VASCULAR PLANT COMMUNITIES OF MADEIRA

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With 15 figrues and 4 tables

CONTENTS

(Photographs by the author)

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Abstract. Field work on Madeira: In 1964-1967, for 11 months. Investigations: Sociology and ecology of vascular plant communities, succession sequence, zonation, influence of man on the natural vegetaion.

Communities distinguished: I. *Aeonio-Lytanthion* with A. *Hyparrhenietum hirtae*, B. *Euphorbietum piscatoriae*, C. *Biserrulae-Scorpiurietum*. II. *Clethro-Laurion* with A. *Vaccinio-Sibthorpietum*, B. *Deschampsietum argenteae*, C. *Campylopo-Airetum*, D. *Ericetum cinereae*. The communities were distinguished by differential species of varying differential values. Minimum areas of the alliances were found to be 25 m².

Zonation: In the S of the island. 0-300 m: (Ia) Coast vegetation, typical *Aeonio-Lytanthion*. 300-700 m: (Ib) *Aeonio-Lytanthion* mixed with cloud zone species, especially in river valleys. 700-1200 m: (IIa) *Laurus-Erica-Vaccinium* shrubforest, typical cloud zone vegetation, *Clethro-Laurion*. 1200-1850 m: (IIb) *Erica* scrub above cloud zone, grassland association of the *Clethro-Laurion*. In the N of the island: 0-100 m (Ia), 100-300 m (Ib), 300-1300 m (IIa), 1300-1850 m (IIb).

The lower altitude limit for the cloud zone communities (700 m on the southward part of the island) depends on the required minimum amounts of precipitation, 1700-2000 mm/year and on permanently high air humidity values above 80%. The lower limit of the cloud zone vegetation on the central islands of the Azores is at 500 m, where climatic conditions are similar. Competition from the cultivated and grazed parts of landscape has for centuries reduced the areas of natural vegetation and now threatens the survival of endemic communities and endemic taxa. Overgrazing has eliminated the shrubs and induced the development of a moss vegetation with a high degree of cover on large areas of the scrub-grassland above the cloud zone. Severe erosion is frequent on slopes inclined more than 30%. Differential protection of the original vegetation within large coherent areas is most urgently required on Madeira.

Acknowledgments. The publication of this work has been preceded by 11 months of field investigations on Madeira and by studies of herbaria in Portuguese Museums and Institutes.

I owe a special dept to Major C. H. C. Pickering and Mrs. M. Pickering (Funchal), who during several excursions, especially in 1964-65, gave me a most important introduction to the flora and vegetation of Madeira. Their generous support in various respects, such as discussion of taxonomic problems and indication of the richest remaining areas of natural vegetation has been most important to this publication. During my first stay on Madeira, I was fortunate to meet Mr. G. E. Maul, head of the Museu Municipal of Funchal. His interest and advice greatly facilitated both my field work and the final publication of the manuscript. He has generously provided space in the Museum for the preparation of collected material as well as for comparative studies of the large amount of herbarium material now available in the Museu Municipal.

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Uppsala in April 1972
Erik A. Sjögren

INTRODUCTION

The archipelago of Madeira has been colonized by man during a little more than five and a half centuries. Colonization was centered on the largest of the islands, Madeira. Rapid increase of the population in the last 100 years, from 110,000 to 250,000 inspite of considerable emigration, (increase between 1815-1870 with only 19,000!) has caused very heavy pressure from man's activities on the original vegetation of the island. This has led to establishment of plots, generally on constructed terraces in the coastal zone, to grazing in the highest zone and cultivation of several kinds of forest trees in a zone in between. The natural vegetation has been pushed back to steep coastal cliffs and the steep slopes of volcanic deposits and to river valleys at altitudes of about 800-1200 m. The original vegetation of the highest peaks has escaped heavy overgrazing only in localities which are inaccessible to sheep and goats.

Madeira is 58 km long from W-E and 23 km across from N-S. The area has been calculated to be 728 km^2. The island is situated in the Atlantic, 978 km SW of Lisbon. It has a volcanic origin, going back to Miocene times. The topography is extremely rugged (cf. fig. 1) because of the deep incision of several rivers into the easily eroded volcanic deposits.

There are already detailed published descriptions of the geology and climate of Madeira; and they will be omitted from this introduction. The geology has been described by Albuquerque & Mousinho (1837), for example, and the climate by Heberden (1751-1765), Manson (1850), Hann (1871), Branco (1936) and Ferreira (1955). Some facts, however, should be included as they help to explain some of the features of the differentiation and distribution of the vegetation. The geology is monotonously basaltic and therefore has no influence on the differentiation of the vegetation. The ecological conditions which have a dominant influence are the local climate, topography (exposure), and soil structure. Madeira has a W-E central ridge with high mountain peaks (Pico Ruivo 1861 m) and a more or less level high plateau, Paul da Serra,

which narrows towards the W where it has been split by the largest river valley of the island, Vale da Ribeira da Janela. Winds are generally from the N and NE, giving the highest amounts of precipitation to the northern part. Precipitation on the S coast is about 400-1000 mm/year but on the N coast 1000-2000 mm. There is an increase of precipitation of about 150 mm per 100 m, up to 1200-1400 m. Above this altitude there is generally no further increase (cf. Ribeiro 1949). Vegetation at altitudes above 1300 m has even been called «méso-xérophytique» (cf. Romariz 1953). Temperatures decrease by an average of about 1° per 156 m (cf. Tavares 1965, p. 56 and Ribeiro 1949, p. 30). Relative humidity increases from the coasts up to the cloud zone and then usually decreases again towards the highest peaks. The average RH at the S coast is 70%, increasing to average values of about 90% in the cloud zone. Mean relative humidity during the year is more or less equally high (more or less 75%) at 700 m (S part) and at 1600 m (S part, Arieiro). These variations of the local climate with increasing altitude are of course also strongly influenced by local topographic conditions. For example, in N-S river valleys, especially in the S of Madeira, there is usually a more or less pronounced stabilization of temperature stratification. In small tributary valleys to these large valleys there is often an evident differentiation of vegetation depending on N or S exposure and consequent differences in desiccation.

All types of soil-rock substratum on Madeira are very permeable to water. The basaltic rocks have many fissures and usually all layers of eroded or deposited volcanic material have a very low water-retaining capacity. However, there is a distinct differentiation of vegetation in relation to the soil structure, especially where amounts of precipitation are not sufficient for plant communities with low drought tolerance to develop.

For example, the hygrophilous cloud zone vegetation shows an increasingly distinct preference for fine grain soils towards the upper and lower altitude limits of distribution. The total ecological status of habitat on Madeira is often the result of compensation of one ecological factor by another: for example, a coarse grain substratum with a water-holding capacity which is too low for the development of a hygrophilous plant community at a particular altitude may be compensated by very slight N exposure. The Madeiran vegetation has been investigated sociologically and ecologically (eco-sociology), including features of zonation, taking these environmental conditions into consideration.

Investigations

The first botanical journey of the present author to Madeira was in 1964. This was followed by two fairly long visits in 1965 and 1966-67 and

by several short visits for herbarium studies. Field work on Madeira was carried out during a total of 11 months, spread over all seasons of the year. Investigations were first centered to bryosociological and bryoecological problems. However, after only a short period of field work, these studies were found to require a solid phytocoenotic foundation. Bryological records have to be made in parallel with records of vascular plant communities. The vascular plant part of the investigation is discussed in the present paper. Descriptions of the phytocoenoses will be completed after examination of the bryophyte material and data collected.

Important botanical investigations on Madeira started at the end of the 18th century (Forster 1787, 1797). Before this a large collection of vascular plants of Madeira has been made by J. Banks and by Dr. Solander in 1768. F. Masson also made important collections in 1776-78 and 1785. Botanical investigations resulted in a rather large number of taxonomic papers in the 19th century. The most important papers on the vascular flora were published by Lowe (1868) and by Menezes (for example 1915). Lichens were treated later by Tavares and bryophytes by Luisier (bibliographies in Tavares 1965, Hansen 1969 and Menezes 1914). In his Flora list of 1914 (p. 222 ff.) Menezes published a very useful list of names of botanists who had worked on Madeira. The botanists who have made the most important collections of vascular plants on Madeira in the 20 th century are M. Vahl, C. A. de Menezes, C. Romariz, J. G. da Costa, J. de G. Barreto, M. Beliz, Rui Vieira, C. H. C. Pickering, and A. Hansen.

The rich differentiation of the vegetation of Madeira, including the zonation, has been described by various authors, from Bowdich (1825) to Romariz (1957). The first important attempt to relate the description of the plants to the ecological conditions was made as late as in 1904, by the Danish botanist Vahl. Published papers during the last 200 years have, however, contained very little information about zonation, ecology and sociology of the natural vegetation of Madeira. This deficiency was the incentive to me to begin botanical studies on the island. Investigations were extended to the westernmost Macaronesian archipelago, the Azores. Old botanical knowledge about that archipelago was also largely taxonomic and centered on the vascular flora.

Both Madeira and the Azores were discovered a little more than 500 years ago and were colonized by the Portuguese shortly afterwards. They therefore provide an interesting source of records of the changes within the natural flora and vegetation during a known period, brought about by the rapid expansion of cultivated areas of the landscape, involving the establishment of fields and grazing land, burning and felling of forests and scrub.

This kind of approach to the study of the original vegetation

naturally leads to predictions of further changes in the relation between the natural and the cultivated areas of the landscape. It was my aim that this paper should not be looked upon only as a record of presentday plant communities and distribution of differential species with more or less narrow ecological ranges. Information derived from my investigation has thus been compared when possible with information given in earlier papers. My intention was also that the descriptions given below should be useful material for comparisons made by botanists continuing investigations on Madeira.

It will also be possible to use the information about areas of natural vegetation worthy of conservation and possible to conserve, if threatened by engulfment in the cultivated areas of the landscape. The remaining natural vegetation of Madeira and the Azores offers to naturalists all over the world unique resources for various kinds of scientific studies of the composition of a relict ecosystem and of the conditions regulating constancy and change within it. This is a most important subject at the present time for naturalists concerned with conservation of vegetation and fauna; and for the Portugese authorities to discuss and make decisions about conservation problems on Madeira and in the Azores.

Plant communities: In this paper have been described the two main plant communities (alliances) of the natural landscape of Madeira. They can be regarded as the basis for further descriptions of associations. The delimitation of these two sociological units was based on a large amount of data from recorded sample plots. In the tables published below, only about 15% of the total available material could be included. The sample plots were recorded from as many localities as possible. The main sample plot areas have been marked on a map (fig. 2).

Differential species with low and high differential value have been distinguished. Their presence in the alliances show a rather uniform composition of these sociological units throughout the island. However, as in Azorean natural vegetation there is considerable and highly frequent variation of the physiognomy of these alliances. It was therefore considered to be misleading to include figures for degrees of cover in the sample plot tables. However, the important dominant species have been mentioned in the description of the communities.

Differential species of high differential value are more or less strictly confined to certain altitudes, because of their narrow ecological ranges. They serve all together as a basis for the description of vegetation zones. Qualitative delimitation of sociological units, physiognomic characteristics of the vegetation zones, and correlation with ecological conditions changing with altitude are inseparable parts of the description of the alliances.

Descriptions of zonation of vegetation, table 3, have therefore

been based on plant communities of the natural vegetation and their groups of differential species. Earlier published descriptions of zonation of vegetation on Madeira have frequently included parts of the cultivated areas. The zonation was thus to some extent parallel to the extent of profitable cultivations of various kinds of crops, which changes considerably from time to time, depending on such conditions as overpopulation, emigration, and available occupation outside the rural areas.

Ecosociological records of the plant communities also led to consideration of the recent — during the last 100 years — and present-day changes in the vegetation brought about both by extension of the areas of fields and grazing land by the deliberate or accidental introduction of exotic species. Madeira has the classic island problem: the threat to the natural vegetation which may always arise after introduction of plants and animals. These aspects will be discussed in the descriptions of the plant communities.

Comments on the ecology and sociology of differential species: Species included in this chapter (p. 83 ff.) are characterized generally by having some differential value. Their sociological value and their zonation were studied especially carefully during the periods of field work. In the information provided, autecological facts have been summarized. Putting together the information about the diff. spp. of a certain community gives synecological information about the ecological range of the community. When the ecological preference of the species has been mentioned, this is applicable to Madeiran conditions of competition in the plant cover. Comparisons have been made with the distribution of some of the diff. spp. in the Azores, depending on ecological conditions including competition.

Exsicats (EXS.) : — Herbaria of museums in Funchal, Lisbon and Coimbra have been examined (comp. abbreviations p. 520). Information on localities and altitude has been published. Unfortunately old herbarium material is generally poor in information about habitat. Names of collectors and institutes where the exsicats can be found have been added, as abbreviations. Exsicats by the present author have been included.

VIDI. — During the work making sociological records and studying the zonation of vegetation, a large number of localities especially of differential species with rather narrow ecological ranges, were collected. As one aim of the eco-sociological investigations was to record as many localities as possible of single species and of communities in order to assemble information about zonation and ecological preferences, time was too short to document all the localities with exsicats.

Habitat (HAB.): — Information is provided about the range of altitudes known so far and about the species for localities above or below

a certain altitude. The preferred altitude range for diff. spp. is usually more or lesse equivalent to that of other diff. spp. and to the community they characterize. For the coast communities there are different upper altitude preference limits, e.g. about 100, 300 or 600-700 m. For the cloud zone vegetation the lower altitude limit is of the greatest importance for the understanding of its ecology. Substratum preference and estimated drought tolerance have been mentioned in some cases together with tolerance to grazing animals. Information about altitude preference indirectly gives an approximate indication of preference for certain amounts of precipitation, air humidity and tempertures. Records of localities in valleys as well as on the ridges between helped to evaluate ecological preferences of single taxa and of more or less sociologically stable groups of species, as distribution for cloud zone vegetation can be found in valleys at much lower altitudes than on the ridges nearby. In the deep river valleys, RH is higher and temperatures lower than at the same altitude on the ridges. Some information about the position of the taxa successional sequences has been included.
Sociology (SOC.) :— In this section, the differential values of the species for the communities described are given. Information about the presence of the taxa in Azorean natural plant communities has also been included. The evaluation of differential values has been based on sociological material comprising about 670 analyses of sample plots and on sociological observations related to the investigations of zonation of taxa and communities.

Abbreviations

COI	Instituto Botânico «Dr. Júlio Henriques», Coimbra
JBF	Jardim Botânico, Funchal
LISFA	Estação de Biologia Florestal, Lisbon
LISI	Instintuto Superior de Agronomia, Lisbon
MMF	Museu Municipal, Funchal
U	Institute of Ecological Botany, Uppsala

Names of collectors:

Ad	Campos Andrada	Orm	Ormonde
Bar	C. J. Barreto	Pa	B. do Castelo da Paiva
Br	Narciso Branco	Pe	Perestrello
Bz	M. Beliz	Pi	C. H. C. Pickering
Co	J. G. da Costa	Ro	C. Romariz
Cvo	José M. de Carvalho	RS	Rui Santos
Fr	Abel Agapito de Freitas	RV	Rui Vieira
Fz	R. Fritze	Sa	Sardinha
Ga	Maria Manuela da Gama	Si	Cecílio Gomes da Silva
Go	Ilídio Botelho Gonçalves	Sjn	Erik Sjögren
Mn	G. Mandon	Va	Valente
Mü	Sch. Müller	Ww	Welwitsch
Mz	C. A. de Menezes		

Other abbreviations:

all.	alliance	hab.	habitat
arch.	archipelago	lev.	levada
ass.	association	loc.	locality
Az.	Azores	Mad.	Madeira
Cab.	Cabêço	P.	Pico
cald.	caldeira	prox.	próximo (near)
cam.	caminho	Q.	Quinta
cit.	mentioned in flora lists	rib.	ribeira
diff. sp.	differential species	soc.	sociology
diff. val.	differential value	u. c.	una cum (together with)
distrib.	distribution	vidi	observed
exs.	exsicats, specimens documented in herbaria		

PLANT COMMUNITIES

The following descriptions of communities of the natural vegetation of Madeira are concentrated on field- shrub- and tree-layers. The general phytocoenotic picture of the vegetation within the coast vegetation is fairly complete. In regard to the cloud zone vegetation, examination and analyses of bryophyte material collected from various substrata will considerably facilitate understanding of the vegetation from an eco-sociological point of view including problems in relation to succession and zonation. Bryophytes are rather rare and there are only a few species in the genuine coast vegetation, whereas there are a large number of taxa, with generally high degrees of cover, on all substrata in the cloud zone vegetation.

The sociologically correct sizes of sample plots for the communities examined were difficult to determine. They could not be found by the traditional method of doubling the size of the sample plots and then choosing the size at which the number of additional species more or less abruptly diminished. This is because the composition of Madeiran natural vegetation is very much mosaic in character and the dominance of different species on ecologically similar areas close to each other can often only be explained as accidental. Thus the correct sample plot sizes had to be established by several preliminary records of plots of different sizes at several localities and at different altitudes. The result that gradually emerged was that vascular plant communities of the rank of alliance could rarely be completely described within sample plots smaller than 25 m^2. In 1965 and 1968, the same result was obtained in respect of sample plot sizes for recording natural vascular plant communities in the Azores Islands. It is mainly communities of the rank of alliance which are treated in the present eco-sociological description. Their splitting into associations has not been documented in sample plot tables but has been suggested in the descriptions below.

Differential species of the alliances have been arranged into groups with varying differential values. Information about diff. values towards plant communities in the Azores has also been included in this grouping. The alliances have been considered as «completely» developed in a locality when the presence of about 75% of the total number of all kinds of diff. spp. is recorded. The presence of an especially large number of diff. spp. with the highest diff. val. is considered to compensate to a large degree for the persence of a lower % of diff. spp. of the groups with lower diff. values. Species with a narrow ecological range, restricted to a certain community but appearing only with low frequency, have not been attributed any diff. val. However, their low characterizing values for the communities described, have been mentioned in the chapter dealing with the distribution and ecology of diff. spp. (p. 83 ff.).

Some diff. spp. with diff. val. for associations have not been excluded from the sample plot tables and the table of diff. spp. Degrees of cover of the the taxa mentioned in the sociological tables are not published, only presence or absence, for the reasons mentioned above.

The vegetation layers are named tree, shrub, field and bottom layers. Bryophyte and lichen cover on the ground is considered as the bottom layer. The field layer extends to 1 m and may consist of a lower stratum of herbs grasses and ferns and one higher stratum of woody plants. The shrub layer extends between 1-2 m and the tree layer above 2 m.

Bryophytes are classified, according to substratum, as epiphytic, epilithic, epixylic, epigeic or epiphyllous.

AEONIO-LYTANTHION E. Sjögren n. all.

The alliance *Aeonio-Lytanthion (A.-L.)* was named after the differential species *Aeonium glandulosum, A. glutinosum* and *Lytanthus salicinus,* species which also frequently occur as dominants in the all. The two *Aeonium* species are so far only known from the Madeira archipelago and *Lytanthus* from Mad. and the Canaries.

The *A.-L.* is a field layer alliance. The shrub layer is only rarely present. The field layer, however, generally consists of a low growing stratum of herbs and grasses and of a higher stratum of low shrubs rarely higher thans 1 m. The bottom layer of mosses is either absent or has only a very low degree of cover and few species. There are no epiphytes on the shrubs but epilithic lichen species are numerous and frequently occur with high degrees of cover.

The size of sample plot suitable for recording the completely developed. *A.-L.* was found to be 25 m^2. Data from a little less than 20% of all the investigated sample plots of the all. have been publiched in table 1. The number of species within the all. is generally about 15, rare-

ly above 20 or below 12. The variation in number of species seems to be accidental, depending on which taxa take part in the primary colonization of bare soil or cliff crevices. Cliffs often cover about 25% of the ground where the all. is found. Thus one sample plot by the coast containing 12 spp. may represent the completely developed A.-L. just as well as an adjacent sample plot with 20 spp., in which the number of occasionally accompanying species is higher.

The number of exclusive diff. spp. of the *A.-L.* is fairly large, because of the rather large number of spp. endemic to Madeira, which frequently occur within the all. (cf. table 4). To this group of endemic diff. spp. have also been added some more or less recently introduced taxa with high differential values towards other plant communities of Madeira and the Azores. They are *Hyparrhenia hirta, Opuntia tuna* and *Avena barbata.* Within the group of diff. spp. in common with the coastal all. *Festucion petraeae* in the Azores there is only one species, *Tolpis fruticosa,* endemic to Madeira-Azores, whereas most of the other species are frequently encountered in westernmost Europe (a summary of the groups of diff. spp. in table 4).

The *A.-L.* was ranked as an alliance. The sociological value of the community was found to be the same as that of the *Festucion petraeae* (Sjögren 1972) of the Azores. As within the Azorean alliance it was found possible to describe some associations but not any lower sociological units with diff. spp. and distinct ecology. Associations of the *Festucion petraeae* have already been described (op. cit.). Three associations of the *A.-L.* have been distinguished so far, and these are not yet documented and summarized in sociological tables. However, they can be given provisional names: A. *Hyparrhenietum hirtae* (coastal grassland throughout the island), B. *Euphorbietum piscatoriae* (sea cliffs through the island), C. *Biserrulae-Scorpiurietum* (coastal grassland on the easternmost peninsula).

These associations can be characterized as follows. Diff. spp. of the *Hyparrhenietum hirtae* towards the associations B and C: *Lagurus ovatus, Bromus madritensis, Lotus subbiflorus, Juncus acutus.* Diff. spp. of the *Biserrulae-Scorpiurietum: Bisserula pelecinus, Scorpiurus vermiculata, Suaeda vera, Senecio incrassatus.*

The *A.-L.* on Madeira is distinctly separate sociologically from the cloud zone vegetation. The diff. spp. readily fall into two groups: species which rarely reach the transitional zone between the *A.-L.* and the cloud zone communities; and species which occur fairly frequently in such transitional zones.

The number of dominant species within the all. is very large. In the lowgrowing stratum of the field layer, either *Hyparrhenia hirta, Avena barbata, Aeonium* spp., *Plantago coronopus* or one of several more or less recently introduced grasses may be dominant. Among the low shrubs of the field layer there may be dominance of either *Lytanthus salicinus,*

Euphorbia piscatoria or *Echium nervosum*. *Opuntia tuna* has frequently supplanted these Macaronesian shrubs and become dominant in several localities. Introduced shrubs such as *Ulex europaeus* and *Sarothamnus scoparius* are also dominant locally.

The group of diff. spp. in common with the coastal all. of the Azores suggests that the *A.-L.* of Madeira and the *Festucion petraeae* of the Azores may eventually be put together to form a higher sociological unit. This may be given the provisional name «*Crithmetalia maritimae*».

The area of the *A.-L.* on Madeira is concentrated along the S coast of the island. The all. is rarely completely developed at altitudes above 300 m. in the S and 100 m in the N. The area of the all. has become very much split up in the densely populated and intensively cultivated zone along the S coast.

The *A.-L.* has an ecological preference for dry habitats strongly exposed to wind and light in which cloud zone species have only a low competitive ability. In such habitats there are comparatively small amounts of precipitation, rarely more than 750 mm per year. There are a large number of sunshine hours per year and mean monthly temperatures range between 15-23°. There is rarely any continuous water supply. Relative air humidity is about 60-70%. Habitats of the *A.-L.* have a similar local climate. The substrata, however, are widely different. The ass. *Euphorbietum piscatoriae (E. p.)* is centered on more or less steep basalt cliffs rich in crevices with accumulated eroded fine material. This ass. has a smaller water supply than the other two associations of the all. The *E. p.* occurs completely developed along the S coast of the island whereas it is rather rare along the N coast, where the frequent supply of water encourages the intrusion of hygrophilous vascular plants and bryophytes, foreign to the *A.-L.*

The *Hyparrhenietum hirtae (H. h.)* occurs on sandy, coarse volcanic soil and covers about the same area as the preceding cliff ass. Water supply throughout the year is larger than the average supply to the *E. p.* but the comparatively small amounts of rain water rapidly penetrate the porous soil. Conditions in the habitats of the *H. h.* are consequently semi-arid and the association can be characterized as a xerophilous or very drought-resistant grass community. It rarely has any bottom layer of bryophytes. The largest areas of the *H. h.* are centered along the S coast, often split into very small areas between fields and villages. There are only small areas along the N coast.

The ass. *Biserrulae-Scorpiurietum (B.-S.)* covers only a small area, centered on the easternmost peninsula S. Lourenço. The community grows on sandy soil mixed with large amounts of fragments of shells, originating from ancient times of submergence of the peninsula. The areas of the ass. are nowadays threatened by extensive severe erosion, caused by the combined action of removal of shrubs, water run off, wind and grazing. The *B.-S.* is still more drought-tolerant than the

Hyparrhenietum hirtae, as precipitation in localities is rarely more than 400 mm/year. The plant cover is very sparse and the dominance of one or two taxa fluctuates frequently, even within a small area.

The zonation of the *A.-L.* breefly described above can be related to the distribution of single differential species. The following species are confined to localities below 100 m (throughout the island):

Crithmum maritimum
Crambe fruticosa
Juncus acutus
Plantago coronopus
Polygonum maritimum
Senecio incrassatus

The following diff. spp. rarely occur above 300 m in the S and 100 m in the N:

Bromus madritensis
Artemisia argentea
Asplenium marinum
Avena barbata
Chenopodium ambrosioides
Echium nervosum
Euphorbia piscatoria
Polypogon maritimus
Silene maritima
Sonchus ustulatus
Tunica prolifera
Gnaphalium luteo-album
Helichrysum obconicum
Hyparrhenia hirta
Matthiola maderensis
Musschia aurea
Opuntia tuna
Phagnalon saxatile
Sedum nudum
Sinapidendron angustifolium
Tolpis fruticosa

The following diff. spp. only rarely occur above 700 m in the S and 400-500 m in the N. Up to these altitudes their frequency in the vegetation decreases successively:

Aeonium glandulosum
Foeniculum vulgare
Lotus subbiflorus
Lytanthus salicinus
Plantago arborescens var.
Sonchus pinnatus

The preceding lists of coastal species indicate that the *A.-L.* reaches its critical altitude at 300 m in the S and at 100 (50) m in the N. Between 300-700 m (S) and 100-400 m (N) there is a level of transition between the *A.-L.* and the cloud zone vegetation. In the S this zonation is especially clear on ridges («lombo, lombadas») between the ravines and river valleys. In the deep river valleys with steep sides, there is a daily intrusion of warm, dry air with the sea breeze, reaching far up into the valleys, sliding on over the cold, more humid air in the bottom of the valleys. These local climatic conditions of stable temperature stratification facilitate the growing of diff. spp. in localities at higher altitudes in the ravines than is general on the ridges. However,

this does not mean that the completely developed *Aeonio-Lytanthion* is much more frequent above 300 m in the ravines than on the ridges. Instead, it has been found that groups of cloud zone taxa are more frequen in the ravines than on the ridges at altitudes between 300-500 m; and groups of coastal taxa at altitudes between 500-700 m. Thus narrow river valleys provide large areas in which the separation of the two large alliances of natural vegetation is much more difficult than on ridges between. The coastal vascular plants extend to somewhat higher altitudes in the valleys in the S, as does the cultivated area, with villages and fields.

The zonation of vegetation on Madeira has already been described by Bowdich (1825), and several subsequent authors; in this paper it has been summarized in table 3. The delimitation of the zones in the N and S of the island was first differentiated by Vahl (1904). The vegetation zones described during the 19th century were only relevant to the S of Madeira. Both the cultivated areas and the original vegetation were included in the descriptions.

Comparison of the limits suggested for the lowest vegetation zone shows a remarkable agreement by all authors that the upper limit of the coastal zone is at altitudes of about 600-800 m. Several botanists consider that the limit of the vegetation nearest the coast is at altitudes below 200-300 m. The «wine region» suggested by Bowdich (1825), with an upper limit at 800 m was, however, a great generalization. The upper limit of the «lower region» of Hartung (1860) at 450-600 m is interesting. It might suggest that cultivation has pushed the low limit of the cloud zone shrub-forest in the S towards slightly higher altitudes during the recent 100 years. Irrigation from new levadas as also run off of water from hydroelectrics has carried cultivation higher and higher up the hillsides. The limitation of the coastal vegetation by Vahl (1904) is similar to mine both for the S and the N of the island. My division is, however, based on two main zones, with the division between them more or less equivalent to the division between Vahl's IIa and IIb and between II and III of Romariz (1957). The coast vegetation in the N of the island has been given more attention by Vahl and Romariz. Earlier botanists have based their descriptions of the vegetational zonation on a combination of qualitative and physiognomic qualities, including also the cultivated plants. My zonation is sociologically based on qualitative differences, which did not allow any further subdivision of the two main zones.

The succession in development of the complete *Aeonio-Lytanthion* seems generally to proceed from a stage consisting of low herbs and grasses to a more soil stabilizing stage, which includes a layer of low shrubs such as *Euphorbia piscatoria* and *Lytanthus salicinus*. Prior to the development of this final, stratified field layer, the primary stage of the *A.-L.* is very susceptible to water- and wind-induced erosion. There is frequently a successional relationship between the associations

Hyparrhenietum hirtae and the *Euphorbietum piscatoriae* along the coasts of Madeira. However, the *Biserrulae-Scorpiurietum* can not be called a pre-stage to the *E. p.* Cessation of soil erosion in habitats of the *B.-S.* would, however, certainly lead to invasion into the ass. by herbs and grasses usually found in the *Hyparrhenietum hirtae.*

In the primary stage of the *B.-S. Plantago coronopus, Mesembryanthemum crystallinum, Lotus macranthus* and *Cynodon dactylon* are frequently recorded. The ass. dominates the plant cover of S. Lourenço, which is now most seriously damaged by erosion of the fine sand deposits. Rainfall on the peninsula is rare and the total amount of precipitation per year is low (+400 mm). Rare abundant rainfalls, however, had heavily eroding ability. Because of the rare rains and the rapid penetration of the rainwater into the porous soil, there is no obvious differentiation between the vegetation of ridges and ravines on the peninsula.

Knowledge about the time of colonization of Madeira is fairly precise, as is knowledge of demographic trends and cultivation methods. Thus the problem of the competition between the natural vegetation and the cultivated man-made areas of the landscape are always attractive to discuss. Since the first half of the 15th century, influences on the *Aconio-Lytanthion* have been essentially of three kinds: 1. Burning, felling and grazing of trees and shrubs round the coasts. 2. Making of fields (building of terraces). 3. Deliberate or accidental introduction of plants for cultivation or ornamentation and of antropochorous, more or less nitrophilous «weeds».

In the first case, the removal of a shrub vegetation, though sparse, certainly provided larger areas for colonization by the *A.-L.* which never develops completely in the shade of trees or a dense scrub. During time of the first colonization of Madeira, *Erica scoparia* was probably a much more frequent shrub at low altitudes than it is now, perhaps together with sparse *Myrica faya. E. scoparia* is even present nowadays but is not frequent at altitudes of about 400 m in the S of the island. In the sandy soil of S. Lourenço there are frequent structures similar to roots encrusted with lime for a long time. The calcareous material originates from the sea shells of molluscs deposited during the time of submergence of the peninsula.

The increasing cultivation of various crops has successively decreased the areas available for the *A.-L.* especially for its ass. *Hyparrhenietum hirtae.* The advance of the cultivated part of the landscape became stabilized and later considerably extended after construction of open aqueducts («levadas») for irrigation purposes had begun. This admirable irrigation system, taking water from the N to the S of the island, now extends for more than 1000 km. It was mainly built during the last 250 years, but constructions started already in the 16th century.

The third kind of change in the natural landscape, caused by

the introduction of a large number of vascular plants, has indeed transformed the original coastal vegetation. However, there are probably only a few species which have recently spread to such an extent that areas of the *A.-L.* have been occupied and the original alliance supplanted. The main species threatening the *A.-L.* nowadays are *Opuntia tuna* and *Eupatorium adenophorum*. The distribution of *Opuntia* is centered on the S coast zone of the island, where this cactus locally reaches total dominance in the *A.-L.* so that there is no more space for development of the shrubs of the all. *Eupatorium* has locally made powerful intrusions into the *Hyparrhenietum hirtae* around all the coasts, especially in the cloud zone vegetation.

Among other very recently introduced species, which are now frequent in the coastal zone should be mentioned especially *Galinsoga parviflora* (cf. Malato-Beliz 1958), *G. ciliata, Erigeron karwinskianus, Senecio mikanioides, Calceolaria chelidonioides* (origin South America — Central America).

