VASCULAR PLANTS NEW TO THE AZORES AND TO INDIVIDUAL ISLANDS IN THE ARCHIPELAGO

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With 7 figures

Abstract. The following vascular plants new to the Azores (not mentioned by Palhinha 1966) were recorded by the author during field work in 1965 and 1968: *Thelypteris limbosperma, Luzula campestris, Elaeagnus angustifolia, Carex acuta, Juncus conglomeratus, Lathyrus japonicus* subsp. *maritimus, Lycopodium inundatum, Stenotaphrum secundatum, Amaranthus retroflexus, Clethra arborea, Pellaea callomelanus, Melilotus dentata, Senecio cineraria* v. *candissimus, Matricaria inodora* v. *maritima*. — 11 spp. new to Flores, 4 to Corvo, 36 to Faial, 20 to Terceira, 7 to S. Miguel and 58 to Pico have been recorded. A list of species new to individual islands (mentioned by Palhinha 1966, but not by Trelease 1897) has been put together. The probable direction of spread of these species, extending their distribution in the archipelago during this century, was investigated. The earlier records of the presence in the Azores of the new species has shown that the islands of S. Miguel, Terceira and Faial are the principal islands of inflow of diaspores. They are also the most probable centres of outflow of diaspores to the rest of the archipelago. The islands of Pico, S. Jorge, Graciosa seem to have been the principal diaspore-accepting islands in this century.

The three principal sources of diaspores are islands with shipping centres in the Azores. Comunication activities of man have a greater influence in the archipelago than natural diaspore spreading agencies such as wind, water and birds, which generally have a gradually decreasing effect as distances increase. These modern conditions of development of flora and vegetation stress the need for urgent activity with regard to conservation of areas with original plant communities in the Azores Islands.

INTRODUCTION

Field work by the author in the Azores was carried out during a total of six months in 1965 and 1968. During the ecosociological work, some vascular plants not mentioned in earlier lists of the flora

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of the archipelago were recorded. During excursions on the islands of S. Miguel, Terceira, Pico, Faial and Flores, several species new to individual islands in the archipelago were also recorded.

Localities of species new to the Azores were examined in respect of some habitat conditions. The presence of the species within one or several plant communities has been reported. These communities have been described and distinguished by Sjögren (1973, in press).

The sociology and ecology of the species new to individual islands have also been described (op. cit) and have therefore not been repeated in this paper. The frequency of earlier records of these species in the island group and the concentration of the records to certain islands is discussed below. The aim has been to compare the earlier reported presence of all species new to individual islands in order to see which islands have probably provided the largest source of diaspores within the Azores. The lists of the flora of Palhinha (1966) and Trelease (1897) were compared with each other in this respect, and localities of recent records by the author were compared with those mentioned in the list of the flora of Palhinha.

Abbreviations

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all.	alliance	hab.	habitat
arch.	archipelago	Lag.	Lagoa
ass.	association	loc .	locality
Az.	Azores	Mad.	Madeira
diff. sp.	differential species	Mac.	Macaronesia
distrib.	distribuition	soc.	sociology
exs.	exsicats, specimens documented in herbaria	u. c.	una cum (together with)

SM	S. Miguel	F	Faial
SMa	Santa Maria	P	Pico
T	Terceira	Fo	Flores
G	Graciosa	C	Corvo
J	S. Jorge		

SPECIES NEW TO THE AZORES

Thelpteris limbosperma (All.) H. P. Fuchs
[*Dryopteris oreopteris* (Ehrh.) Maxon]

LOC. — Pico: Lag. do Paúl, 780 m (Sjn & Go 68: U). — Faial:

Inside Caldeira, S slope, 700 m (Sjn & Go 68: U).

HAB. — At Lag. do Paúl, in transition area between the upper shore zone, which is never flooded, and the following, rarely flooded, zone. Frequent in this steeply sloping part of the shore where erosion and also rare wave action keeps about half of the area more or less permanently free from colonization by vascular plants. In the Caldeira of Faial growing in grass carpet with low cover degree of herbs. Moist habitats above 500 m are probably preferred on these islands. Permanent water supply is probably not required by this fern, and its tolerance to periodical flooding on lake shores seems to be low.

SOC. — On Pico u. c.:

Blechnum spicant
Sibthorpia europaea
Holcus rigidus
Plantago lanceolata
Prunella vulgaris
Deschampsia foliosa

Hydrocotyle vulgaris
Potentilla anglica
Selaginella kraussiana
Osmunda regalis
Viola palustris ssp. *juressi*

Breutelia azorica
Polytrichum commune

Gymnomitrium sp.
Scleropodium illecebrum

On Faial *T. limbosperma* has been recorded growing u. c.:

Carex peregrina
Picris filii
Juniperus brevifolia
Blechnum spicant
Festuca jubata
Culcita macrocarpa
Daboecia azorica
Juncus effusus

Selaginella kraussiana
Vaccinium cylindraceum
Sibthorpia europaea
Myrsine retusa var.
Lysimachia azorica
Luzula purpureo-splendens
Hypericum foliosum
Cardamine caldeirarum

Mnium undulatum
Atrichum undulatum
Echinodium prolixum

Polytrichum formosum
Plagiochila spinulosa

So far the species is only known from the *Juniperion brevifolii: Erico-Myrsinetum* and the *Anagallidetum tenellae* (Sjögren 1973). Lake shore zonation of plant cover at Azorean lakes has been described by the author (op. cit.).

DISTRIB. — In Mac.: Recorded from Madeira. Several localities will eventually be recorded in the Azores, where this fern was probably frequently mistaken for *Th. pozoi* (Lag.) C. V. Morton or for *Cyclosurus dentatus* (Forskål) R. - C. Ching. — Growing in central and NW Europe (cf. Romariz 1953). Mentioned as circumboreal by Dansereau (1961).

Luzula campestris (L.) DC.

LOC. — S. Miguel: E of Lag. do Fogo, 750 m (Sjn 65: U). Lag. do Canario (Sjn 65: U). — Pico: W slope of Pico, 1620 m (Sjn 68: U).

HAB. — On small ridges rich in pumice on the E slope of the Caldeira of Lag. do Fogo. Dry habitat with sparse plant cover.

SOC. — Recorded u. c.:

Calluna vulgaris	*Agrostis castellana*
Rhytidiadelphus squarrosus	*Campylopus polytrichoides*

Between the ridges are narrow deep ravines with very dense plant cover of vascular plants and bryophytes under *Ilex, Erica* and *Juniperus*. The species may eventually be recorded in other localities, probably restricted to the grassland association of the *Juniperion brevifolii*.

DISTRIB. — In Mac.: Recorded from Madeira (Hansen 1969). In several localities in the Azores probably often mistaken for *L. congesta* (Thuill.) Lej. [*L. multiflora* subsp. *congesta* (Thuill.) Hyl.]. — In Europe: eurasiatic-suboceanic.

Elaeagnus angustifolia L.
[*E. hortensis* M. Bieb.]

LOC. — S. Miguel: Sete Cidades, bottom of northern Caldeira, 240 m (Sjn 65: U).

HAB. — Mixed into shrub vegetation dominated by *Laurus azorica*. Moist soil, where water supply is not permanent.

SOC. — Recorded growing u. c.:

Woodwardia radicans	*Fragaria vesca*
Juncus effusus	*Selaginella kraussiana*
Blechnum spicant	*Polystichum setiferum*
Laurus azorica	*Hedera helix* var.
Arundo donax	*Ulex europaeus*

DISTRIB. — Not earlier reported from Mad. or Can. On S. Miguel probably introduced in gardens and recently escaped (Palhinha 1966, p. 77). — The species has an east-mediterranean origin.

Carex acuta L.

LOC. — Pico: Lag. Seca 800 m (Sjn 18.7.68: U). Lag. do Capitão, 750 m (Sjn 5.7.68: U).

