INSTITUTO BOTÂNICO DA UNIVERSIDADE DE COIMBRA

MEMÓRIAS
DA
SOCIEDADE BROTERIANA

VOLUME XXII

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DR. J. BARROS NEVES
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RECENT CHANGES IN THE VASCULAR FLORA AND VEGETATION OF THE AZORES ISLANDS

BY

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(Photography by the author)

Abstract

Field work: In 1965 and 1968, for six months.

Investigations: Sociology and ecology of plant communities, succession flow, zonation, influences of the man-made landscape on the natural vegetation.

Communities distinguished: I. *Mercurialion annuae*. II. *Festucion petraeae* with A. *Polygonetum maritimi*, B. *Euphorbietum azoricae*, C. *Ornithopo-Gaudinietum*. III. *Litorello-Eleocharion*. IV. *Juniperion brevifolii* with A. *Anagallidetum tenellae*, B. *Erico-Myrsinetum*, C. *Festucetum jubatae*. The communities were distinguished by differential species of varying differential values, summarized in table 6. Minimum areas of communities were found to be most different, e. g. 4 m² (I), 25 m² (IV B).

Zonation: 0-100 m: *Festuca petraea-Euphorbia azoica* zone *(Festucion petraeae)*. — 100-500 m: *Myrica faya-(Pittosporum undulatum)* zone (< 300 m, *Mercurialion annuae)*. — 500-1350 m: *Juniperus-Erica-Laurus-Myrsine-Vaccinium-Ilex-Viburnum-Frangula* zone *(Juniperion brevifolii, Litorello-Eleocharion)*. — > 1350 m: *Calluna-Daboecia--Thymus* zone (> 1700 m, caracterized by *Rhacomitrium, Gymnomitrium, Andreaea)*.

Distribution of taxa: Increase of number of taxa (699 taxa mentioned by PALHINHA 1966) of probably about 100 % during the last 150 years During the last 100 years the extension of distribution of a large number of taxa was very marked, due to improved communications and extension of the man-made landscape on all islands. Introduction of weeds and ornamental flowers to the islands has changed the recent composition of some communities of the natural landscape and has now locally become a severe threat to their future survival. The preservation of localities with well-developed endemic Azorean vegetation is most urgently required.

Acknowledgments

The publication of this work has been preceeded by six months of field investigations on the Azores and by studies of herbaria in Portuguese museums and institutes.

I owe a special debt to Eng. JOSÉ MARIA ÁLVARES CABRAL (Ponta Delgada), who was the first Portuguese biologist I met in my first journey to the Azores in 1965. His generous support in various respects was of grcat importance to this publication. On Terceira I had the honour and great pleasure to meet the grand old man of most kinds of scientific work on the Azores, Ten.-Coronel JOSÉ AGOSTINHO His interest and advice greatly facilitated final publication of the manuscript. The field investigations on Terceira were most generously supported by Eng. FERNANDO CORDENIZ FAGUNDES, who for several days also participated in excursions and provided several good pieces of advice. For the successfull fulfilment of my field work on Faial and Pico I am very much indebted to Eng. BOTELHO GONÇALVES. His taxonomic knowledge of the Azorean vascular flora was very important in facilitating the initial work on this publication. I am also grateful for all his practical help during excursions.

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Uppsala, in March 1971
ERIK A. SJÖGREN

I. INTRODUCTION

Climate and geology

The Azorean archipelago is situated in the Atlantic Ocean between 36°55′ and 39°42′ N latitude and between 25° and 31°30′ Long. W of Greenwich. It is composed of three groups of islands, the western: Flores, Corvo; the central: Faial, Pico, S. Jorge, Graciosa, Terceira; the eastern: S. Miguel, Santa Maria. The distance from the most centrally situated island, Faial, to Lisbon is about 1480 km and it is about 1900 km to Newfoundland. The distance from S. Miguel to Corvo is 615 km. According to historical documents (cf. MEES 1901) the Azores Islands were discovered as early as during the XIVth century. Colonization by man was by the Portuguese about the middle of the XVth century. In the nineteen-sixties the population of the archipelago exceeded 300 000.

Climatic and geological data mentioned below have been kept to a minimum as literature on these subjects is rather copious (cf. References and bibliography by AFONSO 1964).

The topography of the islands is considerably dissected by a large number of periodically dry ravines and by river valleys. They have cut deeply down into easily eroded volcanic rocks and deposits. On the nine islands, which are all of volcanic origin, the topography is also marked by one large or by several caldeiras. The largest ones originate from the time of formation of the islands. These volcanic cones are situated, as are the islands, on more or less W-E tectonic lines of weakness (cf. KREJCI-GRAF et al. 1965; KREJCI-GRAF 1956). All the lines converge on the W part of S. Miguel, where Sete Cidades, the largest caldeira of the archipelago, is situated (cf. AGOSTINHO 1935).

The highest altitude, 2350 m, is on Pico. On Faial, Terceira, S. Miguel, and S. Jorge the highest mountains reach somewhat above 900 m. The large caldeiras generally have a vast, slightly sunken convex

bottom with or without small lakes (MACHADO 1957). Small parasitic cones surrounded by vast lava flows from different centuries are also prominent features in the landscape. The lava flows resulting from volcanic activity at times after human colonization of the islands have been dated fairly exactly on S. Jorge, Terceira, Faial, Pico and S. Miguel (MACHADO 1962). The more prominent eruptions were fairly evenly spaced throughout the 16th-18th centuries. They therefore provide botanical scientists with natural sampling areas for investigations of the rate and content of the colonization by plant communities and single taxa. The rate of succession can be compared in localities with substrata of different age but colonized under similar macroclimatic conditions.

The geological conditions for the Azorean vegetation are rather uniform. Basaltic rock predominates. Traquite is also present, especially in zones of eruption. Tuff strata are frequent, formed from densely packed volcanic deposits, transported either by wind or water. Locally, they contain fossil plants (FORJAZ 1960, FORJAZ & MONJARDINO 1964). The chemical soil conditions probably offer very little bases for differentiation of the vegetation in the archipalago. Only in habitats near the coast will there probably be some influence of salt impregnation on the composition of the plant cover. Vegetational differentiation will therefore to a large extent depend on the type of substratum and its degree of weathering and the related facility for absorption and retention of the precipitation water. It also depends primarily on the macro-micro climatic conditions. Substratum preference with respect to the degree of weathering has been discussed under the heading « HABITAT » in the descriptions of the single taxa. The substratum preference has been found to be rather weak for many taxa. On the other hand, a distinct zonation of species and communities related to climatic conditions is often recorded.

The climate of the Azores Islands is clearly oceanic, with small variations of temperature, large amounts of precipitation and high air humidity. The mean annual temperature is about 17.5°. Mean February temperature in Angra do Heroismo (Terceira) is 13.8°. The mean temperatures close to the coasts are fairly similar throughout the archipelago. Frosts are rare below 600 m but night frosts can occur in all months of the year at altitudes above 1600 m (verbal information given by Coronel J. AGOSTINHO).

In contrast, amounts of precipitation are very different in the three groups of islands. They increase westward in the archipelago, from 710 mm/year in Ponta Delgada (S. Miguel), to 951 mm in Angra

do Heroismo (Terceira), 1070 mm in Horta (Faial) and 1592 mm in St. Cruz (Flores). At Ponta Delgada measurable amounts of precipitation are generally recorded on 150 days/year. These meteorological values, like those mentioned below, are a product of very intensive investigations made over more than 50 years by Coronel J. AGOSTINHO (AGOSTINHO 1942 a). He has also provided other information which is most important for botanical research on the Azores, namely data on the changes of temperature and precipitation from the coast up to high altitudes on the islands. These show that mean temperature decreases by 0.6° and that precipitation generally increases by 25% for a 100 m increase in altitude. The % increase in precipitation with altitude is slightly higher on N coasts than on S coasts. It is higher for steep than for less steep slopes and it is also higher over shrub-covered areas than over fields. These meteorological data yield the information e. g. that the annual precipitation is about the same at 500 m on S. Miguel as at 350 m on Pico and at 100 m on Flores (AGOSTINHO 1942 b). The constantly high air humidity is of great importance for the vegetation on the Azores. The mean annual value at Ponta Delgada is rarely lower than 75% RH and at St. Cruz (Flores) it is rarely lower than 80% RH.

Investigations

The results below have been derived from part of the botanical material collected during two journeys to the Azores in 1965 and 1968. The field work lasted 6 months. They are concerned only with the vascular flora and vegetation. The bryophyte material collected will later be used to complete the phytocoenotic picture of the composition of the vegetation.

My investigations started with bryosociological and bryoecological motives. However, it soon appeared to be essential to begin with studies of the vascular flora and vegetation. Studies of succession in the moss cover, its sociology andecological amplitudes of species and communities had to be related to the composition of the field and shrub layers and the degree of influence exerted by man.

The purpose of the investigations was thus directed to questions of sociological differentiation, altitude ranges or zonation both of single taxa and of communities, their degree of substratum preference, drought tolerance, tolerance of periodic flooding and position of species or groups of species in the succession. Further, the distribution of antro-

pochorous species was given special attention with the intention of making comparisons with records published in earlier lists of the flora. Few isolated archipelagos have been influenced by human colonization for such a comparatively short time as the Azores.

The flora and vegetation of the Azores has always appeared to botanists as an exciting object of investigation. As earlier publications have dealt almost exclusively with recorded distribution, there remained much ecological information to be given. The vegetation of the other Macaronesian archipelagos has so far been more comprehensively investigated.

The first biologist visiting the Azores (Faial only) was ADANSON, in 1753. More serious botanical investigation began during the latter half of the 18th century (FORSTER 1787). Then followed a delay of at least 50 years (SEUBERT & HOCHSTETTER 1843). Subsequent botanical publications were more frequent and they have been summarized by PALHINHA (1947) in a valuable list of literature. The comprehensive floristic investigations made by PALHINHA in the Azorean archipelago were published in 1966.

Taxonomic problems were numerous during two centuries of investigations of the Azorean vascular flora. In this work has been followed the taxonomy suggested in Flora Europaea (1964, 1968) and PALHINHA (1966).

Comments on the ecology, sociology and distribution of Azorean vascular plants:

The species treated from various points of view in the following were nearly all observed and collected by the author in 1965 and 1968. In addition some taxa with remarkable recent changes in their distribution in the Azores are mentioned. A total of 414 taxa have been included and discussed in the list of species, of the 699 recorded from the archipelago (PALHINHA 1966). In the information provided about the species, my aim was to combine autecological and synecological facts. Information about the ecological preferences of the species is intended to apply only to Azorean conditions, allowing for conditions of competition in the vegetation of the archipelago and for the various habitat conditions available on the islands. Thetext has deliberately not been made excessively brief, in order to facilitate readability and to avoid too narrow generalizations.

Exsicats (EXS.): — Documentation not included by PALHINHA (1966) has been mentioned, as have old exsicats not mentioned in that flora list. Only information on the altitude of localities are published. Other information about the habitat is unfortunately very rare in old herbarium material. Names of collectors and of institutes where the herbarium specimens may be found have been added in abbreviated form (see list of abbreviations below).

VIDI: — For many taxa the aim was to record as many localities as possible, in order to get information about zonation of species and groups of species, especially the differential species. Time was then too short to take exsicats at all localities and only the observations have therefore been published in this section. Observations published here were generally made in connection with sociological analyses or during investigation of zonation in the vegetation by roads and paths and along other routes of excursions, generally crossing contours at a uniform angle.

Habitat (HAB.): — Information is first provided on altitude range and if possible also on preference for localities above or below a certain altitude. For the species restricted to the coast only the upper altitude limits are generally mentioned, sometimes also their presence in microzones of the *Festucion petraeae* (cf. below). For the cloud zone vegetation, with the *Juniperion brevifolii*, the lower altitude limits are of most importance for the understanding of its ecology. Other information is on the species' tolerance of exposure, drought tolerance and tolerance of periodic flooding. The species' preference for certain air humidity conditions, temperature and amounts of precipitation will appear indirectly from the information on altitude preferences. Information is included on the slope of the habitats, which has an immediate influence on the composition and succession of vegetation, depending on the types of substrata and amounts of precipitation. Degree of substratum preference has been mentioned.

Sociology (SOC.): — This section includes the differential values of the species for communities described. Further information on differential values can be obtained from a comparison with the summary table of differential species (table 6). The evaluation of differential values has been based on sociological material from about 400 analyses of sample plots and on sociological observations connected with the investigations of zonation of taxa and communities. From this sociological

material have been compiled groups of species, within which the species under discussion has generally been recorded. A large number of species treated below have no differential values at all. Several have invaded the archipelago recently and are clearly restricted to the man-made landscape. They have been designated as antropochorous. Only a few of these species have also invaded the natural landscape to any extent independently of human influence.

Distribution (DISTRIB.): — There is an elucidatory table of the distribution of nearly all the treated taxa, as published during the last 100 years or so in three flora lists (DROUET 1866, TRELEASE 1897, PALHINHA 1966). Comments on the area of distribution of the taxa refer only to the Azorean archipelago. In these tables the records by the authors or by their companions on the expeditions are denoted by an ×. Islands not visited by the authors are marked with a –. Records mentioned from these islands were not made by DROUET or SJÖGREN personally. In the comments on the distribution of the species, « recent distribution » refers to the period after 1860. The recent invasion of the Azores by a large number of taxa now influences the composition of the natural vegetation to some extent at almost all altitudes (below 1350 m). In some cases the survival of communities is strongly threatened. Further information about the results of the invasion of antropochorous species has been provided in the descriptions of the communities.

For 72 taxa maps of distribution are included. These maps show the distribution on the four islands best known botanically: S. Miguel, Faial, Pico and Terceira. These islands together with S. Jorge, are those with the highest altitudes in the archipelago and are therefore the only ones well suited to illustrate both lower and upper altitude limits. Observations and exsicats by SJÖGREN have been marked with • on maps. Localities documented by earlier botanists have been marked with *. Lack of sufficient information about localities in old herbarium material has unfortunately strongly decreased the number of these localities which could be indicated on the maps. Many of the maps are of the distribution of differential species, with the purpose of illustrating in this way, indirectly, the zonation of communities. The maps also yield some indirect information about frost tolerance and drought tolerance of species and communities. Several localities will certainly be added to these maps in the future, to complete the picture of altitude preferences. The value of the distribution maps is therefore to be found

primarily in the information on altitude ranges, secondarily on altitude preferences.

It is my hope that these maps will inspire skilled botanists as well as students of the Azores to continue in the very near future the studies on altitude limits of as many taxa as possible in the Azorean vegetation. Such studies are urgently required, because of the expansion of the landscape influenced by man. This expansion will certainly fast continue to obscure the natural altitude limits of many taxa. Il will become successively more difficult to detect the original distribution of taxa and communities of the natural landscape. The description of habitat preferences and ranges of many taxa from their natural altitude distribution will become more difficult and correlations made in this way will become more and more uncertain.

Sociological tables and descriptions of communities

Sociological analyses from Azorean vegetation have not been published in earlier flora lists. Tables of sample plots below (table 1-5) include about 20 % of the sociological records made during the two expeditions. The plant communities described are fairly uniform throughout the archipelago with respect to the presence of differential species. However, differences in dominant species make the physiognomy of the communities rather variable, both in localities on a single island and between all the islands of the archipelago. This is especially obvious for the lake shore community *Litorello-Eleocharion* (cf. below).

Zonation of communities has been treated in the descriptions. The macrotopography of the islands means that it is often possible to distinguish concentric vegetation zones around volcanic cones. There is generally a rather even change of the macroclimatic conditions on the slopes from the coast up to the rim of the caldeiras. An uneven course of ravines and parasitic cones. Sharp zone limits are rare both for single taxa and for communities. They are only recorded around lakes at the usual high water level and on the rims of caldeiras and explosion holes in lava flows. The precence of these sharp limits facilitates the differentiation of sociological units.

The differentiation of communities was not carried out with a purely descriptive aim. The sociological records comprise material from carefully defined localities with endemic Azorean vegetation, the existence of which can be followed, as it has recently been, and will continue to be threatened by the expansion of the landscape influenced

by man. The composition of the described communities can be used as basis for future records of successive changes in the vegetation. This might be most important both for the control man's influence on the landscape and for activities designed for nature conservation.

Abbreviations

Herbaria:

AZ	Museu Carlos Machado, Ponta Delgada.
COI	Instituto Botânico «Dr. Júlio Henriques», Coimbra.
LISE	Estação Agronómica Nacional, Oeiras.
LISFA	Estação de Biologia Florestal, Lisboa.
LISI	Instituto Superior de Agronomia, Lisboa.
LISU	Instituto Botânico, Faculdade de Ciências, Lisboa.
U	Institute of Ecological Botany, Uppala.
HO	Circunscrição Florestal da Horta.

Names of collectors:

Ag	Ten.-Coronel José Agostinho
Bel	M. Beliz
Bs	Manuel Brás Júnior
Canav	José Canavarro
Canto	Eugénio do Canto
Car	Bruno Tavares Carreiro
Carn	Emiliano Manuel Arruda de Castro Carneiro
Chaves	Francisco Afonso Chaves
Cu	Adriano Gonçalves da Cunha
Cy	Pedro Luis de O. Cymbron
Cym	Augusto Cymbron
Ds	Pierre Dansereau
Franco	João Manuel António Pais do Amaral Franco
FSi	Veríssimo Vasconcellos de Freitas da Silva
Go	Ilídio Botelho Gonçalves
Guil	W. Resende Guilherme
Ne	R. Neves
Nu	J. Rosado Nunes
Oliv	Oliveira
Orm	José Ormond
Pa	Ruy Telles Palhinha
Rego	Gonçalo Manuel Estrella Rego
Ro	Romariz
Rod	C. Rodrigues
Samp	José Augusto de Nogueira Sampaio
Sjn	Erik Sjögren
So	Luis Gonçalves Sobrinho
Tr	William Trelease
Vasc	Caetano M. Vasconcelos

Other abbreviations:

Exs.	Specimens documented in herbariums	SM	S. Miguel
Vidi	Observed	SMa	Santa Maria
Hab.	Habitat	T	Terceira
Soc.	Sociology	G	Graciosa
Distrib.	Distribution	J	S. Jorge
Mist.	Mistério	P	Pico
Rib.	Ribeira	F	Faial
Cab.	Cabêço	Fo	Flores
Cald.	Caldeira	C	Corvo
All.	Alliance		
Ass.	Association		
Cit.	Mentioned in flora lists		
U. c.	Together with (una cum)		
Diff. sp.	Differential species		
Diff. val.	Differential value		

II. PLANT COMMUNITIES

Methods

The sociological record of Azorean vegetation, that has been summarized in the following description of plant communities, was obtained from analyses of sample plots. The natural landscape shows a dense physiognomic variation. It very soon became apparent that it was impossible to make a complete description in sample plot tables of all variations in dominance within the communities. The description had to be concentrated on the differential species with wide variations in differential values. The figures for degree of cover were therefore replaced by a sign marking only the recorded presence of the species in the sample plots.

The sociological results from sample plots have been condensed in a summary table of differential species. The distinguishing of differential species of varying degrees of differential values has facilitated the separation of the plant communities. The method also has subsidiary advantages. Above all, the contact communities will be easier to observe. There is generally geographical contact between the communities with sociological contact, and there are more or less large areas of transitions. The species with weak differential values also indicate differences in ecological preference between communities. E. g., table 6 shows the lack of sociological contact between the coast community *Festucion petraeae* and the lake shore community *Litorello-Eleocharion*. Nor is

there any geographical contact or any similarity in ecological preference between these alliances. In these aspects there is, however, a marked contact between the *Litorello-Eleocharion* and the cloud zones alliance *Juniperion brevifolii.*

Determination of the minimum sizes of sample plots for the communities was time-consuming. Important differences were recorded. The *Ornithopo-Gaudinietum* by the coast can be described within 4 m^2 whereas the *Erico-Myrsinetum* requires at least 25 m^2.

The present paper includes descriptions of one layer communities (*Festucion petraeae* and *Mercurialion annuae*), two layer communities (*Litorello-Eleocharion* with epigeic bryophyte layer) and a three layer community (*Juniperion brevifolii*). The lichen layer of the first two alliances has been excluded, as have the epiphytic synusies from the *Juniperion brevifolii.* In the tables, those epigeic bryophytes of the *Litorello-Eleocharion* and the *Juniperion brevifolii* which appear with high constancy in the alliances have been mentioned.

I. MERCURIALION ANNUAE E. Sjögren n. all.

The more than 500 years old combination of forces of the natural and man-made landscape has been largely responsible for the present-day distribution and composition of the plant communities within the Azorean archipelago. The inhabited landscape with fields rarely extends above 300 m altitude. Between 300-600 m there are few houses and human influence is confined to forest plantations and to creation and improvement of grazing land.

Mercurialion annuae (M. a.) is a young plant community on the Azores. It is restricted to the man-made landscape. The localities with the most complete composition are to be found within the densely populated coastal areas. At about 300 m the alliance is weakly developed, and above this altitude the differential species are found in only a few localities, generally occasional and disappearing after a short time. The contact communities of the *M. a.* are the *Festucion petraeae* and *Juniperion brevifolii.* There is no sociological contact with the lake shore community *Litorello-Eleocharion.* Transitions to the coastal all. *Festucion petraeae* are especially frequent (comp. table 6). Transitions to the cloud zone all. *Juniperion brevifolii* are very rare. This all. has contact with the *M. a.* only through its open land ass. *Anagallidetum tenellae* on more or less intensively treated grazing land.

Data from sample plots from the antropochorous all. *M. a.* were not collected in such a way as to show the division of the community into associations. There has, however, been no difficulty in finding exclusive diff. spp. of the all. towards other plant communities of the archipelago. The associations of the all. will probably be difficult to distinguish with diff. spp. of high diff. val.

The all. is physiognomically characterized by a large number of dominants such as: *Rubus ulmifolius, Sporobulus indicus, Mercurialis annua, Conyza canadensis, Poa annua, Oxalis cernua, Umbilicus rupestris, Brevipodium silvaticum, Fumaria muralis, Geranium robertianum, Sonchus spp., Parietaria diffusa, Silene gallica, Sisymbrium officinale* and *Polycarpon tetraphyllum*. Changes from one dominant to another are very frequent in small areas. Recent changes of dominance have probably been numerous. *M. a.* is the community to which the largest number of invading species, not previously recorded from the archipelago, have been added in the last 100 years.

M. a. is generally built up of only one layer, of vascular plants. Mosses and lichens are rare. The size of sample plots rarely needs to exceed 4 m^2 in order to contain at least 10 diff. spp. of the all. No ecological preference of the *M. a.* for particular climatic conditions can be defined and only a slight preference for finegrained soils is detectable. The all. is, however, clearly nitrophilous. The nitrate supply has to be provided regularly, especially as precipitation is high even near the coast. The nitrate supply seems to be sufficient only near villages and roads at low altitudes. It is rarely sufficient in the pastures above 400 m, where precipitation is generally double that at the coast. Salt-impregnation is high near the coast and is responsible for higher pH-values. A few species of the *M. a.*, which are neutrophilous rather than nitrophilous, will therefore occur close to the coast in spite of the lack of nitrate supply. The preference of the *M. a.* for fine-grained soils has not excluded the community from the large available areas of loose black gravel material. It has also been recorded from stone walls near the coast. In such habitats a sample plot size of at least 6 m^2 is required to record the all. adequately.

II. FESTUCION PETRAEAE E. Sjögren n. all.

Among the communities of the natural landscape of the Azores the *Festucion petraeae (F. p.)* covers the largest areas after the *Junipe-*

rion brevifolii. *F. p.* has a sociological conformity all through the archipelago. The community was probably well established on Azorean coasts before human colonization of the islands. The recently increasing influence of man on the landscape within the coastal zone has opened more and more areas for colonization of the *F. p.*, in places where a *Myrica faya* scrub vegetation has been removed. The intrusion into the *F. p.* of antropochorous species, which characterize the *Mercurialion annuae*, has increased at the same time. However, the increase of the all. has been held back because of recent invasion of species with high competitive ability. The upper limit of a weakly developed *F. p.* with *Myrica faya* in the shrub layer has thus been lowered, because of explosively rapid colonization by dense *Pittosporum undulatum* scrub. This tree species was introduced long ago, probably already during the first half of the colonization period. It was planted as protection around orange tree plantations (cf. Foque 1893) and also provided a good source of fuel for the population. The control of spontanous colonization by this shrub then became too weak and during the last 100 years *Pittosporum* has invaded the man-made and natural landscape of the coast zone to such an extent that forest planting and other kinds of cultivation have been obstructed. *Pittosporum* grows extremely rapidly and will usually reach 4-6 m after only 6-7 years. The protection from exposure given by a shrub-tree layer of that age and size is extremely effective. One change in daily human life during the last 20 years has assisted the intrusion of *Pittosporum* in the coast zone of the Azores, i. e. the increasing use of gas instead of wood for household fuel.

On the coastal cliffs and lava flows near the coast, large areas for the *F. p.* became available when *Myrica faya* was cut. In such habitats, as well as on steep cuttings through sand-gravel deposits near the coast, the *F. p.* now has to compete in several localities against a powerful invasion of antropochorous species, which were previouly very rarely found in the archipelago. Deliberately introduced ornamental species such as *Carpobrotus edulis* and *Hydrangea macrophylla* have now outcompeted the *F. p.* in large areas. *C. edulis* has also started to colonize loose sand deposits close to the young volcano of Capelinhos on Faial, both behind the old coastline, to the E, and on the new peninsula formed by the volcanic deposits.

The all. *F. p.* has been characterized by a small number of diff. spp., which have been recorded within all three associations (cf. table 6). *F. p.* has rarely been found at altitudes above 100 m. The

areas of the all. are small and narrow on steep parts of the coast. They extend, however, much further inland where the coast is level. Single diff. spp. only rarely colonize above 300 m. *Myrica faya* is, however, an important shrub in the vegetation up to 500 m. The combination of *Myrica* with *Laurus azorica* forming a «Laurel-forest» *(Perseo-Myrsinetum)* below 600 m, as was suggested by Tutin (1953), could not be verified. The investigations clearly indicate that *Laurus* belongs not to the *Myrica*-zone, with or without *F. p.*, but to the cloud zone vegetation with the *Juniperion brevifolii.*

The sociological contact communities of the *F. p.* are the *Mercurialion annuae* and the *Juniperion brevifolii.* The contact with the *Juniperion brevifolii* will be dealt with below.

The ecological requirements and substratum preference of the *F. p.* are rather indistinct. Thus the *F. p.* has been recorded from loose fine sand as well as from coarse gravel and basaltic coastal cliffs. The associations of the all., however, have rather distinct substratum preferences (cf. below). As fine weathering material and deposits are deeper and more frequent inland, there is a detectable microzonation of species and associations in parallel to the coast line.

F. p. frequently has no bottom layer. On coastal cliffs, however, there is often a species-rich lichen layer. On deposits of fine, densely packed sand in crevices, a few bryophytes are also found, such as *Trichostomum litorale* and *Riccia* spp. (Allorge 1946). On small areas the all. is completely developed in spite of the presence of a low sparse wind-pruned shrub layer of *Myrica faya* and *Erica azorica.*

Records of the *F. p.* required sample plots not smaller than 25 m^2. Especially on bare coastal cliffs, the vegetation is extremely sparse. A rectangular sample plot at right angles to the coast line was often suitable. This covered the microzones and thus as large as possible a range of variation within the all. Only a few species reach dominance and high degrees of cover within the minimum size of sample plot for the *F. p.* The only frequent dominants are *Festuca petraea, Plantago coronopus, Euphorbia azorica, Juncus acutus, Solidago sempervirens, Lotus subbiflorus* and *Myrica faya.*

There are some differences in dominance and frequency of species of the *F. p.* between the Azorean islands. E. g. on Terceira, *Euphorbia azorica. Geranium robertianum* and *Asplenium marinum* are frequent dominants. On Faial, on the contrary, the most frequent dominants are *Polystichum falcatum, Spergularia azorica, Frankenia pulverulenta* and *Centaurium scilloides* ssp. *massonii.* On Pico, *Campanula vidalii* is localy

dominant. On Flores, *Solidago sempervirens* is more frequent as a dominant than on the other islands.

The succession in the vascular plant cover of the *F. p.* is fairly uniform. It starts on bare coastal cliffs with colonization by single plants of *Festuca petraea*, *Euphorbia azorica* and *Juncus acutus*. In habitats where soil has accumulated, it continues with a stage of *Lotus-Ornithopus-Gnaphalium*, on deeper soil invaded by *Myrica* and small plants of *Erica*. The ass. *Ornithopo-Gaudinietum* (cf. below) follows the *Euphorbietum azoricae* in the succession. The *Euphorbietum azoricae* recolonizes habitats where the conditions for the *Ornithopo-Gaudinietum* have become unfavourable, e. g. when occasional storm waves have removed accumulated sand and litter.

Primary colonization by lichens and mosses has been observed on the new peninsula of Capelinhos on Faial. Both on the small lava flow and on sand-gravel deposits (see fig. II), there was not a single lichen 10 years after the volcanic acitivites (1957-1958). Only two small localities colonized by young shoots of *Trichostomum litorale* were found, where very fine sand had occasionally accumulated close to some stones so that humidity at the soil surface was higher than at the surface or the surrounding coarse material. The progress of the succession on coastal cliffs and sand deposits close to the coastline might therefore be judged to be very slow. Just the first stage of succession, with a dense carpet of lichens and a few mosses, might require 25 years or more to reach its optimum, when vascular plants start colonizing.

Within the *F. p.* three associations have been distinguished. They are separated by groups of diff. spp. of varying diff. values. The sociologically distinct associations are also characterized by differences in their ecological preferences.

A. **Polygonetum maritimi** E. Sjögren n. ass.

The ass. *(P. m.)* has been characterized by three diff. spp. (table 6). Transitions towards both the other associations of the all. have been recorded but are rare. The ass. also has a small number of diff. spp. in common with the *Euphorbietum azoricae*. The *P. m.* is a one layer community. It can not be described within sample plots smaller than 16 m^2.

In the Azorean archipelago the only records of the *P. m.* are from Terceira and Faial. This limited area of distribution depends entirely

upon the specialized ecology of the community. It can be found only on beaches with loose sand. There are therefore only a few possibilities for the *P. m.* to extend its distribution in the archipelago. On Faial, however, new suitable habitats have recently been added in 1957-58, on and close to the new peninsula of the Capelinhos volcano. Colonization by vascular plants was, however, very rare there in 1968. There might instead be a decrease of the distribution area of this ass. on the Azores in the near future. Sandy shores and also densely packed sand deposits have recently been invaded by *Cynodon dactylon*. This grass seems to have a very high competitive ability on sandy soils on the Azorean coast. The competition from *Cynodon* seems to be too strong for the *Festucion petraeae* in several localities, except on rough basaltic coastal cliffs.

B. **Euphorbietum azoricae** E. Sjögren n. ass.

This ass. *(E. a.)* is one of the most distinct plant communities in the archipelago (table 6). The number of exclusive diff. ssp. comprises 10 taxa. The most important contact community of the *E. a.* is the *Ornithopo-Gaudinietum* (cf. below). Transitions towards that ass. are frequent. On steep parts of the coast the transition areas are small and narrow but become much larger on level parts of the coast. The sociological transitions towards the *Polygonetum maritimi* are, on the contrary, very rare.

The *E. a.*, like the *Polygonetum maritimi*, is a sparse community which cannot be recorded within sample plots smaller than 16 m^2. It often consists of a bottom layer with several lichen spp. but few moss ssp., and a field layer. There is usually no shrub layer. The number of dominants with high degrees of cover is low. The species which will reach dominance in a locality seems often to be determined by accident. The species which are most frequently recorded as dominants are *Euphorbia azorica*, *Crithmum maritimum*, *Juncus acutus* and *Festuca petraea*.

The *E. a.* is frequent in habitats on coastal cliffs with small amounts of sand and litter accumulated in crevices. The ass. has also colonized large areas of coarse volcanic deposits near the coast. Several of the diff. spp. are frequently recorded among the first colonizing vascular plants on the cliffs. Their colonization rarely extends below the upper limit for storm waves. They are however, apparently very tolerant, of continuous salt spray, so that the ass. is regularly forming

the microzone of the coastal vegetation which is nearest the sea. Next comes the *Ornithopo-Gaudinietum*, in which the cover of *Stereocaulon* spp. starts to become dense on basaltic stones and boulders.

The expansion of the influence by man on the landscape has provided larger areas for colonization of the *E. a.*, in places where the shrub layer has been removed. However, invasion by some recently introduced species, *Carpobrotus edulis*, *Mesembryanthemum* spp. has resulted in the ass. being out-competed in fairly large areas.

C. **Ornithopo-Gaudinietum** E. Sjögren n. ass.

The ass. *Ornithopo-Gaudinietum (O.-G.)* has been named from the diff. spp. *Ornithopus pinnatus* and *Gaudinia fragilis*, which are also locally dominants. The *O.-G.* has been characterized by five exclusive diff. spp. and by five which also occur rarely and occasionally within some of the other associations described (cf. table 6). The ass. has sociological contact especially with the *Euphorbietum azoricae*. Only the *O.-G.* of the associations of the *Festucion petraeae* is also a contact community with the *Juniperion brevifolii*. It should, however, be stressed that there is no distinct narrow transition zone around all the islands with a mixture of weakly developed *O.-G.* and also weakly developed associations of the *Juniperion brevifolii*. The man-made landscape effectively obscures the presence of such a transition zone, or fragments it. Localities with these transitions are instead widely scattered at altitudes between 300-600 m where single diff. spp. of the *O.-G.* and the *Juniperion brevifolii* have been recorded growing closely together. Between these altitudes there are also areas of competition between *Myrica faya-Pittosporum undulatum* and *Erica azorica-Vaccinium cylindraceum-Myrsine africana* var.

The transitions from the *O.-G.* to cloud zone communities have become successively more rare in the last 100 years. The main reason has been the extension of the influence of man on the landscape between 300-600 m and also the extinction of the natural mosaic of vegetation in the *Myrica faya* scrub zone after the explosively strong and rapid invasion by *Pittosporum undulatum*. This tree species has favoured the colonization of some *Juniperion brevifolii* species below their original lower altitude limit. The *Pittosporum* scrub provides dense shade and protection from exposure and also a thick and slowly mouldering litter, not suitable for colonization by any diff. spp. of the *Festucion petraeae*. On the Azores a kind of sociological gap has

therefore recently arisen between the communities of the natural landscape over large areas in the altitude range 300-600 m. Within this altitude range there have also been forest plantations on large areas in the last century.

The *O.-G.* fairly frequently includes a moss cover poor in species and also a sparse shrub layer or in any case some low-grown plants of shrub species, better attributed to the field layer. The development of a dense shrub layer always results in the rapid disappearance of the ass. The *O.-G.* can rarely be recorded within sample plots smaller than 9 m^2. It has only been possible to use a smaller sample plot size in some localities, in habitats with densely packed fine sand deposits.

The dominant species include *Geranium purpureum, Lotus subbiflorus, Ornithopus pinnatus* and *Thymus cespititius.* On Terceira these species have been outcompeted over large areas by the recently introced *Polygonum capitatum.* This species now covers large areas on lava flows with sparse *Myrica* scrub and originally a rather complete *O.-G.*

Compared with *Euphorbietum azoricae* the *O.-G.* has a wider ecological amplitude and it covers a larger area than the other two associations of the *Festucion petraeae* on the Azores. The *O.-G.* has been recorded completely developed up to altitudes of about 300 m. The substratum can be sand as well as coarse black gravel deposits, rarely lava flows with a coarse stony surface.

In the succession of the coastal vegetation at altitudes below 100 m the *O.-G.* has a central place between the *Euphorbietum azoricae* and the dense *Myrica* scrub, which is very poor in species. Favorable climatic conditions for a dense *Myrica* scrub are not available on Madeira (S slopes) or in the Canaries below 400-500 m (cf. Ceballos & Ortuño 1951).

On coastal cliffs in habitats occasionally reached by storm waves this succession will not reach the shrub layer stage and the duration of colonization by the *O.-G.* is often very short.

III. LITORELLO-ELEOCHARION E. Sjögren n. all.

The all. *Litorello-Eleocharion (L.-E.)* in the Azores is restricted to periodically flooded lake shores. The community has been named from the diff. spp. *Litorella uniflora* and *Eleocharis multicaulis* which are also local dominants. Nine exclusive diff. spp. characterize the ass., together with nine diff. spp. in common with one ass. of the *Juniperion*

brevifolii (cf. table 6). The *L.-E.* is sharply distinct from other plant communities of the islands both sociologically and geographically and also has a specialized ecological preference. The only contact community is the *Anagallidetum tenellae* of the *Juniperion brevifolii*, as can be seen from the summary table of diff. spp. This contact is accentuated from E to W within the archipelago, in relation to the increased precipitation in that direction. This means that there is a weakening of the diff. values of the diff. spp. of the all. from E to W.