The *A.-L.*, especially the ass. *Hyparrhenietum hirtae,* is the Madeiran plant community, which has become the most frequently mixed with a large number of introduced species, often with a south European main distribution. They have taken part in decreasing the areas of the *A.-L.* during recent centuries.

Summarizing the expansion of the cultivated areas of the landscape, it can be assumed, that the areas of natural coastal vegetation decreased considerably from the first colonization of the island until the present day and that this vegetation has gradually been considerably changed qualitatively by the intrusion of introduced species. Areas which still have completely developed *A.-L.* are now confined to localities generally not threatened by further extension of cultivation as for example on steep cliffs and slopes of eroded or deposited volcanic material. There is a fair possibility that areas suitable for the *A.-L.* will be provided in the near future due to intensified cultivation of fields with productivity and permanently available irrigation water from levadas and abandonment of fields with low productivity, situated «above water», namely above the highest situated levadas.

A brief comparison of the coastal vegetation of Madeira *(A.-L.)* and of the Azores Islands *(Festucion petraeae)* has already been made above. There are some further points to be made. The physiognomy of the two coast alliances is very different in the two archipelagos. On Madeira, low shrubs are often dominant. In the Azores, shrubs are rare by the coast, with only two species worth mentioning, *Erica azorica* and *Myrica faya*. On Madeira the grassland coastal ass. is very rich in grass taxa, but in the Azores it is characterized by only a small number. The number of species recently introduced into the coastal vegetation is smaller in the Azores than on Madeira.

The coastal vegetation zone with the *Festucion petraeae* in the

Azores (central islands of the archipelago) extends up to 500 m, where it meets the cloud zone communities. On the eastern islands, however, it reaches altitudes of about 600-700 m, and on the westernmost islands only 200-400 m.

Some comparisons of altitude ranges of diff. spp. are given below: *Tolpis fruticosa* on Mad. generally below 300 m, in the Az. generally below 100 m. *Bromus madritensis* on Mad. generally below 300 m, in the Az. 200 m. *Lotus subbiflorus* on Mad. generally below 400 m (recorded up to 850 m), in the Az. below 300 m (recorded only up to 500 m). *Gnaphalium luteo-album* on Mad. generally below 300 m, in the Az. below 200 m but recorded up to 550 m. *Silene maritima* on Mad. generally below 200 m, recorded up to 300 m, in the Az. below 50 m *Asplenium marinum* on Mad. generally below 300 m, in the Az. below 100 m. *Anogramma leptophylla* on Mad. recorded up to 800 m, in the Az. only up to 500 m. *Chenopodium ambrosioides* on Mad. generally below 300 m, in the Az. below 100 m. *Polypogon maritimus* on Mad. generally below 300 m (recorded up to 450 m), in the Az. generally below 100 m.

These figures suggest that altitude ranges are about 200 m narrower in the Az. than on Mad. This figure seems to apply both to the altitude ranges within which the coastal species have their highest frequency and to the total range, including recorded rare and occasional localities at higher altitudes. The precipitation in the S of Madeira increases from the coast towards the mountains, reaching about 1700-2000 mm per year at 700 m. On the central islands of the Azores precipitation is about 1000 mm per year near the coasts (1070 mm in Horta, Faial) and generally about 1700-1800 mm per year at about 300 m. These differences help to explain differences in the zonation of vegetation between Madeira and the Azorean archipelago. The different climatic conditions in the two island groups are also reflected by the altitude ranges of *Erica azorica* and *Myrica faya*. *Erica scoparia* generally occurs above 450 m (recorded down to 100 m) on Madeira whereas *Erica azorica* generally grows above 300 m in the Azores and has been recorded in several localities down near the coast line. *Myrica faya* is rare below 600 m on Madeira but rarely grows above 500 m in the Azores (recorded in a few localities up to 1000 m).

CLETHRO-LAURION E. Sjögren n. all.

The alliance *Clethro-Laurion (C.-L.)* takes its name from the two tree species *Clethra arborea* and *Laurus azorica*. Both species have high diff. values for the all. They are also frequently dominants in the tree-shrub layer of the community. *Laurus azorica* is indigenous to Macaronesian vegetation («Macaronesian» includes the archipelagos of Madeira and the Azores, the Canary Islands and the Cape Verde Islands,

following the limitation suggested by P. B. Webb). *Clethra arborea* was supposed by Hú (1960) to have been introduced to the island in the 18th century. Records of *C. a.* from quaternary tuffs (lignites), however, contradicts this theory. *C. a.* might thus have been a natural constituent of Madeira cloud zone vegetation a very long time before colonization of the island by man (cf. Sleumer 1967). *Clethra* seems to be similar in competitive ability to other trees and shrubs of the *C.-L.*

The *C.-L.* has also been referred to in this paper as the cloud zone community of Madeira since its most typical development is limited to the altitude range with highest cloud frequency, most precipitation and continuously highest relative air humidity on the island.

The phytocoenose of the *C.-L.* is built up by a tree layer in places where the community has not or only slightly been influenced by man. A shrub laver is almost always present; and has frequently replaced the tree layer. The shrub and tree layer are made up of the same species except where grazing pressure has been severe and has successively eliminated several tree species susceptible to grazing (cf. below). The field layer is rich in species especially on cliffs and steeply sloping ground where water supply is abundant and more or less continuous. A bottom layer of bryophytes, usually with a high degree of cover, is present on slopes of volcanic deposits where permanent water supply is available. However, development of the mosses is frequently mosaic in form depending on soil erosion and on accumulation of slowly mouldering litter from trees and shrubs. In localities with basalt cliffs the phytocoenose always has an epilithic moss cover, very varied in development qualitatively and quantitatively, depending on the exposure of the situation. There is nearly always an epiphytic moss cover, with its development also depending on degree of exposure and on the type of bark. The *C.-L.* is the only alliance which may also have an epiphyllous moss cover in sheltered habitats on leaves of trees and on large bryophytes such as *Thamnium alopecurum*.

In this paper, only the vascular plant fraction of the phytocoenose is described. Some preliminary information from the initial analysis of the bryophyte material collected from the cloud zone vegetation for the purpose of future eco-sociological descriptions, will, however, be included below.

The number of vascular taxa within the completely developed *C.-L.* varies between 15-25 spp. and is usually about 20. There is thus as great a variation as within the *Aeonio-Lytanthion,* depending in both alliances on different amounts of intrusion of occasional mainly antropochorous species, including naturalized introduced species.

The documentation of the cloud zone vegetation was accomplished from slightly more than 400 sample plots. Records were taken after determination of minimum size of the community. The size suitable for

a complete description of the all. was found to be rarely smaller than 20 m² and rarely larger than 30 m² within the cloud zone, and 25 m² was the size generally used for the records. A size of about 30 m² or more was required in habitats at or close to the lower cloud zone limit. The smallest sample plot sizes could be used at slightly exposed habitats within the cloud zone, in which the ass. *Deschampsietum argenteae* (cf. below) of the *C.-L.* is frequently present. Sample plot sizes above 25 m² are generally required in more or less heavily grazed scrub vegetation in areas above the cloud zone from 1300 m up to the highest peaks of the island.

Table 2 includes sample plots selected to represent the total material available. Sample plots are from localities with only slight influence from cultivation and other activities of man and from localities above the regions of transition between the *C.-L.* and *Aeonio-Lytanthion.* Within the *Clethro-Laurion* a few associations have been distinguished. However, these have not been treated separately in sample plots. The presence of associations which could not be further split sociologically was a deciding reason for giving the rank of alliance to all the cloud zone vegetation, including its high altitude grazing land association.

The number of differential species of the *C.-L.* with various high diff. values is large, even more than that for the coastal alliance. Diff. spp. have been sumarized in table 4. They are arranged (table 2) in groups of different values. Nearly half the total number of diff. spp. of the *C.-L.* with high diff. values are endemic to the island of Madeira. More than 75% of the diff. spp. with low diff. values are also endemic. Nine taxa have been mentioned as diff. spp. with high diff. val. both for the *C.-L.* and for the *Juniperion brevifolii* of the Azores.

The *C.-L.* is thus well distinguished by endemic diff. spp. and should be called an endemic alliance to Madeira. There is, however, an obvious connection, also through diff. spp. in common, with the endemic cloud zone all. of the Azores, the *Juniperion brevifolii* (Sjögren 1972). This might suggest a combination of the two alliances within a higher sociological unit, which will here be given the provisional name «*Lauro-Ilexetalia*». In this connection, the fairly large number of taxa in the Madeiran cloud zone vegetation which are represented in the parallel vegetation type in the Azores by taxonomically more or less closely related species, should also be mentioned. A more similar vegetation might have existed in the two island groups in prehistoric times; this later became more and more separated by development of genetically separated subspecies or even species.

In localities along the north coast of Spain, in ravines where precititation is around 1700 mm per year, a plant community with several species in common with the Madeira *C.-L.* and the Azorean *Juniperion brevifolii* (cf. Allorge 1941) has been recorded.

A few associations of the *C.-L.* may also be suggested. In slightly

exposed habitats, generally with a more or less permanent water supply, the all. is often represented by the most hygrophilous association, here called A. *Deschampsietum argenteae (D. a.)* after *Deschampsia argentea,* which is often a dominant species. It is also a diff. sp. with high diff. val. and high frequency in the ass. Other diff. spp. are: *Trichomanes speciosum, Sonchus squarrosus, Euphorbia mellifera, Isoplexis sceptrum.* The *D. a.* is similar in hygrophily to exposure to the *Festucetum jubatae* of the cloud zone vegetation of the Azores. It has the diff. sp. *Trichomanes speciosum* in common with this ass. *E. mellifera* is substituted by *E. stygiana* in the *Festucetum jubatae.* The *D. a.* covers only small areas in the cloud zone vegetation of Madeira. It is extremely rich in species in all vegetation layers. The localities of this ass. which is most susceptible to the influence of man, are of primary interest for protection. The conservation of these localities will always require rather large surrounding guard areas in order to maintain the specialized habitat conditions necessary for the ass. The *D. a* is also charaterized by its abundance of hepatics, often growing epiphyllously on leaves of trees and covering large bryophytes. *Thamnium alopecurum,* for example, is often covered by a light green cover, dominated by *Lejeunea lamacerina.*

The largest area within the *C.-L.* shrub-forest is occupied by the B. *Vaccinio-Sibthorpietum (V.-S.).* The name refers to *Vaccinium maderense* and *Sibthorpia peregrina,* both frequent dominants of the ass., with highest frequency in the cloud zone. This ass. is less rich in species in all vegetation layers than the preceding ass. It has few exclusive diff. spp., e. g.: *Helichrysum melanophthalmum, Cytisus maderensis, Bystropogon maderensis, Arabis caucasica.* A large number of diff. spp. however, are common to the *V.-S.* and the *D. a.,* for example: *Ranunculus cortusifolius, Dryopteris borreri, Elaphoglossum paleaceum, Diplazium caudatum, Woodwardia radicans.*

The ass. *V.-S.* can be considered to be a parallel to the *Erico-Myrsinetum* (Sjögren 1972) of the cloud zone in the Azores. The five above-mentioned diff. spp. are in common for these two associations, and for the hygrophilous *Festucetum jubatae.* The third ass. belongs to the areas above the cloud zone, to the grazed grassland. It has been called C. *Campylopo-Airetum* after the rather drought-tolerant mosses, *Campylopus polytrichoides* and *C. flexuosus* and after *Aira caryophyllea* ssp. *caryophyllea, A. praecox* which all occur with high frequency in the ass. and are often also dominants. *Teesdalia nudicaulis, Aphanes microcarpa, Aira caryophyllea* and the mosses *Campylopus polytrichoides, Scleropodium illecebrum* are among the diff. spp. The *C.-A.* can not be considered as a parallel to the grassland ass. *Anagallidetum tenellae* (op. cit.) of the Azores. There are only a few vascular plants in common on the high altitude grazing land of two island groups.

On the cliffs of the highest peaks of the island, there is also an association, not yet sufficiently studied. This is D. *Ericetum cinereae*

with diff. spp. such as: *Erica cinerea* var. *maderensis, Viola paradoxa,* and the bryophyte *Andreaea rupestris.* Some of the endemic species of Madeira are only found within this ass. but they occur with very low frequency and can not therefore be suggested as diff. spp. These are *Anthyllis lemanniana* and *Armeria maderensis* (not characterizing as stated by Davy de Virville, 1965 b).

From these short descriptions of the cloud zone associations it can be seen that there are some important sociological and ecological similarities to cloud zone associations of the Azores. These similarities between the cloud zone alliances support their eventual combination into the order «*Laurio-Ilexetalia*» suggested above.

The physiognomy of the *C.-L.* is very varied, ranging from the low shrub vegetation of the grazing land to the dense forest-shrub phytocoenose of the cloud zone where there is only a slight influence of man. The shrub and tree layer is generally dominated by *Erica scoparia, Erica arborea, Vaccinium maderense, Laurus azorica* and *Clethra arborea.* The field layer of the grazing land is dominated by such species as *Aira caryophyllea, A. praecox, Agrostis castellana, Pteridium aquilinum, Juncus effusus* and a few bryophyte species. Within the cloud zone with a dense shrub-tree layer, the following species are frequently dominants in the field layer: *Sibthorpia peregrina, Senecio maderensis, Bystropogon* spp., *Phyllis nobla, Blechnum spicant, Selaginella denticulata.* The hygrophilous, only slightly exposed, ravine community has few dominants e. g. *Deschampsia argentea, Woodwardia radicans, Hymenophyllum tunbridgense.* Among dominant bryophytes in the open grassland are *Campylopus polytrichoides* and *Scleropodium illecebrum.* Species of the genera *Porella, Neckera, Reboulia, Fissidens, Frullania, Metzgeria, Anthoceros, Plagiochila, Radula, Diplophyllum, Echinodium,* for example are dominants in the dense *Erica-Laurus shrub-forest;* and *Thamnium alopecurum, Philonotis rigida, Mnium undulatum, Conocephalum conicum, Dumortiera hirsuta, Myurium hebridarum, Lunularia cruciata* are frequent dominants in the hygrophilous *Deschampsietum argenteae.*

The cloud zone as well as the coast zone has recently become invaded by several introduced taxa, which have shown a very strong ability to infiltrate under the competitive situation originally prevailing. Thus in large areas of the typical field layer vegetation of the cloud zone the original species have been taken over, especially by *Eupatorium adenophorum,* originating from moist mountain forests in Central America (cf. Krauss 1963). This species has also become a pest in Hawaii, together with *Eupatorium riparium. Erigeron karwinskianus,* originating from Mexico, is also a nowadays most frequently established introduced species. It grows on volcanic deposits and on cliffs from the coasts up to altitudes of about 1000 m. The species is very drought-tolerant but grows also in habitats with a permanent water supply. The invasion into Madeira and the Azores took place recently and became especially pronounced in

the cloud zone vegetation of both. *E. karwinskianus* was mentioned by Menezes (1914) only from two localities, Monte and Gorgulho (cf. Hansen 1968). *Eupatorium adenophorum* has been observed from the coasts up to 1090 m and it will eventually also be recorded at higher altitudes. This species grows on volcanic deposits and also in the crevices of cliffs. It has a fairly high drough-tolerance. The invasion of Madeira and the Azores by *Eupatorium* is also recent. It grows also in Canarian cloud zone vegetation (cf. Schmied 1954). The most severe threat to the original cloud zone vegetation has developed on Madeira, where the species was already frequent over a wide altitude range 100 years ago (cf. Lowe 1868). Azorean cloud zone vegetation has also been invaded by *Eupatorium* and *Erigeron* including *Hedychium gardnerianum,* which has a very high competitive ability. Rencent invasion of *Lantana camara* is also very serious. Further spread of this shrub on Madeira should be carefully prevented. Also the further escape from gardens of *Hedychium* into natural vegetation of Madeira should be prevented (cf. Hansen 1968).

The *Clethro-Laurion* occurs on a wide range of substrata. It grows on fine to coarse volcanic deposits also in crevices of the basalt cliffs. The grassland ass. *Campylopo-Airetum* grows preferentially on fine material, deposited or eroded. The *Vaccinio-Sibthorpietum* and the *Deschampsietum argenteae* grow on fine or coarse material or in habitats with bare, steeply sloping cliffs; whereas the peak ass., *Ericetum cinereae* seems to be restricted to coarse material and crevices on cliffs. The *D. a.* is strongly hygrophilous and requires e continuous water supply. The *V.-S.* is less hygrophilous and not so dependent on the presence of continuous water supply. The two other associations, confined to areas above the cloud zone, are moderately drought-resistant.

The *Clethro-Laurion* requires at least 1700 mm precipitation per year and RH values which are almost permanently above 85%. The open grassland and the very exposed cliffs above the cloud zone have precipitation of more than 2000 mm per year but exposure, soil erosion, absence of a dense shrub-forest layer and rapid penetration of rain water into the porous soils result in much lower water content in the soils of the high plateaus than in the cloud zone even if precipitation is the same. The RH is also generally lower in the open grassland scrub than in the cloud zone (registrations by the author).

Substratum preference of the *C.-L.* in the cloud zone is weak. It becomes successively stronger towards the lower limit of the all., with increasing preference for fine sandy soils with moderately high water holding capacity. Exposure (direction, slope, presence of shading trees) also becomes more and more important towards the edges of the altitude range of the all. Permanent supply of water also strongly favours the presence of scattered areas of the *C.-L.* at edges of the altitude range, though not required, except for the *Deschampsietum argenteae,* in the central parts of the cloud zone.

Studies of the zonation of communities and of their differential species have led to the determination of the limits of the cloud zone vegetation which are correlated with the precipitation and air humidity values mentioned above. The *Clethro-Laurion* has its lower limit at about 700 m in the S of Madeira and at about 300 m in the N. Single diff. species have been recorded down to 300 m even in the S, and down to the coast in the N of the island. The upper limit of the shrub-forest part of the alliance is at 1200 m in the S and at about 1300 m in the N. The roof of the cloud stratum is generally situated at 1400 m. There are diff. spp. extending this altitude rang thus linking the scrub-grassland and high peak cliff vegetation with the cloud zone alliance. The natural range of the original dense shrub-forest vegetation *(C.-L.)* has certainly been narrowed by the expanding areas of cultivation below and the expanding areas of grazing land above. The original extent might, however, not have been much more than 100 m downward and 100-200 m upward, where exposure has probably always been a limiting complex ecological factor. The shrub vegetation covering Madeira in the S down to the coast which was met upon in the year of 1420, the year of discovery of the island by the Portuguese, probably consisted of an *Erica* scrub with *Myrica,* rather poor of cloud zone species (cf. Alcaforado 1671).

The vegetation zones suggested by some botanists since the beginning of the 19th century, have been summarized in table 3. The zones first suggested included components from both the cultivated and the natural areas of landscape (Bowdich 1825, Hartung 1860, Lowe 1868). The «*Sarothamnus* region» with abundant *Erica* mentioned by Bowdich came in between the «Wine-region» and the «*Vaccinium-Laurus* region». It might have been a physiognomic reality before of forest plantations *(Pinus pinaster, Eucalyptus* spp., *Acacia* spp.). His lower limit of the *Vaccinium-Laurus* zone (III) and the lower limit of the grass region (IV) have been set at altitudes, which are too high. The zonation suggested by Hartung is of some interest in relation to the present situation. The low position (450-600 m) of his «high forest region» (II) might suggest a wider altitude range for the *Clethro-Laurion* 100 years ago, due to being the smaller extent of cultivation. Region III was a low forest region, which might suggest a less overgrazed landscape than there is now.

In contrast Lowe (1868) sets the lower limit for the *Clethro-Laurion* (II) at 750 m. However, Lowe, like Hartung, did not indicate that there was an overgrazed zone above III; this again suggests the probability that the development of the badly eroded grassland is the result of only a relatively short period of overgrazing, probably of not more thans 100 years. The zonation as described by Vahl (1904) and Romariz (1957) is the first to stress of the differences between the N and S of the island. The limit between II a and II b (600 m) is equivalent to the lower limit for the *Clethro-Laurion* suggested in this paper. Romariz puts this limit at 750 m. My upper limit (1200 and 1300 m) of

the shrub-forest is the same as that indicated by Vahl and Romariz.

There is thus an indication that the lower limit of the cloud zone vegetation has changed from 450 m (Hartung) to 600 m (Vahl) and 770 m (Sjögren). It is of course dangerous to draw any definite conclusions from these three zone limits, but it seems probable that the *Clethro-Laurion* formerly extended at least 100 m lower than it does now. The description by Bowdich, (1825, p. 55), Hartung and Lowe of the vegetation at altitudes above the cloud zone suggests that it is very probable that there were more moderately grazed scrub areas with isolated trees one hundred years ago than there are now. *

Irregularities of the lower limit of the *C.-L.* coincide with the irregualarities of the upper limit of the *Aeonio-Lytanthion*. Because the topography of the island is characterized by a large number of

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* The bioclimatic vegetation zones suggested by Dansereau (1966) should be treated below. They are generally characterized by a few shrub and tree species and are thus not phytosociologically (phytocoenotically) related. Dansereau has distinguished 6 «formations locales»:

1: «Savane littorale» (0-200 m), characterized by *Olea europaea* var. *maderensis, Sideroxylon marmulano, Dracaena draco, Andropogon hirtus*. Only *Andropogon* can now be attributed a characterizing value as the other species are very rare and localities very scattered. 2: «Forêt-parc» (0-600), characterized by *Apollonias barbujana* and *Myrica faya*. *Appolonias* is now a rare shrub of no characterizing value. *Myrica* with frequent and often abundant localities in the cloud zone has no characterizing value for the altitude range 0-600 m. 3: «Forêt ombrophile de lauriers» (400-1300), characterized by *Laurus azorica, Ocotea foetens, Clethra arborea* and *Prunus lusitanica*. Altitude limits suggested for this zone are only valid for the N of Madeira. *Prunus* is too rare to be attributed any characterizing value. 4: «Savane à genévriers» (1300-1600). This zone has been called dry, which is hardly correct considering its high annual precipitation, high RH values and high cloud frequency. It has been characterized by *Juniperus oxycedrus* ssp. *maderensis*, a species now almost extinct on Madeira. *Juniperus* was probably originally a frequent constituent of Madeiran cloud zone vegetation, but probably also below 1300 m. *J. brevifolia* of the Azores is a frequent cloud zone constituent in *Erica-Laurus* scrub. 5· «Maquis à bruyère» (1200-1500), characterized by *Erica scoparia, Vaccinium maderense, Sorbus aucuparia* var. *maderensis* and *Berberis maderensis*. The frequent presence of *Erica* and *Vaccinium* in the cloud zone below 1200 m means a low characterizing value for these species for the altitude range mentioned. *Sorbus* and *Berberis* are now two of the rarest species on Madeira. *Laurus* is frequently decimated by grazing animals between 1200-1500 m but several scattered localities can still be recorded there. 6: «Désert froid» (1300-1861), characterized by *Erica cinerea, Viola paradoxa* and *Armeria maderensis*. These rare species should be attributed only to altitudes above 1600 m. They have no physiognomic characterizing value: *Erica cinerea* may have been much more frequent at high altitudes before the period of overgrazing.

Fig. 2 showing the situation of Dansereau's bioclimatic zones (op cit., p. 786) gives a wrong impression of the situation of the vegetation zone limits of Madeira: The lower limit of the cloud zone vegetation with *Laurus-Ocotea-Clethra* is in fact situated higher in the S than in the N. The coastal *Andropogon* zone has a much narrower altitude range in the N than in the S. Vegetation zones at high altitudes as drawn in this fig. have no actual relevance on Madeira (cf. above).

deeply incised river valleys (cf. fig. 1) the altitude range of the *C.-L.* does not strictly follow any fixed contours.

There are small outlying areas of cloud zone vegetation at altitudes far below 700 m in several localities, particulary in the river valleys in the S of the island. Small groups of diff. spp. and single diff. spp. are frequently found even down to 300 m in these river valleys, in which cold air is accumulated along the valley bottoms for several hours of the day. A stable stratification of temperatures results. These conditions also lead to higher RH values and less insolation because of cloud formation at the bottom of the deepest valleys than high up on the valley slopes. Suitable ecological conditions for the *C.-L.* which are generally found at about 700 m on ridges («lombo») in the S of the island, are thus available at 500 m in several deep valleys. These irregularities in the position of the base limit for completely developed *C.-L.*, much less pronounced in the N, are to a large extent now obscured in the southern valleys. Colonization and cultivation began in the valleys, as they offered easier access from the coast to the inland of the island than the ridges between.

Both for the coastal *(Aeonio-Lytanthion)* and for the cloud zone all. it is true to say that the preferred altitude range for the communities is distinctly narrower than for their individual diff. spp. Thus several of the diff. spp. of the *C.-L.* have the lower limit of their preferred altitude range 100-200 m lower than that of the all. The lower limit of the cloud zone vegetation on the central islands of the Azores is about 200 m lower than that similar vegetation on Madeira (S part). Precipitation is more or less the same at 700 m on Madeira (S part) and 500 m in the Azores (islands: Pico, Faial, S. Jorge). Several diff. spp. of the cloud zone vegetation of the two archipelagos thus also have the lower limit of their preferred altitude range lower in the Az. than on Mad.

The following species have the lower limit of their preferred altitude range at 500 m in the central part of the Az. Corresponding altitude on Mad. (S part) in (-):

Huperzia selago spp. *selago*	(600)
Culcita macrocarpa	(700)
Hymenophyllum tunbridgense	(600)
Trichomanes speciosum	(600)
Dryopteris borreri	(700)
Elaphoglossum paleaceum	(600)
Ranunculus cortusifolius	(700)
Laurus azorica	(600)
Ilex perado	(600)
Luzula purpureo-splendens	(700)

Lower limit of preferred altitude range in the central Az. 400 m, on Mad. (-):

Phyllitis scolopendrium	(700)
Diplazium caudatum	(700)
Dryopteris aemula	(800)
Woodwardia radicans	(600)
Carex peregrina	(700)
Potentilla anglica	(700)

Vaccinium cylindraceum: preferentially above 400 m in the central Az., *V. maderense* preferentially above 700 m on Mad. *Polystichum setiferum:* in central Az. preferentially above 200 m, on Mad. 700 m. *Rubia angustifolia:* in central Az. preferentially above 300 m. on Mad. 600 m. The differences in local climate are the reason for the lower limit of the *C.-L.* being about 400 m lower in the N than in the S of Madeira. Altitudes of about 700 m in the south have the same precipitation as altitudes of about 300-400 m in the north. These climatic differences also influence the position of the lower limit of the preferred altitude ranges of the diff. spp. Some examples follow below, with altitudes for the S and the N:

	S	N
Blechnum spicant	500	50
Carlina salicifolia	400	50
Cedronella canariensis	750	100
Chrysanthemum mandonianum	600	100
Clethra arborea	400	200
Culcita macrocarpa	700	250
Cytisus maderensis	300	100
Erica scoparia	450	200
Erica arborea	650	400
Euphorbia mellifera	700	400
Gennaria diphylla	600	300
Geranium anemonaefolium	700	500
Hypericum grandifolium	400	100
Laurus azorica	600	200
Polystichum setiferum	700	400
Rubus grandifolius	600	400
Sonchus squarrosus	500	300
Vaccinium maderense	700	400

Records of the zonation of single taxa also helped to establish the transition zone between the *C.-L.* and the *Aeonio-Lytanthion* (S: 300-700 m. N: 100-300 m). The *A.-L.* contains several taxa which do

not occur above 300 m (S) and also several taxa with a scattered distribution up to altitudes of about 700 m, and 400 m in the N. There is also a group of taxa which are distinctly most frequent below 700 m with occasional localities up to altitudes above the cloud zone. In the *Clethro-Laurion,* there is one group of taxa which generally occur above 600-700 m in the S but occasionally recorded down to 300-400 m:

Arabis caucasica
Festuca donax
Ilex canariensis
Polystichum setiferum
Tolpis macrorhiza
Rubia angustifolia
Helichrysum melanophthalmum
Laurus azorica
Saxifraga maderensis
Erysimum mutabile

The following cloud zone taxa generally occur above 300-400 m in the S with a distinct increase in frequency above 600-700 m:

Hypericum glandulosum
H. grandifolium
Phyllis nobla
Rumex maderensis
Senecio maderensis
Sibthorpia peregrina
Teucrium betonicum
Bystropogon maderensis
Agrostis castellana
Adiantum reniforme
Aichryson divaricatum
Bupleurum salicifolium
Carlina salicifolia
Hedera canariensis
Clethra arborea
Erica scoparia

The following cloud zone taxa have localities in the transition zone in the N of the island, extending down to 100-50 m with decreasing frequency:

Hypericum grandifolium
Phyllis nobla
Cedronella canariensis
Rubus grandifolius
Dryopteris aemula
Chrysanthemum mandonianum
Cytisus maderensis

The successional sequence within the *Clethro-Laurion* has been examined. Within the ass. covering the largest areas *(Vaccinio-Sibthorpietum),* the natural sucessional cycle is regulated by wind-felling of trees, by landslides on slopes after unusually heavy rains or periods of drought and by burning after lightning. The influence of man on the succession consists of the felling of trees and cutting of shrubs, burning and grazing. The natural successional sequence at first seems to influence comparatively small areas of the stabilized *V.-S.* The recolonization of fine-coarse volcanic deposits after landslides within cloud zone vegetation proceeds very rapidly, beginning with moss cover after a few years. The subsequent stages include colonization by drought-tolerant

species, which are frequently replaced by hygrophilous taxa after development of a densely shading layer of ferns such as *Dryopteris aemula, Diplazium caudatum, Pteris arguta, Polystichum setiferum* and *Woodwardia radicans*. Natural reforestation nowadays seems generally to start with *Erica scoparia, E. arborea and Vaccinium maderense,* closely followed by *Clethra arborea* and *Laurus azorica*. In the final stage, when there is only little instability in the vegetation strata, there is slight suppression of *Vaccinium* and *Erica*.

The effect of man on original cloud zone vegetation has been concentrated on the felling of trees and shrubs where access is not too difficult, for wood for building and fuel. Burning and total clearing were also frequent methods to make or imrove grazing land available at altitudes above the cloud zone. In recent clearings, the natural succession of the cloud zone forest has often been obscured and disturbed by invasion by introduced species with high competition ability. Such species as *Ulex europaeus* (introduced at the beginning of the 19th century, and reported by Bowdich, 1825, from altitudes 650-1000 m), *Sarothamnus scoparius* (cf. Menezes 1903, p. 23) and *Eupatorium adenophorum* frequently invade clearings in the cloud zone shrub-forest and also areas where cultivated forests e. g. of *Pinus pinaster* (introduced at the end of the 18th century), have been clear-felled. Recolonization by natural *Erica-Vaccinium-Laurus* shrub-forest seems to be most delayed in these large modern clearings.

The succession of the low sparse *Clethro-Laurion* grassland scrub at high altitudes, where grazing suppresses or eliminates the shrubs, is influenced by erosion to some degree. The natural succession would lead from a bryphyte-grass stage to a grassland with a few herbs, finally colonized by a low scrub of *Erica-Vaccinium,* with less *Laurus* and *Clethra* than down at the cloud zone level. However, the scrub-grassland mosaic of the high plateaus and high peaks is now overgrazed nearly everywhere. Scrubs are frequently restricted to ravines and steep slopes (fig. 12) not accessible to the grazing animals, usually sheep.

The first stage of overgrazing, before erosion, strongly influences the qualitative composition of all the layers of the vegetation. It causes a successive decrease in the number of species in all. strata. *Laurus* and *Vaccinium* disappear before *Erica* spp. from the shrub layer. The elimination of *Laurus* by grazing animals was mentioned also by Schmied (1954) from the Canary Islands. Herbs become rare between the shrubs, where they are replaced by grasses. The number of bryophytes on all kinds of substrata becomes successively lower. Field layer on the overgrazed high plateau of Paul da Serra is now dominated by *Pteridium aquilinum* (cf. fig. 15). *Thymus cespititius* has become extensively extinct by grazing animals during the last 70 years (cf. Menezes 1903, p. 23).

The bryophyte component in the grassland increases with increasing grazing pressure. On slopes of more than 30%, erosion frequently

starts when bryophytes have reached a degree of cover of more than 50%. Erosion often seams to start with the formation of horizontal steps on these slopes (fig. 8). Further heavy grazing aggravates the erosion damage. Small erosion holes might initiate a landslide erosion of all the plant cover. The slide starts from a relatively small erosion wound or crack in the grass carpet and often expands considerably down the slope. The bare soil surface often becomes seriously damaged in respect of recolonization by rapid removal of the fine soil by run off water (fig. 10).

