

BRYOPHYTE FLORA AND VEGETATION ON THE ISLAND OF CORVO (AZORES)

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ARQUIPÉLAGO



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The bryoflora of Corvo which had been documented to be 29 spp. is now increased to 134 spp. The recordings carried out in 1978 include 4 spp. endemic to the Azores and 7 spp. endemic to Macaronesia. Considering the small size of Corvo (17 km²), the diversity is 17 times higher than on the largest island of S. Miguel (747 km²). The bryophytes on Corvo show much less pronounced substratum preferences and sociologically distinguishing values than on other Azorean islands (except for Flores). A fairly large number of moisture-demanding cloud-zone species appear at much lower altitudes than on the other islands in the archipelago. Reasons for these discrepancies are the comparatively much larger amounts of precipitation with 1200-1400 mm along the coasts and more than 3000 mm at altitudes of 400 m. Bryo-communities recorded: As epilithic *Ptychomitrium azoricae* n. nom. (= *Grimmia azorica* - *Ptychomitrium* - all. SJN. 1990) with the *Frullanietum dilatatae* n. ass. and *Grimmietum acicularae* n. ass.; as epiphytic the *Echinodio-Lepidozietum cupressinae* SJN. 1978 and the coastal *Frullanietum microphyllae* v. HÜBSCHM. 1974; as epigeic the *Allorgeo-Myurion* n. nom. (= *Myurium-Fissidens pallidicaulis* - all. SJN. 1990); as epiphyllous the *Cololejeuneo-Colurion* n. nom. with the *Cololejeuneetum azoricae* SJN. 1978.

SJÖGREN, ERIK 1993. Flora de briófitos e vegetação na ilha do Corvo (Açores). *Arquipélago*. Ciências Biológicas e Marinhas 11A:17-48. Angra do Heroísmo. ISSN 0870-6581.

A flora de briófitos do Corvo, de que eram conhecidas previamente 29 espécies, ascende agora a 134 espécies. As inventariações realizadas em 1978 incluem 4 espécies endémicas para os Açores e 7 espécies endémicas para a Macaronésia. Apesar do pequeno tamanho do Corvo (17 km²), a diversidade é 17 vezes superior à da ilha maior, S. Miguel (747 km²). Os briófitos no Corvo apresentam preferências pelo substrato e valores sociologicamente discriminantes bastante menos pronunciados que nas outras ilhas Açoreanas (excepto para as Flores). Um número razoável de espécies higrófilas da zona das nuvens ocorrem a altitudes muito inferiores às verificadas nas outras ilhas do arquipélago. As razões para estas discrepâncias são os níveis de precipitação comparativamente mais elevados, com 1200-1400 mm na faixa costeira e mais de 3000 mm já a altitudes de 400 m. As comunidades de briófitos registadas são: como epilítica a *Ptychomitrium azoricae* n. nom. (= *Grimmia azorica* - *Ptychomitrium* - all. SJN 1990) com *Frullanietum dilatatae* n. ass. e *Grimmietum acicularae* n. ass.; como epifítica a *Echinodio-Lepidozietum cupressinae* SJN 1978 e a costeira *Frullanietum microphyllae* v. HÜBSCHM. 1974; como epígea a *Allorgeo-Myurion* n. nom. (= *Myrium-Fissidens pallidicaulis* - all. SJN 1990); como epífila a *Cololejeuneo-Colurion* n. nom. com a *Cololejeuneetum azoricae* SJN 1978.

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INTRODUCTION

The bryophyte flora and vegetation of the island of Corvo were investigated in the summer of 1978. The two weeks stay permitted excursions all over the island, especially at altitudes above 200 m a.s.l. Time was too short for recordings of the coast flora except for the southernmost parts of the island. Also, most of the parts of the W and N

coasts of Corvo are very steep and almost inaccessible.

The vascular flora and vegetation of Corvo were treated earlier (Sjögren 1979). That paper also includes a fairly comprehensive description

of the island, and thus only a short review will be given here.

Corvo, the smallest island in the Azorean archipelago, has a size of about 17 km² (W 31° 05', N 36° 40'). It is 6.5 km long from N to S and

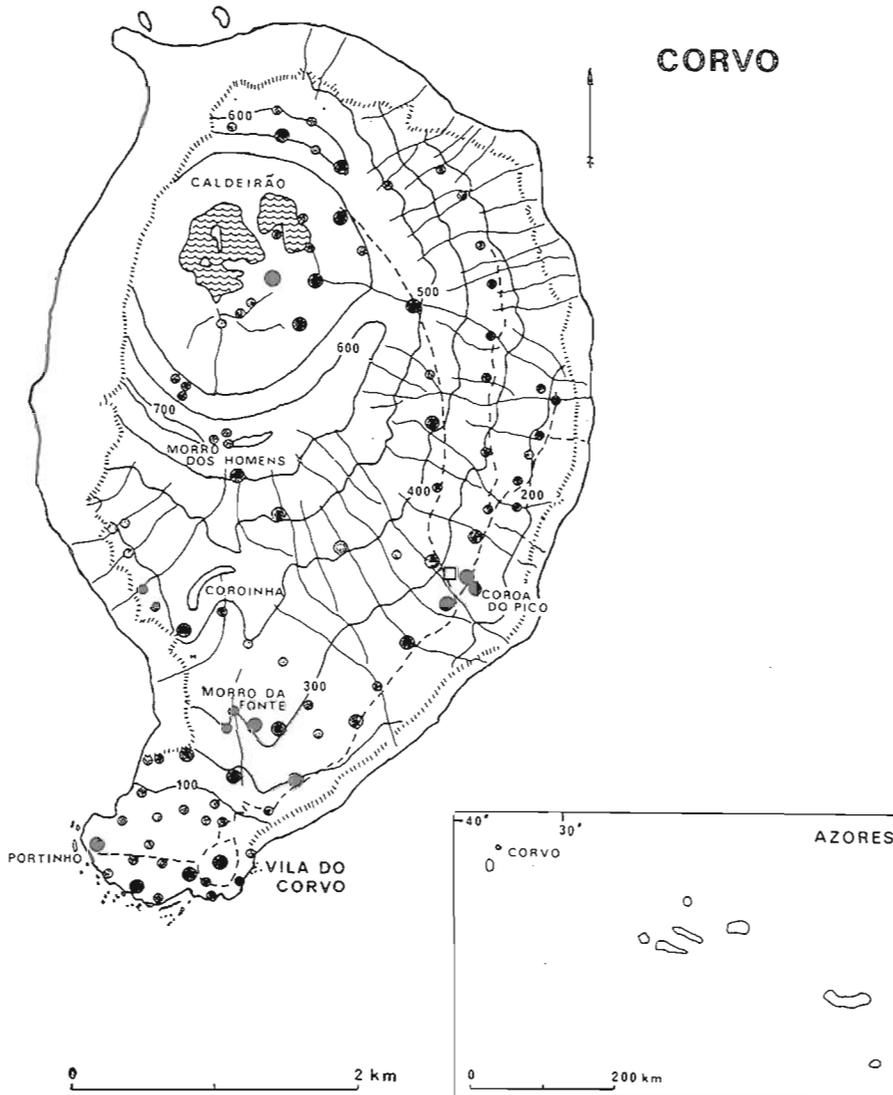


Fig. 1. Map of Corvo, showing the numerous river ravines, 100 m contour lines (solid lines) and the rim position of the coastal escarpment (stippled lines), roads (broken lines), lakes (wavy lines), the "white tool-house" (open quadrat). Big black dots indicate investigated areas of at least 4 hectares, small dots of at least 0.25 hectare. Areas for detailed recording of bryophytes were the same as for vascular plants (cf. Sjögren 1979).

maximally 4 km wide. The highest altitude is 718 m (Morro dos Homens), to the S of the large caldeira (Fig. 1). The island is situated at a distance of 18 km to the NNE of Flores, the westernmost island in the archipelago.

Precipitation is 1200-1400 mm/year at sea level and more than 3000 mm at altitudes above 400 m. Salty rains reach at least up to 300 m, frequently even to 500 m, originating from waves breaking against the coastal cliffs in stormy weather. The same amounts of rain as at 800-1000 m in the central island group (Pico, Faial, S. Jorge, Terceira, Graciosa) are reached at a level at least 400 m lower on Corvo.

The rapidly increasing amounts of precipitation on Corvo from the coast towards higher altitudes naturally influence the zonation of vegetation on the island. The general features of this zonation as compared with the central islands are the presence of coastal plants at much higher and of cloud-zone plants at much lower altitudes. The coexistence of plants with widely different moisture demands and different drought resistance is frequent at altitudes from 200 to 500 m. This typical feature of the Corvo vegetation makes it difficult to distinguish plant communities which, in other parts of the archipelago, are separated in altitude and also equipped with more or less distinctly separating taxa (differential species). Several of these taxa suffer a decrease of their differential values as compared to the central island group (Table 1).

The aim of the bryophyte studies on Corvo was principally to record the flora, providing diversity figures for comparison with the other Azorean islands. Sociological studies comprised recordings for comparison of composition and frequency of Azorean communities earlier distinguished (cf. SJÖGREN 1978, 1990). The intention was to treat the autecology of the species recorded as detailed as possible, principally providing information on zonation and substratum preference (Table 2), in this case also with numerous comparisons with the presence of the species on the other Azorean islands.

Bryophyte flora and diversity

The bryophyte flora of Corvo comprised only 29 taxa in EGGERS (1982) list of species. The total

Table 1

Some differential species of bryo-communities in CAZ and EAZ indicated by +. Due to presence also in other communities indicated by C, these species suffer a decrease of their differential values on Corvo.

	1	2	3	4	5	6	7
<i>Aphanolejeunea teotonii</i>	+	C	C		C		
<i>Calypogeia muelleriana</i>		+		+	C	C	
<i>Cololejeunea azorica</i>	+	C	C				
<i>Drepanolejeunea hamatif.</i>	+	C	C		C		
<i>Frullania dilatata</i> s.lat.						C	+
<i>Frullania tamarisci</i>	+	+		+	C	C	
<i>Frullania teneriffae</i>	+	+		+	C	C	C
<i>Radula aquilegia</i>	+	+			C		
<i>Dicranum scottianum</i>	C	+		+	C		
<i>Echinodium prolixum</i>		+					C
<i>Epipterygium tozeri</i>						+	C
<i>Lepidopilum virens</i>					C	+	
<i>Neckera intermedia</i>		+					(C)

Communities:

1. Cololejeuneetum azoricae (epiphyllous)
2. Echinodio-Lepidozietum cupressinae (epiphytic)
3. Frullanietum microphyllae (epiphytic)
4. Lepidozietum azoricae (epixylic)
5. Tetraetichium-Dumortiera-ass. (epilithic-epigeic)
6. Allorgeo-Myurion (epigeic)
7. Ptychomitron azoricae (epilithic).

number of taxa of the island, treated in this paper, is 134 (53 hepatics and 81 mosses). The expected number of 125 spp. (SJÖGREN 1990) has thus been slightly exceeded. Further investigations may add at least 25 spp. to this number. Bryophyte diversity is thus almost 17 times higher than on the island of S. Miguel (with its 348 spp. on a surface of 747 km²).

A comparison of the species number within different bryo-communities, subject to different environmental conditions, provides large differences on Corvo. For example, 108 and 85 taxa were recorded as epilithic and as epigeic, respectively, but only 24 and 19 taxa as epiphytic and as epiphyllous. On all substrates there were several species, present in only 1 or 2 of the sample plots. It is consequently possible to state that at least one third of all bryophytes on Corvo occur very scattered and must be regarded as rare and probably not securely established on the island. Approximately 90 spp. may be regarded as securely established, with fairly high frequencies in the bryo-communities distinguished.

Table 2

Substratum preferences of some bryophytes in EAz and CAz, indicated by +, (+), = weak. Additional presence of these species on other substrates, decreasing the preferences, has been indicated by C (Corvo) and by G (Graciosa). eph= epiphyllous; ex= epixylic; ef = epiphytic; eg = epigeic; el = epilithic.

	eph	ex	ef	el	eg
Hepaticae					
<i>Anastophyllum minutum</i>				+	C
<i>Aphanolejeunea teotonii</i>	+		CG	G	
<i>Calypogeia muelleriana</i>		+			C
<i>Calypogeia azorica</i>	+		CG		
<i>Cololejeunea minutissima</i>	+		CG		
<i>Drepanolejeunea hamatifolia</i>	+		C	C	C
<i>Frullania dilatata</i> s.lat.				+	C
<i>Frullania tamarisci</i>	+	+	+	C	C
<i>Frullania teneriffae</i>	+	+	+	C	C
<i>Lejeunea flava</i>				+	C
<i>Marchesinia mackaii</i>				+	C
<i>Plagiochila corniculata</i>	+	+	+	C	C
<i>Porella canariensis</i>			(+)	CG	C
<i>Radula aquilegia</i>	+		+	C	
Musci					
<i>Dicranum scottianum</i>	(C)	+	+	C	
<i>Echinodium prolixum</i>				+	C
<i>Epipterygium tozeri</i>					C +
<i>Eurhynchium praelongum</i>	C	C	C	(+)	(+)
<i>Isopterygium elegans</i>	+	+	+	C	C
<i>Lepidopilum virens</i>			C	+	+
<i>Leucobryum juniperoideum</i>		+	+	C	
<i>Neckera intermedia</i>				+	C
<i>Zygodon viridissimus</i>				+	C C

Only 4 of the bryophytes recorded on Corvo are endemic to the Azores and 7 spp. are endemic to Macaronesia. The corresponding figures for the nearby but much larger island of Flores are 5 and 16, respectively. Far-reaching felling of the Juniperion forest on Corvo has most probably eliminated the earlier presence of such endemic species as *Bazzania azorica*, *Plagiochila allorgei* and *Tylimanthus azoricus*, all present on Flores.

This paper treats and describes from various points of view the bryophytes actually recorded on Corvo in 1978. The sociological section includes some comparisons with the other islands of the archipelago. Consequently, it is worthwhile making a few remarks on floristic differences between Corvo and the other Azorean islands.

The epiphyllous species are comparatively few. *Harpalejeunea ovata* and *Lejeunea patens*

are rare; *Cololejeunea madeirensis* and *C. microscopica* were not recorded. The epiphytic bryo-vegetation is even poorer in species than in the CAz. *Neckera intermedia* and *Marchesinia mackaii* are rare; *Lepidozia cupressina*, *Bazzania azorica*, *Metzgeria leptoneura* and *Plagiochila allorgei* are still not recorded. The epilithic vegetation on Corvo is species-rich and at least two associations exist. Some species, in general highly frequent in other parts of the archipelago, are rare, such as *Scorpiurium circinatum*, *Herbertus azoricus* and *Fissidens serrulatus*; a number of species, known as preferentially epilithic and fairly frequent on the other Azorean islands, have still not been recorded on Corvo such as *Brachythecium populeum*, *Leucodon* spp., *Racomitrium heterostichum* and *Riccardia latifrons*. Also the epigeic bryo-vegetation is fairly species-rich on Corvo but among the unrecorded species are *Lepidozia azorica*, *Breutelia azorica* and *Campylopus carreiroanus*, all endemic to the Azores. Altogether, the diversity within the bryo-communities of Corvo is clearly reduced as compared to the other Azorean islands. But the diversity on the small surface of the island is extremely high in comparison with, for example, the islands of S. Miguel, Pico and Terceira.

Bryophyte vegetation

EPILITHIC

The epilithic moss vegetation on Corvo has been studied in 85 sample plots (1/4 m²). The plots were located at altitudes between 25-700 m, most of them at intermediate altitudes between 250-450 m. The total number of species recorded within these plots is very high (108 spp.), but it should be mentioned that 47 of the species were present in only 1 or 2 of the plots. There was 35% hepatics in the total stock of species. Each plot had a number of 4-11 spp. The most species-poor recordings were generally at altitudes below 250 m.