HAB. — On shores of Lag. do Capitão, just below the high water line, where periodical flooding every year is brief. In the so called Lag. Seca the open water surface is now very small or periodically absent. *C. acuta* grows in the central most moist part of the small Caldeira. In the microzone nr. 3 of Azorean lake shore vegetation,

which has been characterized by *Eleocharis multicaulis, Hydrocotyle vulgaris, Chamaemelum nobile* var., *Mentha aquatica, M. pulegium* and the mosse *Philonotis rigida* and *Fissidens adianthoides* (Sjögren 1973).

SOC. — In Lag. do Capitão, recorded u.c.:

Anagallis tenella
Eleocharis multicaulis
Hydrocotyle vulgaris
Osmunda regalis

In Lag. Seca, recorded u. c.:

Huperzia selago
Hydrocotyle vulgaris
Anagallis tenella
Eleocharis multicaulis
Scirpus fluitans

Localities so far recorded are covered by the *Litorello-Eleocharion* (Sjögren 1973).

DISTRIB. — Mac.: Not earlier reported. — Europe: nordic-eurasiatic.

Juncus conglomeratus L.

LOC. — S. Miguel: Shore of Lag. Azul, Sete Cidades, 250 m (Sjn 19.5.65: U).

HAB. — Just above high water level, on fine volcanic deposits.

SOC. — Recorded u. c.:

Lycopus europaeus
Juncus effusus
Scrophularia aquatica
Carex serotina
Mentha aquatica
Juncus bufonius
Cardamine caldeirarum
Callitriche stagnalis

Probably eventually only to be found in the *Litorello-Eleocharion.*

DISTRIB. — Mac.: No earlier records. The sp. might earlier have been mistaken for. *J. effusus* L. var. *compactus* Lej. & Court. In Europe: eurasiatic (suboceanic). Circumpolar.

Lathyrus japonicus Willd. subps. **maritimus** (L.) P. W. Ball
[*Lathyrus maritimus* Bigelow]

LOC. — Pico; Largo d'Areia, S of Madalena, coast (Sjn 24.7.68: U).

HAB. — Basaltic sand and gravel material, above high water line.

SOC. — Recorded in sample plot of 100 m², growing u. c.:

Solidago sempervirens
Juncus acutus
Euphorbia azorica
Plantago coronopus
Atriplex hastata v. *salina*
Salsola kali
Tamarix gallica
Portulaca oleracea
Gnaphalium luteo-album
Daucus carota
Lotus subbiflorus
Myrica faya

Plant community is the *Festucion petraeae* (Sjögren 1973).

DISTRIB. — Mac.: Probably not recorded before. The colonization on Pico Island is probably very recent. — Europe: W. Europe, Baltic region, subarctic Russia (cf. Flora Europaea, 1968).

Lycopodium inundatum L.

LOC. — Just SE of Lag. do Capitão, 770 m (Sjn and Go 26.4.65 and Sjn 5.7.68: U).

HAB. — In permanently moist shallow peatland on fairly level ground.

SOC. — Mosaic vegetation consisting of rather dry large hummocks with a network of wet slightly lower areas in between. *L. inundatum* grows in the permantly moist areas between the hummocks, u.c.:

Anagallis tenella
Hydrocotyle vulgaris
Eleocharis multicaulis
Osmunda regalis
(Sphagnum spp.)

On the hummocks the most frequent species are:

Calluna vulgaris
Vaccinium cylindraceum
Erica azorica
Juniperus brevifolia
Potentilla anglica
Luzula purpureo-splendens
Carex echinata
Blechnum spicant
Holcus rigidus

This vegetation complex has been included in different associations of the *Juniperion brevifolii* (Sjögren 1973).

DISTRIB. — In Mac.: Not reported before. Might be a rather recent invasion of the Azores. Large areas with suitable habitat conditions are available on the islands and further spread of the plant might occur. — In Europe: nordic-suboceanic.

Stenotaphrum secundatum (Walt.) Ktze.
[*S. americanum* Sw.]

LOC. — Faial: By the road from Horta along the south coast, Feiteiras, 10 m (Sjn, Go 25.6.68: U).

HAB. — Dry rather exposed habitat close to the road.

SOC. — Dominating in a dense grass carpet with few anthropochorous species of the *Mercurialion annuae* (Sjögren 1973) present.

DISTRIB. — In Mac.: Recorded on Mad. Introduced to Mad. and the Az. Now spreading rapidly along roads and in villages in these archipelagos. Also reported from the Can. (cf. Eriksson, 1971).

Amaranthus retroflexus L.

LOC. — Pico: Cais do Pico, roadside, 10 m (Sjn 13.7.68: U).

HAB. — Dry habitat, strongly exposed, coarse gravel.

SOC. — Growing in sparse anthropochorous vegetation u.c. species belonging to the *Mercurialion annuae* (Sjögren 1973).

DISTRIB. — In Mac.: Reported from Mad. and Can. In the Azores the sparse colonization of this annual therophyt might be just accidental. The invasion of the archipelago might have had its origin in Macaronesia or in America. — Origin southern N. America, in Europe with trend to continental type of distribution.

Clethra arborea Ait.

LOC. — S. Miguel: Tronqueira, Pico da Vara, 600 m (Fernando Pessoa 66: LISU). Pico da Vara, S of the highest peak, 870 m (Sjn 26.5.65: U).

HAB. — Shallow sheltered ravine extending in W-E direction. Mean annual precipitation at this level of 870 m is 2000 mm.

SOC. — A few specimens of the shrub were found growing in a completely developed *Juniperion brevifolii* all. The following taxa were recorded within a sample plot of 100 m^2 in the locality:

Blechnum spicant
Calluna vulgaris
Erica azorica
Vaccinium cylindraceum
Luzula purpureo-splendens
Festuca jubata
Holcus rigidus
Tolpis nobilis
Picris filii
Lysimachia nemorum ssp. *az.*
Lycopodium cernuum
Woodwardia radicans
Osmunda regalis
Sibthorpia europaea
Eleocharis multicaulis
Juncus effusus
Ilex perado
Juniperus brevifolia
Laurus azorica
Agrostis castellana
Myrsine africana v. *retusa*
Hedera helix ssp. *canariensis*
Rubus hochstetterorum
Huperzia selago ssp. *dentata*
Centaurium scilloides
Elaphoglossum paleaceum

DISTRIB. — Mac.: Mad. and Can. — Probably introduced as an ornamental shrub to S. Miguel and recently escaped.

C. arborea is a frequent member of the cloud zone vegetation of Madeira, in the community called *Clethro-Laurion* (Sjögren 1973). The species is probably a very recent member of the original Azorean cloud zone community and similar in its requirement of high annual precipitation and air humidity and low frost tolerance to the *Clethro-Laurion*. The distance between Madeira and the Azores was evidently an efficient barrier to spontaneous spread of *Clethra*, even though the species is a frequent constituent of cloud zone forest on Madeira and though there is an abundance of localities with suitable habitat conditions in the Azores. *C. arborea* is probably a very old member of the flora of Madeira (cf. Sleumer 1967).

Pellaea callomelanus (Swartz) Link

LOC. — Faial: Salão, by path close to the village 100 m (Sjn, Go 26.6.68: U).

HAB. — Dry habitat, coarse sandy soil, strong exposure.

SOC. — In anthropochorous vegetation with several differential species of the *Mercurialion annuae* (Sjögren 1973).

DISTRIB. — Mac.: Cabo Verde. — In Europe: N.E. Spain (Province of Gerona). Also in S & E Africa (cf. Dansereau 1961). Probably recently introduced to the Azores.

Melilotus dentata (Waldst. & Kit.) Pers.

LOC. — Pico: Between Cais do Pico and St. Roque, by path close to the sea cliffs (Sjn 9.7.68: U).

HAB. — In dry, strongly exposed habitat, in fine eroded material from lava field.