The rate of succession on natural and man-made strongly exposed cuttings through deposits of fine-coarse soil has been observed. Soil slopes above 1000 m in the S part of the island inclined more than 50% and very exposed to the N generally already have a sparse moss cover of *Philonotis rigida* and *Saccogyna viticulosa,* for example, after 2 years. This moss cover has a high degree of cover after 4 years, when the stage of invasion of vascular plants starts, frequently by colonization by *Selaginella denticulata.* At lower altitudes the successional sequence on bare surfaces proceeds at a lower rate. For example, at about 600 m moss invasion in similar conditions as above will start only after 4-5 years. These rates of sucession could easily be followed where roads had been made and the age of the cuttings could be exactly determined. Cuttings through volcanic deposits become more evenly colonized by bryophytes and vascular plants if the soil consists of fine coarse material. Erosion damage, on such slopes is less common than on pure sand slopes. The bryophyte cover on pure sand is also frequently lost after only a few years of colonization, as a result of alternate abundant water supply to the surfaces and drying out of the surfaces (fig. 11).

The succession within the *Ericetum cinereae* does not include any primary bryophyte stage. The ass. is confined to rough cliffs with many crevices and small shelves where soil can accumulate. No dense shrub layer develops as a final stage; there are only sparsely growing low shrubs, generally within the field layer.

The cloud zone vegetation of the island has long been subject, and is now permanently subject, to strong pressure from the influence of man. The Macaronesian cloud zone vegetation has been studied by botanists for two centuries from a taxonomic viewpoint with the aim of making as complete a flora list as possible. A few suggestions of vegetation zonation have also been published, but eco-sociological descriptions were almost completely absent. A vast field for further rising interest in preservation of Macaronesian natural vegetation lies in the still incomplete scientific documentation of the flora and vegetation.

The Madeiran natural vegetation is made up of a large number of more or less rare species, endemic to the island or to Macaronesia. Communities are endemic to Madeira. The distribution of several endemic taxa has decreased during the last 100 years. *Juniperus cedrus* and

Taxus baccata are now almost extinct on the island and *Picconia excelsa, Ocotea foetens* and *Persea indica,* restricted to the cloud zone vegetation, have recently become rare trees. Records of succession within both the coast and cloud zone vegetation have revealed a pronounced susceptibility to the influence of man. Regeneration after overgrazing and the complete clearing of large areas is very slow and is very much delayed by the intrusion of introduced species with high competition ability, foreign to the natural vegetation. It should also be stressed that the remaining cloud zone vegetation on Madeira and in the Azores is a valuable resource for scientists concerned with vegetation history. This vegetation should be called a relict vegetation. It contains several taxa related to constituents of a tertiary south European vegetation type which covered large areas (cf. Depape 1922 and 1928, Ciferri 1962 and Sunding 1970, p. 253). Eco-sociological botanical investigations are always facilitated if natural vegetation, as little influenced as possible by man's activities, is available in an area for comparison.

The demographic development on Madeira in the 20th century suggests an eventual rising pressure against the remains of natural vegetation. Urgent action is required to protect areas of natural landscape at all altitudes, offering resources for further scientific investigations.

It would not be useful to protect a large number of scattered small areas. Concentration on a few large areas composed of parts subject to different degrees of protection would be more realistic. It would then be possible to surround areas with the strictest protection by the required guard areas. Improved facilities to maintain ecological conditions unchanged within the small areas with the strictest protection will be provided.

Some kind of regulation of grazing pressure above the cloud zone is also urgent, to protect soil and vegetation. Complete protection from grazing of the highest peaks, with vegetation most susceptible to grazing, should be arranged if possible. The ass. *Ericetum cinereae* contains several very rare endemic taxa which are now on the verge of extinction. In 1940 the number of grazing goats was 19.800 and the number of sheep 16.500 (Ribeira 1949, p. 117). Largest number of these animals were probably kept at altitudes above 1300 m in the scrub-grassland. The grazing pressure was at that time probably at least 3 animals (goats + sheep) per hectare. The grazing land above the cloud zone might today stand a grazing pressure by goats-sheep of 1 animal per hectare, locally much less.

Detailed control of escaping introduced plants should also be included in the programme for conservation on the island. Planting of such spp. as *Hedychium gardnerianum* and *Hydrangea macrophylla*

should be avoided and these species should if possible be cleared from places where they are already established in the cloud zone vegetation. These two species introduced to the Azores islands together with *Lantana camara,* are now a severe threat to the natural cloud zone vegtation there.

Table 1. — Explanation (abbreviations on p. 52)
Size of sample plots 25 m².
Localities:
1. Monte da Piedade, S. Lourenço. Sandy volcanic deposits, heavily grazed grassland, E-facing slope. 27.4.66. — 2, 3. Porto Novo. NE-facing vertical lava cliffs. 4.5.66. — 4. Faial. Vertical cliffs W-facing. 14.5.66. — 5. Porto da Cruz. Slope with mainly coarse volcanic deposits, N-facing. 14.5.66. — 6. S. Jorge. N-facing coast cliffs 9.6.66. — 7. Ponta do Sol. Coarse volcanic deposits close to the coast line. S-facing. 21.6.66. — 8. Estreito de Câmara de Lobos. In N-S ravine. Cliff slopes slightly exposed, W-facing. 25.6.66 — 9. NW of Porto Moniz. Coarse coastal lava cliffs with sparse deposition of eroded material. 2.7.66. — 10. SE of Calheta. Coarse volcanic deposits, slope S-facing. 3.7.66. — 11, 12. NW of Porto Moniz. Coast cliffs with deep deposits of eroded material. 2.7.66. — 13. N of Rib. Brava. River valley, on very exposed cliffs, E-facing. 5.7.66. — 14. Rib. do Inferno. Mouth of ravine running N-S. On E-facing vertical cliffs. 25.1.67. — 15. S. Vicente. Vertical coast cliffs, E of river mouth, N-facing. 24.1.67. — 16. To the W of lower part of Rib. dos Moinhos. Vertical cuttings through coarse volcanic deposits, exposed towards E. 24.1.67. — 17. Arco S. Jorge. N-facing cliffs. 24.1.67. — 18. Path to lev. do Moinho, just S of Fajã do Limão. Cuttings through coarse volcanic deposits. 14.1.67. — 19. Ponta do Sol, mouth of valley, path to lev. do Moinho. W-facing cliff slopes. 14.1.67. — 20. E of Rib. Brava. Coast cliffs, S-facing. 7.1.67. — 21, 22. W of the river, Boaventura, path close to the Rib. do Porco. On steep cuttings through volcanic deposits, E-facing. 7.2.67.
Differential species:
a. Diff. spp. of the *Aeonio-Lytanthion*.
b. Diff. spp. with low diff. val. of the *Aeonio-Lytanthion* towards the *Clethro-Laurion*.
c. Diff. spp. of the *Aeonio-Lytanthion* and the Azorean all. *Festucion petraeae*.
d. Low diff. val. of the alliances in c.
e. Accompanying spp. (cf. also below table)

Table 1. AEONIO - LYTANTHION

Number of species	8	12	9	13	11	10	22	10	17	12	9	18	17	17	12	17	14	14	10	12	15	18
Altitude (m)	50	50	50	10	10	50	50	300	50	20	100	20	30	50	50	50	420	250	240	10	250	180
Sample plot No. in table	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
a.																						
Hyparrhenia hirta	x	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Euphorbia piscatoria	–	x	x	–	–	–	x	–	–	x	x	x	x	–	–	–	–	x	–	x	–	–
Lytanthus salicinus	–	x	x	–	–	–	–	–	x	x	–	x	x	x	–	x	x	x	x	–	x	x
Echium nervosum	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–
Opuntia tuna	–	–	x	–	–	–	x	–	–	x	–	–	x	–	–	x	–	–	x	–	–	–
Sedum nudum	–	–	–	x	–	–	–	–	x	–	–	x	–	–	x	x	–	–	–	–	–	–
Sonchus ustulatus	–	–	–	x	–	–	x	x	–	–	–	–	–	x	–	–	–	–	–	–	–	–
Avena barbata	–	–	–	x	x	–	x	x	x	–	–	–	x	–	–	–	–	–	–	–	–	–
Plantago arborescens v. mad.	–	–	–	–	–	–	x	–	–	–	–	x	–	x	x	x	–	–	–	–	–	–
Helichrysum obconicum	–	–	–	–	–	–	–	–	x	–	x	–	–	x	x	x	x	–	–	–	–	–
Crambe fruticosa	–	–	–	–	–	–	–	–	–	–	–	x	–	–	x	–	–	–	–	–	–	–
Artemisia argentea	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Matthiola maderensis	–	–	–	–	–	–	x	–	x	x	x	x	–	–	–	x	–	–	–	–	–	–
b.																						
Aeonium glandulosum	–	x	x	x	–	x	x	x	x	x	–	x	x	x	–	x	x	x	x	x	x	–
Aeonium glutinosum	–	–	–	–	–	x	x	x	–	–	x	x	x	x	x	x	x	–	x	–	x	x
Mesembryanthemum crystallinum	–	–	–	–	x	–	x	–	–	–	–	–	–	–	–	x	–	–	–	–	–	x
Sonchus pinnatus	–	–	–	–	–	–	–	–	–	x	–	–	x	–	–	x	–	–	–	x	–	–
Mesembryanthemum nodiflorum	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–
Tunica prolifera	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
c.																						
Tolpis fruticosa	x	x	–	x	x	–	x	x	x	–	x	x	x	–	x	x	x	x	x	x	–	–
Plantago coronopus	x	–	–	x	x	–	x	–	–	–	x	x	–	–	–	–	–	–	–	–	–	–
Crithmum maritimum	x	–	–	x	x	–	x	–	–	–	–	x	–	–	x	–	–	–	–	x	–	–
Atriplex triangularis	–	–	x	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Bromus madritensis	–	–	–	x	x	x	–	x	x	x	–	–	x	–	–	–	–	–	–	–	–	–
Lotus subbiflorus	–	–	–	–	x	–	x	–	–	–	x	–	–	–	–	–	–	–	–	x	–	–
Gnaphalium luteo-album	–	–	–	–	x	x	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Silene maritima	–	–	–	–	–	–	x	–	–	x	–	x	–	–	–	–	–	–	–	x	–	–
Asplenium marinum	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	x	x
Juncus acutus	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
d.																						
Erica scoparia	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	x	
Myrica faya	–	–	–	x	–	–	–	–	x	–	–	–	–	–	–	–	x	–	–	–	–	x
Foeniculum vulgare	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	x	–	–
Cytisus maderensis	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	x	–	–	–	–
Sibthorpia peregrina	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	x	x
Polypodium australe	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	x	x
Umbilicus rupestris	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	x	–	x	x
Hypericum grandifolium	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	x	–	–	–	–	–	x
Aichryson divaricatum	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	x	–	–	–	–
Hypericum glandulosum	–	–	–	–	–	–	–	–	x	–	–	–	–	x	–	x	–	–	–	–	–	–
Rumex maderensis	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	x	–	x	x
Brevipodium silvaticum	–	–	–	–	x	x	–	–	–	–	–	x	x	–	–	–	–	–	–	–	–	–
Andryala glandulosa ssp.	–	–	–	x	x	–	–	–	–	–	x	x	–	–	–	–	–	–	–	–	–	–
Phyllis nobla	–	–	–	x	–	x	x	x	x	–	x	x	x	x	x	x	x	–	–	x	–	x
Adiantum capillus-veneris	–	x	–	–	–	–	x	–	–	–	–	x	–	x	–	x	–	–	x	x	–	–
Setaria sp.	–	x	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Helichrysum foetidum	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	x	–
Selaginella denticulata	–	x	–	–	–	–	–	–	–	–	–	–	–	x	–	–	x	x	–	–	–	–
Davallia canariensis	–	x	–	–	–	–	–	–	x	–	–	x	–	–	–	–	x	x	x	–	x	x
Psoralea bituminosa	–	x	–	–	–	–	–	x	x	–	–	–	x	–	–	–	–	–	–	x	–	–
Euphorbium adenophorum	–	x	–	–	–	–	–	–	–	–	–	–	x	x	–	x	–	–	–	x	x	x
Briza maxima	x	x	–	x	–	x	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–
Echium plantagineum	x	–	x	–	–	–	–	–	x	x	–	–	–	–	x	–	–	–	–	–	–	–
Bidens pilosa	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	x	–
Adiantum reniforme	–	–	–	–	–	–	–	x	–	–	–	x	–	x	–	–	–	x	–	–	–	–
Aichryson villosum	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	x	–
Hedera canariensis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	x	–	–	x

Accompanying species with low cover degree, only recorded from one of the sample plots. No. in (-):
Lotus macranthus (1), Erigeron karwinskianus (22), Myrtus communis (21), Asplenium trichomanes (22), Asplenium onopteris (22), Cynodon dactylon (5), Erysimum mutabile (10), Deschampsia argentea (14), Hypericum undulatum (18), Sideritis massoniana (18), Rubus ulmifolius (17), Juncus effusus (15), Woodwardia radicans (14), Ammi majus (14), Linaria cymbalaria (10), Wahlenbergia nutabunda (6), Rumex bucephalophorus ssp. (17), Digitalis purpurea (4), Leontodon saxatilis (1), Ulex europaeus (6), Linum strictum (6) Briza minima (7), Silene gallica (9), Sarothamnus scoparius (13), Galium parisiense (13), Dactylus glomerata ssp. (15), Clinopodium vulgare ssp. villosa (17).

Table 2. — Explanation (abbreviaitions on p. 00)
Size of sample plots 25 m².
Localities:
1. W slope of Vale da Rib. da Janela. Close to the new lev. 30.6.66. — 2. Rib. da Ametade. Close to lev., cliffs S-facing 20.2.65. — 3. Casa das Queimadas. Slightly exposed cutting through coarse volcanic deposits, narrow ravine 26.2.65. — 4. Vale da Lapa, N of Lombo dos Pecegueiros 5.3.65. — 5. Rib. da Ametade, close to tunnel entrance. On S-facing cliffs. 20.2.65. — 6, 7. Rib. Frio, lev. to Balcões. On NE-facing cliffs, 12.5.66. — 8. Rib. Frio. Cliffs and coarse volcanic deposits by the lev., towards Portela, NW-facing. 5.6.66. — 9. Rib. Frio, lev. to Balcões. Close to the lev., in ravine with small rivulet. Very slight exposure. 18.6.66. — 10. Lev. do Faial towards S from road Santo da Serra to Poiso. Soil cutting by the lev., exposed towards SE. 19.6.66. — 11. E of Queimadas, close to the lev., NE-facing soil cutting, slightly exposed. 24.6.66. — N slope of Vale da Rib. do S. Jorge. Slightly exposed loc., shaded by *Pinus-Eucalyptus* plantations. 28.6.66. — 13. New lev. on W slope of Vale da Rib. da Janela. In slightly exposed ravine close to the lev. 30.6.66. — 14. Above and to the S of Porto Moniz. Ravine at the margin of small high-plateau. 1.7.66. — 15, 16. Vale da Lapa. Close to the new lev. on N-facing slopes where water supply is continuous. 19.7.66. — 17. N of Poiso. N-facing cliffs to the S of the bridge over Rib. da Ametade. 10.7.66. — 18. Close to the N of Poiso. W-facing cliffs, where water supply is continuous. 10.7.66. — 19. N of the Encumeada pass point. Close to the road from Encumeada to S. Vicente in slightly exposed ravine. 5.7.66. — 20. Just NE of the Encumeada pass point. Locality slightly exposed, N-facing. 5.7.66. — 21. Lamaceiros. Locality slightly exposed, N-facing. 31.12.66. — 22. Lev. do Moiro towards lev. da Tabua. Cuttings through volcanic deposits. 7.1.67. — 23. Close to the upper, old lev. in Vale da Rib. da Janela, W slope of the valley. E-facing slopes, slightly exposed, where water supply is continuous. 27.1.67. — 24. Pass point of Encumeada, close to the lev. towards W. S-facing cliffs. 23.2.67. — 25. W of pass point of Encumeada, to the N of the first tunnel. N-facing slopes, slightly exposed where water supply is continuous. 28.2.67. — 26. W slope of Vale do Seixal. Slightly exposed, NE-facing slopes. 22.2.67. — 27. Paul da Serra, close to Rib. do Risco. 22.2.67. — 28. Lev. close to the S of Rib. do João Fernandes, Boaventura. N-facing slopes on volcanic deposits, continuous water supply. 7.2.67. — 29, 30. Boaventura, small tributary to Rib. do Porco. E-facing slopes of volcanic deposits. 7.2.67. — 31. Porto Moniz, lev. do Moinho close to Rib. do Tristão and road Porto Moniz. W-facing slopes. 28.1.67. — Rib. da Janela, W slope of river valley, border of high plateau. Slightly exposed E-facing cliffs. 27.1.67.
Differential species:
a. Diff. spp. of the *Clethro-Laurion*.
b. Diff. spp. with low diff. val. of the *Clethro-Laurion* towards the *Aeonio-Lytanthion*.
c. Diff. spp. of the *Clethro-Laurion* and of the Azorean all. *Juniperion brevifolii*.
d. Diff. spp. with low diff. val. of the *C.-L.* and the *J. b.*
e. Accompanying spp. (cf. also below table)

Number of spp.	22	17	12	15	9	12	11	17	13	23	28	23	10	17	13	18	14	18	20	14	17	28	17	14	33	13	10	13	11	18	17	28
Altitude (m)	350	530	800	550	570	820	920	750	750	700	920	550	375	880	600	600	450	1050	660	900	710	650	950	1000	1000	1300	1300	600	350	600	700	960
Sample plot No. in table	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
a.																																
Sonchus squarrosus	x	–	–	–	x	–	–	–	–	–	–	–	x	–	–	x	–	x	–	–	–	x	x	x	x	–	–	x	–	–	x	x
Chrysanthemum mandonianum	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	x	–	–	–	–	–	–	–	–	x	–	–	–	–
Carlina salicifolia	–	x	–	–	–	–	–	–	–	–	–	–	–	–	x	x	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–
Vaccinium maderense	–	–	x	–	–	x	–	x	–	x	x	x	–	x	–	x	x	–	x	x	x	–	x	–	x	–	x	–	–	x	x	x
Rubus grandifolius	–	–	x	–	–	–	–	x	–	–	–	–	–	x	–	–	–	–	x	x	x	x	–	–	x	–	–	–	–	–	x	–
Cedronella triphylla	–	–	–	x	–	–	–	x	x	–	x	x	x	–	x	–	–	–	x	x	x	x	–	–	x	–	–	–	–	x	x	x
Clethra arborea	–	–	–	x	x	–	–	–	x	–	–	x	–	x	x	x	x	x	x	x	x	x	x	x	x	–	–	–	–	x	–	x
Festuca donax	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	x	x	–	–	–	–	–	–	–
Euphorbia mellifera	–	–	–	–	–	x	–	–	x	–	–	–	–	–	–	–	–	x	–	–	–	–	x	–	x	–	–	–	x	–	–	x
Dactylorhiza maderensis	–	–	–	–	–	–	x	x	–	–	x	x	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–
Geranium anemonecfolium	–	–	–	–	–	–	x	–	–	–	x	–	x	–	–	–	–	–	–	–	–	–	–	x	x	–	–	–	x	–	–	–
Ruscus streptophyllus	–	–	–	–	–	–	x	–	–	–	x	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–
Ocotea foetens	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	x	–	–	–	x	–	–	–
Bupleurum salicifolium	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–
Isoplexis sceptrum	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–
Ilex canariensis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–
b.																																
Helichrysum melanophtalmum	–	–	–	–	x	–	–	–	–	–	–	–	–	–	x	x	x	–	–	–	–	x	–	–	–	–	–	–	–	x	–	–
Teucrium betonicum	–	–	–	–	x	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Tolpis macrorhiza	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	x	–	–
Deschampsia argentea	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	x	–	–	–	–	x	–	x	x	–	x	–	–	–	x
Prunus lusitanica	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Hypericum grandifolium	x	x	–	x	–	–	–	x	–	–	–	x	–	–	x	x	x	x	–	–	–	x	–	–	x	–	–	x	x	x	x	x
Senecio maderensis	x	x	–	–	–	–	–	–	–	–	x	–	–	x	–	x	x	x	–	–	–	x	x	x	x	x	–	x	–	–	–	x
Aichryson divaricatum	–	–	x	–	–	x	–	–	x	–	x	x	x	–	x	–	–	x	x	–	–	x	–	x	x	–	–	–	–	x	x	x
Cytisus maderensis	–	–	–	–	x	–	–	–	–	–	x	x	–	–	x	x	–	–	x	–	–	–	–	–	–	–	–	–	–	x	–	–
Bystropogon maderensis	–	–	–	–	–	–	x	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Arabis caucasica	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	x	–	–	–	–
Bystropogon piperitus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–
Erysimum mutabile	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–
Asplenium monanthes	–	–	–	–	–	–	x	–	–	–	–	–	–	–	x	–	–	–	–	–	–	x	–	–	x	–	–	–	–	–	–	–
c.																																
Laurus azorica	x	–	x	–	–	x	–	x	x	x	x	x	–	x	x	–	x	–	x	x	x	x	x	x	x	x	–	x	x	x	x	x
Ranunculus cortusifolius	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	x	x	–	x	x	–	–	–	x
Trichomanes speciosum	–	–	x	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	x	–	x	–	–	–	–	x	–	–
Hymenophyllum tunbridgense	–	–	–	x	–	–	–	–	–	–	x	x	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	x	x
Culcita macrocarpa	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Diplazium caudatum	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–
d.																																
Rubia angustifolia	x	x	–	x	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	x	–	–
Polystichum setiferum	x	–	–	–	–	–	x	x	x	x	x	–	–	x	–	–	–	–	x	x	–	x	x	–	x	x	x	–	–	x	x	x
Deschampsia foliosa	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Woodwardia radicans	x	–	x	x	–	–	–	x	–	–	x	x	x	–	x	–	–	–	x	x	x	–	x	x	x	–	–	x	–	–	–	x
Potentilla anglica	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–
e.																																
Pteridium aquilinum	–	x	–	–	–	x	–	x	x	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Sideritis massoniana	–	–	–	–	x	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	x	–	–	–	–	–	–	–	x	–	–
Erica arborea	–	–	–	–	–	–	–	–	–	–	–	–	–	x	x	–	x	x	x	x	x	–	–	–	–	x	x	–	–	–	–	x
Asplenium onopteris	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–
Digitalis purpurea	–	–	–	–	–	–	–	–	–	x	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Sibthorpia peregrina	x	x	–	x	–	x	–	x	x	x	x	x	x	x	x	x	x	x	x	–	x	–	x	x	x	x	x	–	x	x	–	x
Hypericum glandulosum	x	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–
Rumex maderensis	x	–	–	–	–	–	–	–	–	–	–	–	–	–	x	x	x	–	–	–	–	x	–	–	x	–	–	–	–	x	–	–
Hedera canariensis	x	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	x	–	–	–	x	–	–	–	–	–	–	–	–	–	–
Myrica faya	x	–	–	–	–	–	–	–	–	–	–	x	–	–	x	–	x	–	x	x	–	x	–	–	–	–	–	–	x	x	–	–
Erica scoparia	x	–	x	–	x	x	–	x	x	x	x	–	–	–	x	x	x	x	x	x	x	x	x	x	x	x	x	–	x	x	x	x
Andryala glandulosa ssp.	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–
Adiantum capillus-veneris	–	x	–	–	–	–	–	–	–	–	–	x	x	–	x	x	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Dystropogon sp.	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	x	–	–	–
Adiantum reniforme	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	x	–	–
Origanum virens	–	x	–	–	–	–	x	–	x	–	–	–	–	–	x	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Umbilicus rupestris	–	x	–	–	–	–	x	–	x	–	–	–	–	–	–	–	–	–	–	–	–	x	x	–	x	–	x	–	–	–	–	x
Davallia canariensis	–	x	x	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	x	–	–
Phyllis nobla	–	x	x	–	x	–	x	–	–	–	–	x	x	–	x	–	x	x	x	x	–	x	x	x	x	–	–	–	x	x	–	x
Blechnum spicant	–	–	x	x	–	–	–	x	–	x	x	x	–	x	–	x	–	–	x	x	x	–	x	–	x	x	x	x	–	–	x	x
Viola riviniana	–	–	–	–	–	x	–	–	x	–	x	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x
Scrophularia scorodonia	–	–	–	–	–	–	x	–	–	x	–	–	–	–	x	x	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–
Sarothamnus scoparius	–	–	–	–	–	–	–	–	–	x	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Sieglingia decumbens	–	–	–	–	–	–	–	–	–	x	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Prunella vulgaris	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	x	–	–	–	–	–	x
Brevipodium silvaticum	–	–	–	–	–	–	–	x	x	x	x	x	–	–	x	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Selaginella denticulata	–	–	–	–	–	–	x	–	–	x	x	x	x	–	–	–	–	x	–	–	–	–	x	–	–	–	–	–	–	–	–	x
Briza maxima	–	–	–	–	–	x	–	–	–	x	x	–	–	x	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–
Geranium robertianum	–	–	–	x	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ulex europaeus	–	–	x	–	–	–	–	–	–	x	x	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–
Fragaria vesca	–	x	–	–	x	–	x	–	x	x	x	–	x	–	–	–	–	x	–	x	–	–	–	–	–	–	–	–	–	–	–	–
Eupatorium adenophorum	–	x	x	–	x	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	x	x	–	x	–	–	–	–	–	–	–	x
Campanula erinus	x	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Juncus effusus	–	–	–	–	–	–	–	–	–	–	x	x	–	x	x	–	–	x	–	–	–	x	x	–	x	–	–	–	–	x	–	–
Cystopteris fragilis	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	x
Rumex bucephalophorus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–
Gennaria diphylla	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	x	–	–	–	–
Galium parisiense	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	x	–

Accompanying species with low cover degree, only recorded from one of the sample plots. No. in (–):
Rhamnus glandulosa (4), Picconia excelsa (4), Heberdenia excelsa (15), Berberis maderensis (15), Sambucus maderensis (15), Persea indica (15), Hypericum humifusum (14), Crepis vesicaria ssp. (10), Aira caryophyllea (10), Geranium purpureum (10), Taraxacum sp. (10), Anthoxanthum odoratum (10), Bidens pilosa (8), Galium aparine (6), Erigeron karwinskianus (4), Geranium lucidum (1), Lythrum hyssopifolia (1), Galactites tomentosa (1), Foeniculum vulgare (1), Silene gallica (1), Conyza canadensis (1), Equisetum maximum (22), Asplenium hemionitis (22), Aichryson villosum (20), Asplenium trichomanes ssp. quadrivalens (26), Polypodium australe (12), Myosotis sp. (12), Juncus articulatus (14), Cytisus tener (15), Hypericum uliginosum (18), Helichrysum foetidum (21), Rubus ulmifolius (32), Huperzia selago ssp. (16), Cirsium latifolium (25), Rubia fruticosa (25), Carex peregrina (25).

Table 3.

Vegetation zones on Madeira

m	feet	Bowdich (1825)	Hartung (1860)	Lowe (1868)	Vahl (1904) S	Vahl (1904) N	Romariz (1957) S	Romariz (1957) N	Sjögren (1972) S	Sjögren (1972) N
100		I. Wine region 0 - 2700 f	I. Lower region 0-1500 (2000) f	I. Cactus, bananas tropical cultivated reg. 0 - 700 f	I a. Lowland region (=Lowe I.)	II a.	I. Lower Macaronesian zone	I. II. III.	I a. Coast veget. Typical Aeonio--Lytanthion	I a. Coast veg. (A.-L.) b. A.-L. freq. mixed with cloud-zone spp.
200				II. Wine Chestnut temperate cultivated reg. 500 - 2500 f	b. Coast veg. mixed with high altitude spp.	b.	II. Mediterranian Macaronesian zone		b. Aeonio--Lytanthion mixed with cloud zone spp. especially in river vallevs	II a.
300	1000				II a. Low shrub reg. mixed with lowland spp. b. Typical (comp. Hartung II.)					
400										
500			II. High forest region 1500 (2000)- 3500 (4000) f							
600	2000									
700				III. Laurus Erica			III. Upper Macaronesian zone		II a. Laurus Erica Clethra shrub-forest Typical cloud-zone veg. (Clethro-Laurion)	
800										
900	3000	II. Sarothamnus region - 3700 f								
1000										
1100			III. Subalpine low forest (shrub) region 3500 (4000) - 6000 f	not cultivated reg. 2500 - 5500 f	c. Transition towards shrub reg.	c.	IV. Atlantic Macaronesian zone	IV.	b. Erica scrub above cloud-zone (grassland ass. of Clethro--Laurion)	
1200	4000	III. Vaccinium Laurus region - 5600 f			III. High shrub region (comp. Hartung III.)	III. High shrub region 1300 - 1859 m				
1300										
1400										
1500	5000									
1600										
1700		IV. Erica arborea and grasses 5600 - 6000 f		IV. Highest peaks 5500 - 6000 f						
1800	6000									

Table 4. — Differential species of Macaronesian vascular plant communities (only taxa with high differential value have been listed)

EM = endemic to Madeira EA = endemic to the Azores
EAM = endemic to Madeira and the Azores

Madeira	Azores
Aeonio-Lytanthion (coast)	*Festucion petraeae* (coast)
EM *Euphorbia piscatoria*	EA *Euphorbia azorica*
EM *Echium nervosum*	EA *Festuca petraea*
EM *Sedum nudum*	EA *Campanula vidalii*
EM *Sonchus ustulatus*	EA *Spergularia azorica*
EM *Plantago arboresc.* v. *mad.*	*Myrica faya*
EM *Helichrysum obconicum*	*Scabiosa atropurpurea*
EM *Crambe fruticosa*	*Polystichum falcatum*
EM *Artemisia maderensis*	*Solidago sempervirens*
EM *Matthiola maderensis*	
Hyparrhenia hirta	
Lytanthus salicinus	
Opuntia tuna	
Avena barbata	

EAM *Tolpis fruticosa*
Plantago coronopus
Crithmum maritimum
Bromus madritensis
Lotus subbiflorus
Gnaphalium luteo-album
Silene maritima
Asplenium marinum
Juncus acutus

(contin.)

Madeira *Clethro-Laurion* (cloud zone)	Azores *Juniperion brevifolii* (cloud zone)
EM *Sonchus squarrosus*	EA *Juniperus brevifolia*
EM *Chrysanthemum mandonianum*	EA *Rubus hochstetterorum*
EM *Vaccinium maderense*	EA *Habenaria micrantha*
EM *Rubus grandifolius*	EA *Habenaria longebracteata*
EM *Festuca donax*	EA *Vaccinium cylindraceum*
EM *Dactylorhiza foliosa*	EA *Tolpis azorica*
EM *Ruscus streptophyllus*	EA *Cardamine caldeirarum*
EM *Isoplexis sceptrum*	EA *Sanicula azorica*
Carlina salicifolia	EA *Picris rigens*
Cedronella canariensis	EA *Daboecia azorica*
Clethra arborea	EA *Carex pilulifera* v. *azorica*
Euphorbia mellifera	EA *Bellis azorica*
Geranium anemonaefolium	EA *Picris filii*
Ocotea foetens	EA *Euphorbia stygiana*
Bupleurum salicifolium	EAM *Frangula azorica*
Ilex canariensis	EAM *Festuca jubata*
Smilax aspera	*Lepidotis cernua*
	Smilax canariensis
	Osmunda regalis

Laurus azorica
Ranunculus cortusifolius
Trichomanes speciosum
Hymenophyllum tunbridgense
Culcita macrocarpa
Diplazium caudatum
EAM *Ilex perado*
Dryopteris aemula
Carex peregrina

COMMENTS ON THE ECOLOGY AND DISTRIBUTION OF DIFFERENTIAL SPECIES

Aeonium glandulosum (Ait.) W. & B.

EXS. — Rib. do Pisão (Mz: COI).

