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

DISTRIB. — First cit. by SEUBERT & HOCHSTETTER (1843). Probably overlooked by DROUET on some islands. The absence from SMa, G and C might indicate a sociological preference for the *Juniperion brevifolii*, as many diff. spp. of this all. are missing from the same islands (cf. *C. pilulifera* var. *azorica*, *C. peregrina*).

Carex hochstetteriana Gay ex Seub.

EXS. — Pico: Miradouro do Cais, 180 m (Sjn 65: U). — Faial: Varadouro, coast (Sjn 65: U). N of Horta by road, 150 m (Sjn 68: U).

HAB. — Probably not growing above 500 m.

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 SEUBERT & HOCHSTETTER (1843). Remarkably stable recent distrib. Significant absence from SMa, G and C (cf. *C. vulcani*). Probably very old member of the Azorean vegetation.

Carex punctata Gaudin
var. **laevicaulis** (Hochst.) Boott

EXS. — Terceira: Monte Brasil, 120 m (Ds 64: LISE). — Pico: By road Cais do Pico-Lajes, 600 m (Sjn 68: U).

HAB. — Ecological preference ill-defined.

SOC. — Both in antropochorous associations at low altitudes and in 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). Probably no recent extension of distrib.

Carex serotina Mérat

EXS. — S. Miguel: Sete Cidades. Lag. do Canário (Sjn 65: U). — Terceira: Bottom of Caldeira (Sjn 68: U). — Pico: Lag. do Paul (Sjn 68: U). Above Furna de Frei Matias, 900 m (Sjn 65: U). — Faial: Caldeira (Sjn 68: U).

HAB. — In PALHINHA (1966) attributed to altitudes from 300 m up to the pasture land (± 600 m). Highest frequency however, between 600--900 m. — In wet grassland in strongly exposed habitats, often in a dense carpet of *Eleocharis multicaulis*, around lakes, growing also very close to low water level.

SOC. — Highest frequency in grassland of the *Juniperion brevifolii*, also 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 & HOCHSTETTER (1843). No recent extension of distrib. Recently more frequent because ot the extension of areas of new cleared grassland for grazing at high altitudes. Characteristic absence from SMa, G and C (cf. *Carex peregrina*).

GRAMINEAE

Sieglingia decumbens (L.) Bernh.

EXS. — S. Miguel: Pico da Vara, 900 m (Sjn 65: U).

VIDI — Terceira: Pico das Perdelas, 400 m. Guilh. Moniz, 420 m. — Pico: Lag. do Capitão, 740 m.

HAB. — Preferentially between 300-900 m. — In wet open grassland and around lakes above high water level.

SOC. — In grassland vegetation of the *Juniperion brevifolii*, u. c.:

Nardus stricta
Myrsine africana var.
Luzula purpureo-splendens
Culcita macrocarpa
Potentilla erecta
Vaccinium cylindraceum
Lysimachia nemorum
Pteridium aquilinum

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

DISTRIB. — First cit. by DROUET. Now spreading to various parts of the archipelago.

Festuca petraea Guthnick ex Seub.

(Fig. 109 and 110)

EXS. — S. Miguel: Fenais da Luz (Sjn 65: U). Cald. Sete Cidades. Seara. Lomba dos Homens, 450 m (Ds 64: LISE) Ponta Delgada near Relva, 100 m (Ds 64: LISE). Relva (Car 04: AZ). Rosto do Cão (Car 1894: AZ). Candelária (Car 04: AZ). Faial da Terra (Car 08: AZ). Lagoa, Janelas do Inferno (Car 03: AZ). Ilhéu de Vila Franca (Car 03: AZ). — Santa Maria: No loc. (Tr 1896: AZ). — Terceira: S. Martinho (Sjn 68: U). Biscoitos, Rolo (Orm: COI). — S. Jorge: Fajã de Ouvidor (Car 08: AZ). — Pico: S. Roque, 3 m (Go 63). Cais do Pico, 2 m (Go 63: LISI, LISFA). — Faial: Varadouro, 10 m (Go 62: LISI, LISFA). Pasteleiro, 10 m (Go 62: LISI). — Flores: Porto de S. Pedro (Sjn 65: U). St. Cruz, Fazenda, 150 m (Go 64: LISI). — Corvo: Vila do Corvo, 100 m (Ds 64: LISE). No loc., 10 m. (Ds 64: LISE). No loc., 150 m (Go 64: LISI). No loc. (Tr 1894: AZ).

VIDI — Localities on maps.

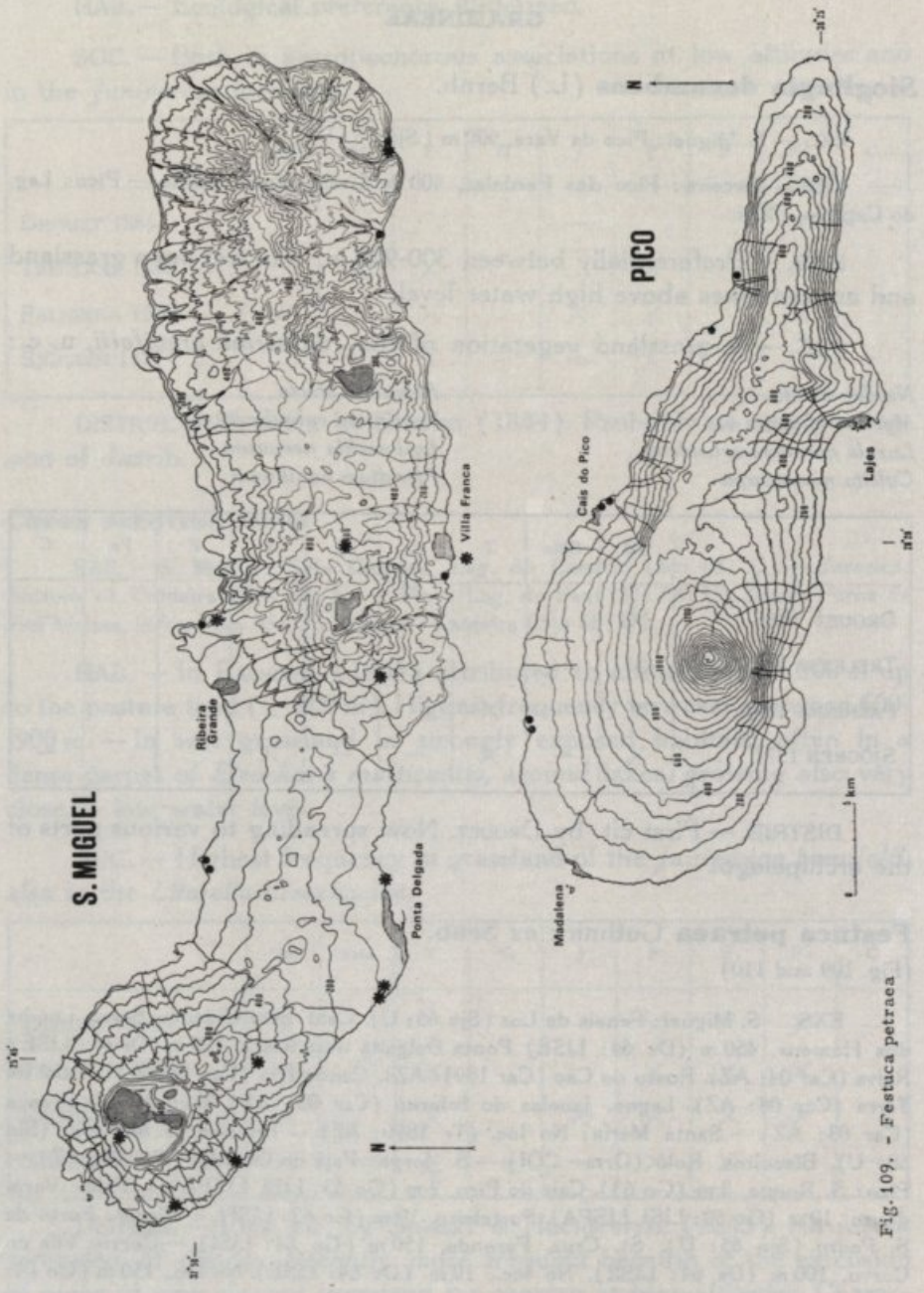
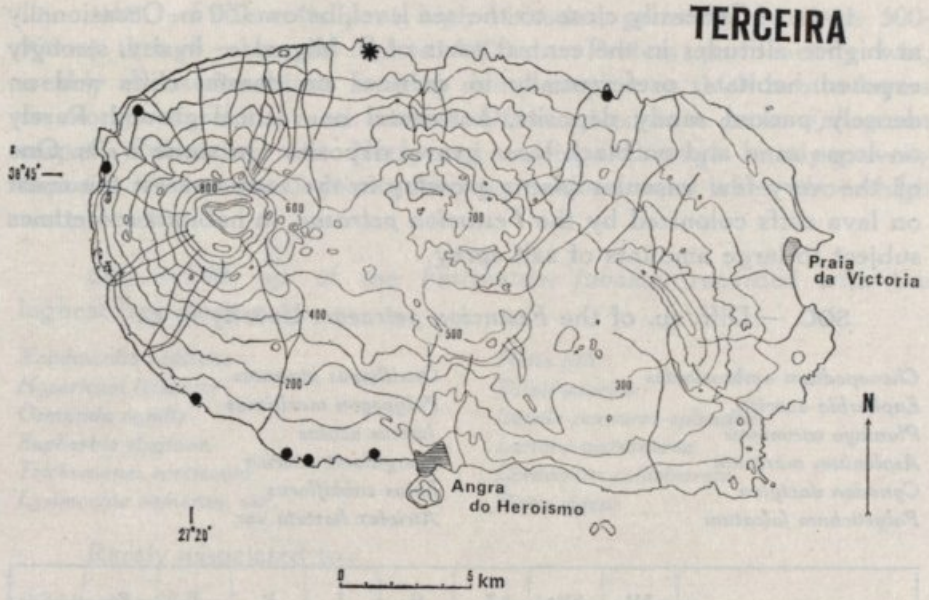


Fig. 109. - Festuca petraea



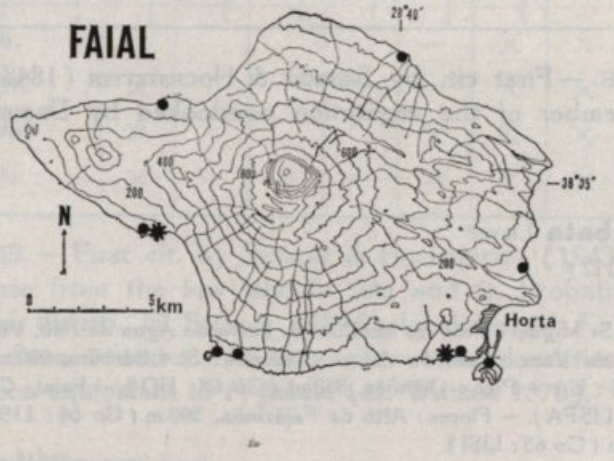


Fig. 110. - Festuca petraea

HAB. — Generally close to the sea level, below 150 m. Occasionally at higher altitudes in the central parts of S. Miguel. — In dry, strongly exposed habitats, preferentially in crevices on coastal cliffs and on densely packed sandy deposits, horizontal or vertical ground. Rarely on loose sand and on black loose gravel deposits. On stone walls. One of the very few vascular plants growing in the zone nearest the coast on lava cliffs colonized by the *Festucion petraeae*, in habitats sometimes subject to large amounts of salt spray.

SOC. — Diff. sp. of the *Festucion petraeae*. Usually u. c.:

Chenopodium ambrosioides
Euphorbia azorica
Plantago coronopus
Asplenium marinum
Cynodon dactylon
Polystichum falcatum
Ornithopus pinnatus
Polypogon maritimus
Juncus acutus
Spergularia azorica
Lotus subbiflorus
Atriplex hastata 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). Probably very old member of the vegetation overlooked by Drouet on some islands.

Festuca jubata Lowe

(Fig. 111 and 112)

EXS. — S. Miguel: Pico do Miradouro, Serra de Água de Pau, Vila Franca (Sjn 68: U). Pico da Vara (Car 05: AZ). — Terceira: St.ª Bárbara, 900 m (Sjn 65: U). Juncal (Sjn 65: U). — Pico: Grotões, 850 m (Go 68: HO). — Faial: Caldeira, 700 m (Go 64: LISI, LISFA). — Flores: Alto da Fajãzinha, 500 m (Go 64: LISI). Rocha dos Bordões, 300 m (Go 63: LISI).

VIDI — Localities on maps. — Flores: Rocha dos Bordões, 250 m. Alto da Fajãzinha, 460 m.

HAB. — Preferentially at high altitudes, generally between 500-900 m, though observed up to 1400 m. — Prefers permanently wet, weakly exposed habitats forming dense carpets on thick humus layers on slopes of ravines and craters. Often mixed in a dense *Sphagnum* carpet. Colonizing wet N-exposed cuttings through sandy-gravelly deposits after about 5 years. Also on banks around lakes, above high water level.

SOC. — Diff. sp. of the *Festucetum jubatae*, recorded with the highest frequency u. c.:

Woodwardia radicans
Hypericum foliosum
Osmunda regalis
Euphorbia stygiana
Trichomanes speciosum
Lysimachia nemorum var.
Picris filii
Tolpis azorica
Luzula purpureo-splendens
Lactuca watsoniana
Cardamine caldeirarum
Picris rigens

Rarely associated to:

Pteridium aquilinum
Fragaria vesca
Anthoxanthum odoratum
Thymus cespititius
Umbilicus rupestris
Asplenium onopteris
Prunella vulgaris
Hypericum humifusum
Calluna vulgaris
Potentilla erecta

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

DISTRIB. — First cit. by Seubert & Hochstetter (1843). Characteristic absence from the low islands SMa and G. Probably no recent extension of distrib. In Seubert (1844) localities of *F. glauca* were mentioned, from P and F. As they were coastal localities this sp. can not have been equivalent to *F. jubata* (cf. Watson 1870).

Lolium multiflorum Lam.

HAB. — Naturalized in many localities. Generally below 600 m.

