In fens, bogs and carrs.
Rhytidiadelphus squarrosus (Hedw.) Warnst. – 53. In a grazed fen.
Rhytidium rugosum (Hedw.) Kindb. – 4. In a bog.
Scorpidium scorpioides (Hedw.) Limpr. – 42, 44, 62, 78. In fens and *Phragmites* marshes.
Sphagnum angustifolium (C.E.O. Jensen *ex* Russow) C.E.O. Jensen – 8 , 10, 11, 12, 14, 15, 16, 17, 18, 22, 23, 24, 26, 29, 30, 32, 34, 35, 36, 37, 38, 41, 51, 52, 53, 54, 55, 56, 58, 59. In fens or at the margin of bogs.
Sphagnum auriculatum Schimp. – 2, 3, 4, 9, 22, 34, 52. In fens.
Sphagnum capillifolium (Ehrh.) Hedw. – 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20, 22, 23, 24, 25, 28, 30, 31, 32, 34, 36, 37, 38, 39, 41, 43, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 58, 59. In bogs.
Sphagnum centrale C.E.O. Jensen – 26, 40, 41, 44. At the margins of small rivulets, in the transition zone between fens and bogs.
Sphagnum compactum Lam. *et* DC. – 2, 4, 6, 19, 20, 28, 31, 39, 43, 47, 52, 59, 65. In wet heaths or senescent bogs.
Sphagnum contortum Schultz – 46, 50, 74, 78. In fens.
Sphagnum fallax (H. Klinggr.) H. Klinggr. – 8, 10, 11, 14, 24, 25, 26, 29, 31, 35, 36, 37, 38, 52, 53, 54, 59. In a wide variety of fens.
Sphagnum flexuosum Dozy *et* Molk. – 3, 4, 7, 9, 12, 25, 44, 52, 54, 56, 57. In a wide variety of fens.
Sphagnum fuscum (Schimp.) H. Klinggr. – 45, 72. In bogs.
Sphagnum inundatum Russow – 3, 4, 7, 15, 25, 26, 27, 37, 44, 45, 47, 48, 52, 54, 56. In grazed fens.
Sphagnum magellanicum Brid. – 1, 8, 9, 10, 11, 12, 16, 17, 18, 19, 24, 25, 30, 31, 32, 34, 35, 37, 41, 44, 45, 51, 52, 53, 54, 56, 57, 58, 59. In bogs.
Sphagnum obtusum Warnst. – 26, 27, 29, 64. In fens.
Sphagnum palustre L. – 1, 3, 4, 6, 7, 13, 22, 25, 29, 30, 32, 34, 39, 46, 51, 52, 53, 54, 55, 56, 57, 59. In a wide variety of peatlands.
Sphagnum papillosum Lindb. – 1, 3, 4, 6, 8, 9, 11, 12, 14, 15, 17, 18, 19, 20, 21, 24, 25, 31, 32, 36, 37, 38, 41, 43, 44, 45, 47, 48, 54, 59. In fens and bogs.
Sphagnum platyphyllum (Lindb. *ex* Braithw.) Warnst. – 18, 20, 21, 41, 43, 75. In fens.
Sphagnum rubellum Wilson – 7, 22, 32, 35, 52. In bogs.
Sphagnum russowii Warnst. – 23, 32, 36, 38, 41, 66, 67. In bogs.
Sphagnum subnitens Russ. *et* Warnst. – 2, 3, 4, 5, 6, 7, 19, 20, 44, 45, 46, 48. In fens.
Sphagnum subsecundum Nees – 2, 3, 4, 5, 6, 8, 17, 39, 40, 41, 44, 46, 50, 53, 57. In fens.
Sphagnum tenellum (Brid.) Pers. *ex* Brid. – 8, 20, 31, 35, 43, 47, 48. In wet heathlands or dry bogs.
Sphagnum teres (Schimp.) Ångstr. – 1, 3, 4, 5, 6, 8, 13, 17, 22, 25, 26, 27, 29, 30, 32, 34, 37, 39, 40, 41, 42, 44, 45, 46, 48, 49, 50, 53, 55, 56, 57, 58, 59. In fens.
Sphagnum warnstorfii Russow – 5, 6, 7, 40, 41, 42, 44, 46, 48, 50. In fens.
Splachnum ampullaceum Hedw. – 24, 25, 41, 54, 59, 62, 67. On dung of cow, in fens and bogs.
Straminergon stramineum (Dicks. *ex* Brid.) Hedenäs – 1, 3, 4, 6, 8, 11, 12, 17, 18, 19, 20, 24, 25, 26, 29, 30, 31, 32, 35, 37, 40, 41, 42, 44, 45, 48, 52, 53, 56, 57, 58, 59. Almost in all type of wetlands.
Thuidium tamariscinum (Hedw.) Schimp. – 1, 2, 6, 15, 22, 46, 52. In bogs.

Tomenthypnum nitens (Hedw.) Loeske – 26, 40, 41, 44, 45, 46, 48, 49, 50, 53, 67, 70. In fens.
Trichodon cylindricus (Hedw.) Schimp. – 9. In disturbed fens.
Warnstorfia exannulata (Schimp.) Loeske – 1, 2, 4, 5, 6, 9, 14, 15, 17, 18, 19, 21, 22, 26, 27, 31, 37, 38, 41, 43, 44, 46, 48, 52, 53, 56, 57, 58, 59. In springs and fens.