VIDI — W of Faial, 10 m. — Rib da Ametade, 350 m. — S. Jorge, coast. — Ponta do Sol, coast. — W of miradouro do S. Jorge, cliff, 20 m. — Ponta do Pargo, 500 m. — Prazeres, 200 and 475 m. — P. Moniz, coast. — S of Calheta, coast. — P. Moniz, cliff, 180 m. — N of Rib. Brava, sea cliff, 30 m. — S of Encumeada, 700 m. — N of the Ametade bridge, 200, 300 and 400 m. — Between Faial and Porto da Cruz, coast. — Porto da Cruz, 10 m. — Porto da Cruz — Portela, 450 m. — N of Rib. Brava, 500 m. — Vera Cruz, Campanário, 390 m. — Fajã de Limão, lev. do Moinho, 260 m. — Rib. do Inferno, 50 m. — E of estuary of S. Vicente, sea cliff. — Rib. dos Moinhos, 50 m. — Bridge over Rib. de Urzal, 120 m. — Arco de S. Jorge, 420 m. — Rib. Brava, sea cliff. — Lev. do Moiro, 630 m. — Estuary Rib. Funda. — Boaventura, 250 m. — Vale da Rib. da Janela, NE slope, 50-150 m. — W slope vale da Rib. Funda, coast up to 200 m. — Boaventura, up to 350 m.

HAB. — Cliffs and steep soil cuttings. Generally below 250 m, recorded up to 700 m, in the S of the island. Occasionally above the cloud zone.

SOC. — Low diff. val. for the *Aeonio-Lytanthion*. Also in weakly developed *Clethro-Laurion*. Frequently dominant species in the field layer of the *A.-L.* together with *A. glutinosum*.

Aeonium glandulosum (Ait.) W. & B.

EXS. — Cabo Garajau, coast (Sjn 65: U). — Roca da Pena (Mz: COI). — Lev. Bom Sucesso, 250 m (Ro 51: LISU). — Monte (Mz 14: LISU). — Rib. St. Luzia (Pa: LISU). — Close to the road from Rib. Brava to Encumeada (Ba 60: JBF). — St. Cruz: freg. do Caniço, Garajau, 100-150 m (Bz 54: MMF). —

VIDI — Ponta do Pargo, 400 m. — P. Moniz, coast, 100 and 180 m. — Rib. Brava, 30, 350, 450 and 650 m. — N of Encumeada, 390 m. — Monte, 710 m. S of the Ametade bridge, 400 m. — Between Faial-Porto da Cruz, 50 m. — Porto da Cruz, coast. — Curral, lev. da Costa, cliff, 450 m. — Rib. do Marques, Santana, 100 m. — Fajã do Limão, lev. do Moinho, 250 m. — Mouth of Rib. do Inferno, 50 m. — Vale de Machico, 100 m. — Garajau, coast. — Seixal, 390 m. — Curral das Freiras, 500 m. — W of Faial, coast. — Ponta do Clerigo, 420 m. — Rib. da Ametade, 360 and 400 m. — Rib. S. Roque, 250 m. — S. Jorge, coast. — Ponta do Sol, coast. — Estr. de Cam. de Lobos, 300 m. — Porto Moniz, 250 m. — Cliff W of Mir. de S. Jorge, 200 m. — Rib. da Cruz, 675 m. — Cliff E of mouth of Rib. S. Vicente, coast. — Rib. dos Moinhos, 50 m. — Arco S. Jorge, 420 and 330 m. — Rib. Funda, S. Jorge, 380 m. — S. Jorge, 70 m. — Lev. dos Moinhos, 240 m. — Capela S. João, 450 m. — S of Encumeada. 490 m. — Boaventura, 180 and 250 m. — Rib. da Janela valley, NW-facing slope, up to 350 m. — W slope Rib. Funda valley, Seixal, coast up to 200 m. — Boaventura, 400 m. — Curral, lev. towards S. Martinho, 400 m.

HAB. — Same as *Ae. glandulosum,* generally below 300 m. Localities observed up to 710 m in the S of the island. More frequent than *Ae. glandulosum* at altitudes above 300 m. Recorded by Lowe (1868) up to 1700 m.

SOC. — Diff. sp. of the *Aeonio-Lytanthion.* Frequently present in the all. but with low diff. val. Frequently dominant species in the field layer of the all.

Artemisia argentea l'Hérit.

EXS. — Ponta do Sol, coast (Sjn 66: U). — Pico Branco, Porto Santo, above 250 m (Sjn 66: U). — Pico Castelo, Port Santo, grazing land (Sjn 66: U). — Ponta do Sol (Mz 04: CCI). — Machico (Ro 51: LISU). — Cabo Girão (Mandon 1865: LISU). Ponta do Pargo, Farol (Ro 49: LISU). — Ilheu de Cima, Porto Santo (Pa: LISU). — Pico Branco, Porto Santo (Pi 57: MMF). — Mont. d. Pecegueiros, 460 m (Bz 54: MMF). — Rocha Quebrada, Porto Santo (RV 58: JBF). — Ponta do Pargo (Co: MMF).

VIDI. — N of Rib. Brava, 200 m.

HAB. — Closely restricted to coastal localities, preferentially on cliffs. Observed up to 500 m, generally below 100 m.

SOC. — High diff. val. for the *Aeonio-Lytanthion.* Cultivated and escaped to several coastal localities. Nowadays more frequently naturalized in the coastal vegetation than 100 years ago (comp. Lowe 1868).

Asplenium hemionitis L.

EXS. — Rib. da Janela, cliff, 500 m (Sjn 65: U). — Seixal (Pa: LISU). — Pico do Facho, Porto Santo (Pa: LISU). — Betwenn Seixal and Cova (Co 28: MMF). — Porto Moniz, Santa (Co 33: MMF). — Rib Frio, house of Serv. Florestais (Bz, RS 57: JBF). — Cerco, acima dos Lamaceiros, Fajã do Penedo, in remaining forest (Bz, RS 57: JBF).

VIDI — Rib. da Janela valley, exposure NE, 150-500 m. — Vale do Seixal, 190 m. — Lev. do Moiro, 630 m. — W slope Rib. Funda, Seixal, 350 m.

HAB. — Preferentially on moist soil, in the N of the island. Probably not growing below 200 m.

SOC. — Restricted to cloud zone vegetation, but not present in heavily grazed regions. Diff. sp. of the *Clethro-Laurion,* though with higher frequency than suggested by table 2.

Asplenium marinum L.

EXS. — Porto Moniz-Seixal, coast (Sjn 66: U). — S. Vicente, coast (Pa: LISU). — Selvagem Grande (Pa: LISU). Between Seixal and Rib. Funda (Ro 51: LISU). — Seixal, Porto (Co 28: MMF). — P. do Facho, Porto Santo (Co 39: MMF). — P. da Gandaia (Co 39: MMF). — Ilheu dos Desembarcadouros (RV 62: JBF). — Perto da Lapa, Deserta Grande (Chazal 53: MMF).

VIDI — Machico, 110 m. — Rib. da Ametade 360 m. — Porto Moniz, coast. — Boaventura, Falca de Cima, 180, 250 and 300 m.

HAB. — Preferentially in coastal localities, cliffs, at altitudes below 300 m, observed up to 360 m.

SOC. — Diff. sp. with high diff. val. of the *Aeonio-Lytanthion*. Frequency rather low. Also diff. sp. of the coastal *Festucion petraeae* in the Azores.

Avena barbata Pott ex Lk.

EXS. — Sta. Cruz, Caniço, Garajau, 150 m (Bz 54: MMF). — Rib. de Sta. Cruz (Co 38: MMF). — Porto Santo, Matas (Co 40: MMF). — Rocha da Pena (Co 38: MMF).

VIDI — N of Rib. Brava, cliff, 500 m. — W of Faial, coast. — Porto da Cruz, 10 m. — Cabo Garajau, coast. Ponta do Sol, coast. — Estr. de Câm. de Lobos, ravine, 300 m. — New lev. do Rib. da Janela, 350 m. — Prazeres, 200 m. — Porto Moniz, coast and 180 m. — N of Rib. Brava, 30 m. — N of Encumeada, 500 and 400 m. — Monte, 300 m. — Close to the Ametade bridge, 200 and 380 m. — Portela, 550 m. — Canhas to Paul da Serra, 450 m. — Rib. da Janela valley, NE slope, up to 150 m. — W slope Rib. Funda valley, Seixal, coast up to 400 m. — Vale da Boaventura, 200 and 450 m. — Curral das Freiras, lev. towards S. Martinho, 400 m.

HAB. — Cliffs and volcanic deposits close to the coasts. Observed up to 550 m but generally below 300 m.

SOC. — High diff. val. for the *Aeonio-Lytanthion*. Growing with rather high frequency in this all.

Bromus madritensis L.

EXS. — Pico Branco, Porto Santo (Sjn 66: U). — Sta. Cruz, by the road (Sjn 65: U). — Rib. S. Roque, 250 m (Sjn 66: U). — P. Castelo, Porto Santo (Sjn 66: U). — Rib. do Tristão (Co 34: LISU). — Rib. Sta. Luzia, 190 m (Ro 51: LISU). — Pico dos Barcelos (Ro 49: LISU). — Fonte d'Areia, Port Santo (Pa: LISU). — Porto Santo, Portela (Co 39: MMF).

VIDI — W of Faial, coast. — Porto da Cruz, 10 m. — Cabo Garajau, coast. — S. Jorge, coast. — Estr. de Câm. de Lobos, 300 m. — Porto Moniz, coast. — Prazeres, 200 m. — S of Calheta, coast. — N of Rib. Brava, 30 and 400 m. — Monte, 300 m. — S of Faial, 50 m. — Between Camacha and Portela, Aguas Mansas, 600 m.

HAB. — Distinctly restricted to dry coastal localities. Observed up to 600 m in the S of the island. Generally below 300 m in the S and below 50 m in the N.

SOC. — Frequent in the *Aeonio-Lytanthion* and with high diff. val. for this all. Connecting diff. sp. to the coastal *Festucion petraeae* in the Azores. Probably not indigenous to Madeira, but frequent already in the beginning of this century (Menezes 1906).

Bupleurum salicifolium Soland.

EXS. — Curral, small valley, cliff by lev. (Sjn 66: U). — Boaventura, 600 m (Sjn 66: U). — Rib. Frio (Mz 1894: COI). Cald. Verde (Ga: COI). — Rabaçal, road to Risco (Ga: COI). — Between Cald. Verde and do Inferno, 950 m (Ro 51: LISU). — Cald. Verde (Ro 51: LISU). — Sta. Luzia (Mz 14: LISU). — Vale da Lapa (Cvo 41: LISI). — Santa Madalena, Porto Moniz (Co: MMF). — Curral above Estreito, Jardim da Serra (MMF). — Pico Branco, peak, Porto Santo (RV 60: JBF). — Lev. do Rib. Frio between Balcões and Quebrada da Areia (RV 62: JBF). — Road to Curral (RV 63: JBF). — Lev. das Queimadas to Caldeirão (RV 68: JBF).

VIDI — Queimadas, 800 m. — Vale da Lapa, 600 m. — Lev. da Costa, Curral, 450 m. — Lev. do Moinho, after Fajã do Limão, 320 m. — Boaventura, João Fernandes, 600 m. — Curral d. Freiras, lev. towards S. Martinho, N-facing cliff in ravine, 400 m.

HAB. — Humid shady habitats, on cliffs. Recorded between 320-950 m. Generally above 400 m and below 1100 m. Altitude range 850-1800 m, mentioned by Lowe (1868) seams too high.

SOC. — Only in completely developed *Clethro-Laurion*. High diff. val. for this all. Rater low frequency.

Carex peregrina Lk.

EXS — Rib. Frio (Mz: COI). — Porto Moniz (Sa: COI). — Rabaçal, lev. do Risco, 1050 m (Ro 51: LISU). — Mont. d. Pecegueiros, 800 m (Ro 51: LISU). Below P. Ruivo, path to Encumeada, 1560 m (Bz 54: MMF). — Rib. Frio by lev. (RV 62: JBF). — Queimadas, 800 m (Sjn 66: U). — After the Passpoint of Encumeada between Lamaceiros and Cova da Roda, on cuttings by the road, u. c. *Erica scoparia* (Bz, RS 57: JBF). — Mont. d. Pecegueiros, close to Rib. da Passagem (Bz RS 57: JBF). — Rib. da Boca do Poiso (Bz, RS 57: JBF). — Cerco: acima dos Lamaceiros, Fajã do Penedo in remaining forest (Bz, RS 57: JBF). — Mont. d. Pecegueiros, 460 m (Bz 54: MMF).

VIDI — W of Encumeada, after the first tunnel, 1000 m.

HAB. — Moist shady habitats in the cloud zone vegetation. Probably rarely below 700 m. Rarely in overgrazed grassland above 100 m.

SOC. — High diff. val. for the *Clethro-Laurion* and also for the Azorean *Juniperion brevifolii*. However less frequent in the cloud zone vegetation of Madeira than of the Azores. Fries & Fries (1925) have mentioned this species from Kenya, East Africa. It was earlier treated as endemic to Madeira and the Azores. If the presence of *C. peregrina* in Kenya is correct this sp. can be added to the interesting group of species with disjunct distribution on the Macaronesian islands and in East Africa (cf. Sunding 1970).

Carlina salicifolia (L. f.) Less.

EXS. — Queimadas, 800 m (Sjn 66: U). — E of Rib. Frio (Sjn 65: U). — Rib. Frio (Mz 1894: COI). — Cald. Verde, 920 m (Ro 51: LISU). — Vale da Lapa, ssp. *spinellosa* Lowe (Cvo 42: LISI). — Rib. do Tristão and Seixal (Co: MMF). — Rib.

de João Gomes (Co 37: MMF). — Prazeres (Ga 57: COI). — Cabo Girão, cliffs below the miradouro (Bz, RS 57: JBF). — Q. do Bom Sucesso close to an old lev. (Bz, RS 57: JBF). — Rib. de S. Jorge close to Cald. do Inferno (Bz, RS: JBF).

VIDI — Rabaçal, 25 fontes, 920 m. — Rib. da Ametade, 400 and 930 m. — Curral d. Freiras, 1000 m. — Seixal, 390 m. — Cidrão, 650 m. — W of Encumeada, 1000 m. — Fajã do Limão, lev. do Moinho, 320 m. — Mouth of Rib. Funda. — Upper lev., S of Encumeada, 490 m. — Boaventura, Falca de Cima, 430 and 600 m. — Road cutting above Porto Moniz, 860 m. — Rib. do Sol, 230 m. — N of Rib. Brava, 30, 450 and 500 m. — N of Encumeada, 390 m. — N of Poiso, 960 m. — N of the Ametade bridge, 200 m. — Vale da Lapa, beginning of the new lev., 600 m. — S. Vicente, coast. — Curral d. Freiras, lev. towards S. Martinho, N-facing cliff, 400 m.

HAB. — Preferentially on cliffs in the cloud zone vegetation. Resistant to severe exposure. Recorded from the coast (N coast) up to 1000 m. Generally above 400 m in the S of the island.

SOC. — Rather low frequency in the *Clethro-Laurion* but with high diff. val. for the all. Not so common now as it was a century ago (comp. Lowe 1868).

Cedronella canariensis (L.) W. & B.

EXS. — Encumeada, S-facing loc., 1000 m (Sjn 65: U). — Caminho dos Loiros, N of Monte, 1220 m (Sjn 65: U). — W of Rib. Frio, 750, m (Sjn 66: U). — Rib. Frio (Mz 12: COI). — Arrebentão (Mz 03: COI). — Jardim da Serra (Mz 1894: COI). — Cald. Verde (Ga: COI). — Between Monte and Terr. da Luta (Sa: COI). — Vale da Lapa (Cvo 41: LISI). Between P. do Prado and Lombo de Baixo, 950 m (Ro 51: LISU). — Mont. d. Pecegueiros, 800 m (Ro 51: LISU). — Rib. Sta. Luzia (Mz 14: LISU). — Pico Grande, Rabaçal (Pa: LISU). Between Rib. Frio and Balcões, 850 m (Ro 51: LISU). — Vereda da Ponta da Encumeada ao Pico dos Cedros a sofé da Rocha Negra (Bar 60: JBF). Between Achadas da Cruz and Lombo do Loural (Bz 54: MMF). — Mont. d. Pecegueiros in forest (Bz 54: MMF). — Mont. d. Pecegueiros, close to tunnel, road to Seixal, close to Finca Bordões (Bz, RS 57: JBF). Between Achadas da Cruz and Lombo do Loural (Co: MMF).

VIDI — Achadas da Cruz, 710 and 840 m. — Seixal, 380 m. — W of Encumeada, 1000 m. Vale da Lapa, 500 m. — Rib. do Inferno, 50 m. — Queimadas, 800 m. — Lev. do Faial, 770 m. — W of Rib. Frio, 750 m. — E of Queimadas, 820 m. — N side of Rib. S. Jorge, 550 m. — New lev. Rib. da Janela, 375 m. — Rib. da Cruz, 700 m. — N of Encumeada, 600, 680 and 900 m. — N of Monte, 750 m. — N of Poiso, 960 m. — Vale da Lapa, beginning of new lev., 600 m. — Lamaceiros, 710 m. — Lev. do Moiro, 630 m. — W of Encumeada, after first tunnel, 1000 m. — Boaventura, 600 m. — Rib. da Janela, 200 m. — Rib. do Moinho, 700 m. — Lev. dos Brasileiros, Rib. da Janela, 900 m. — Rib. da Janela valley, NE slope, observed from 100-500 m. — W slope Rib. Funda, Seixal, 450 m.

HAB. — On cliffs and densely packed volcanic deposits. Recorded from 50-1300 m, but not observed below 750 m in the S of the island. All the island: generally above 500 m. Tolerant to severe exposure.

SOC. — High frequency within the *Clethro-Laurion*. High diff. val. for this all.

Chrysanthemum mandonianum Coss.

EXS. — Ametade, tunnel towards N, 950 m (Sjn 65: U). — Monte (Mz 14: LISU). — Rabaçal, Risco (Ro 51: LISU). — Fajã da Nogueira — Balcões, 700 m (Ro 51: LISU). — Vereda da Ponta da Encumeada ao P. dos Cedros e sofé da Rocha Negra (Bar 60: LISFA). — P. Ruivo, path to Encumeada, 1560 m (Bz 54: MMF). — After passpoint of the Encumeada between Lamaceiros and Cova da Roda, on slopes by the road (Bz, RS 57: JBF). — Between Casa do Arieiro and P. do Arieiro (Bz, RS 57: JBF).

VIDI — Rib. da Ametade, 930 m. — Rib. do Inferno, 100 m. — Between Rib. Frio and Balcões, 820 m. — S of Encumeada, 900 m. — N of Poiso, 1050 m. — N of Encumeada, 600 m. — Boaventura, João Fernandes, 600 m.

HAB. — Generally in the cloud zone vegetation, in moist shady habitats, frequently where continuous water supply is available. Recorded from 50 m on the N coasts up to altitudes about 1600 m. Generally above 600 m in the S (comp. Lowe 1868).

SOC. — Rather low frequency within the *Clethro-Laurion*. However, high diff. val. for this all.

Clethra arborea Ait.

EXS. — Ametade, tunnel towards N (Sjn 65: U). — Rib. Frio, 750 m (Sjn 65: U). — Lombo d. Pecegueiros, Rib. Bonito, 600 m (Sjn 65: U). — Camacha (Mz 03: COI). — Mont. d. Pecegueiros, 800 m (Ro 51. LISU). — Jardim da Serra, Seixal, 800 m (Mandon: LISU). — Lev. Bom Sucesso, 250 m (Ro 51: LISU). — Cald. Verde (LISU). — Close to S. António da Serra (Pa: LISU). — Queimadas (Fr 61: LISI). — Montado do Barreiro, Funchal (Neves 52: LISU). — Folhado, Seixal (Co: MMF). — Mont. d. Pecegueiros, 460 m (Bz 54: MMF). — Below P. Ruivo, path to Encumeada, 1490 m (Bz 54: MMF). — After the passpoint of the Encumeada between Lamaceiros and Cova da Roda (Bz, RS 57: JBF). — Mont. d. Pecegueiros, close to a Rib. da Passagem (Bz, RS 57: JBF). — Queimadas (RV, RS 57: JBF).

VIDI — W of Rib. da Janela, 900 m. — N of Portela, 500 m. — S of Portela, 375 m. — Vale da Lapa, beginning of new lev., 600 m. — S of Ametade bridge, 450 m. — N of Encumeada, 600 and 900 m. — Lamaceiros, 710 m. — Arco S. Jorge, below the miradouro, 330 m. — Rib. Funda, 380 m. — Lev. do Moiro, 630 m. — S of Encumeada, 490 m. — W of Encumeada, 1000 m. — Seixal, 1300 m. — Boaventura, 600 m. — Lev. do Moinho, 630 m. — Vale da Lapa, 550 m. — Rib. da Ametade, 570 m. — Between Rib. Frio and Balcões, 820 m. — Ponta do Clerigo, 420 m. — Rib. S. Roque, 250 m. — W of Rib. Frio, 750 m. — N Vale S Jorge, 550 m. — New lev. Rib. da Janela, 350 m. — Road cutting above Porto Moniz, 880 m. — Salazar Power Station, 500 m. — N of Encumeada, 700 and 800 m. — N of Poiso, 620, 700, 800, 1050 and 1200 m. — W of mouth Rib. Funda, 350 m.

HAB. — Frequent tree and shrub layer constituent of the cloud zone vegetation in wet shady habitats. Recorded from 250-1490 m. Mentioned by Sleumer (1967) form the level 600-1550 m. Throughout the island: generally above 400 m and below the grazing land which extends above 1200 m. Much more frequent between 200-400 m in the N than in the S.

SOC. — Diff. species with high diff. val. for the *Clethro-Laurion* and

with high frequency within this all. Occasionally in transitions between *C.-L.* and *Aeonio-Lytanthion.*

Crithmum maritimum L.

EXS. — Between Seixal and Rib. Funda (Ro 51: LISU). — Between Ponta do Sol and Madalena do Mar, close to dos Anjos (Bz, RS 57: JBF). — Deserta Grande, sea cliffs, W coast, close to the sea (Bz 57: JBF).

VIDI — Caniçal: Piedade, S. Lourenço, 50 m. — W of Faial, 10 m. — Porto da Cruz, 10 m. — Ponta do Sol, coast. — Porto Moniz, coast. — Ponta Delgada, church. — E of mouth of S. Vicente cliff. — Rib. Brava sea cliff. — Mouth Rib. da Janela. — Mouth Rib. Funda, Seixal.

HAB. — Sea cliffs and sandy-gravelly deposits. Never recorded from localities above 100 m.

SOC. — Very high diff. val. for the *Aeonio-Lytanthion* of Madeira as also for the coastal *Festucion petraeae: Euphorbietum azoricae* (Sjögren 1972) in the Azores.

Culcita macrocarpa C. Presl

EXS. — Near S. Vicente (Pa: LISU). — Mont. d. Pecegueiros, 800 m (R. Fritze: LISU). — Rib. Frio, 800 m (Br 69: LISI). — Between Seixal and Rib. de João Delgado (Co 27: MMF).

VIDI — Cliff above Porto Moniz, 250 m. — Vera Cruz, Campanario, 390 m. — Lev. do Costa, Curral, 450 m.

HAB. — In cloud zone vegetation, humid habitats. Throughout the island: generally above 700 m. Recorded down to 250 on the N coast.

SOC. — Low frequency in the *Clethro-Laurion* (cf. Romariz 1953) but it is nominated diff. sp. of the all. *Culcita* is a connecting diff. sp. to the *Juniperion brevifolii* in the Azores. In both archipelagos probably extinct from several localities as the fern has been extensively collected before.

Cytisus maderensis (W. & B.) Masf.

EXS. — Portela, Lev. do Faial, N slope of cliff, 750 m (Sjn 65: U). — Rib. da Ametade, 360 m (Sjn 66: U). — Rib. Frio (Mz 1896: COI). — Cald. Verde (Ga 58: COI). — Rib. do Inferno, coast (H. Persson 52: LISU). — Rib. João Fernandes (H. Persson 52: LISU). — Cald. Verde (Ro 51: LISU). — Between Rib. Frio and Juncal (Mz 15: LISU). — Ponta Delgada, 150 m (Mz 15: LISU). — Curral d. Freiras (Pa: LISU). — Between Balcões and Fajã da Nogueira, 850 m (Ro 51: LISU). — Between S. Vicente and Encumeada (Ro: LISU). — Santana, Queimadas, Lomba do Cedro (Fr 61: LISI). — Rib. do Inferno, very moist slopes (Bz, RS 57: JBF). — Between Casa do Arieiro and P. do Arieiro (Bz, RS 57: JBF). — Cerco: above Lamaceiros, Fajã do Penedo, in remaining forest (Bz, RS 57: JBF). — Rib. do Lombo das Faias (Bar 60: LISFA). — Queimadas (Pi 56: MMF). — Fanal (Co: MMF). — Between S. Jorge and Rib. Bonito in «Laurosilva» close to lev. do meio (Bz, RS 57: JBF). —

VIDI — W of Encumeada, 1000 m. — Rib. da Ametade, 570 m. — Queimadas, 820

m. — W slope Rib. S. Jorge, 550 m. — W of Miradouro do S. Jorge, 200 m. — N of Encumeada, 680 m. N of Poiso, 900 and 850 m. — N of bridge over Rib. da Ametade, 300 and 360 m. — N of Rib. Brava, 500 m. — Vale da Lapa, 600 m. — S of bridge over R. da Ametade, 450 m. — Rib. do Porco, 500 m. — After Fajã do Limão, lev. do Moinho, 300 m. — Ponta do Pargo, Lombo 810 m. — Mouth Rib. do Inferno, 50 m. — Bridge over Rib. do Urzal, 120 m. — Arco S. Jorge, 330 m — Rib. Funda, 380 m. — Before Fajã do Limão, 250 m. — Upper lev. S of Encumeada, 490 m. — Boaventura, 600 m.

HAB. — Preferentially on moist shady slopes of cliffs. Recorded from 50 m (N coast) up to 1000 m. Generally above 300 m. Attributed by Lowe (1868) to altitudes above 850 m. now known to have a much wider altitude range.

SOC. — Rather high frequency in the *Clethro-Laurion*. Occasionally in the *Aeonio-Lytanthion*. Low diff. val. for the cloud zone all.

Dactylorhiza foliosa (Soland.) Soó

EXS.. — By lev., Queimadas, 650 m (Sjn 66: U). — Rib. Frio (Mz 03: COI). — Rib. Frio (Maul 60: MMF). — Path down from P. Ruivo to Cald. do Inferno (Bz: MMF). — Queimadas (RV 62: JBF). — Rib. do P. Pimenta (JBF). — S. Jorge (RV 63: JBF). — Between S. Vicente and Encumeada, above Chão dos Louros, in the border of «Laurisilva» (Bz, RS: JBF).

VIDI — Between Rib. Frio and Balcões, 820 m. — Rib. Frio, 750 m. — E of Queimadas, 820 m. — N slope Rib. S. Jorge, 550 m. — N of Poiso, 1100, 960, 880 m. — N of Portela, 500 m. — N of Encumeada, 900 m.

HAB. — Only in cloud zone vegetation, generally in shady moist habitats. Generally above 500 m.

SOC. — High frequency in the *Clethro-Laurion*. High diff. val. for this all.

Deschampsia argentea (Lowe) Lowe

(incl. var. **purpurascens** Costa var. **gomesiana** Mnzs.)

EXS. — Very exposed habitats, flooded by water, lev. do Faial, 700 m (Sjn 66: U). — Rib. da Caixa, Estreito de C. de Lobos, 300 m (Sjn 66: U). — Paul da Serra, locality protected from grazing, 1400 m (Sjn 66: U). — Rib. Frio (Mz: COI). — Lev. do Curral d. Romeiros (Mz: COI). — Rib. Sta. Luzia (Mz: COI). — Rib. do Tristão (Sa: COI). — Rib. do João Gomes (Mz 01: LISU). — Rib. do Tristão (Co 34: LISU). — Rib. Frio (Mz 09: LISU). Close to P. dos Mariscos (Pa: LISU). — Curral d. Romeiros (Co 38: LISU). — Rib. d. Cales, 1130 m (Ro 51: LISU). — Rib. Funda no Seixal (Co 29: MMF). — Rib. do Tristão (Co 32: MMF). — Porto Moniz (Co 31: MMF). — Seixal (Co 29: MMF). — Fonte da Portela, Seixal (Co 29: MMF). — Varas no Seixal (Co 30: MMF). — Curral d. Romeiros (Co 38: MMF). — Fonte do Rentroia, Seixal (Co 29: MMF). —

VIDI — Rib. Frio, W, 750 m. — Ravine, Estr. Cam. d. Lobos, 300 m. — N of the Ametade bridge, 420 m. — N of Poiso, 1050 m. — After Fajã do Limão, lev. do Moinho, 320 m. — Rib. do Inferno, mouth, 50 m. — S. Jorge, 70 m. — Mouth of Rib. Funda. — W slope Rib. da Janela. — W of Encumeada, after the first tunnel, 1000 m.

— Seixal, 1300 m. — Boaventura, 550 m. — W Rib. da Janela, 980 m. — Curral das Freiras, lev. towards S. Martinho, 400 m.

HAB. — Preferentially on steep cliffs or slopes of volcanic deposits, where there is a continuous water supply. Recorded from the coasts to altitudes of about 1400 m. Highest frequency, however, in the cloud zone vegetation above 700 m. Avoiding open grazed grassland above 1200 m.

SOC. — Not restricted to any special vegetation zone but with diff. val. for the hygrophilous association of the *Clethro-Laurion: Deschampsietum argenteae.*

Deschampsia foliosa Hack.

EXS. — P. Castelo, Porto Santo (Sjn 66:U). — v. *maderensis* Hack. o Bornm: Arieiro, 1600-1800 m (H. Persson 52: LISU). — P. Ruivo, 1700 m (Ro 51: LISU). — Rib. Frio (Ro 54: LISU). — Arieiro (Co 35: LISU and MMF). — Rib. Frio (Co 38: MMF). — Fonte do Rentroia, Seixal (Co 28: MMF). —

VIDI — Vale da Lapa, 550 m. — Vale do Inferno, 50 m. —

HAB. — Preferentially where continuous water supply is available, from coasts to the highest peaks of the island. The species occurs with the highest frequency above 700 m and below 1200 m. It avoids open level grassland vegetation.

SOC. — Diff. val. only for hygrophilous association of the *Clethro-Laurion,* connecting this community to a hygrophilous ass. of the *Juniperion brevifolii* in the Azores.

Diplazium caudatum (Cav.) Jermy

EXS. — Lev. do Moinho, where lev. do Tristão passes the road, 630 m (Sjn 67: U). — Queimadas (Ga 54: COI). — Rabaçal (Ga: COI). — S. Vicente (Sch. Müller 1860: LISU). — Sta. Luzia, rib. close to Cascata (Pa: LISU). — Rib. da Ametade (Pa: LISU). — Rib. Frio (Pa: LISU). — Cald. Verde (Cvo 41: LISI). — Seixal (Co 27: MMF). — Below Paul, lev. to Caramujo, lev. dos Mouros (Pi 61: MMF).

VIDI — New lev. Rib. da Janela valley, 370 m. — W of Encumeada, 1000 m. — W of mouth Rib. Funda, Seixal, 300-500 m.

HAB. — Only moist shady habitats in dense cloud zone vegetation, preferentially where there is a continuous water supply, in deep ravines (cf. Benl & Sventenius 1970). Generally above 700 m.

SOC. — Higher frequency in the *Clethro-Laurion* than is indicated in table 2. High diff. val. for this all. Avoids its open grassland ass. Connecting this all. to the *Juniperion brevifolii: Festucetum jubatae* in the Azores.

Echium nervosum Ait.

EXS. — Ametade, tunnel towards N, 950 m (Sjn 65: U). — Rib. Brava (Mz: COI). — Cabo Garajau (Pa: LISU). — S. Gonçalo (Mz 14 LISU). — Praia Formosa (Ro 51: LISU). — Achadas da Cruz (Ro: MMF). — Sta. Cruz: freg. Caniço (Bz: MMF). — Caniço: Garajau (Bz 54: MMF). — Pico Branco, the peak, Porto Santo (RV 60: JBF). — Fajã dos Arenos, na sopé do Cabo Girão, slopes facing the sea (Bz, RS 57: JBF). — Q. Bom Sucesso (RV 58: JBF). — Terra Chã (RV 58: JBF).

VIDI — Port Novo, 50 m. — Cabo Garajau. — S. Vicente. — Casa dos Vinháticos, 650 m.