The all. has no shrub layer. Only rarely are small dwarf individuals of *Erica azorica* recorded. A bottom layer is always present, though with few species and with very variable degree of cover. The *L.-E.* requires a sample plot size of at least 16 m^2 to record the whole range of variation of the sociologically completely developed all. The sample plot should then be rectangular, placed at right angels to the water line in order to include the microzones of the all.

L.-E. has a rather uniform composition throughout the Azorean archipelago. There is, however, an obvious variation of dominance within the all. between the islands and also between localities around different lakes on the same island. Thus *Hypericum elodes* is not present in the large caldeira of Faial, where *Chamaemelum nobile* var. is the dominant species in the middle microzone. *Chamaemelum nobile* var. is the dominant species in the middle microzone. *Chamaemelum nobile* does not have a high degree of cover around the lakes of Pico, whereas *Hypericum elodes* is most abundant there in and around Lag. do Caiado, as it is on S. Miguel in Lag. do Fogo. *Scirpus fluitans*, *Eleocharis multicaulis* and *Polytrichum commune* are rare around the lake in the caldeira of Faial. They are dominant spp. over large areas of lake shores on Pico and Terceira. *Nardus stricta* is a dominant species only in the highest microzone around Lag. do Canario on S. Miguel. Hummocks dominated be *Polytrichum commune* are a characteristic feature of lake shore vegetation on Pico, Terceira and Flores.

The microzonation round the Azorean lakes is generally characterized by the following species:

I. Below low water level: *Potamogeton polygonifolius*, *Hypericum elodes*, *Isoetes azorica* (F, P, Fo, C).

II. Close to low water level, in a microzone under water for at least 2/3 of the year: *Callitriche stagnalis*, *Peplis portula*, *Eleocharis palustris*, *Litorella uniflora*, *Potamogeton polygonifolius*, *Scirpus fluitans*. On Flores (Lag. da Lomba, 620 m) *Potamogeton polygonifolius* and

Peplis portula have alos been recorded from microzones III and IV, because precipitation is higher than around lakes on Pico.

III. Middle microzone under water for nearly half the year, in winter: *Eleocharis multicaulis, Hydrocotyle vulgaris, Chamaemelum nobile* var., *Mentha aquatica, M. pulegium, Philonotis rigida, Fissidens adianthoides.*

IV. Highest microzone just below high water level, under water for less than 1/3 of the year: *Juncus effusus, Potentilla anglica, Nardus stricta, Polytrichum commune, Scleropodium illecebrum, Rhytidiadelphus calvescens, Breutelia azorica, Thuidium tamariscinum.*

Above high water level follows the *Juniperion brevifolii*, e. g. with the following dominant spp.: *Calluna vulgaris, Holcus rigidus, Blechnum spicant.*

The complete constitution of the *L.-E.* as described here has developed and has been recorded in the last century. Knowledge of the distribution in the archipelago of the diff. spp. has considerably improved recently. The physiognomy of the all. has probably changed recently after the extension of the distribution of such ssp. as *Hydrocotyle vulgaris, Epilobium obscurum, Mentha aquatica* and *M. pulegium.*

The effect of grazing on grassland vegetation of the *Juniperion brevifolii* has also recently strongly influenced the *L.-E.*, even around lakes in deep caldeiras with steep slopes, e. g. in the caldeira of Faial and in the Santa Barbara of Terceira. The regular microzonation around the lakes has to a large extent become fragmented. The supply of nitrates and the trampling has on many lake shores induced invasion of antropochorous species. The succession towards the encroachment of lakes by vegetation initiated from easily eroded *Sphagnum* hummocks with stabilizing *Polytrichum commune* and *Luzula purpureo-splendens*, has been effectivelly stopped or slowed down by grazing animals.

L.-E. with complete composition is restricted to sand-gravel deposits below high water level around lakes. No associations within the all. have yet been distinguished. They would, however, to a large extent be congruent with the microzones described above. Their composition is correlated with tolerance to flooding and with drought resistance of the characteristic species.

The succession within the *L.-E.* will proceed when the encroachment of the lakes by vegetation proceeds undisturbed. It will be stopped or reversed in years with abnormally high precipitation. The encroachment of Azorean lakes seems often to be initiated by *Potamogeton*

polygonifolius and *Hypericum elodes*. The microzones described above will then move down the lake shore. Effective encroachment often starts from small points in the microzones dominated by species generally found in a dryer microzone. Isolated hummocks of *Sphagnum* and grasses can be recorded in the *L.-E.*, also colonized by shrubs of the *Juniperion brevifolii*.

IV. JUNIPERION BREVIFOLII E. Sjögren n. all.

The all. *Juniperion brevifolii (J. b.)* is named from one of the diff. spp. of the shrub layer, which is also frequently dominant over other shrub species. However, the most frequent dominant seems to be *Erica azorica*, which has also been recorded from the coast community *Festucion petraeae*, and was therefore considered unsuitable as a name for the large cloud zone sommunity.

J. b. is the most homogenous community of the Azores from a plant geographical point of view. It contains the largest number of Azorean and Macaronesian endemic species and still covers rather large areas in the archipelago. It is a great exaggeration to say that these areas have almost entirely disappeared, as was stated by Davy de Virville (1965a). It has been invaded recently by cosmopotitan or mediterranean weeds to a comparatively small extent.

The characterization of the all. has been based on 13 exclusive diff. spp. (cf. table 6), including 11 diff. spp. with lower diff. values. *J. b.* is a three layer community with epigeic moss layer and shrub layer. The shrub layer now contains only scattered individual trees higher than 3 m. The shrub layer is generally very sparse and low on the grazed grasslands. In a dense shrub layer there are always epiphytic synusies rich in species. They have been omitted from this description of the *J. b.*

The physiognomic aspect of the *J. b.* is dominated by *Juniperus* and *Erica*. The shrub layer is generally also mixed with *Laurus azorica*, *Ilex perado* ssp., *Vaccinium cylindraceum*, *Viburnum tinus* ssp. and *Myrsine africana* var. These shrub species reach high degrees of cover only locally. The number of dominant spp. of the field layer is so large, that there would be little value in publishing a list of examples here. These conditions have not facilitated the differentation of diff. spp. and were one of the reasons why degrees of cover were not recorded in the sample plots. The minimum area of the *J. b.* was found to be about 40 m^2. The complete all. could rarely be recorded within 25 m^2.

The completely developed *J. b.* generally has a lower altitude limit in the archipelago of about 500 m. The upper altitude limit can only be studied on Pico. It is about 1350 m. Above this limit there is a successive reduction of the number of species of the all., especially of the diff. spp. The number of dominant spp. also decreases and above 1500 m is reduced to only three spp.: *Calluna vulgaris*, *Daboecia azorica* and *Thymus cespititius*. The number of spp. in the bryophyte layer is also reduced. *Rhacomitrium lanuginosum* becomes a dominant species in the bottom layer on large areas. The low temperatures at altitudes above 1500 m might favour the assimilation rate of this bryophyte (cf. Tallis 1964). Only a few bryophytes and vascular plants have been recorded above 2000 m. The number of shrub spp. also decreases. Shrubs become successively shorter and more sparse. Nevertheless it is not sociologically justified to distinguish a new association of the *Juniperion brevifolii*, above 1500 m, such as the *Callunetum* (Tutin 1953 and 1964). No diff. spp. in the plant cover have been found at these altitudes on Pico to distinguish the ass. from the *Erico-Myrsinetum* (cf. below). Only some bryophytes seem to have a diff. val. e. g. *Andreaea rupestris* and *Gymnostomum adustum*. *Gymnostomum* grows frequently in grassland vegetation at high altitudes on St. Bárbara (Terceira). *Aulacomnium palustre*, suggested by Dansereau (1956) from these localities, is however, a very rare bryophyte in the archipelago, only growing in the *Litorello-Eleocharion*.

The lower altitude limit of the all. has been found to decrease from E to W within the archipelago. The all. has been recorded completely developed at 300 m on Flores. The contact with the *Festucion petraeae* is richer in transitions on Flores, which can also be understood from Allorge (1948), where *Festuca petraea* has been recorded from «prairies suspendues» together with such *Juniperion species* as *Bellis azorica* and *Euphrasia grandiflora*.

The completely developed *J. b.* requires high precipitation and permanently high RH values. The all. does not seem to extend below altitudes with less than 2000 mm/year of precipitation. Thus the lower altitude limit of the all. is situated at about 500 m on the central islands, at about 300 m on Flores in the W and at about 700 m on S. Miguel in the E. The mean RH values above this altitude limit are probably higher than 80 %. The limit for the *J. b.* at altitudes above 1500 m on Pico can probably be correlated with winter temperatures below zero. It is also important that drought becomes a limiting factor above this altitude in spite of abundant precipitation. The rain water drains very

rapidly downwards in the coarse black basaltic gravel deposits and only forms rivers or streams at these altitudes to a very small extent. The *J. b.* develops on lava flows with very thin deposits of sand and gravel as well as on deep sand deposits between the lava flows.

The *J. b.* helps to a large extent to form its own suitable habitat conditions on the lava flows when litter accumulates and exposure becomes successively weaker as the shrub layer grows high and dense. The succession from the young bare lava flow to the complete *J. b.* has been calculated to require at least 300 years. For example, on the 200 years old Picos Negros (Terceira) on the lava flow from the year 1761, the lava boulders have been colonized at altitudes between 500-600 m by only a sparse and low *J. b.* with apparently only few diff. spp. present. However, there is already some differentiation of the vegetation. *Fissidens serrulatus* and *Hymenophyllum tunbridgense* are concentrated in the dark habitats between the boulders, and *Aira caryophyllea*, *Hypericum humifusum*, *Rhacomitrium lanuginosum* on the strongly exposed surfaces of the boulders.

Cutting the *Juniperus-Erica* scrub on lava flows in the Azores results in very rapid removal in the precipitation water of the humus -litter layer accumulated over many centuries. Then the succession has to start again from the beginning, or almost so, with a lichen cover often dominated by *Stereocaulon* spp. A new steep cutting through sand, gravel deposits at about 600 m (observation on Faial) can develop a fairly complete *J. b.* after 10 years, as there is a good supply of diaspores from the all. in the immediate vicinity. A moss cover will often develop on fine sand deposits after only 2 years at altitudes above 500 m. Frequent dominant spp. in such a primary stage of colonization are *Anthoceros punctatus* and *Philonotis rigida*. On soil cuttings at about 100 m, this colonization including the invasion of lichens, e. g. *Roccella* spp. on coarse material, has been calculated to require at least 5 years when exposure is weak. *Trichostomum litorale* is generally one of the dominant bryophytes.

The vegetational succession in the areas lying between the comparatively young lava flows proceeds to the complete *J. b.* more rapidly than on the rough lava flows themselves. The seminatural created pastures are in these areas between the lava flows. Cuttings of the shrub layer alone was the easiest way to create grasslands for grazing. The shrubs were also burned for the same purpose. There has now also been important improvement of large areas of pastures by the

sowing of grasses and leguminous plants. The recolonization of these pastures was retarded over large areas because of the development of swampy conditions after a strong invasion by *Sphagnum* spp. This result of intensive cutting in the *J. b.* was especially evident on Flores.

The expansion of the influence of man on the landscape at the present time especially affects the area of *J. b.* and also the composition of the all. Created pastures originate from the *Erico-Myrsinetum* of the *J. b.* During human colonization of the islands there has been a continuous removal of large trees of the cloud zone vegetation. As a result, the *J. b.* is now a shrub community without a tree layer. However, it could probably originally have been classified as a four layer community. In spite of the heavy pressure from the man-made landscape for 500 years, the *J. b.* has in large areas maintained a high percentage of endemic species and has been invaded by cosmopolitan weeds to a comparatively small extent except where cuttings have been very intense. In such areas the regeneration of the *J. b.* was locally prevented altogether by invasion of the introduced *Hedychium gardnerianum*.

Among the antropochorous species which are now strongly established in the *J. b.*, *Erigeron karwinskianus* and *Eupatorium adenophorum* should also be mentioned. These spp. have locally reached dominance in the field layer in the cloud zone vegetation of Madeira, and seem to be present everywhere in the *Erica-Laurus* vegetation. A marked and rapid expansion of the distribution of these spp. in the Azores can unfortunately be expected during coming decades. Their penetration into the natural vegetation can probably not be held back. In contrast, it is probably possible to restrict the expansion of the distribution of *Hedychium* on islands already colonized and to prevent its invasion of those islands which are still free of it. The inside of the largest and oldest caldeira of the archipelago, Sete Cidades on S. Miguel, is now almost completely covered by *Hedychium*, and regeneration of the *J. b.* there might be impossible in future. At about 1860 (Drouet 1866), the vegetation of that caldeira was described as dominated by *Erica*, *Laurus* and *Calluna*. At the beginning of this century (cf. Druce 1911) *Hedychium* was already frequently naturalized.

The three associations of the *J. b.* described below are easily distinguished by the lack and presence of diff. spp. of varying values. The associations also require distinctly different habitat conditions.

A. **Anagallidetum tenellae** E. Sjögren n. ass.

The ass. *(A. t.)* belongs to the open seminatural grasslands of the cloud zone vegetation. These grasslands were cleared between the young lava flows to provide pastures for cattle. *A. t.* generally has no shrub layer. The field layer dominated by grasses is dense except where *Sphagnum* spp. have reached dominance in the bottom layer. Sample plots of at least 16 m^2 are required to describe the full development of the ass. It has rarely also been recorded within 8 m^2.

The only exclusive diff. spp. are, as far as can now be seen, *Origanum virens* and *Carex pilulifera* var. The number of diff. spp. with weaker diff. values is, however, large (cf. table 6). The sociological contact communities of the *A. t.* can also be seen from table 6. The main contact communities are the *Erico-Myrsinetum* (cf. below) and the lake shore all. *Litorello-Eleocharion*. Transitions between the *A. t.* and these communities are especially frequent around the lakes.

The origin of the *A. t.* is always the *Erico-Myrsinetum* of the natural landscape. *A. t.* was probably present in the natural landscape of the islands before human colonization of the archipelago, but only on small areas within the *Erico-Myrsinetum*. That ass. was probably destroyed locally by storm and fire caused by lightning. *A. t.* might at that time, however, have had only a short lifetime because of a comparatively rapid undesturbed recolonization by the *Erico-Myrsinetum*. Large areas of the *A. t.* are now dependent on cutting and grazing. The use of grazing alone to open up large pastures from the *Erico-Myrsinetum* was probably not possible. After intensive cutting, however, intensive grazing alone seems to be sufficient to maintain a dense mosaic of *A. t.* and *Erico-Myrsinetum*, thus holding back the natural progress of succession within the *Juniperion brevifolii* scrub on the land between the lava flows.

The lack of recolonization by the *Erico-Myrsinetum* of areas of created *A. t.* depends on the strong invasion by *Sphagnum*. The layers of fine material in the volcanic deposits seem to become denser after cutting the *Juniperion*. They then tend to prevent the penetration of rain water more than in shrub vegetation, where there is also an important amount of interception of the rain water (fig. VIII). In such swampy areas, after intensive cutting suitable conditions have arisen for invasion by species characterizing the *Litorello-Eleocharion*, first in depressions. When the *A. t.* has become totally deprived of a shrub layer, it becomes very susceptible to erosion on slopes, especially when

the soil surface layer is largely made up of coarse gravel deposits, the so-called 'bagacina'. In such sloping habitats, the ass. becomes characterized by series of long horizontal hummocks (fig. VII) because of the slow landslide going on. The creation of pastures and the improvement of natural grassland is therefore restricted to areas with a slope of less than 30 % because of the danger of erosion. When erosion has started on a slope the plant cover will sooner or later break up and slide down to the bases of the hills. Primary colonization of the bare soil surfaces will generally be by bryophytes such as *Rhacomitrium lanuginosum*, *Philonotis rigida*, *Gymnomitrium* spp., *Reboulia hemisphaerica*. The moss cover then helps to accumulate fine sand material, facilitating recolonization by vascular plants. Where sand gravel is mixed with coarser material, a *Stereocaulon* colonization will be included in the bryophyte stage. Where large areas of coarse basaltic gravel surfaces are deprived of plant cover through erosion, it probably requires centuries for the succession, even if undisturbed, to reach the *Erico-Myrsinetum*. The invasion of mosses is very slow on slopes with unstable gravel. Also the drought is severe on these 'bagacina' surfaces where rain water penetrates immediately. The black material maintains high temperatures, about 30-35° at the surface and about 20° 10 cm below the surface in the middle of a sunny summer day at 500 m altitude. In the secondary stage of colonization, by vascular plants, species which take part frequently include *Sagina procumbens*, *Rumex angiocarpus*, *Galium parisiense* and *Aira caryophyllea* for example.

The *A. t.* has recently been invaded by only a small number of the antropochorous species usually found in the *Mercurialion annuae*. The presence of such spp. is generally only occasional. Some important weeds have been mentioned above. In addition *Hydrangea grandiflora* readily invades the *A. t.* where plantations around fields are not regularly examined. As a result of the creation of open pastures from the *Erico-Myrsinetum*, a strong invasion of the grasslands by *Pteridium aquilinum* has also begun. This invasion is especially evident where the pastures have not been improved. *Pteridium* is rare in dense *Juniperion* scrub, where other ferns such as *Culcita macrocarpa* and *Dryopteris* spp. predominate instead. *Culcita* was probably much more frequent in the archipelago before the 19th century as it has been intensively harvested by the inhabitants, who use the soft basal hairs for pillows.

B. **Erico-Myrsinetum** E. Sjögren n. ass.

The community has been named from *Erica azorica* and *Myrsine africana* var. These species are weak diff. spp. of the *Juniperion brevifolii*. They are especially characteristic physiognomically of the *Erico-Myrsinetum (E.-M.)*. The ass. has only few strong diff. spp. but it is well separated from the two other associations of the all. by lack of a large number of their exclusive diff. spp. The ass. has an especially large number of diff. spp. in common with the *Festucetum jubatae* (cf. below).

E.-M. was until recently the plant community that covered the largest areas within the natural landscape of the Azorean archipelago. It is the original community of the *Anagallidetum tenellae*. It has been colonized by only few antropochorous species. The well established introduces spp. within the ass. are the same as those mentioned under the *Anagallidetum tenellae*.

The sociological documentation of the *E.-M.* appeared to require a mininum sample plot size of 25 m^2. The ass. is regularly made up of three layers. It also contains epiphytic synusies. The dominant species are numerous. The records of the ass. were therefore restricted to finding diff. spp. The most frequent dominants of the shrub layer are *Erica azorica*, *Juniperus brevifolia* and *Myrsine africana* var. Other more rare shrub layer dominants have been named diff. spp. of the *Juniperion brevifolii* (cf. table 6).

The *E.-M.* has been recorded sociologically completely developed down to 500 m on the central islands of the archipelago, on Flores down to 300 m. The upper altitude limit on Pico lies at about 1350 m. The lower limit of the zone with *Erica azorica-Juniperus brevifolia* scrub was put by Marler & Boatman (1952) at 1000 m, which is in my opinion much too high. The ass. has sociological and geographical contact with both the *Festucion petraeae* and the *Litorello-Eleocharion*. The transitions towards the *Anagallidetum tenellae* are often sharp, as at the edges of areas of shrub clearance. They are locally diffuse in a natural mosaic vegetation. The contact with the *Festucetum jubatae*, on the rim of ravines and explosion craters is always very sharp and means the sudden presence of exclusive diff. spp. characterizing the *Festucetum jubatae*. The kind of contact with the *Litorello-Eleocharion* is very variable depending on the topography of the lake shores. The transition area is, however, generally rather narrow. The transition areas towards the *Ornithopo-Gaudinietum* mixed into the *Myrica faya* scrub are

usually composed of groups of species which incompletely characterize the *E.-M.* and the *Ornithopo-Gaudinietum*.

The ecological preference of the *E.-M.* includes only a low tolerance of periodic flooding. Nor are swampy habitats with abundant *Sphagnum* cover colonized by the *E.-M.* The ass. can frequently be recorded completely developed on lava flows where the rain water penetrates rapidly. The litter-humus layer below dense scrub of *Erica* and *Juniperus* seems, however, always to remain moist at altitudes above 500 m. RH mean values are high, generally above 80 %. The optimum habitat conditions for the *E.-M.* will not be reached on young lava flows earlier than three centuries after primary colonization by lichens and mosses has begun. The microtopography of the young lava flows is very rough. There are always deep crevices, 2-3 m deep, and caves in the lava flows. Their influence on the differentiation of the *E.-M.* is especially distinct under a sparse shrub layer. A dense shrub layer has been found to even out the influence. There is generally, however, a very dense mosaic vegetation on the lava flows.

Some measurements of temperatures were made in June 1968 on a cloud-free day at 12.00, on the lava flow of the year 1761 (Terceira, 450 m). The black protruding parts of the lava flow generally had a surface temperature of 35°. The steep sides of 3 dm deep crevices had a surface temperature of only 21°. RH values were about 62 % and about 87 % in the crevices. The caves in the lava flows are known to have very high RH values. On the same day, in the lava flow on the bottom of Cald. de Guilherme Moniz, RH values of about 82 % were measured in a cave, at a distance of only 2 m from the opening, whereas the RH was only 51 % just outside the opening. The walls of the cave tunnel were covered with bryophytes as far in as 5 m from the opening, with *Conocephalum conicum* and *Thamnium alopecurum* as dominants. Among vascular plants, only *Trichomanes speciosum* and *Sibthorpia europaea* were recorded. *Trichomanes* is only rarely colonized by epiphyllous hepatics in caves, although in ravines and parasitic cones this is common. Another cave close by had RH values of 78 % 2 m from the opening and 35 % immediately outside.

A few measurements of RH values were made on some islands at altitudes normally colonized by the *Erico-Myrsinetum*. Measurements were also made during an ascent of the W slope of the Pico volcano. These values on Pico were of especial interest in connection with the sociologically determined altitude limit of *E.-M.* as air humidity was found to drop considerably between 1200-1350 m.

	Island	Altitude	Date	Hour	Temp.°	RH %
1.	Faial	840 m	29.VI.1968	11.00	12,5	82,0
2.	»	2 m	1.VII.1968	08.00	21,0	55,6
3.	»	680 m	»	10.30	17,0	66,9
4.	Terceira	950 m	6.VI.1968	10.30	19,0	68,5
5.	»	920 m	»	13.00	20,0	69,2
6.	»	970 m	7.VI.1968	10.00	18,5	67,7
7.	»	800 m	»	11.30	17,5	75,5
8.	»	500 m	8.VI.1968	10.30	19,0	72,4
9.	»	570 m	»	13.00	19,0	68,5
10.	»	370 m	9.VI.1968	10.00	19,0	72,4
11.	»	560 m	»	13.00	16,5	83,7
12.	»	540 m	10.VI.1968	10.00	15,5	70,0
13.	»	420 m	11.VI.1968	10.00	18,0	71,7
14	Pico	2 m	4.VII.1968	09.00	21,0	69,8
15.	»	740 m	»	10.00	16,5	62,5
16.	»	2 m	16.VII.1968	06.00	18,5	72,0
17.	»	800 m	»	07.30	16,5	79,2
18.	»	1000 m	»	08.15	14,5	82,9
19.	»	1100 m	»	08.35	14,5	82,9
20.	»	1200 m	»	08.50	14,5	82,9
21.	»	1350 m	»	09.15	15,5	49,1
22.	»	1450 m	»	09.45	13,5	50,4
23.	»	1550 m	»	10.10	13,5	54,7
24.	»	1650 m	»	10.30	14,0	55,4
25.	»	1750 m	»	10.50	13,0	58,6
26.	»	1850 m	»	11.50	12,0	62,1
27.	»	1950 m	»	12.10	13,0	41,1
28.	»	2040 m	»	12.30	14,5	35,6
29.	»	2150 m	»	13.00	14,5	39,6

Localities: 1. Inside Caldeira, south slope; 100 % clouds. — 2. Horta; no clouds. — 3. Levada on northern outside slope of Caldeira; no clouds. — 4. Santa Bárbara, SW outside slope; few clouds. — 5. Santa Bárbara, rim of caldeira; 100 % cloud cover. 6,7. Santa Bárbara, SW slope; 100 % cloud cover. — 8. Pico Gordo; no clouds. — 9. Pico do Gaspar; no clouds. — 10. Biscoito da Ferraria; no clouds. — 11. Inside Juncal; 100 % cloud cover. — 12. Furnas do Enxofre; no clouds. — 13. Cald. de Guilherme Moniz; thin cloud cover. — 14. Cais do Pico; no clouds. — 15. Lagoa do Capitão; no clouds. — 16. Cais do Pico; no clouds. — 17. N slope of Pico; no clouds. — 18-29. W slope of Pico; no clouds.

The colonization of lava flows by the *E.-M.* helps to even out their microtopography very slowly. On slightly eroded surfaces there are often differences of 3 m from the top of the often mushroom-shaped protruding parts to the bottom of the crevices. The protruding parts

become eroded from the sides by roots of trees and shrubs. They break off and finally fill the crevices as huge boulders. The lava flow will gradually provide fewer and fewer habitats suitable for the colonization of the most hygrophilous spp. of the *Juniperion brevifolii*, which will be found within the *Festucetum jubatae* (cf. below). The succession in the plant cover on lava flows in the cloud zone in the Azores will contain one primary and one final stage comparatively poor in species, compared with a middle stage extremely abundant on species, both vascular plants and bryophytes. In the Azores, this decline towards the final stage might rarely start sooner than 500 years after the start of the primary colonization of the lava flows.

The succession within the *E.-M.* circulates. The primary stage of lichens and bryophytes, often with dominance of *Campylopus polytrichoides* will be followed by a mixed stage of herbs and shrubs. The young shrub stage will include diff. spp. for the *E.-M.* and the *Juniperion brevifolii* when the shrub layer develops a degree of cover of 40% or more when the shrub layer becomes higher than 1 m. A natural decimation of the shrub layer, or cutting will especially decrease the number of diff. spp. of the *E.-M.* Recolonization by lichens of protruding parts of the lava flow will follow after cutting.

The colonization by the *E.-M.* between young lava flows on sand gravel deposits probably reaches the optimum composition of the ass. much more rapidly than on the lava flows. One frequent type of succession towards a complete *E.-M.* outside the lava flows seems to start with bryophytes, generally *Campylopus* spp. Herbs and grasses will follow, then *Calluna* and *Daboecia* and finally the shrub layer.

In the epiphytic synusies of the *E.-M.* there is also a distinguishable characteristic succession of colonization. It starts with small hepatics, followed by a *Porella-Echinodium-Plagiochila* stage. Finally comes colonization by *Hymenophyllum* and *Elaphoglossum*, and occasionnally other vascular plants such as *Lysimachia nemorum* spp. and *Luzula purpureo-splendens*.

C. **Festucetum jubatae** E. Sjögren n. ass.

The ass. *Festucetum jubatae (F. j.)* is as isolated sociologically as the *Euphorbietum azoricae (Festucion petraeae)* because of its ecological specialization. *F. j.* has been characterized by five exclusive diff. spp., by a group of diff. spp. also recorded rarely in both the other associations of the *Juniperion brevifolii*, and by a large group

of diff. spp. in common with the *Erico-Myrsinetum*. Of the group of spp. mentioned by TUTIN (1964) from habitats in parasitic cones, only *Lactuca watsoniana* and *Euphorbia stygiana* are characteristic of such habitats and also diff. spp. of the *F. j.*, whereas *Sanicula azorica* and *Senecio malvifolius* also mentioned by TUTIN, are not specialized in these habitats, including deep ravines.

The sociological contact is also apparent from the diff. spp. mentioned in table 6. Geographically the *F. j.* is rarely recorded adjacent to the *Anagallidetum tenellae* but is generally mixed into the *Erico-Myrsinetum*. The *F. j.* is also rarely adjacent to the *Litorello-Eleocharion*, e. g. in the bottom of large caldeiras, where ravines have incised into the inside slopes and open at the bottom of the caldeira.

The diff. spp. of the *F. j.* are all characterized by low drought tolerance often also combined with low wind-tolerance. The ass. can therefore only be recorded completely developed in the Azorean cloud zone above 500 m and below 1350 m. The localities within this range of altitude are restricted to deep ravines and the inside of caldeiras, especially deep and narrow parasitic cones and volcanic explosion holes with often vertical sides and almost no protruding rim around the opening in the lava flows.

The succession within the *F. j.* requires a shorter time than in the *Erico-Myrsinetum* to complete the circle from the primary stage to the next primary stage following some kind of destructive erosion. The optimum stage of the *F. j.* is susceptible to erosion on steep slopes. It is unstable, in particular because of the almost permanent water supply which removes small particles of soil material. The walls of basaltic lava in explosion holes in lava flows are always unstable. The shrubs and trees can only remain on the slopes because of the effective protection from the wind. In the localities of the *F. j.* large trunks of *Erica azorica*, *Ilex perado* ssp. and *Juniperus brevifolia* are often so loosely atached to the slopes that they cannot be used for climbing down into the crater holes. Recolonization by bryophytes and stabilizing vascular plants in places where the *F. j.* has been eroded has been found to take place on weakly exposed bare lava walls and on sand-gravel cuttings in craters after only 2-4 years. In the bottom of caldeiras there are always deep deposits of soil, *Sphagnum* hummocks, branches and litter at the bottom of steep slopes.

The *F. j.* is always a three layer community. The shrub and field layers are very rich in species but the epigeic moss cover is poor in species, especially where *Sphagnum* spp. have attained dominance.

The epiphytic synusies are, however, extremely rich in species, as is the epilithic bryophyte cover on basaltic boulders. Epiphyllous hepatics are frequently recorded within the *F. j.* (cf. V. et P. Allorge, 1938-39).

The sociological record of the *F. j.* required sample plots of at least 16 m^2. As in both the associations described above, the number of species which reach high degrees of cover is very high. The most frequent dominant in the shrub layer seems to be *Juniperus brevifolia*, in the field layer *Festuca jubata*, *Dryopteris* spp. and *Diplazium caudatum*. Epiphytic dominants are usually the two *Hymenophyllum* species. In the epilithic moss cover, *Fissidens serrulatus*, *Conocephalum conicum* and *Thamnium alopecurum* have been recorded as the most frequent dominants.

F. j. is certainly the most « exotic » and distinctly endemic plant community in the natural vegetation of the Azores islands. It contains the largest proportion of endemic taxa among the mean number of species of the ass. Because of difficulties in reaching the localities of the *F. j.*, the community has been preserved from influences from the man-made landscape. It rarely contains antropochorous species. The complete composition of the ass. was not revealed until this century. The difficulty in reaching the localities in ravines is often accentuated by the often stair-like kind of erosion in ravines caused by alternating hard and soft rock strata and volcanic sand-gravel deposits.

From the point of view of conservation of the landscape, there is a primary need to preserve ravines and caldeiras dominated by the *F. j.* These localities still contain old and high tree species characteristic of the Azorean cloud zone vegetation. The bottom of large caldeiras with permanent lakes are still extensively grazed. Grazing and trampling by animals has especially damaged the lake shore vegetation, which is extremely susceptible to erosion. Ravines surrounded by man-made pastures have been found only rarely to maintain the *F. j.* as characteristically developed as they do where they are surrounded by dense *Erico-Myrsinetum*, which gives shelter from exposure.

Table 1. FESTUCION PETRAEAE

Name of island	SM	F	F	F	F	F	F	F	P	P	P	SM	SM	SM	T	T	T	T	P	P	P	P	P	P	F	F	F	F	F	F	F	F	T	T	T
Altitude (m)	40	2	2	2	2	2	2	2	2	2	2	100	2	2	2	2	2	2	25	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	150	2
Number of spp.	13	10	12	15	13	17	10	20	17	11	10	23	13	14	17	12	16	13	15	9	11	14	11	15	18	14	12	14	17	13	8	17	10	11
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	33	34
a.																																		
Myrica faya	-	-	-	-	-	x	-	x	x	-	-	-	-	-	x	-	-	x	-	-	-	x	-	-	-	x	-	-	x	x	-	x	-	-
Plantago coronopus	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	x	x	x	x	x	x	x
Festuca petraea	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	-	x	x
Polypogon maritimus	-	-	-	-	-	-	-	-	-	-	x	x	x	x	x	-	-	x	-	x	x	-	x	x	x	-	x	x	-	-	-	-	-	-
Asplenium marinum	x	x	x	-	-	x	-	x	x	x	-	x	-	-	x	x	x	-	x	-	-	-	-	x	x	-	x	-	x	-	x	x	-	x
b.																																		
Polygonum maritimum	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	x	-	x
Ipomoea stolonifera	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
c.																																		
Silene vulgaris ssp. mar.	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	x	x	-	-	-	-	-	-	-	-	-	-	x	-	-
Polystichum falcatum	-	x	-	x	-	x	-	-	-	-	x	x	-	-	-	-	-	-	-	-	-	-	x	-	x	-	x	-	x	-	-	-	-	-
Campanula vidalii	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spergularia azorica	-	-	-	-	x	x	-	-	-	x	x	x	-	-	-	-	-	x	-	-	-	x	-	x	x	x	-	x	-	x	-	-	-	-
Euphorbia azorica	x	x	x	-	x	x	-	x	x	x	-	-	-	-	-	x	x	x	x	x	x	x	x	x	x	-	x	-	-	x	-	x	-	-
Crithmum maritimum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	-	-	x	-	x	-	-	-	-	-	-	-	-	-	-
Tolpis fruticosa	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Juncus acutus	-	-	x	x	x	-	-	x	x	-	x	-	-	-	x	-	x	x	x	-	x	x	-	x	-	-	-	-	x	x	-	-	x	-
Solidago sempervirens	-	-	x	-	x	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	x	-	x	-	-	-	-	-	-	-	-	-	x
Frankenia pulverulenta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	x	-	-	-	-	x	-	-	x	-	-	x	-	x	-	x	-	x
d.																																		
Vulpia bromoides	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anisantha madritensis	-	-	-	-	-	-	-	x	x	-	-	x	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-
Aira caryophyllea	-	-	-	-	-	-	x	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-
Lotus subbiflorus	-	-	-	-	-	-	-	x	-	-	-	-	x	-	x	x	x	x	x	x	-	x	x	x	x	x	-	x	x	x	-	x	x	x
Ornithopus pinnatus	-	-	x	-	x	x	-	x	x	-	-	x	x	-	-	-	x	x	x	-	-	x	-	-	x	x	-	-	x	x	-	-	-	-
Gaudinia fragilis	-	-	-	x	-	-	-	x	x	x	-	x	x	x	x	x	x	-	-	-	-	-	-	-	-	-	-	x	x	-	x	-	x	-
e.																																		
Chenopodium ambrosioides	-	-	-	x	x	x	-	x	-	-	x	x	-	-	x	-	-	-	x	-	x	-	-	-	x	-	-	-	-	-	x	-	-	-
Atriplex hastata var.	-	x	x	x	-	-	-	-	x	x	-	-	-	x	-	-	-	-	x	-	x	x	x	x	-	-	x	x	-	-	-	-	-	-
Salsola kali	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
Scabiosa atropurpurea	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-
Sagina maritima var.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-
Gnaphalium luteo-album	-	-	x	-	-	-	-	x	-	x	-	x	-	x	x	x	x	x	x	-	x	x	-	-	x	x	-	-	-	-	-	x	x	-
f.																																		
Umbilicus rupestris	x	x	x	-	-	-	-	x	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	x	x	-	-	x	x	x	-	-	-	-
Hypericum humifusum	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-
Pteridium aquilinum	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	x	-
Holcus rigidus	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	-	x	-	-	-	-	-	-
Brevipodium silvaticum	x	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	x	-	-	-	-	-
Foeniculum vulgare var.	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-
Carpobrotus edulis	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	x	x
Cynodon dactylon	-	x	x	x	-	x	x	-	-	-	x	x	-	-	x	-	-	x	-	x	-	x	-	-	-	-	-	x	-	-	-	-	-	-
Coronopus didymus	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	x
Hordeum murinum	-	-	-	x	-	-	-	-	-	-	-	x	-	-	x	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	x
Briza maxima	-	-	-	-	x	-	-	-	-	-	-	x	x	-	x	-	-	-	-	-	-	-	-	-	x	x	-	-	-	x	-	-	x	-
Erica azorica	-	-	-	-	-	x	x	x	x	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	x	x	x	-	x	-	x	-	x	-
Holcus lanatus	-	-	-	-	-	-	-	x	-	-	x	-	x	-	x	-	-	x	-	-	-	-	-	-	-	x	-	-	-	x	-	-	-	-
Portulaca oleracea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x	-	-	-	-	-	-	-	-	-	-
Daucus carota	-	-	-	-	-	x	-	-	x	-	-	-	-	-	-	-	x	-	-	x	x	x	-	x	-	x	-	x	-	x	-	-	-	-
Sagina apetala	-	-	-	-	x	-	-	x	x	-	-	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-
Polycarpon tetraphyllum	-	-	-	-	-	-	-	-	x	-	x	x	x	-	x	x	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x
Leontodon taraxacoides	-	-	-	-	-	x	-	-	-	x	x	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	-	-	-	-	-
Sporobulus indicus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	x	-	-	-	-	-	-
Silene gallica	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-

Table 1. Explanations (abreviations on p. 14)
Size of sample plots 25 m².