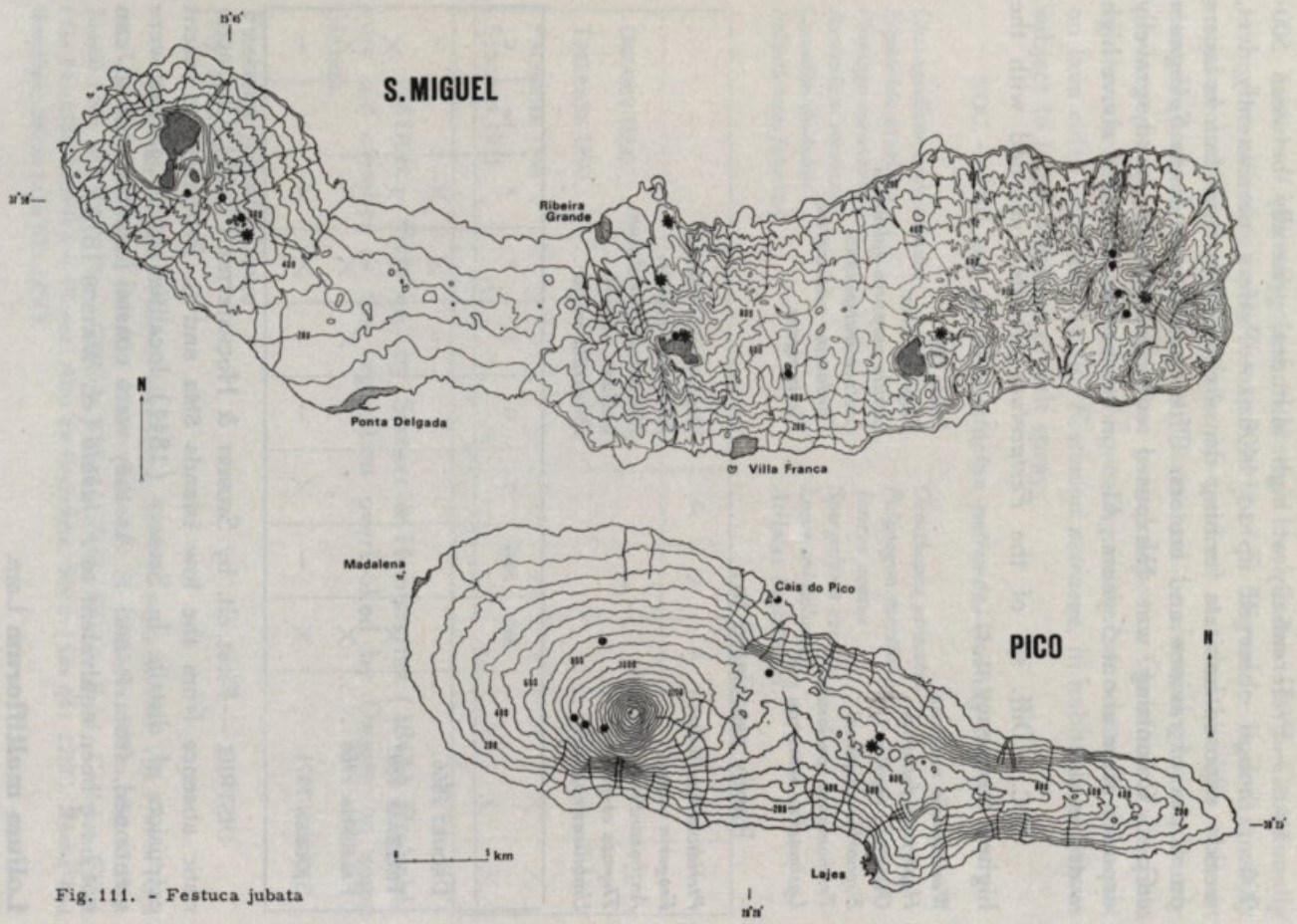


Fig. 111. - Festuca jubata

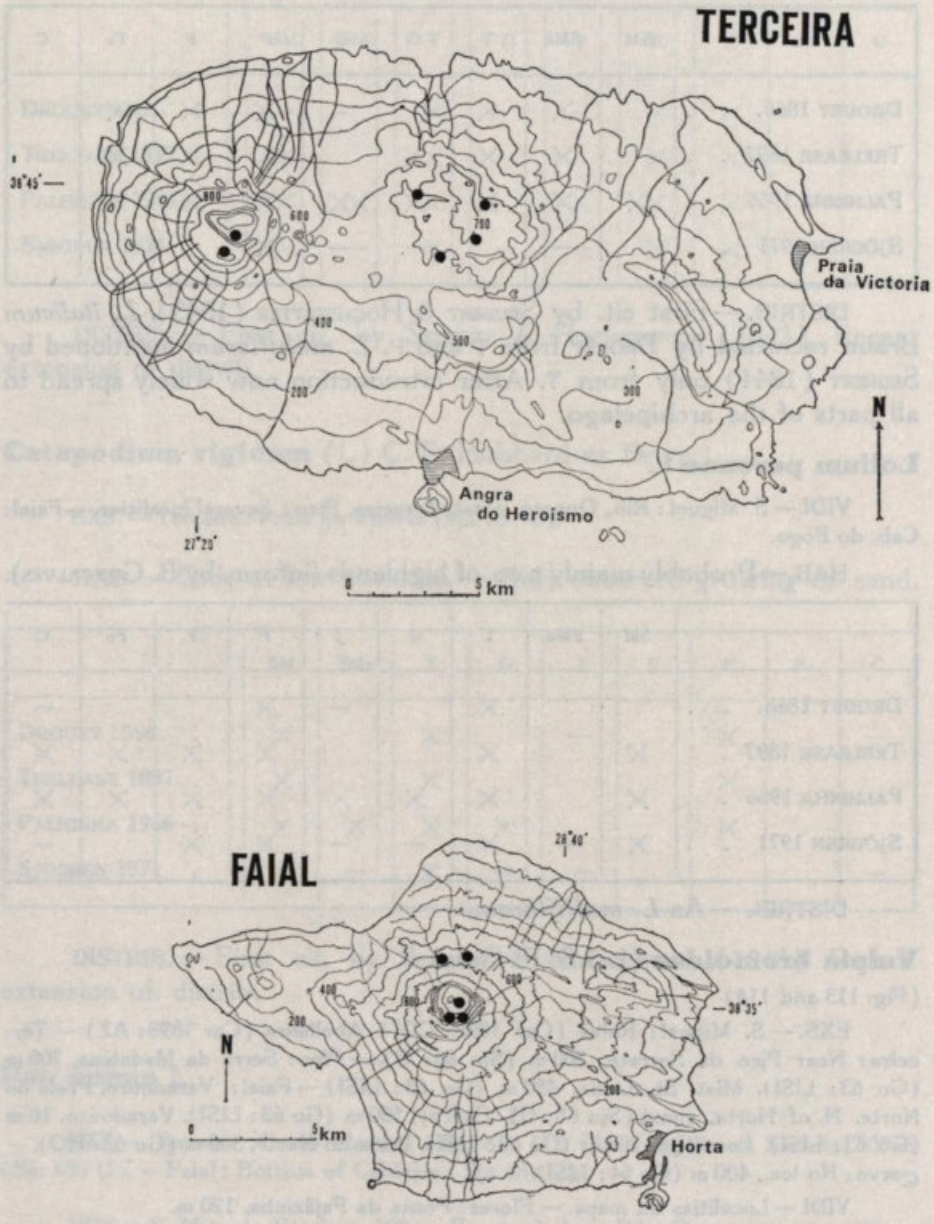


Fig. 112. - Festuca jubata

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

DISTRIB. — First cit. by SEUBERT & HOCHSTETTER (1843). *L. italicum* Braun recorded by DROUET from T and P. *L. multiflorum* mentioned by SEUBERT (1844) only from T. After introduction now widely spread to all parts of the archipelago.

Lolium perenne L.

VIDI — S. Miguel: Rib. Quente, coast.-Terceira, Pico: Several localities. — Faial: Cab. do Fogo.

HAB. — Probably mainly a sp. of highlands (inform. by B. GONÇALVES).

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

DISTRIB. — As *L. multiflorum*.

Vulpia bromoides (L.) S. F. Gray

(Fig. 113 and 114)

EXS. — S. Miguel: Relva (Car 1898: COI). Abelheira (Car 1898: AZ). — Terceira: Near Pico da Serreta, 300 m (Sjn 65: U). — Pico: Serra da Madalena, 700 m (Go 63: LISI). Mist. St. Luzia, 450 m (Go 63: LISI) — Faial: Varadouro. Praia do Norte. N of Horta, coast (Sjn 65: U). Cedros, 500 m (Go 63: LISI). Varadouro, 10 m (Go 63: LISI). Lombega, 200 m (Go 62: LISI). Praia do Norte, 300 m (Go 62: HO). — Corvo: No loc., 400 m (Go 64: LISI).

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

HAB. — Large altitude amplitude but clear preference for altitudes below 300 m. — In dry, strongly exposed habitats, prefers sandy soil. Also on accumulated sand and gravel, on stone walls.

SOC. — Diff. sp. of the *Ornithopo-Gaudinietum*. Weak diff. val.

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

DISTRIB. — First cit. by SEUBERT & HOCHSTETTER (1843). Recent extension of distrib.

Catapodium rigidum (L.) C. E. Hubbard ex Dony

EXS. — Terceira: Praia da Vitória (Sjn 65: U).

HAB. — Only at low altitudes. — Only observed growing on sand.

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

DISTRIB. — First cit. by SEUBERT & HOCHSTETTER (1843). Recent extension of. distrib.

Poa annua L.

EXS. — Terceira: Porto Martins (Sjn 65: U). Close to Pico da Serreta, 300 m (Sjn 65: U). — Faial: Bottom of Caldeira (Sjn 68: U).

VIDI — S. Miguel: Feteiras, 100 m. Fenais da Luz. Rib. Quente, coast. — Pico: Cais-S. Roque. — Faial: Castelo Branco. Almoxarife.

HAB. — At low altitudes close to fields, roads and paths. Probably only accidentally introduced to the bottom of the Caldeira of Faial.

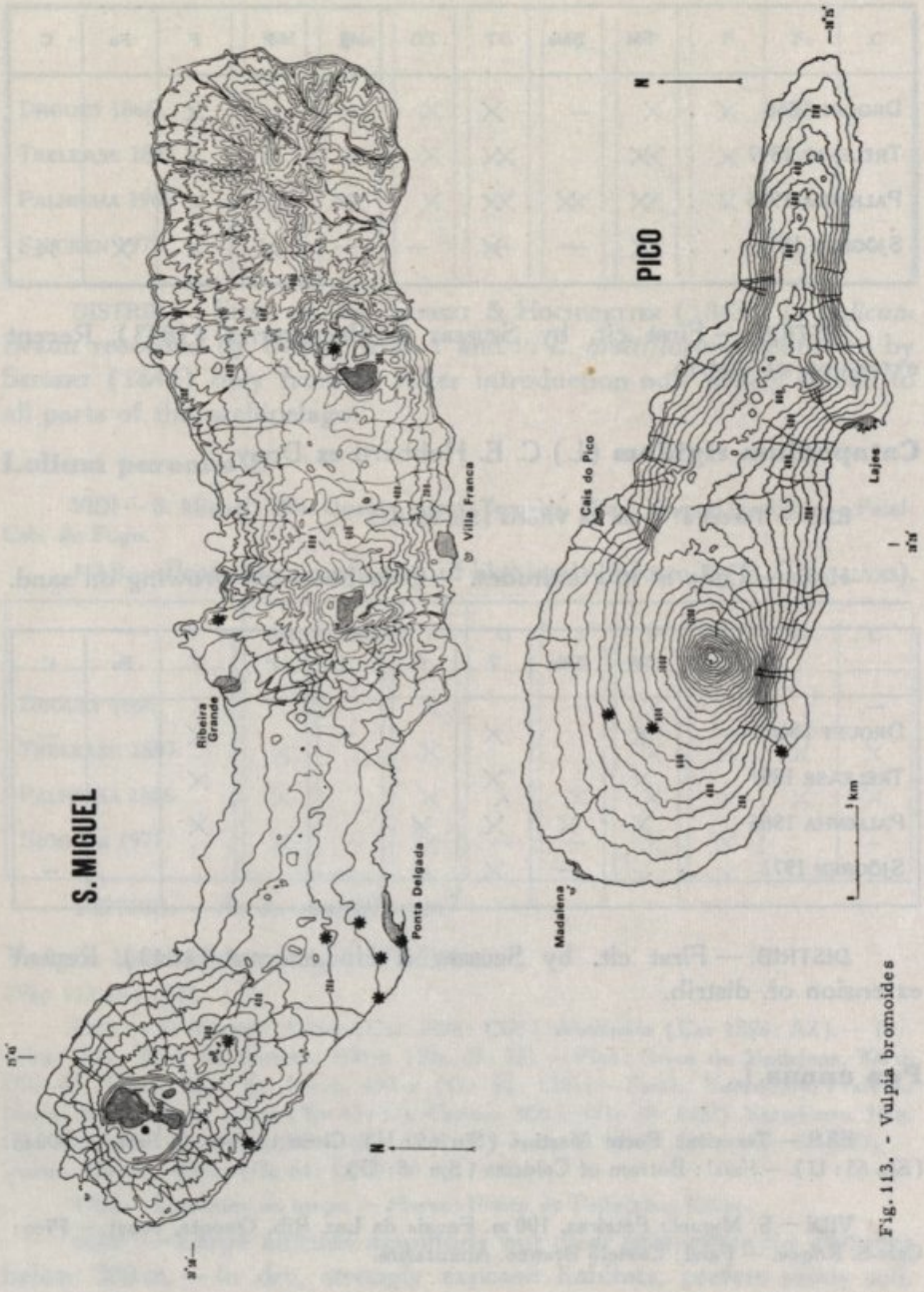


Fig. 113. - Vulpia bromoides

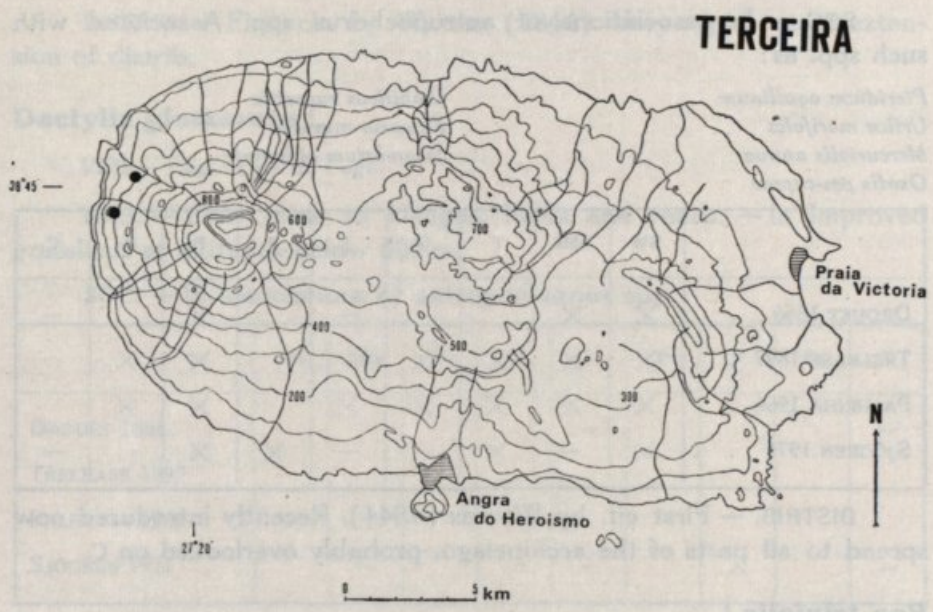


Fig. 114. - Vulpia bromoides

SOC. — In associations of antropochorus spp. Associated with such spp. as:

Pteridium aquilinum
Urtica morifolia
Mercurialis annua
Oxalis pes-caprae
Umbilicus rupestris
Fumaria muralis
Sisymbrium officinale

	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 now spread to all parts of the archipelago, probably overlooked on C.

Poa trivialis L.

EXS. — S. Miguel: Lag. do Congro (Sjn 65: U). — Pico: Torrinhas, 1000 m (Sjn 68: U). — Faial: Bottom of Caldeira (Sjn 68: U).

VIDI — S. Miguel: Rib. Quente, coast. — Pico: Lag. Sêca. — Flores: Rib. da Fazenda, 100 m.

HAB. — Large altitude range. — In permanently moist habitats, close to small streams around lakes, also close to low water level.

SOC. — Generally in the *Juniperion brevifolii* also in grassland of this all., u. c.:

Festuca jubata
Osmunda regalis
Cardamine caldeirarum
Culcita macrocarpa
Centaurium scilloides ssp.
Hypericum undulatum
Tolpis azorica
Luzula purpureo-splendens

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

DISTRIB. — First cit. by WATSON (1844). Very rapid recent extension of distrib.

Dactylis glomerata L.

VIDI — Faial: Cab. do Fogo.

HAB. — Only close to villages, fields and roads. — In improved grassland at altitudes below 600 m.

SOC. — In associations of antropochorous spp.

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

DISTRIB. — First cit. by PALHINHA (1966). Introduced recently. Probable extension of distrib. in the near future.

Briza maxima L.

VIDI — S. Miguel: Rib. Quente. Ginetes. Faial da Terra. — Terceira: Miradouro da Serreta, 180 m. W of Porto Judeu. Salga. — Pico: Mist. St. Luzia, 80 m. Lavafield E of Cais do Pico, 290 m. Cais-S. Roque. — Faial: Coast W of Horta. Varadouro. New lighthouse, Capelinhos. Porto Pim.

HAB. — Preferentially below 300 m. — In dry, strongly exposed habitats, both on sandy deposits and on accumulated sand-humus in micro-crevices on coastal cliffs and young lava flows.

SOC. — In antropochorous associations as well as in the *Festucion petraeae*.

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

DISTRIB. — First cit. by Seubert & Hochstetter (1843). Probably old member of the Azorean vegetation with recently extended distrib.

Briza minor L.

EXS. — Terceira: Canada da Luz, 100 m (Sjn 65: U).

VIDI — Terceira; Terra Chã, 100 m. — Pico: Several localities. — Faial: Almoxarife.

HAB. — Preferentially below 300 m. — Ecological preference very similar to that of *B. maxima*.

SOC. — Recorded in antropochorous associations and in the *Festucion petraeae*.

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

DISTRIB. — As *B. maxima*.

Anisantha madritensis (L.) Nevski
(Fig. 115 and 116)

EXS. — S. Miguel: Pico do Salomão (Car 1898: AZ). — Terceira: No. loc. (Samp: AZ). — Pico: S. Roque, 10 m (Go 62: LISI). Mist. St. Luzia, 120 m (Go 62: LISFA). — Faial: Praia do Norte (Sjn 65: U). Lombega, 100 m (Go 62: LISI). — Flores: No loc. (Tr 1894: AZ). — Corvo: No loc. 200 m. (Go 64: LISI).

VIDI — Localities on maps. — Flores: 160 m, by road.

HAB. — Preferentially below 200 m. Only occasionally at higher altitudes. — In dry, strongly exposed habitats, very high drought tolerance. In sparse vegetation on lava flows, on loose and densely packed sand.

SOC. — Diff. sp. of the *Ornithopo-Gaudinietum*. Also in associations with numerous antropochorous spp. such as:

Poa annua
Polygonum aviculare
Polycarpon tetraphyllum
Briza maxima

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

DISTRIB. — First cit. by SEUBERT (1844). After recent introduction marked extension of distrib., which will certainly soon also reach SMa and G.

Anisantha rubens (L.) Nevski

EXS. — S. Miguel: Rib. Quente, coast (Sjn 65: U).

HAB. — Preferentially close to the coast. — Only recorded on sand-gravel, just above the coastal cliffs.

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

DISTRIB. — First cit. by SEUBERT & HOCHSTETTER (1843). Recent introduction. Unusually stable distrib. since then.

Ceratochloa unioloides (Willd.) P. Beauv.

EXS. — Terceira: Praia da Vitória (Sjn 65: U).

VIDI — Faial: Castelo Branco.

HAB. — Observed only below 300 m.