HAB. — Rarely above 300 m. In crevices on cliffs in very exposed habitats.

SOC. — High diff. val. for the *Aeonio-Lytanthion.*

Elaphoglossum paleaceum (Hook & Grev.) Sledge

EXS. — Lev. do Moinho, 630 m (Sjn 67: U). — Queimadas, 840 m (Sin 65: U). — Achadas da Cruz, 800 m (Sjn 65: U). — Serra do Porto da Cruz (Mz: COI). — Serra de Boaventura (Pa: LISU). — Vale da Lapa (Cvo 41: LISI). — Seixal, Água do Vento (Co 28: MMF). — Porto Moniz, Fonte da Pedra (Co 33: MMF). — After the passpoint of the Encumeada, between Lamaceiros and Cova da Roda, on soil cuttings by the road. (Bz, RS 57: JBF). — Montado d. Pecegueiros on *Ocotea* (Bz, RS 57: JBF). — M. d. Pecegueiros, close to rib. Passagem (Bz, RS 57: JBF). — Fanal (JBF).

HAB. — On volcanic deposits but more frequently on tree trunks. Restricted to the cloud zone, probably rarely below 600 m. In the N of the island down to 200 m (cf. Romariz 1953).

SOC. — Diff. sp. of the phytocoenose *Clethro-Laurion,* as also of associations of the Azorean *Juniperion brevifolii.* Taxonomy of this fern was treated by Sledge (1967) and by Pichi-Sermolli & Schelpe (1968).

Erica arborea L.

EXS. — Pico Castelo, Porto Santo (Sjn 66: U). — Rib. d. Cales, 1090 m (Sjn 65: U). — Rib. Frio (Ga 58: COI). — Arr. de Santana (Ro 49: LISU). — Arieiro, 1500 m (Ro 49: LISU). — Rabaçal (Ro 49: LISU). — Encumeada Alta (Cvo 41: LISI). — P. Ruivo (Cvo 41: LISI). — Queimadas (Cvo 41: LISI). — Machico, close to the tunnel, by the road to Caniçal (Bz 54: MMF). — Fanal de Cima (Co 28: MMF). — Estanquinhos (Co: MMF).

VIDI — Camacha, 700 m. — Monte, 680 m. — Rib. d. Cales, 1150 m. — Passpoint of the Encumeada, N-facing, 960 m. — E of Rib. Frio. — Porto da Cruz, 280 m. — Vale de Machico, 80 m. — Curral d. Freiras, 650 m. — W of Encumeada, 1000 m. — Machico, 110 m. — S of Faial, 500 m. — Rib. S. Roque, 250 m. — Rib. S. Jorge, 530 m. — N of Vale S. Jorge, 460 m. — Cliffs above Porto Moniz, 250 m. — Miradouro S. Jorge, 200 m. — Rib. Tristão, 650 m. — Rib. Cruz, 600 m. — Porto Moniz, W of Rib. da Janela, 800 and 880 m. — S of Encumeada, 900 and 490 m. — N of Encumeada, 900, 700, 600 and 450 m. — N of Monte, 940 and 1000 m. — N of Poiso, 1300, 1050, 800, 650 and 500 m. — Ametade bridge, 300 m. — N of the Ametade bridge, 200 m. — S of Faial, 50 m. — Porto da Cruz to Portela, 100 and 300 m. — Portela, 550 m. — S of Portela, 370 m. — Between Canhas and Paul da Serra, 780 m.

Table 1. AEONIO - LYTANTHION

Number of species	8	12	9	13	11	10	22	10	17	12	9	18	17	17	12	17	14	14	10	12	15	18
Altitude (m)	50	50	50	10	10	50	50	300	50	20	100	20	30	50	50	50	420	250	240	10	250	180
Sample plot No. in table	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
a.																						
Hyparrhenia hirta	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Euphorbia piscatoria	-	x	x	-	-	-	x	-	-	x	x	x	x	-	-	-	-	x	-	x	-	-
Lytanthus salicinus	-	x	x	-	-	-	-	-	x	x	-	x	x	x	-	x	x	x	x	-	x	x
Echium nervosum	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-
Opuntia tuna	-	-	x	-	-	-	x	-	-	x	-	-	x	-	-	x	-	-	x	-	-	-
Sedum nudum	-	-	-	x	-	-	-	-	x	-	-	x	-	-	x	x	-	-	-	-	-	-
Sonchus ustulatus	-	-	-	x	-	-	x	x	-	-	-	-	-	x	-	-	-	-	-	-	-	-
Avena barbata	-	-	-	x	x	-	x	x	x	-	-	-	x	-	-	-	-	-	-	-	-	-
Plantago arborescens v. mad.	-	-	-	-	-	-	x	-	-	-	-	x	-	x	x	x	x	-	-	-	-	-
Helichrysum obconicum	-	-	-	-	-	-	-	-	x	-	x	-	-	x	x	x	x	-	-	-	-	-
Crambe fruticosa	-	-	-	-	-	-	-	-	-	-	-	x	-	-	x	-	-	-	-	-	-	-
Artemisia argentea	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Matthiola maderensis	-	-	-	-	-	-	x	-	x	x	x	x	-	-	-	x	-	-	-	-	-	-
b.																						
Aeonium glandulosum	-	x	x	x	-	x	x	x	x	x	-	x	x	x	-	x	x	x	x	x	x	-
Aeonium glutinosum	-	-	-	-	-	x	x	x	-	-	x	x	x	x	x	x	x	-	x	-	x	x
Mesembryanthemum crystallinum	-	-	-	-	x	-	x	-	-	-	-	-	-	-	-	x	-	-	-	-	-	x
Sonchus pinnatus	-	-	-	-	-	-	-	-	-	x	-	-	x	-	-	x	-	-	-	x	-	-
Mesembryanthemum nodiflorum	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
Tunica prolifera	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
c.																						
Tolpis fruticosa	x	x	-	x	x	-	x	x	x	-	x	x	x	-	x	x	x	x	x	x	-	-
Plantago coronopus	x	-	-	x	x	-	x	-	-	-	x	x	-	-	-	-	-	-	-	-	-	-
Crithmum maritimum	x	-	-	x	x	-	x	-	-	-	-	x	-	-	x	-	-	-	-	x	-	-
Atriplex triangularis	-	-	x	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bromus madritensis	-	-	-	x	x	x	-	x	x	x	-	-	x	-	-	-	-	-	-	-	-	-
Lotus subbiflorus	-	-	-	-	x	-	x	-	-	-	x	-	-	-	-	-	-	-	-	x	-	-
Gnaphalium luteo-album	-	-	-	-	x	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Silene maritima	-	-	-	-	-	-	x	-	-	x	-	x	-	-	-	-	-	-	-	x	-	-
Asplenium marinum	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x
Juncus acutus	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
d.																						
Erica scoparia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x
Myrica faya	-	-	-	x	-	-	-	-	x	-	-	-	-	-	-	-	x	-	-	-	-	x
Foeniculum vulgare	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	x	-	-
Cytisus maderensis	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	x	-	-	-	-
Sibthorpia peregrina	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	x	x
Polypodium australe	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	x	x
Umbilicus rupestris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	-	x	x
Hypericum grandifolium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	-	-	-	-	-	x
Aichryson divaricatum	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	x	-	-	-	-
Hypericum glandulosum	-	-	-	-	-	-	-	-	x	-	-	-	-	x	-	x	-	-	-	-	-	-
Rumex maderensis	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	x	-	x	x
Brevipodium silvaticum	-	-	-	-	x	x	-	-	-	-	-	x	x	-	-	-	-	-	-	-	-	-
Andryala glandulosa ssp.	-	-	-	x	x	-	-	-	-	-	x	x	-	-	-	-	-	-	-	-	-	-
Phyilis nobla	-	-	-	x	-	x	x	x	x	-	x	x	x	x	x	x	x	-	-	x	-	x
Adiantum capillus-veneris	-	x	-	-	-	-	x	-	-	-	-	x	-	x	-	x	-	-	x	x	-	-
Setaria sp.	-	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Helichrysum foetidum	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	x	-
Selaginella denticulata	-	x	-	-	-	-	-	-	-	-	-	-	-	x	-	-	x	x	-	-	-	-
Davallia canariensis	-	x	-	-	-	-	-	-	x	-	-	x	-	-	-	-	x	x	x	-	x	x
Psoralea bituminosa	-	x	-	-	-	-	-	x	x	-	-	-	x	-	-	-	-	-	-	x	-	-
Eupatorium adenophorum	-	x	-	-	-	-	-	-	-	-	-	-	x	x	-	x	-	-	-	x	x	x
Briza maxima	x	x	-	x	-	x	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-
Echium plantagineum	x	-	x	-	-	-	-	-	x	x	-	-	-	-	x	-	-	-	-	-	-	-
Bidens pilosa	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	x	-
Adiantum reniforme	-	-	-	-	-	-	-	x	-	-	-	x	-	x	-	-	-	x	-	-	-	-
Aichryson villosum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	x	-
Hedera canariensis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	x	-	-	x

Accompanying species with low cover degree, only recorded from one of the sample plots. No. in (-):
Lotus macranthus (1), Erigeron karwinskianus (22), Myrtus communis (21), Asplenium trichomanes (22), Asplenium onopteris (22), Cynodon dactylon (5), Erysimum mutabile (10), Deschampsia argentea (14), Hypericum undulatum (18), Sideritis massoniana (18), Rubus ulmifolius (17), Juncus effusus (15), Woodwardia radicans (14), Ammi majus (14), Linaria cymbalaria (10), Wahlenbergia nutabunda (6), Rumex bucephalophorus ssp. (17), Digitalis purpurea (4), Leontodon saxatilis (1), Ulex europaeus (6), Linum strictum (6) Briza minima (7), Silene gallica (9), Sarothamnus scoparius (13), Galium parisiense (13), Dactylus glomerata ssp. (15), Clinopodium vulgare ssp. villosa (17).

— Vale da Lapa, beginning of new lev., 600 m. — S of the Ametade bridge, 450 m. — Lamaceiros, 710 m. — Lev. Ponta do Sol, Lombo, 830 m. — Seixal valley, W slope, 1300 m. — Paul da Serra, Rib. do Risco. — W of Rib. da Janela, 980.

HAB. — Recorded from the coasts up to the highest peaks of the island. In the N of the island grows down close to the coast. In the S grows down to altitudes at about 100 m but generally above 650 m. Becoming a frequent constituent in the vegetation of Madeira above 700 m. In overgrazed grassland above 1100 m, it has frequently been eliminated by grazing, cutting and burning. Covers larger areas above 1500 m than *E. scoparia* (cf. Andrada & Gonçalves 1955).

SOC. — The presence of the shrub at all altitudes makes it unsuitable as diff. species of any special community, although the frequency is distinctly highest in the *Clethro-Laurion*.

Erica scoparia L.

EXS. — Ametade, 800 m (Sjn 65: U). — Rib. da Ametade towards Fajã da Nogueira, 400 m (Sjn 65: U). — Rib. d. Cales, 1090 m (Sjn 64: U). — P. Juliana, Porto Santo (H. Persson 52: LISU). — Arieiro, 1600 m (H. Persson 52: LISU). — P. Ruivo, 1850 m (Ro 51: LISU). — Close to Cabo Girão (Pa: LISU). — Queimadas (Cvo 41: LISI). — Chão das Feiteiras, 1140 m (Bz 54: MMF). — Paul da Serra, close to P. da Urze (Bz 54: MMF). — Prazeres, by the road (Bz, RS 57: JBF). — Santo da Serra, Q. da Junta (RV 58: JBF). — P. Arieiro (RV 60: JBF). — Porto Santo, P. do Castelo (Co: MMF).

VIDI — S of the Ametade bridge, 450 m. — N of Poiso, 1050 m. — N of Encumeada, 900 and 600 m. — Curral, lev. da Costa, 450 m. — Lamaceiros, 710 m. — Below Portela, 350 m. — Rib. do Marquês, Santana, 100 m. — After Fajã do Limão, lev. do Moinho, 300 m. — Ponta do Sol, Lombo, 870 m. — Lev. do Taboa, close to lev. do Moinho, 670 m. — Ponta do Pargo, Lombo, 650 m. — Bridge over Rib. do Urzal, 120 m. — Arco S. Jorge, 330 m. — Rib. Funda, S. Jorge, 380 m. — S. Jorge, 70 m. Lev. do Moiro, 630 m. — Capela S. João, 450 m. — Ravine above Porto Moniz, 800 m. — N of Rib. Brava, 400 m. — N of Encumeada, 770, 700 and 400 m. — Monte, 610 m. — N of Monte, 1000 m. — N of Poiso, 1300, 800 and 620 m. — Close to the Ametade bridge and N of the bridge, 320 and 200 m. — Faial to Porto da Cruz, 20 m. — Porto da Cruz to Portela, 200, 300 m. — Portela, 550 m. — Canhas to Paul da Serra, 900 m. — Vale da Lapa, 600 m. — Rib. da Ametade, 570 and 360 m. — Lev. do Faial from Camacha, 750 m. — Between Rib. Frio and Balcões, 820 m. — S of Faial, 500 m. — Rib. S. Roque, 250 m. — Rib. Frio, 750 m. — Paul da Serra, 1100 m. — E of Queimadas, 820 m. — N slope of S. Jorge valley, 460 m. — New lev. Rib. da Janela, 350 m. — Rib. do Sol, 230 m. — Prazeres, 470 m. — Cam. d. Loiros, 1220 m. — N-facing slope in Vale do Machico, 80 m. — Serra de Água, 300m. — Lamaceiros, 790 m. — NE of Poiso, 1100 m. — Rabaçal, 920 m. — Curral d. Freiras, 1000 and 510 m. — Rib. da Janela, 490 and 600 m. — Achadas da Cruz, 720 m. — Seixal, 390 m. — Cidrão, 650 m. — W of Encumeada, 1000 m. — Queimadas, 880 m. — S of Encumeada, 490 m. — Seixal valley, 1300 m. — Boaventura, 550, 600, 300, 250 and 180 m. — Between Camacha and Portela, Águas Mansas, 600 m. — Rib. do Moinho, 700 m. — Lev. do Moinho, 630 m. — W of Rib. da Janela, 980 m. — Vale Rib. da Janela, NE slope, 300-500 m. — W mouth of Rib. Funda, Seixal, 250-500 m. — Curral, lev. towards S. Martinho, 400 m.

HAB. — Volcanic deposits, sandy soil and coarse gravel, cliffs.

Drought-tolerance high. Recorded from coast up to the highest peaks of the island. Fairly frequent below 200 m in the N but generally above this altitude. However, rarely down to 100 m in the S and generally above 450 m. Thus higher frequency at low altitudes than *E. arborea*. The range of altitude with the highest frequency, however, coincides with that of *E. arborea*. *E. scoparia* is regionally more frequent in the cloud zone vegetation than *E. arborea* and also the most frequent *Erica* species in high altitude grazing land. However, *E. arborea* becomes more frequent towards the highest peaks of the island.

SOC. — Only very low diff. val. can be given to *E. scoparia* as the shrub is present in plant communities at all altitudes. The corresponding species in the Azores is *E. azorica,* with similar ecological preferences and growing within a similar wide altitude range.

Euphorbia mellifera Ait.

EXS. — Rib. Frio, 750 m (Sjn 65: U). — Between Rib. Frio and Balcões (Een, Persson 52: LISU). — Rib. St. Luzia (Maul 52: LISU). — Cald. Verde, 930 m (Ro 51: LISU). — Rib. Frio, Melhada Verde (Mandon: LISU). — Vale da Lapa (Cvo 41: LISU). — Ponta do Pargo (Ro 14: LISU).

VIDI — Seixal, 390 m. — Between Rib. Frio and Balcões, 820 m. — W of Rib. Frio, 750 m. — N slope Rib. S. Jorge, 550 m. — Ponta do Pargo, 575 m. — N of Encumeada, ravine, 680 and 420 m. — N of Poiso, 1050 m. — Bridge over Rib. do Urzal, 120 m. — W of Encumeada, 1000 m. — Boaventura, 550 m. — W of Rib. da Janela, 980 m. — Between Rib. da Janela, 980 m. — Between Rib. da Janela and Rib. Funda, 400 m.

HAB. — Low drought-tolerance. Generally in moist shady habitats where exposure is slight, e. g. in steep, deep ravines. Observed from 120-1050 m. Rarely below 400 m in the N, rarely below 700 m in the S. Throughout the island: Generally above 600 m. rarely 1200 m. Avoids open grassland vegetation.

SOC. — High diff. val. for the *Clethro-Laurion* (hygrophilous association). *Euphorbia stygiana* in Azorean cloud zone vegetation is diff. sp. of the *Juniperion brevifolii:* hygrophilous ass. *Festucetum jubatae* (Sjögren 1972).

Euphorbia piscatoria Ait.

EXS. — Garajau, coast (Sjn 65: U). — Porto Novo, 30 m (Ro 51: LISU). — Madalena do Mar (Ro 49. LISU). — Cabo Girão, (RV 62: JBF). — Fajã dos Asnos, no sopé do Cabo Girão (Bz, RS 57: JBF). — Pico Castelo, Porto Santo (RV 58: JBF).

VIDI — Trigo de Negreiros, 300 m. — Rib. da Janela, coast. — Ponta do Sol, coast. — Prazeres, 200 m. — S of Calheta, coast. — Porto Moniz, coast and 100 m. — N of Rib. Brava, 30, 500 and 650 m. — N of Encumeada, 390 m. — Fajã do Limão, 250 m. — Rib. Brava, coast. — Mouth of Rib. Funda, R. do Seixal and of Rib. da Janela.

HAB. — On cliffs and volcanic deposits, highly drought-resistant. Observed in the S up to 500 m, in the N up to 390 m. Throughout the island: generally below 300 m.

SOC. — High diff. val. for the *Aeonio-Lytanthion,* never growing in completely developed *Clethro-Laurion.*

Festuca donax Lowe

EXS. — Encumeada, S-facing slope, 1000 m (Sjn 65: U). — Rib. Bonito, Lombo d. Pecegueiros (Sjn 65: U). — Rib. da Ametade, 360 m (Sjn 66: U). — Path from Rib. do Inferno to Mont. d. Pecegueiros (Bz 54: MMF). — Porto Moniz (Co 27: MMF). — Between Seixal and Quebrada dos Bois (Co 28: MMF). — Between Porto Moniz and Moinhos (Co 33: MMF).

VIDI — Vale da Lapa, 550 m. — W of Encumeada, 1000 m. — Lev. dos Brasileiros, Rib. da Janela, 900 m. — Rib. da Janela valley, NE slope, 200 m. — W of mouth Rib. Funda, Seixal, 200-500 m. — Boaventura, at altitudes above 250 m. — Curral d. Freiras, lev. towards S. Martinho, 400 m.

HAB. — Observed from 200-1000 m. Probably also at somewhat higher altitudes. Preferentially where continuous water supply is available, on steeply sloping cliffs. Probably rarely below 500 m.

SOC. — High diff. val. of hygrophilous association of the *Clethro-Laurion.* Corresponding diff. sp. of the hygrophilous ass. *Festucetum jubatae* of the *Juniperion brevifolii* in the Azores is *Festuca jubata.*

Galium rotundifolium L.

EXS. — Vale da Lapa, 850 m (Sjn 66: U). — Cald. Verde (Ga: COI). — Rabaçal, cam. para o Risco (COI). — Between Balcões and Fajã da Nogueira, 600 m (Ro 51: LISU). — Cald. Verde, 950 m (Ro 51: LISU). — Rabaçal, lev. Risco, 1050 m (Ro 51: LISU). — Descida para a Rib. do Juncal (RV 62: JBF). — Rocky river bed of Rib. de São Jorge close to Cald. do Inferno (Bz, RS 57: JBF). — Rib. Frio along the lev. (Bz, RS 57: JBF). — Lev. das Queimadas to Cald. Verde (RV 58: JBF).

HAB. — Preferentially in moist shady habitats, on cliffs but also recorded from periodically dry, very exposed habitats on steep cliffs. Not recorded below 600 m. Probably rarely growing above 1200 m.

SOC. — Rather high diff. val. of the *Clethro-Laurion,* though rare in the all.

Gennaria diphylla (Lk.) Parl.

EXS. — Curral d. Freiras, N slope of cliffs, 900 m (Sjn 66: U). — Porto da Cruz, cliff, 300 m (Sjn 65: U). — Rib. Frio, 750 m (Sjn 65: U). — Porto Moniz, Santa (Co 33: MMF). — Rib. Frio, 750 m (Pi 62: MMF). — Rabaçal, path to the 25 fontes (RV 60: JBF). — Lev. do Rib. Frio to Balcões (RV: JBF). — Lev. da Serra, between Rib. Frio and Balcões, close to the lev. (Bz RS 57: JBF). — Santo da Serra, Q. da Junta (RV 58: JBF). — Lev. das Queimadas to Cald. Verde (RV 58: JBF).

VIDI — Between Rib. Frio and Balcões, 820 m.

HAB. — Preferentially in moist shady habitats in cloud zone vegetation, on cliffs and volcanic deposits. Generally above 600 m, but observed down to 300 m in the N.

SOC. — This orchid occurs with rather low frequency within the *Clethro-Laurion.* It is not yet sure if it should be nominated as a diff. sp. of the all.

Geranium anemonaefolium l'Hérit.

EXS. — Queimadas, Taborda (Sjn 65: U). — Rib da Ametade after tunnel 950 m (Sjn 65: U). — Queimadas, by the lev. (Sjn 66: U). — Rib Frio (Sjn 65: U). — Cald. Verde (Ga 58: COI). — Rabaçal, Risco (Ga: COI). — Cerco: above Lamaceiros, Fajã do Penedo, in remaining forest (Bz, RS 57: JBF). — Near Pico Jorge, 1000 m (Ro 51: LISU). — Between Poiso and Rib. Frio (Een, Persson 52: LISU). — Rib. Grande (Een, Persson 52: LISU). — Rib. Frio (Mz: LISU). — Lev. Cald. Verde (Ro 49: LISU). — Rabaçal (Ro 49: LISU). — Near Cald. do Inferno, 950 m (Ro 51: LISU). — Lev. Rib. Frio to Juncal (Mz 15: LISU). — Between Rib. Frio and Balcões (Ro 51: LISU). — Vale da Lapa (Cvo 41: LISI). — Encumeada (Bar 60: LISFA). — Rib. do Tristão and Rabaçal (Co 34: MMF.) — Santa Madalena, Porto Moniz (Co: LISFA). — Lev. das Queimadas, on steep slopes, 1220 m (Bz 54: MMF). — In rocky river bed of Rib. S. Jorge, close to Cald. do Inferno (Bz, RS 57: JBF).

VIDI — Between Rib. Frio and Balcões, 20 m. — E of Queimadas, 820 m. — N of Poiso, 850 and 960 m. — W of Encumeada, 1000 m. — Boaventura, 550 m.

HAB. — Preferentially in shady moist habitats, on steeply sloping cliffs or cuttings through volcanic deposits. Recorded from 500-1500 m. Probably growing also somewhat above this altitude and in the N also below 500 m. Generally above 700 m.

SOC. — High diff. val. for the *Clethro-Laurion.* Rather high frequency within this all. Taxonomy: Specimens on Mad. now called *G. palmatum* Cav. The Canarian *G. anemonaefolium* has now become *G. canariense* Reut.

Gnaphalium luteo-album L.

EXS. — Funchal (Mz 1894: COI). — Porto Novo (Ro 51: LISU). — Lev. dos Piomais, 150 m (Ro 51: LISU). — Between Encumeada and Lombo do Moiro, 1100 m (Ro 51: LISU). — S. Vicente, coast (RV: JBF). — Between Porto da Cruz and Portela (RV 60: JBF).

VIDI — S. Jorge, coast. — Cabo Girão, 400 m. — Ponta do Sol, coast.

HAB. — Localities concentrated in the coastal zone below 300 m. Occasionally above this altitude in the S. Preferentially in dry habitats on cliffs and volcanic deposits. Habitat preference given by Lowe (1868): «on moist rocks and walls and in beds of ravines», is in my opinion not correct.

SOC. — Less frequent in the coast vegetation of Madeira than in the Azores. However, high diff. val. for the *Aeonio-Lytanthion* connecting this all. to the *Festucion petraeae* in the Azores.

Helichrysum melanophthalmum (Lowe) Lowe

EXS. — Machico, sea cliff (Sjn 65: U). — Caniçal, cliff, 200 m (Sjn 64: U). — São Vicente (Mz 1894: COI). — Ponta S. Lourenço (Mz 03: COI). — Rib. Frio (Ga: COI). — Junto da Rib. Sta. Luzia, Funchal (COI). — Quinta Grande, Rib. Brava — Madalena (H. Persson 52: LISU). — Rib. d. Cales, 1250 m (Pi 52: LISU). — Rib. Sta. Luzia, 800 m (Ro 51: LISU). — Between Balcões and Fajã da Nogueira, 850 m (Ro 51: LISU). — Between Santana and S. Jorge, cliff (Pi 56: MMF). — Santa Madalena, Porto Moniz (Co: MMF). — Path to Eira do Serrado, 800-1000 m (Bz 54: MMF).

VIDI — Boaventura, 550 m. — Achadas da Cruz, 710 m. — Rib. da Ametade, 570 and 360 m. — Rib. S. Roque, 250 m. — Rib. do Tristão, 650m. — Rib. da Cruz, 675 m. — Rib. do Porco, electrical power station, 500 m. — N of Encumeada, 610 m. — S of Poiso, 1000 and 1200 m. — N of Poiso, 900 m. — Rib. Frio, 750 m. — N of the Ametade bridge, 300 m. — Vale da Lapa, 600 m. — S of the Ametade bridge. 450 m. — Arco S. Jorge, below the miradouro, 330 m. — Rib. Funda, 380 m. — S of Encumeada, 490 m. — Curral das Freiras, lev. towards S. Martinho, 400 m.

HAB. — In crevices on cliffs. High drought resistence. Observed from coast up to 1300 m. Generally between 600-1100 m. Rare between 300-600 m in the S, frequently down to the coast in the N.

SOC. — Low diff. val. for the *Clethro-Laurion*.

Helichrysum obconicum DC.

EXS. — Garajau (Sjn 65: U). — Paul da Serra (Sjn 65: U). — Gorgulho (Mz 1894: COI). — Ilheu do Gorgulho (Ro 51: LISU). — Sta. Cruz (Cvo 41: LISI). — Sta. Madalena, Porto Moniz (Co: MMF). — W of Funchal (RV 62: JBF). Ponta de Sta. Catarina, Sta. Cruz, coast (RV 62: JBF). — Praia Formosa (RV 62: JBF). — Funchal: Ponta da Cruz (JBF). — Between Porto Moniz and Seixal, road cutting (Bz, (Bz, RS 57: JBF). — In rocky river bed of Rib. de São Jorge, colse to Cald. do Inferno (Bz, RS 57: JBF). — Road between Funchal and Eira do Serrado on rocky slopes (Bz, RS 57: JBF).

VIDI — E of Portela, 550 m. — W of Faial, 10 m. — N slope of Rib. S. Jorge, 550 m. — W of Mir. do S. Jorge, 200 m. — W of Porto Moniz, coast and 100 m. — Between Faial and Porto da Cruz, coast. — Between Porto da Cruz and Portela. — Mouth of Rib. do Inferno, 50 m. — Cliff, E of mouth S. Vicente, coast. — Close to Rib. d. Moinhos, 50 m. — Arco S. Jorge, 420 m.

HAB. — Cliffs, crevices, even where there is very little accumulation of soil, more rarely on sandy volcanic deposits. Very drought-tolerant. Observed up to 550 m but generally growing below 200 m.

SOC. — High diff. val. of the *Aeonio-Lytanthion*. High frequency within the all.

Hymenophyllum tunbridgense (L.) Sm.

EXS. — Lev. do Furado close to Pedra Rochada, 800 m (Ro 51: LISU). — Mont. d. Pecegueiros, 800 m (Ro 51: LISU). — Fanal (Welwitsch: LISU). — Rabaçal (Ro 51: LISU). — Rib. Bonito, S. Jorge (Br 69: LISI). — Fanal (Co 34: MMF).

VIDI — N of Encumeada, 950 and 770 m. — Rib. da Janela, 630 m. — Achadas da Cruz, 800 m. — Vale da Lapa, 550 m. — W of Queimadas, 800 m. — E of Queimadas, 820 m. — N slope Rib. S. Jorge, 550 m. — Lamaceiros, 710 m. — Rib. do Moinho, 700 m. — Lev. do Moinho, 630 m. — W of Rib. da Janela, 980 m.

HAB. — Preferentially on tree trunks within the cloud zone vegetation, above 600 m. Low drought-tolerance. Avoiding sparse scrub vegetation of grazing land at altitude above 1200 m.

SOC. — Growing with very high frequency in the *Clethro-Laurion*. High diff. val. of the all. as also of the *Juniperion brevifolii* in the Azores.

Hyparrhenia hirta (L.) Stapf

EXS. — Rib. da Caixa, Estr. de Câmara de Lobos, 300 m (Sjn 66: U). — Porto Novo, coast (Sjn 66: U). — Caniçal, grazing land (Sjn 64: U). — Rib. Sta. Luzia (Ro 51: LISU). — S. Lourenço (Ro 49: LISU). — Pico dos Barcelos, Funchal (Ro 49: LISU). — Cabo Garajau, 200 m (Ro 49: LISU). — Madalena do Mar (Ro 49: LISU). — Pico da Cruz close to lev. do P. Domaix, 140 m (Ro 51: LISU). — S. Gonçalo (Pa and Mz 14: LISU). — Sta. Cruz (Cvo 55: LISI. — Funchal: Q. do Bom Sucesso (Bz 54: MMF). — Pico dos Barcelos (Co 37: MMF). — Caniço (Co 37: MMF). — Arrudal, Porto Moniz (Co 32: MMF). — Pico da Cruz (Co 37: MMF).

VIDI — Caniçal, cliffs, coast. — Piedade, S. Lourenço, 50 m. — Garajau, 50 m. — S of Encumeada, 650 m. — Mouth Rib. da Janela, 50 m. — W slope Rib. Funda valley, Seixal, 200 m. — Curral d. Freiras, lev. towards S. Martinho, 400 m.

HAB. — In grassland vegetation at low altitudes, also in crevices on steep cliffs. High drought-tolerance. Observed up to 650 m. Generally below 200 m.

SOC. — High diff. val. for the *Aeonio-Lytanthion*. Often growing with high degree of cover within the all. Rather high frequency, which does not emerge from table 1.

Ilex canariensis Poir.

EXS. — Lev. do Moinho, 280 m (Sjn 67: U). — Rib. Bonito, Lombo dos Pecegueiros, Rib. Grande, 600 m (Sjn 65: U). — Cidrão, 600 m (Sjn 65: U). — Vale da Ametade, tunnel, 800 m (Sjn 65: U). — Caramujo, 1300 m (Een, Persson 52: LISU). — Machico (Mz: LISU). — Serra S. Roque, 800-1300 m (Mandon: LISU). — Between S. Vicente and Seixal (Ro 49: LISU). — Machico valley (Ro: LISU). — Santana, Queimadas (Fr 51: LISI). — Vale da Lapa (Co 41: LISI). — Curral das Freiras (Co 38: LISFA and MMF). — Rib. do Tristão (Co 33:LISFA and MMF). — P. do Arieiro (RV 62: JBF). — Between Casa do Arieiro and P. do Arieiro (Bz, RS 57: JBF).

VIDI — Paul da Serra, Rib. do Risco. — W of Rib. da Janela, 980 m.

HAB. — Restricted to cloud zone vegetation in slightly exposed habitats. Recorded between 280-1300 m. Increasing frequency above 600 m. Frequency at different altitudes has recently been obscured by cuttings in the forests.

SOC. — Diff. sp. of *Clethro-Laurion*. Rather low frequency and rarely with high degree of cover in shrub or tree layer. Probably recently to a large extent eliminated from the cloud zone vegetation.

Ilex perado Ait. ssp. **perado**

EXS. — Lev. W of Rib. da Janela, 940 m (Sjn 67: U). — Rib. das Cales, 1000 m (Sjn 64: U). — W of Portela, 750 m (Sjn 65: U). — Rib. de Machico (Mz: COI). — Above Seixal, 800 m (Een, Persson 52: LISU). — Arr. do Campanário, 120 m (Ro 49: LISU). — Metada, Serra S. Roque (Mandon 1865: LISU). — Cald. Verde (Cvo 41: LISI). — Encumeada Alta (Cvo 41: LISI). — Rib. Frio (Cvo 41: LISI). — Rib. do Tristão (Co 33: MMF). — Below Pico Ruivo, path to Encumeada, 1560 m (Bz 54: MMF).