Localities: 1. SM: Ponta da Pontinha. Ravine close to the coast line. 21.3.65. — 2. F: 2 km W of Horta. Cliffs 15 m from coast line. 16.4.65. — 3. F: Varadouro. Cliffs. 16.4.65. — 4. F: Porto Pim. On loose sand. 18.4.65. — 5. F: Varadouro. Cliffs W of the hydroelectric power station. 21.4.65. — 6. F: Praia do Norte. Lavacliffs. 22.4.65. — 7. F: Loc. and date idem. Grassland on sandy deposits. — 8. P: St. Amaro. 27.4.65. — 9. P: Cais do Pico. Cliffs with coarse gravel. 29.4.65. — 10. P: Madalena. Lava cliffs. 5.5.65. — 11. SM: Agua d'Alto. Lava cliffs. 2.6.65. — 12. SM: Faial da Terra. On sand--gravel deposits. 25.5.65. — 13. SM: Ginetes. On densely packed sand deposits. 24.5.65. — 14. Porto Judeu, harbour. Sand deposits. 13.6.68. — 15. T: Salga. Sand deposits. 13.6.68. —16. T: S. Mateus da Calheta. Cliffs with sandy deposits. 12.6.68. — 17. T: Negrito. Idem 16. 12.6.68. — 18 P: St. Amaro. Cliffs with sandy deposits. 7.7.68.

— 19. P: Prainha do Baixo. Idem 16. 7.7.68. — 20, 21. P: Cais do Pico — S. Roque. Lava cliffs. 9.7.68. — 22. P: Madalena, Largo d'Areia. Coarse gravel. 24.7.68. — 23. P: Porto do Cachorro. On gravel deposits. 21.7.68. — 24. P: Cachorro. Lava cliffs with thin sandy deposits. 21.7.68. — 25. P: Prainha de Baixo. Lava cliffs. 7.7.68. — 26. F: Capelinhos, new lighthouse. Young loose sand deposits from eruption 1957-58. 27.6.68. — 27. F: Just E of Feteiras. Thin sandy deposits on cliffs. 26.6.68. — 28. F: Castelo Branco, harbour. Sandy deposits. 25.6 68. — 29. F: Castelo Branco, close to the high cliff. On densely packed sand depos:ts. 25.6.68. — 30. F: Salão. Densely packed sand deposits. 26.6.68. — 31. F: Porto Pim. Loose sand. 29.7.68. — 32. T: Biscoitos, harbour. Sandy deposits on lava cliffs. 12.6.68. — 33. T: Miradouro da Serreta. Sandy deposits. 12.6.68. — 34. T: Ponta das Ribeiras. Lava cliffs. 12.6.68.

Differential species:

a. Diff. spp. of the *Festucion petraeae.*
b. Diff. spp. of the *Polygonetum maritimi.*
c. Diff. spp. of the *Euphorbietum azoricae.*
d. Diff. spp. of tre *Ornithopo-Gaudinietum.*
e. Diff spp. with low diff. val. for the *Euphorbitum azoricae* (see table 6).
f. Accompanying spp. (see below).

Accompanying spp. with low degree of cover recorded only from one or two sample plots. No. in (—).

Mesembryanthemum crystallinum (32, 14)
Myrsine africana var. (8)
Centaurium erythraea (29)
Adiantum capillus-veneris (1)
Raphanus raphanistrum (8)
Selaginella kraussiana (1)
Rumex bucephalophorus (8)
Papaver dubium (8)
Calluna vulgaris (1)
Tamarix gallica (22)
Paspalum distichum (28)
Oxalis pes-caprae (1)
Plantago lanceolata (7)
Echium lycopsis (21)
Juncus effusus (15)
Arrhenatherum elatius (28)
Sagina procumbens (2)
Cichorium intybus (16)
Digitaria sanguinalis (25)
Parietaria officinalis (14, 16)
Cyperus esculentus (4, 5)
Cakile edentula (4)
Galium aparine (4)
Scabiosa nitens (11)
Arundo donax (4)
Solanum nigrum (12)
Centaurium scilloides ssp. (27, 29)
Phytolacca americana (13)
Anagallis arvensis ssp. *latifolia* (28)
Centaurium maritimum (13)
Cyperus eragrostis (5)
Sisymbrium officinale (12)
Sonchus tenerrimus (5)
Apium graveolens (6)
Anagallis arvensis ssp. *arv.* (10)
Lepidium virginicum (16)
Spartium junceum (6)
Fumaria muralis (14)
Scirpus maritimus (32)
Trifolium angustifolium (12)
Conyza canadensis (7)
Lotus uliginosus (7, 29)
Euphorbia peplus (12)
Limonium vulgare (13)
Asplenium onopteris (3)

Table 2. LITORELLO - ELEOCHARION

Name of island	F	P	P	P	P	Fo	SM	SM	P	P	P	P	F	F	F	F
Altitude (m)	500	800	820	800	800	600	750	720	800	800	800	780	500	500	500	500
Number of vascular plants	8	8	7	10	8	12	8	17	12	11	12	12	12	7	9	12
Sample plot No. in table	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
a.																
Potamogeton polygonifolius	x	x	x	-	x	x	x	x	x	x	-	-	-	-	-	x
Callitriche stagnalis	x	-	-	-	x	-	-	x	-	-	-	-	-	-	-	-
Litorella uniflora	x	x	x	-	x	-	x	x	-	x	x	x	x	-	-	x
Mentha aquatica	x	-	-	-	-	-	-	-	-	-	-	-	x	x	x	x
Elatine hexandra	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-
Hypericum elodes	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-
Isoëtes azorica	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Eleocharis palustris	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-
Peplis portula	-	x	x	-	-	x	x	x	-	-	-	x	x	-	-	x
Chamaemelum nobile var.	x	-	-	-	-	-	-	-	-	-	-	-	x	x	x	x
b.																
Eleocharis multicaulis	-	-	-	x	-	-	x	x	x	x	x	-	x	-	-	x
Anagallis tenella	-	-	-	x	-	-	-	-	x	x	x	-	-	-	-	-
Scirpus fluitans	-	x	x	x	x	-	x	x	x	x	-	-	-	-	-	x
Viola palustris ssp.	-	x	-	-	-	-	-	-	-	-	-	x	-	-	-	-
Carex serotina	-	-	-	-	-	-	x	x	-	-	-	-	-	-	-	-
Hydrocotyle vulgaris	-	x	x	x	-	x	x	-	x	x	x	x	-	-	-	-
Potentilla anglica	-	x	x	x	-	-	-	x	-	x	x	x	x	-	x	-
Potentilla erecta	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-
Prunella vulgaris	-	x	-	x	-	-	-	x	-	-	x	x	-	x	-	-
Juncus effusus	x	-	x	x	x	x	-	x	x	-	-	-	x	-	x	x
c.																
Leontodon taraxacoides	-	-	-	x	-	-	-	-	-	-	-	-	-	x	-	-
Holcus rigidus	-	-	-	-	-	-	-	-	-	-	x	x	x	-	x	-
Osmunda regalis	-	-	-	-	-	-	-	x	-	-	-	x	-	-	-	-
Tolpis azorica	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-
d.																
Selaginella kraussiana	x	-	-	-	-	-	-	-	-	-	-	x	x	-	x	-
Lotus uliginosus	-	-	-	-	-	x	-	x	-	-	-	-	-	-	-	-
Sibthorpia europaea	-	-	-	-	-	x	-	-	-	-	-	x	-	-	-	-
Blechnum spicant	-	-	-	-	-	x	-	x	x	-	x	x	-	-	-	-
Erica azorica	-	-	-	-	-	x	-	-	x	-	x	-	x	x	x	x
Agrostis castellana	-	-	-	-	-	x	-	-	x	x	x	-	-	-	-	-
Sagina procumbens	x	-	-	-	-	-	x	-	-	-	-	-	-	x	-	x
Luzula purpureo-splendens	-	-	-	-	-	-	-	x	x	x	-	-	-	-	-	-
Lysimachia nemorum ssp.	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-
Carex echinata	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-
Poa trivialis	-	-	-	-	-	-	-	-	-	-	-	-	x	-	x	-
Deschampsia foliosa	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-
Mentha pulegium	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x
e.																
Philonotis rigida	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x
Fissidens adianthoides	x	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-
Thuidium tamariscinum	x	-	-	x	-	-	-	-	-	-	-	-	x	-	x	x
Scleropodium illecebrum	x	-	-	-	-	-	-	-	-	x	-	-	x	-	x	x
Pleurozium schreberi	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhytidiadelphus calvescens	x	x	x	-	-	-	-	-	-	x	-	-	x	-	x	x
Breutelia azorica	x	-	-	x	-	-	-	-	-	-	x	-	x	x	x	x
Polytrichum formosum	-	-	-	-	-	-	-	-	-	x	x	-	-	-	-	-
Polytrichum commune	x	x	x	-	-	-	-	-	-	-	-	x	-	x	x	x
Aulacomnium palustre	-	-	-	x	-	-	-	-	-	x	-	-	-	-	-	-

Table 2. Explanations (abreviations on p. 14)
Size of sample plots 16 m².

Localities: 1. F: Caldeira do Faial, bottom of old lake. 19.4.65. — 2, 3. P: Shores of small lakes E of Lag. do Landroal. 28.4.65. — 4. P: E shores of Lag. do Landroal. Just below the microzone with *Polytrichum* cushions. 28.4.65. — 5. P: Shore of small lake E of Lag. do Landroal. 1.5.65. — 6. Fo: Shores of Lag. da Lomba. 14.5.65. — 7. SM: E shore of Lag. do Canário. 20.5.65. — 8. SM: Shores of Lag. das Empadadas. 20.5.65. — 9. P: S shore of Lag. do Caiado. Below low steep slope with *Juniperion brevifolii*, reached by high water. 18.7.68. — 10, 11. P: Shores of the E lake of Grotões. 24.7.68. — 12 P: E shores of Lag. do Paúl, slightly sloping. 18.7.68. — 13. F: Bottom of the old lake, Cald. do Faial. 29.6.68. — 14, 15. F: S shores of the new lake, Cald. do Faial. 29.6.68. — 16. F: Bottom of Cald. do Faial, W shores of new lake. 2.8.68.

Differential species:

a. Diff. spp. of the *Litorello-Eleocharion*.
b. Diff. spp. of the *Litorello-Eleocharion* and *Anagallidetum tenellae (Juniperion brevifolii)*.
c. Diff. spp. with weaker diff. val. (see table 6.)
d. Accompanying spp. (see below).
e. Bryophytes.

Accompanying spp. with low degree of cover recorded only from one sample plot. No. in (—).

Anthoxantum odoratum (4)
Cardamine caldeirarum (4)
Scirpus setaceus (5)
Epilobium obscurum (5)
Hypericum humifusum (6)
Dryopteris sp. juv. (6)
Rubus ulmifolius (6)
Plantago coronopus (8)
Thymus cespititius (8)
Plantago lanceolata (12)
Thelypteris pozoi sim. (12)
Scirpus cernuus (16)

Table 3.

JUNIPERION BREVIFOLII

Anagallidetum tenellae

Name of island	SM	SM	SM	SM	T	T	F	F	F	F	P	P	P	SM	SM	SM	T	F	P	P	T	T
Altitude (m)	500	770	580	580	450	550	850	500	650	600	700	820	800	750	900	720	450	640	820	890	350	450
Number of vascular plants	16	19	17	15	11	14	10	21	14	22	19	23	14	16	16	22	15	11	13	15	12	16
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.																						
Ilex perado	x	x	x	-	-	-	-	-	x	x	-	x	x	-	x	-	-	-	-	-	-	-
Laurus azorica	x	x	x	x	-	-	-	-	x	-	-	-	-	-	x	-	x	-	-	-	-	-
Vaccinium cylindraceum	x	x	x	x	x	-	-	x	x	-	-	x	x	-	x	-	x	x	-	x	-	-
Huperzia selago ssp.	x	-	-	-	-	-	x	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-
Erica azorica	-	x	x	-	x	-	-	x	-	-	x	x	x	-	x	-	x	x	-	x	x	x
Hedera helix ssp.	-	x	x	-	-	-	-	-	-	x	-	x	x	-	-	-	-	-	-	-	-	-
Viburnum tinus ssp.	-	x	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lepidotis cernua	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-
Polystichum setiferum	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Culcita macrocarpa	-	-	-	x	-	-	-	x	-	-	-	x	x	-	x	-	-	-	-	-	-	-
Luzula purpureo-splendens	-	-	-	x	-	x	-	x	x	x	x	x	x	x	x	x	x	-	x	x	-	x
Myrsine africana var.	-	-	-	-	x	-	-	x	x	x	-	x	x	-	x	-	x	x	-	-	x	x
Juniperus brevifolia	-	-	-	-	x	x	-	x	x	x	-	x	x	-	x	-	-	-	-	x	-	-
Carex peregrina	-	-	-	-	-	-	x	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Pteris serrulata	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hypericum foliosum	-	-	-	-	-	-	-	x	-	x	-	-	-	x	-	x	-	-	-	-	-	-
Frangula azorica	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-
Habenaria micrantha	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
Tolpis azorica	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	x	-	-	-	-	-	-
b.																						
Fragaria vesca	x	x	x	x	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	x	-
Prunella vulgaris	x	-	-	-	-	x	x	x	x	-	x	x	-	-	-	-	x	-	x	-	-	-
Lotus uliginosus	x	-	-	x	-	x	-	-	-	-	x	x	-	x	-	x	-	-	-	-	-	-
Holcus rigidus	x	-	x	x	-	x	x	x	-	x	-	x	x	x	-	x	-	-	-	-	-	-
Calluna vulgaris	x	x	x	x	-	x	-	-	x	x	-	-	-	x	x	x	x	x	-	-	x	x
Juncus effusus	-	x	-	x	x	x	-	-	-	-	-	-	-	x	-	x	-	x	-	-	-	-
Potentilla erecta	-	x	-	x	-	x	x	-	x	-	x	x	-	x	x	x	x	-	-	x	-	-
Pteridium aquilinum	-	-	x	-	-	-	-	x	-	-	x	x	-	-	-	-	x	-	-	x	x	-
Potentilla anglica	-	-	x	-	-	-	-	x	x	-	x	x	x	x	-	x	-	-	x	-	-	-
Thymus cespititius	-	-	-	-	x	x	-	-	-	x	x	-	-	-	-	x	-	x	-	x	-	x
Polygonum capitatum	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-
Luzula campestris	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Agrostis castellana	-	-	-	-	-	-	x	x	-	-	-	-	-	x	x	x	-	-	x	-	-	-
Hypericum humifusum	-	-	-	-	-	-	x	x	-	-	-	-	-	-	-	-	x	-	-	-	x	x
Daboecia azorica	-	-	-	-	-	-	x	-	x	x	-	-	-	-	-	-	-	-	-	x	-	-
Leontodon taraxacoides	-	-	-	-	-	-	-	x	-	-	x	x	-	x	-	x	-	-	x	x	-	-
Centaurium scilloides ssp.	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	x	-	-	-	x
Osmunda regalis	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x	-	-	-	-	-	-
Eleocharis multicaulis	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Anagallis tenella	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	x	x	-	-
Hydrocotyle vulgaris	-	-	-	-	-	-	-	-	-	-	-	x	x	-	-	-	-	-	x	x	-	-
Viola palustris ssp.	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-
Nardus stricta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-
Scirpus fluitans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-
c.																						
Deschampsia foliosa	x	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-
Woodwardia radicans	x	x	x	x	-	-	-	-	-	-	-	-	-	x	x	x	-	-	-	-	-	-
Festuca jubata	-	-	-	-	-	-	x	-	-	-	-	-	-	x	-	x	-	-	x	-	-	-
Rubia peregrina	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	x	-	-	-	-	-
Picris filii	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-
d.																						
Blechnum spicant	x	x	x	x	x	x	-	x	-	x	x	x	x	x	x	x	x	-	x	x	-	x
Selaginella kraussiana	x	x	-	-	-	x	-	x	-	x	x	x	-	-	-	x	x	-	-	-	-	-
Brevipodium silvaticum	x	-	x	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
Anthoxanthum odoratum	x	x	-	x	-	-	-	-	-	-	x	x	-	-	-	x	-	-	-	-	-	-
Rubus ulmifolius	-	x	x	x	-	x	-	-	-	-	x	-	-	x	-	-	x	-	-	x	x	-
Asplenium onopteris	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x
Umbilicus rupestris	-	-	-	-	x	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	x	x
Lysimachia nemorum ssp.	-	-	-	-	-	-	x	x	x	x	x	x	x	-	-	-	x	-	-	-	-	x
Dryopteris sp. juv.	-	-	-	-	-	-	-	x	x	-	-	-	-	x	-	x	-	-	-	-	-	-
Sibthorpia europaea	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	x	x	-	-	-	-
Plantago lanceolata	-	-	-	-	-	-	-	-	-	-	x	x	-	-	-	-	-	x	-	-	-	-

e.																						
Nardia scalaris	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Calliergonella cuspidata	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Scleropodium illecebrum	x	-	-	-	-	-	-	-	x	-	-	x	-	-	x	-	-	-	-	-	-	x
Breutelia azorica	x	-	x	x	-	-	-	-	x	-	-	-	-	-	x	x	-	-	x	-	-	-
Pleurozium schreberi	-	x	-	-	-	-	-	-	-	-	-	-	x	-	x	-	-	-	-	-	-	-
Thuidium tamariscinum	-	-	x	-	-	-	-	-	x	-	x	x	x	-	-	-	-	-	-	-	-	x
Trichocolea tomentella	-	-	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Conocephalum conicum	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hylocomium brevirostre	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Plagiochila spinulosa	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Philonotis rigida	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
Anthoceros sp.	-	-	-	-	-	-	-	-	-	x	x	-	-	-	-	-	-	-	-	-	-	-
Rebuolia hemisphaerica	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
Myurium hebridarum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-
Polytrichum commune	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	x	-	-	-	-
Leucobryum glaucum ssp.	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
Hylocomium splendens	-	-	-	-	-	-	-	-	-	x	-	x	x	x	x	-	-	-	-	-	-	-

Table 3. Explanations (abreviations on p. 14)
Size of sample plots 16 m².

Localities: 1. SM: E of Vista do Rei close to path to Casal. Ravine. 24.3.65. — 2. SM: Lag. do Fogo. Grassland on the E rim of the caldeira. 25.3.65. — 3. SM: Lag. do Congro. Bottom of 20 m deep ravine. 1.4.65. — 4. SM: Loc. and date idem. Close to the lake shore. — 5. T: Close to the lava flow of the year 1761. 8.4.65. — 6. T: On the S slope of Santa Bárbara. 11.4.65. — 7. F: S close inside Cald. do Faial. 18.4.65. — 8. F: Small crater in the bottom of Cald. do Faial. 19.4.65. — 9. Idem No. 7. — 10. Cab. do Fogo. On coarse basaltic gravel deposits. 21.4.65. — 11. P: Cab. do Afonso, rim of small caldeira. Grazing land. 26.4.65. — 12. P: Shores of lake E of Lag. do Landroal. Grazed grassland above high water level. 28.4.65. — 13. P: Loc. and date idem. Above high water level, above the microzone with *Polytrichum* cushions — 14. SM: Close to Lag. do Canário. above high water level. 20.5.65. — 15. SM: Grassland on top of Pico da Vara. 25.5.65. — 16. SM: Lag. das Empadadas, above high water level. 20.5.65. — 17. T: Cald. do Guilherme Moniz. On old lava flow. 11.6.1968. — 18. F: Above Cedros, close to the levada. 31.7.68. — 19. P: Close to Lag. Seca, above high water level. 18.7.68. — 20. P: Grazing land below Torrinhas. 10.7.68. — 21. T: Biscoito da Ferraria. 9.6.68. — 22. T: Grassland on coarse gravel deposits close to the lava flow of the year 1761. 10.6.68.

Differential species:

a. Diff. spp. of the *Juniperion brevifolii.*
b. Diff. spp. of the *Anagallidetum tenellae.*
c. Diff. spp. of the *Erico-Myrsinetum* and the *Festucetum jubatae,* only occasionally in the *Anagallidetum tenellae.*
d. Accompanying spp. (see below)
e. Bryophytes.

Accompanying spp. with low degree of cover only recorded from one of the semple plots. No. in (—).

Hedychium gardnerianum (1)
Ulex europaeus (2)
Myrica faya (5, 21)
Bellis perennis (6)
Mentha aquatica (8)
Polypodium australe (10, 22)
Asplenium trichomanes (10, 22)
Holcus lanatus (11, 12)
Sagina procumbens (11)
Sieglingia decumbens (15)
Ranunculus repens (16)
Epilobium obscurum (18, 22)
Scirpus cernuus (19)
Scirpus setaceus (19)
Veronica officinalis (20)
Geranium robertianum (21)
Lotus corniculatus (21)
Rumex angiocarpus (22)
Galium parisiense (22)

Table 4. JUNIPERION BREVIFOLII

Erico - Myrsinetum

Name of island	T	T	T	F	F	P	P	P	SM	T	T	T	T	T	T	T	F	P	P	P	T	T
Altitude (m)	500	980	800	710	500	1260	700	1260	900	520	420	530	500	600	600	450	450	780	400	300	530	450
Number of vascular plants	14	13	12	9	11	14	14	11	16	21	19	14	17	22	18	15	18	12	16	14	16	14
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.																						
Laurus azorica	x	-	-	-	-	-	-	-	-	x	x	x	x	x	x	x	-	-	-	-	-	-
Vaccinium cylindraceum	x	x	x	-	-	x	x	-	-	x	x	-	-	x	x	x	-	x	x	x	x	x
Viburnum tinus ssp.	x	-	-	-	-	-	-	-	x	x	x	x	-	-	-	-	-	-	-	-	-	-
Lepidotis cernua	x	-	-	-	-	-	-	-	x	x	-	-	-	-	-	-	-	-	-	-	-	-
Luzula purpureo-splendens	-	x	x	x	x	x	-	x	-	-	x	-	x	x	x	x	x	-	-	-	x	-
Juniperus brevifolia	-	x	x	-	-	x	-	-	-	x	-	x	x	x	x	x	-	-	x	-	x	-
Carex peregrina	-	-	-	x	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-
Ilex perado	-	-	-	-	-	x	x	x	x	x	x	x	x	x	-	-	-	-	x	x	x	x
Daphne laureola	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rubus hochstetterorum	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	x	-	-	-
Frangula azorica	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x	-	-
b.																						
Woodwardia radicans	x	-	-	-	-	-	-	-	x	-	-	x	-	x	x	-	x	-	-	-	-	-
Hedera helix ssp.	x	-	-	-	-	-	x	-	x	x	x	x	x	x	-	-	x	x	-	-	-	x
Calluna vulgaris	x	x	-	x	-	x	-	-	-	x	x	x	x	x	x	x	-	x	x	-	x	x
Culcita macrocarpa	x	x	-	-	-	-	-	-	-	x	x	-	-	x	x	-	-	x	-	-	-	x
Tolpis azorica	x	x	-	-	-	x	-	x	x	-	-	-	-	-	-	-	-	x	-	-	-	-
Huperzia selago ssp.	-	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Myrsine africana var.	-	x	x	-	x	x	-	-	x	x	x	x	x	x	x	x	-	-	x	x	x	x
Elaphoglossum hirtum	-	x	-	-	-	x	x	-	x	-	-	-	x	x	x	x	-	-	-	-	x	-
Festuca jubata	-	-	x	-	-	-	-	x	-	-	-	x	-	x	x	x	-	-	-	-	-	-
Daboecia azorica	-	-	x	-	x	-	-	x	-	-	-	-	-	-	-	-	-	x	-	-	-	-
Hymenophyllum tunbridgense	-	-	x	-	-	-	x	-	-	x	x	-	x	-	x	x	-	-	-	-	-	-
Erica azorica	-	-	-	-	x	x	x	x	-	x	x	x	x	x	-	x	x	x	x	x	x	x
Agrostis castellana	-	-	-	-	x	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-
Picris filii	-	-	-	-	x	-	x	-	x	-	-	-	-	-	-	-	x	-	-	-	-	-
Rubia peregrina	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	x	x	x	-	-
Phyllitis scolopendrium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-
Arceuthobium oxycedri	-	-	-	-	-	x	-	-	-	x	-	-	-	-	-	-	-	-	x	-	-	-
Diphasium madeirense	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hypericum foliosum	-	-	-	-	-	-	x	-	x	x	-	-	-	x	x	-	x	x	x	x	-	-
Euphorbia stygiana	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Osmunda regalis	-	-	-	-	-	-	-	-	x	x	-	x	-	-	-	x	-	-	-	-	-	-
Centaurium scilloides ssp.	-	-	-	-	-	-	-	-	x	x	-	-	x	x	-	x	x	-	-	-	x	x
Picris rigens	-	-	-	-	-	-	-	-	-	-	x	-	-	x	x	-	-	-	-	-	-	-
Pteris serrulata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-
Polystichum setiferum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-
Dryopteris borreri	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-
c.																						
Potentilla erecta	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-
Luzula campestris	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Juncus effusus	-	x	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-
Holcus rigidus	-	-	-	x	x	-	x	-	-	x	x	x	-	-	x	-	x	x	x	x	-	x
Thymus caespititius	-	-	-	-	-	-	-	-	x	x	x	-	-	x	-	-	-	-	-	-	-	-
Pteridium aquilinum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	x	x
Brevipodium silvaticum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-
Hypericum humifusum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-
d.																						
Blechnum spicant	x	x	x	x	-	x	x	x	-	x	x	x	x	x	x	x	x	x	-	x	x	
Selaginella kraussiana	x	-	x	x	x	-	-	x	-	-	x	x	x	x	x	-	x	-	-	x	-	x
Rubus ulmifolius	x	-	-	-	-	-	-	-	-	-	-	-	-	x	-	x	-	-	x	x	-	x
Cystopteris fragilis	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lysimachia nemorum ssp.	-	x	x	x	-	x	x	x	-	x	x	-	x	x	x	x	x	-	-	-	x	x
Dryopteris sp. juv.	-	-	-	x	-	-	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sibthorpia europaea	-	-	-	x	x	-	-	-	-	x	x	-	x	-	-	-	x	-	-	-	x	-
Asplenium onopteris	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	x	-
Myrica faya	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	x	-	x	x	-	-
Polypodium australe	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	-
e.																						
Hylocomium splendens	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thuidium tamariscinum	-	x	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	x
Anthoceros sp.	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Conocephalum conicum	-	-	-	x	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Breutelia azorica	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Plagiochila spinulosa	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhytidiadelphus loreus	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polytrichum formosum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	-	-	-	-	-	-
Lepidozia reptans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-
Leucobryum glaucum ssp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	-	-	-	-	-	-
Fissidens serrulatus	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-
Myurium hebridarum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-

Table 4. Explanations (abreviations on p. 14)
Size of sample plots 25 m².

Localities: 1. SM: Lag. do Fogo, N slope inside the caldeira. 30.3.65. — 2. T: Cald. do Santa Bárbara, inside the exterior caldeira. 11.4.65. — 3. T: Cald. do Santa Bárbara, inside interior caldeira on S slope. 11.4.65. — 4. F: Cald. do Faial. S slope. 19.4.65. — 5. F: Cald. do Faial. Base of S slope. 19.4.65 — 6. P: Cab. Redondo. 26.4.65. — 7. P: Old lava flow W of Lag. do Caiado. 28.4.65. — 8. P: Furna do Frei Matias. 6.5.65. — 9. SM: S slope of Pico da Vara. 26.5.65. — 10. T: Santa Bárbara, W slope close to road from Serreta. 15.6.65. — 11. Loc. and date idem. — 12. T: Close to path Carvão — Agualva, W-exposed cliffs to the E of the path. 14.6.68. — 13, 14, 15. T: Beginning of the path Carvão — Agualva. 14.6.68. — 16. Base of S slope of Cald. do Guilherme Moniz. 11.6.68. — 17. F: N slope of the island close to the road. S of Cedros. 28.6.68. — 18, 19, 20. P: Mist. da Praínha, N of Cab. do Fogo. 13.7.68. — 21. T: E base of Picos Negros. 8.6.68. — 22. Biscoito da Ferraria, E of Lag. Vimieiro, close to Nasce Água. 9.6.68.

Differential species:

a. Diff. spp. of the *Juniperion brevifolii.*
b. Diff. spp. with low diff. val. for the fed. and diff. spp. of the *Erico-Myrsinetum* (see table 6).
c. Diff. spp. of the *Anagallidetum tenellae* and the *Litorello-Eleocharion.*
d. Accompanying spp. (see below)
e. Bryophytes.

Accompanying spp. with low cover degree, only recorded from one sample plot. No. in (—):

Thelypteris pozoi (3)
Sagina procumbens (5)
Asplenium monanthes (7)
Juncus conglomeratus (9)
Umbilicus rupestris (17)
Briza minor (17)

JUNIPERION BREVIFOLII

Table 5. Festucetum jubatae

Name of island	F	F	F	P	P	P	P	SM	T	F	F	F	P	P	T	T	T	F
Altitude (m)	500	650	700	670	1070	1390	700	510	450	680	500	500	870	800	840	570	560	640
Number of vascular plants	21	9	23	28	22	15	27	31	17	25	23	9	24	16	17	22	22	14
Sample plot No. in table	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
a.																		
Ilex perado	-	-	x	x	x	x	x	x	x	-	x	-	x	x	x	x	-	x
Vaccinium cylindraceum	-	-	x	x	x	x	x	-	x	x	x	x	-	x	x	x	x	x
Huperzia selago ssp.	-	-	x	-	-	x	-	-	-	x	-	-	-	-	-	x	-	-
Culcita macrocarpa	-	-	-	x	-	-	x	x	-	x	-	-	-	x	x	-	x	-
Luzula purpureo-splendens	-	-	x	-	-	-	x	x	-	x	-	-	x	x	x	x	x	-
Juniperus brevifolia	-	-	-	x	-	-	x	-	-	-	x	-	-	x	-	-	x	-
Carex peregrina	-	-	-	x	x	-	x	-	-	-	-	-	x	-	-	-	-	x
Frangula azorica	x	-	-	x	-	-	-	-	x	-	x	x	-	x	-	-	-	-
Viburnum tinus ssp.	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Daphne laureola	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rubus hochstetterorum	-	-	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Laurus azorica	-	-	-	-	-	-	x	-	x	-	-	-	-	-	x	x	x	x
b.																		
Festuca jubata	-	-	x	-	x	x	-	x	x	x	x	-	-	-	x	-	x	x
Ranunculus cortusifolius	x	x	x	-	x	x	x	x	x	-	-	x	x	x	x	x	-	x
Euphorbia stygiana	-	x	x	-	x	-	x	-	-	-	-	x	x	x	-	x	-	x
Phyllitis scolopendrium	x	x	-	-	-	-	-	x	-	x	x	-	x	-	-	-	-	-
Rumex azoricus	x	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	x	-
Lactuca watsoniana	x	x	-	x	-	-	-	-	-	-	-	x	x	-	-	-	x	x
Trichomanes speciosum	x	x	-	x	-	-	x	x	-	-	x	-	-	-	-	x	x	-
Smilax excelsa	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prunus lusitanica	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diplazium caudatum	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-
c.																		
Tolpis azorica	-	-	x	-	-	-	x	x	-	x	x	x	x	x	-	-	-	x
Cardamine caldeirarum	-	-	x	x	x	x	-	x	-	-	-	-	x	-	x	x	-	-
Elaphoglossum hirtum	-	-	-	x	x	-	x	-	-	-	-	x	-	-	x	-	-	-
Woodwardia radicans	x	-	x	x	x	x	-	x	-	x	x	-	x	x	-	-	-	-
Sanicula azorica	x	x	-	x	-	-	-	-	-	-	-	-	x	-	-	-	-	-
Hymenophyllum tunbridgense	-	-	-	-	x	x	-	-	-	-	-	-	x	-	-	-	x	-
Deschampsia foliosa	-	-	-	-	-	-	-	-	-	-	-	-	x	x	-	-	-	-
Arceuthobium oxycedri	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dryopteris borreri	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Picris rigens	-	-	-	-	-	-	-	-	x	-	-	-	-	x	x	x	x	x
d.																		
Myrsine africana var.	-	-	-	x	-	-	x	-	x	x	x	x	-	x	x	x	x	x
Polystichum setiferum	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-
Hypericum foliosum	-	-	x	x	-	x	x	x	x	x	x	-	x	-	x	x	x	x
Hedera helix ssp.	x	-	x	x	x	-	-	-	x	x	x	-	-	-	-	x	-	-
Senecio malvifolius ssp.	-	-	-	-	-	-	-	x	-	-	x	-	x	-	-	-	-	-
Centaurium scilloides ssp.	x	-	x	-	-	-	-	-	x	x	x	-	-	-	x	-	-	-
Juncus effusus	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-
Prunella vulgaris	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-
Daboecia azorica	x	-	x	-	-	x	-	-	-	x	-	-	-	-	-	-	-	-
Potentilla erecta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	-
Potentilla anglica	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-
Holcus rigidus	x	-	-	-	x	x	-	x	-	x	x	-	x	x	-	x	x	-
Rubia peregrina	x	-	-	x	-	-	x	-	-	x	-	-	-	-	-	-	-	-
Picris filii	x	-	x	-	x	x	-	x	-	x	x	-	-	-	-	-	-	-
Bellis azorica	-	x	-	-	x	-	-	-	-	-	-	-	x	-	-	-	-	-
Agrostis castellana	-	-	x	-	x	-	-	x	-	-	-	-	-	x	x	-	x	-
Osmunda regalis	-	-	x	-	-	-	-	-	-	x	x	-	-	-	-	-	-	-
Fragaria vesca	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-
Habenaria micrantha	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-
Mentha aquatica	-	-	-	-	-	-	-	-	-	-	x	-	x	-	-	-	-	x
Viola palustris ssp.	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-
Erica azorica	-	-	x	x	x	-	x	-	x	x	x	x	x	x	-	x	-	-

e.																		
Blechnum spicant	x	-	x	x	x	x	x	x	x	x	x	-	x	-	x	x	x	-
Selaginella kraussiana	-	-	x	x	x	-	x	x	-	x	-	-	x	-	x	x	x	-
Dryopteris sp. juv.	-	-	-	-	x	x	x	x	x	-	-	-	-	-	-	-	x	-
Sibthorpia europaea	-	-	x	x	-	x	x	x	-	x	x	-	-	-	-	x	x	-
Lysimachia nemorum ssp.	-	-	x	x	x	x	x	x	-	x	x	-	x	-	-	x	x	-
Umbilicus rupestris	x	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x	-
Calluna vulgaris	-	-	x	-	-	-	-	x	-	-	-	-	-	-	-	x	-	-
Rubus ulmifolius	-	-	-	x	-	-	-	x	x	-	-	-	-	-	-	-	-	x
Asplenium monanthes	-	-	-	-	x	-	-	x	-	-	-	-	x	-	-	-	-	-
f.																		
Anthoceros sp.	-	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Conocephalum conicum	x	-	-	-	x	x	-	-	-	-	-	-	-	x	-	x	-	-
Thamnium alopecurum	-	x	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-
Marchantia polymorpha	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reboulia hemisphaerica	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diplophyllum albicans	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Plagiochila spinulosa	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polytrichum commune	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhytidiadelphus lorens	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-
Scleropodium illecebrum	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	x	-
Eurhynchium stokesii	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-
Heterocladium heteropterum	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-
Thuidium tamariscinum	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	x	-
Breutelia azorica	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-
Pleurozium schreberi	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-
Myurium hebridarum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-
Fissidens serrulatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-

Table 5. Explanations (abbreviations on p. 14)
Size of sample plots 16 m².