ANALYSIS OF THE CATALOGUE

Foristic diversity and richness

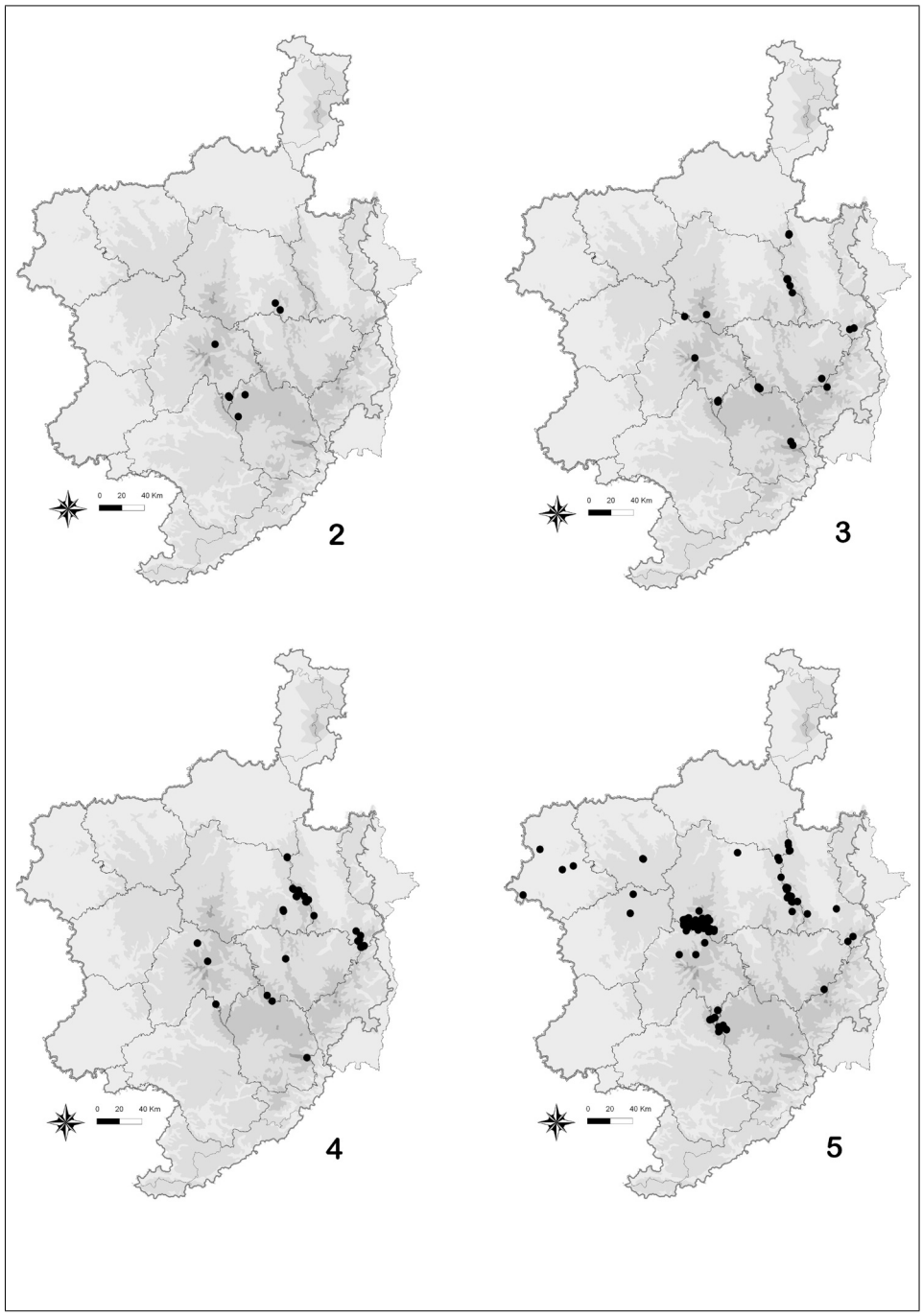
The peat mosses (species of the genus *Sphagnum*) form a large group in the peatlands of Aubrac, with not less than 22 species. They are often dominant in preserved bogs and poor fens. The 9 brown mosses (*Amblystegiaceae* sensu lato) are by contrast characteristic of rich fens. A high number of taxa (more than 15) belonging to the acrocarpous families (*Bryaceae*, *Ditrichaceae*, *Pottiaceae*) are typical of disturbed habitats.

The peatland bryoflora of Aubrac is characterized by a high proportion (almost 1/2) of liverworts relative to mosses, a fact that must be connected with the availability of ground and meteoric water. Jungermanniales are the most diverse, with several genera well represented: *Calypogeia* (5 species), *Cephalozia* (5 species), *Lophozia* (4 species) and *Cephaloziella* (3 species). These species are either typical of disturbed (mainly by grazing) fens and bogs or of sphagna hummocks. Thalloid species are less numerous. Metzgeriales and Pelliales are the only significant groups, with 8 species (of which 4 species belong to the genus *Riccardia*).