There are on Corvo, as also in other parts of the archipelago, numerous examples of transitions between epilithic and epigeic bryo-communities. Such transitions are especially frequent on litter-soil covered surfaces of boulders and cliffs. This is naturally one of the explanations of the large

number of species represented in the total plot material. Also, stone surfaces on Corvo are more species-rich than in CAz as a result of the clear decrease of substratum preference of several bryophytes towards W in the archipelago.

The most frequent species on stone surfaces are *Brachythecium plumosum*, *Eurhynchium praelongum*, *Grimmia trichophylla*, *Hypnum resupinatum*, *Radula carringtonii*, *Heterocladium heteropterum* and *Frullania tamarisci*. Among these species only *Grimmia trichophylla*, *Hypnum resupinatum* and *Heterocladium heteropterum* could be selected as differential species of epilithic bryo-communities.

Among the preferentially epilithic species are only:

<i>Anastrophyllum minutum</i>	<i>Hypnum resupinatum</i>
<i>Frullania dilatata</i> s. lat.	<i>Ptychomitrium</i> spp.
<i>Porella obtusata</i>	<i>Racomitrium aciculare</i>
<i>Grimmia trichophylla</i>	<i>Racomitrium fasciculare</i>
<i>Heterocladium heteropterum</i>	<i>Tortula muralis</i>

Most species recorded on stone surfaces on Corvo are preferentially epilithic and epigeic. Some occur accidentally on boulders and cliffs al-

though being pref. epixylic, epiphytic or even epilithic. A large number of the epigeic species in the epilithic plots have almost no substratum preference at all on Corvo although their preference may be at least recorded as weak in CAz. A few examples of such species are *Calypogeia muellerana*, *Drepanolejeunea hamatifolia*, *Plagiochila corniculata*, and among the mosses *Isopterygium elegans*, *Dicranum scottianum*, *Eurhynchium praelongum*, *Leucobryum juniperoideum*.

Ptychomitrium azoricae SJN. 1993
(= *Grimmia azorica* - *Ptychomitrium* - all. SJN. 1990)

The alliance *Ptychomitrium azoricae* has been illustrated as recorded in 25 sample plots (Tables 3 and 4). It was earlier treated under the name *Grimmia azorica* - *Ptychomitrium* - all. The name *Ptychomitrium azoricae* suggested here for the first time, provides a more practical nomenclature. It is founded on the presence of the three *Ptychomitrium* species, one of them *P. azoricum*, and on *Grimmia azorica* (now included in *G. trichophylla* as spp. *azorica* (Ren. et Card.) Luis.

The alliance is present on dry or moderately dry stone surfaces. It is characterized by the five

Table 3

Epilithic moss vegetation on the island of Corvo (Azores). *Ptychomitrium azoricae*: *Frullanietum dilatatae*.

altitude m a.s.l.	225	225	225	75	75	150	150	25	75	175
number of species	8	7	5	4	4	6	5	4	5	6
no. in table	1	2	3	4	5	6	7	8	9	10
a.										
<i>Grimmia trichophylla</i>	x	x	x	x	x	x	x	.	.	.
<i>Ptychomitrium</i> spp.	.	x	.	.	.	.	.	.	.	x
<i>Hypnum resupinatum</i>	x	.	.	x	x	x	x	x	x	x
b.										
<i>Campylopus pilifer</i>	x	.	.	.	.	.	.	.	.	x
c.										
<i>Frullania dilatata</i> s.l.	x	x	x	x	x	x	x	x	x	x
<i>Zygodon viridissimus</i>	.	.	.	.	x	.	.	x	x	.
<i>Tortella flavovirens</i>	.	.	.	x	.	x	x	x	x	.
d.										
<i>Frullania teneriffae</i>	x	.	.	.	.	.	.	.	.	.
<i>Marchesinia mackaii</i>	.	.	x	.	.	.	.	.	.	.
<i>Radula carringtonii</i>	x	x	.	.	.	x	.	.	.	.
<i>Bryum donianum</i>	x	x	.	.	.	.	.	.	.	.
<i>Eurhynchium praelongum</i>	.	.	.	.	.	x	x	.	.	.

Other accompanying species: *Didymodon insulanus* (1); *Brachythecium plumosum*, *Weissia controversa* (2); *Frullania tamarisci*, *Saccogyna viticulosa* (3); *Sematophyllum substrumulosom* (9); *Scleropodium purum*, *Hypnum* sp. (10). Localities: Coroa do Pico, N of (1-3, 10); Portinho da Areia, E of (4, 5); Fonte Velha, SW of (6, 7); Portinho da Areia (8, 9). a. diff. spp. of the *Ptychomitrium azoricae*; b. weak diff. val of the P.a.; c. diff. spp. of the *Frullanietum dilatatae*; d. accompanying spp.

differential species *Grimmia trichophylla* (incl. ssp. *azorica*), *Hypnum cupressiforme* var. *resupinatum* (in Tables and text as *H. resupinatum* Tayl. in Spruce) and the three *Ptychomitrium* species. Differential species with less distinctly pronounced diff. val. are *Scorpiurium circinatum*, *Campylopus pilifer* and *Heterocladium heteropterum*.

The average species number of the sample plots is 7 spp. (4-12). The total number of species of the two associations is 50 spp. (including all three *Ptychomitrium* in this case as one species). Hepatics constitute 34% of the species stock.

On Corvo the alliance has its most typical composition on strongly exposed boulders at altitudes between 250-450 m. In v. HÜBSCHMANN (1974) the alliance was recorded with the two associations *Ptychomitrium polyphyllum* and *Grimmietum azoricae*.

Frullanietum dilatatae SJN. 1993

Table 3 includes 10 sample plots, all from altitudes below 250 m. They represent the new association *Frullanietum dilatatae*, characterized by the diff. spp. *Frullania dilatata*, *Zygodon viridis*-

Table 4

Epilitic moss vegetation on the island of Corvo (Azores). *Ptychomitrium azoricae*: *Grimmietum acicularae*

altitude m a.s.l.	425	425	425	600	650	250	250	425	425	425	425	600	425	350	350	
number of species	7	11	9	8	6	10	7	8	5	7	11	7	11	6	9	
no. in table	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
a.																
<i>Grimmia trichophylla</i>	x	x	x	.	x	x	.	x	.	x	x	x	x	x	x	
<i>Hypnum resupinatum</i>	.	x	.	.	.	x	x	.	.	x	x	.	.	x	.	
<i>Ptychomitrium</i> spp.	.	.	.	x	x	x	x	.	x	x	.	x	.	.	.	
b.																
<i>Scorpiurium circinatum</i>	.	.	.	.	.	.	.	x	.	.	x	.	.	.	.
<i>Campylopus pilifer</i>	.	.	.	.	.	x	.	.	.	x	x	.	.	.	.
<i>Heterocladium heteropterum</i>	x	.	x	.	.	.	.	x	.	.	.	.	.	.	.
c.																
<i>Racomitrium aciculare</i>	x	x	x	.	x	.	.	x	x	x	x	x	x	x	x	
<i>Racomitrium fasciculare</i>	.	.	x	x	x	x	.	.	.	.	.	x	.	.	.
<i>Brachythecium plumosum</i>	.	.	x	.	.	.	x	.	.	.	.	x	x	.	x
d.																
<i>Frullania teneriffae</i>	x	.	.	.	.	.	.	.	.	x	x	.	x	.	.
<i>Campylopus flexuosus</i>	x	.	x	x	.	.	.	.	.	.	.	.	.	.	.
<i>Marsupella emarginata</i>	x	.	.	.	.	.	.	.	.	.	.	x	.	.	.
<i>Hypnum hochstetteri</i>	x	x	.	.	.	.	.	.	.	.	.	x	x	.	.
<i>Frullania tamarisci</i>	.	x	x	.	.	x	.	x	x	.	.	.	.	.	.
<i>Diphyscium foliosum</i>	.	x	.	.	.	.	.	.	.	.	.	.	x	.	.
<i>Radula carringtonii</i>	.	x	x	.	.	x	.	.	.	.	.	.	x	x	x
<i>Lejeunea lanacerina</i>	.	.	x	.	.	.	.	.	.	.	x	.	.	.	x
<i>Echinodium prolixum</i>	.	.	.	x	.	.	.	.	.	.	x	.	x	x	.
<i>Polytrichum commune</i>	.	.	.	x	.	.	.	.	.	.	.	.	.	.	x
<i>Hypnum uncinulatum</i>	.	.	.	.	x	.	.	x	x	x	x	.	.	.	.
<i>Campylopus setaceus</i>	.	.	.	.	x	.	x	.	.	.	.	.	.	.	.
<i>Eurhynchium praelongum</i>	.	.	.	.	.	x	x	.	.	.	.	.	.	.	x
<i>Philonotis rigida</i>	.	.	.	.	.	.	.	x	x	.	.	.	.	.	.
<i>Campylopus brevipilus</i>	.	.	.	.	.	.	.	x	x	.	.	.	.	.	.
<i>Thamnobryum alopecurum</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	x	x

Other accompanying species: *Plagiochila spinulosa*, *Porella canariensis*, *Harpalejeunea ovata*, *Herbertus azoricus* (2); *Drepanolejeunea hamatifolia*, *Leucobryum juniperoideum*, *Scapania undulata* (4); *Weissia controversa*, *Marchesinia mackaii* (6); *Bryum donianum* (7); *Anastrophyllum minutum* (8); *Lejeunea flava*, *Radula aquilegia* (11); *Polytrichum juniperinum*, *Rhamphidium purpuratum* (13); *Rhynchostegium riparioides* (15). Localities: Caldeirão (1-3, 8-11, 13); Morro dos Homens (4,5); Espigãozinho, E of (6, 7); N rim Caldeirão (12); Coroinha W of (14, 15). a. diff. spp. of the *Ptychomitrium azoricae*; b. weak diff. val. of the P.a.; c. diff. spp. of the *Grimmietum acicularae*; d. accompanying spp.

simus and *Tortella flavovirens*. The association, present on strongly exposed dry boulder surfaces, features an impoverished *Ptychomitrium azoricae*, which is, however, quite possible to describe as a separate association, principally due to the highly frequent presence of *Frullania dilatata*. The *Frullanietum dilatatae* is present on Graciosa (SJÖGREN 1990, Table 3). It should be possible to distinguish this association on other Azorean islands; most probably it is present in CAz and EAz up to an altitude of at least 400 m.

The *Frullanietum dilatatae* is a coastal association which towards higher altitude develops progressively into the *Grimmietum acicularae* (on Corvo). Consequently there are numerous forms of transitions on the island between these two associations of the *Ptychomitrium azoricae*.

The epiphytic *Frullanietum microphyllae* of the *Echinodion* - all. is another low-altitude association, which progressively develops into the *Echinodio-Lepidozietum cupressinae*. However, the *Frullanietum microphyllae* is less distinctly separated by differential species than the *Frullanietum dilatatae*. The two associations are, on the other hand, sociologically well separated from each other.

Grimmietum acicularae SJN. 1993

The *Ptychomitrium azoricae* is represented principally by one set of species on Corvo, the association *Grimmietum acicularae*. This association, not described earlier from the archipelago, is firmly characterized by the diff. spp. *Racomitrium aciculare*, *R. fasciculare* and *Brachythecium plumosum*. The *Racomitrium* species have an unusually strong substratum preference, growing only accidentally on substrates other than stone surfaces. The association is frequently equipped with the diff. spp. of the alliance. Localities are mainly above 300 m altitude and especially on strongly exposed boulders and cliff surfaces. Below 300 m the *Grimmietum acicularae* is replaced by the *Frullanietum dilatatae*, *Frullania teneriffae* and *F. tamarisci* become progressively more frequently replaced by *F. dilatata* towards the coasts.

The *Grimmietum acicularae* has been recorded in 15 sample plots (1/4m²). The average species number of 8 spp. (5-11) is fairly high, in that re-

spect considerably higher than in the *Frullanietum dilatatae*.

The species set in the *Grimmietum acicularae* indicates some affinity to associations of the *Allorgeo-Myurion* (*Myurium*-*Allorgea*-*Fissidens pallidicaulis* - all.). Transitional bryo-vegetation is frequent, related to the amounts of soil-litter on the stone surfaces. However, the typical epilithic species such as *Grimmia trichophylla*, *Ptychomitrium* spp. and *Heterocladium heteropterum* are only met with as coexisting species on such stone surfaces where the accumulation is scarce.

The presence of the *Grimmietum acicularae* in other parts of the archipelago remains to be investigated. The possible presence in CAz would be at altitudes above 500 m.

The habitat of the distinguishing species *Racomitrium aciculare* and *Brachythecium plumosum* in CAz is generally steep rock surfaces and brook boulders in ravines. The rare presence of *R. aciculare* in the Azores mentioned earlier, does not apply to the islands of Flores and Corvo. At least on Flores the species was linked to the ass. *Racomitrio-Scapanietum undulatae* (Allorge 1921) and described as the only island where it is met with on strongly exposed, not water-soaked, rock surfaces (cf. SJÖGREN 1978). *Brachythecium plumosum* was described as a species with sociological affinity to the brook boulder ass. *Platyhypnidium riparioides* (v. Hübschmann 1973). This affinity is not at all maintained on Corvo.

EPIPHYTIC

The epiphytic vegetation on Corvo was studied in 33 sample plots (size 1/4 m²). The total number of species was 24 (73% hepatics). 10 spp. were recorded in only 1 or 2 of the plots. Seventeen of the plots were selected for Table 5. The average number of species in the *Echinodio-Lepidozietum cupressinae* of Corvo was 8 (4-10) in the plots. In the depoverished *Frullanietum microphyllae* the number is much smaller.

The *Echinodion* - all. was recorded between 200-500 m. The general impression of the alliance on Corvo is an impoverished composition as compared to its presence in the well-developed *Juniperion brevifoliae* on the central islands in the archipelago (Faial, Pico, Terceira, S. Jorge). The reason is certainly the poor development of the *Junipe-*

Table 5

Epiphytic moss vegetation on the island of Corvo (Azores). Echinodion: Echinodio-Lepidozietum cupressinae (1-9); Frullanietum microphyllae (10-17).

altitude m a.s.l.	425	275	275	500	500	500	500	500	500	225	225	200	200	200	200	275	275
number of species	8	5	9	6	6	5	4	10	7	3	3	2	2	2	7	5	
no. in table	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
a.																	
<i>Echinodium prolixum</i>	.	.	.	.	x	x	.	x	x	.	.	.	.	.	.	.	.
<i>Lejeunea flava</i>	x	x	x	x	x	x	x	x	x	.	.	.	.	.	.	.	.
b.																	
<i>Cololejeunea minut.</i>	.	x	.	x	.	.	.	x	.	x	x	x	x	x	x	x	x
<i>Frullania microphylla</i>	x	x	x	x	.	.	.	.	.	x	x	x	x	x	x	x	x
c.																	
<i>Dicranum scottianum</i>	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.
<i>Harpalejeunea ovata</i>	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	x
<i>Drepanolejeunea ha.</i>	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.
<i>Metzgeria furcata</i>	x	x	x	x	x	x	x	x	x	.	.	.	.	.	.	x	x
<i>Lejeunea lamacerina</i>	x	.	x	.	.	.	.	x	x	x	.	.	.	.	.	x	x
d.																	
<i>Frullania tamarisci</i>	x	x	x	.	.	.	.	x	.	.	.	.	.	.	.	.	x
<i>Hypnum uncinulatum</i>	x	.	x	x	x	x	x	x	x	.	.	.	.	.	.	.	x
<i>Leucobryum junip.</i>	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Radula carringtonii</i>	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Frullania teneriffae</i>	.	.	x	x	x	x	x	x	x	.	.	.	.	.	.	.	.
<i>Metzgeria conjugata</i>	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Plagiochila spinulosa</i>	.	.	.	.	x	.	.	.	x	.	.	.	.	.	.	.	.
<i>Frullania dilatata</i>	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.
<i>Cololejeunea azorica</i>	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.