SOC. — Recorded growing u. c. such spp. as:

Veronica agrestis
Lotus subbiflorus
Brevipodium silvaticum
Plantago alnceolata
Fumaria muralis
Silene gallica
Trifolium dubium

Fig. 115. - Anisantha madritensis

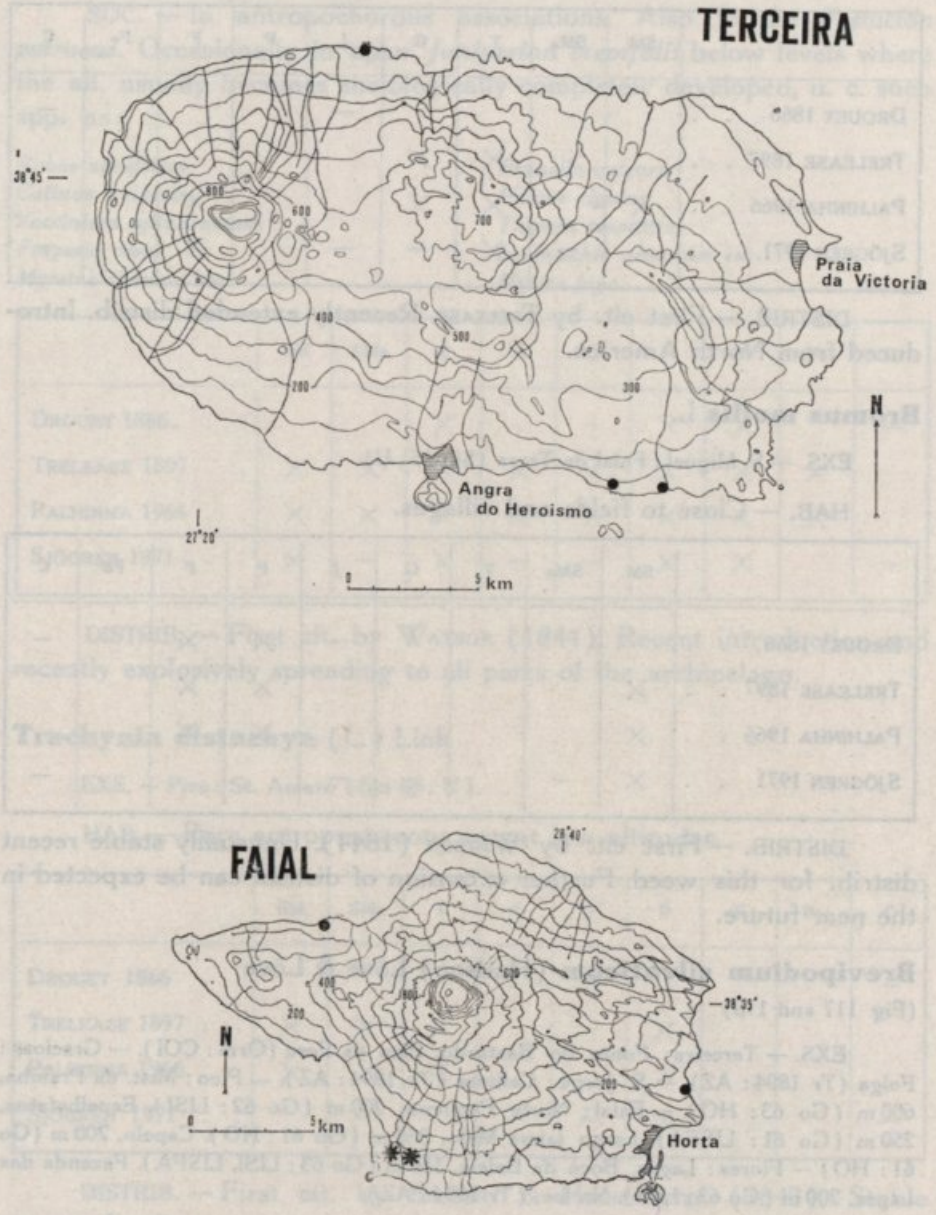


Fig. 116. - Anisantha madritensis

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

DISTRIB. — First cit. by TRELEASE. Recently extended distrib. Introduced from North America.

Bromus mollis L.

EXS. — S. Miguel: Faial da Terra (Sjn 65: U).

HAB. — Close to fields and villages.

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

DISTRIB. — First cit. by WATSON (1844). Unusually stable recent distrib. for this weed. Further extension of distrib. can be expected in the near future.

Brevipodium silvaticum (Hudson) Löve & Löve

(Fig. 117 and 118)

EXS. — Terceira: Fonte do Bastardo, Pico da Fora (Orm: COI). — Graciosa: Folga (Tr 1894: AZ). — S. Jorge: Calheta (Tr 1894: AZ). — Pico: Mist. da Prainha, 600 m (Go 63: HO). — Faial: Norte Pequeno, 200 m (Go 62: LISI). Espalhafatos, 250 m (Go 61: LISFA). Largo Jaime Melo, 250 m (Go 61: HO). Capelo, 200 m (Go 61: HO) — Flores: Lages, Boca da Baleia, 150 m (Go 63: LISI, LISFA). Fazenda das Lages, 200 m (Go 63: LISI). No loc. (Tr 1894: AZ).

VIDI — Localities on maps.

HAB. — Seems to be restricted to altitudes below 300 m., only occasionally up to 600 m. — In rather dry, strongly exposed habitats. No preference for any special kind of substratum has been observed.

SOC. — In antropochorous associations. Also in the *Festucion petraeae*. Occasionally in open *Juniperion brevifolii* below levels where the all. usually becomes sociologically completely developed, u. c. such spp. as:

Rubus ulmifolius
Calluna vulgaris
Vaccinium cylindraceum
Fragaria vesca
Myrsine africana var.
Prunella vulgaris
Holcus rigidus
Thymus cespititius
Lysimachia nemorum var.
Myrica faya

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

DISTRIB. — First cit. by Watson (1844). Recent introduction and recently explosively spreading to all parts of the archipelago.

Trachynia distachya (L.) Link

EXS. — Pico: St. Amaro (Sjn 68: U).

HAB. — Rare antropochorous sp., at low altitudes.

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

DISTRIB. — First cit. by Seubert & Hochstetter (1843). Stable recent distrib.

Hordeum murinum L.

EXS. — Faial: Castelo Branco (Sjn 65: U). Porto Pim (Sjn 68: U).

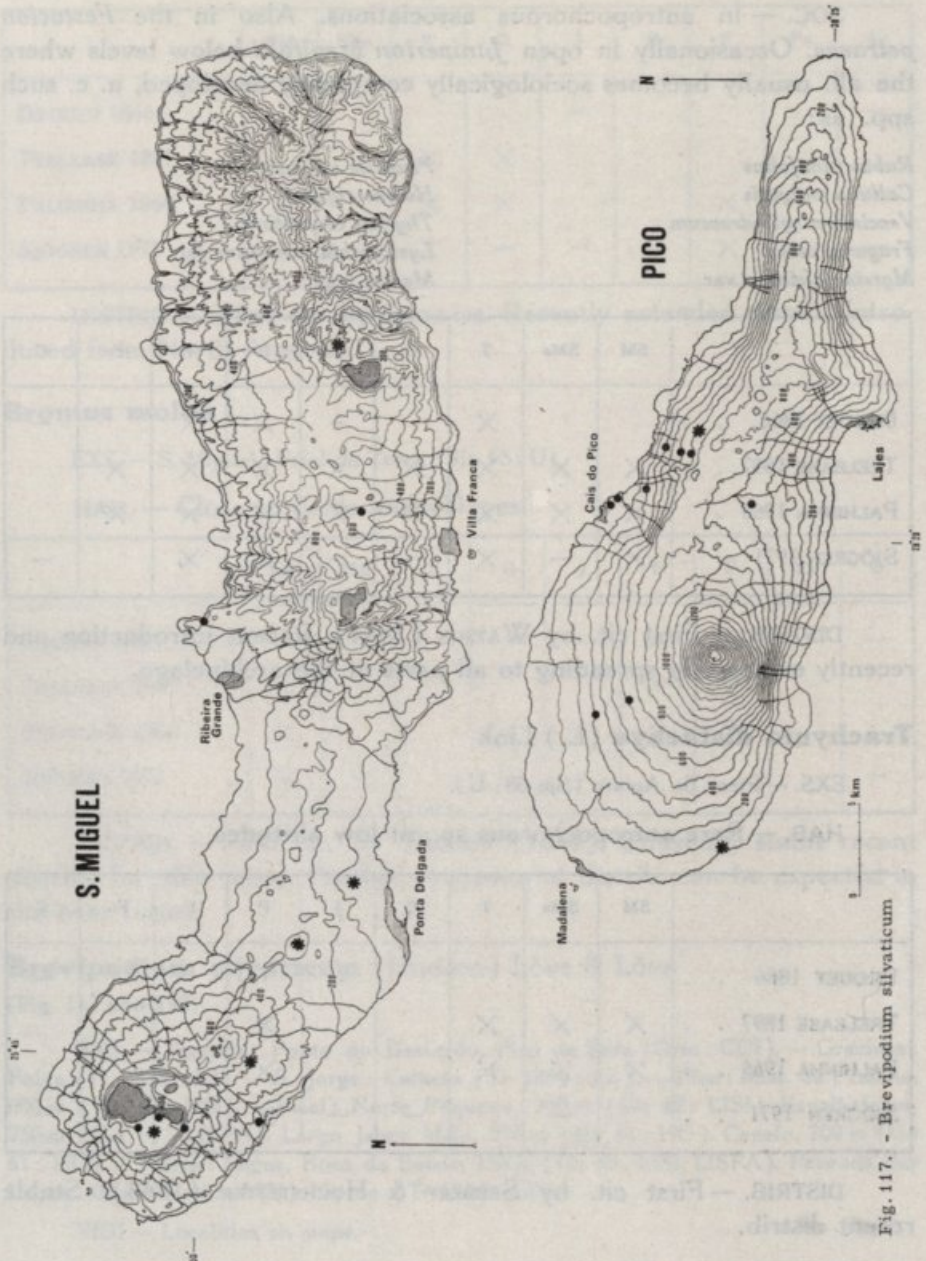


Fig. 117. - Brevipodium silvaticum

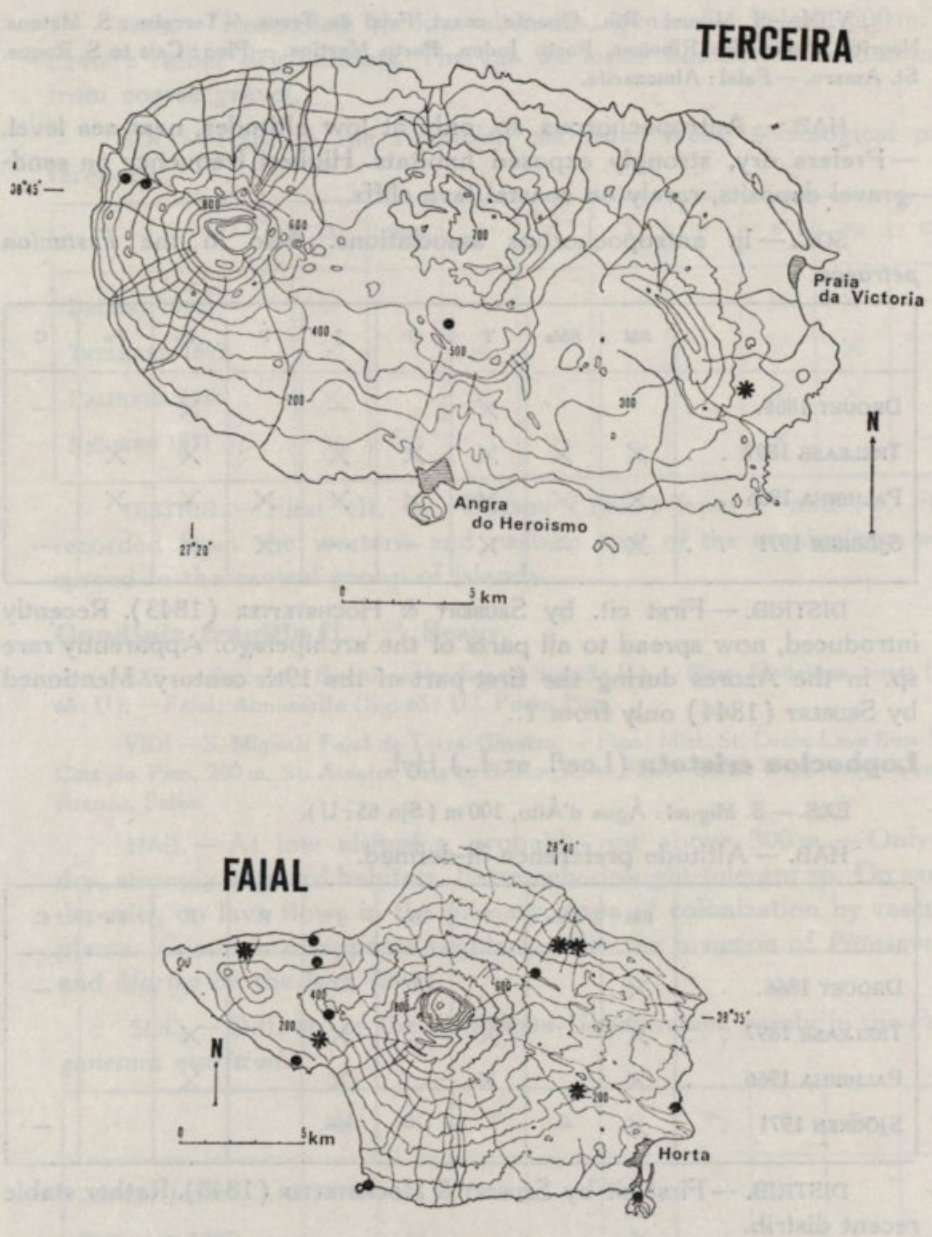


Fig. 118. - Brevipodium silvaticum

VIDI — S. Miguel: Rib. Quente, coast. Faial da Terra. — Terceira: S. Mateus. Negrito. Ponte das Ribeiras. Porto Judeu. Porto Martins. — Pico: Cais to S. Roque. St. Amaro. — Faial: Almoxarife.

HAB. — Antropochorous sp. only at low altitudes, near sea level. — Prefers dry, strongly exposed habitats. Highest frequency on sand--gravel deposits, rarely on coastal lava cliffs.

SOC. — In antropochorous associations. Also in the *Festucion petraeae.*

	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 introduced, now spread to all parts of the archipelago. Apparently rare sp. in the Azores during the first part of the 19th century. Mentioned by Seubert (1844) only from T.

Lophocloa cristata (Loefl. ex L.) Hyl.

EXS. — S. Miguel: Água d'Álto, 100 m (Sjn 65: U).

HAB. — Altitude preference ill-defined.

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

DISTRIB. — First cit by Seubert & Hochstetter (1843). Rather stable recent distrib.

Arrhenatherum elatius (L.) P. Beauv. ex J. & C. Presl

EXS. — Faial: Castelo Branco, coast, var. *bulbosum* (Sjn 68: U).

VIDI — S. Miguel: Rib. Quente, coast. — Faial: N of Caldeira, 650 m.

HAB. — Restricted to low altitudes, generally below 600 m. — Prefers rather dry habitats. The var. *bulbosum* has been recorded only from coarse gravel.

SOC. — Rare in the *Festucion petraeae*. Weak sociological preference.

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

DISTRIB. — First cit. by WATSON (1844) from F and Fo. First recorded from the western and eastern part of the archipelago, now spread to the central group of islands.

Gaudinia fragilis (L.) P. Beauv.

EXS. — Terceira: Biscoitos, harbour (Sjn 68: U). — Pico: Madalena, coast (Sjn 65: U). — Faial: Almoxarife (Sjn 65: U). Porto Pim.

VIDI — S. Miguel: Faial da Terra. Ginetes. — Pico: Mist. St. Luzia. Lava flow E of Cais do Pico, 290 m. St. Amaro. Cais to S. Roque. — Faial: Coast W of Horta. Castelo Branco. Salão.

HAB. — At low altitudes, probably not above 300 m. — Only in dry, strongly exposed habitats. Extremely drought-tolerant sp. On sandy deposits, on lava flows in the primary stage of colonization by vascular plants. *Gaudinia* disappears regularly after the invasion of *Pittosporum* and *Myrica* on the lava flows.

SOC. — Diff. sp. of the *Ornithopo-Gaudinietum*, rarely in the *Polygonetum maritimi*.

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

DISTRIB. — First cit. by TRELEASE. Recently introduced, now spread to all the archipelago except the westernmost islands.

Holcus lanatus L.

VIDI — S. Miguel: Ginetes, Água d'Álto. Feteiras, 100 m. — Terceira: Salga. — Pico: Lag. Sêca. N of Cab. Redondo, 300 m. Cab. do Afonso, 700 m. St. Amaro. W of Lag. Caiado, 820 m. Cais to S. Roque. — Faial: Coast W of Horta. Castelo Branco. New lighthouse of Capelinhos. N of Caldeira, 600 m. — Flores: Porto S. Pedro.

HAB. — In PALHINHA attributed mainly to altitudes above 600 m. Now known from 0-900 m. No evidence of preference for localities above 600 m. — Usually in strongly exposed but moist habitats. Rather high drought tolerance. Recorded on lava cliffs, in moist open grassland, on densely packed sand deposits by the coast. Around lakes, usually above but also just below high water level.

SOC. — In grassland of the *Juniperion brevifolii*, u. c.:

Plantago lanceolata
Leontodon taraxacoides
Anthoxanthum odoratum
Lotus uliginosus
Prunella vulgaris
Potentilla erecta
Pteridium aquilinum
Anagallis tenella

Rarely in the *Litorello-Eleocharion*. Recorded also from the *Ornithopo-Gaudinietum*.

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

DISTRIB. — First. cit. by WATSON (1844). Recent extension of distrib. has apparently reached all islands of the archipelago after a few years.

Holcus rigidus Hochst. ex Seub.

(Fig. 119 and 120)

EXS. — S. Miguel: Sete Cidades (Sjn 65: U). — Terceira: Cald. do Guilh. Moniz (Sjn 68: U). — Pico: Cabouco, 500 m (Go 63: LISI). Mist. da Praínha, 200 and 600 m (Go 63: LISI). — Faial: Abreu, in pastures, 470 m (Ds 64: LISE). Capelo,

near Farol dos Capelinhos, 100 m (Ds 64: LISE). Rib. do Cabo, 300 m (Go 62: LISI). E of Cab. dos Trinta, 850 m (Go 62: HO). Levada, 650 m. Castelo Branco (Sjn 68: U). S. Miguel: Rib. Grande, Miradouro de St. Iria, 75 m (Ds 64: LISE). Achada das Furnas, 800 m (Rego 25: LISI). Caldeiras (Car 99: COI). Termo to Grota de João Luiz (Car 05: AZ). Termo da Lagoa (Car 02: AZ). — Flores: Above Fazenda, 160 m (Ds 64: LISE). St. Cruz, além Fazenda, 200 m (Go 64: LISI). — Corvo: No loc. (Tr 1894: AZ).

VIDI — Localities on maps. — Flores: Sapateira, 410 m. 160 m by road on cliff.

HAB. — In PALHINHA attributed to altitudes above 600 m. Now known from localities below 100 m up to 1350 m. There is a preference for altitudes above 400 m. — Usually in wet, strongly exposed habitats. In open grassland, around hot springs and in localities where hot steam evaporates. On thick humus layers on steep slopes. Around lakes, just above or below high water level. On rather dry hummocks in dense *Eleocharis multicaulis* carpet in grassland or around lakes. At low altitudes on lava flows where a *Pittosporum-Myrica-Erica* scrub gives effective protection against strong exposure. On N-exposed cuttings through densely packed slightly irrigated sandy deposits. Rarely on dry black coarse gravel deposits.