Localities: 1. F: Small crater in the middle of Cald. do Faial. 19.4.65. — 2. F: Deep ravine on S slope inside Cald. do Faial. 19.4.65. — 3. F: Ravine on external slope of Cald. do Faial, above Cedros. 24.4 65. — 4. P: Ravine S of Cais do Pico. 7.5.65. — 5. P: Parasitic crater W of Furna do Frei Matias. 6.5.65. — 6. P: Inside Furna do Frei Matias. 6.5.65. — 7. P: Mist. NW of Cab. do Silvado. 5.5.65. — 8. SM: Ravine on SW slope inside S part of Cald. do Sete Cidades. 17.5.65. — 9. T: Cald. do Guilherme Moniz, base of S slope. 11.6 68. — 10. F: Close to levada above Cedros. 1.7.68. — 11. F: Base of S slope inside Cald. do Faial. 29.6 68. — 12. F: Ravine on S slope inside Cald. do Faial. 23.6 68. — 13. P: Ravine on W slope of Grotões. 18.7.68. — 14. P: Deep ravine just E of Grotões. 24.7.68. — 15. T: Small ravines, base of S slope, inside Cald. do Santa Bárbara. 7.6 68. — 16. Pico do Gaspar, S. slope. 8.6.68. — 17. T: Juncal, base of the SE slope. 9.6.68. — 18 F: On steep slopes close to levada above Cedros, in small ravines. 31.7.68.

Diferential species:

a. Diff. spp. of the *Juniperion brevifolii.*
b. Diff. spp. of the *Festucetum jubatae.*
c. Diff. spp. of the *Festucetum jubatae* and *Erico-Myrsinetum.*
d. Other diff. spp., some with low diff. val. (comp. table 6).
e. Accompanying spp (see below)
f. Bryophytes.

Accompanying spp. with low degree of cover only recorded from one or two of the sample plots. No. in (—):

Hypericum humifusum (3, 10)
Polypodium australe (1)
Lycopus europaeus (1)
Equisetum telmateja (1, 3)
Asplenium hemionitis (1)
Cerastium fontanum (1)
Agrimonia eupatoria ssp. (1, 2)
Carex pendula var. (1, 2)
Conyza canadensis (3)
Cystopteris fragilis (3)
Epilobium obscurum (3)
Rumex conglomeratus (3)
Anthoxanthum odoratum (9)
Thelypteris pozoi (4)
Myrica faya (7)
Galium aparine (7)
Lotus uliginosus (8)
Hypericum undulatum (8)
Ranunculus repens (8)
Brevipodium silvaticum (9)
Leontodon taraxacoides (9)
Gnaphalium purpureum (10)

Table 6. Differential species

	MERCURIALION ANNUAE	FESTUCION PETRAEAE	Polygonetum maritimi	Euphorbietum azoricae	Ornithopo-Gaudinietum	LITORELLO-ELEOCHARION	JUNIPERION BREVIFOLII	Anagallidetum tenellae	Erico-Myrsinetum	Festucetum jubatae
	I	II	A	B	C	III	IV	A	B	C
Parietaria diffusa	—	·	·	·	·	·	·	·	·	·
Polygonum aviculare	—	·	·	·	·	·	·	·	·	·
Portulaca oleracea	—	·	·	·	·	·	·	·	·	·
Silene gallica	—	·	·	·	·	·	·	·	·	·
Fumaria muralis	—	·	·	·	·	·	·	·	·	·
Sisymbrium officinale	—	·	·	·	·	·	·	·	·	·
Lepidium virginicum	—	·	·	·	·	·	·	·	·	·
Coronopus didymus	—	·	·	·	·	·	·	·	·	·
Oxalis pes-caprae	—	·	·	·	·	·	·	·	·	·
Mercurialis annua	—	·	·	·	·	·	·	·	·	·
Solanum nigrum	—	·	·	·	·	·	·	·	·	·
Conyza canadensis	—	·	·	·	·	·	·	·	·	·
Erigeron karwinskianus	—	·	·	·	·	·	·	·	·	·
Galinsoga parviflora	—	·	·	·	·	·	·	·	·	·
Senecio vulgaris	—	·	·	·	·	·	·	·	·	·
Polycarpon tetraphyllum	—	·	·	·	o	·	·	·	·	·
Crassula tillaea	—	·	·	·	o	·	·	·	·	·
Aphanes arvensis	—	·	·	·	o	·	·	·	·	·
Sherardia arvensis	—	·	·	·	o	·	·	·	·	·
Galactites tomentosa	—	·	·	·	·	·	·	o	·	·
Asplenium marinum	·	—	·	·	·	·	·	·	·	·
Myrica faya	·	—	·	·	·	·	·	·	·	·
Plantago coronopus	·	—	·	·	·	·	·	·	·	·
Festuca petraea	·	—	·	·	·	·	·	·	·	·
Polypogon maritimus	·	—	·	·	·	·	·	·	·	·
Polygonum maritimum	·	·	—	·	·	·	·	·	·	·
Lotus commutatus	·	·	—	—	·	·	·	·	·	·
Ipomoea stolonifera	·	·	—	—	·	·	·	·	·	·
Chenopodium ambrosioides	·	·	—	—	·	·	·	·	·	·
Atriplex hastata var.	·	·	—	—	·	·	·	·	·	·
Salsola kali	·	·	—	—	·	·	·	·	·	·
Scabiosa atropurpurea	·	·	·	—	·	·	·	·	·	·
Silene vulgaris ssp.mar.	·	·	·	—	·	·	·	·	·	·
Polystichum falcatum	·	·	·	—	·	·	·	·	·	·
Campanula vidalii	·	·	·	—	·	·	·	·	·	·
Spergularia azorica	·	·	·	—	·	·	·	·	·	·
Anogramma leptophylla	·	·	·	—	·	·	·	·	·	·
Euphorbia azorica	·	·	·	—	·	·	·	·	·	·
Asplenium onopteris	·	·	·	—	·	·	·	o	o	·
Crithmum maritimum	·	·	·	—	·	·	·	·	·	·
Tolpis fruticosa	·	·	·	—	·	·	·	·	·	·
Juncus acutus	·	·	·	—	·	·	·	·	·	·
Solidago sempervirens	·	·	o	—	·	·	·	·	·	·
Frankenia pulverulenta	·	·	·	—	o	·	·	·	·	·
Sagina maritima var.	·	·	·	—	—	·	·	·	·	·
Gnaphalium luteo-album	·	·	·	—	—	·	·	·	·	·
Rumex angiocarpus	·	·	·	·	—	·	·	·	·	·
Geranium purpureum	·	·	·	·	—	·	·	·	·	·
Vulpia bromoides	·	·	·	·	—	·	·	·	·	·
Anisantha madritensis	·	·	·	·	—	·	·	·	·	·
Aira caryophyllea	·	·	·	·	—	·	·	·	·	·
Lotus subbiflorus	·	·	·	o	—	·	·	·	·	·
Ornithopus pinnatus	·	·	·	o	—	·	·	·	·	·
Gaudinia fragilis	·	·	o	·	—	·	·	·	·	·
Polygonum capitatum	·	·	·	·	—	·	·	·	·	·
Hypericum humifusum	·	·	·	·	—	·	·	o	o	·
Thymus cespititius	·	·	·	·	—	·	·	o	—	·

Isoëtes azorica	·	·	·	·	·	—	·	·	·	·
Hypericum elodes	·	·	·	·	·	—	·	·	·	·
Elatine hexandra	·	·	·	·	·	—	·	·	·	·
Peplis portula	·	·	·	·	·	—	·	·	·	·
Callitriche stagnalis	·	·	·	·	·	—	·	·	·	·
Litorella uniflora	·	·	·	·	·	—	·	·	·	·
Chamaemelum nobile var.	·	·	·	·	·	—	·	·	·	·
Potamogeton polygonifolius	·	·	·	·	·	—	·	·	·	·
Eleocharis palustris	·	·	·	·	·	—	·	·	·	·
Mentha aquatica	·	·	·	·	·	—	·	o	·	o
Dryopteris aemula	·	·	·	·	·	—	—	·	·	·
Eleocharis multicaulis	·	·	·	·	·	—	·	—	·	o
Lepidotis cernua	·	·	·	·	·	·	—	·	·	·
Juniperus brevifolia	·	·	·	·	·	·	—	·	·	·
Laurus azorica	·	·	·	·	·	·	—	·	·	·
Rubus hochstetterorum	·	·	·	·	·	·	—	·	·	·
Ilex perado	·	·	·	·	·	·	—	·	·	·
Habenaria micrantha	·	·	·	·	·	·	—	·	·	·
Habenaria longebracteata	·	·	·	·	·	·	—	·	·	·
Frangula azorica	·	·	·	·	·	·	—	·	·	·
Daphne laureola	·	·	·	·	·	·	—	·	·	·
Vaccinium cylindraceum	·	·	·	·	·	·	—	·	·	·
Viburnum tinus ssp.	·	·	·	·	·	·	—	·	·	·
Carex peregrina	·	·	·	·	·	·	—	·	·	·
Luzula purpureo-splendens	·	·	·	·	·	·	—	·	·	·
Tolpis azorica	·	·	·	·	·	o	—	·	·	·
Huperzia selago ssp.	·	·	·	·	·	o	—	·	·	·
Culcita macrocarpa	·	·	·	·	·	o	—	·	·	·
Erica azorica	·	·	·	·	·	·	—	·	·	·
Myrsine africana var.	·	·	·	·	·	·	—	·	·	·
Pteris serrulata	·	·	·	·	·	·	—	·	·	·
Polystichum setiferum	·	·	·	·	·	·	—	·	·	·
Hypericum foliosum	·	·	·	·	·	·	—	·	·	·
Hedera helix ssp.	·	·	·	·	·	·	—	·	·	·
Senecio malvifolius	·	·	·	·	·	·	—	·	·	·
Centaurium scilloides ssp.	·	o	·	·	·	o	—	·	·	·
Origanum virens	·	·	·	·	·	·	·	—	·	·
Carex pilulifera var.	·	·	·	·	·	·	·	—	·	·
Agrostis castellana	·	·	·	·	·	·	·	—	·	o
Fragaria vesca	·	·	·	·	·	·	·	—	·	o
Hydrocotyle vulgaris	·	·	·	·	·	—	·	—	·	·
Anagallis tenella	·	·	·	·	·	—	·	—	·	·
Scirpus fluitans	·	·	·	·	·	—	·	—	·	·
Carex serotina	·	·	·	·	·	—	·	—	·	·
Viola palustris ssp.	·	·	·	·	·	o	·	—	·	o
Potentilla erecta	·	·	·	·	·	—	·	—	·	o
Potentilla anglica	·	·	·	·	·	—	·	—	·	o
Juncus effusus	·	·	·	·	·	—	·	—	·	o
Serapias cordigera	·	·	·	·	·	·	·	—	—	·
Prunella vulgaris	·	·	·	·	o	—	·	—	·	o
Leontodon taraxacoides	·	·	·	—	—	o	·	—	·	·
Bellis azorica	·	·	·	·	·	·	·	—	o	—
Holcus rigidus	·	·	·	·	·	o	·	--	--	o
Rubia peregrina var.	·	·	·	·	·	·	·	o	—	o
Picris filii	·	·	·	·	·	·	·	o	—	o
Osmunda regalis	·	·	·	·	·	o	·	·	—	o
Trichomanes speciosum	·	·	·	·	·	·	·	·	·	—
Euphorbia stygiana	·	·	·	·	·	·	·	·	·	—
Chaerophyllum azoricum	·	·	·	·	·	·	·	·	·	—
Lactuca watsoniana	·	·	·	·	·	·	·	·	·	—
Rumex azoricus	·	·	·	·	·	·	·	·	·	—
Festuca jubata	·	·	·	·	·	·	·	o	o	—
Hymenophyllum wilsonii	·	·	·	·	·	·	·	·	o	—
Phyllitis scolopendrium	·	·	·	·	·	·	·	·	o	—
Diplazium caudatum	·	·	·	·	·	·	·	·	o	—
Ranunculus cortusifolius	·	·	·	·	·	·	·	·	o	—
Prunus lusitanica ssp.	·	·	·	·	·	·	·	·	o	—
Smilax excelsa	·	·	·	·	·	·	·	·	o	—
Diphasium madeirense	·	·	·	·	·	·	·	·	—	—
Dryopteris borreri	·	·	·	·	·	·	·	·	—	—
Woodwardia radicans	·	·	·	·	·	·	·	·	—	—
Cardamine caldeirarum	·	·	·	·	·	·	·	·	—	—
Sanicula azorica	·	·	·	·	·	·	·	·	—	—
Euphrasia grandiflora	·	·	·	·	·	·	·	·	—	—
Picris rigens	·	·	·	·	·	·	·	·	—	—
Hymenophyllum tunbridgense	·	·	·	·	·	·	·	·	—	—
Arceuthobium oxycedri	·	·	·	·	·	·	·	·	—	—
Elaphoglossum hirtum	·	·	·	·	·	·	·	·	—	—
Deschampsia foliosa	·	·	·	·	·	o	·	·	—	—
Daboecia azorica	·	·	·	·	·	·	·	—	—	o
Calluna vulgaris	·	·	·	·	·	·	·	—	—	o

Table 6. Explanations: Summary of differential species of alliances and associations distinguished in the Azores. — = high differential value, -- = low differential value. o denotes rare and accidental occurrence of the differential species.

COMMENTS ON THE ECOLOGY, SOCIOLOGY AND DISTRIBUTION OF AZOREAN VASCULAR PLANTS

LYCOPODIACEAE

Huperzia selago (L.) Bernh. ex Schrank & Mart. incl. spp. **dentata** (Herter) Valentine

(Fig. 1 and 2)

EXS. — S. Miguel: E Lag. do Fogo, 750 m. W Casal, 650 m (Sjn 65: U). Cald. Sete Cidades near the Vista do Rei, 650 m (Ds 64: LISE). Pico da Cruz da Serra de Água de Pau, Vila Franca (Cy 58: LISI). Furnas, Salto do Cavalo (Car 03: AZ). — Terceira: St.ª Bárbara, 960 m (Sjn 68: U). Terra Brava facing Boi, rocky substratum, 650 m (Ds 64: LISE). — Pico: Cab. Redondo (Go 63: HO, LISI). Mist. da Prainha, 750 m (Go 63: HO). E of Landroal, 800 m (Sjn 65: U). Madalena, Brejos, 1000 m (Go 65 LISI, LISFA). Grotões, 700 m (Go 62: LISI). — Faial: Cabouco, 650 m (Go 63: HO, LISI). Baldio de Castelo Branco (Go 63: HO, LISI). Levada N of Caldeira, 650 m (Sjn 68: U). Cedros near Cancela, 500 m (Ds 64: LISE). Cabouco Velho, 520 m (Go 64: LISI, LISFA). — Flores: St. Cruz, R. do Junco, 450 m (Go 68: LISI). Stª. Cruz das Flores (Nu 50: LISI). Pedra de Alface (Ro 49: LISU). No loc. (Tr 1894: AZ). — Corvo: Caldeirão, 500 m (Go 68: LISI).

VIDI — Localities on maps. — Flores: Sapateira.

HAB. — SM: Above 250 m. T: Above 650 m. F: Above 500 m. P. Above 700 m. Fo: Also close to sea level. Azores generally above 500 m. — On strongly exposed, wet habitats. On steeply sloping as well as on horizontal ground. Rarely below high water level on shores of lakes. Often on slopes of deep ravines, in *Sphagnum* carpet. Rarely on young lava flows. Already colonizing fresh cuttings through sandy soil after 5 years.

SOC. — Diff. sp. of the *Juniperion brevifolii*, generally u. c.:

Daboecia azorica
Tolpis azorica
Holcus rigidus
Woodwardia radicans
Agrostis castellana
Festuca jubata
Rubia peregrina
Centaurium scilloides
Lysimachia nemorum ssp.
Blechnum spicant

Rarely in the *Litorello-Eleocharion*.

	SM	SMa	T	G	J	P	F	Fo	C
Drouet 1866 . .	×		×		—	×	×	×	—
Trelease 1897 . .	×		×			×	×	×	
Palhinha 1966 . .	×		×		×	×	×	×	
Sjögren 1971 . .	×	—	×	—	—	×	×	×	—

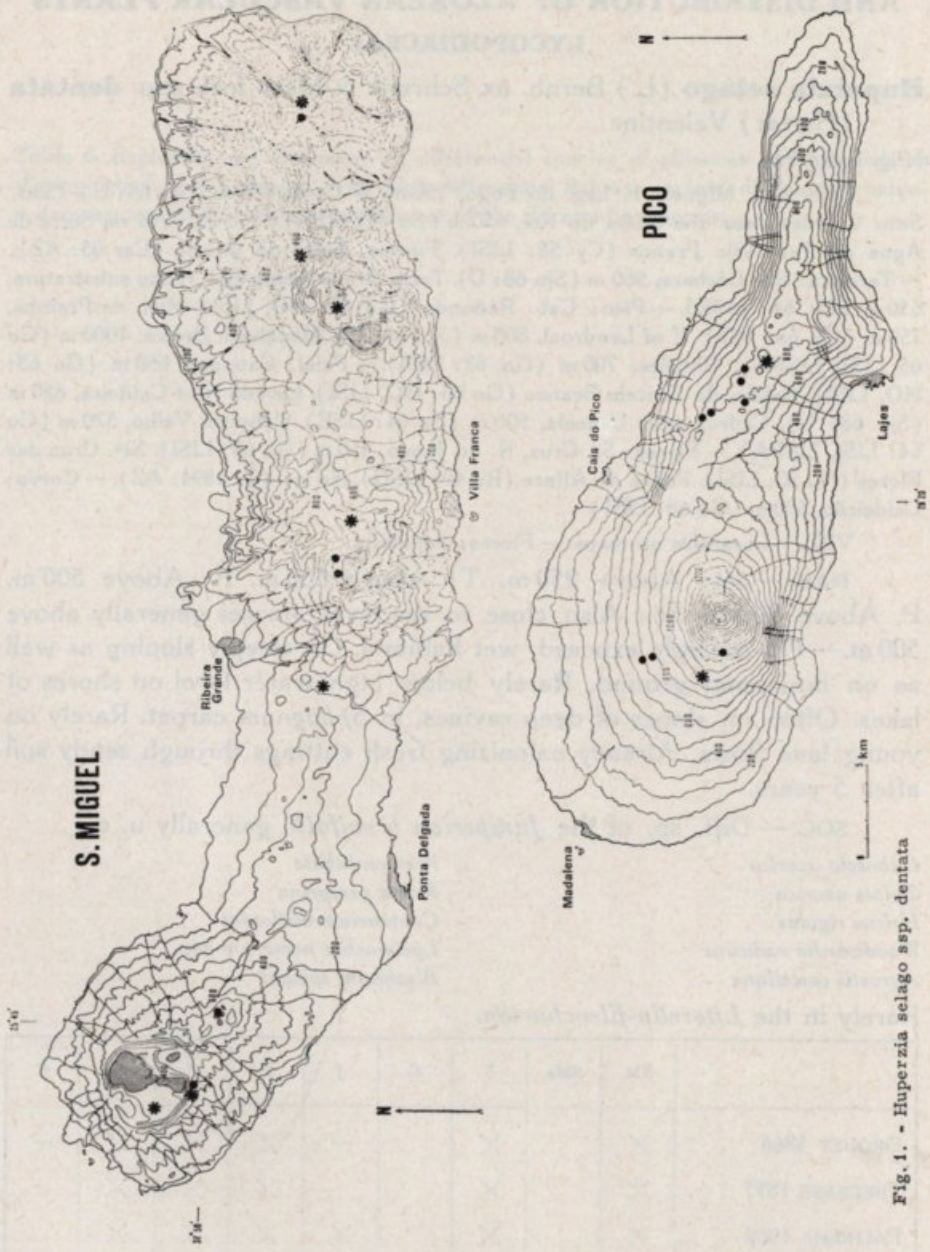
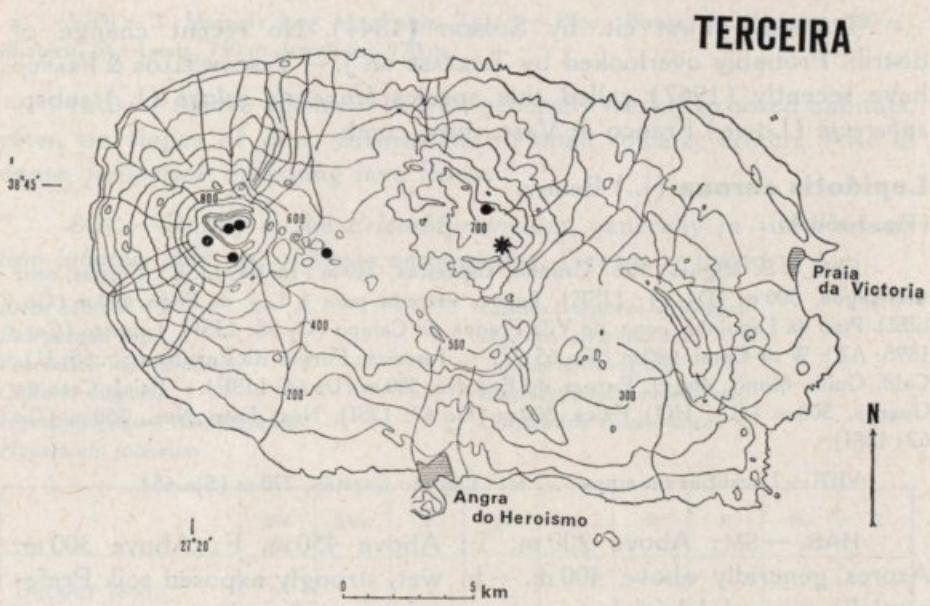


Fig. 1. - Huperzia selago ssp. dentata



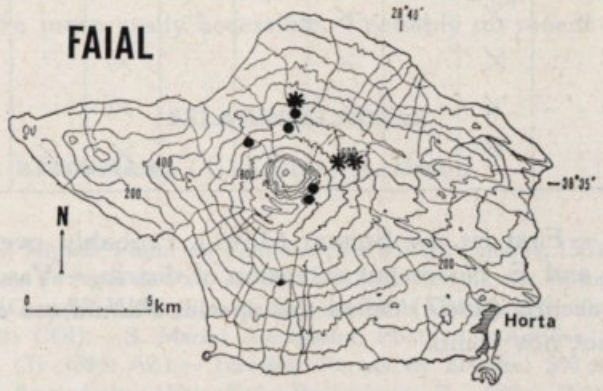


Fig. 2. - Huperzia selago ssp. dentata

DISTRIB. — First cit. by SEUBERT (1844). No recent change of distrib. Probably overlooked by TRELEASE on J. — VASCONCELLOS & FRANCO have recently (1967) called this species *Huperzia selago* (L.) subsp. *suberecta* (Lowe) Franco et Vasc., nov. comb.

Lepidotis cernua (L.) Beauv.

(Fig. 3 and 4)

EXS. — S. Miguel: Rib. Grande, Caldeiras, 240 m (Ds 64: LISE). Furnas, near the Lagoa, 300 m (Ds 64: LISE). Lagoa, estrada para a Lag. do Fogo, 400 m (Go: LISI). Pico da Lagoinha, conc. de Vila Franca do Campo (Cy 58: LISI). Lameiro (Car. 1898: AZ). W of Casal, 600 m (Sjn 65: U). — Terceira: Furnas do Enxofre (Sjn 68: U). Cald. Guilh. Moniz, 460 m. Furnas do Enxofre, 580 m (Ds 64: LISE). — Faial: Casa do Guarda, 300 m (Go: HO). Falca, 300 m (Go 67: LISI). Near Estr. Nac., 350 m (Go 62: LISI).

VIDI — Localities on maps. — Pico: Lag. do Capitão, 770 m (Sjn 65).

HAB. — SM: Above 200 m. T: Above 450 m. F: Above 300 m. Azores generally above 400 m. — In wet, strongly exposed soil. Preferentially around lakes, hot springs and where hot steam evaporates.

SOC. — Diff. sp. of the *Juniperion brevifolii*. Often in open grassland vegetation originating from the *Erico-Myrsinetum*.

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866 . .	×		×		—				—
TRELEASE 1897 . .	×		×			×			
PALHINHA 1966 . .	×		×			×			
SJÖGREN 1971 . .	×	—	×	—	—	×	×		—

DISTRIB. — First cit. by SEUBERT (1844). Probably overlooked by DROUET on P and F. No recent extension of distrib. — VASCONCELLOS & FRANCO have recently (1967) called this species *Palhinhaea cernua* (L.) Franco et Vasc., nov comb.

Diphasium madeirense (Wilce) Rothm.

EXS. — S. Miguel: Lag. do Fogo (Car 1879: LISU). — Pico: Cab. Redondo, 900 m (Go 63: HO). Cab. Redondo, 820 m (Sjn 65: U). Cab. das Torrinhas, 1000 m (Sjn 68: U). Mist. St.ª Luzia, Cab. Redondo (Ds 64: LISE). — Flores: No loc. (Tr 1894: AZ).

VIDI — S. Miguel: Lag. do Fogo, 770 m. — Pico: Bocas do Prainha, 780 m. Mistério St.ª Luzia, 750 m. Landroal, 770 m.

HAB. — Above 700 m. — In wet, generally weakly exposed habitats, often on slopes of deep ravines and in small volcanic craters. Also in dense *Juniperion* on young lava flows.

SOC. — Rarely in the *Erico-Myrsinetum*, generally in the *Festucetum jubatae*. Diff sp. of these associations. Generally found u. c.:

Erica azorica
Ilex perado ssp.
Vaccinium cylindraceum
Calluna vulgaris
Hymenophyllum tunbridgense
Hypericum foliosum
Luzula purpureo-splendens
Myrsine africana var.
Juniperus brevifolia
Elaphoglossum paleaceum
Cardamine caldeirarum

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866. . .	×				—				—
TRELEASE 1897 . .	×							×	
PALHINHA 1966 . .	×				×	×		×	
SJÖGREN 1971 . .	×	—		—	—	×			×

DISTRIB. — First cit by DROUET. New roads on J, P, Fo have made localities there more easily accessible. Probably no recent extension of distrib.

SELAGINELLACEAE

Selaginella kraussiana (G. Kunze) A. Braun

(Fig. 5 and 6)

EXS. — S. Miguel: Ponta da Pontinha (Sjn 65: U). Feteiras, 150 m (Sjn 65: U). Cumieira da Serra de Água de Pau, 750 m (Cy: LISI). Achada das Furnas, Espigão dos Louros, 510 m (Carn 52: LISI). Pico do Cabouco, Rib. Grande (FSi 50: LISI). Pico do Carvão (Car 94: COI). — S. Maria: Almagreira, Ponte dos Agriões, 325 m (Ds 64: LISE). No loc. (Tr 1896: AZ). — Terceira: Furnas do Enxofre, 500 m (Sjn 65: U). Angra near Est. Agronómica, 150 m. Terra Brava facing Boi, 630 m. Cald. Guilh. Moniz, Furna do Cabrito, 400 m (Ds 64: LISE). Q. do Pedregal, Posto Santo (Bz 31: LISI). Pico Bagacina (Orm: COI). No loc. (Tr 1894: AZ). — Graciosa: No loc., 150 m (Ds 64: LISE). — Pico: Lajes above Silveira, Pittosporum wood, 220 m (Ds 64: LISE). Mist. de St.ª Luzia, 550 m. Mist. da Prainha, 600 m (Go 61: LISI). — Faial: Caldeira, 780 m (Ds 64: LISE). P. Almoxarife, 160 m (Go 68: LISI). Ribeirinha (Pa, So 37: LISU). — Flores:

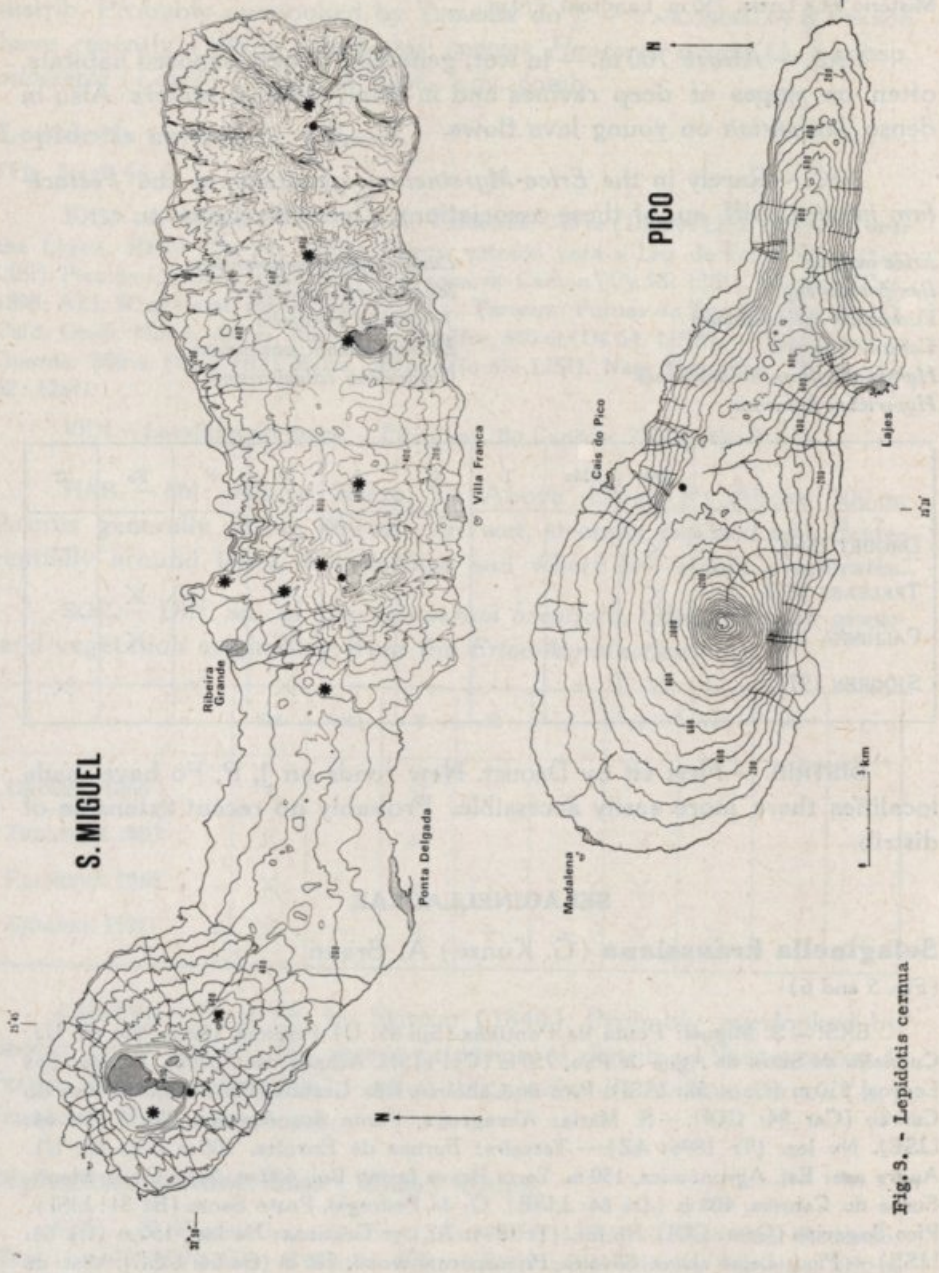


Fig. 3. - Lepidotis cernua

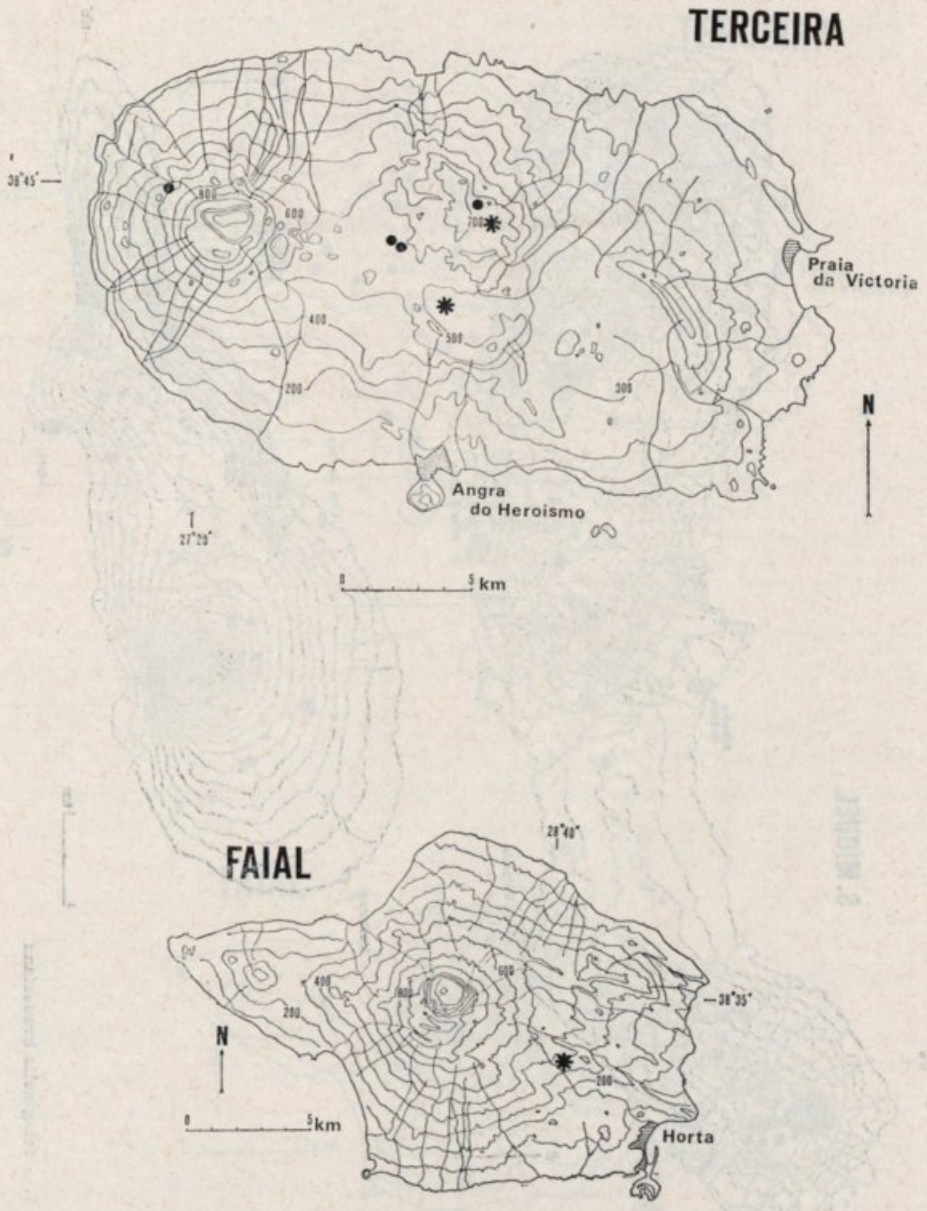


Fig. 4. - Lepidotis cernua

Fig. 5. - Selaginella kraussiana

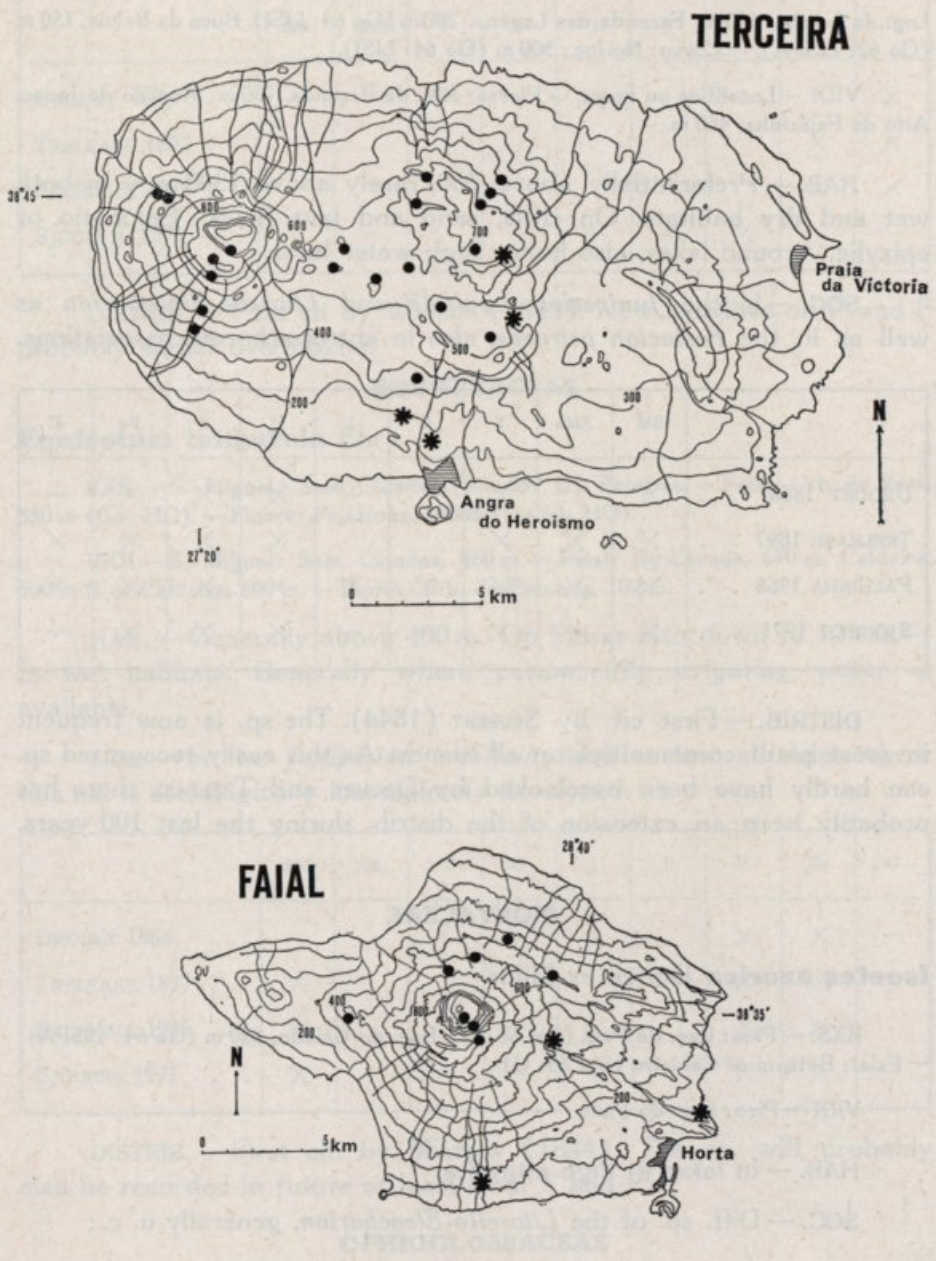


Fig. 6. - Selaginella kraussiana

Lag. da Lomba, 600 m. Fazenda das Lagens. 200 m (Go 64: LISI). Boca da Baleia, 150 m (Go 62: LISFA). — Corvo: No loc., 500 m (Go 64: LISI).