SOC. — Growing in a mixture between anthropochorous species of the *Mercurialion annuae* and species characterizing the coastal alliance *Festucion petraeae*. The following species were recorded in a sample plot of 100 m² in the locality:

Oenothera longiflora
Daucus carota
Cynodon dactylon
Mercurialis annua
Festuca petraea
Polypogon maritimus
Euphorbia azorica
Lutus subbiflorus
Silene maritima
Spergularia azorica
Atriplex hastata v. *salina*
Chenopodium ambrosioides
Gnaphalium luteo-album
Juncus acutus

DISTRIB. — In Mac.: Not recorded before. — In Europe: East and Central Europe, extending northwards to S. Sweden (cf. Flora Europea, 1968). Rencent member of the Azorean flora, rare and possibly accidental.

Senecio cineraria DC. var **candissimus** Hort.
[*Cineraria maritima* L.]

LOC. — Pico: E of Cachorro, Lajido, coast (Sjn 21.7.68: U).

HAB. — On bare lava cliffs and in crevices where there is accumulated eroded material. Strong exposure, dry habitat, subject to salt spray impregnation.

SOC. — In the *Festucion petraeae* (Sjögren 1973) u. c.:

Euphoria azorica
Portulaca oleracea
Festuca patraea
Crithmum maritimum
Plantago coronopus
Lotus subbiflorus
Spergularia azorica
Asplenium marinum
Daucus carota
Polypogon maritimus
Umbilicus rupestris
Frankenia pulverulenta
Solidago sempervirens

DISTRIB. — Mac.: Not reported before. On Pico probably introduced as ornamental flower and recently escaped. Mediterranian origin.

Matricaria inodora var. **maritimum** (L.) Wahlenb.

LOC. — Pico: Porto do Cachorro, coast (Sjn 21.7.68: U).

HAB. — Dry, strongly exposed coastal habitat. On coarse eroded material from basaltic lava cliffs.

SOC. — Recorded in a sample plot of 25 m², u. c.:

Plantago coronopus
Portulaca oleracea
Ornithopus pinnatus
Festuca petraea
Atriplex hastata v. *salina*
Euphorbia azorica
Lotus subbiflorus
Juncus acutus
Spergularia azorica
Polypogon maritimus
Polystichum falcatum

Restricted to the coastal *Festucion petraeae* (Sjögren 1973). Growing in the microzone between the microzone nearest the coast, with sparse vegetation dominated by *Juncus acutus, Asplenium marinum, Festuca petraea* and *Crithmum maritmum,* and the coastal microzone, with low growing *Myrica faya* and with *Pteridium aquilinum.*

DISTRIB. — Mac.: Not reported. — In Europe: nordic-suboceanic.

SPECIES NEW TO INDIVEDUAL ISLANDS IN THE AZORES

From following list of species new to individual islands in the Azores, reported by Palhinha (1966) but not mentioned by Trelease (1897), species endemic to the Azores have been excluded. Species with high differential value for endemic Azorean plant communities were also excluded. This choice was made in order to separate those taxa which had most probably been spreading in the time between the periods of field work preceeding the publication of these two flora lists. The new records by Palhinha of endemic species and differential species are much less likely to be explained on the basis of spread of the species. Records from islands where they were not earlier recorded may in many cases be explained by intensified field work, particularly as the interior of the islands have this century become much more easily accessible because of the construction of new roads. For example the new longitudinal highland road of Pico now cuts through areas of original *Juniperion brevifolii* vegetation, large areas of which have probably not been visited by any botanists before the end of the 19th century. Penetration of this dense natural scrub-forest vegetation on rough lava fields is not often faster than 100 m per hour on foot.

The list of species new to individual islands found by the author (not mentioned by Palhinha) contains all the species found. However, the species used in the diagrams and in the discussion of the dispersal

of diaspores in the archipelago were limited in the same way as mentioned above. They have been marked with x in the list below.

The diagrams (fig. 1-7) have been commented on after the two lists (A and B) of new species. They are intended to show the probability of origin in the archipelago of diaspores of the whole group of species spreading to other islands. The earlier documented presence of these species within the whole group has been marked on the diagrams. This has been done by showing the number of species new to an island which were present, for exemple, on only one other island, on 1-2 other islands, on 1-3 islands, etc. A large number of new species present on only one of the other islands, or on this island and on one or two others, indicates a comparatively high probability of origin of diaspores for the new species.

A. Species below were reported by Palhinha (1966) as new to the islands in question. They were earlier mentioned by Trelease (1897) from the islands marked with x.

Faial:

	SM	SMa	T	G	I	P	F	Fo	C
Polygonum aviculare	X	X	X			X			
Chenopodium ambrosioides	X		X	X	X			X	
Silene maritima	X			X	X			X	X
Trifolium arvense	X	X	X			X			
Lythrum junceum	X	X	X		X	X			
Heliotropium europaeum			X	X	X	X			
Origanum virens	X	X	X		X	X		X	
Thymus cespititius	X	X	X			X		X	X
Mentha spicata		X						X	
Mentha x piperita		X							
Veronica persica	X								
Sonchus asper	X					X		X	X
Gaudinia fragilis		X			X				
Hedychium gardnerianum	X							X	

Flores:

	SM	SMa	T	G	I	P	F	Fo	C
Carpobrotus edulis	X		X						
Papaver rhoeas	X	X	X						
Matthiola incana	X		X			X	X		
Sisymbrella aspera	X						X		
Trifolium arvense	X	X	X	X	X				
Geranium robertianum	X	X	X		X		X		
Malva nicaensis							X		
Verbena bonariensis	X						X		
Mentha x piperita		X							
Digitalis purpurea			X						
Galium aparine	X						X		
Oglifa gallica	X		X				X		
Amaryllis belladonna	X		X				X		

	SM	SMa	T	G	J	P	F	Fo	C
Gladiolus segetum							X		
Ceratochloa unioloides			X	X					

Corvo:

	SM	SMa	T	G	J	P	F	Fo	C
Urtica dubia	X	X	X	X	X	X	X	X	
Amaranthus lividus	X	X						X	
Trifolium arvense	X	X	X	X	X				
Malva parviflora	X	X					X		
Frankenia pulverulenta	X		X				X	X	
Cichorium intybus	X						X	X	
Hypochaeris glabra	X						X	X	

Pico:

	SM	SMa	T	G	J	P	F	Fo	C
Cyclosurus dentatus	X	X					X	X	
Chenopodium ambrosioides	X		X	X	X			X	
Amaranthus deflexus	X	X	X		X		X		
Stellaria media	X	X		X			X	X	
Bryophyllum pinnatum	X								
Aphanes arvensis	X		X				X		X
Trifolium angustifolium		X	X				X		
Lotus subbiflorus	X	X	X				X	X	X
Vicia benghalensis	X		X				X	X	X
Mercurialis annua	X	X		X	X		X		
Euphorbia maculata							X		
Malva pusilla							X		
Hypericum perforatum			X						
Frankenia pulverulenta	X		X				X	X	
Epilobium obscurum	X								
Oenothera rosea	X						X		
Hydrocotyle vulgaris								X	
Foeniculum vulgare v. *azorica*	X		X	X			X	X	X
Convolvulus arvensis	X	X	X	X			X	X	
Ipomoea stolonifera							X		
Cynoglossum creticum	X	X	X	X				X	
Stachys arvensis	X	X	X	X	X		X	X	X
Mentha x piperita		X							
Physalis peruviana	X	X	X	X	X		X	X	X
Verbascum virgatum		X	X					X	
Scrophularia scorodonia	X		X						
Digitalis purpurea			X						
Plantago lanceolata v. *eriop.*	X	X	X	X			X	X	X
Centranthus ruber	X		X		X		X	X	
Scabiosa atropurpurea		X	X				X		
Conyza bonariensis	X	X		X	X		X	X	X
Oglifa gallica	X		X				X		
Gifola germanica	X		X				X	X	X
Gnaphalium purpureum	X		X				X		
Anthemis cotula	X	X	X	X			X	X	X
Picris echioides	X	X	X	X			X	X	