SOC. — Highest frequency in the *Erico-Myrsinetum*, also in open grassland originating from this ass., and in the *Festucetum jubatae*. In transitions between the *Juniperion brevifolii* and the *Litorello-Eleocharion*. Only weak diff. val. towards the *Festucion petraeae*.

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

DISTRIB. — First cit. by SEUBERT & HOCHSTETTER (1843). Probably very old member of the Azorean vegetation. No marked recent extension of distrib.

Deschampsia foliosa Hack.

(Fig. 121 and 122)

EXS. — S. Miguel: Serra de Água de Pau, Pico da Barrosa, 900 m (Ds 64: LISE). Lameiro (Car 1898: AZ). — Terceira: In Cald. St. Bárbara, 800 m (Sjn 65: U). Bottom

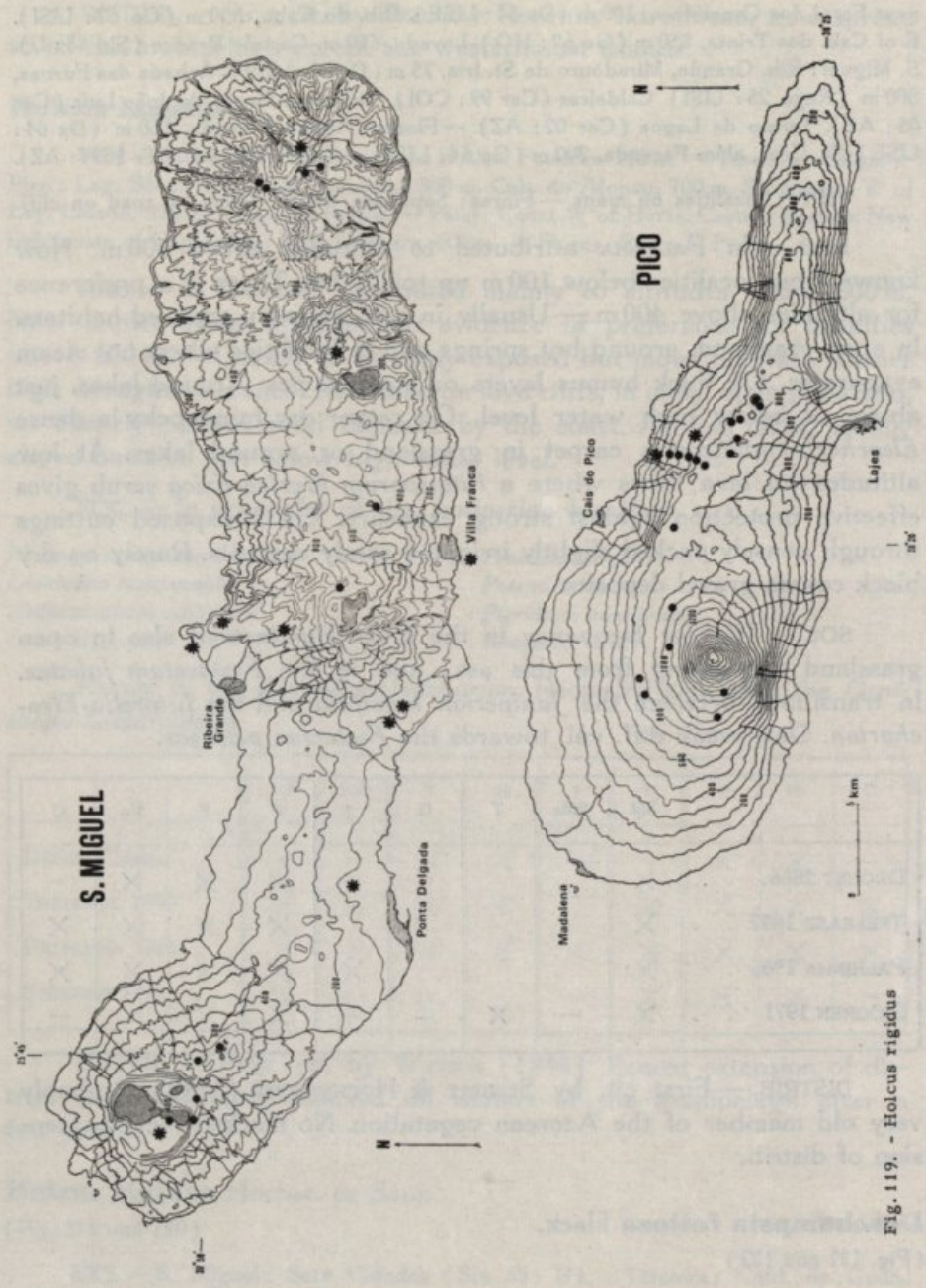
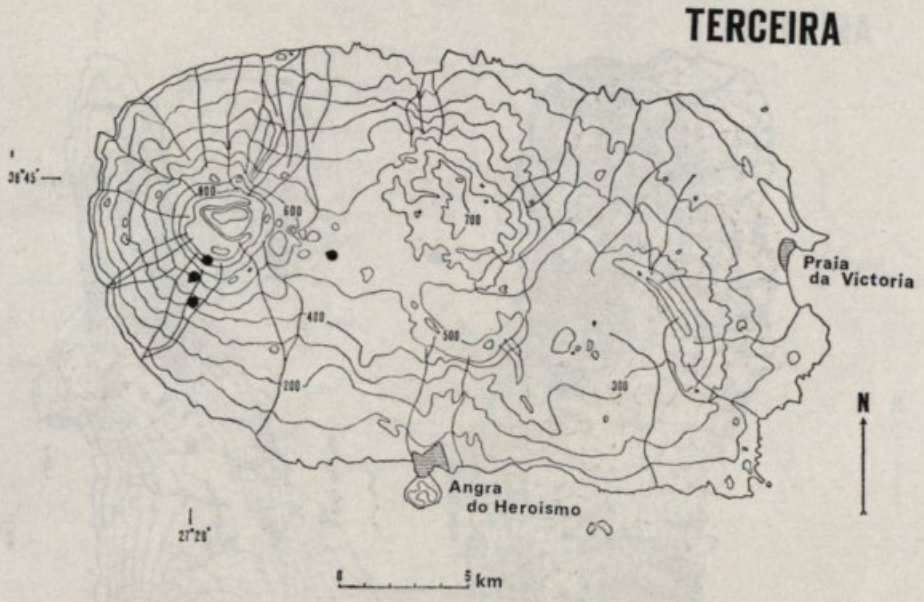


Fig. 119. - Holcus rigidus



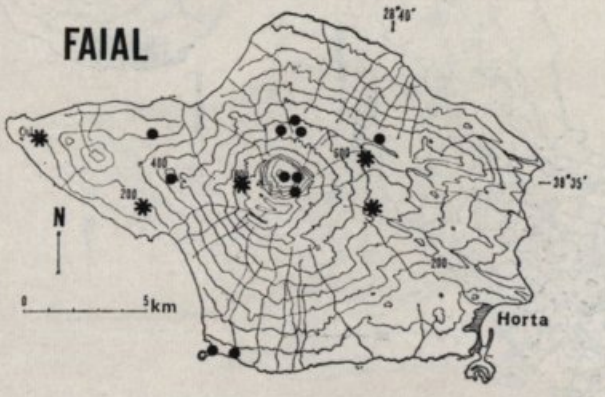
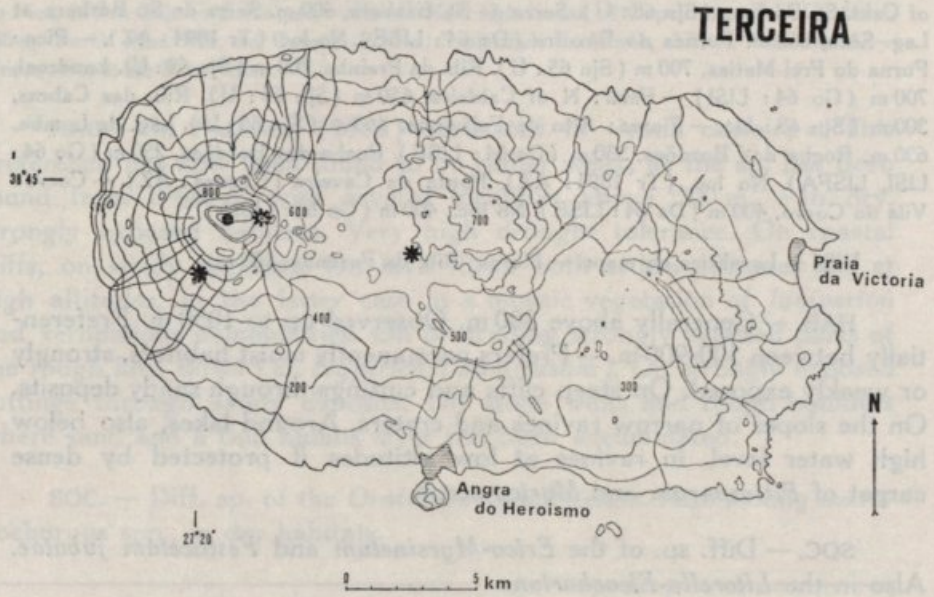


Fig. 120. - Holcus rigidus

Fig. 121. - Deschampsia foliosa



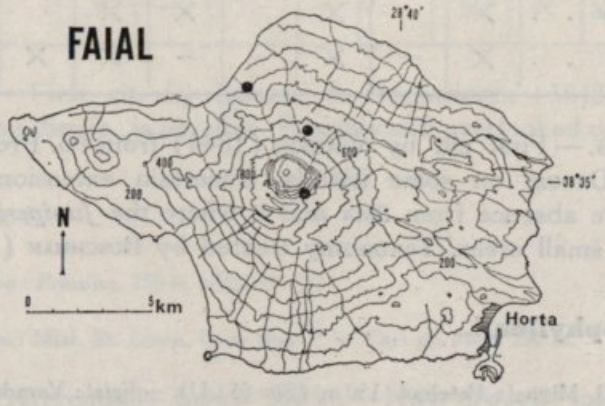


Fig. 122. - Deschampsia foliosa

of Cald. St. Bárbara (Sjn 68: U). Serra de St. Bárbara, 600 m. Serra de St. Bárbara at Lag. Sêca, 850 m. Furnas do Enxofre (Ds 64: LISE). No loc. (Tr 1894: AZ). — Pico: Furna do Frei Matias, 700 m (Sjn 65: U). Rib. da Praínha, 200 m (Sjn 68: U). Landroal, 700 m (Go 64: LISI). — Faial: N of Caldeira, 650 m (Sjn 65: U). Rib. das Cabras, 300 m (Sjn 68: U). — Flores: Alto da Fajãzinha, 460 m (Sjn 65: U). Lag. da Lomba, 630 m. Rocha dos Bordões, 330 m (Ds 64: LISE). Rocha dos Bordões, 250 m (Go 64: LISI, LISFA). No loc. (Tr 1894: AZ). Ponta da Caveira (Chaves: AZ). — Corvo: Vila do Corvo, 400 m (Ds 64: LISE). No loc., 400 m (Go 66: LISI).

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

HAB. — Generally above 300 m. Observed up to 1050 m. Preferentially between 500-900 m. — Prefers permanently moist habitats, strongly or weakly exposed. On steep cliffs and cuttings through sandy deposits. On the slopes of narrow ravines and craters. Around lakes, also below high water level. In ravines at low altitudes if protected by dense carpet of *Pittosporum* and *Myrica* scrub.

SOC. — Diff. sp. of the *Erico-Myrsinetum* and *Festucetum jubatae*. Also 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 Watson (1844) from Fo. Probably overlooked by Drouet on some islands. Uncertain extension of distrib. Characteristic absence from SMa and G where the *Juniperion brevifolii* covers only small areas. Taxonomy treated by Buschman (1950).

Aira caryophyllea L.

EXS — S. Miguel: Feteiras, 150 m (Sjn 65: U). — Faial: Varadouro. Praia do Norte (Sjn 65: U).

VIDI — S. Miguel: Feteiras, 200 m. Sete Cidades, 250 m. Ginetes, coast. — Terceira: Pico Gordo, 500 m. Pico dos Negros, 540 m. Juncal, 570 m. Lava flow of 1761, 450 m. Cald. Guilh. Moniz, 420 m. — Pico: Mist. St. Luzia, 80 m. Lava flow E of Cais

do Pico, 290 m. Cais to S. Roque. — Faial: New lighthouse of Capelinhos. N of Caldeira, 680 m. Porto Pim. Rib. do Cabeço, 670 m. S of Praia do Norte, 170 m. Almoxarife. — Flores: Porto de São Pedro.

HAB. — In PALHINHA (1966) attributed to «zona costeira». This preference has now been found to be rather weak, as the sp. has been found from 0-680 m with several localities above 300 m. — In dry, strongly exposed habitats. Very high drought tolerance. On coastal cliffs, on sandy deposits. On lava flows both at low altitudes and at high altitudes, in the latter case in a mosaic vegetation of *Juniperion* and xerophilous communities. On protruding strongly exposed parts of the rough lava flows (cf. *Hypericum humifusum*). On strongly exposed cuttings through sandy deposits. On stone walls and rough boulders where sand and a thin humus layer has been accumulated.

SOC. — Diff. sp. of the *Ornithopo-Gaudinietum*. Also among antropochorous spp., in dry habitats.

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

DISTRIB. — First cit. by SEUBERT & HOCHSTETTER (1843). Recent extension of the distrib. is possible. Possibly still overlooked on G and C.

Aira praecox L.

EXS. — Pico: Prainha, 250 m (Sjn 65: U).

VIDI — Pico: Mist. St. Luzia. Lava flow E of Cais do Pico, 290 m.

HAB. — Preferentially below 300 m. — High drought tolerance, on lava flows with sparse cover of vascular plants in the primary stage of colonization.

SOC. — Diff. sp. with the same diff. val. as *A. caryophylla*.

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

DISTRIB. — First cit. by TRELEASE. Now spreading within the archipelago.

Agrostis acutiglumis Tutin & Warburg

EXS. — Pico: N slope of Pico, 2075 m (Sjn 65: U).

HAB. — Only at high altitudes above 600 m, as stated by PALHINHA (1966). — Only recorded growing on dry coarse black gravel deposits in habitats with permanently high RH.

SOC. — Recorded from the *Juniperion brevifolii.*

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

DISTRIB. — First cit. by TUTIN & WARBURG (1932). Stable distrib.

Agrostis azorica (Hochst.) Tutin & Warburg

EXS. — Pico: Cima, 2340 m (Go 64: LISI). Serra de Madalena, 700 m (Go 63: LISI, LISFA). — Faial: Lagoa Capelo, 500 m (Go 63: LISI). — Flores: Lag. da Lomba, 600 m (Go 64: LISFA).

HAB. — Probably only at high altitudes, above 500 m and not in «zona costeira» (PALHINHA 1966). — Hygrophilous sp.

SOC. — In the *Erico-Myrsinetum* at the highest altitudes where the ass. is incompletely developed.

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

DISTRIB. — First cit. by SEUBERT & HOCHSTETTER (1843). This sp. might have been overlooked on some islands by earlier botanists visiting the Azores.

Agrostis congestiflora Tutin & Warburg

EXS. — Pico: Piquinho, on rocks, 2340 m (Ds 64: LISE).

HAB. — Observed only at high altitudes. — This sp. can tolerate the dry conditions on coarse gravel deposits only if RH is permanently high (cf. *A. acutiglumis*).

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

DISTRIB. — First cit. by SEUBERT & HOCHSTETTER (1843). Probably no recent extension of distrib.