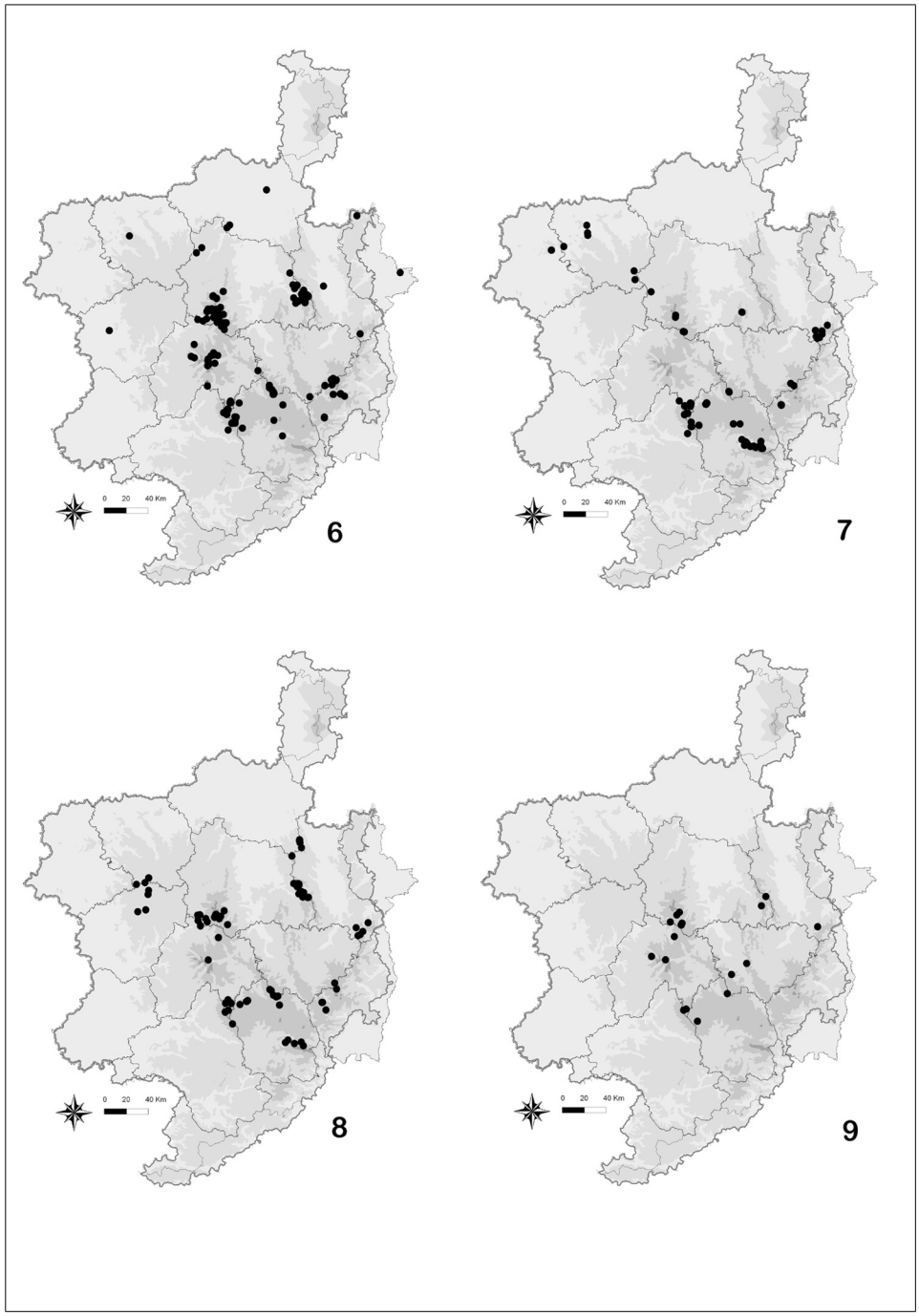
Distribution

The circumboreal s.l. assemblage is largely predominant (Fig. 12) with 67% of the total, of which 34% exhibit a montane bias, which was much expected from the general data on the climate of this typical mountain plateau (see introduction). The Atlantic element s.l. reaches a total of 19%, of which 42% are predominantly montane. Hence, the montane trend is globally very high, representing almost a third (31%) of the total bryoflora. The cosmopolitan taxa are rather diverse, as they represent a 14% of the total. The majority of these taxa are typical of disturbed habitats. Unfortunately, data for comparison are lacking, since the bryoflora of major peaty sites of Massif Central has not been surveyed yet.

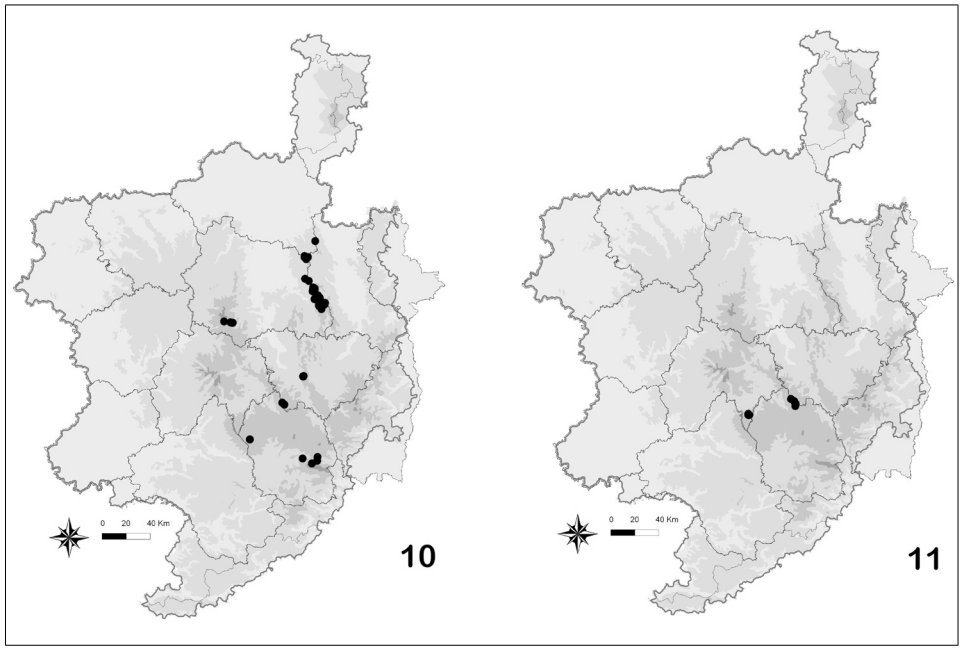
Most species are common in the study area and on the major mountain range of Massif Central (*Hamatocaulis vernicosus*, *Jamesoniella undulifolia*, *Dicranum undulatum* or *Mylia anomala*, Fig. 6, 7, 5, 8*)*. Several other species exhibit a restricted distribution range (Fig 2, 3, 4, 9, 10, 11). *Sphagnum fuscum* (Fig. 10) is more abundant on the eastern side of the Massif Central because it shows some affinity with the coldest peatlands. *Sphagnum obtusum* (Fig. 11) is restricted to exceptionnaly well preserved fens of Aubrac and Margeride. *Calypogeia sphagnicola* (Fig. 3), *Aneura mirabilis* (Fig. 4), *Polytrichastrum longisetum* (Fig. 9) and *Bryum cyclophyllum* (Fig. 2) seem to be restricted owing to high habitat requirements, and to the difficulties experienced in their field detection.