Plots no. 1, 5-9 on *Erica azorica*; 2, 3, 16, 17 on *Juniperus brevifolia*; 10-16 on *Cryptomeria japonica*. Localities: Caldeirão (1); Espigãozinho, E of (2, 3, 16, 17); E rim of Caldeirão (4-9); Coroa do Pico, N of (10, 11); Espigãozinho, SE of (12-15). a. diff. spp. of the Echinodion; b. diff. spp. of the Frullanietum microphyllae; c. weak diff. val. of the Echinodio-Lepidozietum cupressinae; d. accompanying spp.

tion on Corvo, where only small scattered stands of the Azorean native forest remain today. The Echinodion on Corvo is, consequently, equipped with only two diff. spp. of the alliance, *Echinodium prolixum* and *Lejeunea flava*. It was not possible to record any locality for *Lepidozia cupressina* or for *Adelanthus decipiens* and *Bazzania azorica*, earlier treated as diff. spp. of weak diff. val. *Neckera intermedia*, a diff. spp. of the Echinodio-Lepidozietum cupressinae in CAz is apparently missing as epiphytic on Corvo. The Echinodion on Corvo is thus very similar to the composition of the all., for example on Pico, in the very small scattered fractions of the Juniperion brevifoliae left in the high-altitude grazing land at altitudes above 800 m.

Echinodion SJN. 1993

Echinodio-Lepidozietum cupressinae SJN. 1978

The Echinodio-Lepidozietum cupressinae (cf. SJÖGREN 1978, p. 30 ff.) is a famous endemic

Azorean association, especially to be found on *Erica azorica* and *Juniperus brevifolia*. It is absent on Graciosa and S. Maria, present on all the other Azorean islands but poorly developed and scattered on Corvo. In its optimal stages of development, the association is frequently dominated by such species as *Lepidozia cupressina*, *Bazzania azorica* and *Neckera intermedia*, locally by *Herbertus azoricus*. These species, being strongly competitive, may even obscure the typical development of the association, covering the stems of *Erica* and *Juniperus* all around in thick carpets. The final stages of development of the association are apparently not reached on Corvo. The epiphytic bryophyte cover on stems of *Erica* and *Juniperus* appears mostly as thin carpets, frequently split up and interfoliated by almost nude bark spots colonized only by minute hepatics of weak differential value, linked only to primary stages of the association, such as *Cololejeunea minutissima*, *Harpalejeunea ovata*, *Drepanolejeunea*

hamatifolia, *Lejeunea lamacerina* and *Metzgeria furcata*.

Frullanietum microphyllae v. HÜBSCHM. 1974

The association *Frullanietum microphyllae*, described by v. HÜBSCHMANN (1974) and recorded on Graciosa (SJÖGREN 1990) is frequently present on Corvo at altitudes around 200-300 m. It is mostly found on bases of *Cryptomeria*. The composition is very species-poor. *Cololejeunea minutissima* and *Frullania microphylla* are highly frequent species of the ass. They occur very scattered and reach only low percentages of cover within the sample plots of 1/4 m². Larger sizes of plots rarely add more species to the ass. The poor development of the Echinodio-Lepidozietum cypripinae on Corvo is, furthermore, a reason for the difficulties linking the *Frullanietum microphyllae* to the Echinodion - all. Transitions to the main ass. of the Echinodion on Corvo are much rarer on *Erica* and *Juniperus* than in CAz.

EPIGEIC

The epigeic bryo-vegetation on Corvo has been studied in 63 sample plots (1/4 m²). The total number of species recorded in the plots was 85 (36% hepatics). The set of species included 40 which were present in only one or two of the plots. Epigeic vegetation was recorded between 200-700 m. The two types of species-poor vegetation included in the *Sphagnum* carpets at altitudes above 400 m and the *Scleropodium-Thuidium* carpets in open grazing land, have not been included in this study. The recordings were instead concentrated on species-rich localities, on moist soil escarpments, where hepatics are mostly the dominant species.

Allorgeo-Myurion SJN. 1993

(= *Myurium*-*Allorgea*-*Fissidens pallidicaulis* - all. SJN. 1990)

The alliance Allorgeo-Myurion has been described in Table 6. The sample plots are from localities at altitudes between 200-700 m. The average number of species in the plots is 7 (5-14), with more than 10 spp. in only 2 plots. The high total number of accompanying species is due to

the presence of 38 spp., recorded in only 1 or 2 of the plots.

The differential species of the alliance are *Myurium hochstetteri*, *Allorgea berthelotiana*, *Fissidens taxifolius* spp. *pallidicaulis* (here treated as *F. pallidicaulis*) and *Nardia scalaris*. These four species are preferentially epigeic, with more or less frequent presence also as epilithic, growing on moist stone surfaces, preferably where there is at least a thin soil-litter cover.

Four species with weaker but still distinct differential value of the alliance are *Saccogyna viticulosa*, *Epipterygium tozeri*, *Fissidens asplenioides* and *Heterocladium heteropterum*. Being also a differential species of the *Ptychomitrium azoricae*, *Heterocladium* has apparently the weakest differential value of the four last-mentioned species.

At this stage it has not been possible to select a number of efficiently delimited associations within the Allorgeo-Myurion. The alliance has earlier (SJÖGREN 1990) been described from the island of Graciosa, where the suggested differential species are the same, with an addition only of *Scleropodium touretii* and *Calypogeia fissa*, species rarely present in the alliance on Corvo. Further studies of the alliance in the archipelago may lead to an exclusion of these two species from the group of differential species. The average species number in the Graciosa plots is equally high as on Corvo, again due to a large number of accidental species.

The habitat of the Allorgeo-Myurion is principally moist but not water-flooded soil escarpments, in both strongly exposed and sheltered places. In comparison, the alliance on Graciosa is much more frequently present in sheltered habitats.

Communities in connection with the epigeic alliance described are mostly the *Grimmietum aciculatae* fractions of the *Ptychomitrium azoricae*. The *Tetrastichium-Dumortiera*- ass., described from Graciosa (SJÖGREN 1990, Table 2), is characterized by species combinations not possible to record on Corvo. This epilithic-epigeic association on sheltered permanently moist substrata, on cliffs or on soil escarpments, probably belongs to an alliance sociologically separated from the Allorgeo-Myurion. In common with the *Tetrastichium* - ass. there are only such species as *Heterocladium het-*

Table 6

Epigeic moss vegetation on the island of Corvo (Azores). Allorgeo-Myurion (= Myurium-Allorgea-Fissidens pallidicaulis - all.)

altitude m a.s.l.	425	425	425	425	425	425	550	450	425	225	225	225	200	450	450	700	275	200
number of species	7	8	9	8	5	8	6	7	7	6	6	6	7	11	5	14	5	6
no. in table	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
a.																		
<i>Myurium hochstetteri</i>	x	.	.	.	.	.	.	.	.	.	x	.	.	x	x	.	x	.
<i>Allorgea berthelotiana</i>	.	.	.	.	.	.	.	.	.	x	x	x	x	.	.	.	x	x
<i>Fissidens pallidicaulis</i>	x	.	.	x	x	x	.	.	.	.	.	.	.	.	.	x	x	x
<i>Nardia scalaris</i>	x	x	x	.	.	.	x	x	x	x	.	.	.	.	.	.	.	.
b.																		
<i>Saccogyna viticulosa</i>	.	x	.	.	.	.	x	.	.	.	.	.	.	x	.	x	.	.
<i>Epipterygium tozeri</i>	.	.	x	.	.	x	.	.	x	.	.	.	x	.	.	.	.	.
<i>Fissidens asplenioides</i>	.	x	x	.	.	.	.	x	x	x	x	x	.	.	x	.	.	x
<i>Heterocladium heter.</i>	x	.	.	x	x	x	.	.	.	.	.	.	.	x	.	.	.	.
c.																		
<i>Campylopus flexuosus</i>	x	.	.	.	.	.	x	x	.	.	.	.	.	.	.	.	x	.
<i>Entostodon attenuatus</i>	x	x	x	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
<i>Odontoschisma sphagni</i>	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.
<i>Campylopus brevipilus</i>	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Pogonatum aloides</i>	.	x	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.
<i>Polytrichum commune</i>	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Leucobryum juniper.</i>	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.
<i>Philonotis rigida</i>	.	.	x	.	.	.	.	.	x	x	.	.	.	.	.	.	x	.
<i>Sematophyllum sub.</i>	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.
<i>Dumortiera hirsuta</i>	.	.	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Eurhynchium prael.</i>	.	.	.	x	x	x	.	.	.	x	.	.	.	x	.	.	.	.
<i>Plagiothecium cav.</i>	.	.	.	x	.	.	.	.	.	.	.	.	.	x	.	.	.	.
<i>Rhynchostegium ripar.</i>	.	.	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Conocephalum conicum</i>	.	.	.	.	.	.	x	.	.	.	.	.	x	.	.	.	.	.
<i>Radula carringtonii</i>	.	.	.	.	.	.	x	.	.	.	.	x	x	.	x	.	.	x
<i>Frullania teneriffae</i>	.	.	.	.	.	.	.	x	.	.	.	.	.	x	.	.	.	.
<i>Marsupella emarginata</i>	.	.	.	.	.	.	x	x	.	.	.	.	.	.	.	.	.	.
<i>Anthoceros punctatus</i>	.	.	.	.	.	.	.	x	.	x	.	.	.	.	.	.	.	.
<i>Rhamphidium purp.</i>	.	.	.	.	.	.	.	x	x	.	.	.	.	.	.	.	.	.
<i>Calypogeia muellerana</i>	.	.	.	.	.	.	.	.	.	x	.	.	.	x	.	x	x	.
<i>Hypnum resupinatum</i>	.	.	.	.	.	.	.	.	.	.	x	x	.	.	.	.	.	.
<i>Weissia controversa</i>	.	.	.	.	.	.	.	.	.	.	x	x	.	.	.	.	.	.
<i>Frullania tamarisci</i>	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	x	.
<i>Tortella flavovirens</i>	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	x

Other accompanying species: *Lejeunea lamacerina*, *Plagiomnium undulatum* (4); *Atrichum angustatum*, *Rhynchostegium confertum* (6); *Nardia geoscyphus* (7) *Campylopus pyriformis* var. *azoricus* (9); *Radula wichurae*, *Rhynchostegiella surrecta* (13); *Brachythecium plumosum*, *Fissidens viridulus*, *Porella canariensis*, *Thamnobryum alopecurum* (14); *Calypogeia trichomanis* (15); *Anastrophyllum minutum*, *Cephalozia bicuspidata*, *Herbertus azoricus*, *Hypnum uncinulatum*, *Isopterygium elegans*, *Scapania undulata* (16); *Lejeunea flava* (17); *Zygodon viridissimus* (19). Localities: Caldeirão (1-6); NE rim of Caldeirão (7-9); Coroa do Pico, N of (10-12); Fonte Velha, E of (13); Lomba Redonda (14,15); Morro dos Homens (16); Espigãozinho, E of (17); Fojo (18). a. diff. spp. of the Allorgeo-Myurion; b. weak diff. val. of the A-M; c. accompanying species.

eropterum, *Epipterygium tozeri*, *Lejeunea lamacerina*, *Fissidens pallidicaulis* and *Eurhynchium praelongum*; species of inferior or no value as differential species of the Allorgeo-Myurion.

EPIPHYLLOUS

The Azorean epiphyllous bryo-vegetation on

leaves of trees and on fronds of ferns, also but rarely on a few pleurocarpous mosses, offers a community of extraordinary interest (Table 7). This peculiar, ecologically most restricted vegetation, has its only European presence in the Azorean islands. In Macaronesia it is also present on Madeira (SJÖGREN 1975) and in the Canary islands. Typically developed epiphyllous vegetation

Table 7

Epiphyllous moss vegetation on the island of Corvo (Azores). Cololejeuneo-Colurion: Cololejeuneetum azoricae. (T *Trichomanes speciosum*, D *Diplazium caudatum*).

altitude m a.s.l.	300	300	300	300	300	600	600	425	425	425
substrate	T	T	T	T	T	T	T	D	T	T
number of species	6	5	5	6	6	9	10	5	8	6
no. in table	1	2	3	4	5	6	7	8	9	10
a.										
<i>Colura calyptrifolia</i>	.	.	x	x	x	.	.	.	.	.
<i>Cololejeunea minutissima</i>	x	.	x	x	x	x	x	.	x	.
b.										
<i>Aphanolejeunea teotonii</i>	x	x	x	x	.	.	.	x	x	.
<i>Cololejeunea azorica</i>	.	.	x	x	.	x	x	.	x	x
c.										
<i>Frullania microphylla</i>	.	.	.	x	.	.	.	x	.	.
<i>Radula aquilegia</i>	.	.	.	.	.	x	.	.	.	.
<i>Lejeunea lamacerina</i>	x	x	.	.	x	x	x	x	x	x
<i>Lejeunea patens</i>	.	.	.	.	.	.	x	x	.	x
d.										
<i>Dicranum scottianum</i>	x	.	.	.	.	x	x	.	.	.
<i>Frullania tamarisci</i>	x	x	.	x	x	x	x	.	.	.
<i>Plagiochila spinulosa</i>	.	.	.	.	.	x	x	.	x	x
<i>Hypnum uncinatum</i>	x	.	x	.	x	.	x	x	x	.
<i>Eurhynchium praelongum</i>	.	x	.	.	.	.	.	.	x	.
<i>Saccogyna viticulosa</i>	.	x	.	.	.	.	.	.	.	x
<i>Lejeunea flava</i>	.	.	.	.	x	.	x	.	.	.
<i>Frullania teneriffae</i>	.	.	.	.	.	x	x	.	x	x
<i>Myurium hochstetteri</i>	.	.	.	.	.	x	.	.	.	.

a. diff. spp. of the Cololejeuneo-Colurion; b. diff. spp. of the Cololejeuneetum azoricae; c. diff. spp. with weak diff. val. of the ass. C.a.; d. accompanying species. Localities: Espigãozinho, E of (1-5); N rim of the Caldeirão (6, 7); exterior NE slope of the Caldeirão (8-10).

in the Azores is restricted to the optimally developed natural cloud-zone forest, the Juniperion brevifoliae. The frequent presence of species-rich epiphyllous vegetation in the Azores is generally an indicator of vegetation worth consideration for conservation, as it also includes the largest number of endemic vascular plants in the archipelago.

Cololejeuneo-Colurion (S.J.N. 1978 prov.)
Cololejeuneetum azoricae S.J.N. 1978

The epiphyllous ass. Cololejeuneetum azoricae belongs to the all. Cololejeuneo-Colurion, recorded on all the Azorean islands except for S. Maria and Graciosa. The all. also includes the Cololejeuneetum microphyllae S.J.N. 1975, recorded on Madeira (not Porto Santo). Diff. spp. of the all. are *Colura calyptrifolia* (the most important diff. sp.), *Cololejeunea minutissima*, *Drepanolejeunea hamatifolia* and *Harpalejeunea ovata*, the three latter, although highly frequent, with weaker diff. values.

The Cololejeuneetum azoricae is characterized by the diff. spp. *Aphanolejeunea teotonii* and *Cololejeunea azorica*. There are also four species with weak diff. val. namely *Frullania microphylla*, *Lejeunea lamacerina*, *L. patens* and *Radula aquilegia*. The Cololejeuneetum microphyllae of Madeira is distinctly separated from the Azorean ass. due to the presence of the diff. spp. *Metzgeria fruticulosa* and *Frullania polysticta*. Also *Frullania microphylla* has a diff. val., although weak, of the Madeira ass. and this species is much more frequent in the Cololejeuneetum microphyllae than in the Cololejeuneetum azoricae.

Epiphyllous vegetation on Corvo was studied in 14 sample plots, on the ferns *Trichomanes speciosum*, *Diplazium caudatum*, *Hymenophyllum tunbrigense* and *Pteridium aquilinum*. The development of the Cololejeuneetum azoricae was more complete on *Trichomanes* than on other ferns. Sample plots were 1/10-1/5 dm². The average number of species was 6.5 (5-10). In the total number of plots 19 spp. (14 hepatics) were re-

corded. Only 7 of the species were present in more than 2 plots. The species diversity in the ass. is generally clearly higher in CAz than on Corvo. The phorophytes on Corvo grow in dark narrow ravines, weakly sheltered by tree canopies, whereas in CAz they are generally located to dense *Juniperus*-vegetation on rough lava flows.