	SM	SMa	T	G	J	P	F	Fo	C
Crepis capillaris	X		X	X	X		X	X	
Leontodon taraxacoides	X	X	X	X	X		X	X	
Taraxacum officinale	X		X	X			X		
Gladiolus segetum							X		
Juncus bufonius	X	X	X				X	X	X
Juncus acutus	X	X	X				X	X	
Juncus maritimus			X						
Scirpus setaceus	X						X	X	X
Carex divulsa	X	X	X	X	X		X	X	
Lolium remotum		X							
Anisantha madritensis	X						X	X	
Hordeum marinum	X	X	X	X	X		X	X	
Gaudinia fragilis		X		X					
Polypogon monspeliensis		X	X				X	X	
Cynodon dactylon	X	X	X				X		
Hedychium gardnarianum	X							X	

S. Miguel:	SM	SMa	T	G	J	P	F	Fo	C
Muehlenbeckia sagittifolia			X					X	
Amaranthus hybridus							X		
Mirabilis jalapa		X			X			X	
Ranunculus flammula			X						
Potentilla reptans						X			
Medicago lupulina				X					
Trifolium angustifolium		X	X	X			X		
Vicia articulata							X		
Oxalis martiana							X		
Daphne laureola						X			
Oenothera tetrasperma					X				
Fuchsia magellanica								X	
Hydrocotyle vulgaris								X	
Melissa officinalis			X			X		X	
Mentha x *piperita*		X							
Solanum auriculatum			X						
Verbascum virgatum		X	X					X	
Cymbalaria muralis							X		
Digitalis purpurea			X						
Parentucellia viscosa			X						
Trachelium coeruleum			X				X		
Eupatorium adenophorum			X						
Petasites fragrans							X		
Senecio mikanioides			X				X		
Cirsium vulgare						X	X		
Allium roseum		X	X						
Carex bullockiana							X		
Carex distans							X		
Lolium multiflorum		X	X	X		X	X	X	
Vulpia myuros			X						
Ceratochloa unioloides			X	X					
Gaudinia fragilis		X			X				
Eragrostis megastachya			X						
Polypogon monspeliensis		X	X				X	X	
Lagurus ovatus			X				X	X	
Zantedeschia aethiopica		X							

Santa Maria:

	SM	SMa	T	G	J	P	F	Fo	C
Spergularia marina	X					X			
Agrimonia eupatoria ssp. *grand.*	X		X	X		X	X	X	
Vicia hirsuta	X		X				X	X	X
Euphorbia lathyrus	X					X	X		
Euphorbia exigua	X		X				X		
Hypericum perforatum			X						
Fuchsia magellanica								X	
Crithmum maritimum	X				X	X	X	X	X
Foeniculum vulgare v. *azorica*	X		X	X			X	X	X
Centranthus ruber	X		X		X		X	X	
Calendula arvensis	X		X	X			X		
Cichorium intybus	X						X	X	
Leontodon nudicaulis	X						X		
Potamogeton polygonifolius	X		X			X	X	X	X
Scirpus setaceus	X						X	X	X
Vulpia bromoides	X		X				X		
Catapodium rigidum	X		X				X		
Polypogon maritimus	X		X			X	X	X	X

Terceira:

	SM	SMa	T	G	J	P	F	Fo	C
Beta vulgaris ssp. *maritima*	X	X					X		X
Salsola kali	X						X		
Stellaria media	X	X		X			X	X	
Spergula arvensis	X						X		
Spergularia marina	X					X			
Cyclosurus dentatus	X	X					X	X	
Delphinium consolida						X		X	
Aquilegia vulgaris						X			
Papaver somniferum		X					X		
Papaver dubium	X						X	X	X
Raphanus raphanistrum							X	X	
Crassula tillaea	X					X	X	X	
Spartium junceum		X		X		X	X	X	
Ulex europaeus ssp. *europaeus*	X	X							
Trifolium dubium	X						X	X	
Lotus angustissimus	X	X		X			X	X	
Ornithopus perpusillus	X	X						X	X
Oxalis martiana							X		
Mercurialis annua	X	X		X	X		X		
Euphorbia lathyrus	X					X	X		
Sida rhombifolia	X	X		X	X	X	X	X	
Elatine hexandra	X							X	X
Epilobium obscurum	X								
Oenothera rosea	X								
Fuchsia magellanica								X	
Crithmum maritmum	X				X	X	X	X	X
Anagallis arvensis	X	X		X		X	X	X	
Gomphocarpus fruticosus							X		
Myosotis maritima						X	X		X
Myosotis discolor	X	X							
Verbena bonariensis	X						X		
Lamium amplexicaule	X								

	SM	SMa	T	G	J	P	F	Fo	C
Mentha aquatica	X					X	X	X	
Hyoscyamus albus	X	X		X		X	X	X	
Cymbalaria muralis							X		
Mimulus moschatus	X								
Galium aparine	X						X		
Conyza bonariensis	X	X		X	X		X	X	X
Erigeron karwinskianus	X								
Xanthium strumiferum	X							X	
Chrysanthemum parthenium	X								
Petasites fragrans							X		
Carduus pycnocephalus ssp. *ten.*	X	X		X	X	X			
Cirsium vulgare						X	X		
Smilax excelsa	X					X			
Narcissus tazetta							X		
Romelea colmnae	X								
Iris germanica								X	
Juncus bulbosus	X							X	X
Tradescantia multiflora							X	X	
Cyperus eragrostis								X	X
Carex polyphylla	X					X	X	X	
Carex echinata	X					X	X	X	
Sieglingia decumbens	X								
Poa trivialis	X	X				X	X	X	X
Anisantha madritensis	X						X	X	
Gaudinia fragilis		X			X				
Aira praecox	X								
Hedychium gardnerianum	X							X	
Zantedeschia aethiopica		X							
Arisarum vulgare	X								

Graciosa:

	SM	SMa	T	G	J	P	F	Fo	C
Rumex conglomeratus	X	X	X				X	X	X
Spergularia marina	X					X			
Aquilegia vulgaris						X			
Fumaria bastardii	X	X							
Matthiola incana ssp. *incana*	X		X			X	X		
Coronopus didymus	X	X	X		X	X	X	X	
Medicago polymorpha var. *vulg.*	X	X	X				X		
Melilotus indicus	X		X		X				X
Trifolium ligusticum	X	X				X	X	X	X
Trifolium glomeratum	X	X					X	X	
Lotus subbiflorus	X	X	X				X	X	X
Vicia hirsuta	X		X				X	X	X
Vicia bengalensis	X		X				X	X	X
Oxalis martiana							X		
Ruta chalepensis	X	X	X			X			
Euphorbia lathyrus	X					X	X		
Hypericum perforatum			X						
Frankenia pulverulenta	X		X				X	X	
Crithmum maritimum	X				X	X	X	X	X
Centaurium erythraea	X	X	X			X	X	X	X
Gomphocarpus fruticosus							X		
Verbena bonariensis	X						X		

Thymus cespititius	X	X	X			X	X	X	X
Solanum pseudocapsium	X		X		X	X	X	X	
Galium parisiense	X	X	X			X	X	X	X
Galium murale	X								
Centranthus ruber	X		X		X		X	X	
Oglifa gallica	X		X				X		
Chrysanthemum segetum	X	X	X			X	X	X	X
Tanacetum parthenium	X								
Senecio elegans	X								
Centaurea melitensis		X				X	X		
Cichorium intybus	X						X	X	
Urospermum picroides	X						X		
Hypochaeris glabra	X						X	X	
Potamogeton polygonifolius	X		X			X	X	X	X
Iris foetidissima	X	X					X		
Scirpus cernuus	X	X	X			X	X	X	X
Scirpus setaceus	X						X	X	X
Cyperus esculentus	X		X			X	X	X	X
Lolium perenne	X		X			X	X	X	X
Vulpia myuros			X						
Catapodium rigidum	X		X				X		
Poa trivialis	X	X				X	X	X	X
Briza minor	X	X	X			X	X	X	X
Avene barbata	X	X	X			X	X		X
Arrhenatherum elatius	X		X				X	X	
Gaudinia fragilis		X			X				
Polypogon maritimus	X		X				X	X	X
Setaria verticillata	X		X				X		
Serapias cordigera	X		X			X	X		

