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Sphagnum auriculatum Schimp. in Portugal with late Quaternary occurrences

Séneca, A.[1]; Sérgio, C.[2]; Queiróz, P.[3] and Mateus, J.[3]

1. Instituto de Botânica Dr. Gonçalo Sampaio. Rua Campo Alegre, 1191. P-4100 Porto
2. Museu. Laboratório e Jardim Botânico. Faculdade de Ciências. 1294, Lisboa Codex
3. Laboratório de Paleoecologia. Museu Nacional de Arqueologia. Lisboa

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Abstract. *Sphagnum auriculatum* Schimp. occurs in Portugal mainly in the northern and central parts of the country where the precipitation rates vary between 800-2800 mm/yr. It occupies the atlantic and pre-atlantic territories though two of the collections were made south of Lisbon, in the mediterranean territory. Holocene records exist 50 km south of these locations suggesting a wider distribution of this species towards the south in the Quaternary. Climate changes together with habitat disturbances may be responsable for its disappearance from these areas.

Resum. *Sphagnum auriculatum* Schimp. a Portugal i la seva presència al Quaternari. *S. auriculatum* Schimp es troba a Portugal, principalment, al nord i centre del país, on hi ha una precipitació anual de 800 a 2800 mm. Ocupa els territoris atlàntics i subatlàntics tret de dues localitats al sud de Lisboa, de tipus mediterrani. S'han trobat registres holocènics a 50 km al sud d'aquestes localitats i això fa pensar que aquesta espècie presentava, al Quaternari, una àrea de distribució més àmplia. Canvis climàtics juntament amb alteracions del medi poden ser la causa de la desaparició de l'espècie en aquestes àrees.

Introduction

Portugal is very complex in terms of topography, orography and climate. Great contrasts exist between the northern and southern parts, the river Tejo apparently forming a flexible barrier in both climate and orography. Roughly, the northern part is dominated by an old granitic relief with sharp quartzitic crests, very resistent to erosion, formed during the Paleozoic and oriented SW-NE. The central coastal area is a stepwise plateau interrupted by river valleys, estuaries or deltas, with very complex petrographic structure that includes limestone elevations and sedimentary plains, originated in early Tertiary. The general climate type of these areas is atlantic with precipitation rates that vary between 800 mm/yr in the central coastal range and 2800 mm/yr in the highest mountains. In these regions there is a minimum of 75 days/yr with precipitation rates greater than 1 mm.

Sphagnum has been collected in Portugal since 1843 by Welwitsch, though the communities where it occurs were never studied thorougly, at least from

the bryophytic standpoint. The number of *Sphagnum* taxa in the country have risen since 1987 (Séneca-Cardoso 1987) from 11 up to 17 after the most recent taxonomic revisions and field work. *S. auriculatum* is the most common, occupying all the areas capable of supporting plants with such ecological requisites. These areas vary greatly in relation to macroclimate and ecological variables. Where they attain the minimum values suitable for these plants to live, *S. auriculatum* is, in most cases, the only *Sphagnum* species present. This apparent ability to grow within large intervals of these variables inevitably leads to its well known polymorphism (Suzuki 1958, Goossens & de Sloover 1981. Daniels & Eddy 1985).

Apart from its present abundant occurrence in the north and central part of Portugal, plant material of this species was found in several macrofossil and polen analysis of some relatively deep deposits of Holocene peat, at Lagoa Travessa and Lagoa do Barbaroxa, in the southern littoral region. During the Holocene the formation of a complex coastal barrier including an important system of modern dunes blocked several old river mouths and several coastal lagoons were then formed. The complexity of paleoecological data of North Litoral Alentejo was presented recently with the regional picture of Holocene landscape evolution, by Mateus (1988-89, 1991).

Methods

The portuguese *Sphagnum* material kept in portuguese herbaria together with material collected in very recent field work and from the Holocene deposits were taxonomically revised according mainly to the criteria of Daniels & Eddy (1985). Also the Pierrot (1973), Crum (1984), Nyholm (1969) and Casares (1925) publications were considered.

Recently, Dirkse & Isoviita (1986) transfered *Sphagnum auriculatum* Schimp. to the older name *S. denticulatum* Brid., but in this paper, we follow the concepts of Daniels & Eddy (1985) for the european *Sphagnum*.

After this, it was possible to select the material included in *Sphagnum auriculatum* Schimp. and study its distribution in a UTM grid (10x10 Km) and the major bioclimatic, topographic and vegetation characteristics of these areas. The forms considered by Daniels & Eddy (1985) as *obesum* and *crassicladum* are shown in a separate map, as they often occur with the type and have ecological value since they occupy different places in the water level gradient (Goossens & de Sloover 1981). The methodology used in the stratigraphic studies is described in Mateus (1988-1989).