VIDI — Localities on maps. — Flores: Rib. da Fazenda, 100 m. Rochão do Junco, Alto da Fajãzinha, 460 m.

HAB. — Preferentially above 300, rarely above 1300 m. — In both wet and dry habitats. On cliffs, sand and lava flows. Epiphytic or epixylic. Around lakes, also below high water level.

SOC. — In the *Juniperion brevifolii* and *Litorello-Eleocharion* as well as in the *Festucion petraeae*, also in antropochorous associations.

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866 . .	×		×		–	×	×	×	–
TRELEASE 1897 . .	×	×	×			×	×	×	×
PALHINHA 1966 . .	×	×	×	×	×	×	×	×	×
SJÖGREN 1971 . .	×	–	×	–	–	×	×	×	–

DISTRIB. — First cit. by SEUBERT (1844). The sp. is now frequent in most plant communities on all islands. As this easily recognized sp. can hardly have been overlooked by DROUET and TRELEASE there has probably been an extension of the distrib. during the last 100 years.

ISOETACEAE

Isoetes azorica Durieu ex Milde

EXS. — Pico: Lag. do Paúl (Sjn 68: U). Lag. do Caiado, 820 m (Go 64: LISFA). — Faial: Bottom of Caldeira (Sjn 68: U).

VIDI — Pico: Lag. do Paúl.

HAB. — In lakes at high altitudes.

SOC. — Diff. sp. of the *Litorello-Eleocharion*, generally u. c.:

Juncus effusus
Callitriche stagnalis
Scirpus fluitans
Epilobium obscurum
Potamogeton polygonifolius
Litorella uniflora
Scirpus setaceus

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866 . .					—				×
TRELEASE 1897 . .								×	×
PALHINHA 1966 . .								×	×
SJÖGREN 1971 . .		—		—	—	×	×		—

DISTRIB. — First cit by WATSON (1844). New localities on P and F probably earlier overlooked.

EQUISETACEAE

Equisetum telmateia Ehrh.

EXS. — S. Miguel: Sete Cidades (Sjn 65: U). Feteiras. — Faial: Cab. da Vara, 550 m (Go: HO). — Flores: Fajãzinha, 100 m (Go 64: HO).

VIDI — S. Miguel: Sete Cidades, 460 m. — Faial: By Levada, 670 m. Caldeira, 500 m N of Caldeira, 600 m. — Flores: Rib. da Fazenda, 100 m.

HAB. — Generally above 400 m. On Flores also down to 100 m. — In wet habitats. Generally where permanently irrigating water is available.

SOC. — In the *Juniperion brevifolii*, also at low altitudes where this all. is sociologically incompletely developed.

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866. . .					—		×	×	—
TRELEASE 1897 . .	×						×	×	
PALHINHA 1966 . .	×				×		×	×	
SJÖGREN 1971 . .	×	—		—	—		×	×	—

DISTRIB. — First cit. by WATSON (1844). The sp. will probably also be recorded in future at least from T and P.

OPHIOGLOSSACEAE

Botrychium lunaria (L.) Swartz in Schrader

EXS. — Pico: W slope, 1800 m (Sjn 68: U).

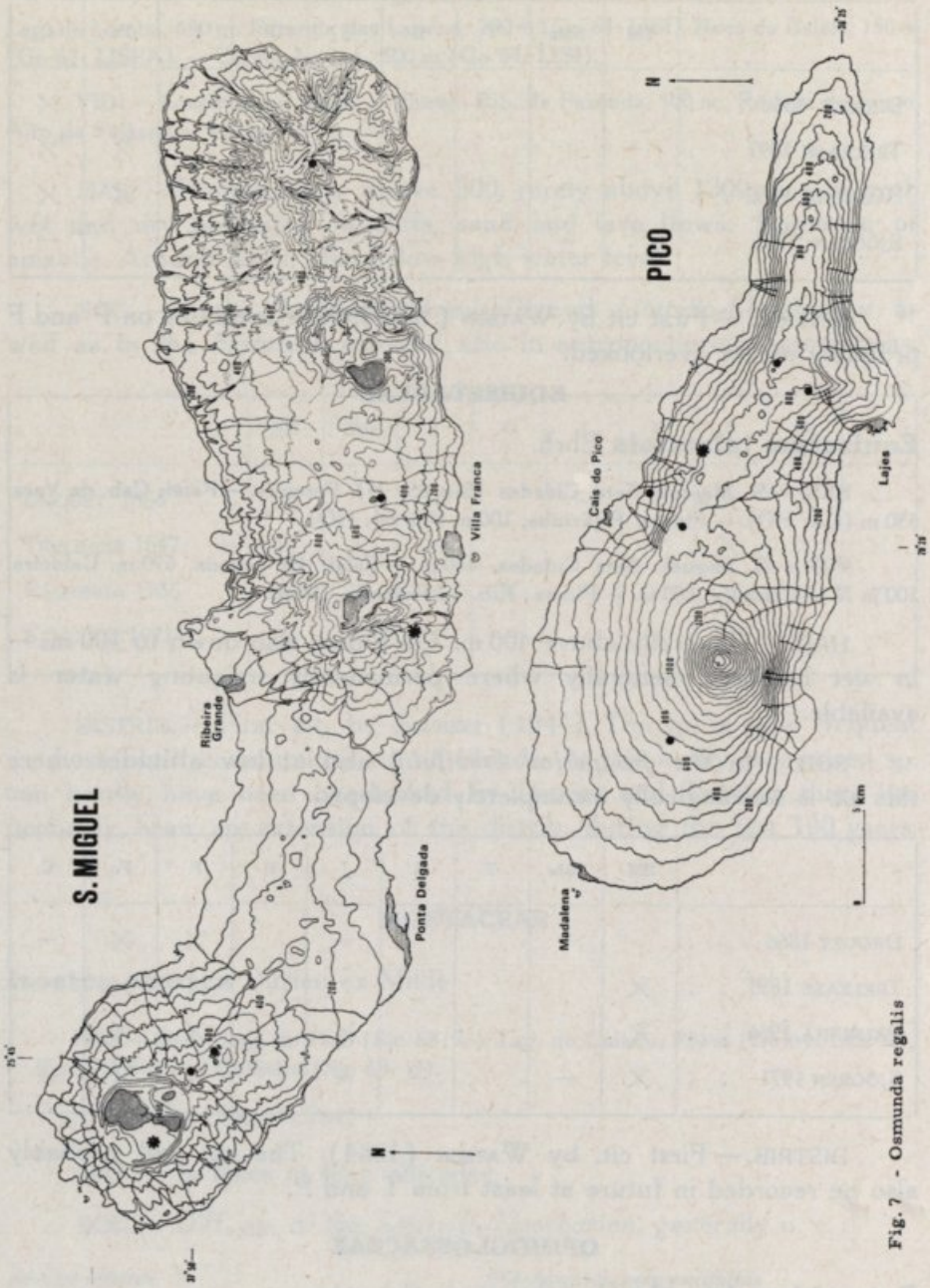


Fig. 7 - Osmunda regalis

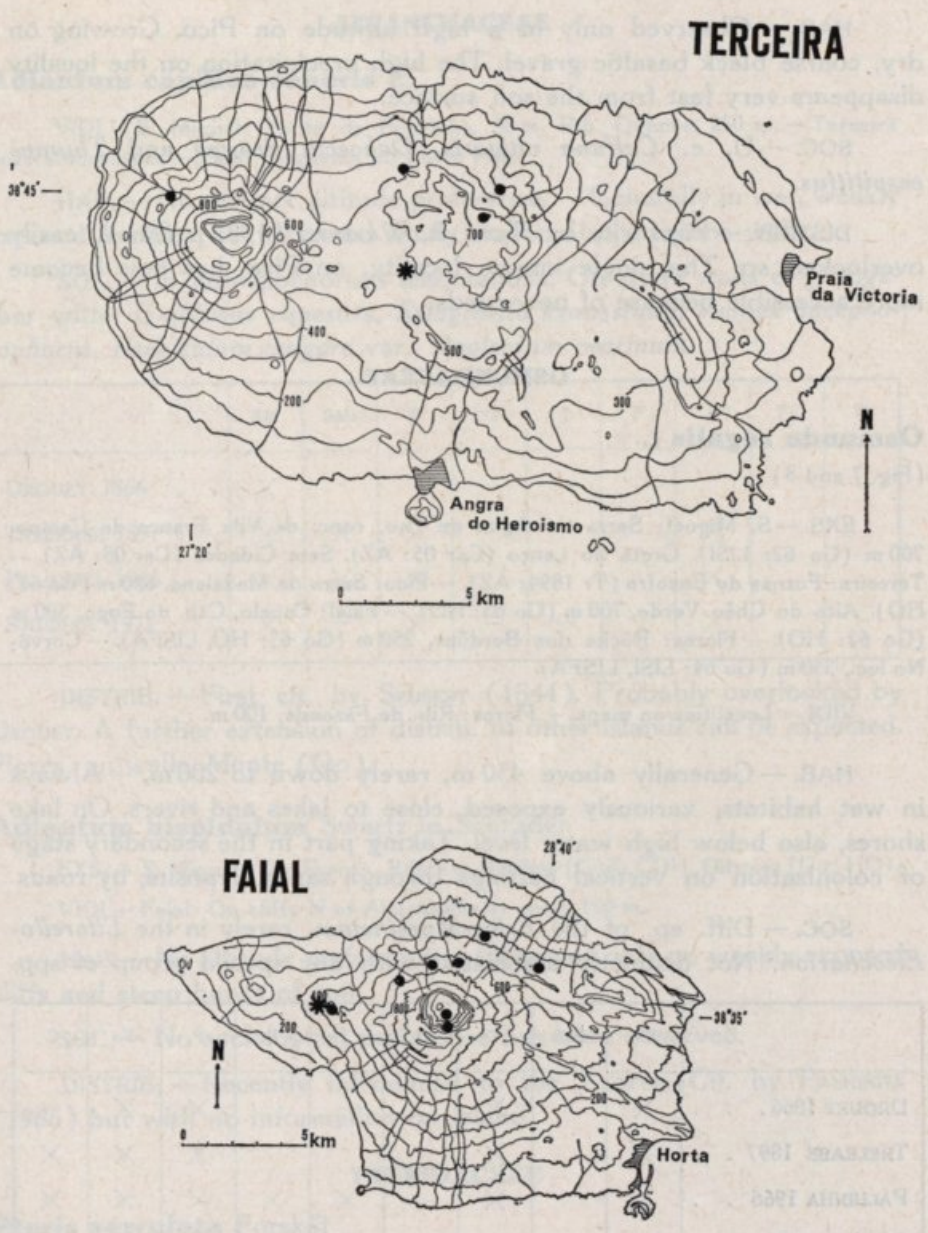


Fig. 8. - Osmunda regalis

HAB. — Observed only at a high altitude on Pico. Growing on dry, coarse black basaltic gravel. The high precipitation on the locality disappears very fast from the soil surface.

SOC. — U. c. *Calluna vulgaris*, *Daboecia azorica* and *Thymus cespititius*.

DISTRIB. — First cit. by TUTIN & WARBURG (1932). Small, easily overlooked sp. The single known locality, on Pico, has now become more accessible because of new roads.

OSMUNDACEAE

Osmunda regalis L.

(Fig. 7 and 8)

EXS. — S. Miguel: Serra de Água de Pau, conc. de Vila Franca de Campo, 700 m (Go 62: LISI). Grota do Lanço (Car 05: AZ). Sete Cidades (Car 08: AZ). — Terceira: Furnas do Enxofre (Tr 1894: AZ). — Pico: Serra da Madalena, 650 m (Go 62: HO). Alto do Chão Verde, 700 m (Go 63: HO). — Faial: Capelo, Cab. do Fogo, 500 m (Go 62: HO). — Flores: Rocha dos Bordões, 250 m (Go 63: HO, LISFA). — Corvo: No loc., 350 m (Go 64: LISI, LISFA).

VIDI — Localities on maps. — Flores: Rib. da Fazenda, 100 m.

HAB. — Generally above 450 m, rarely down to 200 m. — Always in wet habitats, variously exposed, close to lakes and rivers. On lake shores, also below high water level. Taking part in the secondary stage of colonization on vertical cuttings through sandy deposits, by roads.

SOC. — Diff. sp. of the *Erico-Myrsinetum*, rarely in the *Litorello-Eleocharion*. Not distinctly associated with any special group of spp.

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866 . . .	×		×		—		×	×	—
TRELEASE 1897 . .	×		×				×	×	×
PALHINHA 1966 . .	×		×		×	×	×	×	×
SJÖGREN 1971 . .	×	—	×	—	—	×	×	×	—

DISTRIB. — First cit. by SEUBERT (1844). Localities on P probably overlooked by DROUET. No recent extension of distrib.

ADIANTHACEAE

Adiantum capillus-veneris L.

VIDI — S. Miguel: Ponta da Pontinha, 50 m. Rib. Quente, 250 m. — Terceira Several localities. — Faial: Bagacina do Porto Pim.

HAB. — No distinct altitude preference. — Generally in wet, weakly exposed habitats, on cliffs and sandy slopes, also on stone walls.

SOC. — In antropochorous associations. On stone walls e. g. together with: *Umbilicus rupestris, Selaginella kraussiana, Rumex bucephalophorus, Foeniculum vulgare* var., *Asplenium marinum.*

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866 . .	×				—				—
TRELEASE 1897 . .	×	×	×				×		
PALHINHA 1966 . .	×	×	×				×		
SJÖGREN 1971 . .	×	—	×	—	—		×		—

DISTRIB. — First cit. by SEUBERT (1844). Probably overlooked by DROUET. A further extension of distrib. to other islands can be expected. Flores, on walls, Monte (Go).

Adiantum hispidulum Swartz in Schrader

EXS. — S. Miguel: Vila Franca. Rib. dos Fairhos (Guil: COI). Ginetes (Go: HO).

VIDI — Faial: On cliffs N of Almoxarife by road, 100 m.

HAB. — No altitude preference. — Observed only on weakly exposed cliffs and steep banks of soil.

SOC. — No sociological preference has been observed.

DISTRIB. — Recently introduced to the Azores. Cit. by PALHINHA (1966) but with no information on island.

PTERIDACEAE

Pteris serrulata Forskål

(Fig. 9 and 10)

EXS. — Terceira: Mata da Serreta (Sjn 65: U). Mata do Posto Agrário, 200 m (Ds 64: LISE). Cald. Guilh. Moniz near Cabrito, 460 m (Ds 64: LISE). Terra Chã, Rosário (Orm: COI). — Pico: Lajes, above Silveira in Pittosporum wood (Ds 64: LISE).

Fig. 9. - Pteris serrulata

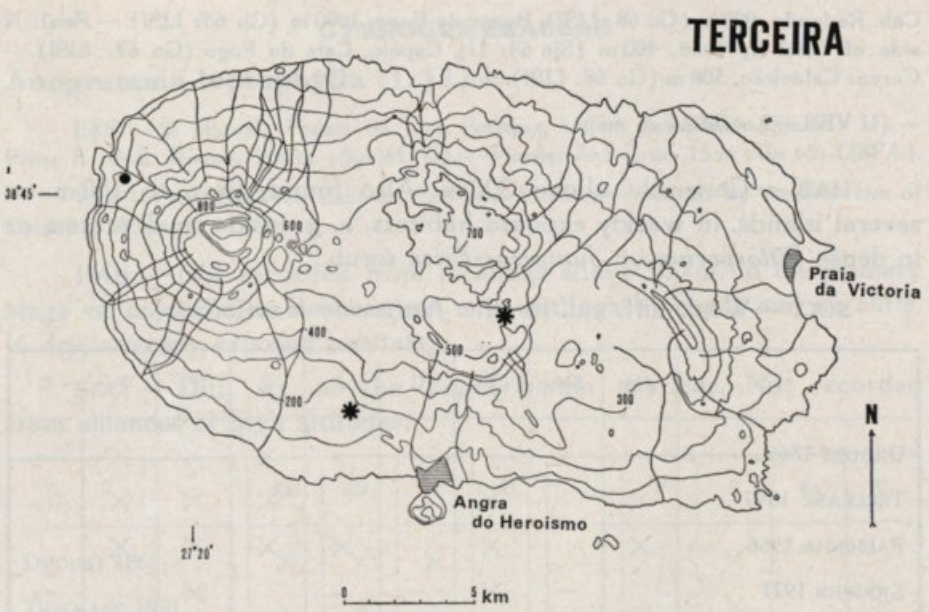


Fig. 10. - Pteris serrulata

Cab. Redondo, 900 m (Go 68: LISI). Bocas do Fogo, 1000 m (Go 68: LISI). — Faial: N side of Faial by road, 400 m (Sjn 68: U). Capelo, Cab. do Fogo (Go 62: LISI). — Corvo: Caldeirão, 500 m (Go 68: LISI).

VIDI — Localities on maps.

HAB. — Generally above 300 m. Also found down to 150 m on several islands. In weakly exposed habitats, e. g. inside small craters or in dense *Pittosporum* or *Juniperus-Erica* scrub.

SOC. — Weak diff. val. for the *Juniperion brevifolii*.

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866. . .					—	×	×	×	—
TRELEASE 1897 . .	×		×			×	×	×	
PALHINHA 1966 . .	×		×		×	×	×	×	
SJÖGREN 1971 . .		—	×	—	—		×		—

DISTRIB. — First cit. by SEUBERT (1844) from F and P. Localities on SM and T may have been overlooked by DROUET.

Pteris vittata L.

EXS. — S. Miguel: Caldeiras, S of Rib. Grande (Sjn 65: U). Ponta Delgada, 5 m (Go 68: LISI). — Faial: Capelo, Cab. do Fogo, 500 m (Go 62: LISI, LISFA).

HAB. — No distinct altitude preference. Ecological preference ill-defined. Observed growing on coarse basaltic gravel.

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866 . .					—				—
TRELEASE 1897 . .									
PALHINHA 1966 . .	×								
SJÖGREN 1971 . .	×	—		—	—		×		—

DISTRIB. — First cit. by TUTIN & WARBURG (1932). Recently introduced.

GYMNOGRAMMACEAE

Anogramma leptophylla (L.) Link

EXS. — S. Miguel: Fenais da Luz. Feteiras, 150 m. Achadinha (Sjn 65: U). — Pico: E of S. Roque, 200 m (Sjn 65: U). — Flores: St.ª Cruz, 15 m (Go 65: LISFA).

VIDI — Pico: Between Cais do Pico and S. Roque. — Faial: By road to rim of Caldeira, 500 m.

HAB. — Not recorded from localities above 500 m. In the primary stage of colonization on bare soil e. g. cuttings by roads and on cliffs. In dry, strongly exposed habitats.

SOC. — Diff. sp. of the *Euphorbietum azoricae*. Not recorded from alliances of high altitudes.

	SM	SMa	T	G	J	P	F	Fo	C
Drouet 1866. . .	×	×	×		—		×		—
Trelease 1897 . .	×	×	×				×		×
Palhinha 1966 . .	×	×	×		×		×		×
Sjögren 1971 . .	×	—		—	—	×		×	—

DISTRIB. — First cit. by Seubert (1844), only from SM, T and F. Localities on P and Fo may have been overlooked by Drouet and Trelease. Localities have increased in number, especially on banks by new roads.

DICKSONIACEAE

Culcita macrocarpa C. Presl

(Fig. 11 and 12)

EXS. — S. Miguel: Lag. do Fogo, 700 m. Casal, 600 m (Sjn 65: U). Serra da Tronqueira, conc. de Nordeste, 800 m (Cy 59: LISI). Capelas, nas matas (Oliv: LISU). Pico da Vara (Car 05: AZ). Furnas (Car 05: AZ). Lombadas (Car 01: AZ). — Terceira: Biscoito da Ferraria, 580 m (Ds 64: LISE). Terra Brava, Bagacina, 550 m (Ds 64: LISE). Terra Chã (Pa 34: LISU). Furnas do Enxofre (Tr 1894: AZ). — Pico: Mist. St.ª Luzia, 550 m (Sjn 68: U). Prainha, Rib. do Mistério: 500 m (Go 61: LISI). — Faial: Horta, Capelo, Cab, do Fogo, 500 m (Go 62: LISI). Cedros, Rib. Funda, 700 m (Go 62: LISFA). — Flores: St.ª Cruz das Flores. Lag. Rasa, 400 m (Go 68: LISI).

VIDI — Localities on maps.

HAB. — SM: Generally above 500 m. T: Generally above 400 m. F: Above 400 m. P: Above 500 m. On several islands also down to

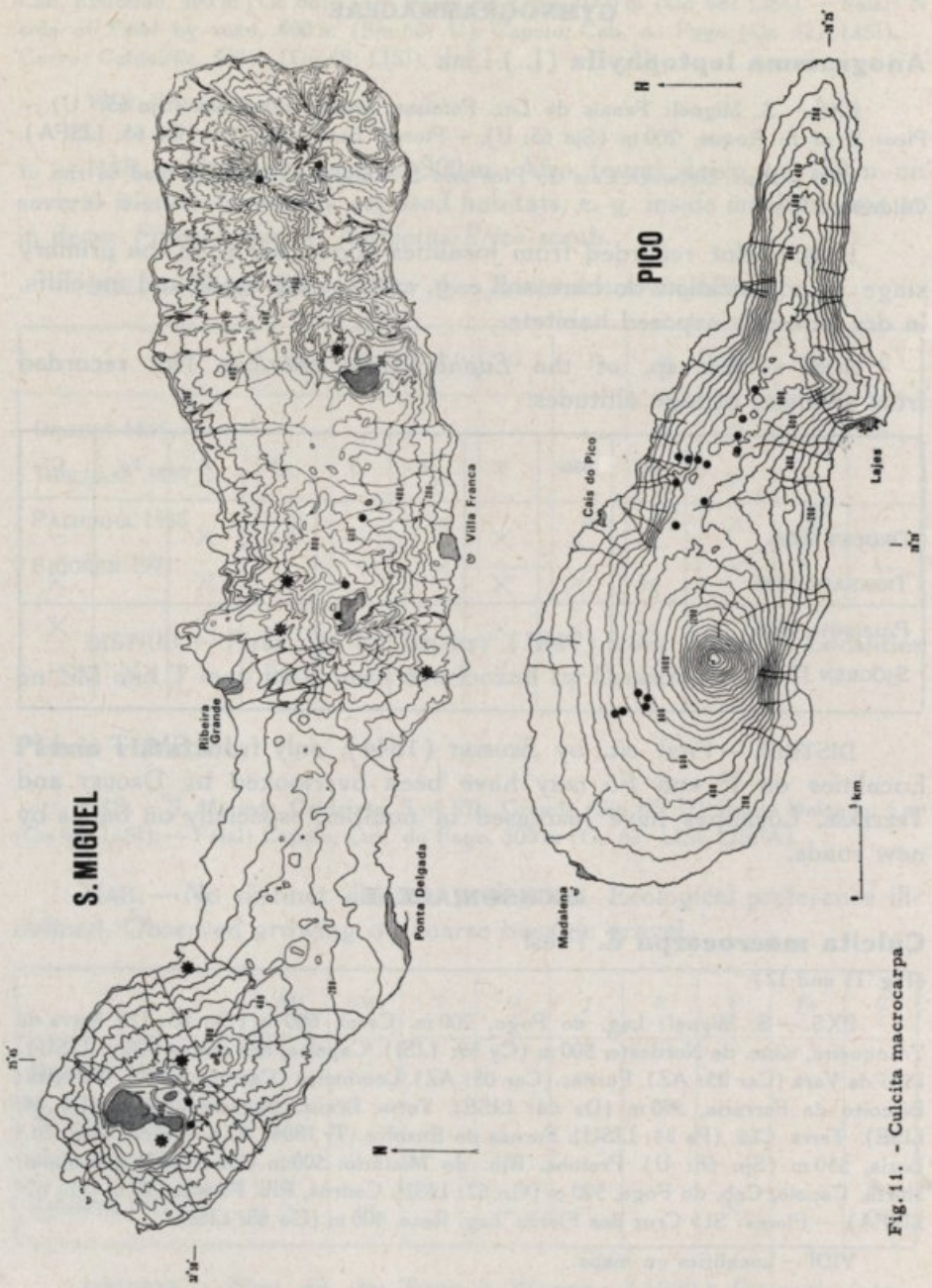


Fig. 11. - Culcita macrocarpa

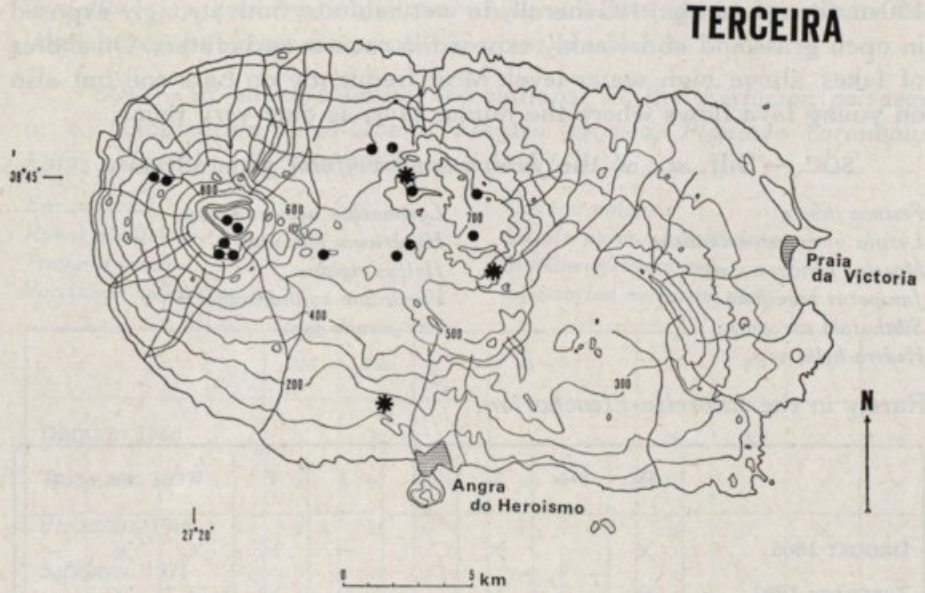


Fig. 12. - Culcita macrocarpa

150 m, though rarely. — Generally in wet habitats, both strongly exposed in open grassland and weakly exposed in ravines and craters. On shores of lakes above high water level. Most frequently on bare soil but also on young lava flows where the humus layer is only very thin.

SOC. — Diff. sp. of the *Juniperion brevifolii*, generally u. c.:

Festuca jubata
Luzula purpureo-splendens
Myrsine africana var.
Juniperus brevifolia
Sibthorpia europaea
Hedera helix ssp.
Lysimachia nemorum ssp.
Hypericum foliosum
Holcus rigidus
Vaccinium cylindraceum
Ilex perado ssp.

Rarely in the *Litorello-Eleocharion*.

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866. . .	×		×		—	×	×	×	—
TRELEASE 1897 . .	×		×			×	×	×	
PALHINHA 1966 . .	×		×		×	×	×	×	
SJÖGREN 1971 . .	×	—	×	—	—	×	×		—

DISTRIB. — First cit. by SEUBERT (1844). *Culcita* may have become extinct on SMa, G and C, because of man's activities as this fern was previously extensively collected (cf. SEUBERT 1844, p. 16). These islands also offer small areas of the *Juniperion brevifolii*.

HYPOLEPIDACEAE

Pteridium aquilinum (L.) Kuhn in Decken

VIDI — S. Miguel: Feteiras, 100 m. Sete Cidades, 240 and 460 m. Fenais da Luz by the coast. Ponta da Pontinha, 40 m. Lag. do Fogo, 550 m. Lag. das Furnas, 250 m. Lag. do Congro, 580 m. — Terceira: Picos dos Negros, 530 m. Pico do Gaspar, 450 m. Pico das Perdelas, 400 and 450 m. Cald. Guilh. Moniz, 420 m. Miradouro of NW, 180 m. Biscoito da Ferraria, 600 m. Terra Chã, 100 m. Furnas do Enxofre, 500 m. Mata da Serreta, 200 and 350 m. — Pico: Picos das Torrinhas, 890 m. Mist. da Prainha, 700 m. Largo da Areia, Madalena, coast. Cab. do Afonso, 700 m. Lag. do Caiado, 820 m. Cais — S. Roque, coast. Miradouro, Cais do Pico, 170 m. N slope of Pico, 1060 m. — Faial: Castelo Branco, 50 m. Bottom Caldeira. Alto da Pedreira, 520 m.

HAB. — No distinct altitude limits but rarely above 1100 m. — Generally in strongly exposed, dry or wet habitats. On cliffs and young

lava flows in crevices, on stone walls, soil cuttings, sandy coasts and lake shores, but most frequently in open grassland.

SOC. — In antropochorus associations. In the *Festucion petraeae*, u. c. *Gnaphalium luteo-album*, *Festuca petraea*, *Plantago coronopus*, *Lotus subbiflorus*. In the *Juniperion brevifolii* u. c.:

Erica azorica
Rubus ulmifolius
Fragaria vesca
Vaccinium cylindraceum
Calluna vulgaris
Luzula purpureo-splendens
Myrsine africana var.
Lysimachia nemorum ssp.

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866 . .	×	×			—	×	×	×	—
TRELEASE 1897 . .	×	×	×	×		×	×	×	×
PALHINHA 1966 . .	×	×	×	×	×	×	×	×	×
SJÖGREN 1971 . .	×	—	×	—	—	×	×		—

DISTRIB. — First cit. by SEUBERT (1844). Probably more frequent nowadays because of larger areas of pastures laid out within the *Juniperion*. Localities on T and G might have been overlooked by DROUET. Troublesome «weed» in pastures at all altitudes.

HYMENOPHYLLACEAE

Hymenophyllum tunbridgense (L.) Sm. in Sowerby

(Fig. 13 and 14)

EXS. — S. Miguel: Serra da Tronqueira, conc. de Nordeste (Cy 59: LISI). Lag. do Fogo (Car 02: AZ). — Terceira: Terra Brava, Bagacina, 550 m (Ds 64: LISE). Furnas do Enxofre (Tr 1894: AZ). — S. Jorge: Pico do Brenho (Car 08: AZ). — Pico: Bocas do Fogo, Prainha, 780 m (Sjn 68: U). S. Roque do Pico E of Junqueira, Mist. Prainha, 730 m (Ds 64: LISE). Lag. Caiado, 750 m (Go 67: LISI). Junqueira, 700 m (Go 64: LISI). Prainha, Rib. do Mistério, 500 m (Go 61: LISI). — Faial: Caldeira, 750 m (Go 68: LISI). — Flores: St.ª Cruz d. Flores, Lag. Rasa, 400 m (Go 68: LISI). Rocha dos Bordões, 350 m (Go 64: LISI). Caldeira da Lomba (Tr 1894: AZ).

VIDI — Localities on maps.