Figs 2-5. Distribution in the Massif Central of **(2)** *Bryum cyclophyllum* (Schwägr.) Bruch *et* Schimp., **(3)** *Calypogeia sphagnicola* (C. Massal. *et* Carestia) Müll. Frib., **(4)** *Aneura mirabilis* (Malmb.) Wickett *et* Goffinet, **(5)** *Dicranum undulatum* Schrad. *ex* Brid.



Figs 6-9. Distribution in the Massif Central of **(6)** *Hamatocaulis vernicosus* (Mitt.) Hedenäs, **(7)** *Jamesoniella undulifolia* (Nees) Müll. Frib., **(8)** *Mylia anomala* (Hook.) Gray, **(9)** *Polytrichastrum longisetum* (Sw. *ex* Brid.) G.L. Sm.



Figs 10-11. Distribution in the Massif Central of **(10)** *Sphagnum fuscum* (Schimp.) H. Klinggr., **(11)** *Sphagnum obtusum* Warnst.

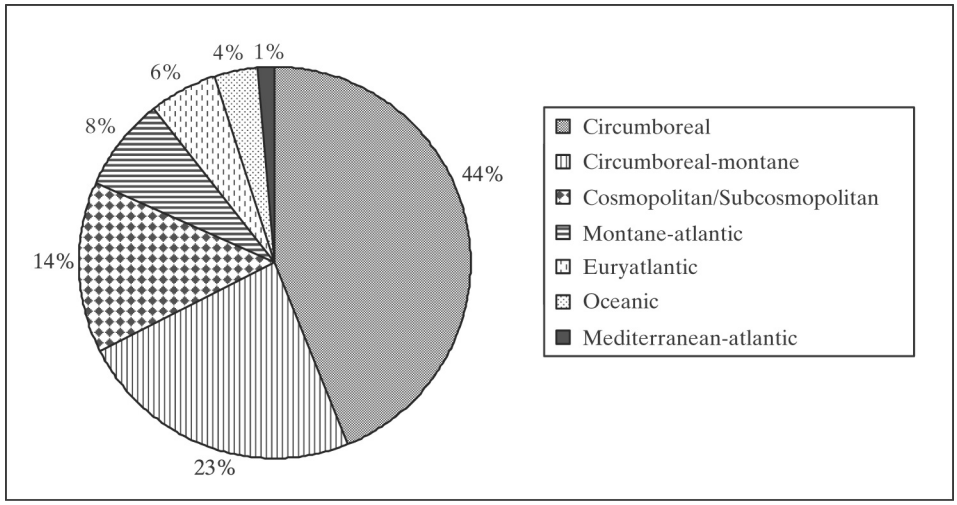


Fig. 12. Bryogeographic profile of the peatlands of Aubrac according to Lecointe (1979, 1981a, b) and Düll (1983, 1984, 1985, 1992).

Bryocoenotic richness

The standing water of several lakes is a marshy habitat, floristically poor, often dominated by *Phragmites australis* (*Phragmition communis* Koch 1926). This habitat is seasonally flooded, and is generally nutrient and base-rich, with only a superficial peat layer. The marshes are rare in the Aubrac plateau, and the associated bryophytes are rather scarce. *Scorpidium scorpioides* and *Bryum pseudotriquetrum* are the most important components of the bryophyte layer. Occasionally the *Carex vesicaria* marshes may exhibit a diverse bryoflora, with *Bryum cyclophyllum* at the base of the tussocks and *Sphagnum platyphyllum* in the hollows.

The carrs are as rare as the marshes and they never form an important physiognomic habitat. *Salix acuminata* and *Betula pendula* are the most notable tree species (*Salicion cinereae* Müller *et* Görs 1958). They are an important habitat for a rich epiphytic bryoflora, which is not the subject of the present contribution. The understorey bryoflora is generally rather dense, with *Sphagnum palustre*, *Rhizomnium punctatum* and exceptionally *Aneura mirabilis*.

The minerotrophic fens (*Caricion lasiocarpae* Vanden Berghen *in* Lebrun, Noirfalise, Heinemann & Vanden Berghen 1949), either topo- or, more commonly, soligenous, occupy important areas. The internal drainage is generally slow, but there can be an oversurface flow that allows a rich pioneer bryoflora to develop (*Riccardia incurvata*, *Cladopodiella francisci*…). The most abundant species are sphagna (*Sphagnum subsecundum*, *S. contortum*, *S. warnstorfii*, *S. obtusum*…) and the so called "brown mosses" (*Campylium stellatum*, *Hamatocaulis vernicosus*…) (Hugonnot, 2004). Hummocks may achieve small dimensions (far less than in bogs). *Sphagnum warnstorfii* is the dominant species in the best examples of rich fens. In poor ones, *Sphagnum papillosum* or *S. capillifolium* may cover significant portions of the fen and lead to a hummock-hollow topography.

Fragments of spring communities (*Montio fontanae-Cardaminetea amarae* Br.-Bl. & Tüxen *ex* Klika & Hadač 1944) can be observed in the vicinity of streamlets. *Scapania undulata*, *Bryum weigelii*, *Philonotis tomentella* are the most noteworthy species.