Results and discussion

Distribution

The present known distribution of *Sphagnum auriculatum* including *obesum*

and *crassicladum* forms is shown in Fig. 1.1 and 1.2. Its occurrence is mainly in the northern part of the country, specially in the northwest where it's more abundant. The inland occurrences are in most cases restricted to high altitude mountains or places with suitable atmospheric or ground moisture. (See apendix of the specimens examined, sorted by UTM sequence).

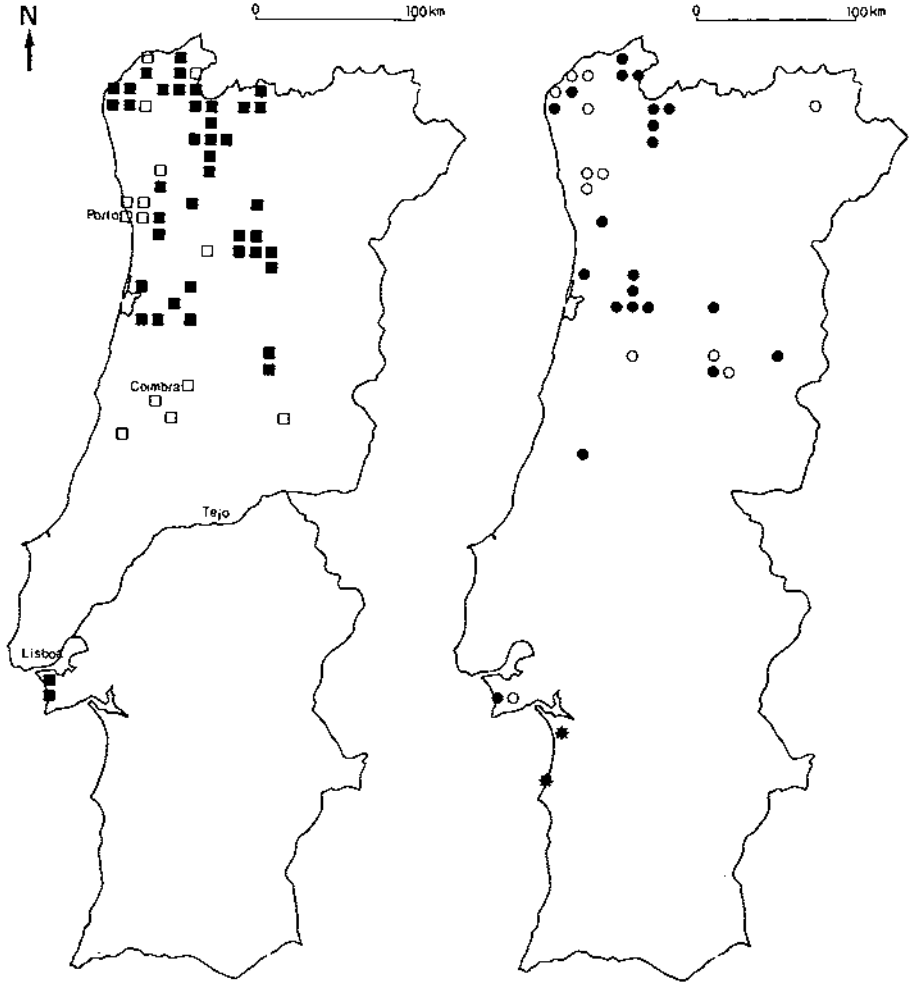

Figure 1.1. Distribution in Portugal of *Sphagnum auriculatum* Schimp (*sensu stricto*) in a UTM grid (10x10 Km); □ before 1950, ■ after 1950. 1.2. Distribution in Portugal of the *crassicladum* and *obesum* forms of *Sphagnum auriculatum* in a UTM grid (10x10 Km); ○ before 1950, ● after 1950. ✻ Holocene records.

Other species of *Sphagnum* are known to occur in other atlantic areas: the mountains Serra de Sintra, near Lisboa and in the south, Serra de Monchique. In the first, the absence of *S. auriculatum* is probably due to poor exploration whilst in the last two further field work is needed to confirm present day occurrence since, *S. auriculatum* is likely to be the only present survivor of their *Sphagnum* flora.

The destruction of suitable habitats erased the *Sphagnum* presence in several other locations and in some cases *S. auriculatum* was the unique presence. That is the case of the Porto region where it is impossible to repeat any of the collections shown on Fig. 1.1 and 1.2 since building has destroyed most of the places available for its growth. The same reason and in this case probably the lack of more recent field work explains why no collections were made in the area south of Coimbra after 1950.

There seems to be no difference between the distribution of the type and the *crassicladum* and *obesum* forms, though these are likely to occupy locally flooded spots in dryer areas.