This habitat difference is most probably one reason for the low diversity on Corvo. The *Cololejeuneetum azoricae* in CAz becomes much more abundantly and frequently invaded by accidental species, especially in late stages of succession, in the very species-rich *Juniperion* community, where also a larger number of vascular plants and ferns appear as phorophytes.

Transitions between the epiphyllous community and communities on other types of substrates are much less frequent than for other communities, not only on Corvo but on all the Azorean islands. The only community in "sociological contact" is the epiphytic *Echinodio-Lepidozietum cupressinae*. On Corvo this ass. has an accidental and scattered presence of *Aphanolejeunea teotonii* and *Cololejeunea azorica*, a presence not recorded earlier in CAz except on Graciosa (but there in the *Frullanietum microphyllae* in strongly sheltered forest). Other species on Corvo generally with their highest frequency in the epiphyllous ass., are also fairly frequent in the epiphytic ass., such as *Cololejeunea minutissima*, *Lejeunea lamacerina* and *Frullania microphylla*. Some pref. epiphytic species occur accidentally in the *Cololejeuneetum azoricae* such as *Dicranum scottianum*, *Lejeunea flava* and *Plagiochila spinulosa*. They are predominant only in late stages of development of the ass. but occur more frequently than in CAz. On the other hand, *Colura calyptrifolia* is a strictly epiphyllous species on Corvo.

Nomenclature: Hepatics and mosses are treated according to GROLLE (1983) and CORLEY et al. (1981). For some species, names frequently applied earlier are also given as synonyms. - The new name for *Allorgea berthelotiana* (Mont.) Ando is *Andoa berthelotiana* (Mont.) Ochyra.

Abbreviations:

Mac. - Macaronesia
Az - Azores islands
S - Santa Maria
M - São Miguel
T - Terceira
J - São Jorge

P - Pico
G - Graciosa
F - Faial
L - Flores
C - Corvo
CAz - Central island group (TJPGF)
EAz - Eastern island group (MS)
WAZ - Western island group (LC)
SJM - E. Sjögren
ass. - association
all. - alliance
diff. sp. - differential species
diff. val. - differential value
leg. - collected by
pref. - preferentially
spl. - samples
u.c. - together with

Bryophytes of Corvo, with remarks on their presence, ecology and sociology

HEPATICAE

Anastrophyllum minutum (Schreb.) Schust.
= *Sphenolobus minutus* (Schreb.) Berggr.
(Lophoziaceae)

Samples. C: Central part of Morro dos Homens, 700 m, epilithic-epigeic. In the Caldeirão, 425 m, epilithic (3 spl.). - Azorean distrib.: M T J P F.
Habitat. Most earlier Azorean records between 700-1500 m. *A.m.* occurs on C on sheltered as well as on non-sheltered boulders (as on P) in the open grazing-landscape originating from the *Juniperion brevifoliae*. The fairly high drought-tolerance of *A.m.* may be indicated by its presence at 425 m u.c. *Campylopus pilifer* (cf. that species).

Anthoceros punctatus L.
(Anthocerotaceae)

Sample. C: W of Coroinha, 350 m, epixylic-epigeic at the base of densely growing specimens of *Festuca jubata*. Caldeirão, 450 m, epilithic;epigeic (2 spl.). E of Topo, 125 m, epigeic. - Azorean distrib.: S M T G J F L (in 1992 also on P; leg. SJN).

Aphanolejeunea teotonii Jov.-Ast. et V. Allorge
= *Cololejeunea teotonii* (Jov.-Ast. et V. All.) Grolle
(Lejeuneaceae)

Samples. C: Close to Fojo, 275 m, epiphytic on *Juniperus*. S of Cancela do Pico, 300 m, epiphyllous

ious on *Trichomanes* (5 spls.). In the Caldeirão, 425 m, epiphyllous on *Hymenophyllum* and *Trichomanes*; on *Diplazium caudatum* and *Trichomanes*, 450 m, in the southernmost part of the Caldeirão; N rim, 600 m, epiphyllous on *Trichomanes*. W of Coroinha, in a dense moss carpet on a brook boulder in ravine, 350 m, epiphyllous on *Echinodium renauldii* and *Porella canariensis*. Coroa do Pico, 275 m, S of Espigãozinho, epiphytic on *Juniperus* (2 spls.). - Azorean distrib.: M T G J P F L.

Habitat. Pref. epiphyllous, as in CAz, but at lower altitudes (equally low as on G), however, generally and significantly in much less sheltered localities. The less pronounced need for shelter, the weaker substratum preference as well as its presence at lower altitudes is significant for several species on L and C as compared to CAz. This is important for the description of habitat ranges and sociological affinities.

Sociology. The diff. val. for the epiphyllous *Cololejeuneetum azoricae* SJN. 78 is maintained on C. The most frequently associated species are *Lejeunea lamacerina* and *Cololejeunea* spp. (incl. *C. azorica*).

Calypogeia arguta Mont. et Nees
(Calypogeiaceae)

Samples. C: W of Coroinha, 360 m, epilithic on dry, sheltered rock surface. Caldeirão, 425 m, epilithic and epigeic-epilithic on cliffs (3 spls.). - Azorean distrib.: M T G J P L.

Habitat. No substratum preference or sociological affinity in the Azores.

Calypogeia fissa (L.) Raddi
(Calypogeiaceae)

Samples. C: W Coroinha, 360 m, in ravine close to the coast, epilithic-epixylic on base of *Festuca jubata*. - Azorean distrib.: S M T G J P F L.

Habitat. In CAz pref. epiphytic and epixylic, on G pref. epigeic. Probably no substratum preference maintained on C.

Sociology. The low diff. val. of the Allorgeo-Myurion (cf. SJÖGREN 1990, Table 4) is not maintained on C.

Calypogeia muellerana (Schiffn.) K. Müll.
(Calypogeiaceae)

Samples. C: Morro dos Homens, 700 m, epilithic on sheltered boulder surface. W of Coroinha, 350m, epilithic and epixylic on base of *Festuca jubata*. Caldeirão, 425 m, epilithic and epigeic on lake shore; on soil escarpment (3 spls.); epixylic on *Vaccinium* and *Osmunda*. N of Coroa do Pico, 200 m, epigeic on moist sheltered soil slope. Coroinha, 350 m, epigeic (2 spls.). Coroa do Pico, 275 m, epigeic under sheltering *Juniperus* (3 spls.). - Azorean distrib.: M T J P F L.

Habitat. Probably common on all sorts of substrates above 200 m. *C.m.* may be the most common of the *Calypogeia*-species in the Az. (cf. SJÖGREN 1978, p. 105).

Sociology. The diff val. of epiphytic and epixylic communities in CAz is not maintained on C.

Calypogeia trichomanis (L. em. Müll.) Corda
(Calypogeiaceae)

Samples. C: Lomba Redonda, 450 m, epigeic on soil slope. Coroa do Pico, 275 m, epiphytic on *Juniperus*. Caldeirão, 425 m, epigeic in dark crevice. - Azorean distrib.: M J P L (V. & P. ALLORGE 1950; according to BISCHLER 1970 only on M).

Cephalozia bicuspidata (L.) Dum.
(Cephaloziaceae)

Samples. C: Caldeirão, 425 m, epilithic in grassland with scattered *Sphagnum palustre* -hummocks; epigeic on lake shore. Morro dos Homens, 700 m, epigeic (2spl.). - Azorean distrib.: M T J P F L.

Habitat. Preferences, see SJÖGREN 1978, p. 107. Sociology. Preferably u.c. species of primary stages of colonization with lower competitive ability, such as *Calypogeia muellerana*, *Nardia scalaris*, *Fissidens viridulus*.

Cephalozia bicuspidata (L.) Dum. ssp. *lammersiana* (Hub.) Schust.
(Cephaloziaceae)

Samples. C: In the Caldeirão, 425 m, epigeic (2 spls.). - Azorean distrib.: S T F L.

Chiloscyphus pallescens (Ehrh. ex Hoffm.) Dum.
(Geocalyceaceae)

Samples. C: W of Coroinha, 350 m, epilithic on brook boulder. - Azorean distrib.: M T J.

Cololejeunea azorica V. Allorge et Jov.-Ast.
(Lejeuneaceae)

Samples. C: Canceia do Pico, 275-300 m, epiphyllous on *Trichomanes* (3 spl.) and epiphytic on *Juniperus*. NW of Fojo, 200 m, epiphytic on *Cryptomeria*. N rim of Caldeirão, 600 m, epiphyllous on *Trichomanes* (2 spl.) and at 425 m, epiphyllous on *Trichomanes* in ravine (2 spl.). - Azorean distrib.: M G J P F L.

Habitat. Pref. epiphyllous on C, but also sampled epiphytic, as on G.

Sociology. The species was attributed a weaker diff. val. of the *Cololejeuneetum azoricae* than in CAz on a whole as a consequence of its presence in the epiphytic *Frullanietum microphyllae* on G (SJÖGREN 1990). The epiphytic presence of *C.a* on C, although rare, has supported this statement.

Cololejeunea minutissima (Sm.) Schiffn.
(Lejeuneaceae)

Samples. C: Fairly frequent epiphytic and epiphyllous between 100-500 m. - Azorean distrib.: S M T G P F L.

Habitat. Pref. epiphyllous in the Az. On C with less pronounced preference as frequently growing also epiphytic (on *Erica*, *Juniperus*, *Cryptomeria*). Sociology. Diff. val. towards epigeic and epilithic communities at all altitude levels maintained on C.

Colura calyptrifolia (Hook.) Dum.
(Lejeuneaceae)

Samples. C: Canceledo do Pico, 300 m, epiphyllous on *Trichomanes* (3 spl.) in very narrow ravine. - Azorean distrib.: M T J P F L.

Habitat. Pref. epiphyllous species. Earlier records of *C.c.* in the archipelago are between 550 - 900 m. The presence of this ecologically highly specialized shelter-demanding species at 300 m on C is exceptional in the Az. Unusually low base-levels for many bryophytes of the *Juniperion brevifoliae* are, however, numerous on C as well as on L.

Sociology. Diff. sp. of the epiphyllous *Cololejeuneetum azoricae* SJN 78. Associated species are e.g. *Aphanolejeunea teotonii*, *Cololejeunea* spp. incl. *C. azorica*.

Conocephalum conicum (L.) Underw.
(Conocephalaceae)

Samples. C: Several samples, between 75-450 m, epilithic and epigeic but mostly epilithic. - Azorean distrib.: S M T G J P F L.

Habitat. Pref. epilithic and epigeic, both on naked rock surfaces and where soil / litter has been accumulated. Pref. in strongly sheltered habitats where there is a permanent moisture supply.

Sociology. No diff. val. (cf. SJÖGREN 1990, p. 79). In several localities u.c. *Epipterygium tozeri*, *Thamnobryum alopecurum* and *Eurhynchium praelongum*.

Diplophyllum albicans (L.) Dum.
(Scapaniaceae)

Samples. C: Rim of the Caldeirão, 600 m, epilithic on N-facing cliff. - Azorean distrib.: S M T J P F L.

Drepanolejeunea hamatifolia (Hook.) Schiffn.
(Lejeuneaceae)

Samples. C: S of Morro dos Homens, 450 m, epiphytic on *Hypericum foliosum*; at 600 m, epilithic. NW rim of the Caldeirão, 500 m, epiphytic on *Erica*. S of Espigãozinho, epiphytic on *Juniperus*. - Azorean distrib.: M T G J P F L.

Habitat. Pref. epiphyllous species. On G also epigeic. On C also epilithic.

Sociology. The strong diff. val towards epigeic and epilithic bryo-communities in CAz is maintained on C. As epiphyte, only in primary stages of bryo-succession and thus u.c. species with restricted competitive ability, such as *Metzgeria furcata*, *Cololejeunea* spp., *Lejeunea flava*. Among the pref. epiphyllous hepatics *D.h.* has evidently the widest ecological range in the Az. and consequently also has the weakest diff. val.

Dumortiera hirsuta (Sw.) Nees
(Wiesnerellaceae)

Samples. C: In the Caldeirão, 425 m, epilithic in

caves (3 spls.); at 550 m, epigeic-epilithic on cliff; at 500 m, epilithic in cave, epigeic in soil crevice. Morro dos Homens, 700 m, epilithic-epigeic on soil slope. W of Coroinha, 350 m, epilithic in cave. N rim of the Caldeirão, 450 m, epigeic in cave. - Azorean distrib.: M T G J P F L.

Habitat. Epilithic and epigeic. Epigeic both on fine and large-grain volcanic deposits. On C more frequent on dry substrates than in CAz.

Sociology. On C *D. h.* is typically associated with *Tetrastichium fontanum*, *Thamnobryum alopecurum*, *Jubula hutchinsiae*, *Heteroscyphus denticulatus*, *Philonotis rigida*, thus linked to the *Tetrastichium-Dumortiera* - ass. (cf. SJÖGREN 1978, 1990).

Fossombronia angulosa (Dicks.) Raddi
(Codoniaceae)

Samples. C: SW of Coroa do Pico, 150 m, epigeic on coarse volcanic ash. SE point of the island, epigeic between sheltering boulders. - Azorean distrib.: M T G J P F L.

Frullania dilatata (L.) Dum. s. lat.
(Frullaniaceae)

Samples. C: Several samples between 25 - 250 m, most frequently epilithic, in a few samples epigeic or epigeic-epilithic; epixylic (1 spl.), epiphytic on *Cryptomeria* (1 spl.). - Azorean distrib.: S M T G J P F L.

Habitat. On C pref. epilithic and distinctly confined to low altitudes. The same preferences were recorded on G (SJÖGREN 1990, Table 3) and are also valid in other parts of the archipelago. The epigeic presence of *F.d.* on C indicates a slightly weaker substratum preference as compared to CAz.

Sociology. Frequently associated species on C as on G are *Grimmia trichophylla*, *Hypnum resupinatum*. Diff. sp. of the *Frullanietum dilatatae*, association of the *Ptychomitrium azoricae*.

Earlier records in the archipelago of *Frullania dilatata*, recently referred to *F. cesatina* (BISANG et al. 1988), should be treated as *F. dilatata* s. lat., until further knowledge on the taxonomy of the species is available (pers. comm. by Grolle in 1992).

Frullania microphylla (Gott.) Pears.
(Frullaniaceae)

Samples. C: Several samples between 200 - 600 m. Mostly epiphytic, on *Erica*, *Juniperus* and *Cryptomeria*, rarely epiphyllous on *Trichomanes* and *Diplazium caudatum*. - Azorean distrib.: M T G J P F L.

Habitat. Pref. epiphytic on C like in all the Az. *F.m.* was recorded on C with high cover degree, even on strongly exposed tree trunks. The presence of this hepatic on G at altitudes around 200 m is restricted to sheltered habitats in forest vegetation.

Sociology. The diff. val. of the *Frullanietum microphyllae* is maintained on C. Associated species are principally *Cololejeunea* spp. Towards higher altitudes the ass. develops progressively into the much more species-rich *Echinodio-Lepidozietum*, where *F.m.* appears with reduced frequency due to low competitive ability.

Frullania tamarisci (L.) Dum.
(Frullaniaceae)

Samples. C: A large number of samples, between 175 - 700 m, equally frequent epilithic and epiphytic; epigeic (2 spls.), and epiphyllous (7 spls.). - Azorean distrib.: S M T G J P F L.

Habitat. The weak substratum preference of *F.t.* in CAz is not maintained on C. The species is highly frequent above 175 m. Below 250 m it becomes substituted in many localities by *F. dilatata*.

Sociology. *F.t.* has lost its weak diff.val. on C towards epilithic and epigeic bryo-communities, which was earlier suggested for the species in CAz.