HAB. — SM: Above 500 m. T: Above 400 m. F: Above 500 m. P: Above 400 m. Fo: Down to 350 m. Generally above 500 m and below 1400 m. — Generally in wet weakly exposed habitats. Observed on all types of substrata. Suitable humidity conditions are available in dense

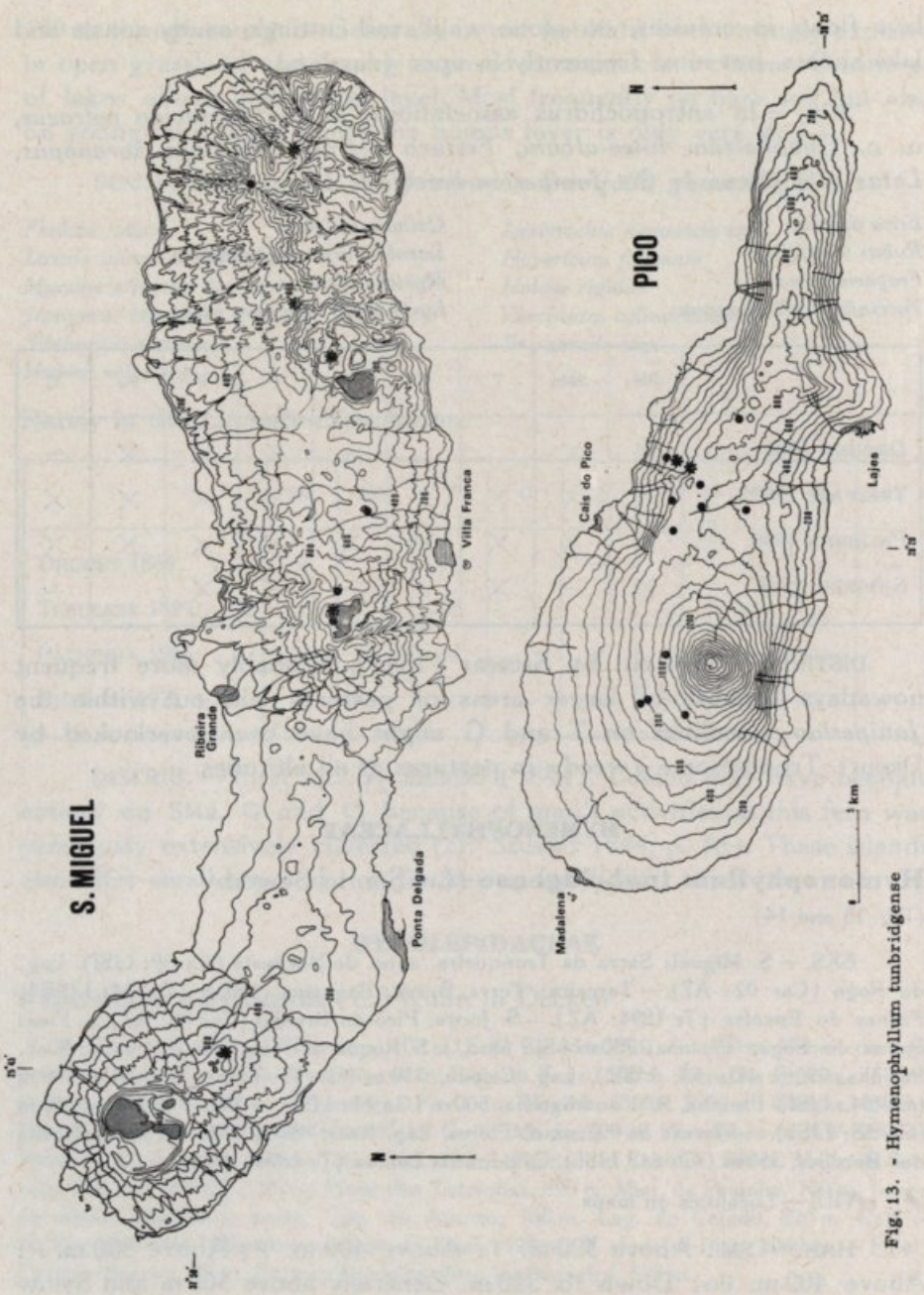


Fig. 13. - Hymenophyllum tunbridgense

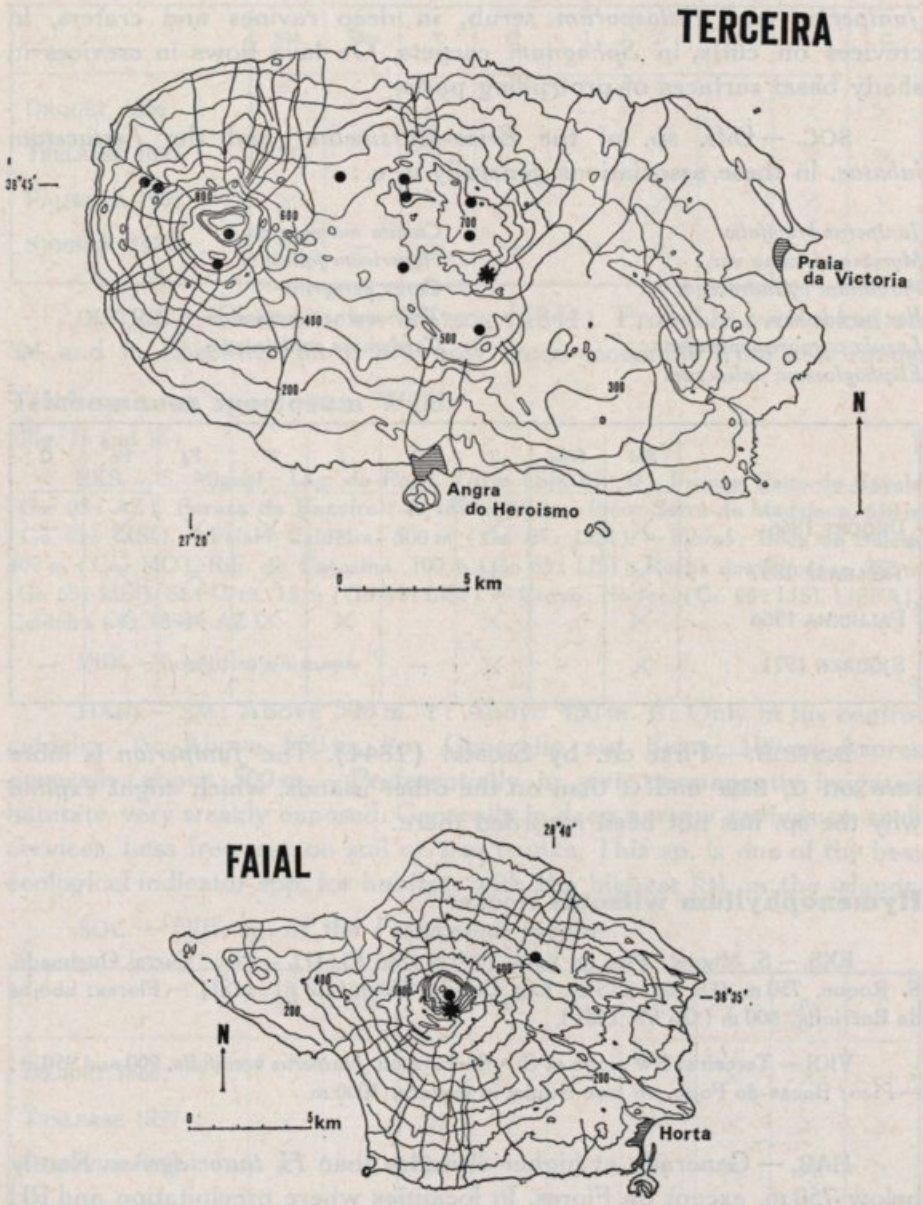


Fig. 14. - Hymenophyllum tunbridgense

Juniperion and *Pittosporum* scrub, in deep ravines and craters, in crevices on cliffs, in *Sphagnum* carpets. On lava flows in crevices in shady basal surfaces of protruding parts.

SOC. — Diff. sp. of the *Erico-Myrsinetum* and the *Festucetum jubatae*. In these associations generally u. c.:

Juniperus brevifolia
Myrsine africana var.
Vaccinium cylindraceum
Ilex perado ssp.
Luzula purpureo-splendens
Elaphoglossum paleaceum
Culcita macrocarpa
Hypericum foliosum
Carex peregrina
Trichomanes speciosum
Cardamine caldeirarum

	SM	SMa	T	G	J	P	Fé	Fo	C
DROUET 1866. . .	×		×		–	×	×	×	–
TRELEASE 1897 . .	×		×			×	×	×	
PALHINHA 1966 . .	×		×		×	×	×	×	
SJÖGREN 1971 . .	×	–	×	–	–	×	×		–

DISTRIB. — First cit. by SEUBERT (1844). The *Juniperion* is more rare on C, SMa and G than on the other islands, which might explain why the sp. has not been recorded there.

Hymenophyllum wilsonii Hooker

EXS. – S. Miguel: Pico da Vara, 1060 m (Sjn 65: U). — Pico: Curral Queimado, S. Roque, 750 m (Ds 64: LISE). Lag. Caiado, 750 m (Go 67: LISI). — Flores: Lomba da Burrinha, 600 m (Go 67: LISI).

VIDI — Terceira: SW slope of St.ª Bárbara on *Juniperus brevifolia*, 900 and 950 m. — Pico: Bocas do Fogo, on tree trunks in craters, 1000 m.

HAB. — Generally at higher altitudes than *H. tunbridgense*. Rarely below 750 m, except on Flores. In localities where precipitation and RH is permanently high, on weakly exposed habitats, on tree trunks, cliffs and boulders. Frequently in narrow deep ravines and craters.

SOC. — Diff. sp. of the *Festucetum jubatae*, rarely in the *Erico-Myrsinetum*.

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866 . .			×		—			×	×
TRELEASE 1897 . .	×		×					×	×
PALHINHA 1966 . .	×		×			×		×	×
SJÖGREN 1971 . .	×	—	×	—	—	×			—

DISTRIB. — First cit. by WATSON (1844). Probably overlooked on SM and P. Localities on P are now more accessible from new roads.

Trichomanes speciosum Willd.

(Fig. 15 and 16)

EXS. — S. Miguel: Lag. do Fogo, 770 m (Sjn 65: U). Furnas, Salto do Cavalo (Car 03: AZ). Furnas do Enxofre (Tr 1894: AZ). — Pico: Serra da Madalena, 650 m (Go 63: LISI). — Faial: Caldeira, 500 m (Go 65: LISI). — Flores: Boca da Baleia, 400 m (Go: HO). Rib. do Cascalho, 100 m (Go 65: LISI). Rocha dos Bordões, 250 m (Go 63: LISI). St.ª Cruz, 15 m (Go 64: LISI). — Corvo: No loc. (Go 64: LISI, LISFA). Caldeira (Tr 1894: AZ).

VIDI — Localities on maps.

HAB. — SM: Above 500 m. T: Above 450 m. F: Only in the central caldeira. P: Above 550 m. Fo: Generally not below 100 m. Azores generally, above 500 m. — Preferentially in wet, permanently irrigated habitats, very weakly exposed. Generally in deep narrow ravines or rock crevices. Less frequent on soil or tree trunks. This sp. is one of the best ecological indicator spp. for habitats with the highest RH on the islands.

SOC. — Diff. sp. of the *Festucetum jubatae*.

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866. . .					—		×	×	—
TRELEASE 1897 . .	×		×			×	×	×	×
PALHINHA 1966 . .	×		×		×	×	×	×	×
SJÖGREN 1971 . .	×	—	×	—	—	×	×	×	—

DISTRIB. — First cit. by SEUBERT & HOCHSTETTER (1843). Usually in localities which are now more accessible, which might explain why DROUET only observed the sp. on two islands.

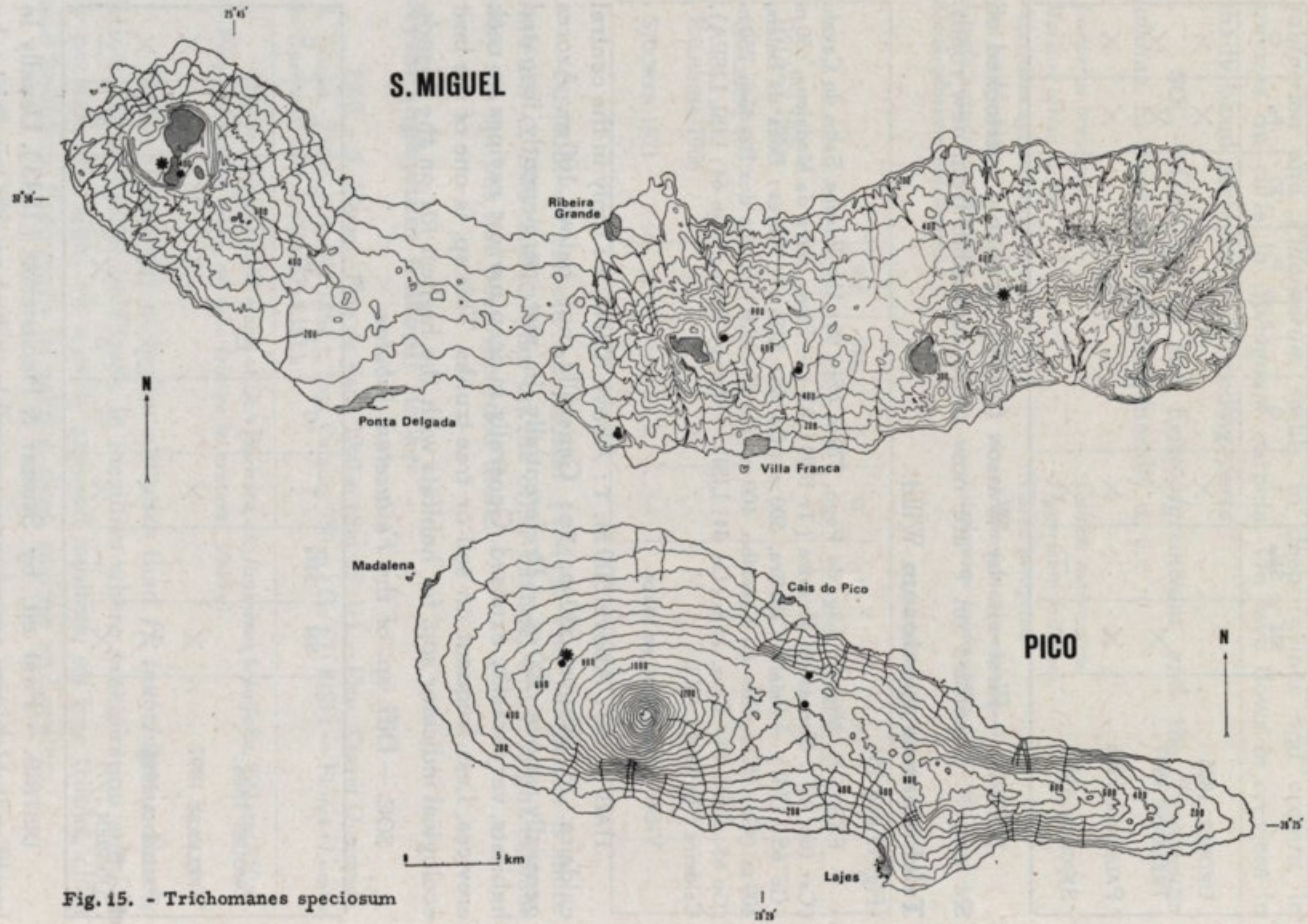


Fig. 15. - Trichomanes speciosum

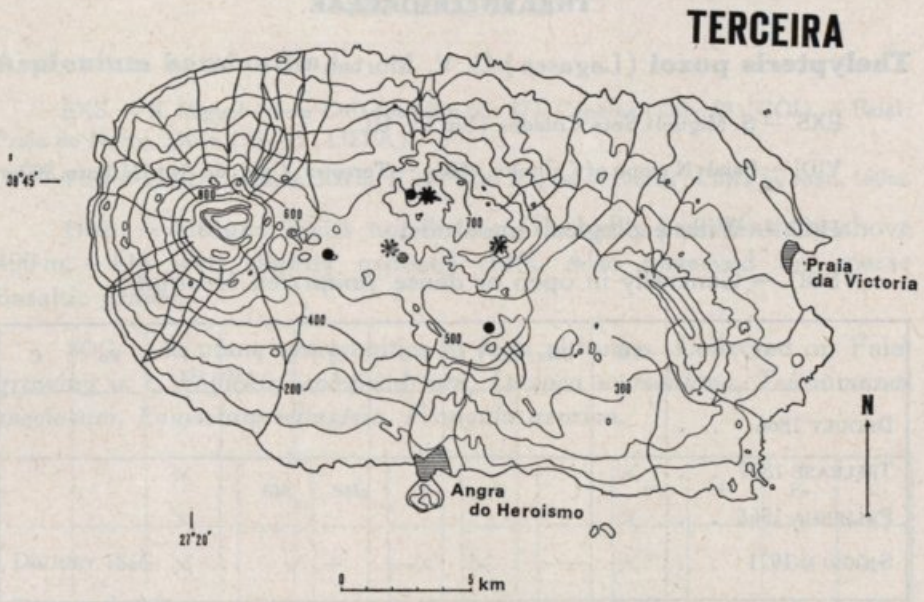


Fig. 16. - Trichomanes speciosum

THELYPTERIDACEAE

Thelypteris pozoi (Lagasca) C. V. Morton

EXS. — S. Miguel: Sete Cidades (Sjn 65: U).

VIDI — Faial: N slope of Caldeira, 650 m. — Terceira: Cald. do St.ª Bárbara, 900m.

HAB — Wide ecological amplitude.

SOC. — Generally in open or dense *Juniperion brevifolii*.

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866 . .					—		×		—
TRELEASE 1897 . .	×						×		
PALHINHA 1966 . .	×						×		
SJÖGREN 1971 . .	×	—	×	—	—		×		—

DISTRIB. — First cit. by DROUET (1866) under the name of *Gymnogramma lowei* Hook. & Grev. from F, then by WATSON (1870) also from SM (coll. HUNT). Recently introduced. Distrib. has remained rather stable.

Cyclosurus dentatus (Forskål) R.-C. Ching

EXS. — S. Miguel: Sete Cidades, E of the big lake (Sjn 65: U). Feteiras, 150 m. — Faial: Bottom of Caldeira (Sjn 68: U).

HAB. — Preference for altitude level ill-defined.

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866 . .					—		×	×	—
TRELEASE 1897 . .	×	×					×	×	
PALHINHA 1966 . .	×	×	×		×	×	×	×	
SJÖGREN 1971 . .	×	—		—	—		×		—

DISTRIB. — First cit. by SEUBERT (1844). Recently appeared in the Azorean vegetation and with rapidly extended distrib.

ASPLENIACEAE

Asplenium hemionitis L.

EXS. — S. Miguel: Sete Cidades (Sjn 65: U). Capelas (Oliv 53: COI). — Faial: Praia do Norte, 350 m (Go 63: LISFA).

VIDI — Faial: Caldeira, 500 m. E of Pedro Miguel. — Flores: Cliffs by road, 160m.

HAB. — Altitude limits not distinct. Probably preferentially above 400 m. — On wet, slightly exposed cliffs. Also observed on coarse basaltic gravel.

SOC. — In plant communities at high altitudes. Collected on Faial growing u. c. *Phyllitis scolopendrium, Lactuca watsoniana, Trichomanes speciosum, Equisetum telmateia, Frangula azorica.*

	SM	SMa	T	G	J	P	F	Fo	C
Drouet 1866. . .			×		—			×	—
Trelease 1897 . .	×		×			×	×	×	×
Palhinha 1966 . .	×		×		×	×	×	×	×
Sjögren 1971 . .	×	—		—	—		×	×	—

DISTRIB. — First cit by Seubert (1844). As this fern is easily recognized it can hardly have been overlooked on so many islands by Drouet. Probably recently extended distrib.

Asplenium marinum L.

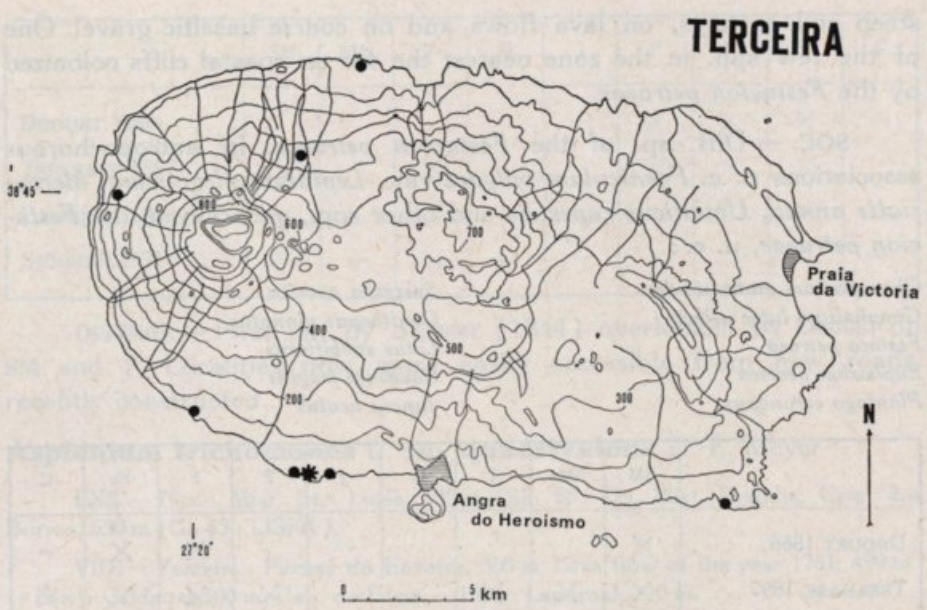
(Fig. 17 and 18)

EXS. — S. Miguel: Fenais da Luz, 150 m (Sjn 65: U). Capelas (Oliv. 53: COI). Relva (Car 1898: AZ). Caldeiras (Car 1897: AZ). Bretanha (Car 1899: AZ). — S. Maria: No loc. (Pa, So 37: LISU). — Terceira: S. Mateus, 10 m (Ds 64: LISE). — Pico: Mist. Cab. Fogo, 770 m (Sjn 65: U). S. Roque, 5 m (Ds 64: LISE). S. António, 10 m. St.ª Luzia, Cachorro, 10 m (Go 62: LISI, LISFA). — Faial: Varadouro, 5 m (Go 61: LISI). — Flores: Fábrica Baleia, 5 m (Go 63: LISI). — Corvo: Vila do Corvo (Ds 64: LISE). Vila, 20 m (Go 68: LISI). No loc. (Tr 1894: AZ).

VIDI — Localities on maps. — Flores: Rib. da Fazenda, 100 m. Porto S. Pedro.

HAB. — Restricted to coast. SM: Not above 300 m. T: Not above 350 m. F: Not above 50 m. P: Generally not above 50 m, locality at 770 m probably very occasional: Fo: Below 100 m. Azores generally below 100 m. — In dry, strongly exposed habitats, on cliffs, stone walls,

Fig. 17. - Asplenium marinum



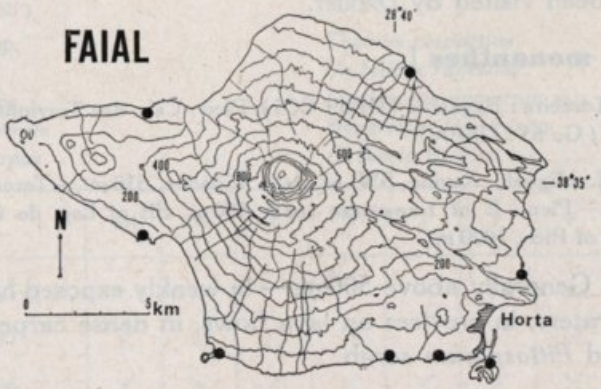


Fig. 18. - Asplenium marinum

steep soil cuttings, on lava flows and on coarse basaltic gravel. One of the few spp. in the zone nearest the sea on coastal cliffs colonized by the *Festucion petraeae*.

SOC. — Diff. sp. of the *Festucion petraeae*. In antropochorous associations u. c. *Foeniculum vulgare* var., *Lepidium virginicum*, *Mercurialis annua*, *Umbilicus rupestris* and other spp., generally in the *Festucion petraeae*, u. c.:

Chenopodium ambrosioides
Gnaphalium luteo-album
Festuca petraea
Euphorbia azorica
Plantago coronopus
Spergula azorica
Ornithopus pinnatus
Lotus subbiflorus
Gaudinia fragilis
Juncus acutus

	SM	SMa	T	G	J	P	F	Fo	C
Drouet 1866 . .	×				—		×	×	—
Trelease 1897 . .	×	×	×	×		×	×	×	×
Palhinha 1966 . .	×	×	×	×	×	×	×	×	×
Sjögren 1971 . .	×	—	×	—	—	×	×	×	—

DISTRIB. — First cit. by Seubert (1844). Probably overlooked by Drouet. The sp. was recorded by Trelease from four more of the islands which have been visited by Drouet.

Asplenium monanthes L.

EXS. — Terceira: Bagacina (Orm: COI). Pico: Cab. das Torrinhas (Sjn 68: U). Grotões, 900 m (Go 65: LISFA).

VIDI — S. Miguel: Ravine SW of Sete Cidades, 510 m. — Terceira: Mata do Estado, 350 m. — Pico: E of transverse road, 590 m. SE of Lag. do Caiado, ravine, 870 m. W slope of Pico, 1020 m.

HAB. — Generally above 500 m. — In weakly exposed habitats, e. g. in ravines, craters, in crevices on lava flows, in dense carpets of *Erica-Juniperus* and *Pittosporum* scrub.

SOC. — Generally in the *Juniperion brevifolii*, u. c.:

Cardamine caldeirarum
Hymenophyllum tunbridgense
Hypericum foliosum
Ranunculus cortusifolius
Woodwardia radicans
Ilex perado ssp.
Elaphoglossum paleaceum
Tolpis azorica

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866. . .					—	×	×	×	—
TRELEASE 1897 . .	×		×			×	×	×	
PALHINHA 1966 . .	×		×		×	×	×	×	
SJÖGREN 1971 . .	×	—	×	—	—	×			—

DISTRIB. — First cit. by SEUBERT (1844) overlooked by DROUET on SM and T. Localities now more easily accessible from new roads, recently constructed.

Asplenium trichomanes L. ssp. **quadrivalens** D. E. Meyer

EXS. — Pico: Mist. St.ª Luzia, 100 m (Sjn 68: U). Mist. Prainha, Cam. dos Burros, 650 m (Go 63: LISFA).

VIDI — Terceira: Furnas do Enxofre, 500 m. Lava flow of the year 1761, 490 m. — Faial: Caldeira, 500 m. Cab. do Fogo. — Pico: Landroal, 770 m.

HAB. — Weak preference for altitudes above 400 m. — In dry as well as wet habitats, variously exposed. On stone walls, lava flows, cliffs, on coarse basaltic gravel.

SOC. — Generally in the *Juniperion brevifolii* but also at low and high altitudes where this all. as its limits for complete development. Growing u. c.:

Hedera helix ssp.
Holcus rigidus
Calluna vulgaris
Polypodium australe
Rumex angiocarpus
Thymus cespititius
Umbilicus rupestris
Lysimachia nemorum ssp.
Hypericum humifusum
Daboecia azorica

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866 . .		×			—	×	×	×	—
TRELEASE 1897 . .	×	×	×	×		×	×	×	×
PALHINHA 1966	×	×	×	×	×	×	×	×	×
SJÖGREN 1971 . .		—	×	—	—	×	×		—

DISTRIB. — First cit. by SEUBERT (1844). No recent extension of distrib.

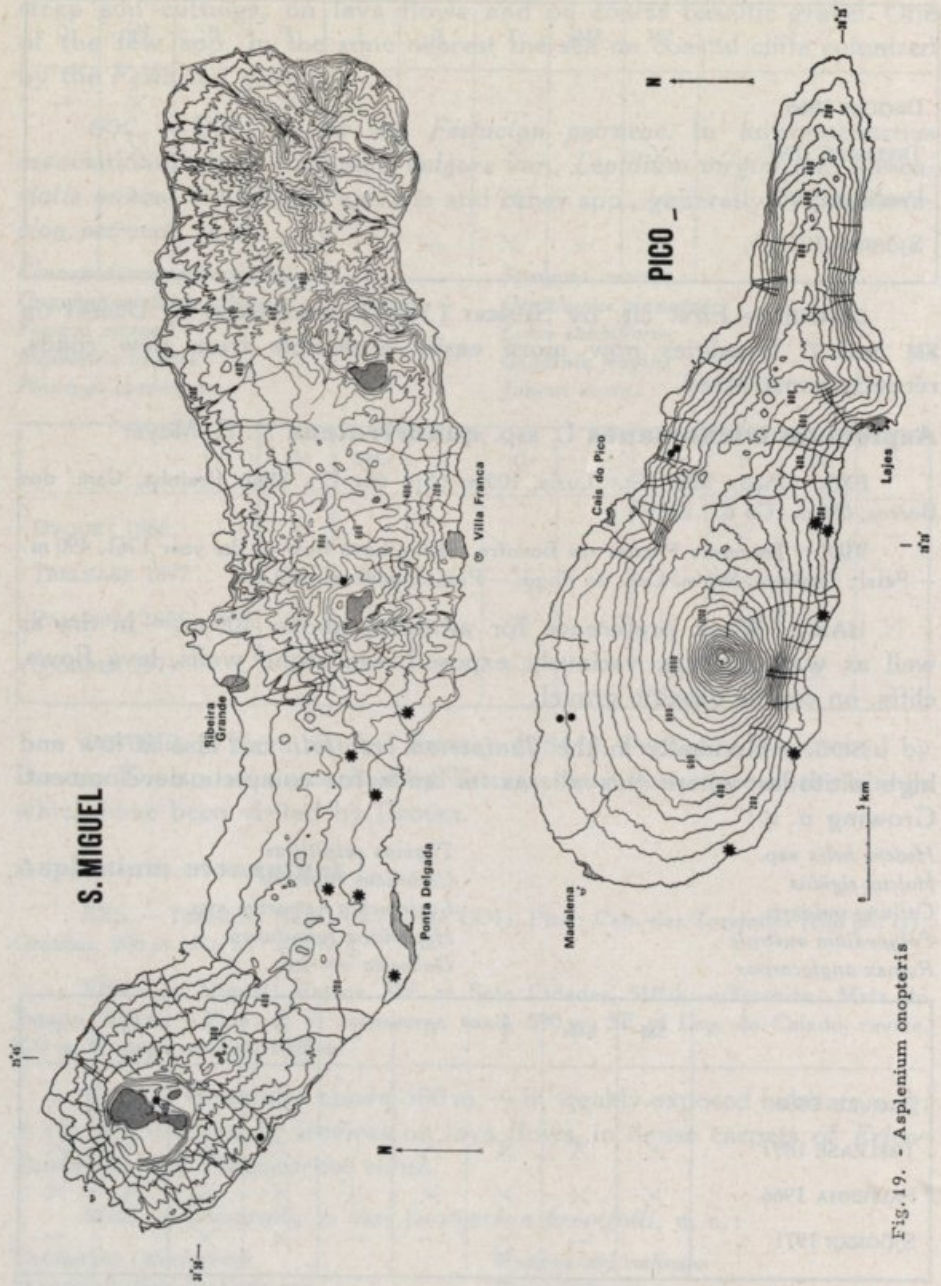
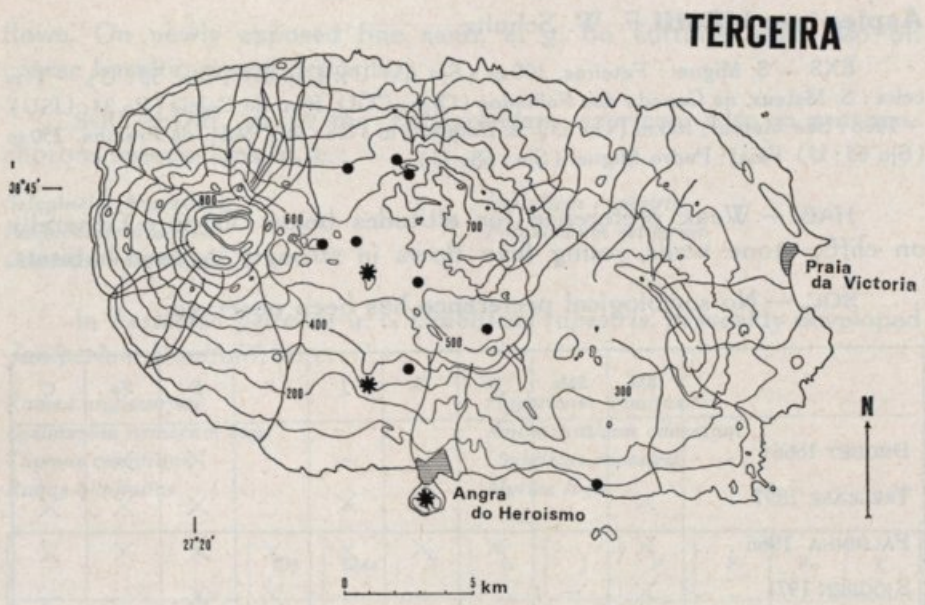


Fig. 19. - Asplenium onopteris



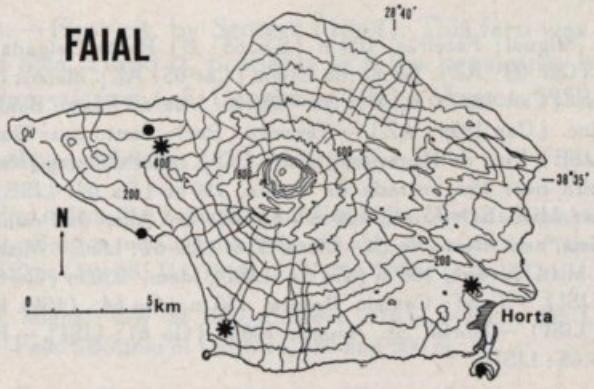


Fig. 20. - Asplenium onopteris

Asplenium billotii F. W. Schultz

EXS. — S. Miguel: Feteiras, 100 m (Sjn 65: U). Capelas (Oliv 53: U). — Terceira: S. Mateus, na Canada dos Folhados (Orm: COI). Pico do Celcio (Po 34: LISU). — Pico: São Mateus, 100 m (Go 63). S. Roque, 3 m (Go: 68). Mist. da Prainha, 250 m (Sjn 65: U). Faial: Pedro Miguel (Sjn: 68: U).

HAB. — Weak preference for altitudes below 300 m. — Generally on cliffs, stone walls, young lava flows in strongly exposed habitats.

SOC. — No sociological preference has been observed.

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866. . .					–		×	×	–
TRELEASE 1897 . .	×			×	×		×	×	×
PALHINHA 1966 . .	×		×	×	×	×	×	×	×
SJÖGREN 1971 . .	×	–		–	–	×	×		–

DISTRIB. — First cit. by WATSON (1844). Probably overlooked by him on some islands. In WATSON (1870) reported also from SM.

Asplenium onopteris L.

(Fig. 19 and 20)

EXS. — S. Miguel: Feteiras, 100 m (Sjn 65: U). Ponta Delgada, 50 m (Go 68: LISI). Cabouco (Car 03: AZ). Termo da Lagoa (Car 05: AZ). Malaca (Car 05: AZ). Senhora da Rosa (Car 1897: AZ). — St.ª Maria: Vila do Porto, Baldio, 400 m (Go 68: LISI). No loc. (Car 1899: AZ). — Terceira: Porto Santo near Quinta do Freixo, 300 m (Ds 64: LISE). Pico da Bagacina (Orm: COI). Monte Brasil (Pa 34: LISU). — Graciosa: Caldeira near the entrada da Furna, 150 m (Ds 64: LISE) No loc. (Car 03: AZ). — Pico: Mist. St.ª Luzia, 100 m (Sjn 68: U). Mist. da Prainha, 370 m (Sjn 68: U). Candelária, near Porto de St.ª Clara, 30 m (Ds 64: LISE). Mist. S. João, 80 m (Ds 64: LISE). Mist. Silveira, 100 m (Go 62: LISI). Idem, 250 m (Go 67). S. Mateus, 50 m (Go 63: LISI). — Faial: Castelo Branco, 150 m (Go 64: LISI). Praia do Norte, 300 m (Go 63: LISI). — Horta, St. Amaro, 100 m (Go 61: LISI). — Flores: Rib. da Cruz, 150 m (Go 65: LISI).

VIDI — Localities on maps.

HAB. — SM: Rarely above 200 m, occasionally at 600 m. T: Not above 600 m. F: Generally below 300 m. P: Generally below 350 m. — Highest frequency in strongly exposed habitats, on cliffs, stone walls, lava

flows. On newly exposed fine sand, e. g. on cuttings and also on coarse basaltic gravel deposits.

SOC. — Diff. sp. of the *Euphorbietum azoricae*. Also in antropochorous associations, u. c.:

Selaginella kraussiana
Polypodium australe
Geranium robertianum
Umbilicus rupestris
Polystichum setiferum

In *Festucion petraeae* u. c. *Umbilicus rupestris*. In weakly developed *Juniperion brevifolii*, u. c.:

Rumex angiocarpus
Lysimachia nemorum ssp.
Thymus cespititius
Rubus ulmifolius
Hypericum humifusum
Anthoxanthum odoratum
Umbilicus rupestris
Myrica faya

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866. . .	×				—	×	×	×	—
TRELEASE 1897 . .	×	×	×	×	×	×	×	×	×
PALHINHA 1966 . .	×	×	×	×	×	×	×	×	×
SJÖGREN 1971 . .	×	—	×	—	—	×	×		—

DISTRIB. — First cit. by SEUBERT (1844). This fern was not recorded by DROUET on SMa, T and G, probably as it has previously been mistaken for *A. adiantum-nigrum* (cf. DANSEREAU 1961; MORTON 1959).

Phyllitis scolopendrium (L.) Newman

EXS. — Pico: Mist. St.a Luzia, 550 m (Go: HO). Mist. da Prainha, 600 m (Go 61: LISFA). — Faial: Bottom of Caldeira (Sjn 65: U). By road in *Pittosporum* scrub N slope of Faial, 450 m (Sjn 68: U). Praia do Norte, 300 m (Go: HO).

VIDI — S. Miguel: SW of Sete Cidades, 510 m. — Pico: SE Lag. do Caiado, ravine, 870 m. — Faial: Bottom of Caldeira, 580 and 500 m.

HAB. — Generally above 400 m. — Generally in wet shady habitats, most frequently in ravines and deep narrow craters. Also observed in dense shade in *Pittosporum* scrub.

SOC. — Diff. sp. of the *Festucetum jubatae*, rarely in the *Erico-Myrsinetum*, generally u. c.:

Ranunculus cortusifolius
Sanicula azorica
Centaurium scilloides
Lactuca watsoniana
Trichomanes speciosum
Picris filii
Tolpis azorica
Cardamine caldeirarum
Holcus rigidus
Deschampsia foliosa
Myrsine africana var.
Woodwardia radicans
Hypericum foliosum

	SM	SMa	T	G	J	P	F	Fo	C
Drouet 1866. . .					—		×	×	—
Trelease 1897 . .	×	×	×				×	×	
Palhinha 1966 . .	×	×	×		×	×	×	×	
Sjögren 1971 . .	×	—		—	—	×	×		×

DISTRIB. — First cit. by Seubert (1844). There might have been a recent extension of the distrib. as this large peculiar fern is not easily overlooked.