Bioclimatic territories and Sphagnum *communities*

S. auriculatum has a circumboreal distribution with ocean tendencies in Europe (Daniels & Eddy 1985) or is described as southern boreal to subtropical by Isoviita (1966). In Portugal, according to the definition of bioclimatic territories as a correlation between Gaussen and Emberger climatic rates (Alcoforado et al. 1982) most of the *S. auriculatum* references fall in the atlantic and preatlantic territories. The southern most reference, however, is included in the coastal pre-mediterranean territory. In this area it occurs around small lakes and sometimes temporary lagoons where it grows completly submerged during the winter and survives 6 months where there is no precipitation at all. They survive the dry season due to soil moisture. *Erica cinerea*. *Halimium* spp., *Myrtus communis*, *Corema alba* among others form the shrub vegetation that surround these lagoons.

The north coastal plain extended between Coimbra and Porto is deltaic with high atmospheric moisture, and it's included in the pre-atlantic territory. *S. auriculatum* is quite abundant here, filling mild depressions and integrating the small heathland communities of their edges. It occurs with other *Sphagnum* species and it's seen either as a pioneer in the bare muddy borders where it characteristically is very small in size and has a green-yellowish color, or at the non submerged borders of the lagoons where it sometimes grows at the base of *Eriophorum angustifolium* and has its typical form. It is also found in carrs, where the shade of *Alnus glutinosa*. *Salix repens* and *Myrica gale* produce long dark green plants with large capitula.

The atlantic territory is where this species is most abundant and also where the majority of the collections have been made. Nevertheless this territory includes a wide range of vegetation communities where *Sphagnum* species importance varies from occasional to dominant. In most of the northwest

S. auriculatum occurs as the only *Sphagnum* species. It grows at the edges of roads where water flushes and colonizes sandy soils near water courses, or grows at the borders of rivers and temporary water patches, where its polymorphy is well represented. If there is a depression, eventually other species may be present each in its place along ecological gradients. In Penêda-Gerês National Park where the highest elevations of this area exist the *Sphagnum* flora increases in importance and diversity. *S. auriculatum* is here included in the flora of fen meadows, spring and occasionaly rich-fens (sensu Andrus 1980). The surrounding vegetation of these communities problably differs from that of the communities mentioned due to the peculiarity of the overall vegetation of the country but the ecological value of their components is the same.

The only place where peat deposits are accumulating is in Serra da Estrela, the highest mountain system (2000 m) with precipitation rates of 2400 mm/yr, much of it as snow. Here *Sphagnum* occupies extensive areas and occurs as part of heathland communities and bogs above 1500 m. A few *Sphagnum* species weren't found anywhere but here, and the importance of *S. auriculatum* in the total *Sphagnum* flora decreases. Above 1600 m where arborescent vegetation becomes rare, the landscape is dominated by enormous granitic blocks and *Juniperus communis* ssp. *alpina*, *Calluna* and *Erica* shrubs (Pinto da Silva & Teles 1986). Its presence becames quite inconspicuous due to the massive presence of other *Sphagnum* species.

The Holocene occurrences

Recent palaeoecological research on Holocene peat deposits of the coastal mires of the North Litoral of Alentejo, showed a relative abundance of *Sphagnum* (presumably *S. auriculatum*) during the Holocene, as part of the last stages of the regional hydroseres (Mateus 1988-1989, Queiróz 1989, Mateus and Queiróz 1991).

Our evidence is mainly from spores. *Sphagnum* spores occur, although with a relatively modest presence from 6500 BP till sub recent times in coastal lagoons, like Lagoa Travessa and in the fluvial basin of Carvalhal. It is quite striking that the «stratigraphical behaviour» of the *Sphagnum* spores curve in the diagrams has neat positive affinities with the pollen curves related to the wet fen, and moor vegetation communities and respective hydroseral stages (semi terrestrial peats). A clear parallelism is seen particularly in relation to the *Erica erigena* pollen curve-reflecting wet heathland (one of the last stages of the mire hydroseres). This relationship is well attested nowadays in the present-day vegetation of the Lagoa da Casa (50 km north), where we find together both the modern vestigiary remnants of the *Sphagnum auriculatum* and of *Erica erigena* vegetation.

Sphagnum leaflets were present also at Poço do Barbaroxa de Cima, where fossil macroremains were sistematically studied along the peat profile (Queiróz 1989, Mateus and Queiróz 1991), with very high amounts between about 5500 ant 4900 BP. Incidently no spore was recorded, probably reflecting a popula-

tion growing in conditions too wet to produce spores (Birks, oral communication). These *Sphagnum* remains were identified by one of us (Sérgio) as belonging to *Sphagnum auriculatum* (*obesum* form) with characteristic large and concave branche leaves, without pores in both surfaces (Fig. 2).