S. Jorge:

	SM	SMa	T	G	J	P	F	Fo	C
Anogramma leptophylla	X	X	X				X		X
Cyclosurus dentatus	X	X					X	X	
Parietaria debilis	X					X			X
Rumex crispus	X	X	X	X				X	X
Rumex conglomeratus	X	X	X				X	X	X
Rumex bucephalophorus	X	X	X			X			
Rumex angiocarpus	X	X	X				X	X	X
Polygonum aviculare	X	X	X			X			X
Polygonum hydropiperoides	X		X					X	X
Beta vulgaris ssp. *maritima*	X	X					X		
Atriplex hastata var. *salina*	X	X	X	X		X	X	X	X
Amaranthus hybridus							X		
Portulaca oleracea ssp. *oler.*	X	X	X			X	X	X	X
Cerastium glomeratum	X	X	X				X	X	X
Cerastium fontanum ssp. *trivialis*	X		X				X	X	
Stellaria media	X	X		X			X	X	
Silene maritima	X					X		X	X
Silene gallica	X	X	X	X		X	X	X	X
Ranunculus repens	X		X			X	X		
Fumaria muralis ssp. *muralis*	X		X	X		X	X	X	
Matthiola incana	X		X			X	X		
Sisymbrella aspera	X						X		
Nasturtium officinale	X	X	X				X	X	X
Capsella bursa pastoris	X	X	X					X	X

	SM	SMa	T	G	J	P	F	Fo	C
Rapistrum rugosum ssp. *rugosum*	X			X					
R. rugosum ssp. *orientale*			X	X					
Reseda luteola	X	X	X	X		X	X	X	X
Crassula tillaea	X					X	X	X	
Rubus ulmifolius	X	X	X	X		X	X	X	X
Fragaria vesca	X	X	X			X	X	X	X
Potentilla erecta	X		X			X	X	X	X
Potentilla reptans						X			
Aphanes arvensis	X		X				X		X
Spartium junceum		X		X		X	X	X	
Ulex europaeus ssp. *europaeus*	X	X							
Sarothamnus scoparius	X		X				X	X	X
Trifolium lappaceum							X		
Trifolium ligusticum	X	X				X	X	X	X
Trifolium repens	X	X	X				X	X	
Trifolium dubium	X						X	X	
Lotus angustissimus	X	X		X			X	X	
Lotus subbiflorus	X	X	X				X	X	X
Lotus corniculatus		X	X			X		X	
Ornithopus pinnatus	X	X	X	X			X	X	X
Ornithopus perpusillus	X	X						X	X
Vicia hirsuta	X		X				X	X	X
Vicia bengalensis	X		X				X	X	X
Oxalis martiana							X		
Geranium molle	X		X	X			X		
Geranium dissectum	X	X	X						
Ruta chalepensis	X	X	X			X			
Euphorbia exigua	X						X		
Callitriche stagnalis	X	X	X			X	X		X
Rhus coriaria				X		X		X	
Malva nicaensis							X		
Malva parviflora	X	X					X		
Malva pusilla							X		
Frankenia pulverulenta	X		X				X	X	
Viola odorata	X						X	X	
Peplis portula	X		X			X	X	X	
Epilobium obscurum	X								
Oenothera longifolia	X					X	X	X	
Fuchsia magellanica								X	
Hydrocotyle vulgaris								X	
Foeniculum vulgare var. *azorica*	X		X	X			X	X	X
Calluna vulgaris	X	X	X			X	X	X	
Anagallis arvensis ssp. *arvensis*	X	X		X		X	X	X	
Anagallis tenella		X				X		X	
Centaurium erythraea	X	X	X			X	X	X	X
Vinca difformis	X		X				X	X	
Gomphocarpus fruticosus							X		
Convolvulus arvensis	X	X	X	X			X		X
Myosotis discolor	X	X							
Verbena afficinolis	X	X	X	X		X	X	X	X
Marrubium vulgare	X	X	X	X		X			
Prunella vulgaris	X	X	X			X	X	X	X
Satureja nepeta	X		X	X		X	X	X	X
Mentha aquatica	X					X	X	X	

	SM	SMa	T	G	J	P	F	Fo	C
Solanum nigrum	X	X	X	X		X	X	X	X
Verbascum virgatum	X	X						X	
Verbascum thapsus							X		
Kickxia elatine	X		X				X		
K. spuria	X	X	X			X	X	X	X
Scrophularia scorodonia	X		X						
Veronica officinalis	X		X			X	X		
Veronica serphyllifolia	X		X			X	X	X	X
Veronica arvensis	X		X				X	X	
Parentucellia viscosa			X						
Plantago major	X		X	X			X	X	X
Plantago lanceolata v. *eriophylla*	X	X	X	X			X	X	X
P. coronopus	X	X	X	X		X	X	X	X
Galium palustre	X						X	X	
Galium parisiense	X	X	X			X	X	X	X
Galium aparine	X						X		
Ecballium elaterium	X	X	X						
Eupatorium adenophorum			X						
Conyza canadensis	X		X	X		X	X	X	X
Gnaphalium luteo-album	X		X	X		X	X	X	X
G. purpureum	X		X				X		
Anthemis cotula	X	X	X	X			X	X	X
Chrysanthemum coronarium	X		X				X		
C. segetum	X	X	X			X	X	X	X
Calendula arvensis	X		X	X			X		
Cirsium vulgare						X	X		
Galactites tomentosa	X	X	X	X		X	X		
Cichorium intybus	X						X	X	
Tolpis barbata		X	X					X	
T. umbellata	X		X				X	X	
Urospermum picroides	X						X		
Taraxacum officinale	X		X	X			X		
Sonchus asper	X					X		X	X
S. oleraceus	X	X	X	X		X	X	X	X
Alisma lanceolatum		X							
Potamogeton polygonifolius	X		X			X	X	X	X
P. pusillus	X	X						X	
Allium ampeloprasum	X			X			X		
Ruscus aculeatus	X		X			X		X	
Smilax excelsa	X					X			
Juncus tenuis	X		X			X	X		X
Juncus bufonius	X	X	X				X	X	X
J. acutus	X	X	X				X	X	
J. capitatus	X		X				X	X	X
Eleocharis multicaulis	X	X	X			X	X	X	
E. palustris								X	X
Scirpus cernuus	X	X	X			X	X	X	X
S.setaceus	X						X	X	X
S. fluitans	X		X			X			
Cyperus badius	X	X	X	X			X	X	
C. eragrostis								X	X
C. esculentus	X		X			X	X	X	X
Carex bullockiana								X	
C. serotina	X		X			X	X	X	
Lolium multiflorum		X	X	X		X	X	X	

	SM	SMa	T	G	J	P	F	Fo	C
L. perenne	X		X			X	X	X	X
Vulpia bromoides	X		X			X	X		
Poa annua	X	X	X	X			X	X	
Poa trivialis	X	X				X	X	X	X
Cynosurus cristatus	X	X				X			
Falona echinata	X	X	X			X	X		
Briza maxima	X	X	X	X		X	X	X	X
B. minor	X	X	X			X	X	X	X
Anisantha madritensis	X						X	X	
Arrhenatherum elatius	X		X				X	X	
Gaudinia coarctata	X						X		
Aira caryphyllea	X	X	X				X	X	X
Aira praecox		X							
Polypogon monspeliensis		X	X				X	X	
Gastridium ventricosum	X	X		X		X	X	X	
Lagurus ovatus			X				X	X	
Anthoxanthum odoratum	X		X			X	X	X	X
Eleusine indica	X		X			X	X	X	
Cynodon dactylon	X	X	X				X		
Echinochloa crus-galli	X		X	X		X	X	X	
Digitaria sanguinalis	X		X	X		X	X	X	X
Setaria verticillata	X		X				X		
Hedychium gardnerianum	X							X	
Serapias cordigera	X		X				X		

Probable directions of spread of vascular plants within the archipelago (diagrams 1-7) in the time between the two periods of field work preceeding publication of the flora lists of Trelease and Palhinha (1897 and 1966):

1. Faial (14 new species).

There was a probable inflow of diaspores of the species from the westernmost islands, (from the nearby island Pico), and from the easternmost islands of S. Miguel and Santa Maria. There is a slightly stronger probability that the origin of the diaspores was these easternmost two islands.