HAB. — Similar ecological preference and generally at the same altitude as *I. canariensis*. Not observed by Lowe (1868) below 1000 m, probably overlooked.

SOC. — High diff. val. for the *Clethro-Laurion* as also for corresponding cloud zone community *Juniperion brevifolii* in the Azores. Taxonomy treated by Tutin (1933).

Isoplexis sceptrum (L.) Lindl.

EXS. — Boaventura, João Fernandes, 600 m (Sjn 67: U). — Vale da Lapa, 600 m (Sjn 66: U). — Serra da Boaventura (Mz 03: COI). — Torrinhas (Mz: COI). — Rib. Frio (Mz: COI). — Vale da Lapa (Cvo 41: LISI). — Rib. Frio (Co 38: MMF). — Lev. da Serra between Rib. Frio and Balcões, border of lev. (Bz, RS 57: JBF). — **Queimadas (RV, RS 57: JBF).**

VIDI — E of Rib. Frio. — W of Encumeada, after the first tunnel, 1000 m. — Vale da Lapa, E slope in ravine. — Lev. dos Brasileiros, Rib. da Janela, 900 m.

HAB. — Restricted to slightly exposed habitats, preferentially where there is a continuous water supply, above 600 m. Avoiding open grassland above 1200 m, generally on steep cliffs and in ravines. Colony above Encumeada near path to P. Ruivo, indigenous. Along the levadas many specimens have been planted by Serviços Florestais (inform. by C. H. C. Pickering).

SOC. — High diff. val. for the *Clethro-Laurion*. Highest frequency in the most hygrophilous association of the all.

Juncus acutus L.

EXS. — Sta. Cruz, ravine, coast (Sjn 65: U). — Caniçal, ravine in grazing land (Sjn 65: U). — Ponta do Sol (Sa: COI). — Ponta de S. Lourenço (Bz 54: MMF). — Between the tunnel of Caniçal and Ponta de S. Lourenço (RV, RS 60: JBF).

VIDI — Coast, Ponta do Sol.

HAB. — Closely restricted to grassland localities by the coasts, on sandy deposits in exposed habitats. Probably not growing above 100 m.

SOC. — Diff. sp. of the *Aeonio-Lytanthion*. Low diff. val. for the all. as growing with low frequency in the part of the all. nearest the coast. The high diff. val. of the coastal all. *Festucion petraeae* in the Azores is thus not maintained on Madeira.

Laurus azorica (Seub.) Franco incl. var. **lutea** (Mnzs.) A. Hans. comb. nov.

EXS. — W of Rib. da Janela, 980 m (Sjn 65: U). — Rib. Frio (Mz: COI). — Encumeada da Serra de Água (Ro 49: LISU). — Cald. Verde (Ro 49: LISU). — Monte (Mz: LISU). — Santana, sítio do Longueira, Faial (A. Franco 61: LISI). — Queimadas (Cvo 41: LISI). — Chão das Feiteiras, 1140 m (Bz 54: MMF).

VIDI — N of Encumeada, 600, 700, 770 and 1000 m. — Lev. do Faial, close to Camacha, 750 m. — E of Portela, 550 m. — Between Rib. Frio and Balcões, 800 m. — Rib. da Ametade, 360 m. — S of Poiso, 1190 m. — Rib. S. Roque, 250 m. — Rib. Frio, 750 m. — E of Queimadas, 820 m. — N slope of Rib. S. Jorge, 550 m. — New lev. Rib. da Janela, 350 m. — Road cutting above Porto Moniz, 860 m. — Rib. do Sol, 230 m. — Rib. do Tristão, 650 m. — Porto Moniz, coast. — Camacha, 700 m. — W of Poiso, 1240 m. — E of Rib. Frio. — Cam. dos Loiros, 1220 m. — Lamaceiros, 790 m. — E of Poiso, 1300 m. — Rib. da Ametade, 400 and 570 m. — S of Encumeada, 1000 m. — Rib. da Janela, 490 and 600 m. — Achadas da Cruz, 850 m. — Seixal, 440 m. — Cidrão, 650 m. — Arco S. Jorge, below miradouro, 330 m. — Rib. Funda, 380 m. — S. Jorge, 70 m. — Fajã do Limão, 250 m. — Lev. do Moiro, 630 m. — N of Rib. Brava, 400 and 490 m. — W slope Vale da Rib. da Janela, 970 m. — W of Encumeada, 1000 m. — Vale do Seixal 1300 m. — Boaventura, João Fernandes, 600 and 550 m. — Boaventura, Falca de Cima, 430, 250 and 180 m. — Rib. do Moinho, 700 m. — Lev. do Moinho, 630 m. — Ravine above Porto Moniz, 880 m. — N of Monte, 940 and 1000 m — S of the Ametade bridge, 400 m. — Vale da Lapa, 600 m. — Lamaceiros, 710 m. — Rib. do Marques, Santana, 100 m. — Lev. da Costa, Curral, 450 m. — Ponta do Sol, Lombo, 830 m. — Lev. da Tabua close to lev. do Moinho, 670 m. — Bridge over Rib. do Urzal, 120 m. — Mouth Rib. da Janela, NE-facing slope, above 100 m, up to 500 m. — Curral d. Freiras, lev. towards S. Martinho, N-facing slope in ravine, 400 m.

HAB. — Important constituent of cloud zone vegetation. Low drought-resistance. Generally above 200 m in the N, rarely below 450 m in the S. Throughout the island: generally 600-1100 m. To a large extent eliminated by overgrazing, burning and cutting from altitudes above 1200 m. Rarely reaching altitudes above 1500 m.

SOC. — Diff. sp. of the *Clethro-Laurion*, locally dominant species in tree and shrub layers. High frequency in the all. Also diff. sp. of the cloud zone all. in the Azores.

Lotus subbiflorus Lag.

EXS. — Porto da Cruz, sea cliff (Sjn 66: U). — Between Porto Moniz and Seixal (Sjn 66: U). — S. Jorge, 50 m (Sjn 66: U). — S. Lourenço, grazing land (Sjn 66: U). — Between Caniçal and P. do Degroal, 100 m (Co 54: LISU). — N of Machico (Ro 51: LISU). — Close to Porto Novo (Ro 51: LISU). — Ponta do Pargo, farol (Ro 49: LISU). — Caniço (Mz 15: LISU). — Lev. do Cald. Verde (Cvo 41: LISI). — Vale da Lapa (Cvo 41: LISI). — Paul da Serra (Bar 60: LISFA). —

Sta. Cruz, Caniço, Ponta da Oliveira, 20 m (Bz 54: MMF). — Monte (Co 37: MMF).

VIDI — W of Faial, 10 m. — Porto da Cruz, 10 m. — Lev. do Faial, 700 m. — Ponta do Sol, coast. — Vale S. Jorge, 460 m. — Porto Moniz, coast and 100 m. — N of Poiso, 620 m. — Ametade bridge, 380 m. — Rib. Brava, coast cliff. — High plateau above Porto Moniz, W of Rib. da Janela, 850 m.

HAB. — High drought-tolerance. Low competitive ability. Both on cliffs and on sandy volcanic deposits. The presence of the species in mountain pastures above 850 m as mentioned by Lowe (1868), was verified only in one locality. Generally growing below 400 m in the S.

SOC. — Not recorded from completely developed *Clethro-Laurion*. High diff val. for the *Aeonio-Lytanthion*. Connecting diff. sp. to the coastal *Festucion petraeae* in the Azores.

Lytanthus salicinus (Lam.) Wettst.

EXS. — Caniçal, cliff, 150 m (Sjn 64: U). — Rib. St. Luzia, Ponte da Fundra, 300 m (Ro 51: LISU). — Foz. a Rib. do Porto Novo (Ro 51: LISU). — Rib. da Furna (Ro 51: LISU). — Praia Formosa (Mz 14: LISU). — Monte, Sarmento (Mz 12: LISU). — Close to S. Jorge and S. Vicente (Pa: LISU). — Miradouro do Porto Moniz (Bar 60: LISFA). — Rib. da Janela (Co 28: MMF). — Caniço: Garajau, 150 m (Bz 54: MMF).

VIDI — Prazeres, 200 and 475 m. — Porto Moniz, coast. — S of Calheta, coast. — N of Rib. Brava, 30, 350, 500 and 650 m. — Rib. do Porco, 500 m. — S of Encumeada, 700 m. — N of Encumeada, 390 m. — Monte, 300 m. — N of Poiso, 420 m. — N of the Ametade bridge, 200 and 300 m. — Between Faial and Porto da Cruz, 50 m. — Between Porto da Cruz and Portela, 300 m. — Between Canhas and Paul da Serra, 500 m. — Garajau, 25 m. — Rib. da Ametade, 400 and 360 m. — Rib. da Janela, coast. — Cidrão, 650 m. — Vale da Lapa 550 m. — Porto Novo, 50 m. — W of Faial, 10 m. — Ponta do Clérigo, 420 m. — Rib. S. Roque, 250 m. — Ravine, Estreito de Câmara de Lobos, 300 m. — Cliff above Porto Moniz, 250 m. — New lev. on E-facing slope of the Rib. da Janela valley, 350 m. — Rib. da Cruz, 600 m. — 3 km above Ponta do Pargo, 400 m. — Curral das Freiras, lev. da Costa, 450 m. — Rib. do Marques, Santana, 100 m. — Lev. do Moinho after Fajã do Limão, 260 m. — Mouth of Rib. do Inferno, 50 m. — Rib. d. Moinhos, 50 m. — Bridge over Rib. do Urzal, 120 m. — Arco S. Jorge, 420 m. — Mouth of Rib. Funda. — Boaventura, 250 and 180 m. — Between Camacha and Portela, Águas Mansas, 600 m. — Rib. da Janela valley, NE slope, 300 m. — W slope Rib. Funda, Seixal, from coast up to 300 m. — Boaventura, up to 400 m. — Curral, lev. towards S. Martinho, 400 m.

HAB. — On cliffs and volcanic deposits, level and steeply sloping ground. Recorded up to 700 m in the S but generally not above 500 m. In the N rarely above 400 m. Throughout the island: generally below 300 m.

SOC. — High diff. val. of the *Aeonio-Lytanthion*, frequently dominant in the all. Never observed in completely developed cloud zone vegetation.

Matthiola maderensis Lowe

EXS. — Coast cliff, Porto Moniz — Seixal (Sjn 66: U). — Funchal (Sjn 65: U).

— Garajau, coast (Sjn 66: U). — Porto Santo, S coast (Sjn 66: U). — Gorgulho, (Mz: COI and LISU). — Close to Furado da Feiyá (Ro 66: LISU). — Gorgulho, 15 m (Ro 51: LISU). — Praia Formosa (Pi 56: MMF). — S. Gonçalo (Co 37: MMF). — Porto Moniz (Co 32: MMF). — Ilheu do Farol (Bz 54: MMF). — Fonte da Areia, Porto Santo (RV 60: JBF). — Ilheu dos Desembarcadouros (RV 62: JBF). — Cabo Girão (RV 63: JBF). — Praia Formosa (Bz, RS 57: JBF). — Between Porto Moniz and Seixal by the road (Bz, RS 57: JBF).

VIDI — Queimadas, 800 m. — Garajau, 50 m. — Ponta do Sol, coast. W of Porto Moniz, coast and 100 m. — S of Calheta, coast. — S of Faial, 50 m. — Between Faial and Porto da Cruz, 50 m. — Rib. d. Moinhos, 50 m. — Garajau, coast. — Porto Santo, W of village, coast.

HAB. — Generally below 200 m, on cliffs and volcanic deposits. High drought-tolerance. Said by Lowe (1868) to be common up to 850 m, which was certainly an exaggeration for this typical coastal plant.

SOC. — Diff. sp. of the *Aeonio-Lytanthion,* rather low frequency in the all. Lowe (1868): «very common», now there are smaller areas of suitable localities than 100 years ago.

Musschia aurea (L. f.) DC.

EXS. — Garajau, coast (Sjn 66: U). — Cabo Garajau (Tavares: LISU). — Praia Formosa (Mz 1900: LISU). — Road from Rib. Brava, to Ponta do Sol (Bar 60: LISFA). — Between Ponta do Sol and Madalena do Mar, close to dos Anjos (Bz, RS 57: JBF). — Pináculo close to the miradouro (RV, RS 57: JBF). — Estr. da Rib. to Lugar de Baixo numa parede marginal (RV, RS 57: JBF). — St. Martinho (Co: MMF).

HAB. — Preferentially on densely packed sandy deposits, very exposed localities. Generally below 300 m. Accidentally until 500 m (cf. Boesser 1951).

SOC. — Diff. species of the *Aeonio-Lytanthion.* Rather low diff. val., however, as the frequency is low within the all. Contrarily to *M. aurea* there is another species of the same genus, *M. wollastoni* Lowe which is now extremely rare and confined to the cloud zone vegetation in the N (cf. Johnson 1857).

Myrica faya Ait.

EXS. — Rib. da Janela, 400 m (Sjn 65: U). — Machico, 200 m (Sjn 65: U). — Rib. das Cales, 1090 m (Sjn 64: U). — Camacha (Mz 03: COI). — Seixal (Sa: COI). — Santana: Queimadas, close to Casa da Junta (Fr 61: LISI). — Q. do Palheiro (Bz, RS 57: JBF). — Mont. d. Pecegueiros, close to Rib. da Passagem (Bz, RS 57: JBF). — Lev. da Serra between Rib. Frio and Balcões, border of lev. (Bz, RS 57: JBF).

VIDI — W of Porto Moniz, coast. — Rib. do Porco, 500 m. — S of Encumeada, 700 m. — N of Encumeada, 900, 700, 600 and 400 m. — N of Poiso, 800 and 850 m. — N of the Ametade bridge, 300 and 380 m. — S of Faial, 50 m. — Porto da Cruz, coast. Between Portela and Porto da Cruz, 300 m. — S of Portela, 450 and 350 m. — Vale da Lapa, 600 m. — S of the Ametade bridge, 450 m. — Vale de Machico, 100 m.

— Rib. da Janela, 480 and 600 m. — Seixal, 380 and 440 m. — W of Encumeada, 1000 m. — Lev. do Faial, 770 m. — W of Faial, 10 m. — Ponta do Clérigo, 10 m. — Rib. S. Roque, 250 m. — Cabo Girão, 500 m — Rib. S. Jorge, 530 m. — N slope Rib. S Jorge, 550 m. — New lev. W slope of Rib. da Janela, 350 m. — W of Miradouro S. Jorge, 200 m. — Rib. Tristão, 650 m. — Rib. da Cruz, 700 m. — Rib. do Marques, Santana, 100 m. — Lev. da Costa, Curral, 450 m. — Bridge over Rib. do Urzal, 120 m. — Arco S. Jorge, 420 and 330m, below miradouro. — S. Jorge, 70 m. — Lev. do Moiro, 630 m. — Boaventura, 550, 600 m and Falça de Cima 430, 180 m. — Lev. do Moinho, 630 m. — Vale da Rib. da Janela, NE slope, from 100-500 m. — Mouth Rib. Funda, Seixal, coast up to 500 m. — Boaventura, 250 m. — Curral, lev. towards S. Martinho, 400 m.

HAB. — On cliffs and sandy — coarse volcanic deposits. High drought-tolerance. Growing from coasts up to about 1000 m. Frequently below 600 m but also a fairly frequent and locally abundant constituent of the cloud zone vegetation. Attributed by Bowdich (1825) to mountain localities.

SOC. — The diff. val. for coastal plant communities is much lower on Madeira than in the Azores. *Myrica* is not rare in the tree and shrub layer of cloud zone vegetation on Madeira. In the Canary Islands the cloude zone vegetation is frequently composed by *Erica arborea* and *Myrica faya* (cf. Schmied 1954).

Ocotea foetens (Ait.) Baill.

EXS. — Vale da Lapa, 600 m (Sjn 66: U). — Monte (Mz: COI). — Rabaçal (Pa: LISU). — Serra de Santana (Ro 49: LISU). — Lamaceiros, Santana (Fr 61: LISI). — Mont. d. Pecegueiros (Cvo 41: LISI). — Same, 460 m (Bz 54: MMF). — Between P. Ruivo and Cald. do Inferno, 1700 m (Bz 54: MMF). — Rib. das Lages (RV 62: JBF).

VIDI — W of Encumeada, 1000 m. — Boaventura, 550 m. — Between Rib. da Janela and mouth of Rib. Funda, 450 and 500 m.

HAB. — Only in cloud zone vegetation in moist, slightly exposed habitats. Rarely below 600 m.

SOC. — Now rare tree or shrub in the *Clethro-Laurion* but with high diff. val. of the all. Recently eliminated from several localities as the wood is in great demand for construction and furniture.

Opuntia tuna (L.) Mill.

VIDI — Caniçal, 225 m. — Vale de Machico, 100 m. — Trigo de Negreiros. — Cabo Garajau, coast. — Ponta do Sol, coast. — S of Calheta, coast. — N of Rib. Brava, 30 and 500 m. — Rib. d. Moinhos, 50 m. — Towards lev. do Moinho, mouth of the valley, 240 m. — Curral d. Freiras, lev. da Costa, 450 m. — Curral das Freiras, lev. towards S. Martinho, 400 m.

HAB. — High drought-tolerance. Recorded up to 500 m in the S, rare on the N coast. Generally below 300 m.

SOC. — Introduced in order to bread cochineal, an export once quite

profitable. Now naturalized regionally especially in the S coast vegetation on volcanic deposits. High diff. val. of the *Aeonio-Lytanthion* and frequently dominant species in this all. Already well established on Madeira 100 years ago (comp. Lowe 1868).

Phagnalon saxatile (L.) DC.

EXS. — Sta. Cruz, sea cliff (Sjn 65: U). — S. Lourenço, coast (Sjn 66: U). — Porto Santo, SW coast below 200 m (Sjn 66: U). — Encumeada, Capela de S. João, 490 m (Sjn 67: U). — Caniço, Garajau, 150 m (Bz 54: MMF). — Q. do Curral d. Romeiros (RV 62: JBF). — Lev. do Bom Sucesso (RV 63: JBF). — Pico Branco, Porto Santo (RV 62: JBF). — Caniçal, Piedade (RV 65: JBF). — Ponta S. Lourenço (Bz 57: JBF). — Fajã dos Arnos, no sopé do Cabo Girão (Bz, RS 57: JBF). — Porto Santo: Pico Ana Ferreira (RV 58: JBF). — Between the tunnel of Caniçal and Ponta de S. Lourenço (RV, RS 60: JBF).

HAB. — High drought tolerance. Preferentially in open grassland on sandy volcanic deposits. Rarely above 200 m.

SOC. — High diff. val. for the *Aeonio-Lytanthion* but growing with a rather low frequency in this all.

Plantago arborescens Poir. var. **maderensis** (Dcne.) Pilg. incl. var. **compacta** Barneoud (incl. P. **costae** Mnzs).

EXS. — Machico, N coast, 100 m (Sjn 65: U). — Porto da Cruz, sea cliff, 300 m (Sjn 65: U). — Porto Santo: Pico Castelo, 300 m (Sjn 66: U). — Caniçal, cliffs, 200 m (Sjn 65: U). — Pousada d. Vinhaticos (H. Persson 52: LISU). — Gorgulho, coast (Ro 51: LISU). — Praia Formosa, 50 m (Ro 51: LISU). — S. Vicente (Ro 49: LISU). — Cabo Girão (Pa: LISU). — Sta. Cruz freg. do Caniço, Garajau (Bz 54: MMF). — Path down from Quebrada de Azeda to Lev. do Juncal (RV 62; JBF). — Praia Formosa (RV 62: JBF). — Incultos de fena acima e perto da Estr. junto ao Pináculo, S. Gonçalo (RV: JBF). — Porto Santo: Pico Branco (RV 63: JBF). — Porto Santo: Pico Ana Ferreira (RV 64: JBF). — Praia Formosa (Bz, RS 57: JBF) — Fajã dos Arnos, no sopé do Cabo Girão (Bz, RS 57: JBF). — Porto Santo: Pico Castelo (RV 58: JBF). — Porto Moniz (Co 33: MMF). — Porto Santo: P. do Castelo (Co 40: MMF). — Rib. Brava (Co 36: MMF). — Porto Santo: Pico do Conselho (Co 39: MMF).

VIDI — Garajau. — W of Encumeada, 1000 m. — Ponta do Sol, coast. — Porto Moniz, coast. — Rib. do Porco, 500 m. — Lev. da Costa, Curral, 450 m — Ponta Delgada, close to the church, coast. — Mouth of Vale da Rib. do Inferno, 50 m. — E of mouth S. Vicente, — Rib. d. Moinhos, 50 m. — Curral, lev. towards S. Martinho, 400 m.

HAB. — Preferentially on cliffs, also on densely packed volcanic deposits, in very exposed habitats. Generally below 400 m. Occasionally reaching 1000 m in the S.

SOC. — Diff. sp. of the *Aeonio-Lytanthion*. High diff. val.

Plantago coronopus L.

EXS. — Caniçal, cliffs, 5 m (Sjn 65: U). — Ilheu d. Desembarcadouros (Ad, Go: COI). — Gorgulho, coast (Mz 03: COI and Mz 14: LISU). — Deserta Grande,

cliffs close to the sea, W coast (Bz 57: JBF). — S. Lourenço, Cancela (Ro 51: LISU). — Ilheu do Gorgulho (Ro 51: LISU). — Choupana (Mz 1889: LISU). — Porto Moniz (Co 33: MMF). — Porto Santo: Pico do Castelo (Co 40: MMF). — Deserta Grande (Co 38: MMF). — Rib. Brava (Co: MMF). — P. do Conselho (Co: MMF). — S. Martinho, Arieiro (Co 38: MMF) — Praia Formosa (Co 38: MMF). — Ilheu do farol (Bz: MMF).

VIDI — Caniçal. — Porto da Cruz. — Sta. Cruz. — Piedade, 50 m. — W of Faial, 10 m. — Cabo Garajau. — Ponta do Sol, coast. — Porto Moniz, coast and 100 m.

HAB. — Sea cliffs and coarse volcanic deposits as well as on fine densely packed deposits. High drought-tolerance. Probably only rarely above 100 m.

SOC. — High diff. val. of the *Aeonio-Lytanthion* as also of the coastal *Festucion petraeae* in the Azores.

Polygonum maritimum L.

EXS. — Caniçal, S. Lourenço, loose sand in ravine, 50 m (Sjn 65: U). — S. Lourenço (Ro 49: LISU) — Praia do Porto Santo (LISU). — Fonte da Areia (RV 58: JBF). — Between fábrica and Ponta de S. Lourenço (RV, RS 60: JBF).

HAB. — Only in coastal grassland vegetation on sandy deposits below 200 m, restricted to the easternmost peninsula of Madeira. High drought resistance.

SOC. — Connecting the *Festucion petraeae: Polygonetum maritimi* (Sjögren 1972) in the Azores to the *Aeonio-Lytanthion: Bisserulae-Scorpiurietum,* on Madeira recorded only from Ponta de S. Lourenço.

Polypogon maritimus Willd.

EXS. — Ilheu dos Desembarcadouros (Ro 51: LISU). — Porto Moniz (Co 32: LISU). — Porto Santo: P. Branco (Co 40: LISU). — Porto Santo: Vale Formoso (Co 39: MMF). — Porto dos Frades (Co 40: MMF). — Terra Chã on Pico Branco, Porto Santo (MMF). — Porto Moniz, Figueiral (Co 32: MMF). — Ilheu do Farol (Bz: MMF).

VIDI — Vale da Rib. da Janela, NE slope, coast up to 400 m. — Rib. Funda, Seixal, W slope from coast up to 450 m. — Boaventura, up to 400 m. — Curral das Freiras, lev. towards S. Martinho, 400 m.

HAB. — Restricted to dry coastal localities where there is little competition in the plant cover. Rarely above 300 m.

SOC. — Low frequency makes the sp. unsuitable as diff. sp. of the *Aeonio-Lytanthion.* However, it connects this all. with the Azorean *Festucion petraeae.* On Madeira growing frequently u.c. *Lagurus ovatus.*

Polystichum setiferum (Forssk.) Moore ex Woynar

EXS. — Rabaçal, 920 m (Sjn 65: U). — Lev. do Faial, 780 m (Sjn 66: U). — Rib. da Janela, 500 m (Sjn 65: U). — Rib. Frio (Ga 53: COI). — Terreiro da

Luta (Ga 54: COI). — Curral d. Freiras (Sa: COI). — Rib. Frio (Pa: LISU) — Between Curral d. Romeiros and Choupana, 600 m (Ro 51: LISU). — Rabaçal (Ro 49: LISU). — Rib. Frio (Co 38: MMF). — Porto Moniz (Co 32 and 28: MMF). — Arieiro, between the house and Pico, 1590 m (Bz 54: MMF). — Juncal e Rib. das Lages (RV 62: JBF). — Lev. dos Balcões (RV 62: JBF). — Between Santo da Serra and Sta. Cruz (JBF). — Road to Terr. da Luta (Bz, RS 57: JBF). — Queimadas, lev. (Pi 58: MMF).

VIDI — Vale do Seixal, 1300 m. — Paul da Serra, Rib. do Risco. — Boaventura, 600 m. — Rib do Moinho, 700 m. — W of Rib. da Janela, 980 m. — Rib. Frio to Balcões, 820 m. — Rib. Frio, 750 m. — Lev. do Faial, 700 m. — E of Queimadas, 820 m. — N slope of the S. Jorge valley, 460 m. — New lev. W slope of Vale da Rib. da Janela, 350 m. — Above Porto Moniz, 880 m. — N of Poiso, 1300 m. — S of Portela, 400 m. — N of Encumeada 600 and 900 m. — Ponta do Sol, Lombo, 850 m. — Ponta do Pargo, Lombo, 650 m. — Lev. do Moiro, 630 m. — Rib. Funda, 380 m. — W of Encumeada after the first tunnel, 1000 m. — Rib. da Janela valley, NE-facing slope, 300 m.

HAB. — Preferentially in dense cloud zone vegetation in slightly exposed habitats. Recorded from 300-1590 m. In the N frequently growing down to 400 m, but in the S, rarely below 600 m. Highest frequncy between 700-1100 m.

SOC. — Rather high diff. val. of the *Clethro-Laurion* but also present in transitions between the *C.-L.* and the *Aeonio-Lytanthion.* Connecting diff. sp. to the *Juniperion brevifolii* in the Azores.

Pteris arguta Ait.

EXS. — Queimadas (Ga 54: COI). — Rabaçal (Ga 60: COI). — Lev. Cald. Verde (Ro 49: LISU). — Rib. Frio (LISU). — Lev. do Furado por baixo do Cab. dos Pecegueiros a Areche (Ro: LISU). — Rabaçal (Pa: LISU). — Cald. Verde, Santana (Cav 41: LISI). — Queimadas (Pi 58: MMF). — Between Rib. do Inferno and Mont. d. Pecegueiros (Bz 54: MMF). — Between Pico Ruivo and Cald. do Inferno, 1700 m (Bz 54: MMF). — Rabaçal, 25 fontes (RV: JBF). — Seixal (Co 27: MMF). — Rib. Frio (Co 38: MMF).

VIDI — Lev. dos Brasileiros, Rib. da Janela, 990 m. — Rib. da Janela valley, NE-facing slope, 350-500 m. — Boaventura, at altitudes above 250 m.

HAB. — Restricted to moist, slightly exposed habitats in the cloud zone vegetation. Probably rarely below 700 m but recorded up to 1700 m.

SOC. — Rather rare species with diff. val. of the *Clethro-Laurion* as also of the *Juniperion brevifolii* in the Azores.

Ranunculus cortusifolius Willd.

EXS. — Rabaçal (Een, Persson 52: LISU). — Fonte do Bispo (Co 35: MMF). — Bica da Cana, 1620 m (Bz 54: MMF). — Rib. da Ametade, mouth of the tunnel, 570 m (Sjn 65: U). — Arieiro, 1600 m (Sjn 66: U). — E of Rib. Frio, 750 m (Sjn 65: U). — Arieiro, 1500 m (Ro 49: LISU). — Between Pico Ruivo and Cald. do Inferno, 1700 m (Bz 54: MMF). — Rabaçal, path to the 25 fontes (RV 60: JBF). — Mont. d. Pecegueiros emargossas da Rib. da Passagem (RV 57: JBF). — Chão das Feiteiras (Bz, RS 57: JBF). — Lev. das Queimadas to Cald. Verde (RV 58: JBF). — Fonte da Pedra (Co 31 and 48: MMF).

VIDI — Rib. da Ametade, 930 m. — Queimadas, 800 m. — W slope of Vale da Rib. da Janela, 950 m. — W of Encumeada, 1000 m. — Paul da Serra, S of Rib. do Risco. — Boaventura, João Fernandes, 600 m.

HAB. — Preferentially in slightly exposed habitats where there is a water supply. In dense cloud zone vegetation or in crevices of cliffs at high altitudes. Observed between 570-1700 m. Generally between 700-1200 m. Lowe (1868): «rather common»; now rather rare.

SOC. — High diff. val. of the *Clethro-Laurion*. However, absent from the grassland ass. of the all. on level or slightly sloping ground above 1200 m. *R. cortusifolius* connects the *C.-L.* with the *Juniperion brevifolii* in the Azores (cf. table 4) as the sp. is also a diff. sp. of this all.

Rubia angustifolia L.

EXS. — Achadas da Cruz, 800 m (Sjn 65: U). — Rib. Frio (Mz 03: COI). — Lev. do Furnado below P. do Suma, 750 m (Ro 51: LISU). — Cald. Verde, 920 m (Ro 51: LISU). — Rib. Frio (Mz 15: LISU). — Lev. do Rib. Frio (RV 62: JBF) — Mont. dos Pecegueiros, junto a Rib. da Passagem (Bz, RS 57: JBF). — Lev. da Serra, between Rib. Frio and Balcões, border of the lev. (Bz, RS 57: JBF). — Cerco: above Lamaceiros, Fajã do Penedo, in remaining forest on slope above tunnel (Bz, RS 57: JBF).

VIDI — Rib. da Ametade, 930 m. — Valè da Lapa, 550 m. — Rib. Frio, 750 m. — E of Queimadas, 870 m. — New lev. W slope of Vale da Rib. da Janela, 350 m. — N of Encumeada, 750 and 680 m. — W of Encumeada, 1000 m. — Boaventura, 600 m. — Lev. dos Brasileiros, 900 m. — NE of mouth of Rib. da Janela, 400 m. — W of mouth of Rib. Funda, Seixal, 350-500 m.

HAB. — Growing within a rather wide altitude range from 350 up to at about 1000 m, generally above 600 m. High drought tolerance, as frequently recorded from crevices of very exposed cliffs. Also on cuttings through volcanic deposits.

SOC. — Rather high diff. val. for the *Clethro-Laurion*. Growing with rather high frequency within the all. The *Rubia* of the cloud zone all. in the Azores is named *R. peregrina* L. var. *azorica* Tut. & War. (cf. Palhinha 1966).

Rubus grandifolius Lowe

EXS. — Rib. Frio (Sjn 65: U). — Rib. Frio (Mz: COI). — Rib. St. Luzia (Mz 03: COI). — Queimadas dos Furados do Cald. Verde, 900 m (Ro 51: LISU). — Rib. da Ametade (Mandon 1865-66: LISU). — Santana. Queimadas (LISI). — Seixal (MMF). — Mont. dos Pecegueiros, 460 m (Bz 54: MMF). — Rib. das Queimadas (RV: JBF).

VIDI — Rib. da Ametade, 400 m. — Rib. da Janela, W slope, 490 m. — Queimadas, 800 m. — Rib. do Inferno, 50 m. — N slope Rib. S. Jorge, 500 m. — Rib. do Porco, 500 m. — N of Poiso, 960 m. — Vale da Lapa, 600 m. — N of Encumeada,

900 m. — W of Encumeada, 1000 m. — Rib. do Moinho, 700 m. — Rib. da Janela valley, NE-facing slope, 350 m. — W of mouth of Rib. Funda, Seixal, 350 m.