Frullania teneriffae (F. Web.) Nees
(Frullaniaceae)

Samples. C: A large number of samples between 200-600 m, mostly epilithic, in some samples epigeic, epixylic or epiphytic (on *Juniperus*, *Vaccinium*, *Pittosporum*); epiphyllous on *Trichomanes* (4 spls.) on sheltered cliff surfaces at 600 m, to the N of the Caldeirão. - Azorean distrib.: M T J P F L.

Habitat. Earlier regarded as pref. epiphytic-epixylic-epiphyllous. On C also frequently epigeic

and epilithic, thus with almost no substratum preference, if the presence in all the archipelago is considered. In CAz pref. above 500 m, on C pref. above 300 m. Much more frequent on C in strongly exposed habitats than in CAz and EAz. Sociology. The diff. val. in CAz towards epilithic and epigeic bryo-communities is not maintained on C, where *F.t.* occurs in the Allorgeo-Myurion and frequently in the Ptychomitron azoricae.

Harpalejeunea ovata (Hook.) Schiffn.
(Lejeuneaceae)

Samples. C: E of Espigãozinho, 275 m, epiphytic on *Juniperus*. NE rim of the Caldeirão, 450 m, epilithic (2sp.). Coroa do Pico, 275 m, epiphytic on *Juniperus* (3 sp.). - Azorean distrib.: S M T G J P F L.

Habitat. Pref. epiphyllous and epiphytic. Rare on C but as in other parts of the Az. apparently confined to communities of the *Juniperion brevifoliae*.

Sociology. Diff. val. towards epilithic and epigeic bryo-communities.

Herbertus azoricus (Steph.) Richards
(Herbertaceae)

Samples. C: NE rim of the Caldeirão, 450 and 500 m, epilithic. Morro dos Homens, 700 m, epilithic and epilithic-epigeic (soil-covered boulder). N of the Caldeirão, 550 m, epilithic. - Azorean distrib.: M T J P F L (?).

Habitat. The records on C support the earlier treatment of *H.a.* as pref. epilithic. However, recently recorded (leg. SJN. 1992) as a frequent epiphytic species on *Juniperus* on St. Barbara (Terceira) at the rim of the Caldeira. On C both dry and moist boulders and cliffs become colonised by *H.a.* even in strongly exposed habitats. In CAz pref. above 600 m, on C pref. above 500 m.

Sociology. Frequently associated species on boulders and cliffs are the same as those mentioned from CAz (SJÖGREN 1978, p. 132), except for *Bazzania azorica* and *Lepidozia cupressina*, still not found on C. The sociological affinity of the species is still difficult to define but there is definitely a strong diff. val. towards all bryo-communities at altitude levels below the typically developed *Juniperion brevifoliae*.

Heteroscyphus denticulatus (Mitt.) Schiffn.
= *Chiloscyphus denticulatus* Mitt.
(Geocalycaceae)

Samples. C: In the Caldeirão, 425 m, epilithic and epigeic in caves: epilithic-epigeic in ravine. NE rim of Caldeirão, 500 m, epilithic in cave. - Azorean distrib.: M G J P L.

Habitat. The habitat preference of this overlooked hepatic is still not quite clear. Localities on L and C are more frequent below 500 m than in CAz.

Sociology. No pronounced diff. val. although with some weak preference growing u.c. moisture demanding species of the *Tetrastichium-Dumortiera* - ass. (cf. species listed in SJÖGREN 1978, p. 111).

Jubula hutchinsiae (Hook.) Dum.
(Jubulaceae)

Samples. C: W of Coroinha, 360 m, epilithic in deep ravine (3 sp.). Fojo, 200 m, epilithic. - Azorean distrib.: M T J P F L.

Habitat. Weak substratum preference in the Az. The exclusive epilithic occurrence on C is probably accidental. In EAz and CAz pref. above 600 m, only on L and C also fairly frequent down to 200 m.

Sociology. *J.h.* has some affinity to occur u.c. species of the *Tetrastichium-Dumortiera* - ass. and of the *Echinodio-Lepidozietum cupressinae*

Jungermannia atrovirens Dum.
= *Solenostoma atrovirens* (Dum.) K. Müll.
(Jungermanniaceae)

Samples. C: Coroinha, 300 m, epigeic on steep soil escarpment. - Azorean distrib.: M F L.

Sociology. In sample u.c. *Enthostodon attenuatus*, *Pogonatum aloides*, *Fissidens asplenioides*.

Jungermannia hyalina Lyell in Hook.
= *Plectocolea hyalina* (Lyell) Mitt.
(Jungermanniaceae)

Samples. C: W of Coroinha, 350 m, in deep ravine, epigeic on moist soil escarpment; epixylic on base of *Festuca jubata*. - Azorean distrib.: M J F L.

Sociology. In the epigeic sample u.c. *Tetrastichium fontanum*, *Riccardia multifida*, *Jubula hutchinsiae*, *Fissidens serrulatus*, *Heterocladium*

heteropterum (species composition close to that of the *Tetrastichium-Dumortiera* - ass.).

Lejeunea flava (Sw.) Nees
(Lejeuneaceae)

Samples. C: In the Caldeirão, 425-500 m, epiphytic on *Erica* (7 spls.) and epilithic (2 spls.); epiphyllous on *Trichomanes*, 600 m, on wilted specimens (2 spls). E of Espigãozinho, 275 - 300 m, epiphytic on *Juniperus* (2 spls.); epigeic under *Juniperus* (2 spls.); epilithic and epiphyllous on *Trichomanes*. W of Coroinha, 350 m, epilithic on strongly sheltered brook boulder in ravine. Morro dos Homens, 525 m, epilithic on boulder. - Azorean distrib.: M T J P F L.

Habitat. Pref. epiphytic on C as in other parts of the Az, but with weaker preference as also recorded on other types of substrates. As on L, recorded more frequently at altitudes below those preferred in CAz. The epigeic and epilithic occurrences are generally in habitats sheltered by *Juniperus* or *Erica*.

Sociology. Maintained diff. val. of the Echinodio-Lepidozietum cupressinae. Associated species are frequently *Echinodium prolixum*, *Hypnum uncinulatum*, *Lepidozia cupressina* (not on C), *Cololejeunea* spp.

Lejeunea holtii Spruce
(Lejuncaceae)

Samples. C: Coroinha, 350 m, epilithic on moist cliff surface. - Azorean distrib.: S M T J P F L.

Lejeunea lamacerina (Steph.) Schiffn.
(Lejeuneaceae)

Samples. C: A very large number of samples between 125-600 m. Equally frequent epiphytic (on *Erica*, *Juniperus*, *Hydrangea*) and epiphyllous (on *Trichomanes*, *Diplazium caudatum*, *Thamnobryum alopecurum*); epixylic on base of old specimens of *Dryopteris aemula* (3 spls.); epilithic in caves, on sheltered cliffs and boulders (brook boulders); epigeic (1 spl.). - Azorean distrib.: M T G J P F L.

Habitat. The recordings of *L. l.* on G and now on C have considerably weakened the substratum

preference of the species. Still, most records on C are epiphytic and epiphyllous.

Sociology. The diff. val. of the epiphyllous, epixylic and epiphytic bryo-communities is weak, so also on C. The most frequently associated species on ferns are *Aphanolejeunea teotonii*, *Cololejeunea minutissima*, *C. azorica*; where epiphytic on *Erica*, *Juniperus*, *Cryptomeria* the most frequent ones are *Frullania microphylla*, *F. tamarisci*, *F. teneriffae* and *Cololejeunea* spp. *L. l.* is a highly competitive species which frequently becomes dominant, obscuring the composition, especially of the *Cololejeuneetum azoricae*.

Lejeunea patens Lindb.
(Lejeuneaceae)

Samples. C: N rim of the Caldeirão, 600 m, epiphyllous on *Trichomanes*; bottom of the Caldeirão, 425 m, on *Trichomanes*, on *Diplazium caudatum* (2 spls.), on *Pteridium aquilinum*. - Azorean distrib.: S M T J P F L.

Lophocolea bidentata (L.) Dum.
(Geocalyceae)

Samples. C: N of Coroa do Pico, 200 m, epixylic on *Pittosporum*. - Azorean distrib.: M G J L.

Marchesiania mackaii (Hook.) Gray
(Lejeuneaceae)

Samples. C: Lomba, 225 m, epixylic-epiphytic on *Pittosporum*. E of Espigãozinho, 250 - 300 m, epilithic (2 spls.) and epiphytic on *Hydrangea* (2 spls.). Coroa do Pico, 230 m, epilithic; at 200 m epilithic. - Azorean distrib.: S M T G J P F L.

Habitat. In the Azores as a whole pref. epiphytic-epixylic-epiphyllous. On C also epilithic and thus with weaker preference than in other Azorean islands, probably only except for Flores. In general a species with unusually wide ecological range.

Sociology. No diff. val. The species may, however, when more frequently recorded, prove to be a species with at least some affinity to the low-altitude *Frullania microphylla* - ass. (cf. SJÖGREN 1990).

Marsupella emarginata (Ehrh.) Dum.
(Gymnomitriaceae)

Samples. C: In the Caldeirão, 425 m, epilithic on strongly exposed boulder; epigeic-epilithic on cliff (2 spl.); at 550 m epigeic on vertical soil cutting. NE rim of the Caldeirão, 450 m, epilithic (2 spl.). Morro dos Homens, 600 and 700 m, epilithic. - Azorean distrib.: M T J P F L (incl. *M. aquatica* and *M. ustulata*).

Metzgeria conjugata Lindb.
(Metzgeriaceae)

Samples. C: S of Espigãozinho, 275 m, epiphytic on *Juniperus*. W of Coroinha, 360 m, epiphyllous on *Echinodium renaudtii*, growing on brook boulder in deep ravine. - Azorean distrib.: J P F.

Habitat. In CAZ pref. above 500 m, in the *Juniperion brevifoliae*. On C even at fairly low altitudes, as characteristic for several other Azorean hepatics.

Sociology. The rare scattered presence of *M.c.* in the Az makes it difficult to attribute any diff. val. although there may be at least some affinity of the species with epiphytic and epiphyllous communities of the *Juniperion brevifoliae*.

Metzgeria furcata (L.) Dum.
(Metzgeriaceae)

Samples. C: In the Caldeirão, 425 m, epilithic on cliff surface, as epiphytic-epixylic on *Vaccinium* and *Erica*, epixylic on *Dryopteris aemula*. E of Espigãozinho, 275 m, epiphytic on *Juniperus* (7 spl.). Northern rim of the Caldeirão, 490 m, epiphytic on *Erica* (6 spl.). - Azorean distrib.: M T J P F L.

Habitat. On C pref. epiphytic, epiphyllous and epixylic as in other parts of the Az. Wide altitude range. On L and C even at low altitude levels around 200 m.

Sociology. Earlier treated as rare in the Az (SJÖGREN 1978). Now known to be fairly frequent at least on the central and western islands. Weak diff. val. towards epigeic and epilithic bryo-communities. Accidentally with high cover degree as epiphyllous, where not outcompeted by *Lejeunea lamacarina*.

Nardia geoscyphus (De Not.) Lindb.
(Jungermanniaceae)

Samples. C: NE rim of the Caldeirão, 550 m, epigeic on vertical soil slope. Morro dos Homens, 700 m, epilithic-epigeic. - Azorean distrib.: M F.

Nardia scalaris S. Gray
(Jungermanniaceae)

Samples. C: Caldeirão, 425 m, epigeic on strongly exposed soil escarpment (3 spl.); epigeic-epilithic on cliff; at 550 m, epigeic on vertical soil escarpment; at 450 m, epigeic (2 spl.). N of Coroa do Pico, 200 m, epigeic on moist sheltered soil escarpment; Morro dos Homens, 700 m, epilithic-epigeic; at 600 m, epilithic on brook boulder. Coroa do Pico, 250 m, on soil slope (2 spl.).

Habitat. Frequently growing on moist soil escarpments, in many localities highly dominant, leaving space for only few other species such as *Philonotis rigida* and *Saccogyna viticulosa*. Wide altitude range.

Sociology. Close affinity to species of the Allorge-Myurion.

Odontoschisma sphagni (Dicks.) Dum.
(Cephaloziaceae)

Samples. C: Caldeirão, 425 m, epigeic on strongly exposed soil escarpment (3 spl.) and on lake shore; epilithic on moist cliff surface. Lomba Redonda, 450 m, epigeic on soil escarpment (2 spl.). - Azorean distrib.: M T J P F L.

Plagiochila corniculata (Dum.) Dum.
(Plagiochilaceae)

Samples. C: NE rim of the Caldeirão, 450 m, epilithic on sheltered cliff. Morro dos Homens, 700 m, epilithic on strongly exposed boulder. W of Coroinha, 350 m, epilithic on dry sheltered cliff in ravine. Bottom of Caldeirão, 425 m, epixylic on *Dryopteris aemula*. - Azorean distrib.: M T G J P F L.

Habitat. Weak substratum preference in the Az as confirmed on G (SJÖGREN 1990). The species is probably more frequent on C than reflected by the few samples. Many specimens of *P.c.* may be easily confused with young immature specimens of *Plagiochila spinulosa*. The localities at low alti-

tudes on C and G are exceptional, considering the preferred range 600-900 m in CAz.
Sociology. No diff. val.

Plagiochila spinulosa (Dicks.) Dum.
(Plagiochilaceae)

Samples. C: A very high number of samples, between 360-700 m, most frequently in the samples epilithic, also frequently epiphytic (on *Erica*, *Vaccinium*), in some samples epixylic (on bases of *Festuca jubata*, *Dryopteris aemula*), epiphyllous on highly wilted specimens of *Trichomanes*. - Azorean distrib.: M T G J P F L.

Habitat. Records of *P.s.* on C as well as on G confirm that this species has no substratum preference in the Az. In CAz pref. between 500-900 m, on C also frequent and evenly spread between 300-500 m. Generally much more frequent in strongly exposed habitats on stone surfaces than in CAz.

Sociology. No diff. val. of any bryo-community of the Juniperion brevifoliae, but clearly between those and the coastal communities on all sorts of substrates. Only accidental in the Allorgeo-Myurion.

Porella canariensis (F. Web.) Bryhn
(Porellaceae)

Samples. C: In the Caldeirão, 450 m, epilithic (3 spl.). NE rim of the Caldeirão, 450 m, epilithic on strongly exposed cliff. Fojo, 225 m, epilithic under *Cryptomeria*. S of Morro dos Homens, at 350 and 475 m, epilithic. E of Espigãozinho, 300 m, epilithic and epigeic in ravine. W of Coroinha, 325 m, epilithic; at 350 m, epilithic (5 spl.) on brook boulder in ravine, and on moist cliff surface. N of Coroa do Pico, 200 m, epixylic on *Pittosporum*. - Azorean distrib.: S M T G J P F L.

Habitat. More frequent epilithic and epigeic on C than in CAz. In CAz pref. above 500 m. All records on C are from below that level. As on G present in both strongly and weakly exposed habitats. Non-sheltered stone walls get frequently colonised.

Sociology. The wide ecological range of *P.c.* and the weak substratum preference makes the species unsuitable as diff. sp. of any bryo-community in the Az (also confirmed on G).

Porella obtusata (Tay.) Trev.
(Porellaceae)

Samples. C: W of Coroinha, 360 m, on brook boulder in deep ravine. - Azorean distrib.: G J.

Habitat. There may be a preference of this under-recorded although rare species to occur epilithic on moist stone surfaces or at least in very sheltered habitats, such as on boulders in narrow river ravines.

Sociology. Associated species in sample as well as on nearby boulders with *P. o.* are *Frullania teneriffae*, *Thamnobryum alopecurum*, *Lejeunea lamacerina*, *Conocephalum conicum*, *Allorgea berthelotiana*, *Lejeunea flava*, *Rhynchostegium riparioides*, *Brachythecium plumosum*, *Radula carringtonii*. This species spectrum is close to that of the epilithic Tetrastichium-Dumortiera-ass. and to some fraction of the epigeic Allorgeo-Myurion.