2. Flores (15 new species).

The inflow of diaspores might have occured generally from Faial, S. Miguel and Terceira. There is a clear dominance of the earlier records of the new species listed above on these islands. The earlier presence of the species new to Flores was comparatively rarely documented on Graciosa, S. Jorge and Pico. These islands, with difficult landing conditions for ships, generally had only indirect communication by ship with the island of Flores.

3. Corvo (7 new species).

The species new to Corvo were earlier generally reported from S. Miguel, Faial and Flores. The inflow of diaspores to Corvo might have had its origin mainly on the nearby island of Flores and on the commercially important island of Faial in the central group of islands

of the archipelago. Inflow of diaspores from S. Miguel was also probable. Diaspores are likely to have been provided to a very small extent from Graciosa, S. Jorge and Pico (cf. Flores). The number of species new to Corvo is, however, much too low to provide any certain indication of the direction of the inflow of diaspores to this island.

4. Pico (52 new species).

The diagram (fig. 1) clearly separates three groups of islands. The earlier records of the new taxa to Pico are concentrated on S. Miguel and Terceira and the nearby island of Faial. Flores and Santa Maria are in a group with less records. Graciosa, Corvo and S. Jorge show a very low earlier presence of the species new to Pico. It seems natural that S. Miguel and Terceira, as important shipping centres in the archipelago, provided the largest amount of diaspores to other islands. The close combination of Faial with these islands is also to be expected as Faial is also an island of importance for communication, with a good and fairly large harbour. The distance from Faial to Pico is also short.

5. S. Miguel (36 new species).

The main islands for communications, Terceira and Faial, stand out as probable principal origins of diaspores (fig. 2). Santa Maria is also high in probability, maybe also due to the short distance between S. Miguel and this island. Pico, S. Jorge and Graciosa, as usual belong to the group of islands which are more characterized by a recent inflow of diaspores than by an outflow.

6. Santa Maria (18 new species).

The inflow of diaspores has most probably been from S. Miguel, Terceira and Faial. S. Miguel is the nearest island. Graciosa, S. Jorge, Pico and also Corvo belong to the group of islands which have probably provided only very small amounts of diaspores to Santa Maria. 15 of the taxa new to Santa Maria were recorded by Trelease from both S. Miguel and Faial or from these two islands and Terceira.

7. Terceira (61 new species).

The large number of species new to Terceira supports the «probability diagram» (fig. 3) designed to show the supposed origin of diaspores which reached Terceira. The most probable origin seems to have been S. Miguel and Faial. The islands of Santa Maria, Pico and Flores might have provided much smaller amounts of diaspores, though Flores comes rather close to S. Miguel and Faial in the diagram. However there are comparatively few taxa new to Terceira which were earlier (1897) reported only from Flores or from Flores and one other island in the archipelago.

8. Graciosa (51 new species).

The earlier presence of the species new to Graciosa on other islands in the archipelago (fig. 4) suggests an inflow of diaspores principally from S. Miguel and Faial. Corvo and S. Jorge are the least

probable sources of diaspores. Communications between S. Jorge and Graciosa were not important. The short distance between these islands does not seem to have increased the importance of S. Jorge within the archipelago as a source of diaspores for Graciosa.

9. S. Jorge (127 new species).

This island probably had its largest inflow of diaspores in the first quarter of this century though it should be stressed that several of the taxa listed above were probably neglected by Trelease. S. Jorge still has the least-known flora and vegetation in the archipelago. As usual, S. Miguel, Faial and Terceira seem to have been the most probable sources of diaspores (fig. 5). Flores is also high on the probability scale as a source of diaspores. The other five islands in the archipelago seem to have been the main diaspore-accepting islands. Graciosa, Corvo and S. Jorge were nearly always in the group which probably provided the smallest amounts of diaspores to the islands above.

B. The following taxa were recorded during my excursions in 1965 and 1968 (cf. Sjögren 1973) on islands, from which Palhinha published no records in 1966. Species marked by x have been treated in fig. 6 and 7. Species followed by Go were found by I. B. Gonçalves.

Flores:

X *Anogramma leptophylla*
X *Polystichum falcatum*
Sagina apetala
X *Callitriche stagnalis*
Ammi huntii
X *Hypochaeris radicata*
X *Sonchus tenerrimus*
Festuca jubata
X *Vulpia bromoides*
X *Anthoxanthum aristatum*
X *Diplazium allorgei*

Corvo:

Umbilicus rupestris (Go)
Lotus angustissimus (Go)
Vulpia bromoides (Go)
Anisantha madritensis (Go)

Faial:

Lepidotis cernua (Go)
Isoetes azorica
Adianthum hispidulum
Pteris cretica v. *albo-lineata* (Go)
Pteris vittata (Go)
Diplazium caudatum (Go, Sjn)
Diplazium allorgei (Go)
X *Parietaria debilis*
X *Polygonum persicaria*
X *Chenopodium album*
X *Carprobotus edulis*
Sagina apetala
X *Chelidonium majus*
X *Oenothera biennis*
X *Hydrocotyle vulgaris*
X *Echium plantagineum*
X *Lantana camara*
X *Lycopus europaeus*
X *Veronica catenata*
X *Eupatorium adenophorum*
X *Erigeron karwinskianus*
X *Tolpis barbata*
X *Sonchus tenerrimus*
Sonchus glaucescens
X *Eleocharis palustris*
X *Scirpus fluitans*

X *Potentilla anglica*
X *Ulex europaeus* ssp. *europaeus*
X *Ornithopus perpusillus*
X *Oxalis pes-caprae*
X *Epilobium obscurum*

Terceira:

X *Thelypteris pozoi*
Diplazium caudatum
Dryopteris azorica
X *Polygonum persicaria*
X *Spergularia rubra*
Sagina apetala
X *Silene maritima*
Ranunculus cortusifolius
X *Potentilla anglica*
X *Geranium purpureum*
X *Kyllingia brevifolia*
Dactylis glomerata
Deschampsia foliosa
X *Spartina versicolor*
X *Cyperus eragrostis*
Euphorbia stygiana
X *Hydrocotyle vulgaris*
X *Centaurium maritimum*
X *Bellardia trixago*
Rubia peregrina
X *Cichorium intybus*
Lactuca watsoniana
Festuca jubata
Holcus rigidus
X *Sporobulus indicus*

S. Miguel:

Adianthum hispidulum
Pteris cretica v. *albo-lineata* (Sjn,
Pityrogramma calomelanus
Diplazium allorgei
Urtica morifolia
Daboecia azorica
Tradescantia multiflora

Pico:

Isoetes azorica
X *Anogramma leptophylla*
X *Polystichum falcatum*
Dryopteris azorica
X *Parietaria diffusa*
Rumex conglomeratus
X *Salsola kali*
X *Boussingaultia cordifolia*
X *Cerastium glomeratum*
Sagina apetala
X *Ceratophyllum demersum*
X *Papaver dubium*
X *Sisymbrium officinale*
X *Barbarea verna*
X *Cardamine hirsuta*
X *Capsella bursa-pastoris*
X *Teline monspessulana*
X *Sarothamnus scoparius*
X *Melilotus indicus*
X *Trifolium arvense*
X *Trifolium glomeratum*
X *Trifolium dubium*
X *Trifolium incarnatum*
X *Ornithopus pinnatus*
X *Lathyrus tingitanus*
X *Oxalis purpurea*
X *Oxalis pes-caprae*
X *Geranium purpureum*
X *Geranium molle*
X *Hypericum elodes*
X *Elatine hexandra*
X *Myrtus communis*
Chaerophyllum azoricum (Sjn, Go)
X *Vinca difformis*
X *Borago officinalis*
X *Lantana camara*
X *Lamium amplexicaule*
X *Satureja vulgaris*
X *Cymbalaria muralis*
X *Galium palustre*
X *Galium aparine*
X *Campanula erinus*
Campanula vidalii
X *Eupatorium adenophorum*
X *Erigeron karwinskianus*
X *Senecio mikanioides*
X *Tolpis barbata*
X *Urospermum picroides*
X *Sonchus tenerrimus*
Juncus effusus
X *Juncus capitatus*
X *Tradescantia multiflora*
X *Eleocharis palustris*
X *Sieglingia decumbens*
X *Poa annua*
X *Aira praecox*
X *Polypogon maritimus*

(B.) Species new to Azorean islands, recorded after 1960, but not mentioned by Palhinha in 1966:

1. S. Miguel (7 new species).

2. Flores (11 new species).
Largest number of new species were earlier recorded on S. Miguel, Terceira and Faial. There is a low probability that the supply of diaspores was from Graciosa, Pico, Santa Maria and Corvo.

3. Corvo (4 new species).

4. Faial (36 new species).
Diaspores have probably been supplied chiefly from S. Miguel and Terceira (fig. 6). There is a clearly lower probability that Pico, Flores or S. Jorge have been the source of diaspores recently reaching Faial.

5. Terceira (20 new species).
The largest number of taxa to Terceira were earlier recorded on S. Miguel, Pico and Faial. Only few species were earlier reported from Corvo, Graciosa and S. Jorge, and then generally on one of these islands and on two or more of the other islands in the archipelago. There seems to be a high probability that S. Miguel has provided a large amount of diaspores to Terceira.

6. Pico (57 new species).
The largest number of plants new to Pico were earlier recorded on S. Miguel, Terceira and Faial (fig. 7). The outflow of diaspores seems most probably to have been from these three islands. There was no species which was found exclusively on one of the other five islands before the recent record from Pico.

DISCUSSION

The spread of plants was previously mainly regarded as a result of agents of wind, water and animals, especially birds. These factores are often complex and interacting, and probably up to the end of the 19th century were quite dominant as diaspore spreading agencies. The recent explosive development of communications by land, water and air has added another complex factor: the deliberate or accidental spreading of diaspores by man.

In the Azorean archipelago, dispersal of diaspores only by wind, water or birds have in a natural way up to now brought about the development of differences in flora and vegetation between individual islands and between the three groups of islands forming the archipe-

lago. These differences exist, though they are not pronounced, for example between plant communities of the natural landscape on different islands. Differences in dominance in the lake shore vegetation are, however, as evident between S. Miguel and Pico as between Pico and Faial (Sjögren 1973). Local winds and sea currents around the Azores are very much subject to changes in direction during the year and these diaspore spreading agencies did not create any permanent and marked isolation of one part of the archipelago from another.

Existing natural differences in flora and vegetation within the Azores due to the degree of geographical isolation of certain islands from each other are now being further decreased. Recent inflow of new species to the Azores has been illustrated by the comparison of the number of recorded vascular taxa for the different islands in 1870 (Watson), 1897 (Trelease), 1966 (Palhinha), 1973 (Sjögren). On all these four occasions the highest number of recorded species was on S. Miguel, Terceira and Faial. These three islands have also been shown to be the most probable origin of further spread of vascular plants in the archipelago.

Islands characterized by an important rise in the number of taxa in their flora are Graciosa, S. Jorge and Pico. The islands of S. Miguel, Terceira and Faial have been the main centres for shipping since the colonization of the Azores. It is thus natural that they have been subject to the heaviest inflow of diaspores from the continents. It is also natural that they have secondarily served as centres for outflow of diaspores to other islands in the archipelago.

The comparison of the flora lists by Trelease (1897) and Palhinha (1966), and between Palhinha and new records by the author, have all suggested S. Miguel, Terceira and Faial as the most probable sources of diaspore spread. Species new to individual islands, recorded by Palhinha and by Sjögren, were most frequently earlier recorded from these three islands. It is especially remarkable that islands with a pronounced recent inflow of new species (Graciosa, S. Jorge, Pico) probably had the largest amount of inflow of diaspores from S. Miguel and Faial and not from nearest islands. The influence of spreading agencies such as wind, water, birds seem to have become easily dominated by frequent communications with these three islands.

The revealed recent invasion of the Azores by a large number of vascular plant taxa has made recommendations for conservation of areas of original vegetation at different altitude levels on the islands of immediate importance. They are especially urgent on the three communication centre islands.

Natural vegetation and fauna on isolated islands is generally most susceptible to invasion by non-indigenous taxa. Introduction of foreign weeds and ornamental flowers to Madeira has strongly in-

fluenced the composition and to some extent also the survival ability of natural plant communities. A similar invasion now takes place in the Azores islands but is not yet as extensive as on Madeira. The inflow of foreign diaspores should be controled in detail, especially on S. Miguel, Terceira and Faial, but also on Pico, S. Jorge and Flores, which in this century have been the most important diaspore-accepting islands in the Azores.

REFERENCES

Dansereau, P. :
1961-1963. Études Macaronésiennes I. Géographie des Cryptogames vasculaires — *Agronom. Lusit.* 23: 151-181.

Ericsson, O. :
1971. Check-list of vascular plants of the Canary Islands. — Section of Ecological Botany, Departament of Biology, Umeå University, Sweden.

Flora Europaea
1964-1968. Vol I and II. — Ed. Tutin, Heywood, Burges, Valentine, Walters, Webb. Cambridge.

Hansen, A. :
1969. Checklist of the vascular plants of the archipelago of Madeira. — *Bol. Mus. Mun. Funchal.* 24: 1-62.

Palhinha, T. T. :
1966. Catálogo das plantas vasculares dos Açores. — *Ed. da Soc. de Estudos Açorianos Afonso Chaves.* — 186 pp. Lisboa.

Pickering, C. H. C. & Hansen, A. :
1969. List of higher plants and cryptogams known from the Salvage Islands. — *Bol. Mus. Mun. Funchal.* 24: 63-71.

Romariz. C. :
1953. Flora da Ilha da Madeira. Pterodófitos. — *Rev. Fac. Cienc. Lisboa. 2. Sér.* C. 3 (1): 53-112.

Sjögren. E. :
1972. Vascular plant communities of Madeira. — *Bol. Mus. Mun. Funchal.* 24:45-125.
1973. Recent changes in the vascular flora and vegetation of the Azores Islands. — *Mem. Soc. Brot. XXII. Coimbra.* (in press).

Sleumer, H. :
1967. Monographia Clethracearum. — *Engl. Bot. Jahrb.* 87.

Trelease, W. :
1897. Botanical observations on the Azores. — *Rep. Missouri Bot. Gard.* 8: 77-220.

FIGURES

Fig. 1-7. — The diagrams show the earlier reported presence of a number of vascular plants new to individual islands. Their presence on a particular island within the archipelago, and on 1-8 of the other islands, has been recorded.