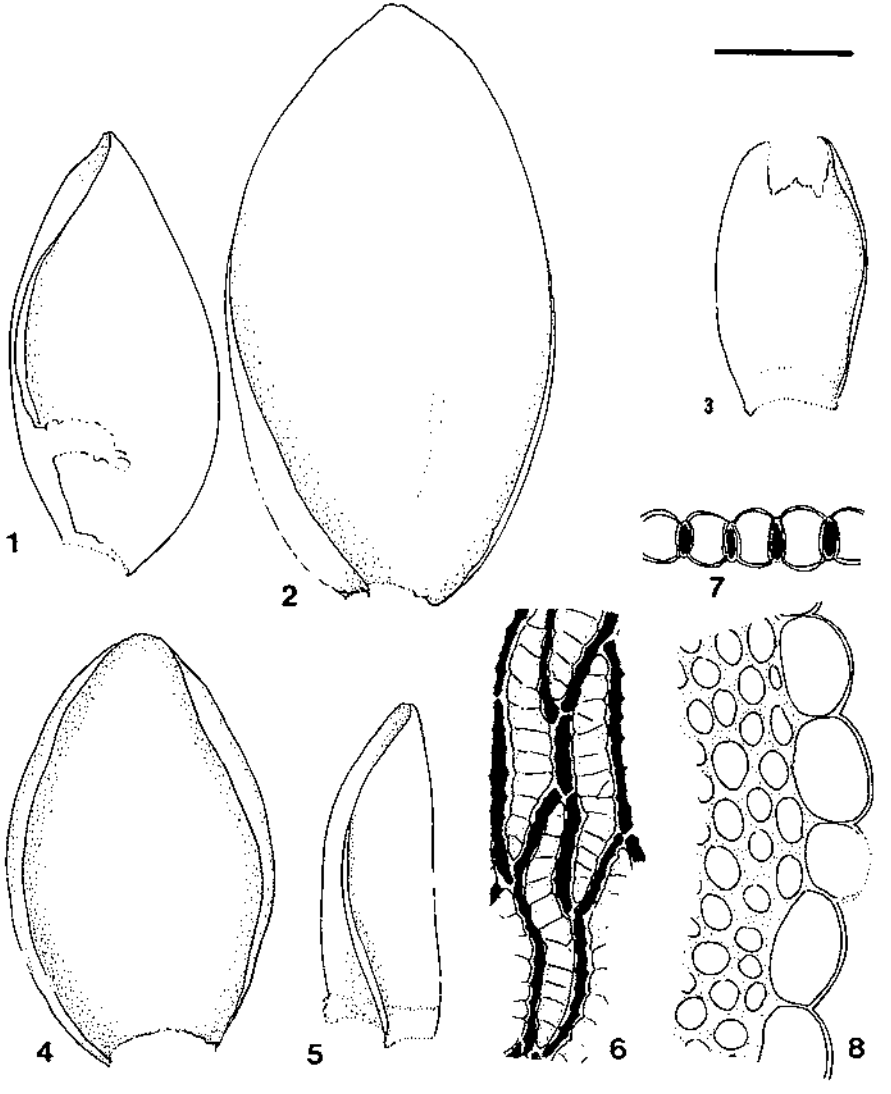

Figure 2. *Sphagnum auriculatum* (*obesum* form) from the Holocene (5500 and 4900 BP) in Portugal (macrofossil material) **1**, **2**, **4**. Branch leaves; **3**, **5**. Stem leaves; **6**. Adaxial (dorsal) surface cells (without pores in the abaxial and adaxial faces); **7**. Transversal section of branch leaves; **8**. Transversal section of stem, with the cortex with 1 layer of hyaline cells; **1**, **3**. nº PBA 200-205; **2**, **8**. nº PBA 240-245; **4**, **6**, **7**. nº PBA 230-235. Del C. Sérgio 1991. Scale: 1-5=250μm and 6-8=60μm.

Contrasting with the fossil occurence, *S. auriculatum* is rare in this SW portuguese region-the southern most part of its modern occurence in Europe. It seems that its overall desappearence from most of the wetland ecosystems here is due to the very strong direct human impact on the mire systems of the region (installing wetland pastures, rice fields, horticultural plots) and/or to the indirect anthropogenic influence (extensive eutrophication of the lagoons and fluvial systems).

Conclusion

Though there are areas where field work is still needed, *S. auriculatum* occurs in Portugal where it's expected - in the north and central regions where precipitation rates attain maximum values. Its polymorphism is well represented in the whole area and much is left to do concerning the characterization of its populations in an area that lies in the southern limit of its range.

Its presence in Portugal was most probably more extense in the Quaternary than at present due especially to mans' influence. Its present wide range in the atlantic areas has been established since early Holocene. In this case it can not be considered a glacial relict. The present southern most record, may be considered an atlantic rich fen relict as opposed to the northern occurrences.