ATHYRIACEAE

Athyrium filix-femina (L.) Roth

EXS. — S. Miguel: Sete Cidades, bottom (Sjn 65: U). — Faial: N of Caldeira, 650 m (Sjn 65: U).

VIDI — Faial: By levada, N of Caldeira, 650 m.

HAB. — Lower altitude limit not distinct. Preferentially above 500 m. — In wet, rather weakly exposed habitats, e. g. in the *Juniperion brevifolii*, in ravines and craters.

SOC. — In the *Erico-Myrsinetum* and *Festucetum jubatae*, u. c.:

Cardamine caldeirarum
Myrsine africana var.
Phyllitis scolopendrium
Viburnum tinus ssp.
Sanicula azorica
Carex peregrina
Rubia peregrina
Deschampsia foliosa

	SM	SMa	T	G	J	P	F	Fo	G
DROUET 1866. . .	×	×	×		—	×		×	—
TRELEASE 1897 . .	×	×	×			×	×	×	×
PALHINHA 1966 . .	×	×	×		×	×	×	×	×
SJÖGREN 1971 . .	×	—	×	—	—	×	×		—

DISTRIB. — First cit. by WATSON (1844). This fern was probably also present in the Azorean vegetation before 1866.

Diplazium caudatum (Cav.) Jermy

EXS. — S. Miguel: Feteiras, 150 m (Sjn 65: U). Sete Cidades, Lag. do Congro, 440 m (Sjn 65: U). — Terceira: Bottom Cald. St.ª Bárbara (Sjn 68: U). — Pico: Furna Frei Matias, 900 m (Sjn 65: U). Miradouro do Cais, 180 m (Sjn 65: U). S. Roque, Chão Verde, 630 m (Go 65: LISI, LISFA). Mist. da Prainha, Mesas, 600 m (Go 61: LISI) — Faial: Horta, Cedros, 400 m (Go 68: LISI). Fazenda das Lajes (Go 61: LISFA). — Flores: Rib. da Cruz, 150 m (Go 65: LISI). Rocha dos Bordões, 250 m (Go 63: LISI).

VIDI — S. Miguel: Lag. do Congro, 440 m. — Faial: N slope of Cald., 450 m.

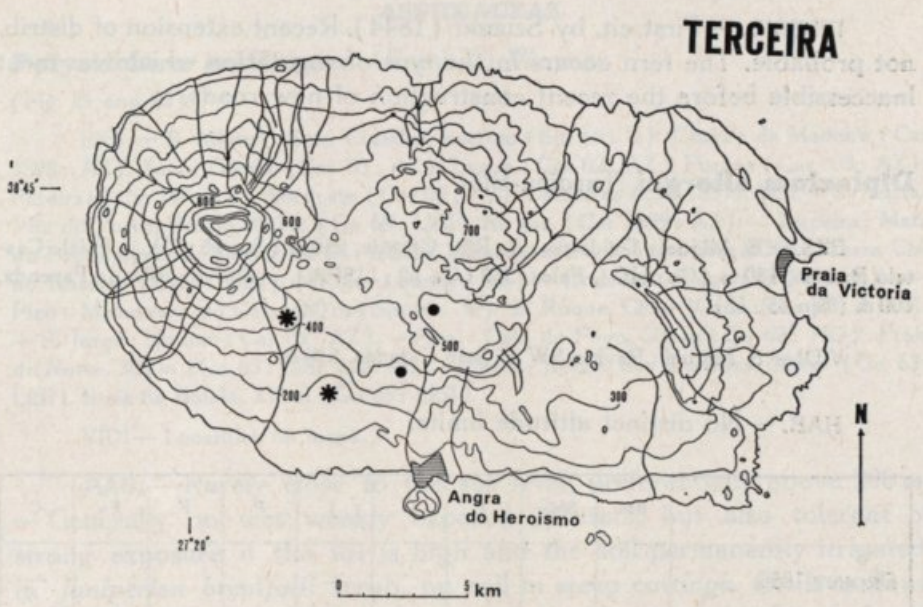
HAB. — Prefers altitudes above 400 m. On Flores, also in localities below 300 m. — In wet shady habitats, e. g. in narrow deep ravines and craters. Also observed under dense carpet of *Pittosporum*.

SOC. — Rarely in the *Erico-Myrsinetum*. Diff. sp. of the *Festucetum jubatae*, generally u. c.:

Cardamine caldeirarum
Trichomanes speciosum
Luzula purpureo-splendens
Tolpis azorica
Culcita macrocarpa
Hypericum foliosum
Ilex perado ssp.
Woodwardia radicans
Festuca jubata

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866. . .					—	×		×	—
TRELEASE 1897 . .	×	×				×		×	
PALHINHA 1966 . .	×	×				×		×	
SJÖGREN 1971 . .	×	—	×	—	—	×	×		—

Fig. 21. - Polystichum setiferum



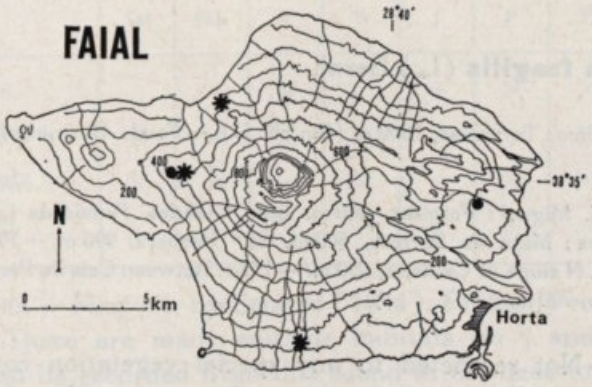


Fig. 22. - Polystichum setiferum

DISTRIB. — First cit. by SEUBERT (1844). Recent extension of distrib. not probable. The fern occurs in the type of vegetation which was most inaccessible before the recent construction of new roads.

Diplazium allorgei Tardieu-Blot

EXS. — S. Miguel: Caldeiras, S. Rib. Grande, 250 m (Sjn 65: U). — Faial: Castelo Branco, 150 m (Go: HO). Falca, 350 (Go 62: LISFA). — Flores: Rib. da Fazenda, 100 m (Sjn 65: U).

VIDI — S. Miguel: Ravine SW of Sete Cidades, 510 m.

HAB. — No distinct altitude limits.

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866. . .					—				—
TRELEASE 1897 . .									
PALHINHA 1966 . .	×								
SJÖGREN 1971 . .	×	—		—	—		×	×	—

DISTRIB. — Recently described (TARDIEU-BLOT 1938).

Cystopteris fragilis (L.) Bernh.

EXS. — Pico: Torrinhas, 1000 m (Sjn 68: U). — Faial: Bottom of Caldeira. (Sjn 68: U).

VIDI — S. Miguel: Feteiras, 200 m. Sete Cidades. Fenais da Luz, close to the coast. — Terceira: Mata da Serreta, 500 m. St.ª Bárbara, 990 m. — Faial: Bottom of Caldeira, 450 m. N slope of Caldeira, 650 m. — Pico: Between Cais do Pico and S. Roque. Cab. do Silvado, 700 m.

HAB. — Not restricted to any special vegetation zone. On lava streams, stone walls, solitary boulders. Strong drought tolerance.

SOC. — No differential value.

DISTRIB. — First cit. by SEUBERT (1844). Mentioned by PALHINHA (1966) from all islands except SMa and G.

ASPIDIACEAE

Polystichum setiferum (Forskål) Woynar

(Fig. 21 and 22)

EXS. — S. Miguel: Sete Cidades, bottom (Sjn 65: U). Charco da Madeira (Car 1898: AZ). Serra Gorda (Car 03: AZ). Lagoa (Car 02: AZ). Furnas (Car 03: AZ). Feteiras (Car 03: AZ). Nordeste (Car 05: AZ). Caldeiras (Car 1897: AZ). — S. Maria: Vila do Porto, Baldio, 400 m (Go 68: LISI). No loc. (Car 1899: AZ). — Terceira: Mata do Posto Agrário, 200 m (Ds 64: LISE). Escampadoiro, 315 m (Orm: COI). Terra Chã no Rosário (Orm: COI). No loc. (Samp: AZ). — Graciosa: Folga (Tr 1894: AZ). — Pico: Miradouro do Cais, 180 m (Sjn 65: U). S. Roque, Chão Verde (Go 68: LISI). — S. Jorge: No loc. (Car 03: AZ). — Faial: Cab. do Fogo, 500 m (Go 62: HO). Praia do Norte, 300 m (Go 63: LISI, LISFA). — Flores: Rocha dos Bordões, 300 m (Go 63: LISI). Boca da Baleia, 350 m (Go 65: LISI).

VIDI — Localities on maps.

HAB. — Rarely close to the sea level, preferentially above 200 m. — Generally on wet weakly exposed habitats, but also tolerant of strong exposure if the RH is high and the soil permanently irrigated. In *Juniperion brevifolii* scrub, on soil in steep cuttings. On lava flows and cliffs. Also in *Pittosporum* scrub and various kinds of forest plantations.

SOC. — Rarely collected in antropochorous associations. More frequently in the *Juniperion brevifolii* but not associated with any special group of spp. within the all. Weak diff. sp. of this all.

	SM	SMa	T	G	J	P	F	Fo	C
Drouet 1866. . .			×		—	×	×	×	—
Trelease 1897 . .	×	×	×	×			×	×	
Palhinha 1966 . .	×	×	×	×		×	×	×	
Sjögren 1971 . .	×	—	×	—	—	×	×	×	—

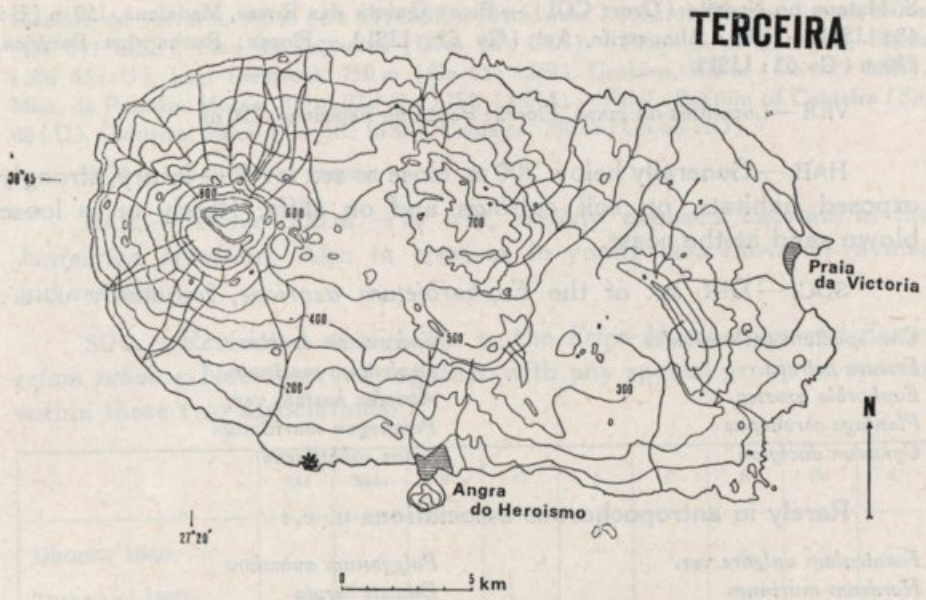
DISTRIB. — First cit. by Seubert (1844). Probably recent extension of distrib. There are many suitable habitats on J and the fern will certainly also be recorded from this island in the near future.

Polystichum falcatum (L. fil.) Diels

(Fig. 23 and 24).

EXS. — S. Miguel: Fenais da Luz (Sjn 65: U). Ponta Delgada, 5 m (Go 68: LISI). Capelas (Oliv 53: COI). Termo da Lagoa, cultivada (Car 02: AZ). — Terceira:

Fig. 23. - Polystichum falcatum



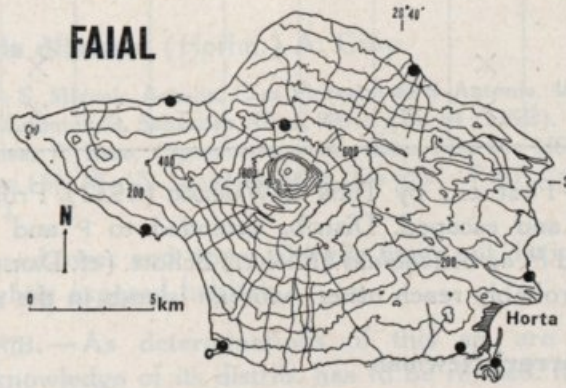


Fig. 24. - Polystichum falcatum

S. Mateus no Negrito (Orm: COI). — Pico: Quinta das Rosas, Madalena, 150 m (Go 63: LISI). — Faial: Almoxarife, 5 m (Go 62: LISI). — Flores: Rocha dos Bordões, 250 m (Go 63: LISI).

VIDI — Localities on maps. Flores: Ponta da Fajãzinha, 120 m.

HAB. — Generally below 200 m, close to sea level. — In dry, strongly exposed habitats, on soil cuttings and on cliffs. Rarely on a loose blown sand at the coast.

SOC. — Diff. sp. of the *Euphorbietum azoricae*, frequently u. c.:

Chenopodium ambrosioides
Festuca petraea
Euphorbia azorica
Plantago coronopus
Cynodon dactylon
Spergularia azorica
Asplenium marinum
Atriplex hastata var.
Polypogon maritimum
Lotus subbiflorus

Rarely in antropochorous associations u. c.:

Foeniculum vulgare var.
Hordeum murinum
Solanum nigrum
Euphorbia peplus
Polygonum aviculare
Daucus carota
Parietaria officinalis
Hyoscyamus albus

	SM	SMa	T	G	J	P	F	Fo	C
Drouet 1866. . .					—				—
Trelease 1897 . .									
Palhinha 1966 . .	×						×		
Sjögren 1971 . .	×	—		—	—	×	×	×	—

DISTRIB. — First cit. by Tutin & Warburg (1932). Probably introduced recently and escaped. Distrib. extended to P and Fo. Earlier mistakenly called *P. acrostichoides* (Michx.) Schott. (cf. Dansereau 1961). This fern will probably reach other Azorean islands in the near future.

Dryopteris borreri Newman

(Fig. 25 and 26)

EXS. — S. Miguel: Mata das Furnas, 600 m (Rego 25: LISI). Serra da Tronqueira, 600 m (Cy 58: LISI). Sete Cidades (Car 03: AZ). Termo da Lagoa, Junqueiras (Car 04: AZ). Furnas (Car 05: AZ). Lag. do Congro (Car 09: AZ). Tronqueira (Car 05: AZ). Grota do Lanço (Car 05: AZ). — Terceira: Mist. do 1761 (Sjn 68: U).

Biscoito da Ferraria, 580 m (Ds 64 : LISE). Idem, near Rocha da Chama, Juncal, 650 m (Ds 64 : LISE). Pico da Bagacina (Orm 66 : COI). — Pico : E of Landroal, 800 m (Sjn 65 : U). Lag. Landroal, 750 m (Go 65 : LISI). Grotões, 900 m (Go 65 : LISI). Mist. da Prainha, Mesas, 700 m (Go 61 : LISI, LISFA).— Faial : Bottom of Caldeira (Sjn 68 : U). Caldeira, 500 m (Go 68 : LISI). Caldeira, 750 m (Go 68 HO).

VIDI — Localities on maps.

HAB. — Above 500 m. — In wet, weakly exposed habitats in the *Juniperion brevifolii*. Also in crevices in young lava flows, in ravines and craters.

SOC. — Restricted as diff. sp. to the *Erico-Myrsinetum* and *Festucetum jubatae*. Not observed together with any special group of species within these two associations.

	SM	SMa	T	G	J	P	F	Fo	C
Drouet 1866. . .					—		×	×	—
Trelease 1897 . .	×						×	×	
Palhinha 1966 . .	×		×		×	×	×	×	
Sjögren 1971 . .		—	×	—	—	×	×		—

DISTRIB. — First cit. by Seubert (1844). Probably overlooked by Drouet on SM and P. Nomenclature treated by Holub (1967).

Dryopteris dilatata (Hoffm.) A. Gray

EXS. — S. Miguel: Achada, Casa Florestal de S. António, 480 m (DS 64: LISE). Planalto dos Graminhais, Sebastião Alves, 900 m (Ds 64 : LISE). — Terceira : Biscoito da Ferraria near P. Raso, *Cryptomeria* wood, 600 m (Ds 64 : LISE). — Pico : Lag. do Capitão, 770 m (Sjn 68 : U). Landroal, 700 m (Go 65). — Faial : Caldeira, bottom, 500 m (Go 64 : HO).

HAB. — Lower and upper altitude limits not distinct. Preferentially in wet, slightly exposed habitats.

DISTRIB. — As determinations of this sp. are wrong in many herbaria, knowledge of its distrib. has to be revised. It has been shown that *D. dilatata* is very rare compared with *D. azorica* and *D. aemula*.

Dryopteris azorica (Christ) Alston

EXS. — Terceira : Bottom of St.ª Bárbara (Sjn 68 : U). S border of St.ª Bárbara, 900 m (Sjn 65 : U). Near Pico Agudo, 650 m (Sjn 68 : U). — Pico : S of Cais do Pico,

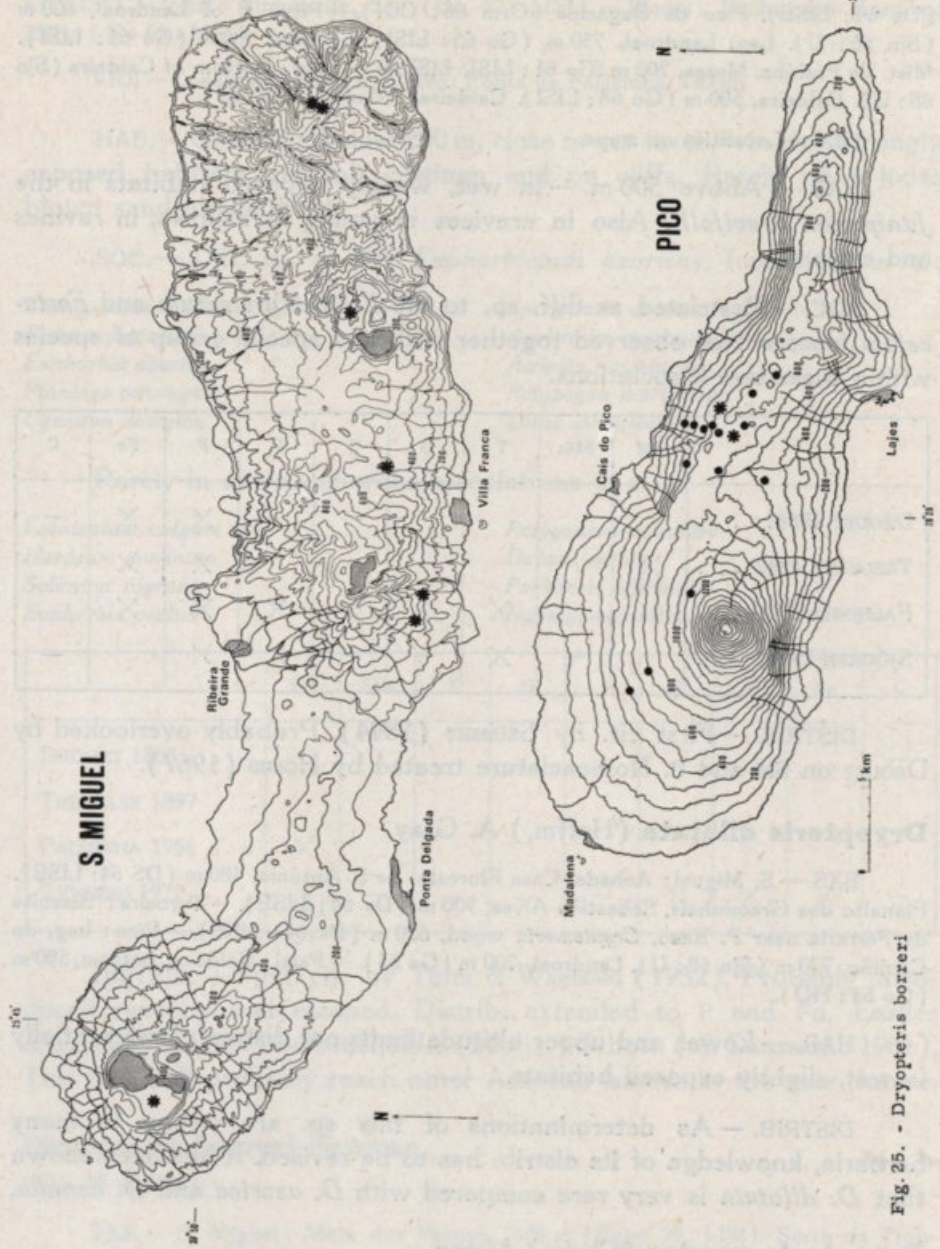


Fig. 25. - Dryopteris borreri

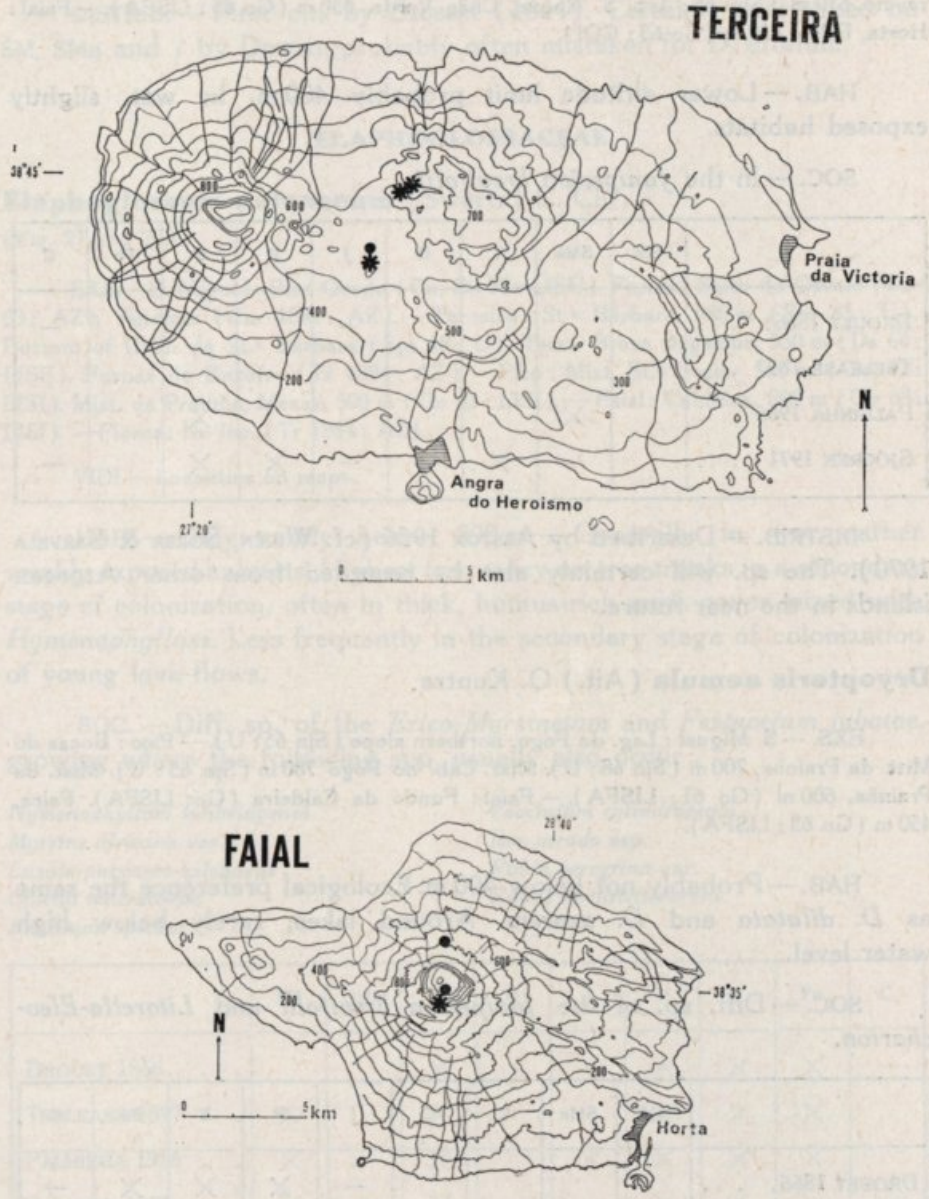


Fig. 26. - Dryopteris borreri

ravine, 670 m (Sjn 65: U). S. Roque, Chão Verde, 630 m (Go 65: LISFA). — Faial: Horta, Falca, 450 m (Go 63: COI).

HAB. — Lower altitude limit probably 400 m. In wet, slightly exposed habitats.

SOC. — In the *Juniperion brevifolii.*

	SM	SMa	T	G	J	P	F	Fo	C
Drouet 1866. . .					—				—
Trelease 1897 . .									
Palhinha 1966 . .		×					×		
Sjögren 1971 . .		—	×	—	—	×	×		—

DISTRIB. — Described by Alston 1956 (cf. Widén, Sorsa & Sarvela 1970). The sp. will certainly also be recorded from other Azorean islands in the near future.

Dryopteris aemula (Ait.) O. Kuntze

EXS. — S. Miguel: Lag. do Fogo, northern slope (Sjn 65: U). — Pico: Bocas do Mist. da Prainha, 700 m (Sjn 68: U). Mist. Cab. do Fogo 780 m (Sjn 65: U). Mist. da Prainha, 600 m (Go 61: LISFA). — Faial: Fundo da Caldeira (Go: LISFA). Falca, 450 m (Go 63: LISFA).

HAB. — Probably not below 400 m. Ecological preference the same as *D. dilatata* and *D. azorica.* Around lakes, rarely below high water level.

SOC. — Diff. sp. of the *Juniperion brevifolii* and *Litorello-Eleocharion.*

	SM	SMa	T	G	J	P	F	Fo	C
Drouet 1866. . .					—	×	×	×	—
Trelease 1897 . .	×	×	×			×	×	×	×
Palhinha 1966 . .	×	×	×		×	×	×	×	×
Sjögren 1971 . .	×	—	×	—	—	×	×		—

DISTRIB. — First cit. by SEUBERT (1844). Certainly overlooked on SM, SMa and T by DROUET, probably often mistaken for *D. dilatata*.

ELAPHOGLOSSACEAE

Elaphoglossum paleaceum (Swartz) C. Chr.

(Fig. 27 and 28)

EXS. — S. Miguel: Pico Gordo (Cu, So 38: LISU). Furnas, Salto do Cavalo (Car 03: AZ). Feteiras (Car 1891: AZ). — Terceira: St.ª Bárbara, 980 m (Sjn 65: U). Bottom of Cald. de St.ª Bárbara (Sjn 68: U). Terra Brava Bagacina, 550 m (Ds 64: LISE). Furnas do Enxofre (Tr 1894: AZ). — Pico: Mist. St.ª Luzia, 550 m (Go 62: LISI). Mist. da Prainha, Mesas, 500 m (Go 61: LISI). — Faial: Caldeira, 800 m (Go 68: LISI). — Flores: No loc. (Tr 1894: AZ).

VIDI — Localities on maps.

HAB. — Only rarely below 500 m. — Generally in wet, rather weakly exposed habitats. Highest frequency on tree trunks in a secondary stage cf colonization, often in thick, humus-rich moss cover mixed with *Hymenophyllum*. Less frequently in the secondary stage of colonization of young lava flows.

SOC. — Diff. sp. of the *Erico-Myrsinetum* and *Festucetum jubatae*, growing where the following spp. usually also occur:

Hymenophyllum tunbridgense
Myrsine africana var.
Luzula purpureo-splendens
Culcita macrocarpa
Blechnum spicant
Vaccinium cylindraceum
Ilex perado ssp.
Rubia peregrina var.
Rubus hochstetterorum

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866. . .			×		—	×	×	×	—
TRELEASE 1897 . .	×		×			×	×	×	
PALHINHA 1966 . .	×		×		×	×	×	×	
SJÖGREN 1971 . .	×	—	×	—	—	×	×		—

DISTRIB. — First cit. by SEUBERT (1844). The absence of this diff. sp. from SMa, G and C is typical, as these islands have comparatively small areas of well-developed *Juniperion brevifolii*.

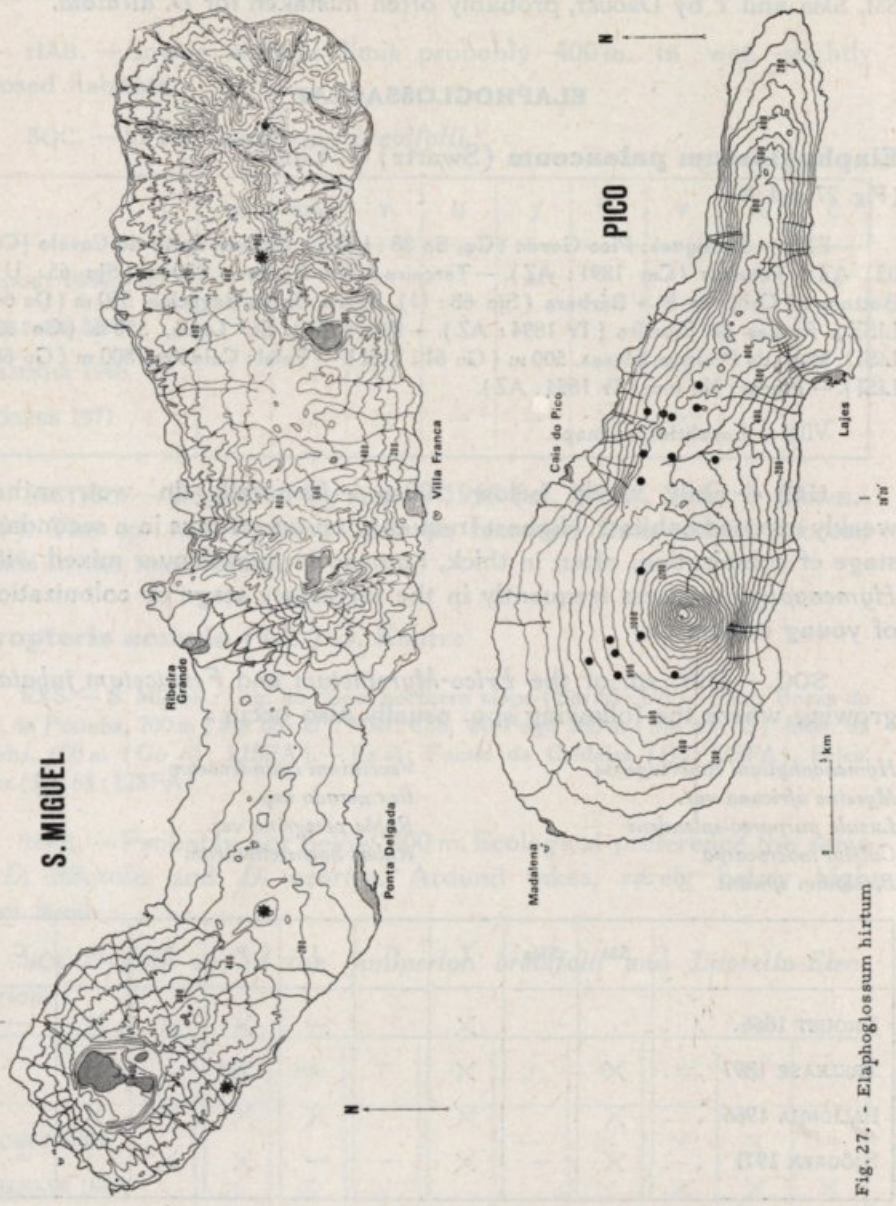


Fig. 27. - Elaphoglossum hirtum

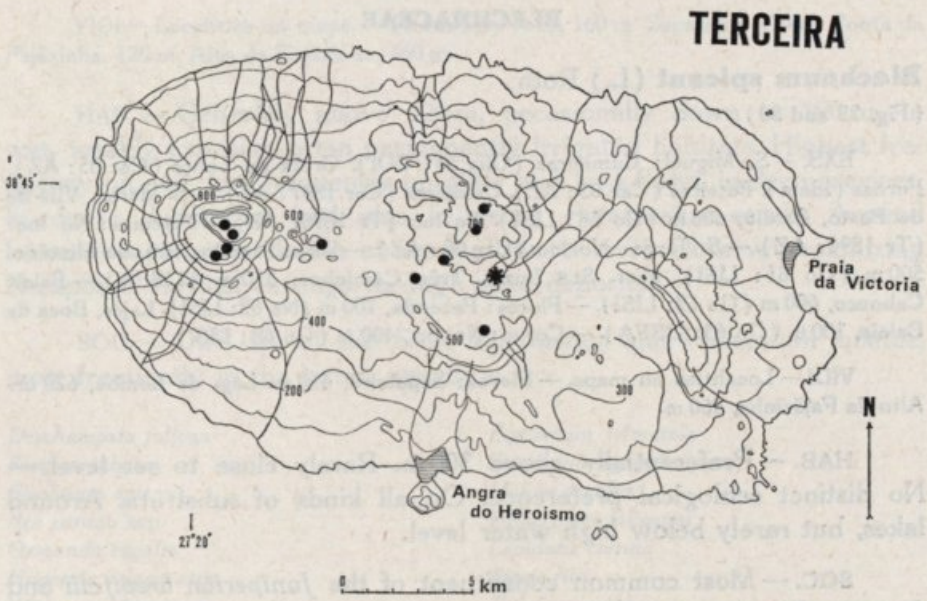


Fig. 28. - Elaphoglossum hirtum

BLECHNACEAE

Blechnum spicant (L.) Roth

(Fig. 29 and 30)

EXS. — S. Miguel: Cumieiras (Oliv 53: COI). Grota do Lanço (Car 05: AZ). Furnas (idem). Feteiras (Car 03: AZ). Caldeiras (Car 1897: AZ). — S. Maria: Vila do do Porto, Baldio, 400 m (Go 68: LISI). No loc. (Tr 1896: AZ). — Terceira: No loc. (Tr 1894: AZ). — S. Jorge: No loc. (Car 08: AZ). — Pico: Prainha, Rib. do Mistério, 500 m (Go 61: LISI). Mist. St.ª Luzia, Três Caminhos, 550 m (LISFA). — Faial: Cabouco, 600 m (Go 62: LISI). — Flores: Fazenda, 100 m (Ne 63: LISI). Lajes, Boca da Baleia, 100 m (Go 63: LISFA). — Corvo: No loc., 400 m (Go 68: LISI).

VIDI — Localities on maps. — Flores: Sapateira, 410 m. Lag. da Lomba, 620 m. Alto da Fajãzinha, 460 m.

HAB. — Preferentially above 300 m. Rarely close to sea level. — No distinct ecological preference. On all kinds of substrata. Around lakes, but rarely below high water level.

SOC. — Most common constituent of the *Juniperion brevifolii* and *Litorello-Eleocharion*.

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866. . .	×		×		—	×	×	×	—
TRELEASE 1897 . .	×	×	×			×	×	×	×
PALHINHA 1966 . .	×	×	×	×	×	×	×	×	×
SJÖGREN 1971 . .	×	—	×	—	—	×	×	×	×

DISTRIB. — First cit. by SEUBERT (1844). Mentioned by DROUET under the synonymous names *B. boreale* and *B. spicant*, the first one recorded from SM, F, Fo, P «et la plupart des autres iles».

Woodwardia radicans (L.) Sm.

(Fig. 31 and 32)

EXS. — S. Miguel: Achada das Furnas, Cerrado da Grade (Carn 52: LISI). Capelas (Oliv 53: COI). Furnas (Car 05: AZ). — St.ª Maria: No loc. (Tr 1896: AZ). — Pico: Ravine S of Cais do Pico, 670 m (Sjn 65: U). Mist. Prainha, Mesas, 600 m (Go 61: LISI). — Terceira: No loc. (Tr 1894: AZ). — S. Jorge: No loc. (Car 08: AZ). — Faial: Viveiro de St.° Amaro, 120 m (Go 61: LISI). Cab. do Fogo, Capelo, 500 m (Go 62: LISFA). — Flores: Rocha dos Bordões, 250 m (Go 63: LISI). No loc. (Tr 1894: AZ). — Corvo: Caldeirão, 500 m (Go 68: LISI).

VIDI — Localities on maps. — Flores: By road, 160 m. Sapateira, 410 m. Ponta da Fajãzinha, 120 m. Alto da Fajãzinha, 460 m.