Bogs (either domed or rather flat) are notably well represented in Aubrac. They are ombrotrophic peatlands dominated by sphagna (*Sphagnum capillifolium*, *S. magellanicum*, *S. angustifolium*…). Lawns are often extensive and rather poor, with *Sphagnum magellanicum* and members of the section *Cuspidata* (*Sphagnum fallax*…) being the most prominent components. They belong to *Oxycocco palustris-Sphagnetea magellanici* Br.-Bl. & Tüxen *ex* V. West., Dijk & Paschier 1946. The hummocks are invaded by social species like *Polytrichum strictum*, and in senescing phases, by species of heaths (*Pleurozium schreberi*, *Pseudoscleropodium purum*…). The degenerating mats of apiculi are colonized by communities dominated by liverworts, of which *Jamesoniella undulifolia*, *Mylia anomala*, *Calypogeia sphagnicola*, *Cephalozia loitlesbergeri*, *Cephaloziella hampeana*… (Hugonnot *et al.*, 2002) are the best examples. The margins of the bogs are generally very wet, and numerous sphagna can be found there (*Sphagnum fallax, S. flexuosum, S. magellanicum, S. teres*…).

Pools, either disseminated in bogs or in topogenous basin, are scarce and invaded by *Sphagna* (section *Cuspidata* notably) and *Warnstorfia exannulata*.

Dungs of cattle in wet heath and bogs are invaded by tufts of *Splachnum ampullaceum*. This ecologically highly specialized species is sensitive to desiccation, and only colonizes dungs that are protected from direct sunlight radiation. Associated bryophytes are scarce, including a few depauperate *Bryum* sp. (sterile) and *Ceratodon purpureus*.

Peat cuttings in bogs or fens, ditch banks and disturbed peaty-sandy-gravely substrates, either in minerotrophic or ombrotrophic peatlands, may support a rich bryoflora that mostly is connected to the high level of disturbance (mainly due to trampling of cattle). Species like *Atrichum undulatum*, *Bruchia vogesiaca* (Hugonnot & Ully, 2003), *Bryum pallens, Cephalozia bicuspidata, Dicranella rufescens, Ephemerum* div. sp., *Riccia canaliculata, Scapania irrigua, Trichodon cylindricus* may achieve dominance in certain phases of colonization.

Wooded bogs are almost inexistent in Aubrac. Isolated trees are rarely observed and they are never so abundant to impact the bryophyte cover significantly.

Conservation

The 32 taxa of high conservation value are mainly species living in micro-habitats, such as dying sphagna (*Calypogeia sphagnicola, Cephalozia loitlesbergeri, Cephalozia macrostachya, Jamesoniella undulifolia*…) or bare and exposed peat (*Bruchia vogesiaca, Bryum cyclophyllum, B. tenuisetum, Riccardia incurvata*…). Additionally, there are species of rich or poor fens (*Calliergon giganteum, Hamatocaulis vernicosus, Sphagnum contortum, S. warnstorfii*).

The richness of the peatland complexes varies from 1 to 121 species (i.e. from 0,7 to 86% of the total richness of the Aubrac peatlands) (Table 2). The mean richness is 35,1 taxa (standard deviation = 29,5) per complex. The number of taxa of high conservation value varies from 0 to 18 in the complexes (mean = 4,6; standard deviation = 4,92). Although a global concordance between species richness/richness in taxa of high conservation value is observed (Fig. 13), several discrepancies are apparent. Several sites not particularly rich in taxa, exhibit an abnormally high number of taxa of high conservation value and, conversely, several rich localities do appear in fact notably devoided of taxa of high conservation value. Four sites (sites 1, 2, 3 and 4, Fig. 14) are considered of high interest from both richness and high conservation value criteria, and are consequently designated as bryological local hot-spots. In all, the floristic richness of the 4 designated hot-spots allows the conservation of 121 species and 86% of the floristic richness is captured within these 4 hot-spots. Each of these 4 hot-spots exhibits additionally 2 taxa listed in the Annex II of EU directive on Habitats. Interestingly, the 4 hot-spots are currently integrated into the Natura 2000 network.

Grazing by cattle, drainage and fertilization are most probably very ancient practices in Aubrac. The effect of grazing on peatland is the most controversial one, as it surely provides a huge of bryophytic micro-habitats but also causes a severe disturbance of peat layer and dammage of sphagna, and may alter the vegetation (Rydin & Jeglum, 2006). Drainage and fertilization cause heavy ground disturbances, modifies water balance and alters nutrient equilibrium, which may result deleterious to the bryoflora, and are among the most important threats (Hallingbäck & Hodgetts, 2000 ; Payette & Rochefort, 2001). Paradoxically, the most noticeable sites from a bryological perspective are the disturbed ones. The small scale habitat of bryophyte may ensure, to a certain degree, a protection to the species, because, even in disturbed bogs, small remnants of living sphagna or small pools, for example, may arbour taxa of a high conservation value. This kind of "protection" should not be overemphasized because there may be a time gap between cause and effect in the cryptogam strata.

Table 1. Status of taxa with high conservation value (+ means presence)

Taxon	*EU Habitat Directive*	*World Red List of Bryophyte*	*Red Data Book*	*Livre rouge de France*	*National or local interest*
Aneura mirabilis					+
Barbilophozia kunzeana					+
Bruchia vogesiaca	**Annex II**		+	+	
Bryum cyclophyllum					+
Bryum tenuisetum			+		
Bryum weigelii					+
Calliergon giganteum					+
Calypogeia sphagnicola					+
Cephalozia loitlesbergeri					+
Cephalozia macrostachya					+
Cephalozia pleniceps					+
Cladopodiella francisci					+
Dicranum undulatum					+
Fissidens osmundoides					+
Hamatocaulis vernicosus	**Annex II**		+	+	
Jamesoniella undulifolia		+	+	+	
Mylia anomala					+
Nardia insecta					+
Pohlia sphagnicola					+
Polytrichastrum longisetum					+
Pseudobryum cinclidioides					+
Rhizomnium pseudopunctatum					+
Riccardia incurvata					+
Scorpidium scorpioides					+
Sphagnum centrale					+
Sphagnum contortum					+
Sphagnum fuscum					+
Sphagnum obtusum					+
Sphagnum platyphylllum					+
Sphagnum warnstorfii					+
Splachnum ampullaceum					+
Tomenthypnum nitens					+