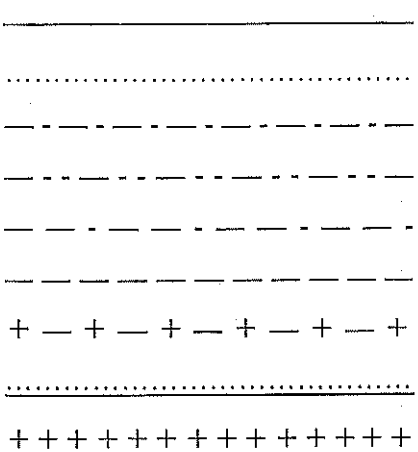
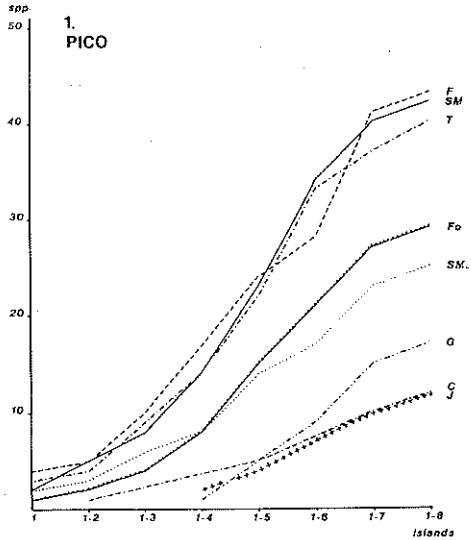


Fig. 1-5. — Species new to Pico, S. Miguel, Terceira, Graciosa and S. Jorge reported by Palhinha (1966), earlier mentioned by Trelease (1897). — Explanatory example (fig. 1): 10 species new to Pico (Palhinha) were earlier reported (Trelease) from Faial only, or from Faial and one or two other islands.

Fig. 6, 7. — Species new to Faial and Pico, recorded by the author (1973) and earlier mentioned by Palhinha (1966). — Explanatory example (fig. 6): One species new to Faial (Sjögren) was earlier reported (Palhinha) only from S. Miguel. 20 new species were reported either from S. Miguel and one or two other islands.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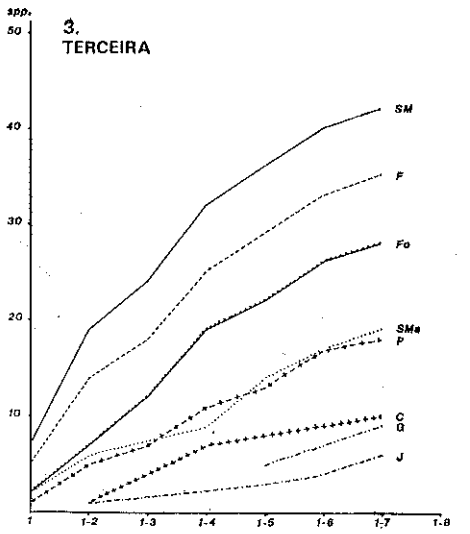
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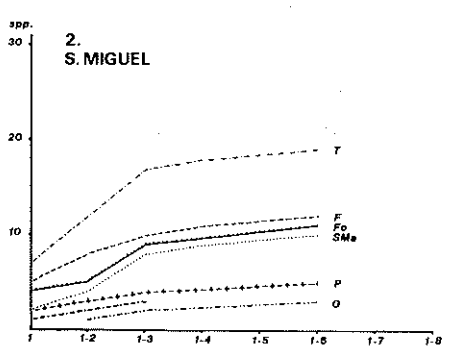
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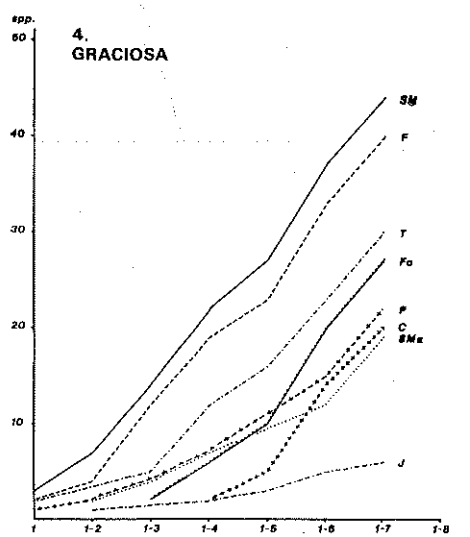
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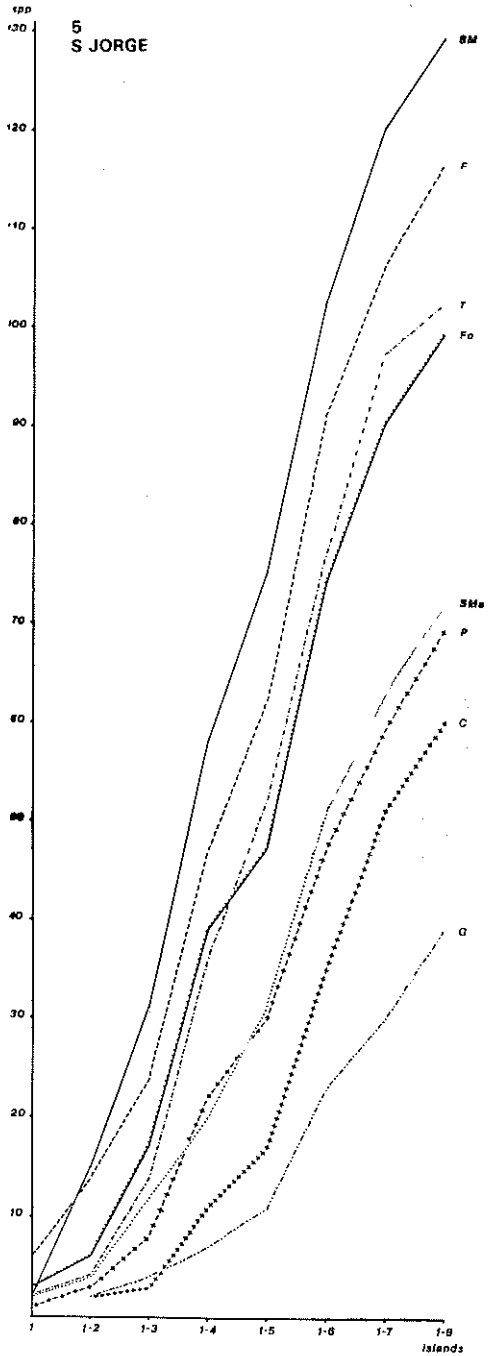
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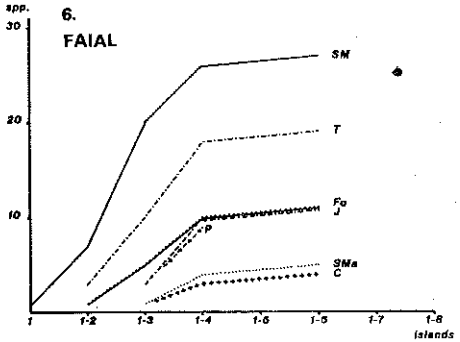
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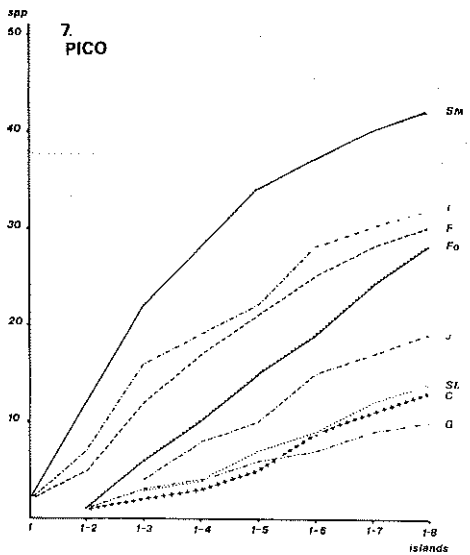
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