HAB. — Generally above 400 m, occasionally down to 100 m. In wet, weakly exposed, often permanently irrigated habitats. Highest frequency on soil, less frequently on cliffs and lava flows, in deep crevices. In dense *Juniperion* and also in dense *Pittosporum* scrub. Around lakes, always on the banks above high water level. Observed colonizing N-exposed vertical cuttings through sand deposits.

SOC. — Diff. sp. of the *Erico-Myrsinetum* and *Festucetum jubatae*, most frequently in the latter, usually u. c.:

Deschampsia foliosa
Festuca jubata
Blechnum spicant
Ilex perado ssp.
Osmunda regalis
Huperzia selago ssp.
Viburnum tinus ssp.
Luzula purpureo-splendens
Trichomanes speciosum
Equisetum telmateia
Vaccinium cylindraceum
Holcus rigidus
Hypericum foliosum
Lepidotis cernua
Picris filii
Tolpis azorica
Phyllitis scolopendrium

	SM	SMa	T	G	J	P	F	Fo	C
Drouet 1866. . .					—	×	×	×	—
Trelease 1897 . .	×	×	×			×	×	×	
Palhinha 1966 . .	×	×	×			×	×	×	
Sjögren 1971 . .	×	—	×	—	—	×	×	×	—

DISTRIB. — First cit. by Seubert (1844). Certainly overlooked by Drouet on SM, SMa and T. Localities now more easily accessible from new road. Locatities on J will probably be found in the near future.

Polypodium australe Fée

EXS. — Faial: Caldeira, 800 m (Sjn 65: U).

VIDI — Terceira: Pico dos Negros, 530 m. Lava flow of 1761 on coarse gravel deposits, 450 m. Mata do Estado, 350 m. — Pico: Mist. da Prainha, 300 m. N of Cab. Redondo, 300 m. — Faial: S slope of Caldeira, 500 and 850 m. Cab. Fogo, 500 m. — Flores: On cliff by road, 160 m.

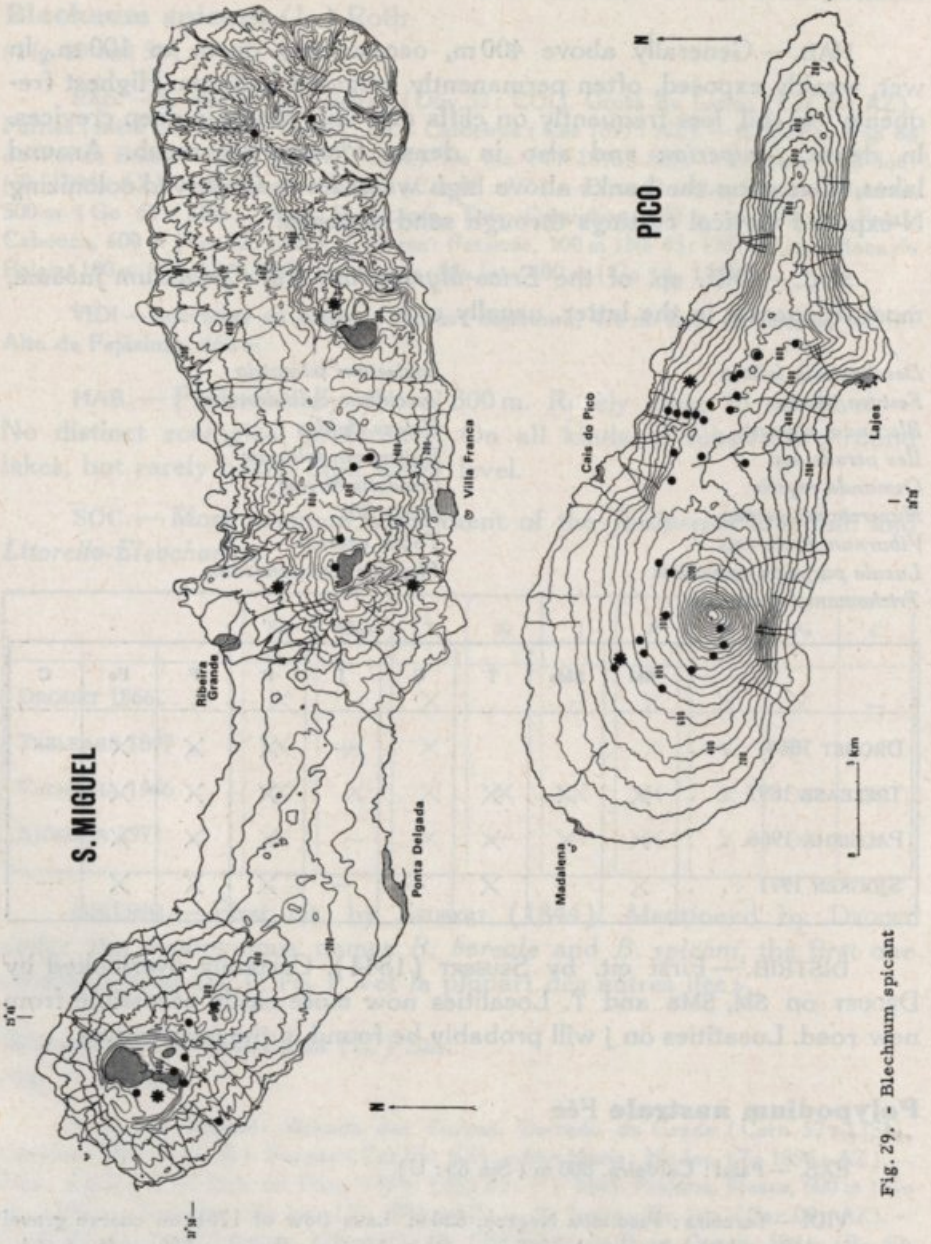
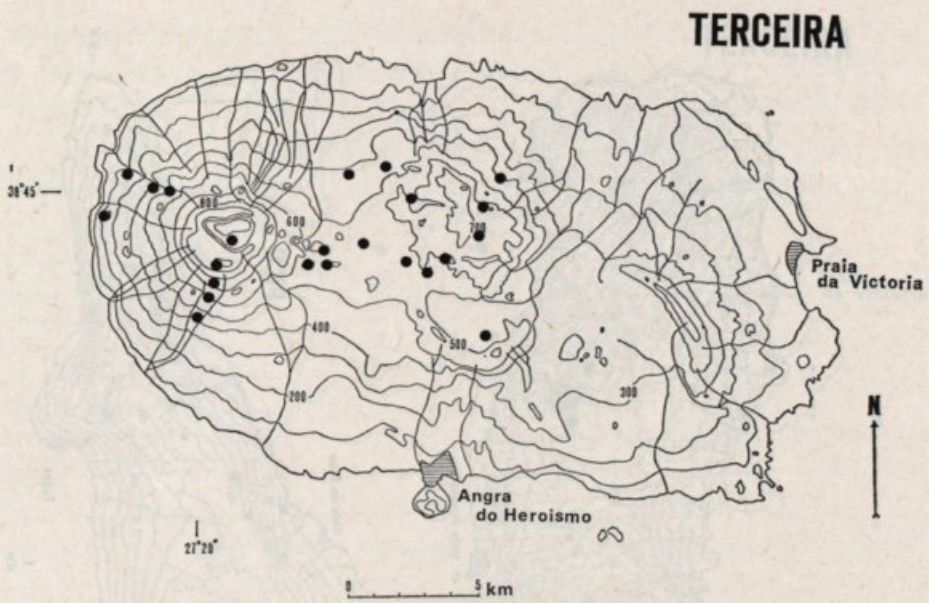


Fig. 29. - Blechnum spicant



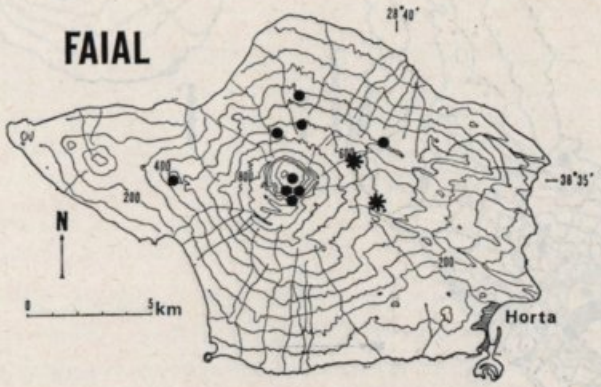


Fig. 30. - Blechnum spicant

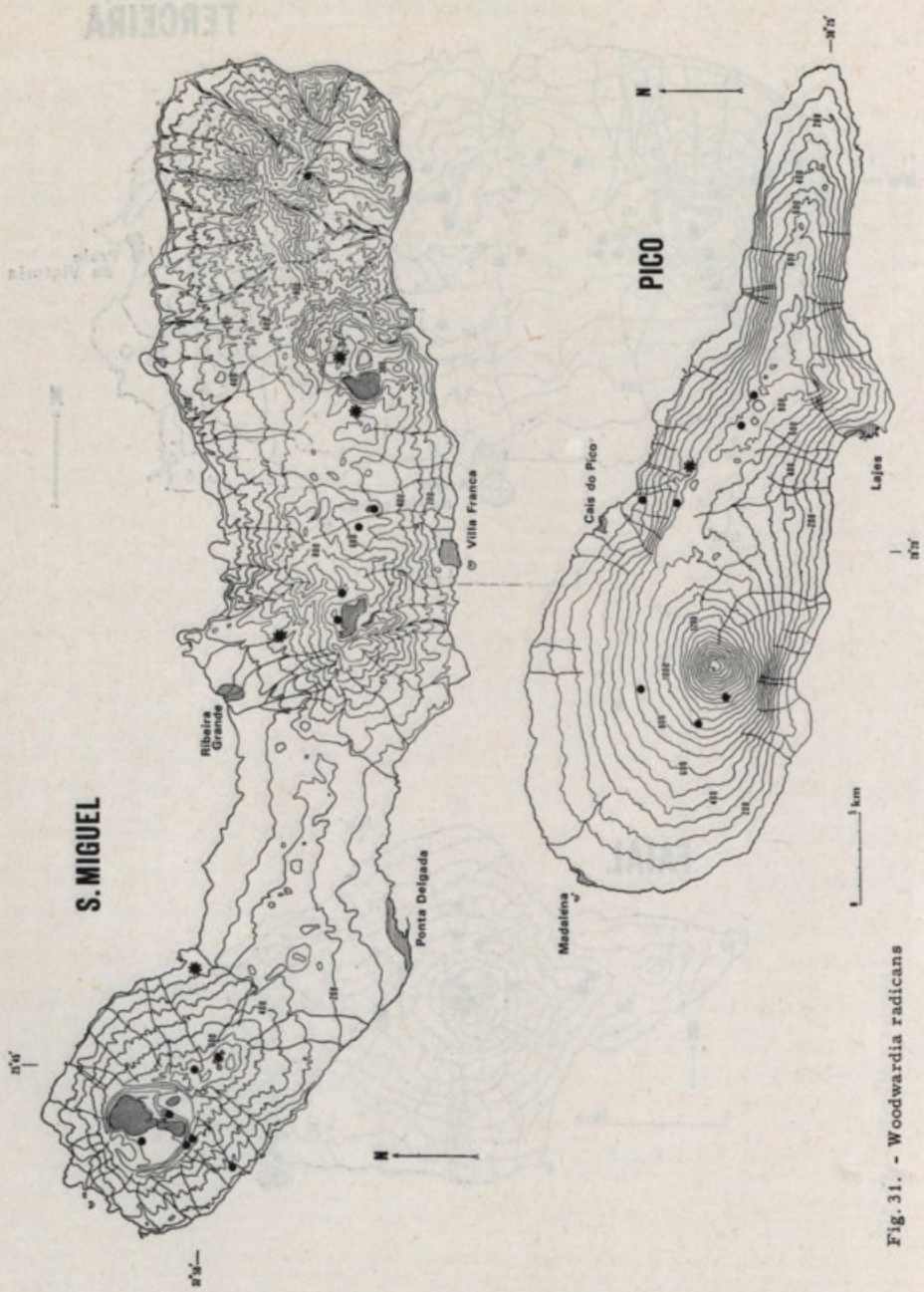
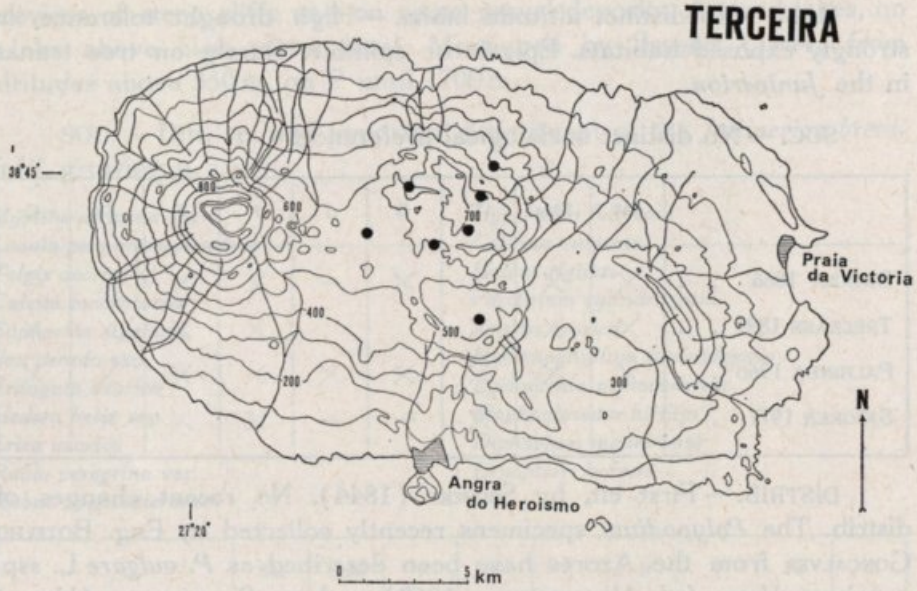


Fig. 31. - Woodwardia radicans



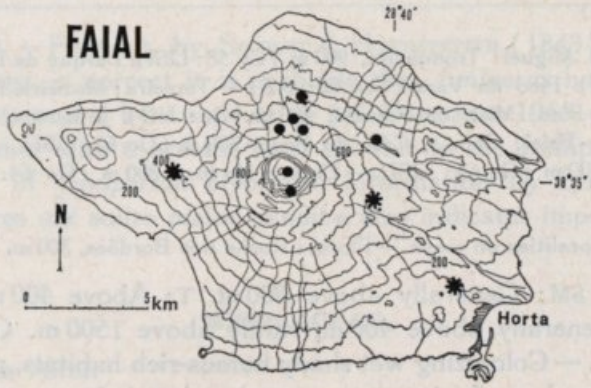


Fig. 32. - Woodwardia radicans

HAB. — No distinct altitude limits. — High drought tolerance, in strongly exposed habitats. Epigeic or epilithic. Rarely on tree trunks in the *Juniperion*.

SOC. — No distinct sociological preference.

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866 . .	×	×	×	×	—	×	×	×	—
TRELEASE 1897 . .	×	×	×			×	×	×	×
PALHINHA 1966 . .	×	×	×	×	×	×	×	×	×
SJÖGREN 1971 . .		—	×	—	—	×	×	×	—

DISTRIB. — First cit. by SEUBERT (1844). No recent changes of distrib. The *Polypodium* specimens recently collected by Eng. BOTELHO GONÇALVES from the Azores have been described as *P. vulgare* L. ssp. *azoricum* Vasc. (cf. VASCONCELLOS 1968) and as *P. azoricum* (Vasc.) R. Fernandes (cf. R. FERNANDES 1968). Taxonomy of *P. australe* treated by ROTHMALER & SCHNEIDER (1962).

CUPRESSACEAE

Juniperus brevifolia (Seub.) Antoine

(Fig. 33 and 34)

EXS. — S. Miguel: Tronqueira, 900 m (Cy 58: LISI). Parque da Lag. das Furnas (Rego 25: LISI). Pico da Vara (Car 05: AZ). — Terceira: Macieira, lava flow, 450 m (Sjn 65: U). — Pico: Mist. da Prainha, 400 m (Go: HO). Junqueira, 700 m (Go 62: LISI, LISFA). — Faial: Capelo, Cab. do Fogo, 500 m (Go 62: LISI). — Flores: Rocha dos Bordões, 300 m (Go 63: LISI). — Corvo: No loc., 300 m (Go 64: LISI). No loc. (Tr 1894: AZ).

VIDI — Localities on maps. — Flores: Rocha dos Bordões, 300 m.

HAB. — SM: Generally above 500 m. T: Above 400 m. F: Above 500 m. P: Generally above 400 m, rarely above 1500 m. On Fo and C also at 300 m. — Colonizing wet shady humus-rich habitats, preferentially on lava flows, where *Juniperus* to a great extent helps to create suitable ecological conditions for further colonization. Also on the youngest lava flows of the archipelago on T (from the year 1761). Where forest clearance of richly developed *Juniperion brevifolii* creates grassland vegetation, the recolonization by *Juniperus* is strongly retarded. In

crevices of steep cliffs and on corse gravel deposits. Around lakes, on banks above high water level. Mentioned by SEUBERT (1844) from altitudes above 350 m, on P until 1700 m.

SOC. — Diff. sp. and important constituent of the *Juniperion brevifolii*, growing u. c.:

Myrsine africana var.
Luzula purpureo-splendens
Tolpis azorica
Culcita macrocarpa
Euphorbia stygiana
Ilex perado ssp.
Frangula azorica
Hedera helix ssp.
Erica azorica
Rubia peregrina var.
Rubus hochstetterorum
Hypericum foliosum
Calluna vulgaris
Holcus rigidus
Vaccinium cylindraceum
Laurus azorica
Hymenophyllum tunbridgense
Lysimachia nemorum var.
Elaphoglossum hirtum
Diphazium madeirense
Dryopteris borreri

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866 . .	×	×	×	×	—	×	×	×	—
TRELEASE 1897 . .	×					×	×	×	×
PALHINHA 1966 .	×		×		×	×	×	×	×
SJÖGREN 1971 . .	×	—	×	—	—	×	×	×	×

DISTRIB. — First cit. by SEUBERT & HOCHSTETTER (1843). If information by DROUET is correct it is probable that *Juniperus* has been made extinct on SMa and G by over-cutting (cf. DANSEREAU 1965, p. 18). These islands, together with C are the least suitable in the archipelago for the development of *Juniperion brevifolii*. Information by SEUBERT (1844) «in ins. Flores ubi solito maior evadit» also indicates important recent cuttings.

MYRICACEAE

Myrica faya Aiton

(Fig. 35 and 36)

EXS. — S. Miguel: Serra da Tronqueira, Nordeste, 400 m (Cy 58: LISI). Água de Pau (Car 1891: AZ). — St.ª Maria: São Lourenço, Mir. do Espigão, 200 m (Ds 64: LISE). No loc. (Cr 1899: AZ). — Terceira: Monte Brasil, 120 m (Ds 64: LISE). — Pico: S. Roque E of Junqueira in Mist. da Prainha do Norte, 700 m (Ds 64: LISE).

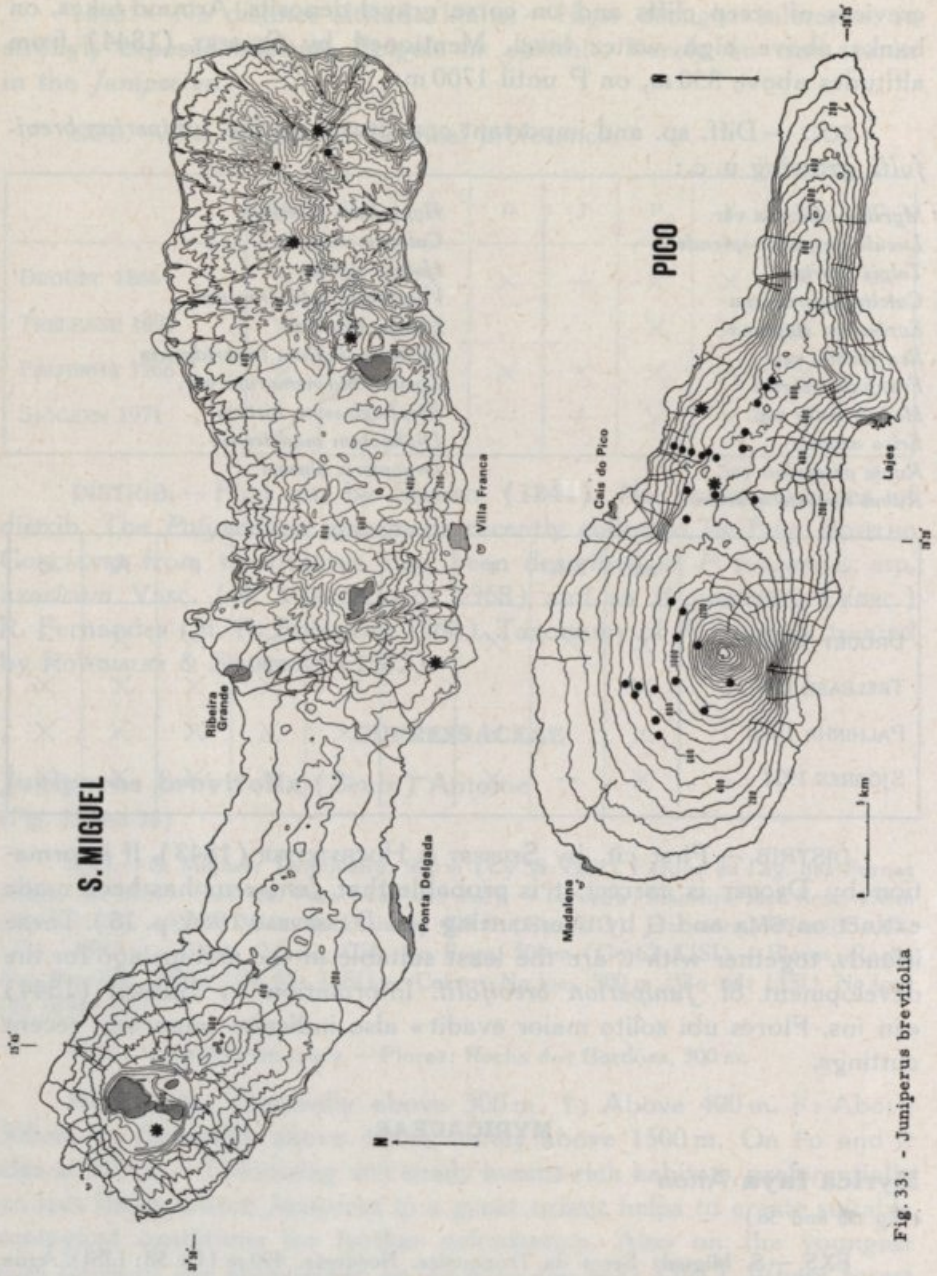


Fig. 33. - Juniperus brevifolia

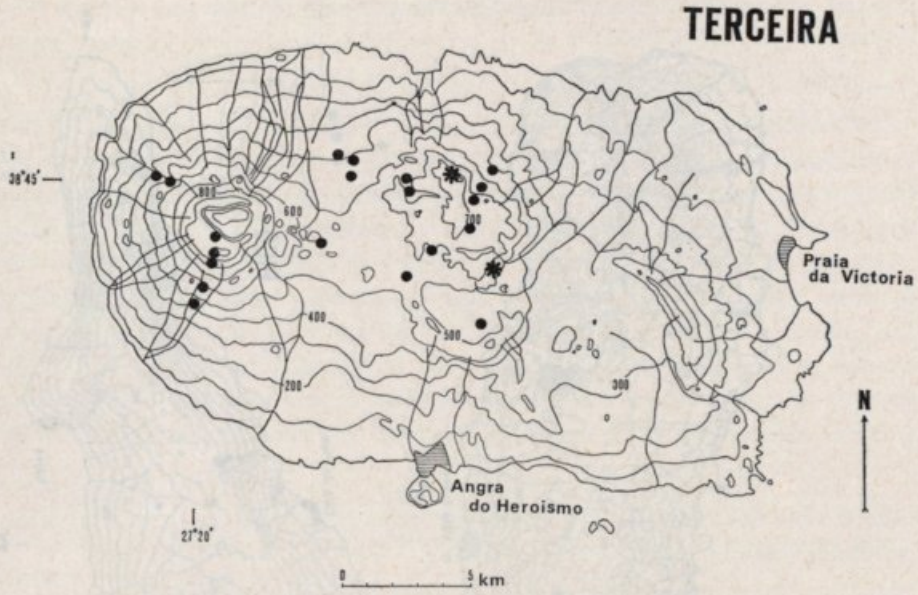


Fig. 34. - Juniperus brevifolia

Fig. 35. - Myrica faya

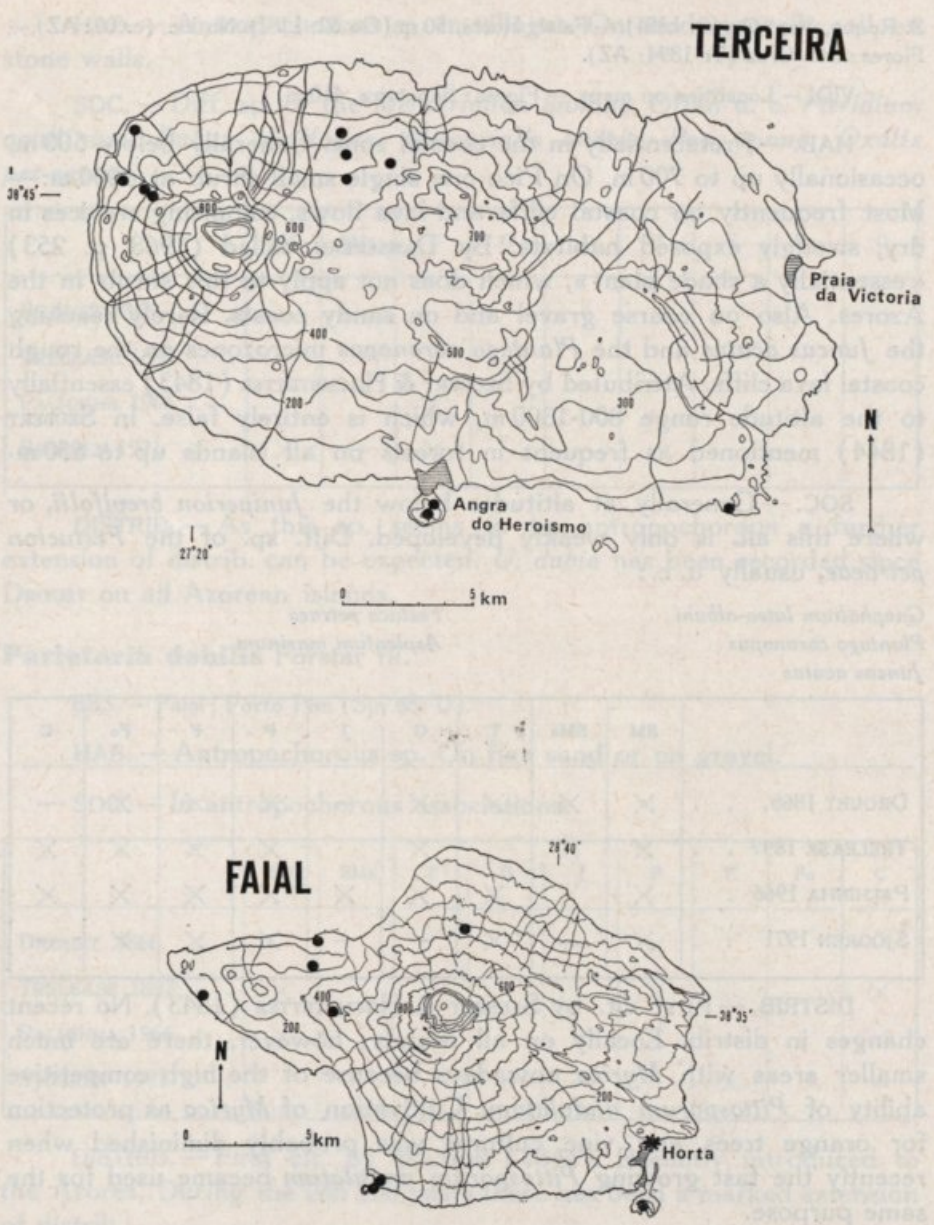


Fig. 36. - Myrica faya

S. Roque, 3 m (Go 68: LISI). — Faial: Horta, 50 m (Go 62: LISI). No loc. (cr 07: AZ).— Flores: St.ª Cruz (Tr 1894: AZ).

VIDI — Localities on maps. — Flores: Sapateira, 410 m.

HAB. — Preferentially in the coastal zone. Generally below 500 m, occasionally up to 700 m. On Pico one single small shrub at 1000 m. — Most frequently on coastal cliffs and lava flows, colonizing crevices in dry, strongly exposed habitats. By DANSEREAU called (1968, p. 253) « essentially a shade plant », which does not apply to this shrub in the Azores. Also on coarse gravel and on sandy coasts. Rarely reaching the *Juncus acutus* and the *Plantago coronopus* microzones on the rough coastal lava cliffs. Attributed by SEUBERT & HOCHSTETTER (1843) essentially to the altitude range 800-1300 m, which is entirely false. In SEUBERT (1844) mentioned as frequent in forests on all islands up to 650 m.

SOC. — Generally at altitudes below the *Juniperion brevifolii*, or where this all. is only weakly developed. Diff. sp. of the *Festucion petraeae*, usually u. c.:

Gnaphalium luteo-album
Plantago coronopus
Juncus acutus
Festuca petraea
Asplenium marinum

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866. . .	×	×	×	×	—	×	×	×	—
TRELEASE 1897 . .	×	×		×		×	×	×	×
PALHINHA 1966 . .	×	×	×	×	×	×	×	×	×
SJÖGREN 1971 . .	×	—	×	—	—	×	×	×	—

DISTRIB. — First cit. by SEUBERT & HOCHSTETTER (1843). No recent changes in distrib. Locally on all islands; however, there are much smaller areas with *Myrica* nowadays because of the high competitive ability of *Pittosporum undulatum*. Cultivation of *Myrica* as protection for orange trees and vine cultures was probably diminished when recently the fast growing *Pittosporum undulatum* became used for the same purpose.

URTICACEAE

Urtica morifolia Poir.

VIDI — S. Miguel: Feteiras, 100 m. Fenais da Luz, coast. — Terceira: Terra Chã, 100 m.

HAB. — Antropochorous sp. in villages. On sandy-gravelly soil, on stone walls.

SOC. — Diff. sp. of the *Mercurialion annuae*. Often u. c. *Pteridium aquilinum, Rubus ulmifolius, Mercurialis annua, Poa annua, Oxalis pes-caprae.*

	SM	SMa	T	G	J	P	F	Fo	C
Drouet 1866. . .					—				—
Trelease 1897 . .									
Palhinha 1966 . .			×						
Sjögren 1971 . .	×	—	×	—	—				—

DISTRIB. — As this sp. seems to be antropochorous a further extension of distrib. can be expected. *U. dubia* has been recorded since Drouet on all Azorean islands.

Parietaria debilis Forster fil.

EXS. — Faial: Porto Pim (Sjn 68: U).

HAB. — Antropochorous sp. On fine sand or on gravel.

SOC. — In antropochorous associations.

	SM	SMa	T	G	J	P	F	Fo	C
Drouet 1866 . .					—	×			—
Trelease 1897 . .	×					×			×
Palhinha 1966 . .	×				×	×			×
Sjögren 1971 . .		—		—	—		×		—

DISTRIB. — First cit. by Watson (1844). Recently introduced to the Azores. During the last 100 years there has been a marked extension of distrib.

Parietaria diffusa Mert. & Koch in Röhling

VIDI — Terceira: S. Mateus. Porto Judeu. Porto Martins. — Faial: Porto Pim. — Pico: Cais do Pico.

HAB. — At low altitudes, probably not above 300 m. On fine sandy soil and on coastal cliffs where a thin layer of sand and humus is accumulated in sheltered crevices.

SOC. — Diff. sp. of the *Mercurialion annuae*, usually u. c.:

Conyza canadensis
Foeniculum vulgare var.
Hordeum murinum
Polygonum aviculare
Solanum nigrum
Anagallis arvensis
Euphorbia peplus

	SM	SMa	T	G	J	P	F	Fo	C
Drouet 1866 . .	×	×			—		×	×	—
Trelease 1897 . .	×	×	×				×	×	
Palhinha 1966 . .	×	×	×				×	×	
Sjögren 1971 . .		—	×	—	—	×	×		—

DISTRIB. — First cit. by Seubert & Hochstetter (1843). Only small recent changes in distrib. Further extension of distrib. to G, J and C might follow in the near future.

LORANTHACEAE

Arceuthobium oxycedri (DC.) Bieb.

EXS. — Faial: Caldeira, 700 m (Sjn 65: U). – Pico: Junqueira, 700 m (Go 62: LISFA).

VIDI — Terceira: St.ª Bárbara from Serreta, 510 m. — Faial: Caldeira, 800 and 870 m. – Pico: Torrinhas, 1000 m. Mist. da Prainha, 400 and 700 m. Cab. Redondo, 780 m. Landroal, 770 m. Mist. Cabeços do Fogo, 750 m. Ravine S of Cais do Pico, 670 m.

HAB. — Observed only as an epiphyte on *Juniperus brevifolia*, rarely below 600 m, generally in slightly exposed habitats with permanently high RH values.

SOC. — Diff. sp. of the *Erico-Myrsinetum* and *Festucetum jubatae*.

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866 . .					—				—
TRELEASE 1897 . .									
PALHINHA 1966 . .			×		×	×	×		
SJÖGREN 1971 . .		—	×	—	—	×	×		—

DISTRIB. — This rare sp. is not easily discovered and might have been overlooked by DROUET and TRELEASE. It was first mentioned by GUPPY (1917). *A. oxycedrus* can be found only in habitats with sociologically well-developed *Juniperion brevifolii* (cf. PALHINHA 1942, p. 140). These localities were difficult to reach before the construction of the new roads across the islands.

POLYGONACEAE

Rumex azoricus Rech. fil.

EXS. — Faial: Bottom of Caldeira (Sjn 65, 68: U).

VIDI — Faial: N of Caldeira.

HAB. — Probably never below 500 m. — In wet, weakly exposed habitats, preferentially where permanently irrigating water is available, in narrow deep ravines and craters.

SOC. — Diff. sp. of the *Festucetum jubatae*, usually u. c.:

Ranunculus cortusifolius
Sanicula azorica
Picris filii
Phyllitis scolopendrium
Lactuca watsoniana
Trichomanes speciosum
Festuca jubata
Myrsine africana var.

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866. . .					—				—
TRELEASE 1897 . .	×						×		
PALHINHA 1966 . .					×		×		
SJÖGREN 1971 . .		—		—	—		×		—

DISTRIB. — First cit. by SEUBERT & HOCHSTETTER (1843). Recently described (1948). Because of the very specialized ecology of this sp., further extension of distrib, might be very slow.

Rumex crispus L.

EXS. — Flores: Rib. da Fazenda, 100 m (Sjn 65: U).

VIDI — Terceira: W of Angra, near the coast.

HAB. — Close to villages, roads and paths.

SOC. — Associated with antropochorous groups of spp.

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866. . .					—				×
TRELEASE 1897 . .	×	×	×	×				×	×
PALHINHA 1966 . .	×	×	×	×	×			×	×
SJÖGREN 1971 . .		—	×	—	—			×	—

DISTRIB. — First cit. by WATSON (1844). It is not probabe that this sp. could have been overlooked on so many islands by DROUET. Thus there has probably been a very rapid recent extension of distrib. A further extension to P and F will certainly take place in the near future.

Rumex conglomeratus Murray

EXS. — Pico: Cais do Pico (Sjn 68: U). — Faial: Bottom of Caldeira (Sjn 68: U) N of Caldeira, 650 m (Sjn 68: U). — Flores: Boca da Baleia, 150 m.

HAB. — Ecological preference ill-defined.

SOC. — Not distinctly linked with any special association.

	SM	SMa	T	G	J	P	F	Fo	C
DROUET 1866 . .	×	×			—		×	×	—
TRELEASE 1897 . .	×	×	×				×	×	×
PALHINHA 1966 . .	×	×	×	×	×		×	×	×
SJÖGREN 1971 . .		—		—	—	×	×	×	—

DISTRIB. — First cit. by WATSON (1844). Recent rapid extension of distrib. from four islands to all parts of the archipelago.