Agrostis castellana Bss. & Reuter

(Fig. 123 and 124)

EXS. — S. Miguel: Sete Cidades (Sjn 65: U). Caldeiras (Car 1897: AZ). Lagoa (Car 03: AZ). Serra de Água de Pau, Pico da Barrosa, 900 m. Povoação, Lomba de João Loução, 175 m (Ds 64: LISE). Lomba dos Homens, 300 m (Cy 58: LISI). Pico da Vara (Car 05: AZ). Pico da Cruz (Car 1894: AZ). Rego d'Água (Car 03: AZ). — Terceira: Cald. Guilh. Moniz. (Sjn 65: U). Estrada das Doze, near Pico da Falsa (Orm: COI). Escampadoiro (Orm: COI). — Pico: Mist da Prainha, 450 m (Go 63). Lag do Caiado, 750 m (Go 65). Mist. N of Cab. Redondo, 780 m (Sjn 68: U). W slope of Pico, 1450 m

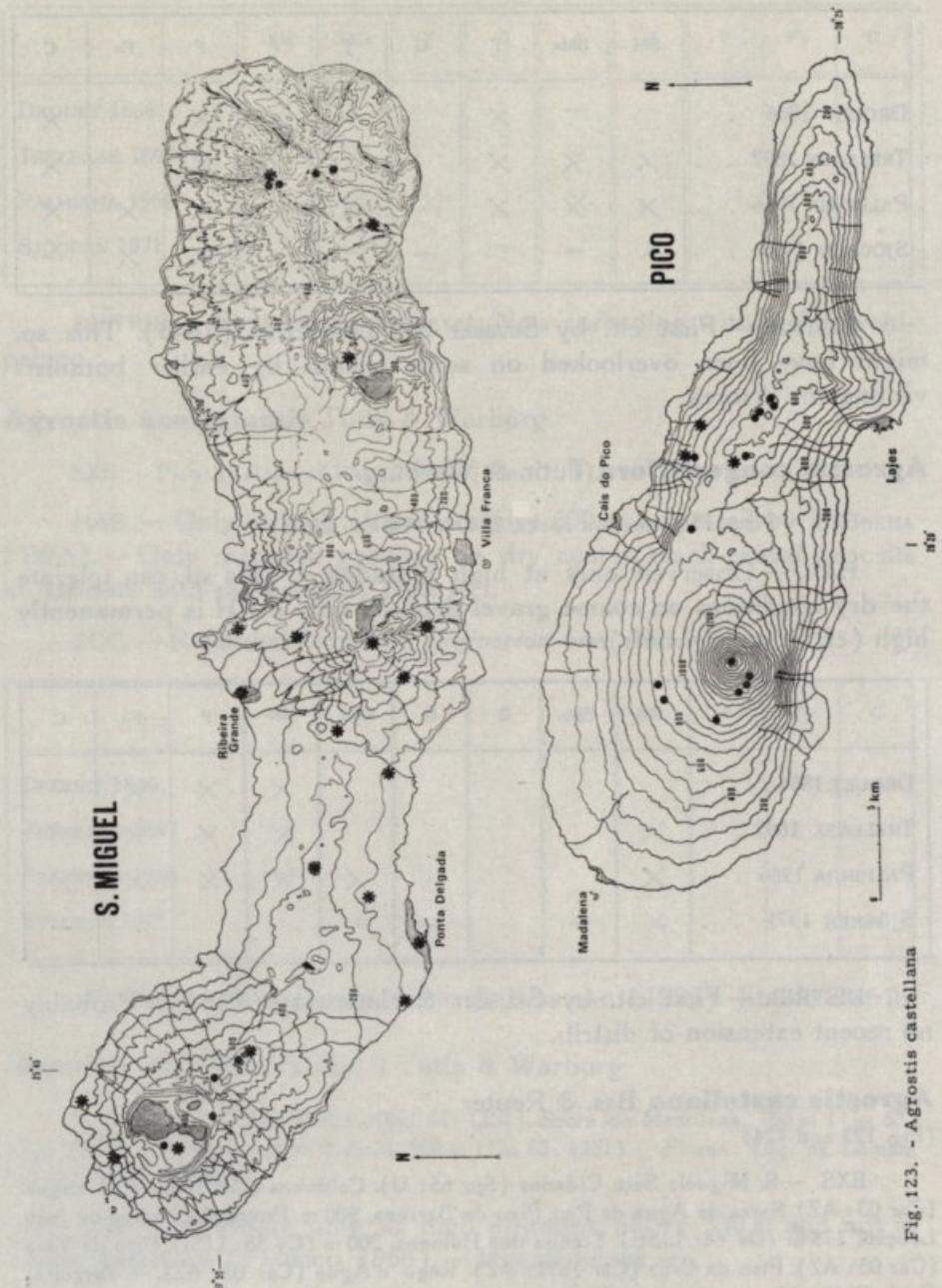
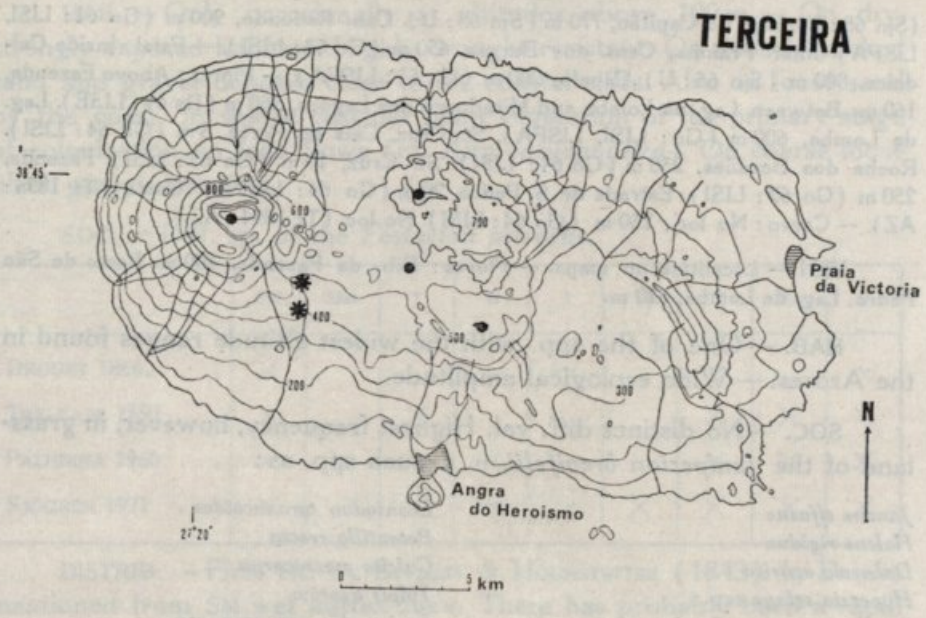


Fig. 123. - Agrostis castellana



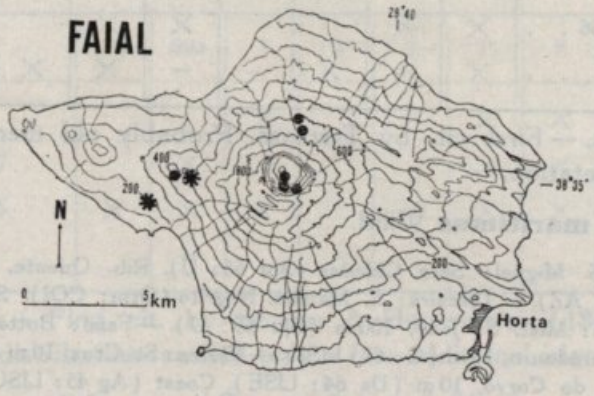


Fig. 124. - Agrostis castellana

(Sjn 68: U). Lag. do Capitão, 770 m (Sjn 68: U). Cab. Redondo, 900 m (Go 61: LISI, LISFA). Mist. Prainha, Cam. dos Burros, 450 m (Go 63: LISI). — Faial: Inside Caldeira, 800 m (Sjn 65: U). Capelo, 200 m (Go 61: LISFA). — Flores: Above Fazenda, 160 m. Between Lag. da Lomba and Miradouro das Lagoas, 560 m (Ds 64: LISE). Lag. da Lomba, 600 m (Go: LISI, LISFA). St. Cruz, Cais do Porto, 3 m (Go 64: LISI). Rocha dos Bordões, 250 m (Go 64: LISI). St. Cruz, 10 m (Go 63: LISI). Fazenda, 250 m (Go 62: LISI). Estrada de S. Pedro, 20 m (Go 64: LISFA). Costa (Tr 1894: AZ). — Corvo: No loc., 250 m (Go 64: LISI). No loc. (Tr 1894: AZ).

VIDI — Localities on maps. — Flores: Rib. da Fazenda, 100 m. Porto de São Pedro. Lag. da Lomba, 620 m.

HAB. — One of the spp. with the widest altitude ranges found in the Azores. — Wide ecological amplitude.

SOC. — No distinct diff. val. Highest frequency, however, in grassland of the *Juniperion brevifolii*, u. c. such spp. as:

Juncus effusus
Holcus rigidus
Daboecia azorica
Huperzia selago ssp.
Luzula purpureo-splendens
Leontodon taraxacoides
Potentilla erecta
Culcita macrocarpa
Tolpis azorica
Lysimachia nemorum ssp.

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

DISTRIB. — First cit. by Trelease. Probably old member of the Azorean vegetation.

Polypogon maritimus Willd.

EXS. — S. Miguel: Sete Cidades (Sjn 65: U). Rib. Quente, coast. Lagoa, coast (Car 02: AZ). — Terceira: S. Mateus, Negrito (Orm: COI). S. Mateus (Sjn 65: U). — Pico: Mist. S. João, 100 m (Sjn 65: U). — Faial: Bottom of Caldeira (Sjn 68: U). Varadouro, 15 m (Go 62: LISI). — Flores: St. Cruz, 10 m (Go 65: LISI). — Corvo: Vila do Corvo, 10 m (Ds 64: LISE). Coast (Ag 45: LISU). No loc. (Tr 1894: AZ).

VIDI — S. Miguel: Rib. Quente. Ginetes, Faial da Terra. Água d'Alto. — Terceira: Ponte das Ribeiras. W of Porto Judeu. Porto Judeu. Salga. Porto Martins. Ponta da Vila Nova. — Pico: St. Amaro. Cais to S. Roque. E of Cachorro. — Faial: Feteiras. Harbour of Castelo Branco. Salão. Varadouro. New lighthouse of Capelinhos. Porto Pim

HAB. — Only occasionally at altitudes above 100 m. — On dry, strongly exposed habitats. Highly drought resistant. On densely packed sand and gravel deposits close to the coastal cliffs. Also on loose sand by the coast. In sparse vascular plant vegetation of the primary stage of colonization on lava flows (cf. *Aira caryophyllea*). On coarse loose black gravel deposits.

SOC. — Diff. sp. of the *Festucion petraeae*.

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

DISTRIB. — First cit. by Seubert & Hochstetter (1843). In Drouet mentioned from SM «et autres îles». There has probably been a rapid recent extension of distrib. Coastal topography on J offers fewer localities with suitable habitat conditions for this sp. than on the other islands of the archipelago.

Polypogon monspeliensis (L.) Desf.

HAB. — Restricted to altitudes below 300 m.

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

DISTRIB. — First cit. by Seubert & Hochstetter (1843). Recent extension of distrib. has reached only a few additional islands.

Gastridium ventricosum (Gouan) Schinz & Thell.

EXS. — S. Miguel: Ginetes, coast (Sjn 65: U).

HAB. — At low altitudes, probably rarely above 300 m. Only observed growing on densely packed sandy deposits.

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

DISTRIB. — First cit. by FORSTER (1787). Apparently no marked recent extension of distrib. Two synonyms, *G. australe* and *G. lendigerum*, mentioned by DROUET.

Lagurus ovatus L.

HAB. — Altitude preference ill-defined.

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

DISTRIB. — First cit. by SEUBERT & HOCHSTETTER (1843). There has been a recent extension of distrib.

Sporobulus indicus (L.) R. Br.

EXS. — Faial: Varadouro. Castelo Branco (Sjn 65: U).

VIDI — Pico: Miradouro do Cais do Pico. Cais to S. Roque. — Faial: Several localities.

HAB. — Preferentially below 300 m — Highest frequency on dense sandy deposits.

SOC. — In antropochorous associations, u. c. such spp. as:

Malva rotundifolia
Urtica morifolia
Stellaria media
Galinsoga parviflora
Sisymbrium officinale
Mercurialis annua
Poa annua
Oxalis pes-caprae
Fumaria muralis
Rubus ulmifolius

	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. Now spreading to all parts of the archipelago.

Anthoxanthum odoratum L.

EXS.! — Terceira: Furnas do Enxofre (Sjn 65: U).

VIDI — S. Miguel: Sete Cidades, 240 m, E of Vista do Rei. Lag. do Fogo, 770 m. Lake between Lag. do Congro and Lag. do Fogo, 580 m. Lag. das Empadadas, 720 m. Pico da Vara, 1000-1100 m. — Terceira: Cald. Guilh. Moniz, 420 m. — Pico: Torrinhas, 890 and 1100 m. Cab. do Afonso, 700 m. W of Lag. do Caiado, 820 m. Lag. Landroal. N slope of Pico, 1060 m. W slope of Pico, 1150 m. — Faial: N of Caldeira, 600 m. — Flores: Sapateira, 410 m.

HAB. — In PALHINHA (1966) attributed to pastures above 600 m. Now observed from 240-1150 m. Preferentially above 400 m. — In dense grassland vegetation, frequent in rather moist habitats, often in dense carpets of *Eleocharis multicaulis*. Around lakes, above and just below high water level. On moist cuttings through sandy deposits.

SOC. — In grassland within the *Juniperion brevifolii*, u. c.:

Calluna vulgaris
Holcus rigidus
Prunella vulgaris
Fragaria vesca
Lysimachia nemorum ssp.
Leontodon taraxacoides
Holcus lanatus
Potentilla erecta
Thymus cespititius
Luzula purpureo-splendens

In the *Litorello-Eleocharion*, mainly in transitions towards the *Juniperion brevifolii*, u. c.:

Juncus effusus
Hydrocotyle vulgaris
Anagallis tenella
Leontodon taraxacoides
Prunella vulgaris
Scirpus fluitans
Eleocharis multicaulis
Cardamine caldeirarum

	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 extension of distrib. Possibly overlooked on SMa and G. Now becoming more frequent on all islands in new cleared grassland for grazing at high altitudes.

Anthoxanthum aristatum Bss.

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

HAB. — Altitude and ecological preference indistinct.

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

DISTRIB. — First cit. by PALHINHA (1966). Introduced recently.

Nardus stricta L

EXS — S. Miguel: Lag. do Canário, 750 m (Sjn 65: U).

VIDI — S. Miguel: Pico da Vara, 700-1100 m.

HAB. — Rare sp., preferentially above 600 m. — Restricted to wet, strongly exposed habitats, in open grassland and around lakes, also below high water level.

SOC. — In grassland vegetation within the *Juniperion brevifolii*, u. c.:

Rubus hochstetterorum
Sieglingia decumbens
Eleocharis multicaulis
Lysimachia nemorum ssp.
Luzula purpureo-splendens
Calluna vulgaris
Holcus rigidus
Juncus effusus
Agrostis castellana
Blechnum spicant

DISTRIB. — First cit. by DROUET (observation by WATSON). Remarkably, restricted to SM, though suitable habitats of the same type as on SM are available on T, J, P, F and Fo.

Spartina patens (Ait.) Muhl.

VIDI — Faial: Almoxarife.

HAB. — Below 300 m. On sandy-gravelly deposits.

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

DISTRIB. — First cit. by PALHINHA (1966). Introduced recently.

Eleusine indica (L.) Gaertner

HAB. — Probably only rarely above 300 m.

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

DISTRIB. — First cit. by SEUBERT & HOCHSTETTER (1843). Very rapid recent extension of distrib.

Cynodon dactylon (L.) Pers.

EXS. — Terceira: Praia da Vitória (Sjn 65: U). — Faial: Porto Pim (Sjn 65: U).

VIDI — S. Miguel: Sete Cidades, 250 m. Rib. Quente. Faial da Terra. Água d'Álto — Terceira: Salga. Praia da Vitória — Pico: Prainha de Baixo. Cais to S. Roque.

Madalena. — Faial: W of Horta, coast. Feteiras. Harbour Castelo Branco. 2 km W of Horta. Praia de Norte. Almoxarife. — Flores: Porto São Pedro.

HAB. — Preferentially below 300 m. — In dry, strongly exposed habitats. Preferentially on sandy deposits, including loose sandy soil by coasts, stabilizing the sand drift. On rough lava flows where sand has accumulated in crevices.

SOC. — In the *Ornithopo-Gaudinietum* and in transitions towards the *Euphorbietum azoricae*, u. c.:

Hordeum murinum
Anisantha madritensis
Festuca petraea
Atriplex hastata var.
Chenopodium ambrosioides
Polypogon maritimus
Plantago coronopus
Briza maxima
Gnaphalium luteo-album
Ornithopus pinnatus

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

DISTRIB. — First cit. by SEUBERT & HOCHSTETTER (1843). Recent extension of distrib. has apparently been very rapid. Mentioned by SEUBERT (1844) only from F.

Paspalum distichum L.

EXS. — Faial: Castelo Branco (Sjn 68: U). Porto Pim (Sjn 65: U).

VIDI — Faial: Feteiras.

HAB. — Antropochorous sp., generally below 300 m. — Wide ecological amplitude.

SOC. — 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 DROUET (observation by MORELET). Extremely rapid recent extension of distrib. to all parts of the archipelago.

Echinochochloa crus-galli (L.) P. Beauv.

HAB. — Probably only below 300 m.

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

DISTRIB. — First cit. by WATSON (1844). Recent extension of distrib.

Digitaria sanguinalis (L.) Scop.

EXS. — Faial: Varadouro (Sjn 65: U).

VIDI — Faial: Feteiras. New lighthouse of Capelinhos.

HAB. — Only below 300 m. — Seems to prefer loose sandy deposits in dry, strongly exposed habitats.

SOC. — Sociological preference ill-defined. Recorded from the *Festucion petraeae.*

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

DISTRIB. — First cit. by SEUBERT & HOCHSTETTER (1843). Explosive recent extension of distrib.

Setaria glauca (L.) P. Beauv.

EXS. — Pico: Largo da Areia, Madalena, coast (Sjn 68: U).

HAB. — Close to villages, fields, pastures at low altitudes.

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

DISTRIB. — First. cit. by SEUBERT & HOCHSTETTER (1843). Recent extension of distrib. Mentioned by SEUBERT (1844) only from P.

Setaria verticillata (L.) P. Beauv.

HAB. — Altitude preference indistinct.

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

DISTRIB. — Cit. by DROUET. Observation on T by MORELET and on F by WATSON (1844). Recent extension of distrib.

Cenchrus tribuloides L.

VIDI — Faial: New lighthouse of Capelinhos.

HAB. — On loose sandy deposits.

DISTRIB. — First cit. by PALHINHA (1966). Only on F.

ZINGIBERACEAE

Hedychium gardnerianum Roscoe

VIDI — S. Miguel: E of Vista do Rei. — Terceira: Pico das Perdelas, 450 m. Mata da Serreta, 200 m. — Pico: Cais to S. Roque. — Faial: Cab. do Fogo. Alto da Pedreira, 500 m.

HAB. — Introduced and naturalized on most of the islands. Not above 800 m. — Prefers permanently moist not necessarily weakly exposed habitats, in open grassland, on steep slopes and in the bottom of ravines.

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

DISTRIB. — First cit. by TRELEASE. There has been a very rapid recent extension of distrib. of this newly introduced plant. It has an extremely strong competitive ability in the natural Azorean vegetation at high altitudes, especially where colonization has been favoured by cutting and overgrazing. This sp. is now a most dangerous threat to the survival of natural vegetation of the *Juniperion brevifolii* in the Azores and should be extinguished whereever new localities appear. Authorities on SMa, G and C should pay especial attention to any future invasion by *Hedychium*. The plant originates from N India (E Himalaya, Nepal, Sikkim).

ORCHIDACEAE

Serapias cordigera L.

EXS. — Pico: N of Torrinhas, 900 m (Sjn 68: U). Close to the transversal road, 600 m (Sjn 68: U). Furna Frei Matias, 800 m (Go: HO). Serra da Madalena, 700 m (Go 63: LISFA).— Faial: Cabouco, 550 m (Go: HO).