HAB. — Preferentially in moist shady habitats. Highest frequency in slightly exposed ravines and crevices. On cliffs and soil cuttings. Recorded from 50-1000 m. In the S part of the island rarely below 600 m, in the N rarely below 400 m. Localities below 400 m are generally to be found only on the N coasts. These localities on the N coast were not mentioned by *Lowe* (1868).

SOC. — Strong diff. val. of the *Clethro-Laurion,* however, with low frequency in the most drought tolerant ass. of the all., in open grassland vegetation. A large species with similar ecological preference and diff. val. of the cloud zone all. in the Azores is *Rubus hochstetterorum* (Sjögren 1972).

EXS. — Lev. do Moinho, 630 m (Sjn 67: U). — Rib. Frio, 750 m (Sjn 65: U). — Rabaçal close to path to 25 fontes (RV 60: JBF). — Montada da Ilha (RV 60: JBF). — After the Encumeada passpoint, between Lamaceiros and Cova da Roda on slopes close to the road (Bz, RS 57: JBF). — Lev. da Serra between Rib. Frio and Balcões, border of lev. (Bz, RS 57: JBF). — Cerco: above Lamaceiros, Fajã do Penedo, in remaining forest on cliffs above the tunnel (Bz, RS 57: JBF). — Lev. das Queimadas to Cald. Verde (RV 58: JBF).

VIDI — Between Rib. Frio and Balcões, 820 m. — E of Queimadas, 820 m. — New lev. E-facing slope Vale da Rib. da Janela, 375 m. — Vale da Lapa, 600 m. — Rib. do Moinho, 700 m.

HAB. — Prefers slightly exposed habitats in dense cloud zone vegetation. Rarely beloy 600 m. Recorded below this altitude only in the N. Avoids open grassland vegetation at high altitudes. This sp. appears frequently with epiphyllous hepatics on the leaves in very sheltered habitats with usually high RH values above 85%.

SOC. — High diff. val. of the *Clethro-Laurion,* highest frequency in its most hygrophilous association, *Deschampsietum argenteae.* Taxonomy treated by Yeo (1968).

Saxifraga maderensis Don

EXS. — Arieiro, 1600 m (Sjn 66: U). — Curral d. Freiras, 1000 m (Sjn 65: U). — Lev. do Rib. Frio (Mz: COI). — Between Rib. Frio and Balcões (Een, Persson 52: LISU). — Pousada dos Vinháticos (Een, Person 52: LISU). — Cald. Verde, 950 m (Ro 51: LISU). — Balcões to Fajã da Nogueira, 850 m (Ro 51: LISU). — Rib. Frio (Mz 1900: LISU). — Cald. Verde (Cvo 41: LISI). — Seixal (Co 27: MMF). — Rib. do Tristão (Co: MMF). — P. do Cidrão (Maul 59: MMF). — Rabaçal near Risco (Pi 58: MMF). — Between P. Ruivo and Cald. do Inferno, 1700 m (Bz 54: MMF). — Near Eira do Serrado, 900 m (Bz 54: MMF). — Rabaçal close to path to Risco (RV 60: JBF). — Cam. to Curral d. Freiras (RV 63: JBF). — Rocky riverbed of Rib. de São Jorge, near Cald. do Inferno (Bz, RS 57: MMF). — Between P. Arieiro and Cidrão (RV: JBF).

VIDI — Soil cutting, P. do Arieiro, 1720. — Rib. da Ametade, 930 m. — N of

Rib. Brava, 500 m. — Curral, lev da Costa, 450 m. — Rib. da Ponta do Sol, Fajã do Limão, 320 m. — Curral d. Freiras, lev. towards S. Martinho, cliff exposed towards N, 400 m.

HAB. — Preferentially in moist, slightly exposed habitats, on steeply sloping cliffs. Observed from 320-1720 m but generally growing above 600 m and below 1500 m.

SOC. — Diff. sp. of the *Clethro-Laurion*. Only in rather few localities, therefore not present in the sample plots of table 2.

Sedum nudum Ait.

EXS. — Porto da Cruz, coast (Sjn 65: U). — Porto Santo: Pico Castelo (Sjn 65: U). — Tunnel of Fajã da Areia, coast (Ro 51: LISU). — Cab. da Malhada, 300 m (Ro 51: LISU) — S. Vicente, coast (RV 62: JBF).

VIDI — Caniçal, cliff, 150 m. — W of Faial, 10 m. — Porto Moniz, coast. — E of mouth S. Vicente, coast. — Rib. d. Moinhos, 50 m. — Valley of Rib. da Janela, NE-facing slope, coast and 100 m. — Mouth of Rib. Funda, Seixal.

HAB. — High drought tolerance. Preferentially on very exposed cliffs. Rarely above 200 m. Observed up to 300 m. On Porto Santo recorded at 330 m (inform. by C. H. C. Pickering).

SOC. — High diff. val. for the *Aeonio-Lytanthion,* rather frequent in the all. on sea cliffs along both N and S coasts. Confusion with *Sedum brissemoretii* might occur on the N coast, where this species grows in equal habitats as *S. nudum* (cf. Hansen 1969 a).

Senecio incrassatus Lowe

EXS. — Caniçal, 50 m (Sjn 65: N). — Porto Santo: Fonte da Areia, coast (Sjn 66: U). — S. Lourenço (Sjn 66: U). — Deserta Grande (Co: MMF). — Ilheu Chão (Co: MMF). — Ilheu do Farol (Bz 54: MMF). — Caniçal, Piedade (RV 65: JBF). — Ilheu d. Desembarcadouros (Bz: JBF). — Near Garajau, close to the road (Bz, RS 57: JBF). — Between fábrica and Ponta de S. Lourenço (RV, RS 60: JBF). — Porto Santo, Lombas (Co 39: MMF).

HAB. — High drought tolerance. Restricted to open grassland by the coasts, mainly on the easternmost part of the island. Colonizing in the primary stage of succession, on eroded volcanic sand-gravel deposits, below 200 m.

SOC. — Low diff. val. of the *Aeonio-Lytanthion,* as the species has very low frequency in the all.

Silene maritima With. incl. v. **elata** P. Cout. ex C. Romariz

EXS. — Ponta do Sol, coast (Sjn 66: U). — Ponto Santo: P. Branco (Sjn 66: U). — Cabo Garajau, coast (Sjn 66: U). — Ponta do Sol (Mz: COI). — Ponta de S. Lourenço (Mz: COI). — P. do Degroal, S. Lourenço (Ro 52: LISU). — Cab. da Malhada, 300 m (Ro 51: LISU). — Rib. Frio (Mz: LISU). — Cabo Garajau (Pa: LISU). — Poso da Neve (Mandon 1865-66: LISU). — S. Lourenço (Ro 49: LISU). —

Porto Moniz (Co 32: LISU). — Deserta Grande (Co 38: MMF). — Porto Moniz (Co 32: MMF). — Seixal (Co 27: MMF). — Porto Santo: Pico do Baisco (Co 40: MMF). — S. Vicente, coast (RV 62: JBF). — Ponta S. Lourenço (Bz 57: JBF). — Ilheu Chão, Desertas (Bz 57: JBF). — Ponto Santo: Azoirão and Terra Chã (RV 58: JBF).

VIDI — Vale de Machico, 270 m. — Ponta do Sol, S of Calheta, Porto Moniz. — Rib. Brava, by the coast. — Mouth of Rib. da Janela.

HAB. — High drought tolerance. On cliffs and volcanic deposits. Recorded up to 300 m but generally below 200 m.

SOC. — High diff. val. of the *Aeonio-Lytanthion*. Growing with rather high frequency in the all. Also diff. sp. of one association of the coastal all. the *Festucion petraeae* in the Azores (Sjögren 1972).

Sinapidendron angustifolium (DC.) Lowe

EXS. — S of Paul da Serra, 300 m (Sjn 65: U). — Lugar de Baixo (Mz: COI). — Rochas da Praia Formosa (Mz 14: LISU). — Cabo Girão, 550 m (Bz 54: MMF and RV 63: JBF). — Praia Formosa (RV 57: JBF).

VIDI — Sea cliffs by the road W of Rib. Brava.

HAB. — On very exposed sea cliffs, probably very drought tolerant species. Rarely above 500 m.

SOC. — Closely restricted to the *Aeonio-Lytanthion* but with much too low a frequency to be nominated a diff. sp. of the all.

Sinapidendron frutescens (Ait.) Lowe

EXS. — W of Encumeada, 1000 m (Sjn 65: U). — Rib. Funda, 490 m (Sjn 65: U). — Prox. Casa das Torrinhas, Falça de Cime to the Torrinhas Pass (Een, Persson 52: LISU). — Near P. das Torrinhas, 1420 m (Ro 51: LISU). — Cald. do Inferno, 900 m (Ro 51: LISU). — Vale da Lapa (Cvo 41: LISI). — Cald. Verde (Cvo 41: LISI). — Between P. Ruivo and Cald. do Inferno, 1700 m (Bz 54: MMF). — Path to Eira do Serrado, 900 m (Bz: MMF). — Curral d. Freiras (RV 63: JBF). — Lapa da Cadela, close to P. Ruivo (Co 35: MMF).

HAB. — Preferentially in moist, slightly exposed habitats, where there is a continuous water supply, on steep cliffs. Recorded from 490-1700 m but generally growing between 700-1100 m (v. *diffusa* Lowe). Mentioned by Lowe (1868) also from «sea-cliffs on the N coast». This information, however, refers to the v. *succulenta* Lowe.

SOC. — Rather low frequency in the *Clethro-Laurion*. Diff. sp. of the all. Avoids open grassland vegetation at high altitudes.

Sonchus squarrosus DC. non Jasq.

EXS. — Rib. Frio (Sjn 65: U). — Rib. de Sta. Luzia (Mz 03: COI and Mz 14: LISU). — Camacha and Monte (Mz: COI). — Mont. d. Pecegueiros, close to Rib. da Passagem (Bz, RS 57: JBF).

VIDI — Lamaceiros, 790 m. — Rabaçal, 25 Águas. — Rib. do Inferno, 100 m. — Rib. da Ametade, 570 m. — Queimadas, 800 m. — New lev. E-facing slope of Vale da Rib. da Janela, 375 and 350 m. — W of Miradouro de S. Jorge, 200 m. — Ponta do Pargo, 450 m. — Rib. do Porco, 500 m. — Vale da Lapa, 600 m — N of Poiso, 1050 m. — Rib. da Ponta do Sol, Fajã do Limão, 370 m. — Ponta do Sol, Lombo, 650 and 830 m. — Arco S. Jorge, 330 m. — Lev. do Moiro, 630. — W of Encumeada, 1000 m. — Boaventura, João Fernandes, 600 m. — Rib. do Moinho, 700 m. — W slope Rib. da Janela, lev. dos Brasileiros, 930 and 900 m.

HAB. — Preferentially in slightly exposed habitats, generally where there is a continuous water supply, on steep cliffs in crevices and narrow ravines. Recorded altitude range: 50-1050 m. In the N generally above 300 m, in the S rarely below 500 m.

SOC. — High diff. val. of the *Clethro-Laurion* with highest frequency in the most hygrophilous association. Avoids open grassland vegetation above 1200 m.

Sonchus ustulatus Lowe

EXS. — Porto Santo: Pico Branco (Sjn 66: U). — Porto da Cruz, sea cliff (Sjn 66: U). — Ilheu dos Desembarcadouros (Mz 15: LISU). — Seixal — Rib. Funda (Ro 51: LISU). — Funchal: Ponta da Cruz (Bz, RS 57: JBF).

VIDI — Garajau, 25 m. — W of Faial, 10 m. — Ponta do Sol, coast. — Ravine, Estreito de Câmara de Lobos, 300 m. — Mouth of Rib. da Janela and of Rib. Funda, W of Seixal.

HAB. — Preferentially on very exposed cliffs or soil cuttings. Not recorded from altitudes above 300 m.

SOC. — High diff. val. of the *Aeonio-Lytanthion,* growing with rather high frequency in the all.

Tolpis fruticosa Schrank

EXS.— S. Lourenço (Sjn 66: U). — Faial, sea cliff (Sjn 66: U). — Porto Santo, SW part of the island, coast (Sjn 66: U). — Caniçal (Sjn 64: U). — Rocha da Pena (Mz 1894: COI). — Ilheu de Cebolas, S. Lourenço (Ad, Go: COI). — Caniçal (RV: JBF). — Lev. dos Balcões (RV 62: JBF). — Praia Formosa (Shell 62: JBF). — Road between Funchal and Eira do Serrado on rocky slopes (Bz, RS 57: JBF).

ssp. **pectinata** (DC.) Mnzs:
Garajau, coast (Sjn 65: U). — Machico: close to the tunnel, close to the road to Caniçal, 100 m — (Bz 54: MMF). — Sta. Cruz: freg. do Caniço, Garajau, 100-150 m (Bz 54: MMF).

ssp. **ligulata** Lowe:
Sta. Cruz, freg. do Caniço, Garajau, 100 m (Bz 54: MMF).

VIDI — Porto da Cruz, 10 and 110 m. — Piedade, 50 m. — Porto Novo, 25 m. — W of Faial, 10 m. — Ponta do Sol, coast. — Ravine, Estreito de Câmara de Lobos, 300 m. — Porto Moniz, coast, 100, 180 and 250 m. — N Rib. Brava, 30 m.— N of Encumeada, 390 m. — Vera Cruz, Campanário, 350 m. — S of Portela, 350 m. — E of mouth S. Vicente, coast. — Rib. d. Moinhos, 50 m. — Rib. do Urzal, 120 m. — Arco S Jorge, 420 m. — Between Poiso and Carreiras, road cuttings 9 years old. — Valley of Rib. da Janela, NE-facing slope, from coast up to 300 m. — Mouth of Rib. Funda, Seixal. — Curral d. Freiras, lev. towards S. Martinho, 400 m.

HAB. — High drought tolerance. Both on cliffs and on sandy or coarse volcanic deposits. Rarely above 400 m. — Generally below 300 m.

SOC. — High diff. val. of the *Aeonio-Lytanthion* and growing with high frequency in this all. Rarely recorded from completely developed *Clethro-Laurion*. Diff. val. also of an association of the coastal *Festucion petraeae* in the Azores.

Tolpis macrorhiza (Lowe) Lowe

EXS. — Rib. Frio, 750 m (Sjn 65: U). — Rib. Sta. Luzia (Mz 1894: COI). — Arrebentão (Mz 03: COI). — Between Sto. António and Curral (Pi 56: MMF).

VIDI — Arieiro, 1700 m. — Between Rib. Frio and Balcões, 820 m. — Rib. S. Roque, 250 m. — Lev. do Faial, 700 m. — Monte, 710 m. — S of Poiso, 1200 m. — N of the Ametade bridge, 380 m. — Between Porto da Cruz and Portela, 300 m. — Lev. da Costa, Curral, 450 m. — Below lev. do Moinho, 240 m. — Lev. do Moiro, 630 m. — Capela S. João, 450 m — N of Rib. Brava, 490 m.

HAB. — On cliffs or volcanic soil, sand or gravel. High drought tolerance. Growing within a wide altitude range. Observed from about 250 m until the highest peaks of the island. In the N generally above 300 m, in the S rarely below 400 m. Highest frequency between 600-1200 m. A suggested altitude range extending only above 850 m (cf. Lowe 1868) is much too narrow.

SOC. — Rather high diff. val. of the *Clethro-Laurion* but also growing in transitions between *C.-L.* and *Aeonio-Lytanthion*.

Trichomanes speciosum Willd.

EXS. — *Laurus-Myrica* wood, Seixal, 480 m (Sjn 65: U). — São Jorge, 460 m (Sjn 66: U). — N of Poiso, 1100 m (Sjn 65: U). — Serra d'Agua e S. Vicente (Pa: LISU). — Mont. d. Pecegueiros, 800 m. (Ro 51: LISU). — Rib. Bonito, São Jorge (Br 69: LISI). — In MMF, leg. by Co: Seixal, Rib. Funda (1927). Achadas da Cruz, Rib. do Covão (40). Quebrada, Porto Moniz (40). Seixal, Água do Vento (28). — Encumeada, 1000 m (Pi 58: MMF). — Lamaceiros (Pi 58: MMF). — Montado da Ilha (RV 62: JBF). — Caldeirão (RV 53: JBF).

VIDI — Rib. da Janela, 630 m. — Queimadas 800 m. — Vale da Lapa, 550 m. — W of Encumeada, 1000 m. — Rib. S. Jorge, 550 m — Lamaceiros, 710 m. — Ponta do Sol, Lombo, mouth of tunnel, 850 m. — W of Encumeda, 1000 m. — Rib. do Moinho, 700 m.

HAB. — On cliffs or soil cuttings. One of the most distinctly hygrophilous vascular plants of the island, only growing in very sheltered habitats, requiring not only a permanently moist substratum but also permanently very high RH values (cf. Benl & Sventenius 1970, p. 417). These conditions are provided especially on the N part of the island in crevices and deep, narrow ravines. Rarely growing in the S of the island. Generally above 600 m.

SOC. — High diff. val. for the most hygrophilous association of the *Clethro-Laurion* as also diff. sp. of the most hygrophilous ass. of the *Juniperion brevifolii* in the Azores.

Vaccinium maderense Lk.

EXS. — Pico do Poiso (Sjn 65: U). — Poiso, 1340 m (Sjn 65: U). — Caniçal, 210 m (Sjn 64: U). — Serra do Poiso (Mz 12: COI). — Casa das Torrinhas, Falça de Cima — Torrinhas Pass (Een, Persson 52: LISU). — Encumeada (Persson 52: LISU). — Achada do Páu Branco, near Santana (Ro 49: LISU). — Rabaçal (Ro 49: LISU). Arieiro, 1500 m (Ro 49: LISU). — Rib. Frio (Ro 49: LISU). — Rabaçal, lev. do Risco, 1050 m (Ro 51: LISU). — Arco S. Jorge, Cab. da Quinta (Ro 51: LISU). — Encumeada, Serra de Agua, 1050 m (Ro 49: LISU). — Poiso (A. Sarmento 12: LISU). — Poiso (Mz 14: LISU). — Near P. Ruivo (Pa: LISU). — Queimadas (Fr 61: LISI). — Mont. d. Pecegueiros, 460 m (Bz 54: MMF). — Chão das Feiteiras, grazing land with remains of forest, 1230 m (Bz 54: MMF). — P. Arieiro (RV 60: JBF).

VIDI — Rib. Tristão, 650 m. — Above Porto Moniz, 800 and 880 m on small high plateau. — S of Encumeada, 700 m. — N of Encumeada, 600, 700 and 900 m. — S of Poiso, 1200 m. — N of Poiso, 1300, 1000, 800, 700 and 650 m. — N of Portela, 500 m. — S of the Ametade bridge, 450 m. — Lamaceiro, 710 m. — Ponta do Sol, Lombo, 850 m. — Rib. Funda, 380 m. — W of Poiso, 1340 m. — Vale de Machico, 200 m. — NE of Poiso, 1100 m. — Vale da Rib. da Janela, 600 m. — Vale do Seixal, 380 m. — W of Encumeada, 1000 m. — Queimadas, 800 m. — E of Portela, 550 m. — Lev. do Faial, 770 m. — P. Arieiro, 1500 m. — Between Rib. Frio and Balcões, 820 m. — N slope Rib. S. Jorge, 550 m. — Boaventura, 600 m. — Rib. do Moinho, 700 m. — Valley of Rib. da Janela, NE-facing slope, 350-500, 980 m.

HAB. — Preferentially in dense cloud zone vegetation, also very tolerant to strong exposure in open grassland at altitudes above 1100 m. Recorded from 200 m up to altitudes of about 1500 m. In the N generally above 600 m. Throughout the island: highest frequency in the cloud zone vegetation from 700-1200 m. The natural frequency of the shrub at altitudes above 1200 m is nowadays obscured in several localities owing to overgrazing, burning and cutting. *Vaccinium* was reported by Bowdich (1825) as a frequent shrub both on the high plateau of Paul da Serra and at the highest altitudes on the island. *V. maderense* seems to be less tolerant to grazing than *Erica* spp. and *Laurus*.

SOC. — Diff. sp. of the *Clethro-Laurion*. Locally dominant species in shrub or tree layer. *V. cylindraceum* is the corresponding species in the cloud zone all. *Juniperion brevifolii* in the Azores.

SUMMARY

Plant communities

Differentiation of plant communities of the natural landscape has been based on the qualitative composition of the plant cover. Minimum areas for description of the communities were found to be at least 25 m². The work was concentrated on the sociological delimitation of alliances. Some associations were also defferentiated but not documented separately in sample plot tables. Differential species with variously high differential values were used for the characterization of the communities. The geology of Madeira is monotonous, and correlations of distribution and composition of the communities mostly were environmental factors such as precipitation, air humidity, exposure, types of substrata (sand, gravel, cliff), and water supply.

Aeonio-Lytanthion (abbrev. *A.-L.*). Field layer alliance with few bryophyte spp. in bottom layer. Sociological minimum area 25 m². Mean number of species is 15. A large number of species occur as dominants. Among differential species with high differential value: *Hyparrhenia hirta, Euphorbia piscatoria, Sedum nudum, Sonchus ustulatus, Crambe fruticosa, Plantago arborescens* var. *maderensis*. Associations: A *Hyparrhenietum hirtae* (grassland ass. on sand-gravel deposits), B. *Euphorbietum piscatoriae* (on cliffs), C. *Biserrulae-Scorpiurietum* (grassland ass. restrictet to sand deposits on the easternmost peninsula).

The alliance has some diff. spp. in common with the coast alliance *Festucion petraeae* in the Azores for example *Crithmum maritimum, Bromus madritensis, Lotus subbiflorus, Asplenium marinum*. The *A.-L.* and the *Festucion petraeae* may provisionally be united into an order named «*Crithmetalia maritimae*».

The *A.-L.* grows along the S coast of Madeira, rarely above 300 m, on the N coast rarely above 100-50 m. In these habitats, precipitation is generally not over 750 mm/year and air humidity usually about 60-70%.

Among the diff. spp. of the all., there is one group of species rarely found above 100 m and several spp. rarely found above 300 m.. A few diff. spp. extend their distribution up to 700 m (in the S of the island). The position of the upper limit for the complete *A.-L.* is irregular, especially in the south of the island. Fractions of the all. there extend up to 500 m in river valleys where local climatic conditions are rather unfavourable near the valley bottoms because of the stable stratification of temperatures.

Succession within the *A.-L.* begins with a stage of grasses and herbs. A more effective soil stabilizing stage of low shrubs follows, and forms a finally stratified field layer. The all. is now distributed in the small areas not occupied by fields or forest plantations. During the time just after the colonization of Madeira by the Portuguese, areas suitable for the all. were probably greatly increased by cutting and burning of shrubs and trees in the zone near the coast. Increase in the cultivated areas of the landscape eventually diminished the areas of the all. more and more. The composition of the coast vegetation has recently (in the last 100 years) to a large extent been transformed by invasion by a large number of introduced species, mainly anthropochorous and with their center of distribution in Mediterranian countries. The S part of the island is now densely colonized by *Opuntia tuna and Eupatorium adenophorum* in areas outside cultivated areas.

Clethro-Laurion (abbrev. *A.-L.*). In inaccessible areas, this alliance may have a continuous tree layer, but generally there is only a shrub layer. Field and bottom layers are rich in species. Epiphytic and epilithic moss communities are nearly always present, and there is rarely also an epiphyllous moss cover. Sociological minimum area is rarely less thans 25 m². The mean number of vascular plant taxa within the sample plots of the all. is 20.

Nearly 50% of the total number of diff. spp. with a high diff. val. for the all. are endemic to the island, so the *C.-L.* is an endemic plant community of Madeira. The fact that there are some diff. spp. in common with the cloud zone all. in the Azores, *Juniperion brevifolii,* supports a possible arrangement of the two Macaronesian communities under a higher rank sociological unit called «*Lauro-Ilexetalia*».

Associations: A. *Deschampsietum argenteae* (hygrophilous ass. requiring a continuous water supply, in crevices of cliffs and on slopes of volcanic deposits), B. *Vaccinio-Sibthorpietum* (covering the largest areas of the all. within the cloud zone, hygrophilous ass., on cliffs or volcanic deposits), C. *Campylopo-Airetum* (above the cloud zone, dominating in the grazing land, fairly drought tolerant ass. on sand-gravel deposits), D. *Ericetum cinereae* (cliffs of the highest peaks, drought-tolerant ass.). Parallel associations exist in the cloud zone vegetation in the Azores islands.

Few species reach dominance in the shrub-tree layer *(Erica scoparia, E. arborea, Laurus azorica, Vaccinium maderense, Clethra arborea).* However, the number of physiognomically important spp. in the bottom and field layer is very large. Some introduced spp. have got a high competitive ability in the *C.-L.* and now locally threaten the survival of the original vegetation: *Erigeron karwinskianus, Eupatorium adenophorum, Bidens pilosa.*

Studies of the distribution of the *C.-L.* have led to the conclusion

that the all. requires precipitation of at least 1700 mm/year to reach complete development, including permanently high relative air humidity values of at least 85%. These conditions are reached in the S of the island at about 700 m and in the N at about 400 m. The lower limit of the *C.-L.* corresponds to these altitudes; the upper limit is 1200, respectively, 1300 m for the dense cloud zone shrub-forest.

The natural base of the *C.-L.* might, however, have been situated more or less 100 m lower 100-150 years ago. Earlier botanits have not mentioned any severe overgrazing at altitudes above 1200 m. This suggests that large areas of the now overgrazed landscape with few shrubs and trees and frequent soil erosion might have developed only during the last 100 years.

The lower limit of the all. is irregular in the S of the island, owing to local climatic conditions in deep river valleys. Exclaves of the *C.-L.* frequently occur in these valleys at altitudes far below the lower limit of 700 m of the all. The coastal plant communities also extend their distribution to higher altitudes in the river valleys than on the ridges between, because of the frequent stabilization of the temperature stratification in the valleys.

Zonation of cloud zone vegetation on Madeira and the Azores was found to have a similar correlation with climate (Sjögren 1972). The lower limit in the Azores is 500 m in the central part of the archipelago, 700 m in the eastern and 300 m in the western. At all these altitudes, precipitation reaches values of 1700-2000 mm per year. Differential species common to the *C.-L.* and the *Juniperion brevifolii* (Azores) often have the lower limit of the preferred altitude range at lower altitudes in the Azores than on Madeira.

Natural succession in the *C.-L.* above 800 m on slopes of volcanic deposits is very rapid, starting with a moss cover which reaches a high degree of cover after only 3 years. Then follows the vascular plant cover. The first colonizing drought-tolerant species are replaced after a couple of years by large shading ferns. Conditions are then favourable for the development of a shrub stage.

The influence of man in the cloud zone vegetation delays and changes the successional sequence. Clearings in the *C.-L.* will be invaded for example by *Ulex europaeus, Sarothamnus scoparius* and *Eupatorium adenophorum,* forming a dense impenetrable carpet slowly colonized by shrubs and trees of the original vegetation.

Erosion in the grazing land part of the *C.-L.* influences the successional sequence in places. Vegetation with $>50\%$ cover of bryophytes starts to be damaged by erosion on slopes inclined $>30\%$.

The total pressure of the influence of man on the natural vegetation on Madeira has made the problems related to conservation of nature on the island very topical. Urgent action is now required to preserve the endemic plant communities which are very susceptible to cultural in-

fluences. Preservation of a few large areas with rules of varying strictness throughout the area should be preferred to the protection of a large number of small areas. Within the large areas it will be possible to surround the most valuable parts with a protecting guard of preserved land which will help to maintain ecological conditions undisturbed.

Conservation of nature should also take into consideration the circumstance that an ecologically specialized natural island vegetation, like that of Madeira, can easily be disturbed and made unstable by introduced species. Escapes of introduced ornamental flowers and the distribution of «weeds» should be put under careful control. There may be an eventual economical advantage from the permanent control of the invasion of taxa with high competitive ability.

The original vegetation of Madeira has been subject to the influence of man for only a relatively short period. It offers to biological science an unusually rich resource for differentiated documantation and exploration, especially about the development of the cultivated parts of the landscape. There are in the near future few problems for science of greater importance than investigation of the balance or rather the lack of balance between cultivated and natural parts of the landscape.

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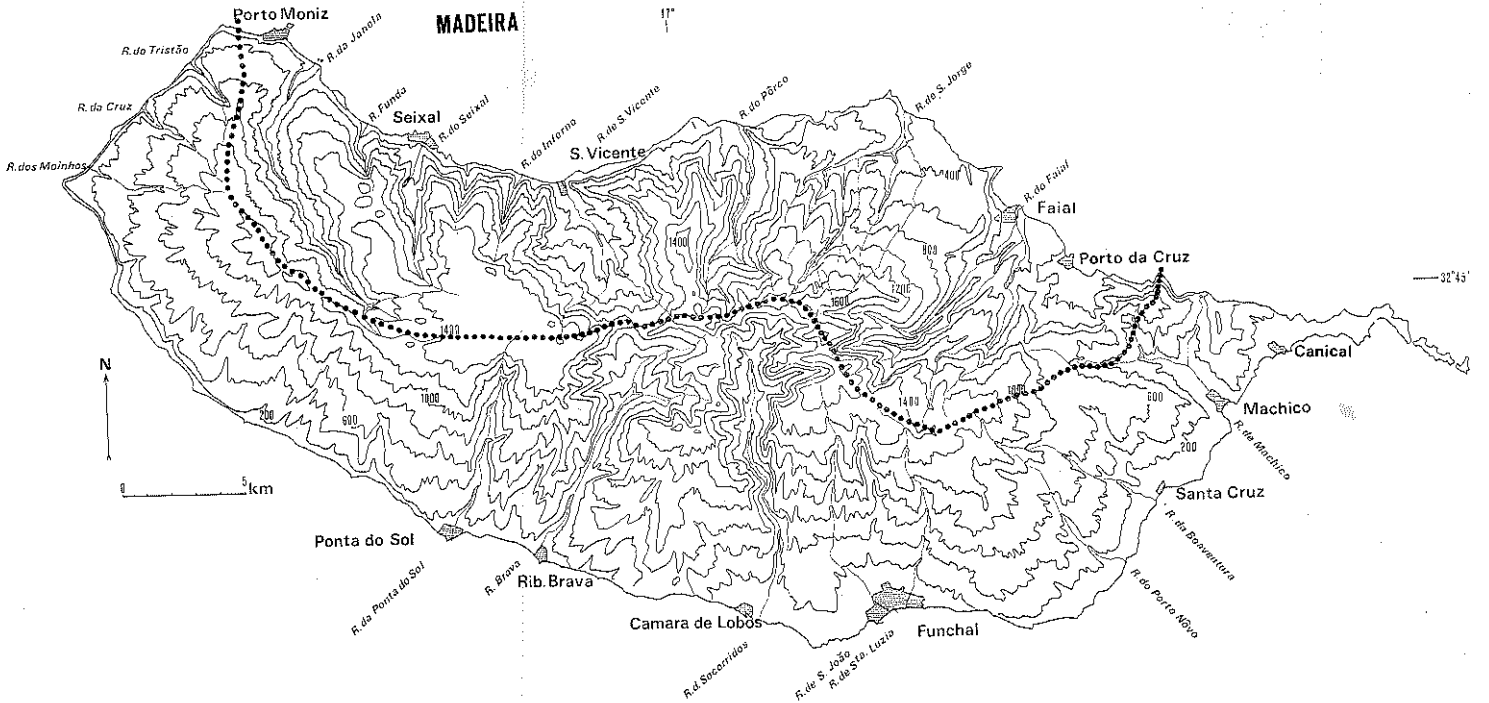

Fig. 1. — The map of Madeira shows rivers, towns, 200 m contours and the boundary between the N and S parts of the island in this paper. S part with precipitation generally below 1800 mm per year. N part with precipitation generally above 1800 mm and locally above 3000 mm per year (cf. Ribeiro 1949).