Radula aquilegia (Hook. f. et Tayl.) Gott. et al.
(Radulaceae)

Samples. C: Fojo, 200 m, epilithic on strongly sheltered boulder. Morro dos Homens, 700 m, epilithic. W of Coroinha, 350 m, epilithic in ravine (2 spl.). Caldeirão, 425 m, epilithic; 600 m, epiphyllous on *Trichomanes*. - Azorean distrib.: M T J P F L.

Habitat. Pref. epiphyllous and epiphytic in CAz. A few earlier records of the species as epilithic on J and L. On C reduced substratum preference as compared to CAz. Most records in CAz are above 600 m. Like several other cloud-zone species *R.a.* appears at unusually low altitudes on C.

Sociology. The affinity in CAz to the *Coiolejeuneetum azoricae* and the *Echinochio-Lepidozietum* is reduced on C.

Radula carringtonii Jack.
(Radulaceae)

Samples. C: Several samples between 100-600 m, in most samples epilithic. Epixylic on base of wilted *Festuca jubata*, epigeic (6 spl.), epiphytic on *Pittosporum* and *Erica*, epiphyllous on *Echinodium renauldii*. - Azorean distrib.: S M T G J P F L.

Habitat. Pref. epilithic on C, in the Az as a whole no pronounced substratum preference. The altitude range on C and in CAz is very wide. The

shelter demands are apparently stronger in CAz than on C. The most common of the *Radula*-species in the Az.

Radula wichurae Steph.
= *R. limbata* Schiffn.
(Radulaceae)

Samples. C: N of Coroa do Pico, 200 m, epilithic on sheltered boulder. Portinho da Areia, 125 m, epigeic in ravine (2 spls.). E of Topo, 125 m, epigeic-epilithic. Caldeirão, 425 m, epixylic on base of *Dryopteris aemula* (2 spls.). - Azorean distrib.: S M T G J P F L.

Reboulia hemisphaerica (L.) Raddi
(Aytoniaceae)

Samples. C: Fojo, 200 m, epigeic. W of Coroinha, 350 m, epigeic, epilithic and epixylic. SE coast, 75 m, epigeic on moist soil escarpment. NE rim of the Caldeirão, 450 m, epilithic. - Azorean distrib.: S M T G J F L.

Riccardia multifida (L.) S. Gray
(Aneuraceae)

Samples. C: In the Caldeirão, 425 m, epilithic on moist boulder in ravine. W of Coroinha, 350 m, epigeic on moist soil escarpment. - Azorean distrib.: M T J P F L.

Saccogyna viticulosa (L.) Dum
(Geocalycaceae)

Samples. C: Several samples between 200-700 m, equally frequently epilithic and epigeic; epiphyllous on wilted specimens of *Trichomanes*; epixylic at base of wilted *Festuca jubata*. Frequent species all over the island. - Azorean distrib.: S M T G J P F L.
Habitat. Wide altitude range, no substratum preference.

Scapania curta (Mart.) Dum.
(Scapaniaceae)

Samples. C: Lomba Redonda, 475 m, epilithic on brook boulder. Morro dos Homens, 700 m, epigeic on old *Sphagnum* hummock. - Azorean distrib.: J P F L.

Scapania gracilis Lindb.
(Scapaniaceae)

Samples. C: Coroinha, 350 m, epilithic on moist cliff. In the Caldeirão, 425 m, epilithic; rim of the Caldeirão, 600 m, epilithic. - Azorean distrib.: M T J P F L.

Scapania undulata (L.) Dum
(Scapaniaceae)

Samples. C: In the Caldeirão, 425 m, as primary colonizer on boulder surface; epigeic on lake shore. Morro dos Homens, 600 m, epilithic on boulders (2 spls.), epigeic (1 spl.). - Azorean distrib.: M T J P F L.
Habitat. No substratum preference in the Az.

Telaranea nematodes (Gott. et Aust.) Howe
(Lepidoziaceae)

Samples. C: In the Caldeirão, 425 m, epigeic on sheltered soil escarpment. - Azorean distrib.: M T J P F L.

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Allorgea berthelotiana (Mont.) Ando
(Hypnaceae)

Samples. C: Several samples between 200-500 m. Equally frequently epilithic and epigeic. Epixylic (1 spl.). - Azorean distrib.: S M T G J P F L.
Habitat. Pref. epigeic and epilithic as on other Azorean islands (SJÖGREN 1978, p. 179). Pref. on sheltered stone and fine soil surfaces. In strongly exposed habitats only where the surfaces are kept almost permanently moist.
Sociology. Most frequently associated species are on C, as on other Azorean islands, *Myurium hochstetteri*, *Eurhynchium praelongum*, *Radula carringtonii*, *Porella canariensis*. The *Myurium*-*Allorgea*-*Fissidens pallidicaulis* - all. is, however, less distinctly maintained on C than on islands in CAz.

Alophozia azorica (Ren. et. Card.) Card.
(Polytrichaceae)

Samples. C: N rim of Caldeirão, 600 m, epilithic. - Azorean distrib.: M T J P F L.

Atrichum angustatum (Brid.) B.S.G.
(Polytrichaceae)

Samples. C: In the Caldeirão, 450 m, epigeic (2 spls). Espigãozinho, 450 m, epilithic on strongly exposed boulder. Close to Lomba, 225 m, epigeic and epilithic in strongly exposed habitat (2 spls). Lomba Redonda, 450 m, epilithic. - Azorean distrib.: M J F L.

Habitat. Pref. epigeic, where epilithic preferably in fissures with accumulated soil. Strongly drought-tolerant.

Sociology. No diff. val. Growing u.c. a fairly high number of species with various habitat ranges.

Barbula unguiculata Hedw.
(Pottiaceae)

Samples. C: Portinho, 125 m, epigeic (2 spls.). - Azorean distrib.: S M G P F L.

Brachythecium plumosum (Hedw.) B. S. G.
(Brachytheciaceae)

Samples. C: Several samples between 250-500 m, in all samples epilithic, only epigeic in one. - Azorean distrib.: S M G J P F L.

Habitat. Strongly pref. epilithic species. Rarely on dry strongly exposed stone surfaces in the coastal zone. In CAz and EAz more closely linked to moist stone surfaces than on C.

Sociology. On C *B. p.* is less clearly confined to the epilithic *Platyhypnidium riparioidis* (cf. v. HÜBSCHMANN 1974) than in other islands in the archipelago. The species has been ranked as a diff. sp. of the *Grimmietum acicularae* (ass. of the *Ptychomitrium azoricae*).

Brachythecium rutabulum (Hedw.) B. S. G.
(Brachytheciaceae)

Samples. C: W of Coroinha, 350 m, epilithic on moist cliff surface. Caldeirão, 425 m, epilithic. - Azorean distrib.: M F L.

Brachythecium velutinum (Hedw.) B. S. G.
(Brachytheciaceae)

Samples. C: Coroa do Pico, 200 m, epilithic on dry boulder surface. Portinho, 125 m, epigeic

close to stone fence. S of Espigãozinho, 275 m, epilithic. - Azorean distrib.: M T P F.

Habitat. This species, pref. epilithic and epiphytic in many European countries, is remarkably rare in the Az and its habitat preferences in the archipelago are not clearly pronounced.

Sociology. No affinity to any bryo-community.

Bryum alpinum With.
(Bryaceae)

Samples. C: NE border of the Caldeirão, 450 m, epigeic. S of Morro dos Homens, 475 m, epilithic (2 spls.) and epigeic on soil-covered boulder and on soil escarpment. - Azorean distrib.: S M T P L.

Bryum argenteum Hedw.
(Bryaceae)

Samples. C: Topo, 100 m, epigeic. E of Topo, 50 m, epilithic-epigeic in boulder fissures. - Azorean distrib.: S M T L (in 1992 also on P; ieg. S.J.N.).

Habitat. This typically anthropochorous species is unexpectedly rare on C, as on other islands in the Az.

Bryum donianum Grév.
= *B. pachyloma* Card.
(Bryaceae)

Samples. C: Exterior NE slope of the Caldeirão, 450 m, epilithic on strongly exposed cliff. N of Coroa do Pico, 200 m, on boulders (4 spls.). Coroa do Pico, 250 m, epilithic. Espigãozinho, 300 m, epilithic on moist stone surface. - Azorean distrib.: M T G P L.

Campylopodium euphorocladum (C.Müll.) Besch.
var. *laevigatum* (Thér.) Thér. in Luis
(Dicranaceae)

Samples. C: Caldeirão, 425 m, epigeic-epilithic in cave, u.c. *Dumortiera hirsuta*. - Azorean distrib.: M T J L.

Campylopus brevipilus B.S.G.
(Dicranaceae)

Samples. C: W of Coroinha, 325 m, epigeic on hummocks in open grassland. In the Caldeirão, 425 m, epilithic on strongly exposed boulder;

epigeic on soil escarpment (2 spls.) and epigeic on lake shore. Lomba Redonda, 450 m, epigeic on soil escarpment. - Azorean distrib.: M T F L. Habitat. Probably pref. epigeic in the Az. Other preferences are still unclear.

Campylopus flexuosus (Hedw.) Brid.
(Dicranaceae)

Samples. C: A fairly large number of samples between 250 - 700 m, equally frequently epigeic and epilithic. - Azorean distrib.: S M T J P F L. (A highly variable species. *C. flexuosus* var. *azoricus* (Mitt.) Thér. = *C. azoricus* Mitt. is now treated as *C. pyriformis* var. *azoricus* (Mitt.) Corley.) *C. flexuosus* and *C. pilifer* are probably the most frequent *Campylopus*-species in the Az, both present in the islands with wide altitude ranges and in widely different habitats.

Campylopus fragilis (Brid.) B.S.G.
(Dicranaceae)

Samples. C: Caldeirão, 425 m, epilithic in grassland with scattered *Sphagnum palustre* - hummocks (2 spls.). - Azorean distrib.: M T G J P F L. Habitat. Preferences still unclear, considering earlier records, however, probably to be treated as a species with fairly wide ecological range. Sociology. Associated species in the sample are e.g. *Cephalozia bicuspidata*, *Anastrophyllum minutum* and *Entostodon attenuatus* as primary colonizers.

Campylopus pilifer Brid.
(Dicranaceae)

Samples. C: Several samples between 125-500 m. Mostly epilithic, also epigeic and on boulders with thin soil cover. - Azorean distrib.: S M T G J P F L. Habitat. Pref. epigeic and epilithic. On C frequently in early stages of bryo-colonization on both strongly exposed and on sheltered stone surfaces. Sociology. *C.p.* is a diff. sp. of the epilithic Ptychomitrium azoricae as in other parts of the Az. Frequently associated species are *Grimmia trichophylla* and *Frullania dilatata*.

Campylopus pyriformis (Schultz) Brid. var. *azoricus* (Mitt.) Corley
= *C. flexuosus* var. *azoricus* (Mitt.) Thér.

Samples. C: NE rim of the Caldeirão, 450 m, epilithic and epigeic. Lomba Redonda, 450 m, epigeic on soil escarpment. - Azorean distrib.: S M J F L.

Campylopus setaceus Card.
(Dicranaceae)

Samples. C: Coroa do Pico, 250 m, epilithic; 200 m, epigeic on soil escarpment. Morro dos Homens, at 425 and 600 m, epilithic. - Azorean distrib.: S M T J P F L.

Ceratodon purpureus (Hedw.) Brid.
(Dicranaceae)

Samples. C: N of Coroa do Pico, 200 m, on strongly exposed boulder. - Azorean distrib.: S M T G J P F L.

Dicranum scottianum Turn.
(Dicranaceae)

Samples. C: E of Espigãozinho, 300 m, epiphyllous on *Trichomanes*. Northern rim of the Caldeirão, 600 m, epiphyllous on withered specimens of *Trichomanes* (2 spls.); epilithic (2 spls.). In the Caldeirão, 425 m, epilithic (2 spls.). - Azorean distrib.: M T J P F L.

Habitat. Earlier in the Az. recorded altitude range 400 -1050 m. The preference of *D.s.* to grow epiphytic and epixylic in CAz and EAz is less pronounced on L and C.

Sociology. Only diff. val. towards epigeic bryo-communities is maintained on C, as probably also on L, thus a weakening as compared to the presence of the species in other parts of the archipelago.

Didymodon insulanus (De Not.) M. Hill
= *Barbula cylindrica* (Tayl.) Schimp. in Boul.
(Pottiaceae)

Samples. C: N of Coroa do Pico, 200 m, epilithic on strongly exposed boulder. - Azorean distrib.: S M T.

Diphyscium foliosum (Hedw.) Mohr
(Buxbaumiacae)

Samples. C: S of Morro dos Homens, 425 m, epigeic on soil escarpment. NE rim of the Caldeirão, 450 m, epilithic on strongly exposed cliff and epilithic in cave (2 spls.). Lomba Redonda, 450 m, epigeic on soil escarpment. - Azorean distrib.: S M T G J P F L.

Habitat. Preferences on C uncertain but probably pref. epigeic as in other parts of the archipelago. Sociology. *D. f.* is linked to species of the Allorgeo-Myurion, but the diff. val. is still uncertain.

Echinodium prolixum (Mitt.) Broth.
(Echinodiaceae)

Samples. C: S of Morro dos Homens, between 475-525 m, epilithic on strongly exposed boulders (2 spls.). W of Coroinha, 350 m, epilithic on brook boulder in ravine (2 spls.). Northern rim of the Caldeirão, 500 m, epiphytic on *Erica* (4 spls.). N of the Caldeirão, 600 m, epilithic. - Azorean distrib.: M T G J P F L.

Habitat. In the Az pref. epiphytic. On C much more frequent epilithic than on other Azorean islands, except for L, thus indicating a decline of the substratum preference.

Sociology. *E. p.* is a diff. sp. of the Echinodium with highest frequency in its ass. Echinodio-Lepidozietum cupressinae. There are, however, still no records of *Lepidozia cupressina* on C. *Lejeunea flava* is on the other hand, a highly frequent species of this ass. on C. The diff. val. of *E. p.* is weaker on C than in CAz. *E. p.* is thus a typical example of decline of diff. values of several bryophytes taking place towards the W in the Azorean archipelago.

Echinodium renauldii (Card.) Broth.
(Echinodiaceae)

Samples. C: W of Coroinha, 350 m. on strongly sheltered boulder surfaces in deep ravine. - Azorean distrib.: M J P F L (also on T; leg. E. DIAS, R. M. GABRIEL and E. SJÖGREN 1992).

Habitat. Several of the old withered specimens of *E. r.* are richly covered by pref. epiphyllous hepatics. Habitat is the same on J and P except that the stone surfaces on C are periodically moistened and more exposed. The essential need of the

species seems to be permanently high air humidity and efficient shelter. *E. r.* is, however, very rare in the whole archipelago in spite of the large number of suitable potential localities on almost all the islands. - *Echinodium renauldii* is no doubt one of the best examples of species of the Azorean bryoflora which may be regarded as endangered. Sociology. No diff. val.

Enthostodon attenuatus (Dicks.) Bryhn
= *Funaria attenuata* (Dicks.) Lindb.
(Funariaceae)

Samples. C: Morro dos Homens, 700 m, epilithic-epigeic on boulder. Coroinha, 300 m, epigeic on soil escarpment; at 325 m, epigeic between hummocks in open grassland. W of Coroinha, 350 m, epixylic on decaying carpet of *Festuca jubata* and epilithic on moist rock surface. Lomba Redonda, 450 m, epigeic on soil escarpment. In the Caldeirão, 425 m, epilithic; epigeic (3 spls.). - Azorean distrib.: M T J P F L.

Habitat. The altitude range and ecological range of *E. a.* is very wide in the Az. The preference of the species to grow epigeic in CAz is less pronounced on C.

Epipterygium tozeri (Grev.) Lindb.
(Bryaceae)

Samples. C: Several samples, between 75-460 m, generally epigeic, in some samples epilithic. Small size species, easily overlooked. - Azorean distrib.: S M T G J P F L.