HAB. — Only at high altitudes, above 500 m. Probably not above 1000 m. — Observed only in wet, strongly exposed habitats in open grassland on a thick humus layers.

SOC. — Generally in grassland vegetation of the *Juniperion brevifolii*, also 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 Seubert & Hochstetter (1843). Probably old member of Azorean vegetation with no marked recent extension of distrib. Possibly still overlooked on Fo and C.

Habenaria longebracteata Hochst. ex Seub.

EXS. — S. Miguel: Planalto dos Graminhais, Sebastião Alves, 700 m (Ds 64: LISE). Sete Cidades (Tr 1894: AZ).

VIDI — Pico: Landroal, 770 m. Mist. Cab. do Fogo, 750 m.

HAB. — At altitudes above 500 m and below 1000 m. — Hygrophilous sp.

SOC. — Diff. sp. of 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). There has probably been no recent extension of the distrib. This orchid may also be observed on T and F in the near future.

Habenaria micrantha Hochst. ex Seub.

EXS. — S. Miguel: Lag. do Fogo, 750 m (Sjn 65: U). Sete Cidades (Car 1898: AZ). Feteiras (Canto 02: AZ). — Terceira: Mata da Serreta (Pa, So 37: LISU). — Pico: Cab. do Fogo, mist., 800 m (Sjn 65: U). Torrinhas, 1000 m (Sjn 68: U). Cab. da Macela, 850 m (Go: HO). Serra da Madalena, 700 m (Go 62: LISI). Mist. da Prainha, Chão Verde, 750 m (Go 63: LISFA). — Faial: Close to levada, 650 m (Sjn 68: U). Falca, 350 m (Go: HO) — Flores: Rocha dos Bordões, 250 m (Go 64: LISI).

VIDI — Faial: Cab. do Fogo.

HAB. — In PALHINHA (1966) attributed to altitudes above 600 m. Now observed from 200-1000 m. Preferentially above 600 m. — In moist, rather strongly exposed habitats. Generally in open grassland with a thick humus layer.

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

Eleocharis multicaulis
Calluna vulgaris
Holcus rigidus
Thymus cespititius
Lysimachia nemorum ssp.
Huperzia selago ssp.
Picris filii
Tolpis azorica
Luzula purpureo-splendens
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 (1844). No marked recent extension of distrib.

ARACEAE

Zantedeschia aethiopica (L.) Spreng.

VIDI — Terceira: Terra Chã.

HAB. — Cultivated and escaped, close to villages and roads.

DISTRIB. — First cit. by DROUET. Distrib. still restricted to the eastern part of the archipelago.

SUMMARY

PLANT COMMUNITIES

The differentiation of Azorean plant communities was based on the qualitative composition in the plant cover. Therefore, only presence or absence of taxa was recorded in the sociological tables, in order to avoid an incorrect physiognomic picture of the communities. In almost all associations and alliances there are a large number of species which reach high degrees of cover.

Minimum areas necessary for description of the communities were determined. They vary from 4-40 m². In this paper, the sociological descriptions have been centred on alliances. Some associations have also been described. The communities are phytocoenoses. Epiphytic synusies of the *Juniperion brevifolii* and epilithic synusies of the *Festucion petraeae* have, however, been excluded. The sociological differentiation of the communities was based on presence and absence of differential species with differential values of varying strength. In addition to the sociological descriptions and tables, there is a summary table of all the differential species which have been discussed.

The communities are generally easily correlated with certain environmental factors. As the Azorean geology is uniform, these correlations can be centred upon macromicro climatic conditions, to differences of exposure due to microtopography, to types of substrata, such as lava flows or sand-gravel, and to the duration of periodic flooding around lakes.

I. Mercurialion annuae

The all. *(M. a.)* is very rich in species. It has a fairly uniform composition throughout the archipelago. Differential species generally have a wide distribution in the Azores. The variation of dominant species is large, even within small areas. The community is restricted to the landscape which has been influenced by man around villages and close to roads and fields. It is rarely sociologically completely developed above 300 m. Most of the species of the *M. a.* are antropochorous and nitrophilous. A contact community is the *Festucion petraeae,* especially the *Ornithopo-Gaudinietum* of this all. In the *Juniperion brevifolii* species characteristic of the *M. a.* are recorded as permanently present in the ass. *Anagallidetum tenellae.* Sociological material available of the *M. a.* was not considered sufficient for publication in a table.

II. Festucion petraeae

The coastal landscape below 100 m is completely dominated by the *Festucion petraeae (F. p.).* The sociological weakening of the all. becomes clear at altitudes above 100 m. Localities of single diff. spp. have, however, been recorded up to 300 m in open habitats in sparse *Myrica-Pittosporum* scrub. The all. covers large areas along level parts of the coast and appears in several localities with transitions towards the *Mercurialion annuae.* Along steep parts of the coast there are only narrow areas of the *F. p.* with few tran-

sitions towards the *Mercurialion annuae*. Sample plot size should not be smaller than 25 m². The shape of the sample plots should generally be rectangular, to cover the microzones of the all. Three associations have been distinguished:

A. *Polygonetum maritimi*

The ass. is ecologically restricted to level shore with loose sand. There are a few such habitats in the archipelago and the community is therefore very rare. Exclusive diff. spp. are few (table 6). *Polygonum maritimum* has also been recorded on loose sand deposits on Madeira but the diff. spp. of the ass. on the Azores, *Lotus creticus*, is there replaced by *L. macranthus*. The diff. spp. of the ass. rarely reach high degrees of cover. A recent invasion by *Cynodon dactylon* threatens the survival of the *P. m.* Sample plot size should not be smaller than 16 m².

B. Euphorbietum azoricae

The ass. *(E. a.)* colonizes coastal cliffs or coarse gravel deposits in the coastal zone below 100 m. The community can rarely be completely recorded in sample plots smaller than 16 m². The sociological contact towards the *Mercurialion annuae* is weak. The *E. a.* has high drought tolerance and a high tolerance of salt spray. Habitats on cliffs have deposits of sand and litter only in crevices. The community is one of the most distinct in the Azores, ecologically and sociologically.

C. Ornithopo-Gaudinietum

The ass. *(O.-G.)* colonizes coarse gravel or fine sand deposits, often in habitats with no humus layer. The localities are always situated higher up than the ass. nearest the coast, described above. The community requires at least 9 m² for complete recording. Transitions towards the *Mercurialion annuae* are frequent. Drought tolerance is very high. The *O.-G.* reaches far into the *Myrica* zone with sociologically incomplete composition, and meets the lowest outposts of species characterizing the *Juniperion brevifolii*.

The microzonation within the *Festucion petraeae* is uniform in the archipelago. Starting from nearest the sea, there is first a dominance of *Juncus acutus, Asplenium marinum, Crithmum maritimum, Euphorbia azorica* and *Festuca petraea*. Higher up follows a microzone dominated by *Plantago coronopus, Lotus subbiflorus, Ornithopus pinnatus*. Further landward, there is successively denser scrub vegetation of *Myrica faya* with abundant *Pteridium aquilinum* and *Rubus ulmifolius*. The recent invasion of the *Festucion petraeae* and the *Myrica* zone by introduced species will be mentioned below.

III. Litorello-Eleocharion

The all. *(L.-E.)* is sociologically sharply distinct from other communities described in this paper. The number of exclusive diff. spp. is high. There are suitable habitat conditions only on lake shores. Most Azorean lakes are

situated at altitudes above 500 m. Both the coast alliances are therefore eliminated as sociological or geographical contact communities. Transitions are frequent towards the *Juniperion brevifolii*, generally towards the ass. *Anagallidetum tenellae*. The lake shore all. has a fairly uniform composition throughout the archipelago. There is, however, a clear variation physiognomically between lakes on the same island and on different islands. Size of sample plots should not be smaller than 16 m².

Microzonation around lakes is generally the following:

1. Below low water level: *Potamogeton polygonifolius, Hypericum elodes, Scirpus fluitans, Isoetes azorica.*
2. Just above low water level, usually under water for more than ⅔ of the year: *Callitriche stagnalis, Peplis portula, Eleocharis palustris, Litorella uniflora, Potamogeton polygonifolius, Scirpus fluitans.*
3. Microzone usually under water for more than ½ the year: *Eleocharis multicaulis, Hydrocotyle vulgaris, Chamaemelum nobile* var., *Mentha aquatica, M. pulegium* (bryophytes: *Philonotis rigida, Fissidens adianthoides*).
4. Just below high water level, rarely under water: *Juncus effusus, Potentilla anglica, Nardus stricta* (bryophytes: *Polytrichum commune* hummocks, *Scleropodium illecebrum, Rhytiadelphus loreus, Rh, calvescens, Breutelia azorica, Thuidium tamariscinum*).

Above high water level follows the *Juniperion brevifolii* with dominants such as: *Erica azorica, Holcus rigidus, Blechnum spicant, Calluna vulgaris.*

Of the species mentioned above, *Scirpus fluitans, Eleocharis multicaulis* and *Polytrichum commune* are rare around the lake in the caldeira of Faial. *Hypericum elodes* has not been recorded there, whereas *Chamaemelum nobile* var. is a dominant of microzone no 3. This sp. has no physiognomic importance in the *Litorello-Eleocharion* around lakes on Pico. *H. elodes*, on the other hand, is very frequent around and in Lag. do Caiado (Pico). *Nardus stricta* is characteristic only of the highest microzone around Lag. do Canário on S. Miguel. *Polytrichum commune* hummocks are frequent in the highest microzone around lakes on Pico.

The lake shore vegetation of the *L.-E.* could first be described this century, when the distribution of some of the diff. spp. had become much better known. These species are *Litorella uniflora, Isoetes azorica, Callitriche stagnalis, Elatine hexandra* and *Peplis portula*. It should also be stressed that the all. has probably recently changed its quantitative structure to a large extent because of the recent extension of the distribution of such spp. as *Hydrocotyle vulgaris, Epilobium obscurum, Mentha aquatica, M. pulegium.*

IV. Juniperion brevifolii

The Azorean cloud zone vegetation, covering the largest areas of the islands and of the natural landscape, has been described within the *Juniperion brevifolii (J. b.)*. The range of variation of this all. is apparent from the associations described and from the descriptions of zonation of communities

and single taxa. The all. includes both hygrophilous groups of species in ravines and caldeiras and the small group of species at altitudes above 1350 m with high tolerance of drought and exposure. A fairly large number of diff. spp. for the all. unites the vegetation of ecologically quite different localities at altitudes above 500 m. The size of sample plots for recording the complete *J. b.* can rarely be smaller than 40 m².

The summary table of diff. spp. (table 6), shows how the sociological contact with communities other than the *Litorello-Eleocharion* is weak. The *J. b.* has been colonized only rarely and occasionally by diff. spp. of the *Mercurialion annuae*. The contact towards the *Festucion petraeae* in the *Myrica* zone is also weak. From a summary of zonation of diff. spp. of the *J. b.* it appears that the complete all. can rarely be recorded below 500 m or above 1350 m. The upper altitude limit can only be studied on Pico. On Flores the lower limit goes down to 300 m, on S. Miguel, in contrast, the complete *J. b.* is rarely found below 700 m. These differences can easily be correlated with climatic conditions, mainly increasing precipitation and increasing relative humidity from E towards W in the archipelago. Three associations have been distinguished:

A. Anagallidetum tenellae

The ass. *(A. t.)* generally has only a sparse shrub layer. It has increased in area recently since large areas of cultivated pastures have been added in this century to the landscape more or less influenced by man. This grazing land was cleared from the *Erico-Myrsinetum* (cf. below). Cutting the *Juniperion brevifolii* in areas between the young lava flows (less than 500 years old) gradually resulted in a mosaic vegetation structure, where regeneration of the forest-scrub was too slow and the value of the pastures was often too low. Management of pastures was adopted as a solution.

The *A. t.* has the *Litorello-Eleocharion* and the *Erico-Myrsinetum* as main contact communities. The minimum sample plot size was found to be 16 m². Weeds of the coastal zone vegetation only rarely reach the ass. The habitats generally have a thick humus layer on tuff layers or on rather loosely accumulated sand-gravel deposits. On the latter, the *A. t.* is very susceptible to erosion on slopes. In the very hilly landscape above 500 m, the composition of the vegetation of the open grassland depends on the water supply. At the bottom of shallow ravines, for example *Juncus effusus, Eleocharis multicaulis, Scirpus fluitans, Anagallis tenella* and *Sphagnum* spp. are often dominant. On dryer ridges between, on the other hand, the dominants are often *Agrostis castellana, Holcus rigidus, Pteridium aquilinum, Luzula purpureo-splendens.*

B. Erico-Myrsinetum

The ass. *(E.-M.)* can be distinguished within the altitude range 500-1350 m. Sociological contact communities have been mentioned above. Towards the upper limit of the *Myrica* zone there is a weak contact with the *Festucion*

petraeae. The number of exclusive diff. spp. is comparatively small. Size of sample plots should not be smaller than 25 m².

The *E.-M.* has colonized and survived completely developed mainly on young lava flows. In the shrub layer the main dominants are *Juniperus brevifolia* and *Erica azorica*. Local dominants are *Viburnum tinus* ssp., *Vaccinium cylindraceum, Laurus azorica, Frangula azorica, Ilex perado* ssp. and *Myrsine africana* var. The number of species with a high degree of cover in the field layer is high.

Most of the characteristic species of the ass. have a low drought tolerance. The lava flows provide, however, very dry microhabitats on the protruding unshaded parts. These are often colonized by a group of highly drought-tolerant species such as *Aira caryophylla, Hypericum humifusum, Thymus cespititius, Campylopus polytrichoides* and *Stereocaulon* spp. On the sheltered walls of crevices in the lava flows the bryophyte cover is generally dominated by *Myurium hebridarum, Fissidens serrulatus, Conocephalum conicum* and *Thamnium alopecurum*.

At altitudes above 1350 m on Pico the *E.-M.* successively looses its diff. spp. towards the peak of the volcano. The plant cover becomes very uniform, with mainly *Calluna vulgaris, Daboecia azorica* and *Thymus cespititius* as dominant species. The moss cover also becomes poor in species. Precipitation increases above 1350 m to more than 3000 mm, but only provides small amounts of water to the vegetation. The rain water drains very rapidly down into the black, loose basaltic gravel and stone deposits. The black colour of the material also increases heat absorption and thus the rate of evaporation from the soil surface. Frost temperatures and snow are not rare in winter at altitudes above 1500 m. Colonization by the complete *E.-M.* is probably limited above 1350 m as much by low minimum temperatures as by the paradoxical drought, in spite of excess of precipitation, including comparatively low RH values.

C. Festucetum jubatae

The most «exotic» ass. of the Azorean vegetation is the *Festucetum jubatae (F. j.)*. The community is well distinguished by diff. spp. (see table 6). Almost the only contact community is the *Erico-Myrsinetum*. Localities of the ass. are few and comparatively very small. They are confined to deep, narrow ravines, caldeiras, parasitic cones and explosion holes in lava flows. Habitat conditions are there charecterized by strong protection from exposure, high air and substratum humidity. All these conditions are necessary for the full development of the *F. j.* The ass. contains more Azorean and Macaronesian endemic vascular taxa than the other communities distinguished. Localities have recently become more accessible from new roads. The complete composition of the ass. as well as the distribution of its diff. spp. in the archipelago, became sufficiently known first in this century. *Diphasium madeirense, Diplazium caudatum, Ranunculus cortusifolius, Lactuca watsoniana, Prunus lusitanica, Chaerophyllum azoricum, Euphorbia stygiana,* and *Euphrasia grandiflora* are among the diff. sp. of the ass. Many localities of the ass. are, however, even now impossible to reach without ropes and other equipment suitable

for the descent of explosion holes with nearly vertical walls. The minimum size of sample plots should not be smaller than 16 m².

The *F. j.*, including moss cover on all types of substratum, is the phynocoenose with the largest number of species in the archipelago. The number of epiphytic and epilithic spp. is especially high. A characteristic feature is the nearly constant presence of epiphyllous hepatics on the leaves of many tree species and on ferns such as *Blechnum spicant, Diplazium caudatum* and especially on *Trichomanes speciosum* and *Hymenophyllum*. Occasionally colonizing antropochorous species are rare. Only the introduced spp. which invaded the natural landscape independently of human influence can be found in the ass.

Frequent dominants are: *Festuca jubata, Deschampsia foliosa, Agrostis castellana, Woodwardia radicans, Diplazium caudatum, Dryopteris* spp. Even the nearly vertical slopes are covered over large areas by a dense *Sphagnum* cover. This most unstable moss cover often falls down to the base of the slopes, forming mounds several m high of moss, with litter, sand and boulders. The *F. j.* occurs unevenly spread over the *Juniperion* areas. However, the ass. rarely develops below 700 m or above 1200 m.

ZONATION

The summary of the zonation of the Azorean vegetation is based on the figures mentioned in the descriptions of the communities and taxa. Descriptions of the zonation can be found in: a. SEUBERT & HOCHSTETTER (1843), b. SEUBERT (1844), c. MORELET (1860), d. GUPPY (1917) and e. ALLORGE (1946).

The coastal zone has been called «cultivated zone» (b, c), mediterranean zone (a), *Myrica-Erica-Persea* zone (d). Altitude limits of 460 m (a), 500 m (b, c) and 600 m (d, e) have been suggested. The range from 460-600 m is generally looked upon as a transition area, above which another kind of vegetation follows. The name used by GUPPY (d) is deceptive, as *Erica* is not characteristic of the coastal zone, and *Persea* is now very rare there. Only *Myrica faya* is a characteristic shrub or tree of the coastal zone in which the introduced *Pittosporum undulatum* also occurs. It is not possible to distinguish a Lauracé zone between 460-760 m, as was suggested by SEUBERT & HOCHSTETTER (1843) and by MARLER & BOATMAN (1952).

A generally narrow *Euphorbia azorica Festuca petraea* zone between 0-100 m should be added. This zone, with the *Festucion petraeae* seems to have uniform limits throughout the archipelago. The *Myrica-Pittosporum* zone is especially extensive on the eastern islands, where the upper limit is at about 600-700 m. On the central islands, this limit is at about 400-600 m, and on the western it is at 200-400 m. The *Mercurialion annuae* belongs to this zone but is rarely completely developed above 300 m anywhere in the archipelago.