Table 2. Value of the sites from a conservational point of view (in bold the taxa either cited in the EU Directive on habitats or in the World Red Data list)

Site	*Locality*	*Richness*	*Number of taxa of high conservation value*
1	Tras Recous Las Gazelles	78	18
2	Truc de l'Aiguille	121	11
3	Landes du Clapier	63	10
4	Sources du Roc	55	15

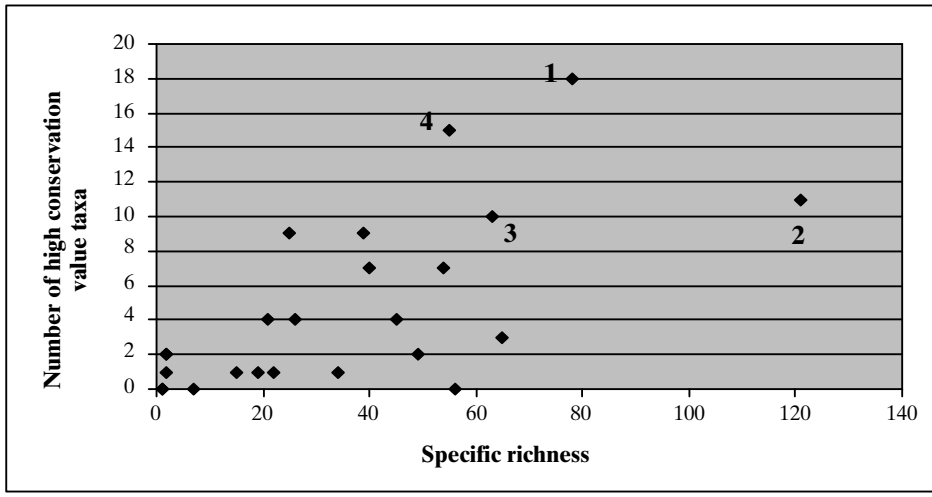


Fig. 13. Relationship between specific richness and number of high conservation value taxa.

CONCLUDING REMARKS

There is an urgent need of a phytoeconological characterization of bryophyte habitats, with a special emphasis on the processes involved in the local maintenance and spreading of groupings, notably those (mainly liverworts) directly linked to the sphagna hummocks. The energetic balance between vegetative multiplication versus sexual one, the strategy at the local and landscape scales… should be surveyed. Surely, this would shed some light over those specialized and still poorly known taxa, such as *Jamesoniella undulifolia* or *Calypogeia sphagnicola.*

Several taxa that have not been observed during our survey should be actively searched for in the future: *Sphagnum majus* that is known to occur in haut Forez, northern Cézallier, Aigoual, and Limousin; *Odontoschisma sphagni*, *O. denudatum a*nd *O. elongatum* are present in different kinds of peatlands of Massif Central but notably absent from Aubrac; *Meesia triquetra* is exceptionally rare in the Massif Central, and *M. longiseta* has not been refound for more than 50 years.

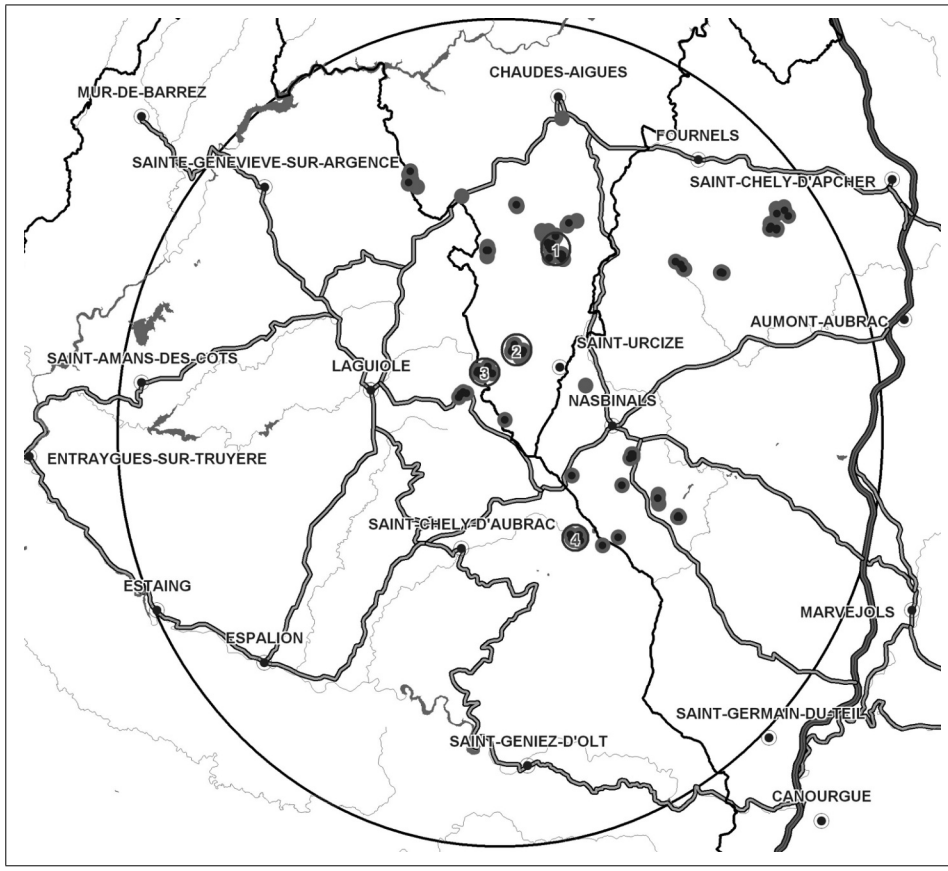


Fig. 14. Localisation of sites in Aubrac plateau with high conservation value.