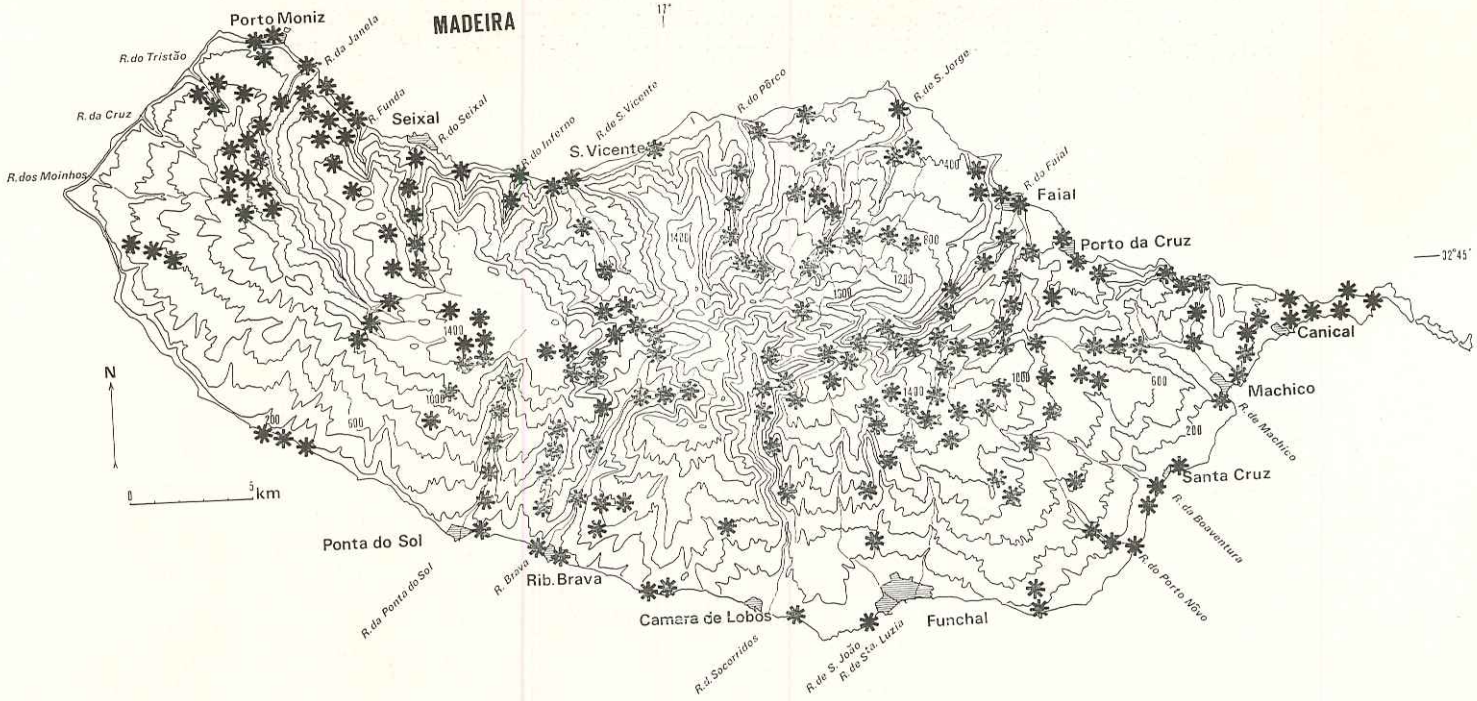

Fig. 2. — Map showing localities of the more important sample plots, collections of exsicats, studies of zonation, temperatures and relative air humidity.

Fig. 3. — Sparse coast vegetation on fine, easily eroded volcanic deposits. *Aeonio-Lytanthion: Biserrulae-Scorpiurietum* (p. 55 ff.). The ass. is restricted to the easternmost peninsula of Madeira. Moss layer is generally absent. Dominant species: *Plantago coronopus, Lotus subbiflorus* and *Cynodon dactylon* provide an efficient protection from erosion in this primary stage of succession. — Caniçal, Prainha. June 1966. Altitude 10 m.

Fig. 4. — *Aeonio-Lytanthion* with primary stage of colonization on cliffs and densely packed coarse volcanic deposits. If erosion does not impede, further colonization will proceed to the *Euphorbietum piscatoriae* (p. 55 ff.). Dominant species: *Aeonium glutinosum* and *Plantago coronopus*. Diff. spp.: *Sonchus ustulatus* and *Sedum nudum*. — S. Vicente. Jan. 1967. Altitude 20 m.

Fig. 5. — Basal part of trunk of *Laurus azorica* in *Clethro-Laurion* community (p. 61 ff.). The all. is poor in species on level ground, but very rich in species in habitats with a continuous supply of water on steeply sloping cliffs or cuttings through volcanic deposits. A thick slowly mouldering carpet of litter is frequently an efficient obstacle to the development of both field and bottom layer. Species present in the photography: *Woodwardia radicans, Sibthorpia peregrina, Blechnum spicant, Carex peregrina, Vaccinium maderense.* The epiphytic moss cover is dominated by species belonging to the following hepatic genera: *Plagiochila, Porella, Lejeunea, Frullania, Metzgeria,* which are typical of the cloud zone phytocoenose. — E of Queimadas. June 1966. Altitude 820 m.

Fig. 6. — Close-up photograph of qualitatively rich and dense field layer vegetation of the *Clethro-Laurion* (p. 61 ff.) on steeply sloping ground with a more or less continuous water supply. Extremely rich bottom layer with dominance of large hepatics such as *Reboulia hemisphaerica, Conocephalum conicum* and *Dumortiera hirsuta*. Frequently dominant vascular plants in the all.: *Phyllis nobla, Pteris arguta Diplazium caudatum*. Diff. spp.: *Ranunculus cortusifolius, Sonchus squarrosus*. — E of the Encumeada passpoint. Febr. 1967. Altitude: 1050 m.

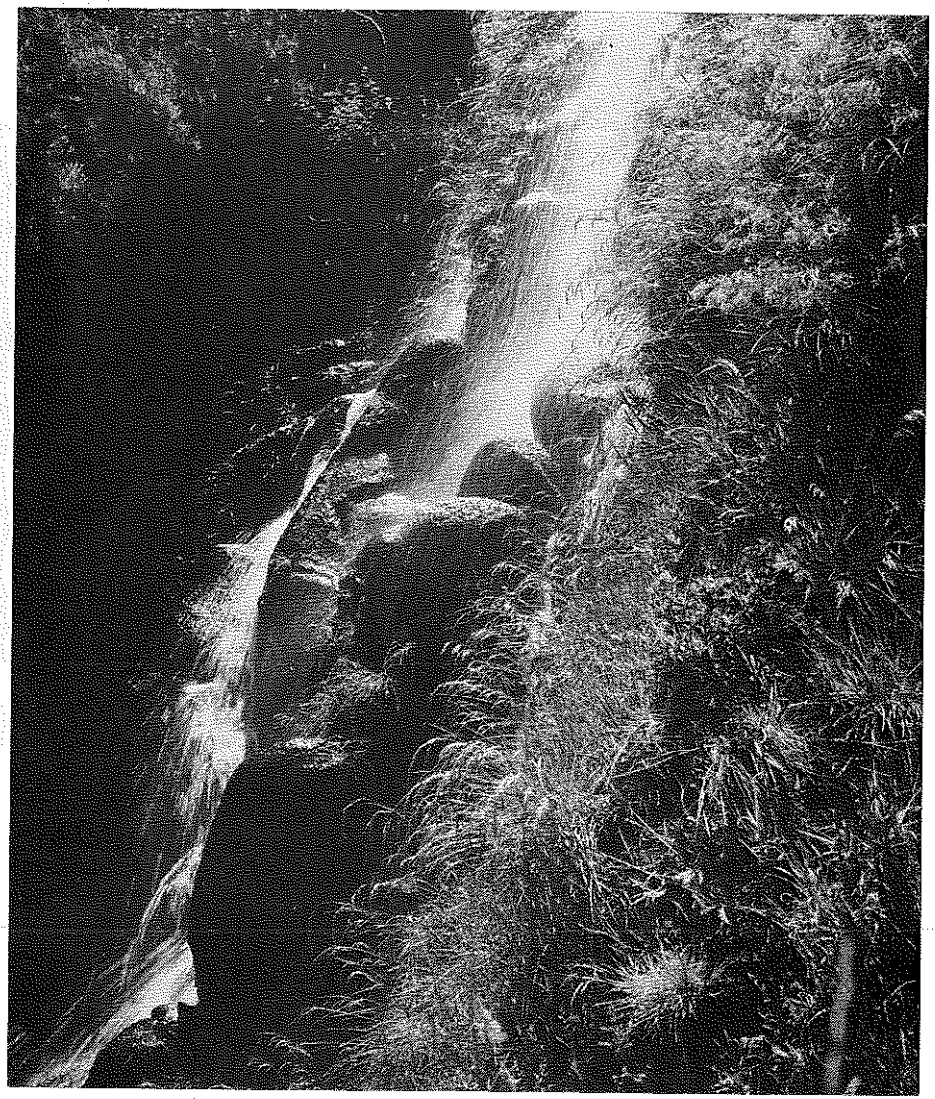

Fig. 7. — Narrow ravines with small water falls are frequent in the cloud zone. They are surrounded by the *Clethro-Laurion: Deschampsietum argenteae* (p. 61 ff.). The dominant species in the field layer is generally *Deschampsia argentea*. Bottom layer and stones are dominated by large hepatics and mosses: *Thamnium alopecurum, Mnium undulatum* and *Rhynchostegium* spp. Epiphyllous hepatics are frequently present on large mosses, on ferns such as *Blechnum, Trichomanes, Elaphoglossum* and on leaves of *Laurus* and *Ocotea*. There is generally a large number of diff. spp. of the *C.-L.* in this kind of habitat, where exposure is very slight and relative ari humidity permanently high, generally above 80%. — Lev. da Serra do Faial. June 1966. Altitude: 700 m.

Fig. 8. — Erosion type, close to final stage, in overgrazed sloping grassland above the cloud zone vegetation. The sparse grass carpet dominated by *Aira caryophyllea* and *Agrostis castellana* is split up into numerous horizontal steps (p. 72 ff.).Moss cover colonizing bare soil is poor in species but generally has high degree of cover. The most frequent dominant species are: *Campylopus flexuosus, C. polytrichoides, Scleropodium illecebrum.* Shrubs are totally absent. — S of Arieiro. July 1966. Altitude: 1700 m.

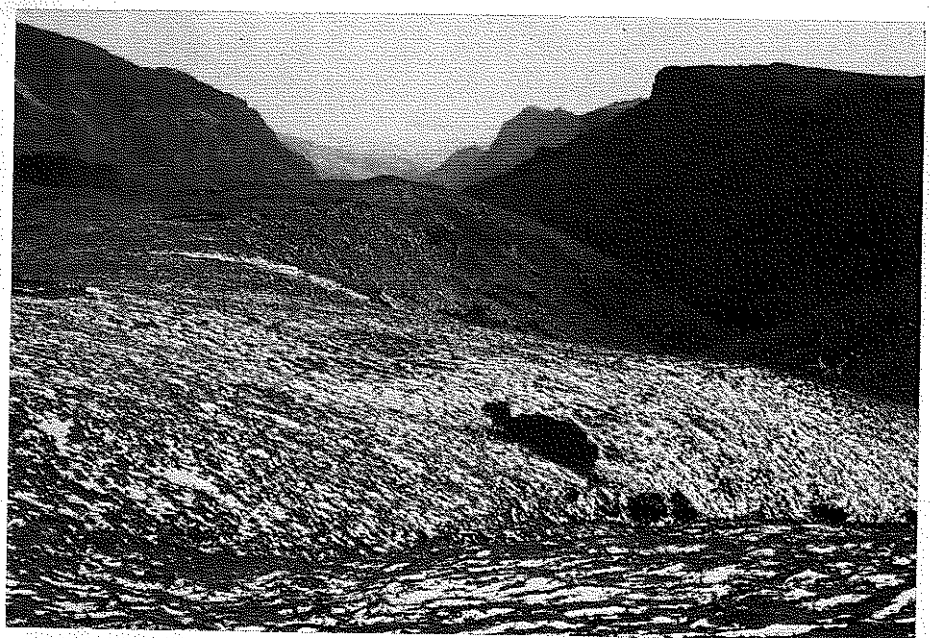

Fig. 9. — During December-March, snow fall might occur at levels above 1600 m. Snow generally lies for only a few days. In this heavily grazed region, snow accumulates in erosion holes and at the horizontal eroded steps (comp. fig. 8). There are very few remaining shrubs of *Erica* and *Laurus*. — S of Arieiro. Febr. 1967. Altitude 1700 m.

Fig. 10. — On this slope, the penultimate stage of erosion forming horizontal steps has in places reached the final stage, forming large bare areas with coarse material at the soil surface from which fine material has been removed and carried down towards the bottom of the valleys by heavy rains. Moss cover is only sparsely developed, owing to the lack of fine material. Thus the conditions required for recolonization with the primary stage of succession in the grassland vegetation have mostly been destroyed. — S of Arieiro. June 1966. Altitude: 1600 m.

Fig. 11. — Colonization of freshly eroded or manmade slope cuttings through fine volcanic deposits is very rapid within and above the cloud zone (p. 73 ff.). The close-up photograph shows an artificial cutting by a road, 5 years old, N-facing, with no surrounding sheltering shrub layer. A dense moss cover frequently dominated by *Saccogyna viticulosa, Diplophyllum albicans, Philonotis rigida* is generally formed after only 2-5 years. Colonization by vascular plants generally begins after 4-6 years: here there is *Blechnum spicant* and small specimens of *Agrostis castellana.* Succession is often stopped and forced to begin again after erosion caused by the formation of cracks in the moss carpet after alternating wetting and drying of the surfaces. — Achadas da Cruz, P. da Roseira. July 1966. Altitude: 880 m.

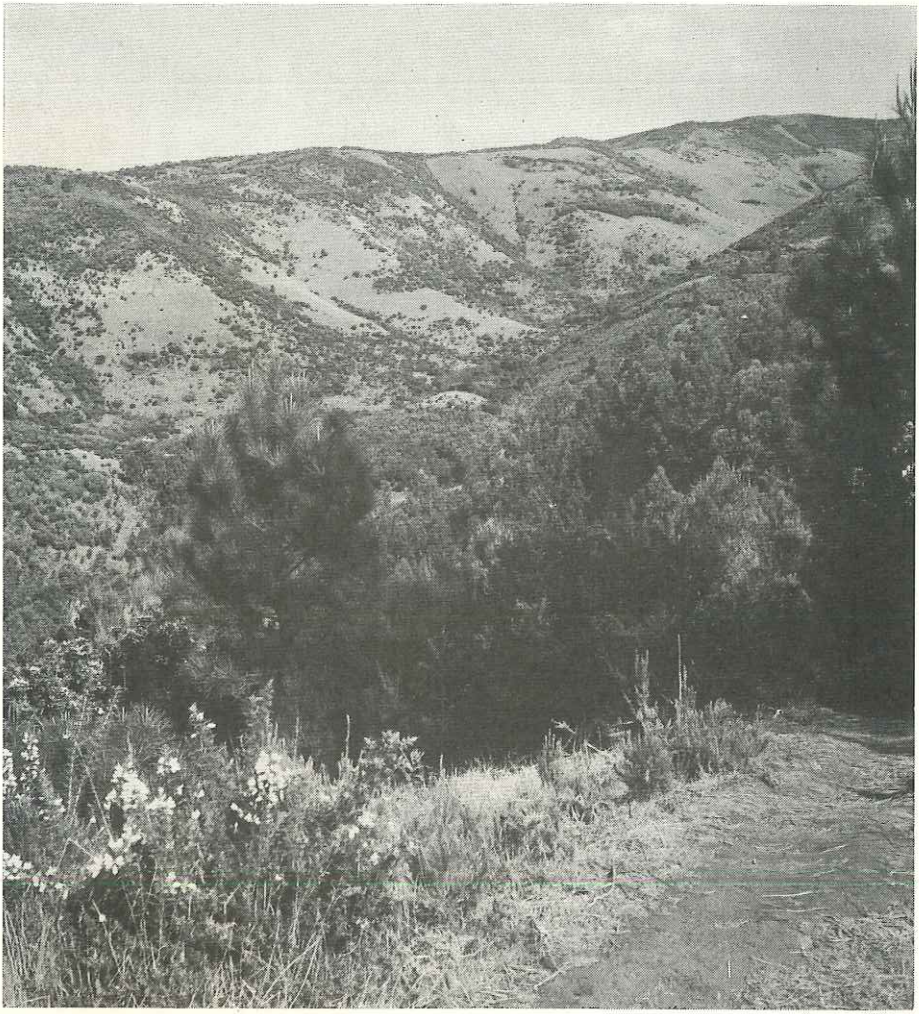

Fig. 12. — Shrub vegetation of *Erica-Vaccinium-Laurus* in the grazing land above 1200-1300 m is sparse or absent nowadays. Remains of the original scrub vegetation on slopes are generally to be found growing like vertical strings in ravines, difficult for grazing animals to reach (p. 72 ff.). The scrub-grassland vegetation belongs to the *Clethro-Laurion: Campylopo-Airetum*. Large areas of grazing land are now planted with *Pinus pinaster*. Some areas, in which the original scrub vegetation has become sparse as a result of grazing, cutting and burning, become recolonized by the introduced *Ulex europaeus*. — Achadas da Cruz. July 1966. Altitude: 900 m.

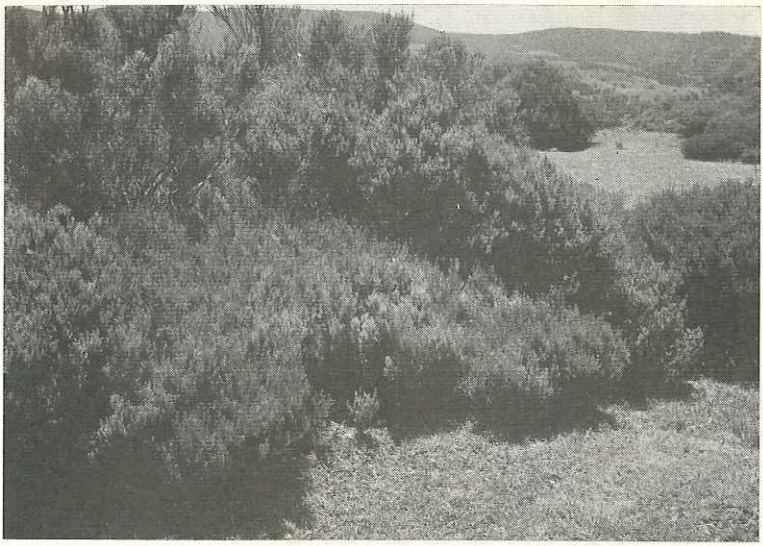

Fig. 13. — Close-up photograph of scrub-grassland vegetation where grazing pressure is relatively low, and does not eliminate the shrubs or cause erosion damage in the grass areas between *Erica* shrubs which become sculptured like cushions by the grazing animals (p. 72 ff.). The vegetation is poor in species, especially in the grassland part with dominating *Agrostis castellana, Aira caryophyllea, A. praecox, Viola broussonetiana* and *Campylopus* spp. — Achadas da Cruz, P. da Roseira. June 1966. Altitude: 950 m.

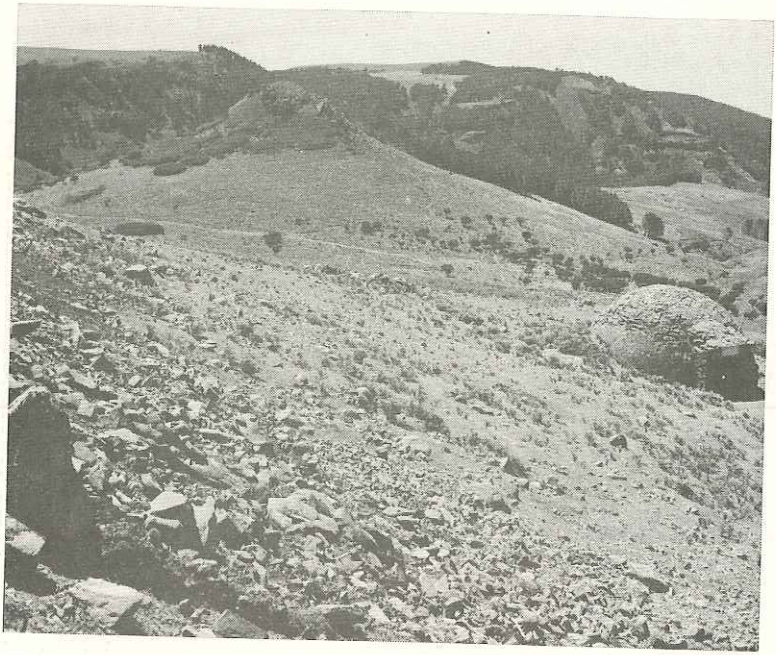

Fig. 14. — Areas heavily overgrazed for centuries. Few *Erica* shrubs have escaped the animals, and there are some sparsely growing *Laurus* trees with the wide crowns and short trunks charateristic of the open cultivated landscape. In the foreground, soil erosion leaving only coarse material round the old «ice-house» colonized by few grasses and mosses, *Pteridium aquilinum* and *Juncus effusus*. On the ridges in the background, reafforestation with *Pinus pinaster*. — S of P. do Arieiro. July 1966. Altitude: 1600 m.

Fig. 15. — Final stage of transformation of level grazing land. Permanent overgrazing has caused erosion of fine soil, suppression of the grass component, increase of the bryophyte carpet degree of cover to more than 50% and invasion of *Pteridium* (p. 72 ff.). Photograph taken towards N at 13 hours, when clouds from the N coast of the island usually reach the N part of the high plateau. Excavations have revealed that the plateau was once covered by shrub vegetation, probably with a high percentage of *Juniperus cedrus,* of which there are now only a few specimens remaining in natural vegetation on the island, but which was probably formerly a frequent component of natural cloud zone vegetation. — Paúl da Serra. June 1966. Altitude: 1475 m.

List of vascular plants mentioned in this paper

Adiantum capillus-veneris L.
A. reniforme L.
Aeonium glandulosum (Ait.) W. & B.
A. glutinosum (Ait.) W. & B.
Agrostis castellana Boiss. & Reut.
Aichryson divaricatum (Ait.) Praeg.
A. villosum (Ait.) W. & B.
Aira caryophyllea L. ssp. caryophyllea
A. praecox L.
Ammi majus L.
Andryala glandulosa Lam.
Anogramma leptophylla (L.) Lk.
Anthoxanthum odoratum L.
Anthyllis lemanniana Lowe
Aphanes microcarpa (Boiss. & Reut.) Rothm.
Apollonias barbujana (Cav.) Bornm.
Arabis caucasica Schlecht
Arabidopsis thaliana (L.) Heynh.
Arceuthobium oxycedri (DC.) M. Bieb.
Ardisia excelsa Ait.
Armeria maderensis Lowe
Artemisia argentea l'Hérit.
Asplenium hemionitis L.
A. marinum L.
A. monanthes L.
A. onopteris L.
A. scolopendrium [= Phyllitis scolopendrium (L.) Newm.]
Avena barbata Pott ex Lk.

Bellis azorica Hochst. ex Seub.
Berberis maderensis Lowe
Bidens pilosa L.
Biserrula pelecinus L.
Blechnum spicant (L.) Roth
Brevipodium silvaticum (Huds.) PB.
Briza maxima L.
B. minor L.
Bromus madritensis L. [= Anisantha madritensis (L.) Nevski]
Bupleurum salicifolium Soland.
Bystropogon maderensis Webb
B. piperitus Lowe

Calceolaria chelidonioides HBK.
Campanula erinus L.
C. vidalii Wats.
Cardamine caldeirarum Guthn. ex Seub.
Carex peregrina Lk.
C. pilulifera L.
» » var. azorica (Gay) Christ
Carlina salicifolia (L.f.) Less.
» » ssp. spinelossa Lowe
Cedronella canariensis (L.) W. & B. [= C. triphylla Moench]
Chenopodium ambrosioides L.
Chrysanthemum mandonianum Coss. [= C. pinnatifidum L. f. var. m. Coss.]
Cirsium latifolium Lowe
Clethra arborea Ait.
Clinopodium vulgare L. ssp. villosa (de Noé) Bothmer
Conyza canadensis (L.) Cronz. [= Erigeron c. L.]
Crambe fruticosa L. f.
Crepis vesicaria L.
Crithmum maritimum L.
Culcita macrocarpa C. Presl.
Cymbalaria muralis G., M. & Sch. [= Linaria cymbalaria (L.) Mill.]
Cynodon dactylon (L.) Pers.
Cystopteris fragilis (L.) Bernh.
Cytisus maderensis (W. & B.) Masf.
C. tener Jacq. [= Genista virgata (Ait.) Lk.]

Daboecia azorica Tut. & Warb.
Dactylorhiza foliosa (Soland.) Soó
Dactylus glomerata L.
Davallia canariensis (L.) Sm.
Deschampsia argentea (Lowe) Lowe
» » var. purpurascens Costa
Deschampsia argentea var. gomesiana Mnzs.

D. foliosa Hack.
D. maderensis (Hack. & Bornm.) Buschm. [= D. foliosa var. maderensis Hack. & Bornm.]
Digitalis purpurea L.
Diplazium caudatum (Cav.) Jermy
Dracaena draco L.
Dryopteris aemula (Ait.) Ktze.
D. borreri Newm.

Echium nervosum Ait.

E. lycopsis L. in Grufb. [= E. plantagineum L.]
Elaphoglossum paleaceum (Hook. & Grev.) Sledge
Equisetum telmateja Ehrh.
Erica arborea L.
E. azorica Hochst. ex Seub.
E. cinerea L. var. maderensis DC.?
E. scoparia L.
Erigeron karwinskianus DC.
Erysimum mutabile (l'Hérit.) Wettst. non Boiss. & Heldr.
Eupatorium adenophorum Spreng [now named Ageratina adenophora (Spreng.) King & Robinson]
E. riparium Schultz-Bip.
Euphorbia azorica Hochst.
E. mellifera Ait.
E. piscatoria Ait.
E. stygiana Wats. [= E. mellifera sensu Seub. et Drouet, non Ait.]

Festuca donax Lowe
F. jubata Lowe
F. petraea Guthn. ex Seub.
Filago minima (Sm.) Pers.
Foeniculum vulgare Mill.
Fragaria vesca L.
Frangula azorica Tutin

Galactites tomentosa Moench
Galinsoga ciliata (Raf.) Blake
G. parviflora Cav.
Galium aparine L.
G. parisiense L.
G. rotundifolium L.
Gaudinia fragilis (L.) PB.
Gennaria diphylla (Lk.) Parl.
Geranium anemonaefolium l'Hérit. [now G. palmatum Cav.]
G. canariense Roth.
G. lucidum L.
G. purpureum Vill.
G. robertianum L. [var. maritimum Bab. now G. rubescens Yeo]
Gnaphalium luteo-album L.

Habenaria longebracteata Hochst. ex Seub.
H. micrantha Hochst. ex Seub.
Heberdenia excelsa (Ait.) Banks ex DC. [= Ardisia excelsa Ait.]
Hedera canariensis Willd [= H. helix L. ssp. can. (Willd.) P. Cout.]
Hedychium gardnerianum Roscoe
Helichrysum foetidum (L.) Moench
H. melanophthalmum (Lowe) Lowe
H. obconicum DC.
Huperzia selago (L.) Berbh. ex Schrank & Mart. ssp. selago
H. selago (L.) Bernh. ex Schrank & Mart. ssp. dentata (Hert.) Valentine
Hydrangea macrophylla (Thunb.) Sér.
Hyparrhenia hirta (L.) Sm.
Hypericum foliosum Ait.
H. grandifolium Choisy
H. humifusum L.
H. undulatum Schousb. ex. Willd.

Ilex canariensis Poir.
I. perado Ait. ssp. perado
Isoplexis sceptrum (L.) Lindl.

Juncus acutus L.
J. articulatus L.
J. effusus L.
Juniperus brevifolia (Seub.) Antoine [= J. oxycedrus L. var. brevifolia Seub.]
J. cedrus W. & B. [= J. oxycedrus L. ssp. maderensis Mnzs.]

Lagurus ovatus L.
Lantana camara L.
Laurus azorica (Seub.) Franco
L. azorica (Seub.) Franco var. lutea (Mnzs.) A. Hans.
Leontodon saxatilis Lamk. ssp. rothii (Ball) Maire
Linum strictum L.
Lotus macranthus Lowe
L. subbiflorus Lag.
Luzula purpureo-splendens Seub.
Lycopodium cernuum L. [= Lepidotis cernua (L.) PB.]
L. selago L.
L. selago L. ssp. suberectum (Lowe) Romariz [= Huperzia selago (L.) Bernh. ex Schrank & Mart. ssp. dentata (Hert.) Valentine]
Lytanthus salicinus (Lam.) Wittst. [= Globularia s. Lam.]
Lythrum hyssopifolia L.

Matthiola maderensis Lowe
Mesembryanthemum crystallinum L.
M. nodiflorum L.
Musschia aurea (L. f.) DC.
M. wollastoni Lowe
Myrica faya Ait.
Myrtus communis L.

Ocotea foetens (Ait.) Baill.
Olea europaea L. var. maderensis Lowe
Opuntia tuna (L.) Mill.
Origanum virens Hoffmsg. & Lk.
Ornithopus perpusillus L.
Osmunda regalis L.

Persea indica (L.) Spreng.
Phyllis nobla L.
Phagnalon saxatile (L.) DC.
Picconia excelsa (Ait.) DC. [= Notelaea e. (Ait.) W. & B.]
Picris filii (Hochst.) B. D. Jackson
P. rigens (Ait.) B. D. Jackson
Pinus pinaster Ait.
Pittosporum undulatum Vent.
Plantago arborescens Poir. var. maderensis (Dcne.) Pilg.
Plantago arborescens var. compacta Barnecoud
P. coronopus L.
P. costae Mnzs.
Polygonum maritimum L.
Polypodium australe Fée
Polypogon maritimus Willd.
Polystichum falcatum (L. f.) Diels
P. setiferum (Forssk.) Moore ex Woynar
Potentilla anglica Laich.
Prunella vulgaris L.
Prunus lusitanica L.
» » ssp. azorica (Mouillef.) Franco
Psoralea bituminosa L.
Pteridium aquilinum (L.) Kuhn
Pteris arguta Ait.

Ranunculus cortusifolius Willd.
Rhamnus glandulosa Ait.
Rubia angustifolia L.
R. fruticosa L.
R. peregrina L. var. azorica (L.) W. & B.
Rubus grandifolius Lowe
R. hochstetterorum Seub.
R. ulmifolius Schott
Rumex bucephalophorus L.
R. maderensis Lowe
Ruscus streptophyllus P. F. Yeo

Sambucus maderensis Lowe
Sanicula azorica Guthn. ex Seub.
Sarothamnus scoparius (L.) Wimm. ex Koch [= Cytisus scoparius (L.) Lk.]
Saxifraga maderensis Don
Scabiosa atropurpurea L.
Scorpiurus vermiculata L.
Scrophularia scorodonia L.
Sedum brissemoretii Hamet
Sedum nudum Ait.
Selaginella denticulata (L.) Lk.
Senecio incrassatus Lowe
S. maderensis DC. [= S. auritus l'Hérit.]
S. mikanioides Otto ex Walp.
Sibthorpia europaea L.
S. peregrina L.
Sideroxylon marmulano Banks ex Lowe
Sideritis massoniana Benth.
Sieglingia decumbens (L.) Bernh.
Silene gallica L.
S. maritima With. [= S. vulgaris (Moench) Garcke ssp. maritima] (With.) A. & D. Löve
S. maritima With. var. elata P. Cout. ex C. Romariz
Sinapidendron angustifolium (DC.) Lowe
S. frutescens (Ait) Lowe
Smilax aspera L. var. altissima Moris & de Not.
S. canariensis Willd. [= S. excelsa L.]
Solidago sempervirens L.
Sonchus pinnatus Ait.
S. squarrosus DC. non Jasq.
S. ustulatus Lowe
Sorbus maderensis Dode
Spergularia azorica (Kindb.) Lebel
Suaeda vera J. F. Gmel.

Taxus baccata L.
Teesdalia nudicaulis (L.) R. Br.
Teucrium betonicum l'Hérit.
Thymus cespititius Brot.
Tolpis azorica (Nutt.) P. Silva
T. fruticosa Schrank
» » ssp. pectinata (DC.) Mnzs.
» » ssp. ligulata Lowe
T. macrorhiza (Lowe) Lowe
Trichomanes speciosum Willd.
Tunica prolifera (L.) Scop.

Ulex europaeus L. ssp. europaeus
Umbilicus rupestris (Salisb.) Dandy

Vaccinium cylindraceum Sm.
V. maderense Lk.
Viola broussonetiana Roem. & Schult. [earlier referred to as V. riviniana Rchb.]
V. paradoxa Lowe

Wahlenbergia nutabunda DC.