Above the *Myrica* zone follows a *Juniperus* shrub zone. Its extent was earlier defined as 760-1370 m (a), 500-1500 m (b, c), 600-1370 m (d), 600--1500 m (e). The upper altitude limit can only be studied on the Pico Island. On the W slope of Pico, the upper limit for dense scrub vegetation of *Erica azorica* higher than 1 m is at 1450-1500 m.

On the N slope the upper limit for a dense *Erica-Vaccinium-Myrsine* scrub is at 1200-1250 m. The upper limit for the *Juniperus* shrub has therefore

been taken to be an average of 1350 m. This altitude limit might not be natural, as burning to create pastures has been carried out at that level (cf. WATSON, 1843).

The peak zone, with dominance of *Calluna-Daboecia-Thymus*, reaches the highest altitudes on Pico Island. The lower half, between 1350-1700 m, has a few dwarf examples of *Erica azorica*. A few individuals of *Lysimachia nemorum* ssp., *Agrostis castellana*, *Blechnum spicant*, *Polygala vulgaris*, *Fragaria vesca*, *Potentilla erecta*, *Ilex perado* ssp., *Vaccinium cylindraceum* and *Myrsine africana* var. can be recorded in the field layer which becomes more and more sparse towards the peak. In the upper half of the peak zone, above 1700 m, there is a change to dominance of bryophytes, with *Rhacomitrium* spp. dominant over large areas. Small occurences of *Gymnomitrium adustum* and *Andreaea rupestris* are characteristic of the highest altitudes. The limit at 1700 m is at about the same as that suggested by SEUBERT & HOCHSTETTER, SEUBERT and by GUPPY. No distinct *Juniperus-Daphne-Euphorbia* zone was found between 1370-1670 m, as was suggested by GUPPY. *Juniperus* is rare above 1200 m. *Daphne* is a very rare species at these altitudes. *Euphorbia stygiana* occurs scattered in the *Juniperion brevifolii*, mainly between 700-1000 m in habitats with a suitable microclimate in ravines and caldeiras.

Azorean vegetation zones:

0-100 m. I. *Festuca petraea — Euphorbia azorica* zone *(Festuca petraeae)*.
100-500 m. II. *Myrica faya — (Pittosporum undulatum)* zone (0-300 m. *Mercurialion annuae*).
500-1350 m. III. *Juniperus-Erica-Laurus-Myrsine-Vaccinium-Ilex-Viburnum--Frangula* zone. *(Juniperion brevifolii* and *Litorello-Eleocharion)*.
> 1350 m. IV. Zone of impoverishment of the *Juniperion brevifolii*, *Calluna--Daboecia-Thymus* zone.
1350-1700 m. A. Subzone with dwarf specimens of *Erica*, *Vaccinium*, *Myrsine* and with some diff. spp. of the *Juniperion brevifolii*.
> 1700 m. B. Subzone with no shrubs and with very few vascular plants, *Rhacomitrium-Gymnomitrium-Andreaea* bryophyte subzone.

DISTRIBUTION

The assessment of the tables, summarizing the recent records of the distribution of Azorean taxa, its stability and changes, had to follow several lines. Early investigations of the Azorean flora were unevenly spread within the archipelago. DROUET (1866) published a large flora list of 599 vascular taxa. Only S. Jorge and Corvo were not personally visited by DROUET. Records from these islands were then added by TRELEASE (1897) and PALHINHA (1966). The flora list by PALHINHA contains 699 vascular plant taxa. The flora of the natural Azorean vegetation was probably fairly completely recorded by SEUBERT & HOCHSTETTER (1843) and by SEUBERT (1844). It comprised 300 taxa, of which about 50 were said to be Azorean endemics and 20 Macaronesian endemics. WATSON mentioned 350 taxa (1844).

It is above all in the group of introduced species that floristic investigations show a very strong and rapid invasion of the Azores during the

last 130 years. It is probable that the Azorean flora has increased by nearly 300 species, mainly introduced deliberately or accidentally in the last 150 years. The flora has thus increased by about 100 % in just the last two centuries.

The large number of introduced species, which were already recorded in the Azores in about 1860 was at that time very unevenly distributed on the islands or groups of islands. Spread through the archipelago was held back by natural obstacles. The distance from S. Miguel to Corvo, e. g., is 615 km. After 1850, communications were improved rapidly between the islands as well as between the Azores and the rest of the world. Obstacles to distribution became rapidly smaller. Several antropochorous species, weeds, which were earlier recorded from only a few localities on a few islands, were already recorded by the turn of the century from all or nearly all islands of the archipelago. Before the discovery of the Azores, geographical conditions probably favoured, through isolation, the development of endemic races of several vascular plant species on the islands. These conditions have disappeared during the last few centuries. The Azorean archipelago has long been a natural stopping-place for Atlantic shipping and earlier also for shipping going round South Africa (cf. MEES, 1901). In recent decades it has also become a depot for transatlantic air services. The Azores had a strategic position during the two world wars, which was put to use. This increased invasion pressure exerted by introduced species against the vegetation of the natural landscape.

Examples of the group of introduced species with an especially strong and rapid recent extension of their distribution in the Azores are:

Rumex crispus
Chenopodium ambrosioides
Atriplex hastata var.
Amaranthus lividus
Aphanes arvensis
Coronopus didymus
Capsella bursa-pastoris
Carpobrutus edulis
Portulaca oleracea
Stellaria media
Spergularia rubra
Polycarpon tetraphyllum
Silene gallica
Sisymbrium officinale
Verbena officinalis
Stachys arvensis
Solanum nigrum
Verbascum virgatum
Misopates orontium
Veronica officinalis
Sherardia arvensis
Centranthus ruber
Eupatorium adenophorum
Conyza canadensis
Calendula arvensis
Cirsium arvense
Galactites tomentosa
Picris echioides
Crepis capillaris
Sonchus asper
Polypogon maritimus
Briza minima
Brevipodium silvaticum
Sporobulus indicus
Cynodon dactylon
Digitaria sanguinalis
Hedychium gardnerianum

Records of particular taxa from an increasingly large number of islands during the last 100 years can, however, not always be taken as a sign of a recent extension of the distribution. Inaccessible localities, where such species

have probably been present for several centuries, have recently become more easily reached from new roads. There has been considerable construction of new roads at high altitudes in this century in order to reach new cultivated pastures or forest plantations. Typical species of this group are:

Diphasium madeirense
Isoetes azorica
Diplazium caudatum
Ranunculus cortusifolius
Cardamine caldeirarum
Rubus hochstetterorum
Prunus lusitanica
Euphorbia stygiana
Callitriche stagnalis
Elatine hexandra
Peplis portula
Chaerophyllum azoricum
Euphrasia grandiflora
Litorella uniflora
Viburnum tinus ssp.
Tolpis azorica
Picris filii
Picris rigens
Lactuca watsoniana
Festuca jubata

There are some species which in spite of improved communications have up to now maintained a surprisingly stable distribution. In some cases the reason might be found in the specialized ecological preferences of the species, e. g.:

Polygonum maritimum
Lotus creticus
Hypericum elodes
Ipomoea stolonifera

For other species the stability of the recent distribution is difficult to explain, on the basis of present knowledge of their ecological preferences and the availability of suitable habitats on the islands. An extension of the distribution in the near future, may be expected e. g. for:

Equisetum telmateja
Polystichum falcatum
Parietaria diffusa
Polygonum capitatum
Chenopodium album
Mesembryanthemum crystallinum
Teline monspesulana
Trifolium striatum
Erodium malacoides
Euphorbia maculata
Euphorbia peplus
Euphorbia peplis
Viola palustris ssp.
Daphne laureola
Anagallis tenella
Calystegia sepium
Heliotropium europaeum
Solanum auriculatum
Datura stramonium
Scrophularia aquatica
Bellardia trixago
Centranthus calcitrapa
Senecio vulgaris
Scirpus fluitans
Bromus mollis
Lantana camara

The recent increase in the area of landscape influenced by man, especially through increase in areas of cultivated pastures derived from the *Erico-Myrsinetum*, means that larger open areas become available for colonization

by species characterizing the *Anagallidetum · tenellae*. These changes in the landscape have resulted in extension of the distribution e. g. of:

Fragaria vesca
Potentilla anglica
Ulex europaeus
Origanum virens
Lotus uliginosus
Prunella vulgaris
Leontodon taraxacoides

There are no records of a large number of differential species of the *Juniperion brevifolii* from the three lowest islands of the archipelago (Graciosa, Corvo, Santa Maria). It is possible that intensive cutting of an even originally weakly developed *Juniperion* has rapidly decreased the number of ecologically suitable habitats for the following species:

Juniperus brevifolia
Laurus azorica
Myrsine africana var.
Vaccinium cylindraceum
Ilex perado ssp.
Huperzia selago ssp.
Osmunda regalis
Pteris serrulata
Culcita macrocarpa
Hymenophyllum tunbridgense
Hymenophyllum wilsonii
Trichomanes speciosum
Asplenium monanthes
Dryopteris borreri
Elaphoglossum paleaceum
Sanicula azorica
Bellis azorica
Chamaemelum nobile var.
Luzula purpureo-splendens

The following table shows the number of recorded taxa on the islands. The increase in the number should be interpreted against the background of: intensified floristic recording, improvement of communications on and between the islands and to the rest of the world, increase of the influence of man on the landscape on all islands. Along the bottom line «**Sjögren 1971**» are published new records added to figures obtained from PALHINHA (1966):

		SM	SMa	T	G	J	P	F	Fo	C
WATSON	1870	372	105	174	25	3	156	303	235	39
TRELEASE	1897	430	215	283	96	53	204	320	290	123
PALHINHA	1966	548	247	417	168	315	301	365	313	163
SJÖGREN	1971	552	—	436	—	—	359	402	324	169

The recent floristic changes in the Azores are thus fairly extensive as can be seen from the information under «distribution» in the comments about the collected taxa. The quantitative changes within the Azorean vegetation during the last 100 years have also been evident. The competitive pressure from introduced species has brought about important local changes in the natural landscape. In the coastal vegetation there has recently been a potent invasion of the *Festucion petraeae*, especially by *Carpobrotus edulis, Polypogon maritimum* and *Cynodon dactylon*. These species have rapidly reached high degrees of cover in this all. The survival of the *Polygonetum maritimi* is now strongly threatened by the competition from *Cynodon dactylon*. The *Euphor-*

bietum azoricae, and transitions between this ass. and the *Ornithopo-Gaudinietum*, is threatened locally by *Carpobrotus edulis*. On the south coast of Terceira, the *Euphorbietum azoricae* is locally coloured red by the *Carpobrotus*, which outcompeted both field layer and lichens on the coastal cliffs.

The coastal zone below 300 m contains the antropochorous *Mercurialion annuae* on fairly large areas. This all. is now formed to a large extent of recently introduced species. Species characteristic of this all. have in several localities invaded the *Festucion petraeae*, especially its ass. *Ornithopo-Gaudinietum*.

The *Myrica faya* dominated zone has recently become strongly influenced by the expansion of the areas of fields and forest plantations. Towards the middle of the 19th century, *Pittosporum undulatum* was frequently planted as shelter for fields and gardens (DROUET, 1866). This tree was also frequently used as fuel. It has not been possible to find out exactly when *Pittosporum* was introduced to the archipelago. A fossil *Pittosporum* has been recorded from tuff layers (FORJAZ, 1960). During the last 100 years, control of the natural spread of *Pittosporum* has been insufficient, especially on lava flows at low altitudes. The explosive spread of this tree species now threatens the survival in the coastal zone of the *Myrica faya* scrub.

The dark green physiognomy of the *Myrica* dominated coastal zone has now changed over large areas to the shining light-green colour of the young *Pittosporum* leaves. In the dense shade of the *Pittosporum* woods, recent records have shown that the previous lower limits of several vascular plants and of bryophytes characterizing the *Juniperion brevifolii* have moved downwards, e. g. *Sanicula azorica, Deschampsia foliosa, Cardamine caldeirarum* and *Myurium hebridarum, Fissidens serrulatus*. In the upper half of the *Myrica* zone on Terceira, *Polygonum capitatum* has recently spread very rapidly. This sp. has now reached a high degree of cover in sparse *Myrica-Erica* scrub on the lava flow of the year 1761 in the sociologically unstable transition area towards the *Juniperion brevifolii*.

The ecologically specialized cloud zone vegetation of the Azores has not escaped the influence of recently introduced species. There are very far-reaching local changes in the *Juniperion brevifolii*. About the middle of the 19th century, *Hedychium gardnerianum (Zingiberaceae)* was introduced, probably deliberately, as an ornamental flower. The result was very serious. The spontaneous invasion of intensively cut and grazed *Juniperion* was extremely potent and rapid, especially on S. Miguel. In and close to the caldeiras of Sete Cidades, a fatal dominance of *Hedychium* followed. This large species has an extremely high competitive ability and is now a serious threat to the *Juniperion* in several localities in the archipelago and is also an expensive obstacle to clearance of pastures, forest plantations and building of new roads. Two other introduced species, *Erigeron karwinskianus* and *Eupatorium adenophorum* now have a wide spontaneous distribution in the archipelago which might increase still more in the near future. These species are as dangerous to the survival of the cloud zone vegetation on Madeira as *Hedychium* is in the Azores.

In the Azores, *Hydrangea macrophylla* is often used as hedges around fields and pastures. This shrub, too, has a high ability to spread spontaneously in pastures and scrub vegetation of the lower parts of the cloud

zone (cf. DAVY DE VIRVILLE, 1965*a*). It can be considered most important that the spontaneous spread of *Hydrangea* will be carefully controlled and prevented. Otherwise the prospect for the Azorean vegetation below 1000 m might be the dominance of *Pittosporum, Hydrangea* and *Hedychium*. It is true that this would be a dense, attractively flowering plant cover but still most monotonous when carefully examined and, further, from a plant geographical point of view completely foreign to the archipelago.

In the *Juniperion brevifolii*, the ass. *Festucetum jubatae* in sheltered ravines and caldeiras has escaped the influence of introduced species from the landscape, influenced by man. The ass. *Anagallidetum tenellae* and the lake shore ass. *Litorello-Eleocharion* have to a large extent been invaded recently by the same species which often reach high degrees of cover e. g. *Hydrocotyle vulgaris, Epilobium obscurum, Mentha aquatica, M. pulegium* and *Lotus uliginosus*. These species have, however, in no localities shown such a high competitive ability compared as *Hedychium, Erigeron* and *Eupatorium* (cf. above). In an ecologically very specialized island flora like that of the Azores Islands, the stability in the composition of the vegetation is easily upset by introduced species.

It is apparent from the above how necessary it is to maintain careful control of the vegetation both of the natural and the man-made landscape in the Azores. This control should always include observation of all imports of new ornamental flowers or new specimens for cultivation. Further, it would be most valuable to carry out a continuous check of recently introduced weeds. Regular floristic records, including records of changes of dominance within permanent sample plots, are desirable. Such records have a high purely scientific value but will certainly also provide economically very important information for future management of the landscape, influenced by man. The fight against invasion by taxa with high competitive ability could start on an early stage, before they have spread too far.

The Azores is the archipelago with the largest areas of natural landscape with original vegetation in all Macaronesia. The plant communities are characterized by a large number of Azorean and Macaronesian endemic species. Communities described are also endemic for the archipelago with the probable exception of the antropochorous *Mercurialion annuae*. It is therefore of considerable European interest, and of high priority, to delimit areas for preservation of these communities in the Azores in the very near future. These areas should be protected from various types of influence by man. Their situation and boundaries should be sanctioned by authorities in Lisbon. In this way it would be possible to guarantee their survival, which might otherwise be dependent on local more or less short-term interest.

REFERENCES

ADANSON
1757 Histoire naturelle du Sénégal. Paris.

AFONSO, JOÃO
1964 Subsídios para um Ensaio sobre a Açorianidade. Inst. Açoriano de Cultura. Angra do Heroísmo.

AGOSTINHO, J.
1935 Tectónica, Sismicidade e Vulcanismo das ilhas dos Açores. *Açoreana*, I. Angra do Heroísmo.
1942*a* Clima dos Açores. IV. Pluviosidade. *Açoreana*. Angra do Heroísmo.
1942*b* Clima dos Açores. V. O Clima dos Açores no quadro dos climas mundiais. *Açoreana*, III: 1. Angra do Heroísmo.

AITON
1789, 1810-1813 Hortus Kewensis, or a catalogue of the plants cultivated in the royal garden at Kew. Vol. 3 and 5. London.

ALLORGE, V. et P.
1938-39 Sur la répartition et l'écologie des hépatiques aux Açores. *Bol. Soc. Brot.*, XIII. Alcobaça.
1948 Végétation bryologique de l'île de Flores (Açores). *Rev. Bryol. et Lichen.*, XVII: 1-4. Paris.
1946 Les étages de végétation muscinale aux îles Açores et leurs éléments (Un contribution à l'étude du peuplement des îles Atlantides). *Mém. Soc. Biogéog.*, VIII. Paris.

ALSTON, A. H. G.
1956 New African ferns. *Bol. Soc. Brot.*, **30**.

ATLAS FLORAE EUROPAEAE
1972 Distribution of vascular plants in Europe. Ed.: Jaakko Jalas & Juha Suominen. Helsinki.

BUSCHMANN, A.
1950 Die makaronesischen Deschampsia-Arten. *Phyton*, 2. Horn. N.-Ö. (Austria).

CEBALLOS, L.
1953 Macaronesia. Algumas consideraciones sobre la flore y vegetación forestal. *An. Inst. Sup. Agron.*, **20**. Lisboa.

CEBALLOS, L. e ORTUÑO, F.
1951 Vegetación y Flora Forestal de las Canarias Occidentales. *Inst. Forest. de Investig. y Exper.* Madrid.

CEDERCREUTZ, C.
1941 Beitrag zur Kenntnis der Gefässpflanzen auf den Azoren. *Comment. biol.*, **8**. Helsingfors.