Considering the rich bryoflora of Aubrac, this plateau could well be integrated into the Bryophyte site register for France as an important area for conservation of peatland bryophytes (Hodgetts, 1995). The remarkable sites from a conservation perspective (the 4 hot-spots) should be monitored in the future to precociously detect any potentially deleterious change. This applies for other peaty complexes (Cézallier, Artense, Margeride), that should be bryofloristically surveyed in order to properly evaluate their respective interests and affinities.

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Appendix 1. Prospected localities

1 – Cantal, Saint-Urcize, SW of le Truc de l'Aiguille, N 44.7059 E 2.96298, 1220-1230 m, 24/9/2008.
2 – Cantal, Saint-Urcize, le Truc de l'Aiguille, N 44.7067 E 2.96369, 1210-1220 m, 24/09/2008.
3 – Cantal, Saint-Urcize, 250 m north of le Truc de l'Aiguille, N 44.7081 E 2.96468, 1210-1215 m, 24/09/2008.
4 – Cantal, Saint-Urcize, 500 m north of le Truc de l'Aiguille, N 44.7101 E 2.96542, 1195-1197 m, 24/09/2008.
5 – Cantal, Saint-Urcize, 100 m south-east of le Truc de l'Aiguille, N 44.7061 E 2.96537, 1218 m, 24/09/2008.
6 – Cantal, Saint-Urcize, 300 m north-west of Puech Tindoire, N 44.7059 E 2.97064, 1197 m, 24/09/2008.
7 – Cantal, Saint-Urcize, 200 m north-west of Puech Tindoire, N 44.7063 E 2.97239, 1188-1190 m, 24/09/2008.
8 – Cantal, La Trinitat, north-east of Les Vergnes, N 44.7673 E 2.94383, 1000 m, 24/09/2008.
9 – Cantal, La Trinitat, 200 m west of La Prade, N 44.7653 E 2.94442, 1113-1114 m, 24/09/2008.
10 – Cantal, Jabrun, south of les Goutilles, N 44.7969 E 2.92281, 1070 m, 24/09/2008.
11 – Cantal, Lieutadès, 300 m south of les Vergnes des Mazes, N 44.8099 E 2.87975, 990-1000 m, 25/09/2008.