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Appendix

Sphagnum auriculatum Schimp. (*sensu stricto*). Specimens examined:

E. Fernão Ferro, Lagoa da Casa, MC86, *Catarino*. 91/06/14, PO. E. Fogueteiro, MC87, *Augusto*, 72/04, LISU. E. entre Fogueteiro e Casal do Marco, MC87, *Sobrinho & Cúmano*, 59/06/10, LISU. BL, Pinhal do Urso, pr. Louriçal, NE22, 50 m, *Fernandes*, 1929, COI. BL, pr. Aveiro, ribeiro de Azurva, NE39, 50 m, *Reis*, 71/09/12, LISU. BL, Eirol, ribeiro da Horta, NE39, 50 m, *Reis*, 70/09/22, COI. BL, Eirol, Ribeira da Fonte, NE39, 50 m, *Ormonde*, 67/08/21, COI. BL, Eirol, Vale da Fonte, NE39, 50 m, *Ormonde*, 67/08/07, COI. BL, Eixo, Vale dos Pinheiros, NE39, 50 m, *Sérgio*, 90/12/30, LISU. BL, Vale de Vila Pouca, NE44, 100 m, *Ervideira*, 21/08, LISU. BL, Bucha, Pateira de Fermentelos, NE49, *Almeida & Nogueira*, 69/08/07, COI. BL, Miranda do Corvo, NE53, 200 m, *Tamagnini*, LISU. BL, Ponte de Mucela, Moura Morta, NE65, 100 m, 5/1892, COI BL, S. João do Monte, Caramulo, NE69, 700 m, *Fernandes, Allorge & Sérgio*, 65/06/24, COI. DL, Requesende, Seixas, NF25, 50 m, *Newton*, 2/1884, PO. DL, Afurada, NF25, *Newton*, 9/1886, PO. DL, Pedras Rubras, NF26, 50 m. *Newton*, 16/10/1887, PO. DL, Lugar do Paço, Sto André do Canadelo, NF26, 50 m, *Newton*, 6/1878, PO. DL, Leça da Palmeira, NF26, *Newton*, PO. DL, Pampolide Velho, NF26, *Newton*, 16/10/1884, PO. DL, Vila Nova da Telha, NF26, 50 m, PO. BL, Ponte Nova, pr. Ovar, NF31, 51 m, *Ormonde*, 67/07/03, COI. DL, Oliveira do Douro, NF35, 50 m, *Newton*, 4/1884, PO. DL, S. Cristovão de Mafamude, NF35, 50 m, *Newton*, 9/1879, PO. DL, Coimbrões, NF35, 50 m, *Newton*, 14/2/1884, PO. DL. Ermesinde, NF36, 100 m, *Newton*, 2/1887, PO. DL, Fânzeres, NF36, 200 m, *Newton*, 4/1884, PO. DL, Foz do Sousa, NF44, 50 m, *Newton*, 6/1887, PO. DL, Porto, Crestuma, Tapada do Outeiro, NF44, 100 m, *Séneca*, 90/11/14, PO. DL, Porto, Lever, Vales, NF44, 200 m, *Séneca*, 90/11/22, PO. DL, Valongo, entre Salto do Ferreira e Couce, NF45, 300 m, *Sérgio*, 23/8/82, LISU. DL, Serra de Valongo, Bicas, NF45, 50 m, *Silva*, 88/07/21, PO. DL, Valongo, Serra de Santa Justa, NF45, 300 m, *Newton*, 6/1878, PO. DL, Serra de Santa Justa, Couce, NF45, 50 m, *Séneca*, 19/3/89, PO. DL, Santo Tirso, capela N. Sª de Valinha, NF47, 400 m, *Paiva*, 17/3/81, LISU. DL, Santo Tirso, NF47, 200 m, *Luisier*, 1933, INA. Mi, Famalicão, NF48, 200 m, *Machado*, 1929, PO. BA, Paredes, Castêlo, NF50, 500 m, *Sérgio* 31/12/76, LISU. BA, Sto Adrião, NF50, 500 m, *Sérgio*, 2/12/78, LISU. BA, pr. de Lagoa, Ladário, NF61, 500 m, *Sérgio*, 27/12/77, LISU. BL, Ladário, pr. Arcozelo das Maias, NF61, 200 m, *Sérgio*, 71/03/24, COI. Mi, Amarante, Vila Meã, NF66, 300 m, Jardineiros, 4/1989, PO. BA, Serra de Montemuro, pr. Alvarenga, NF73, 400 m,