Habitat. Pref. epigeic, on fine soil escarpments as in other parts of the Az. On C also epilithic or epilithic-epigeic in boulder fissures.

Sociology. The weak diff. val. of the epigeic Allorgeo-Myurion is maintained on C, although *E. t.* also appears quite frequently u.c. highly drought-tolerant species both on boulders and on soil escarpments, even at low altitudes below 200 m.

Eurhynchium hians (Hedw.) Sande Lac.
= *E. swartzii* (Turn.) Cum.
(Brachytheciaceae)

Samples. C: S of Morro dos Homens, 475 m, epilithic. W of Coroinha, 360 m, epilithic (2 spls.) and epigeic (1 spl.). - Azorean distrib.: S M T J P F L.

Habitat. Preferences not possible to define (cf. SJÖGREN 1978, p. 222).

Sociology. No sociological affinity on C or in other parts of the Az.

Eurhynchium meridionale (B.S.G.) De Not.
= *E. canariense* Jaeg.
(Brachytheciaceae)

Samples. C: Coroa do Pico, 175 m, epilithic-epigeic. - Azorean distrib.: M T L.

Eurhynchium praelongum (Hedw.) B.S.G.
(Brachytheciaceae)

Samples. C: A large number of samples, between 75 - 600 m. In most samples epilithic and epigeic. - Azorean distrib.: S M T G J P F L.

Habitat. Almost no substratum preference on C. In CAz still with a slight preference to grow epilithic or epigeic. Wide ecological range.

Fissidens asplenioides Hedw.
(Fissidentaceae)

Samples. C: Large number of samples between 200-500 m. Generally epigeic but almost as frequently epilithic. - Azorean distrib.: S M T J P F L.

Habitat. Pref. epilithic and epigeic in CAz, also on C.

Sociology. The diff. val. of *F. a.* has been treated in detail in SJÖGREN (1978). Records and samples of the species on C indicate a weak diff. val. of the Allorgeo-Myurion.

Fissidens taxifolius Hedw. ssp. *pallidicaulis* (Mitt.) Amann
(Fissidentaceae)

Samples. C: Large number of samples between 125 - 700 m. Epigeic and epilithic; epixylic in 1 spl. - Azorean distrib.: S M T G J P F L.

Habitat. Pref. epigeic. Earlier supposed to grow pref. below 600 m. Now known as fairly frequent in CAz also between 600 - 1000 m. The species grows in all the archipelago, pref. on moist soil surfaces.

Sociology. Diff. sp. of the Allorgeo-Myurion.

Fissidens serrulatus Brid.
(Fissidentaceae)

Samples. C: W of Coroinha, 350 m, epigeic (2 spls.) and epixylic on base of *Festuca jubata*. In the Caldeirão, 425 m, epigeic on vertical soil escarpment. Morro dos Homens, 700 m, epilithic (2 spls.). - Azorean distrib.: S M T G J P F L.

Habitat. Pref. epilithic and epigeic, as in other parts of the archipelago. The preference of *F. s.* to grow in sheltered habitats is maintained on C.

Sociology. Associated species on C are those of the *Tetrastichium-Dumortiera* - ass., which may eventually be ranked as belonging to epigeic Allorgeo-Myurion.

Fissidens viridulus (Sw.) Wahlenb.
(Fissidentaceae)

Samples. C: Caldeirão, 425 m, epigeic on lake shore and in ravine on soil escarpment. N of Coroa do Pico, 200 m, epigeic. Coroinha, 350 m, epigeic-epilithic. Lomba Redonda, 450 m, epilithic (2 spls.). Espigãozinho, 300 m, epilithic in ravine (2 spls.). SW coast, 100 m, epigeic between boulders (4 spls.)

Grimmia trichophylla (Wils.) Smith incl. ssp. *azorica* (Ren. et Card.) Luis.
(Grimmiaceae)

Samples. C: Several samples between 50-600 m, in most samples epilithic; epigeic (2 spls.); in 2 spls. on thick litter/soil cover on boulder. - Azorean distrib.: S M T G J P F L.

Habitat. Strong preference to grow epilithic. Very few Azorean bryophytes have an equally strong substratum preference if their presence throughout the archipelago is considered. *G. t.* is able to grow in both strongly exposed and in sheltered habitats and is evenly spread on C below 600 m. - In many cases the ssp. *trichophylla* and ssp. *azorica* are difficult to separate and they have therefore been treated together in this paper. Also, it has not been possible to find any differences in habitat preferences between the subspecies.

Sociology. *G. t.* is a diff. sp. of the *Ptychomitrium azoricae* (earlier *Grimmia azorica* - *Ptychomitrium* - all. SJN 1990) in CAz and EAz. Its strong diff. val. is maintained on C. Frequently associated species are *Frullania dilatata*, *Campylopus pilifer*.

Ptychomitrium spp., *Hypnum resupinatum*. The alliance on C is represented by one low-altitude very drought-tolerant ass., the *Frullanietum dilatatae* and one less drought-tolerant ass., the *Grimmietum accicularae*, mostly at altitudes above 250 m. In that way *G. l.* on C appears associated with numerous species, some of them with widely different ecological preferences.

Heterocladium heteropterum B.S.G.
(Thuidiaceae)

Samples. C: In the Caldeirão, 425 m, epilithic (6 spl.); epigeic on lake shore and on soil escarpment; epilithic-epigeic (4 spl.). NE rim of the Caldeirão, 450 m, epilithic. N of Coroa do Pico, 200 m, epilithic on sheltered boulder in ravine. Espigãozinho, 300 m, epilithic in ravine (2 spl.). W of Coroinha, 350 m, epilithic and epigeic in ravine. N of Caldeirão, epilithic. - Azorean distrib.: M T G J P F L.

Habitat. Pref. epilithic in CAZ. Decrease of preference on C as also epigeic in many localities. Wide altitude range on C, growing both in strongly exposed and in sheltered habitats.

Sociology. Associated species on C are those of the Allorgeo-Myurion and of the *Ptychomitrium azoricae*: *Grimmietum acicularae*. Therefore treated as diff. sp. with weak diff. val. of both alliances. The diff. val. towards epiphytic, epixylic and epiphyllous communities is, on the other hand, very strong.

Hypnum cupressiforme Hedw. var. *lacunosum* Brid.
(Hypnaceae)

Samples. C: Caldeirão, 425 m, epilithic on cliff. S of Coroa do Pico, 175 m, epigeic. - Azorean distrib.: S M T P F.

Hypnum cupressiforme Hedw. var. *resupinatum* (Tayl. et Spruce) Schimp.
(Hypnaceae)

Samples. C: Large number of samples, between 25-500 m, epilithic and epigeic. Epixylic on *Pittosporum*, epiphytic on *Juniperus* (2 spl.) and on *Erica* (1 spl.). - Azorean distrib.: S M T G J F L.

Habitat. Pref. epilithic, epigeic generally on soil covered boulders. Wide altitude range. Highly drought-tolerant. Preferably at altitudes below the *Juniperion brevifoliae*.

Sociology. Frequently u.c. species of the *Ptychomitrium azoricae* (such as *Grimmia trichophylla*, *Frullania dilatata*, *Ptychomitrium* spp., *Campylopus pilifer*, *Scorpiurium circinatum*). The species has been treated (as *Hypnum resupinatum*) as a diff. sp. of the *Ptychomitrium azoricae*. Only rare presence in the Allorgeo-Myurion and in the epiphytic *Echinodion*.

Hypnum uncinulatum Jur.
= *H. canariense* (Mitt.) Jaeg.
(Hypnaceae)

Samples. C: Large number of samples between 225-700 m, equally frequent epiphytic (on *Juniperus*, *Erica*) and epilithic; also epigeic and epilithic-epigeic (2 spl.); epixylic on *Dryopteris aemula* (2 spl.); epiphyllous on *Trichomanes* and on *Diplazium caudatum* in late stages of succession. - Azorean distrib.: S M T G J P F L.

Habitat. Pref. epilithic and epiphytic species with wide altitude range. Strongly drought-tolerant. More frequently epilithic on C than in CAZ.

Sociology. Highly frequent in the *Juniperion brevifoliae* but also as on C in low-altitude fractions of the cloud-zone forest. No diff. val. as associated to a large number of species linked to various bryo-communities on soil, rocks and trunks.

Isopterygium elegans (Brid.) Lindb.
(Plagiotheciaceae)

Samples. C: In Caldeirão, 425 - 450 m, epilithic and epigeic. NE rim of the Caldeirão, 450 m, epilithic in cave. Morro dos Homens, 700 m, epilithic-epigeic. E of Espigãozinho, 275 m, epilithic and epigeic under *Juniperus* (2 spl.). South coast, 25 - 75 m, epilithic (2 spl.) and epixylic on *Pteridium*. - Azorean distrib.: M T J P F L.

Habitat. No substratum preference. On C more frequent epilithic and epigeic than in CAZ. Wide altitude range.

Sociology. No diff. val. In many bryo-communities. On C as in CAZ in all successional stages on different substrates.

Isoethecium myosuroides Brid.
(Brachytheciaceae)

Samples. C: E of Espigãozinho, 275 m, epilithic under sheltering *Juniperus* shrubs. Caldeirão, 425 m, epilithic on cliff (2 spls.). - Azorean distrib.: M T J P F L.

Lepidopilum virens Card.
(Daltoniaceae)

Samples. C: W of Coroinha, 373 m, epixylic on bases of withered *Festuca jubata*. In the Caldeirão, 425 m, epixylic on *Vaccinium*. Espigãozinho, 300 m, epilithic in sheltered ravine. S of Morro dos Homens, 425 m, epiphyllous on *Trichomanes*. - Azorean distrib.: M T G J P F L.
Habitat. In CAz pref. epigeic and epilithic. Its presence as epixylic has not yet been recorded in other parts of the archipelago.
Sociology. No diff. val. on C. In other parts of the Az diff. sp. of the *Tetrastichium-Dumortiera* - ass.

Leucobryum juniperoideum (Brid.) C. Müll.
(Dicranaceae)

Samples. C: In the Caldeirão, 425 m, epilithic (3 spls.); epilithic on *Erica*; epigeic on lake shore. Cabaceira, 300 m, epigeic. Morro dos Homens, 650 m, epilithic (2 spls.); epigeic (2 spls.). N rim of the Caldeirão, 450 m, epixylic on *Osmunda* and *Dryopteris aemula*. - Azorean distrib.: S M T G J P F L.
Habitat. On C on all sorts of substrates between 300 - 700 m. The fairly frequent epilithic presence of the species on C is exceptional as compared to CAz. Also much more frequent epigeic than in other parts of the archipelago.
Sociology. Due to high competitive ability, often obscuring the typical structure of the Echinodio-Lepidozietum cupressinae. Old cushions often appear overgrown by *Frullania* spp.

Myurium hochstetteri (Schimp.) Kindb.
(Myuriaceae)

Samples. C: Several samples between 200 - 700 m. In most samples epigeic and epilithic. A few samples epiphyllous and epixylic on withered specimens of *Trichomanes*. - Azorean distrib.: S M T G J P F L.

Habitat. *M. h.* is pref. epigeic and epilithic in CAz and maintains that preference on C. The altitude range is wide. Strongly exposed habitats become colonized if the substrate is kept more or less permanently moist.
Sociology. Diff. sp. of the Allorgeo-Myurion.

Neckera intermedia Brid.
(Neckeraceae)

Samples. C: NE rim of Caldeirão, 450 m, epilithic on sheltered vertical cliff. W of Coroinha 325 m, epilithic on N-facing boulders in stone fence. N of the Caldeirão, 600 m, epilithic. - Azorean distrib.: M T G J P F L.
Habitat. In the Az as a whole pref. epiphytic. Rare on C and only recorded epilithic.
Sociology. No diff. val. on C. In one locality u.c. the ecologically widely different species *Grimmia trichophylla*. The presence of *N. i.* on C provides just one of several features in the bryo-vegetation of C, indicating far-reaching differences as compared to CAz and EAz.

Philonotis rigida Brid.
(Bartramiaceae)

Samples. C: Highly frequent between 200 - 600 m. Only epigeic and epilithic. - Azorean distrib.: S M T G J P F L.
Habitat. Wide altitude range. Strong preference to grow epilithic and epigeic.
Sociology. The species has not been given any diff. val. although with preference linked to species of the Allorgeo-Myurion.

Plagiomnium rostratum (Schrad.) Kop.
(Mniaceae)

Samples. C: Lomba Redonda, 450 m, epilithic. - Azorean distrib.: M L.

Plagiomnium undulatum (Hedw.) Kop.
(Mniaceae)

Samples. C: In the Caldeirão, 425 m, epilithic-epigeic. S of Morro dos Homens, 450 m, epilithic. W of Coroinha, 350 m, epilithic in ravine on moist brook boulders. - Azorean distrib.: M T J P F L.

Plagiothecium cavifolium (Brid.) Iwats.
(Plagiotheciaceae)

Samples. C: E of Espigãozinho, 300 m, epigeic (2 spls.) and epilithic. W of Coroinha, 350 m, epilithic on moist cliff surface. S of Morro dos Homens, 425 m, epiphyllous on *Trichomanes*. In the Caldeirão, 425 m, epixylic on *Vaccinium*; epilithic-epigeic in ravine (3 spls.). - Azorean distrib.: G J.

Habitat. Pref. epigeic and epilithic. Shelter-demanding, as on J and G. - Small specimens may be confused with *Tetrastichium*, which has, however, much larger cells.

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

Samples. C: Several samples above 200 m, only epigeic. - Azorean distrib.: S M T J F L.

Polytrichum commune Hedw.
(Polytrichaceae)

Samples. C: In the Caldeirão, 425 m, epigeic (3 spls.). S of Morro dos Homens, 600 m, epilithic; at 350 m, epigeic. W of Coroa do Pico, 300 m, epigeic. Highly frequent all over the island. - Azorean distrib.: S M T P F L.

Polytrichum formosum Hedw.
(Polytrichaceae)

Samples. C: Highly frequent between 300 - 700 m. - Azorean distrib.: M T J P L.

Habitat. On C, as on other islands, frequently mixed into *Sphagnum*-hummocks, especially where decreased moisture supply hinders *Sphagnum* development and hummock degeneration has started.

Polytrichum juniperinum Hedw.
(Polytrichaceae)

Samples. C: In the Caldeirão, 450 m, epigeic and epilithic. Morro dos Homens, 700 m, epigeic on old *Sphagnum* hummock. E of Espigãozinho, 250 m, epigeic on soil escarpment. - Azorean distrib.: S M T G J P L.

Pterogonium gracile (Hedw.) Sm.
(Leucodontaceae)

Samples. C: In the Caldeirão, 450 m, epilithic. W of Coroinha, 350 m, epilithic on top of strongly exposed boulder. - Azorean distrib.: M G L.

Habitat. Distinctly pref. epilithic. Only few Azorean bryophytes have an equally strong substratum preference (cf. *Grimmia trichophylla*).

Ptychomitrium azoricum (Card.) Par.
(Ptychomitriaceae)

Samples. C: Coroa do Pico, 225 m, epilithic (2 spls.). S of Morro dos Homens, 525-600 m, epilithic (3 spls.). E of Espigãozinho, 250 m, epigeic on soil escarpment and epilithic. Coroinha, 325 m, epilithic-epigeic on stone wall. Caldeirão, 425 m, epilithic on cliff. - Azorean distrib.: S M T J P F L (*P. polyphyllum* incl. *P. azoricum*).

Habitat. Strongly drought-tolerant, pref. epilithic. Rarely in strongly sheltered habitats. On cliffs and boulders, with wide altitude range. - The three *Ptychomitrium* species of the Az seem to have the same ecological ranges.

Sociology. Together with *P. polyphyllum* and *P. nigrescens* diff. spp. of the *Ptychomitrium azoricum* group. Frequently u.c. *Grimmia trichophylla*, *Camptopogon pilifer*, *Hypnum resupinatum*. - Young infertile specimens of *P.a.* are very difficult to separate from small specimens of *P. polyphyllum* and *P. nigrescens*.