12 – Cantal, Lieutadès, 100 m south of les Vergnes des Mazes, N 44.8108 E 2.8809, 980-990 m, 25/09/2008.
13 – Cantal, Lieutadès, les Vergnes des Mazes, N 44.8118 E 2.88109, 989 m, 25/09/2008.
14 – Cantal, Lieutadès, 400 m west of Les Tournades, N 44.8095 E 2.88112, 990-1000, 25/09/2008.
15 – Cantal, Lieutadès, Les Claques, N 44.8062 E 2.88226, 983 m, 25/09/2008.
16 – Cantal, Lieutadès, north-east of Puech des Issarts, N 44.8052 E 2.87961, 990 m, 25/09/2008.
17 – Cantal, Jabrun, wetlands complex between la Chassagne and les Roustières, N 44.792 E 2.96767, 1080-1090 m, 25/09/2008.
18 – Cantal, Saint-Rémy-de-Chaudes-Aigues, north of Tras Recous, N 44.7626 E 3.00388, 1210-1220 m, 25/09/2008.
19 – Cantal, Saint-Rémy-de-Chaudes-Aigues, Tras Recous, N 44.7616 E 3.00338, 1210-1220 m, 25/09/2008.
20 – Cantal, Saint-Rémy-de-Chaudes-Aigues, north-west of Tras Recous, N 44.7622 E 3.00498, 1210-1220 m, 25/09/2008.
21 – Cantal, Saint-Rémy-de-Chaudes-Aigues, west of Tras Recous, N 44.7597 E 3.0057, 1110-1120 m, 25/09/2008.
22 – Cantal, Jabrun, north of Las Gazelles, N 44.7656 E 2.99539, 1203-1203 m, 30/09/2008.
23 – Cantal, Jabrun, north of Las Gazelles, N 44.7663 E 2.99538, 1200 m, 30/09/2008.
24 – Cantal, Jabrun, north of Las Gazelles, N 44.7672 E 2.99615, 1198 m, 30/09/2008.
25 – Cantal, Jabrun, north of Las Gazelles, N 44.7676 E 2.99579, 1193-1198 m, 30/09/2008.
26 – Cantal, Jabrun, 500 m north of Las Gazelles, N 44.7673 E 2.9945, 1190-1197 m, 30/09/2008.
27 – Cantal, Jabrun, north of Las Gazelles, N 44.7686 E 2.99395, 1188-1190 m, 30/09/2008.
28 – Cantal, Jabrun, north of Las Gazelles, N 44.769 E 2.99327, 1188 m, 30/09/2008.
29 – Cantal, Jabrun, north of Las Gazelles, N 44.7695 E 2.99342, 1188 m, 30/09/2008.
30 – Cantal, Jabrun, north of Las Gazelles, 1196-1200 m, N 44.7707 E 2.99407, 1196-1200 m, 30/09/2008.
31 – Cantal, Jabrun, north of Las Gazelles, N 44.7689 E 2.99662, 1190 m, 30/09/2008.
32 – Cantal, Jabrun, Sagne Haute, N 44.7763 E 2.9937, 1214-1219 m, 30/09/2008.
33 – Cantal, Jabrun, Puy d'Aubraquet, N 44.7752 E 2.99062, 1200-1215 m, 30/09/2008.
34 – Cantal, Jabrun south-east of Sagne Haute, N 44.7736 E 2.99989, 1210-1113 m, 30/09/2008.
35 – Cantal, Jabrun south-east of Sagne Haute, N 44.7721 E 2.99922, 1204-1209 m, 30/09/2008
36 – Cantal, Jabrun, Puy d'Aubraquet, N 44.7747 E 2.99111, 1206-1208 m, 30/09/2008.
37 – Cantal, Deux-Verges, Puy Siglar, N 44.7821 E 3.01736, 1245-1248 m, 30/09/2008.
38 – Cantal, Deux-Verges, west of Puy Pagat, N 44.7793 E 3.00933, 1244-1247 m, 30/09/2008.
39 – Aveyron, Prades d'Aubrac, west of le Pendouliou de Ramel, N 44.5922 E 3.03599, 1301-1324 m, 01/10/2008.
40 – Aveyron, Prades d'Aubrac, sources du Roc, N 44.5949 E 3.01737, 1301-1304 m, 01/10/2008.
41 – Aveyron, Prades d'Aubrac, sources du Roc, N 44.597 E 3.01128, 1268-1279 m, 01/10/2008.
42 – Lozère, Nasbinals, northern margin of lac des Salhiens, N 44.6437 E 3.06148, 1211 m, 01/10/2008.
43 – Lozère, Nasbinals, north of lac des Salhiens, N 44.6449 E 3.06096, 1211-1214 m, 01/10/2008.
44 – Lozère, Nasbinals, western margin of lac des Salhiens, N 44.6429 E 3.05927, 1210-1228 m, 01/10/2008.
45 – Lozère, Marchastel, western margin of lac de Born, N 44.6087 E 3.09825, 1259 m, 01/10/2008.
46 – Aveyron, Laguiole, Troubades, N 44.6819 E 2.9231, 1254-1289 m, 25/10/2008.
47 – Aveyron, Laguiole, landes du Clapier, N 44.6922 E 2.93834, 1285-1286 m, 25/10/2008.
48 – Aveyron, Laguiole/Saint-Urcize, north-west of the landes du Calpier, N 44.6943 E 2.93524, 1287 m, 25/10/2008.
49 – Cantal, Saint Urcize, 900 m north-east of landes du Clapier, N 44.6972 E 2.94333, 1270-1280 m, 25/10/2008.
50 – Cantal, Saint Urcize, Vacheries de la Matte, N 44.6937 E 2.94517, 1245-1270 m, 25/10/2008.
51 – Lozère, La Fage Montivernoux, Le Faltre, N 44.7784 E 3.17647, 1198-1199 m, 26/10/2008.
52 – Lozère, La Fage Montivernoux, Le Faltre, N 44.7764 E 3.18082, 1200-1207 m, 26/10/2008.
53 – Lozère, La Fage Montivernoux, Le Faltre, N 44.7763 E 3.17574, 1197 m, 26/10/2008.
54 – Lozère, La Fage Saint Julien, north-east of Landel, N 44.7838 E 3.19114, 1206 m, 26/10/2008.
55 – Lozère, La Fage Saint Julien, north of Landel, N 44.7879 E 3.18783, 1184 m, 26/10/2008.
56 – Lozère, La Fage Saint Julien, Roche Aigude, N 44.7866 E 3.18145, 1180-1210 m, 26/10/2008.
57 – Lozère, La Fage Montivernoux, La Magouse, N 44.7509 E 3.13602, 1235-1238 m, 26/10/2008.
58 – Lozère, Brion, Puech de la Pause, N 44.7533 E 3.10492, 1235-1237 m, 26/10/2008.
59 – Lozère, Brion, north-west of Puech de la Pause, N 44.7568 E 3.10026, 1190-1220 m, 26/10/2008.
60 – Cantal, La Trinitat, les Issendous, N 44.7651 E 2.94305, 1115 m, 16/8/2002.
61 – Aveyron, Laguiole, Troubades, N 44.6795 E 2.91942, 1250 m, 20/8/2002.
62 – Aveyron, Prades d'Aubrac, source du Roc, N 44.5983 E 3.0172, 1270 m, 30/8/2002.
63 – Cantal, Chaudes Aigues, N 44.8422 E 3.00563, 14/9/2002.
64 – Cantal, Jabrun, Requistat, las Gazelles, N 44.7605 E 2.99437, 1200 m, 14/9/2002.

65 – Cantal, Leutadès, Les Claques, N 44.8059 E 2.88177, 985 m, 16/8/2002.
66 – Cantal, Deux-Verges, Puy de la Tuile, N 44.7809 E 3.01083, 1230-1235 m, 20/8/2002.
67 – Cantal, Saint-Rémy-de-Chaudes-Aigues, Tras Recous, N 44.7612 E 3.00482, 1210 m, 5/8/2002.
68 – Cantal, Saint Urcize, landes du Clapier, N 44.6948 E 2.93648, 1280 m, 13/8/2002.
69 – Cantal, Saint Urcize, Pas de Mathieu, N 44.666 E 2.95714, 1290 m, 20/8/2002.
70 – Cantal, Saint Urcize, Puech Tindoire, N 44.7048 E 2.97156, 1210 m, 13/8/2002.
71 – Cantal, Lieutadès, Les Planous, N 44.8027 E 2.88666, 975 m, 16/8/2002.
72 – Lozère, Marchastel, Lac de Born, N 44.6082 E 3.09901, 1255 m, 03/9/2002.
73 – Lozère, Nasbinals, Les Moussous, N 44.633 E 3.01147, 1300 m, 03/9/2002.
74 – Lozère, Nasbinals, lac de Souveyrols, N 44.6271 E 3.05236, 1220 m, 30/8/2002.
75 – Lozère, Nasbinals, ruisseau des Plèches, N 44.5966 E 3.04913, 1310 m, 30/8/2002.
76 – Lozère, Recoules d'Aubrac, Lous Bousquillous, N 44.6856 E 3.0234, 1073 m, 20/8/2002.
77 – Lozère, Marchastel, lac de Saint Nadéol, N 44.6193 E 3.08163, 1225 m, 03/8/2002.
78 – Lozère, Nasbinals, lac des Salhiens, N 44.6454 E 3.06145, 1210-1220 m, 03/9/02.