49/08, LISU. Mi, entre Fafe e Cabeceiras, NF78, 600 m, *Silva & Tavares*, 89/04/24, PO. Mi, Fafe, Queimadela, NF79, 500 m, *Siva & Caldas*, 90/12/05, PO. BA, Serra de Montemuro, Relva, NF93, 850 m, *Teles & Raínha*, 57/08/01, LISE. TM, Serra de Montemuro, pr. Ribabelida, NF94, 920 m, *Teles & Raínha*, 57/07/30, LISE. Mi. Serra de Santa Luzia, S. Mamede, NG12, 400 m, *Séneca & Sérgio*, 89/05/08, PO. Mi, Moledo do Minho, NG13, 100 m, *Machado*, 1921, PO. Mi, Moledo do Minho, NG13, 100 m, *Machado*, 1924, PO. Mi, Moledo do Minho, Azevedo, NG13, 200 m, *Séneca & Sérgio*, 90/01/10, PO. Mi, Serra de Góis, Lanhelas, NG13, 300 m, *Séneca & Sérgio*, 90/01/10, PO. Mi, Serra de Santa Luzia, Orbacém, Montaria, NG22, 300 m, *Séneca, Sérgio & Daniels*, 90/03/08, PO. Mi, Serra de Arga, Real, NG23, 150 m, *Séneca & Sérgio*, 89/05/09, PO. Mi, Serra de Arga, Arga de S. João, NG23, 440 m, *Séneca & Sérgio*, 89/05/09, PO. Mi, Sá, Poço de S. Cipriano, NG32, 100 m, *Sampaio*, 8/1897, PO. Mi, Formigoso, NG32, 200-300 m, *Sampaio*, 8/1897, PO. Mi, Serra de Antelas, NG32, 400 m, *Sampaio*, 08/1987, LISU. Mi, Insalde, Monte Cotão, NG34, 500 m, *Machado*, 1931, PO. Mi, entre Alto dos Teares e Picoto, S. Lourenço, NG34, 500 m, *Séneca & Sérgio*, 90/01/10, PO. Mi, Valença do Minho, Monte Srª do Faro, NG35, 500 m, *Newton*, 07/1889, LISU. Mi, Arcos de Valdevez a 10 km de Paredes de Coura, NG43, 500 m, *Sérgio*, 14/4/76, LISU. Mi, Arcos de Valdevez, ponte do Vilela, NG43, 50 m, *Silva*, 88/07/13, PO. Mi, Serra da Penêda, a 12 km de Arcos, NG43, 400 m, *Sérgio*, 81/03/18, LISU. Mi, Serra da Penêda, Sto António, NG53, 500 m, *Sérgio*, 18/3/81, LISU. Mi, Gerês, PNPG, entre Avelcira e Arcos de Valdevez, NG54, 600-1000 m, *Sérgio*, 1981, LISU. Mi, PNPG, Seida, Lamas do Vez, NG54, 1000 m, *Séneca, Sérgio & Daniels*, 90/01/09, PO. Mi, entre Lordelo e Fonte do Vidoeiro, NG54, 1050 m, *Séneca, Sérgio & Daniels*, 90/09/03, PO. Mi, Arcos de Valdevez, Soajo, mata do Ramiscal, NG54, 1200 m, *Sérgio*, 82/05/26, LISU. Mi, Rio Mouro, pr. Tangil, NG55, 300 m, *Sérgio*, 18/3/81, LISU. Mi, Ponte de Mouro, NG55, 100 m, *Sérgio*, 18/3/81, LISU. Mi, Massajães, NG55, 300 m, *Sérgio*, 81/03/18, LISU. TM, Montalegre, pr. Travassos, NG60, 900 m, *Teles & Raínha*, 59/07/17, LISE. Mi, Gerês, Turio, Monte de Cipreste, NG62, 500-1000 m, *Palhinha*, 1948, LISU. Mi, Portela do Homem, NG62, 900 m, *Cardoso*, 77/06, LISU. Mi, Serra Amarela, Lindoso, NG62, *Sérgio*, 1978, LISU. Mi, Lindoso, NG63, 500 m, *Tavares*, 58/06/18, LISU. Mi, Serra da Cabreira, de Arga para Vieira do Minho, NG70, 800 m, *Séneca & Sérgio*, 89/05/11, PO. Mi, entre Vieira do Minho e o cruzamento para a Serra da Cabreira, NG70, 500 m, *Séneca & Sérgio*, 89/05/11, PO. Mi, Serra da Cabreira, NG71, 1140 m, *Séneca & Sérgio*, 89/05/11, PO. Mi, Gerês, rio Arado, ponte para Fafialho, NG71, 700 m, *Sérgio*, 1978, LISU. Mi, PNPG, entre Cascata do Arado e Malhadoura, NG71, 900 m, *Séneca, Sérgio & Daniels*, 90/03/10, PO. Mi, Ruivães, Vila da Ponte, NG71, 500 m, *Sérgio*, 80/07/16, LISU. Mi, Gerês, Leonte, NG72, 900 m, *Machado*, 1921, PO. Mi, Gerês, Albergaria, NG72, 650-800 m, *Sérgio*, 1978, LISU. Mi, Serra do Gerês, Chã de Lamas, NG72, *Tavares*, 1944, LISU. Mi, Serra do Gerês, caminho para Malhadoura, NG72, 900 m, *Sérgio*, 1978, LISU. Mi, Serra do Gerês, caminho para os Carris, NG72, 1000 m, *Melo*, 77/11/02, LISU. Mi, Serra do Gerês, Leonte, NG72, 900 m, *Tavares*, 44/08/30, LISU. Mi, Gerês, Albergaria, NG72, 900 m, *Barros*, 43/07/17, LISFA. Mi, Serra do Gerês, entre a cascata do Arado e Malhadoura, NG72, 900 m, *Sérgio*, 80/07/15, LISU. Mi, Serra do Gerês, pr. de Leonte, NG72, 900 m, *Tavares*, 44/08/01, LISU. Mi, Cabeceiras de Basto, Ponte da Frágua, NG80, 500 m, *Silva*, 88/08/20, PO. Mi, Cabeceiras de Basto, Pombeiros, NG80, 500 m, *Silva*, 88/08/16, PO. Mi, Cabeceiras de Basto, Lamelas, NG80, 500 m, *Silva & Tavares*, 89/05/01, PO. Mi, Serra da Cabreira, pr. de Trovão, NG81, 1000 m, *Catarino*, 91/05, LISU. TM, Vila Real, Covelães, rio Mau, NG92, 800 m, *Séneca & Sérgio*, 89/05/10, PO. TM, Montalegre, Sezelhe, NG92, 1000 m, *Teles & Raínha*, 59/07/15, LISE. BA, Serra da Estrela, Lagoa de Loriga, PE16, 1800 m, *Welwitsch*, 08/1848, LISU. BA, Serra da Estrela, pr. Lagoa do Peixão, PE16, 1800 m, *Welwitsch*, 1848/08, LISU. BA, Serra da Estrela, Charcos, PE16, 1800 m, *Séneca*, 89/08/21, PO. BA, Serra da Estrela, Barragem do Covão do Curral, PE16, 1500 m, *Séneca*, 89/08/21, PO. BA, Serra da Estrela, Srª do Desterro, PE17, 800 m, *Tavares*, 54/08, LISU. BA, BB, Serra da Gardunha, PE23, 1000 m, *Luisier*, 06/08, LISU. BA, Serra de Leomil, Arcas, PF03, 900 m, *Teles & Raínha*, 58/08/02, LISE. BA, entre Lamego e Moimenta da Beira, PF04, 800 m, *Sérgio*, 67/03/30, COI. TM, Montalegre, pr. Santa Marta de Penaguião, PF06, 300 m, *Teles & Raínha*, 59/07/22, LISE. TM, Montalegre, Veiga, PF06, 1000 m, *Pedro*, 43/06/15, LISE. TM, Montalegre, Serrado, PF06, 1000 m, *Pedro & Myre*, 43/06/17, LISE. BA, Serra de Leomil, Águas Boas, PF12, 800 m, *Teles & Raínha*, 57/08/08, LISE. BA, Serra de Leomil, Caria, PF13, 875 m, *Teles & Raínha*, 58/08/04, LISE. TM, Montalegre, Serra do Larouco,