Ptychomitrium nigrescens (Kunze) Wijk et Marg.
(Ptychomitriaceae)

Samples. C: N of Coroa do Pico, 200 - 250 m, epilithic on strongly exposed boulders (3 spls.). - Azorean distrib.: S M T G J P F L.

Habitat. see *P. azoricum*.

Ptychomitrium polyphyllum (Sw.) B.S.G.
(Ptychomitriaceae)

Samples. In the Caldeirão, 425 m, epilithic on strongly exposed boulders (3 spls.); at 600 m, epilithic. - Azorean distrib.: S M T J P F L (incl. *P. azoricum*).

Habitat. see *P. azoricum*.

Racomitrium aciculare (Hedw.) Brid.
(Grimmiaceae)

Samples. C: Several samples between 350 - 600 m, in all epilithic - Azorean distrib.: M T J F L.
Habitat. Very strong preference to grow epilithic. As on other Azorean islands, pref. on moist cliffs and on brook boulders but on L and C also frequently on strongly exposed boulder surfaces.
Sociology. Diff. sp. of the *Ptychomitrium azoricum*: *Grimmietum acicularae*. The supposed diff. val. of the *Racomitrium-Scapanietum undulatae* All. 1921 (cf. v. HÜBSCHMANN 1971, 1974) is not possible to maintain on C and should be further tested in CAz.

Racomitrium fasciculare (Hedw.) Brid.
(Grimmiaceae)

Samples. C: NE exterior slope of the Caldeirão, 450 m, epilithic on strongly exposed cliffs (2 spl.); at 600 m epilithic on boulder. Morro dos Homens, 600 m, epilithic-epigeic, at 250 m, epilithic. - Azorean distrib.: M J P F.
Habitat. Strong preference to grow epilithic.
Sociology. Diff. val. on C for the *Grimmietum acicularae* (*Ptychomitrium azoricum*). Whether this diff. val. is valid also in CAz and EAz remains to be tested. At least *R. f.* is certainly a valuable diff. sp. towards epiphytic, epixylic and epiphyllous communities, probably also towards epigeic ones.

Rhamphidium purpuratum Mitt.
(Pottiaceae)

Samples. C: S of Morro dos Homens, 475 m, epigeic. NE rim of the Caldeirão, 450 m, epilithic; epigeic (3 spl.). NE of Coroa do Pico, 200 m, at a base of *Pittosporum undulatum*. - Azorean distrib.: M T J F L.

Rhynchostegiella curviseta (Brid.) Limpr.
(Brachytheciaceae)

Samples. C: NE of the Caldeirão, 500 m, epilithic in cave. E of Topo, 125 m, epilithic-epigeic. - Azorean distrib.: S J L.

Rhynchostegiella surrecta (Mitt.) Broth.
(Brachytheciaceae)

Samples. C: N of Coroa do Pico, 200 m, epigeic in *Cryptomeria*-forest and on strongly exposed soil escarpment. - Azorean distrib.: M J.

Rhynchostegium confertum (Dicks.) B.S.G.
(Brachytheciaceae)

Samples. C: Caldeirão, 425 m, epilithic on boulder u.c. *Racomitrium aciculare*; epigeic-epilithic (2 spl.); epigeic in ravine. Lomba Redonda, 450 m, epilithic. - Azorean distrib.: S M T J F L.

Rhynchostegium megapolitanum (Web. et Mohr)
B.S.G.
(Brachytheciaceae)

Samples. C: W of Coroinha, 350 m, epilithic on periodically moist boulder surface. - Azorean distrib.: S M.

Rhynchostegium riparioides (Hedw.) Card.
(Brachytheciaceae)

Samples. C: W of Coroinha, epilithic on brook boulder (2 spl.). Caldeirão, 550 m, epigeic-epilithic (2 spl.) - Azorean distrib.: S M G J F L.

Rhytidadelphus squarrosus (Hedw.) Warnst.
(Hypnaceae)

Samples. C: In the Caldeirão, 425 m, epigeic (2 spl.). S of Morro dos Homens, 475 m, epigeic between grass hummocks. Frequent species all over the island. - Azorean distrib.: M T G J P F L.

Scleropodium purum (Hedw.) Limpr.
(Brachytheciaceae)

Samples. C: Several samples between 175 - 425 m, in most samples epigeic. - Azorean distrib.: S M T G J P F L.

Habitat. Generally in the open grassland vegetation. Wide altitude range. Pref. epigeic, as in other parts of the archipelago.

Scleropodium touretii (Brid.) Koch
(Brachytheciaceae)

Samples. C: Caldeirão, 425 m, epilithic on boulder. Probably underrecorded. - Azorean distrib.: M T G P F.

Scorpiurium circinatum (Brid.) Fleisch. et Loeske
(Brachytheciaceae)

Samples. C: In the Caldeirão, 425 m, epilithic (3 spls.). - Azorean distrib.: S M T G J P F L.
Habitat. Pref. epilithic. On the other Azorean islands known as strongly drought-tolerant and fairly common on strongly exposed boulders at altitudes below the *Juniperion brevifoliae*.
Sociology. Diff. sp. of the *Ptychomitrium azoricae*, frequently u.c. *Grimmia trichophylla*, *Hypnum resupinatum*, *Campylopus pilifer*. Further recordings on C may reveal several localities, especially at levels below 400 m.

Sematophyllum substrumulosum (Hampe) Britt.
(Sematophyllaceae)

Samples. C: In the Caldeirão, 425 m, epilithic on cliff; epigeic on soil escarpment. Morro dos Homens, 700 m, epigeic. SW coast of the island, 100 m, epilithic (2 spls.) and epixylic on *Pteridium*. - Azorean distrib.: S M T G J P F L.
Habitat. The wide altitude range of the species, earlier not recorded but now confirmed, was first indicated by P. & V. ALLORGE (1946). Pref. epixylic and epiphytic in CAZ, on C with no substratum preference.
Sociology. The diff. val. for epixylic and epiphytic bryo-communities suggested earlier (SJÖGREN 1978) cannot be maintained on C.

Sphagnum lescurii Sull.
(Sphagnaceae)

Samples. C: Morro dos Homens, 700 m, epigeic. Highly frequent species at high altitudes. - Azorean distrib.: M T J P F.

Sphagnum palustre L. (incl. *S. centrale* C. Jens.)
(Sphagnaceae)

Samples. C: Cabaceira, 300 m, in open grassland. S of Morro dos Homens, 350 - 600 m, highly fre-

quent in the open grassland. Bottom of the Caldeirão, 425 m, in hummocks around the lakes u.c. *Polytrichum*. - Azorean distrib.: M T J P F L.

Sphagnum squarrosum Crome
(Sphagnaceae)

Samples. C: In the Caldeirão, 425 m, epigeic. - Azorean distrib.: L.

Sphagnum subnitens Russ. et Warnst.
(Sphagnaceae)

Samples. C: S of Morro dos Homens, 475 m. In the Caldeirão, 425 m, dry top of hummock dominated by *S. palustre*. - Azorean distr.: M T J P F L.

Tetrastichium fontanum (Mitt.) Card.
(Hookeriaceae)

Samples. C: In the Caldeirão, 425 m, epigeic in sheltered ravine. W of Coroinha, 350 m, epilithic in cave; epigeic in dense vegetation dominated by *Festuca jubata* (2 spls.); epilithic on moist brook boulders (2 spls.). - Azorean distr.: S M T G J F L.
Habitat. Pref. epilithic and epigeic, in other parts of the archipelago.
Sociology. Diff. sp. of the *Tetrastichium-Dumortiera* - ass. SJN. 1990. This epilithic-epigeic ass. has not been possible to record on C in its typical composition. Mixtures with fractions of the epigeic Allorgeo-Myurion are more frequent.

Thamnobryum alopecurum (Hedw.) Nieuwl.
= *Thamnium alopecurum* (Hedw.) B.S.G.
(Thamniaceae)

Samples. C: Coroinha, 350 m, epilithic. S of Morro dos Homens, 450 m, epilithic (2 spls.). W of Coroinha, 375 m, epilithic in cave, in ravine and on brook boulders (9 spls.). N of Coroa do Pico, 200 m, epilithic on sheltered boulder in ravine. - Azorean distrib.: M T G J P F L.
Habitat. Pref. epilithic on C, but in the Az as a whole with only weak substratum preference.
Sociology. No diff. val. on C or on other Azorean islands. The earlier proposed diff. val. towards epiphytic and epiphyllous bryo-communities of the *Juniperion brevifoliae* as well as towards the

Ptychomitrium azoricae is, however, maintained on C.

Thuidium tamariscinum (Hedw.) B.S.G.
(Thuidiaceae)

Samples. C: Highly frequent species on C. - Azorean distrib.: M T G J P F L.
Habitat. Pref. epigeic. Also in many localities growing on soil-covered boulders and on the bases of trunks. In open grassland frequently together with *Scleropodium purum*.

Tortula muralis Hedw.
(Pottiaceae)

Samples. C: Portinho, 125 m, epilithic on stone wall. - Azorean distrib.: S M T G J F L.

Tortella flavovirens (Bruch.) Broth.
(Pottiaceae)

Samples. C: A large number of samples between 75 - 450 m. Generally epilithic although in many localities epigeic on soil escarpments and on soil-covered stone surfaces. - Azorean distrib.: S M G J (also on T; leg. SJN. 1992).
Habitat. Under-recorded species, probably present on all the Azorean islands. Pref. epilithic and epigeic. Most records are below 300 m. Strongly drought-tolerant species, generally in non-sheltered habitats.
Sociology. Diff. sp. of the epilithic ass. *Frullanietum dilatatae* of the *Ptychomitrium azoricae*.

Trichostomum brachydontium Bruch (incl. var. *litorale* (Mitt.) C. Jens.)
(Pottiaceae)

Samples. C: Coroinha, 325 m, epilithic on stone wall (2 spls.). N of Coroa do Pico, 200 m, epilithic. Portinho, 125 m, epilithic. Espigãozinho, 300 m, epilithic. - Azorean distrib.: S M T G J P F L.
Habitat. Coastal species, pref. epilithic and epigeic. On C at unusually high altitude.

Trichostomum crispulum Bruch
(Pottiaceae)

Samples. C: SW point of the island, 50 m,

epilithic on strongly exposed stone surface. - Azorean distrib.: M J L.

Weissia controversa Hedw.
(Pottiaceae)

Samples. C: Several samples between 125-425 m, epigeic and on soil-covered boulders. - Azorean distrib.: S M T G J P F L.
Habitat. Strongly drought-tolerant species, pref. on soil in early stages of bryo-succession.

Zygodon viridissimus (Dicks.) Brid.
(Orthotrichaceae)

Samples. C: Portinho, 75 m, epilithic (2 spls.); at 25 m, epigeic and epilithic. Coroinha, 325 m, epigeic-epilithic. Coroa do Pico, 175 m, epilithic-epigeic. - Azorean distrib.: S M T G J F L.
Habitat. The presence on C as epilithic and epigeic has made the substratum preference of this species slightly weaker, earlier probably erroneously treated as pref. epiphytic in CAZ.
Sociology. This easily overlooked small species, often growing with a few specimens within dense cushions of other moss species, seems to be linked on C to the epilithic *Frullanietum dilatatae* of the *Ptychomitrium azoricae*. It has been treated as a diff. sp. of that ass. together with *Tortella flavovirens* and *Frullania dilatata*. The diff. val. of the species on the other Azorean islands remains to be tested.

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Index of bryophyte taxa, sampled and recorded on Corvo

HEPATICAEE

Anastrophyllum minutum
Anthoceros punctatus
Aphanolejeunea teotonii
Asterella africana
Calyptogeia arguta
Calyptogeia fissa
Calyptogeia muellerana
Calyptogeia trichomanis
Cephalozia bicuspidata
Chiloscyphus pallescens
Cololejeunea azorica
Cololejeunea minutissima
Colura calyptrifolia
Conocephalum conicum
Diplophyllum albicans
Drepanolejeunea hamatifolia
Dumortiera hirsuta
Fossombronina angulosa
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Frullania microphylla
Frullania tamarisci
Frullania teneriffae
Harpalejeunea ovata
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Heteroscyphus denticulatus
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Jungermannia hyalina
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Lejeunea holtii
Lejeunea lamacerina
Lejeunea patens
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Marchesinia mackaai
Marsupella emarginata
Metzgeria conjugata
Metzgeria furcata
Nardia geoscyphus
Nardia scalaris
Odontoschisma sphagni
Plagiochila corniculata
Plagiochila spinulosa
Porella canariensis
Porella obtusata
Radula aquilegia
Radula carringtonii
Radula wichurae
Reboulia hemisphaerica
Riccardia multifida

Saccogyna viticulosa
Scapania curta
Scapania gracilis
Scapania undulata
Telaranea nematodes

MUSCI

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Alophozia azorica
Atrichum angustatum
Barbula unguiculata
Brachythecium plumosum
Brachythecium rutabulum
Brachythecium velutinum
Bryum alpinum
Bryum argenteum
Bryum donianum
Campylopodium euphoroeladum
Campylopus brevipilus
Campylopus flexuosus
Campylopus fragilis
Campylopus pilifer
Campylopus pyriformis
Campylopus setaceus
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Tortula muralis
Tortella flavovirens
Trichostomum brachydontium
Trichostomum crispulum
Weissia controversa
Zygodon viridissimus

REFERENCES

- ALLORGE, V. & P. ALLORGE 1946. Les étages de végétation muscinale aux îles Açores et leurs éléments. *Mémoires de la Société de Biogéographie* 8., VIII: 369-386.
- ALLORGE V. & P. ALLORGE 1950. *Aphanolejeunea teotonii* nov. sp. hépatique des Açores. *Revue Bryologique et Lichenologique*. N.S. 19: 19-24
- BISANG, I., R. SCHUMACHER, C. SÉRGIO, C. & R. GROLLE 1988. Clé didentification des espèces du genre *Frullania* Raddi (Hepaticae) en Europe et en Macaronésie. *Giornale Botanico Italiano* 122(5-6): 255-266.
- BISCHLER, H. 1970. Les espèces du genre *Calypogeia* sur le continent africain et les îles africaines. *Revue Bryologique et Lichenologique*. NS. 37: 63-134.
- CORLEY, M.F.V., A.C. CRUNDWELL, R. DULL, M.O. HILL & A.J.E. SMITH 1981. Mosses of Europe and the Azores: an annotated list of species, with synonyms from the recent literature. *Journal of Bryology* 11: 609-689.
- EGGERS, J. 1982. Artenliste der Moose Makaronesiens. *Cryptogamie, Bryologie, Lichénologie* 3(4): 283-335.
- GROLLE, R. 1983. Hepatics of Europe including the Azores: an annotated list of species, with synonyms from the recent literature. *Journal of Bryology* 12: 403-459.
- HÜBSCHMANN, A. v. 1971. Bryosozologische Studien auf der Insel Madeira. *Nova Hedwigia* 22: 423-467.
- HÜBSCHMANN, A.v. 1974. Bryosozologische Studien auf der Azoreninsel São Miguel. *Revista da Faculdade de Ciências Lisboa*. 2^a série. C17: 628-702.
- SJÖGREN, E. 1975. Epiphyllous bryophytes of Madeira. *Svensk Botanisk Tidskrift* 69: 217-288.
- SJÖGREN, E. 1978. Bryophyte vegetation in the Azores Islands. *Memórias da Sociedade Broteriana* 26: 1-283.
- SJÖGREN, E. 1979. Contributions to the vascular flora and vegetation of the island of Corvo (Azores). With autecological and synecological remarks. *Boletim do Museu Municipal do Funchal* 32: 19-87.
- SJÖGREN, E. 1990. Bryophyte flora and vegetation on the island of Graciosa (Azores), with remarks on floristic diversity of the Azorean islands. *Arquipélago. Life and Earth Sciences* 8: 63-96.

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