PG03, 1250 m, *Séneca & Sérgio*, 89/05/10, PO. TM, Montalegre, Serra do Larouco, estradão para Padornelos, PG03, 1200 m, *Séneca & Sérgio*, 89/05/10, PO. TM, Montalegre, Avelar, PG03, 1060 m, *Pedro*, 43/06/16, LISE. TM, Montalegre, Padroso, Lama do Povo, PG03, 1000 m, *Pedro & Myre*, 43/06/18, LISE. TM, Montalegre, margens do Cávado, PG03, 1000 m, *Pedro & Myre*, 43/06/24, LISFA.

Sphagnum auriculatum Schimp. (*obesum* form). Specimens examined:

E, Fernão Ferro, Lagoa do Golfo, MC86, *Catarino*, 91/06/06, PO. E, entre Corroios e Sesimbra, MC96, 50 m, *Daveau*, 1885/04, LISU. Mi, Famalicão, NF38, 200 m, *Machado*, 9/1912, PO. DL, Serra de Santa Justa, rio Ferreira, Couce, NF45, 50 m, *Séneca & Sérgio*, 19/3/1989, PO. BL, Ladário, pr. Arcozelo das Maias, NF61, 200 m, *Sérgio*, 70/03/24, COI. BA, Vouzela, Penoita, NF70, 600-700 m, *Sérgio*, 73/03/06, LISU. Mi, Viana do Castelo, Serra de Santa Luzia, NG12, 400 m, *Séneca & Sérgio*, 89/05/08, PO. Mi, Serra de Santa Luzia, S. Mamede, NG12, 400 m, *Séneca & Sérgio*, 89/05/08, PO. Mi, Serra de Arga, Arga de S. João, NG23, 440 m, *Séneca & Sérgio*, 89/05/09, PO. Mi, Vila Nova de Cerveira, Serra de Nogueira, NG24, 300 m, *Silva*, 43/10/10, LISE. Mi, Ponte do Lima, Sá, NG32, 100 m, *Sampaio*, PO. Mi, Ponte do Lima, Serra de Antelas, NG32, 200 m, *Sampaio*, 1897/08, COI. Mi, Seida, Lamas do Vez, NG54, 1000 m, *Séneca, Sérgio & Daniels*, 90/03/09, PO. Mi, Lamas do Vez, NG64, 1200 m, *Sérgio & Schumacker*, 84/06/19, LISU. Mi, Serra da Cabreira, Anjos, NG70, 600 m, *Séneca, Sérgio & Daniels*, 90/03/20, PO. Mi, Serra da Cabreira, NG71, 1140 m, *Séneca & Sérgio*, 89/05/11, PO. BA, Serra da Estrela, PE16, 500-2000 m, *Ricardo da Cunha*, 1881, LISU. BA, Serra da Estrela, Fonte dos Perús, PE16, 1800 m, *Tavares*, 52/09/17, LISU. BA, Serra da Estrela, Lagoa Longa, PE16, 1600 m, *Welwitsch*, 1848, LISU. BA, Serra da Estrela, pr. Lagoa do Peixão, PE16, 1800 m, *Welwitsch*, 1848/08, LISU. BA, Serra da Estrela, PE16, 500-2000 m, *Henriques*, 1843, COI. BA, Serra da Estrela, pr. de Sabugueiro, PE17, 1300 m, *Welwitsch*, 1848/08, LISU. BB, Serra da Estrela, Sanatório, PE26, 1500 m, *Luisier*, 06/09, COI. TM, Serra de Nogueira, casa R. Obello, PG72, 1000 m, *Silva & Lima*, 43/10/10, LISFA.

Sphagnum auriculatum Schimp. (*crassicladum* form). Specimens examined:

BL, entre Murtosa e Estarreja, NE31, *Fernandes et al*, 65/04/22, COI. BA, Serra do Caramulo, Gandra, NE67, 100 m, *Resende*, 1946, LISU. BL, Ponte da Arriada, pr. Ovar, NF32, 50 m, *Ormonde*, 67/07/03, COI. DL, S. Romão, NF37, 100 m, *Newton*, 4/1884, PO. Mi, Famalicão, ribeiro de Cavalões, NF38, 100 m, *Machado*, 1924, PO. DL, Valongo, NF45, 200 m, *Machado*, 1927, PO. Mi, Famalicão, Joane, NF48, 200 m, *Machado*, 1927, PO. BA, Sto Adrião, NF50, 500 m, *Sérgio*, 2/12/78, LISU. BA, Campia, margens do Alfusqueiro, NF60, 300 m, *Sérgio*, 25/8/81, LISU. DL, Serra da Freita, Srª da Lage, NF62, 1000 m, *Sérgio*, 91/07/08, PO. Mi, Serra de Sta Luzia, NG12, 400 m, *Séneca, Sérgio & Daniels*, 90/03/08, PO. Mi, Viana do Castelo, Orbacém, pr. Montaria, NG12, m, *Séneca, Sérgio & Daniels*, 90/03/08, PO. Mi, Moledo, NG13, 100 m, *Machado*, 1924, PO. Mi, Serra de Arga, Arga de S. João, NG23, 440 m, *Séneca & Sérgio*, 89/05/09, PO. Mi, Ponte de Lima, Serra de Antelas, NG32, 200 m, *Sampaio*, 1897/08, COI. Mi, Paredes de Coura, NG34, 400 m, 8/1913, PO. Mi, Coura, Chã de Lamas, NG34, 500 m, *Machado*, 1917 e 1927, PO. Mi, Coura, Insalde, Monte Cotão, NG34, 500 m, *Machado*, 1931, PO. Mi, Soajo, Mata do Ramiscal, NG54, 1200 m, *Sérgio*, 1982, LISU. Mi, Ponte de Mouro, NG55, 100 m, *Sérgio*, 18/3/81, LISU. Mi, Serra da Cabreira, entre Arga e Vieira do Minho, NG70, 800 m, *Séneca & Sérgio*, 89/05/11, PO. Mi, entre Cascata do Arado e Malhadoura, NG71, 900 m, *Séneca, Sérgio & Daniels*, 90/03/10, PO. Mi, Ruivães, pr. Vila da Ponte, NG71, 500 m, *Sérgio*, 80/07/16, LISU. Mi, Portela do Homem, mata da Bouça da Mó, NG72, 850 m, *Séneca & Sérgio*, 13/5/1988, PO. TM, Cabril, Lagoas da Marinha, NG 82, 1150 m, *Sérgio & Schumacker*, 1984, LISU. BA, Serra da Estrela, Charcos, PE16, 1850 m, *Séneca*, 89/08/21, PO. BB, Serra da Estrela, Sanatório, PE26, 1500 m, *Luisier*, 06/09/03, LISU. BA, entre Guarda e Sabugal, PE57, 800 m, *Sérgio*, 80/07/17, LISU. BA, entre Aguiar da Beira e Satão, PF11, 700 m, *Ormonde*, 67/07/06, COI.