DANSEREAU, P.
1961 Études macaronésiennes. I. Géographie des Cryptogames Vasculaires *Agron Lusit.*, **23**: 3.
1965 Iter Azoricum. *The Garden Journal*, **15**: 1-4. New York.
1968 Macaronesian studies. II. Structure and functions of the Laurel Forest in the Canaries. *Collectanea Botanica*, VII: 1. Barcione.

DAVY DE VIRVILLE, A.

1965*a* L'endémisme végétal dans les îles Atlantides. *Rev. Gén. Bot.*, **72**.

1965*b* Contribution à l'étude de l'endémisme végétal dans les îles Atlantides. *Compt. Rend. Soc. Biogéogr.*, **41**.

DROUET, H.

1866 Catalogue de la flore des îles Açores, précédé de l'itinéraire d'un voyage dans cet archipel. *Mém. de la Soc. Acad. d'agricult., Sc., Arts et belles lettres du départ de l'Aube.* Troyes.

DRUCE, G. c.

1911 Plants of the Azores. *J. Bot.*, **49**. London.

FERNANDES, ROSETTE BATARDA

1968 Sobre a ocorrência do complexo Polypodium vulgare nos Açores. *Bol. Soc. Brot.*, XLII: 2. Coimbra.

FLORA EUROPAEA

1964, 1968 Ed. T. G. TUTIN et al. Cambridge.

FORJAZ, V. H.

1960 Notícia de alguns Fósseis na Ilha do Faial. *Atlantida*, IV: 1. Angra do Heroísmo.

FORJAZ, V. H. & MONJARDINO, JOÃO L.

1964 Notícia preliminar sobre os tufos vulcânicos fossilíferos de Santo António, ilha do Pico, Açores. *Atlantida*, VIII: 3. Angra do Heroísmo.

FOQUE, F.

1893 Voyages géologiques aux Açores (I-III). *Revue des deux mondes.*

FORSTER, G.

1787 Fascicules plantarum magellanicarum, et plantae atlanticae, ex insulis Madeira, St. Jacobi, Adscensionis, et. Helena et Fayal reportatae. *Comment. Soc. Reg. Sci. Goetting.*, **9**.

1797 Herbarium australe, seu catalogus plantarum, exsiccatarum...; nec non earum quas ex insulis Madeira, St Jacobi, Adscensionis, St. Helenae et Fayal reportavit. Schneider. Goettingae.

FRANCO, JOÃO DO AMARAL

1960 Lauráceas Macaronésicas. *Anais do Inst. Sup. de Agronomia*, XXIII. Lisboa.

FRIEDLAENDER, J.

1929 Die Azoren. *Zeitschr. f. Vulkanologie.* XII. Berlin.

GODMAN, FR. DU CANE

1870 Natural history of the Azores or Western Islands. London.

GUPPY, H. B.

1917 Plants, seeds and currents in the West Indies and Azores. London.

HARTUNG, G.

1860 Die Azoren in ihren ausseren Erscheinung, und nach ihrer geognostischen Natur geschildert. Leipzig.

HEDBERG, O.

1955 A taxonomic revision of the genus Sibthorpia L. *Bot. Not.*, **108**. Lund.

HEER, O.

1856 On the probable origin of the organized beings now living in the Azores, Madeira, and the Canaries. *Amer. Journ. Sci. & Arts.*, **23**.

HOLUB, J.
1967 Remarks on the Nomenclature of «Dryopteris borreri NEWMAN 1854». *Fol. Geobot. Phytotax.*, **3**: 2. Praha.

HUNT, T. C.
1845 A description of the island of St. Mary and St. Michael (Azores). *J. Roy. Geogr. Soc. Lond.*, XV.

KREJCI-GRAF, K.
1956 Vulkanische Beobachtungen auf den Azoren. *Frankfurter geographische Hefte*, **30**. Frankfurt am Main.
1961 Vertikal-Bewegungen der Makaronesien. *Geolog. Rundschau*, **51**. Stuttgart.

KREJCI-GRAF, K., FRECHEN, J., WETZEL, W., COLOM, G.
1958 Gesteine und Fossilen von den Azoren. *Senckenbergiana Lethaea*, **39**. Frankfurt am Main.

LÖVE, A. & D.
1968 Cytotaxonomy of Blechnum spicant. *Collectanea Botanica*, II: 1. Barcione.

MACHADO, F.
1957 Caldeiras Vulcânicas dos Açores. *Atlantida*, I: 5. Angra do Heroísmo.
1962 Erupções históricas do Sistema Vulcânico Faial-Pico-S. Jorge. *Atlantida*, VI: 2. Angra do Heroísmo.

MARLER, P. & BOATMAN, D. J.
1952 An analysis of the vegetation of the northern slopes of Pico — the Azores. *J. Ecol.*, **40**.

MASSON, F.
1778 An account of the Island of San Miguel. *Philosoph. Transact.*, LXVIII: 2.

MEES, J.
1901 Histoire de la découverte des îles Açores. *Rec. de travaux Fac. Philosoph. et lettres*, Univ. de Gand.

MILDE, J.
1867 Filices Europae et Atlantidis. Lipsiae.

MORELET, A.
1860 Notice sur l'histoire naturelle des Açores. Paris.

MÖSCHL, W.
1951 Cerastia lusitaniae archipelagorumque «Açores» et Madeira. *Agron. Lusit.*, **13**: 1. Sacavém.

MORTON, C. V.
1959 Sur la nomenclature de deux Fougères rares d'Espagne. *Bull. Soc. Bot. France*, **106**.

PAIVA, J. A. R. & ORMONDE, J.
1972 The species of *Picris* L. from Azores. *Bol. Soc. Brot.*, XLVI.

PALHINHA, R. T.
1942 Algumas considerações sobre a distribuição geográfica e a ecologia do Arceuthobium oxycedri (DC.) Marsch.-Bieb. *Bol. Soc. Brot.*, XVI. Coimbra.
1947 Explorações botânicas nos Açores. *Bol. Soc. Brot.*, XXI. Coimbra.

1950 Subsídios para o conhecimento da flora açoreana. Plantas Vasculares. Contribuição preliminar apresentada ao XX Congresso Luso-espanhol de Lisboa 1950. *Açoreana,* IV: 4. Angra do Heroísmo.

1954 Nota preliminar sobre a distribuição geográfica da flora dos Açores. *Mem. Acad. Ciênc. Lisboa.,* 6.

1966 Catálogo das plantas vasculares dos Açores. (Texto revisto e preparado para publicação por A. R. PINTO DA SILVA). *Soc. Estudos Açoreanos Afonso Chaves.* Lisboa.

PALHINHA, R. T., GONÇALVES DA CUNHA, A., GONÇALVES SOBRINHO, L.

1941 Algumas observações ecológicas sobre o archipélago açoreano. *Bol. da Soc. Portug. de Ciências Naturais,* XIII. Lisboa.

RECHINGER, K. H.

1939 Versuch einiger natürlichen Gliederung des Formenkreises von Rumex bucephalophorus L. *Bot. Not.,* 92. Lund.

ROTHMALLER, W. e SCHNEIDER, U.

1962 Die Gattung Polypodium in Europa. *Die Kulturpflanze,* Bh., 3.

SAINT-YVES, A.

1922 Les Festuca (Subg. Eu-Festuca) de l'Afrique du Nord et des îles Atlantiques. *Candollea,* 1.

SEUBERT, M.

1844 Flora azorica (quam ex collectionibus schedisque Hochstetteri patris et filii elaboravit). Marcus, Bonnae.

SEUBERT, M. & HOCHSTETTER, C.

1843 Übersicht der Flora der azorischen Inseln. *Arch. Naturgesch.,* 9.

SIMAS, M. J.

1957 Relatório do fim do curso. Santarém. Escola de Regentes Agrícolas de Santarém.

TALLIS, J. H.

1964 Growth studies in Rhacomitrium lanuginosum. *The Bryologist,* 67.

TARDIEU-BLOT, M.-L.

1938 Un Diplazium nouveau des Açores: D. allorgei. *Notul. syst.,* 7.

1946 Sur la flore ptéridologique des îles atlantiques. *Mém. Soc. Biogéogr.,* VIII. Paris.

TRELEASE, W.

1897 Botanical observations on the Azores. *Rep. of the Missouri Bot. Garden,* 8.

TUTIN, T. G.

1933 On Ilex perado Ait. and Notelaea excelsa. *J. Bot. Lond.,* 71.

1953 The vegetation of the Azores. *J. of Ecol.,* 41. Cambridge.

1964 A vegetação dos Açores. *Açoreana. Bol. Soc. Afonso Chaves,* VI: 1. Angra do Heroísmo.

TUTIN, T. G. & WARBURG, E. F.

1932 Notes on the flora of the Azores. *J. Bot.,* 70. London.

VASCONCELLOS, JOÃO DE CARVALHO E.

1968 Nota sobre o Polipódio dos Açores. *Bol. Soc. Brot.,* XLII. Coimbra.

VASCONCELLOS, J. DE CARVALHO & J. DO AMARAL FRANCO

1967 Breves notas sobre Licopodiáceas. *Bol. Soc. Brot.,* 41. Coimbra.

WATSON, H. C.
1843 Notes of a botanical tour in the Western Azores. *Hooker's London J. Bot.*, **2**.
1844 Notes on the botany of the Azores. *Hooker's London J. Bot.*, **3**.
1847 Supplementary notes on the botany of the Azores. *Hooker's London J. Bot.*, **6**.
1870 Botany of the Azores. In: Godman's «Natural history of the Azores or Western Islands». John van Voorst, London.

WIDÉN, C.-J., SORSA, V. and SARVELA, J.
1970 Dryopteris dilatata s. lat. in Europe and the Island of Madeira. A chromatographic and cytological study. *Acta. Bot. Fennica*, **91**. Helsinki.

ADDENDA

Huperzia selago (L.) Bernh. ex Schrank & Mart. ssp. *dentata* (Herter) Valentine
DISTRIB. — Now reported also from C. On SM both ssp. *dentata* and ssp. *selago*.

Lepidotis cernua (L.) Beauv.
DISTRIB. — In «Atlas Florae Europaeae» (1972) not mentioned from F.
Lycopodiella cernua (L.) Pichi-Serm. = *L. cernua* (L.) Beauv.

Selaginella kraussiana (G. Kunze) A. Braun
DISTRIB. — Native of tropical and south Africa.

Equisetum telmateia Ehrh.
DISTRIB. — Recorded also from SMa.

Osmunda regalis L.
DISTRIB. — Recently reported also from SMa (op. cit.). There might have taken place a recent extension of the distrib. of this species.

Thelypteris pozoi (Lagasca) C. V. Morton
DISTRIB. — Now reported also from Fo and P. Recent extension of distrib.

Cyclosurus dentatus (Forskål) R.-C. Ching
DISTRIB. — Now recorded also from G (op. cit.).

Asplenium hemionitis L.
DISTRIB. — Reported also from SMa (Atlas Florae Europaeae, 1972).

Phyllitis scolopendrium (L.) Newman
DISTRIB. — Reported also from C (op. cit.).

Athyrium filix-femina (L.) Roth
DISTRIB. — Reported also from G (op. cit.).

Diplazium caudatum (Cav.) Jermy
DISTRIB. — Reported also from C, P and SMa (op. cit.).

Polystichum setiferum (Forskål) Woynar
DISTRIB. — Reported also from C (op. cit.).

Polystichum falcatum (L. fil.) Diels
DISTRIB. — Native of E. Asia.

Dryopteris borreri Newman
DISTRIB. — Nomenclature: *D. pseudomas* (Wollaston) J. Holub & Pouzar = *D. borreri* Newman.

Dryopteris dilatata (Hoffm.) A. Gray

DISTRIB. — In «Atlas Florae Europaeae» (1972) only reported from P.

Dryopteris azorica (Christ) Alston

DISTRIB. — Now reported also from Fo and J (op. cit.).

Blechnum spicant (L.) Roth

DISTRIB. — Not reported from G (cp. cit.). Probably present on all islands of the archipelago.

Festuca jubata Lowe

DISTRIB. — Probably not identical with *Festuca glauca* var. *longearistata* (cf. SEUBERT, 1844), mentioned from coastal rocks on F and P as those were nowhere recorded as habitats of *F. jubata*.

Determinations of Azorean plants in LISI were recently checked *(Lycopodiaceae-Plantaginaceae)* by Prof. J. do A. FRANCO. His corrections have been added below:

Huperzia selago (L.) Bernh. ex Schrank & Mart.

Specimens from Madalena and Grotões (P) are ssp. *selago*.

Adiantum hispidulum Swartz in Schrader

Also on P (LISI).

Cyclosorus dentatus (Forskål) R.-C. Ching

Also on P and Fo; LISI (1971).

Phyllitis scolopendrium (L.) Newman

Also on T; LISI (1971).

Dryopteris dilatata (Hoffmm.) A. Gray

According to A. Franco, true *D. dilatata* was only found on P, 1000 m, LISI). In «Atlas Florae Europaeae», 1972 only reported from P.

Dryopteris azorica (Christ) Alston

Also on Fo (LISI) and J (Atlas Florae Europaeae, 1972).

Dryopteris aemula (Ait.) O. Kuntze

Also on Fo (LISI).

Blechnum spicant (L.) Roth

Not reported from G (op. cit.) but probably present on all islands.

Parietaria diffusa Mert. & Koch in Röhling

Read: *Parietaria punctata* Willd.

Polygonum aviculare L.

Specimens may be *P. rurivagum* Jordan ex Boreau or *P. arenastrum* Boreau.

Atriplex hastata L. var. *salina* Wallr. ex Gr. & Godr.

Read: *A. prostrata* Boucher.

Salsola kali L.

Read: *S. kali* L. ssp. *tragus* (L.) Nyman.

Althernanthera peploides (Humb. & Bonpl.) Urban

Read: *A. caracasana* Humb., Bonpl. & Kunth.

Cerastium glomeratum Thuill.

Specimens from SM, T, G, P and F cfr. *C. fontanum* Baumg. ssp. *triviale* (Link) Jalas.

Sagina apetala Ard.
Specimens Biscoitos, Porto Judeu, Salga, Porto Mateus (T) and specimens seen on P, Fo and F probably *S. maritima* G. Don.

Spergularia rubra (L.) J. & C. Presl
Probably *S. bocconii* (Scheele) Ascherson & Graebner, now known from all the islands (LISI).

Silene vulgaris (Moench) Garcke ssp. *prostrata* (Gaudin) Chater & Walters
Read: *S. vulgaris* (Moench) Garcke ssp. *crateriola* Franco.

Papaver dubium L.
Read: *P. pinnatifidum* Moris.

Capsella bursa-pastoris (L.) Medicus
All specimens are probably *C. rubella* Reut.

Raphanus raphanistrum L. ssp. *raphanistrum*
The most common ssp. throughout the islands is ssp. *microcarpus* (Lange) Thell.

Aphanes arvensis L.
Read: *A. microcarpa* (Boiss. & Reut.) Rothm.

Geranium robertianum L.
All specimens are probably *G. purpureum* Vill.

Tamarix gallica L.
According to LISI there is only *T. africana* Poiret on G, P, F and C.

Torilis arvensis (Hudson) Link
On P: ssp. *neglecta* (Schultes) Thell. in Hegi; on Sm, T, G, J and F: ssp. *arvensis* (LISI).

Daucus carota L.
Incl. *D. carota* L. ssp. *azoricus* Franco and ssp. *maritimus* (Desf.) Pall.

Lysimachia nemorum L. ssp. *azorica* (Hornem. ex Hooker) Palhinha
Read: *L. nemorum* L. as ssp. omitted according to FRANCO.

Echium lycopsis L.
Read: *E. plantagineum* L.

Satureja nepeta (L.) Scheele and *Satureja vulgaris* (L.) Fritsch
The correct name is *Calamintha sylvatica* Bromf. ssp. *ascendens* (Jordan) P. W. Ball.

Solanum pseudocapsicum L.
cfr. *S. capsicastrum* Link ex Schauer, from temperate E. South America.

Solanum auriculatum Aiton
Read: *S. mauritanum* Scop.

Kickxia spuria (L.) Dumort
Read: *K. spuria* (L.) Dumort ssp. *integrifolia* (Brot.) R. Fernandes.

Scrophularia aquatica L.
Read: *S. auriculata* L.

ERRATA

pag.	line	instead of	read
—	—	*Juniperion brevifolii*	*Juniperion brevifoliae*
31	28	*Hydrangea grandiflora*	*Hydrangea macrophylla*
44, 46, 48	(tables)	*Elaphoglossum hirtum*	*Elaphoglossum paleaceum*
46	(table)	[*Daphne laureola* in sample plot 4]	recorded in sample plot 5
54	8	(Go:	(Go 68:
54	12	Near Estr. Nac.,	Falca, near Estr. Nac.,
80	16	*Cyclosurus*	*Cyclosorus*
91	1	G [in last column]	C
103	4	*Elaphoglossum paleaceum* (Swartz.) C. Chr.	*Elaphoglossum paleaceum* (Hook. & Grev.) Sledge
105	(Fig.)	*Elaphoglossum hirtum*	*Elaphoglossum paleaceum*
133		[on top of page]	AMARANTHACEAE
149	26	*Laurus azorica* (Seub.) J. Franco	*Laurus azorica* (Seub.) Franco
165	24	*Reseda luteola* L.	*Reseda luteola* L. ssp. *luteola*
194		[easternmost dot on map S. Miguel]	shall be excluded
202	25, 26	— Flores: N	— Flores: No loc.
211	25	*Frangula azorica* Tutin in Palhinha	*Frangula azorica* Tutin
231	23	ALORAGACEAE	HALORAGACEAE
362	2	No Lag. do ...	In Lag. do ...
362	25	First cit. ...	First cit. by ...
406	(Fig.)	[Locality on top of Pico (2340 m)]	shall be excluded
424	36	charecterized	characterized
425	3, 4	phynocoenose	phytocoenose
426	21	*(Festuca petraeae)*	*(Festucion petraeae)*
429	40	maritimum	maritimus
436		*Cyclosurus*	*Cyclosurus*

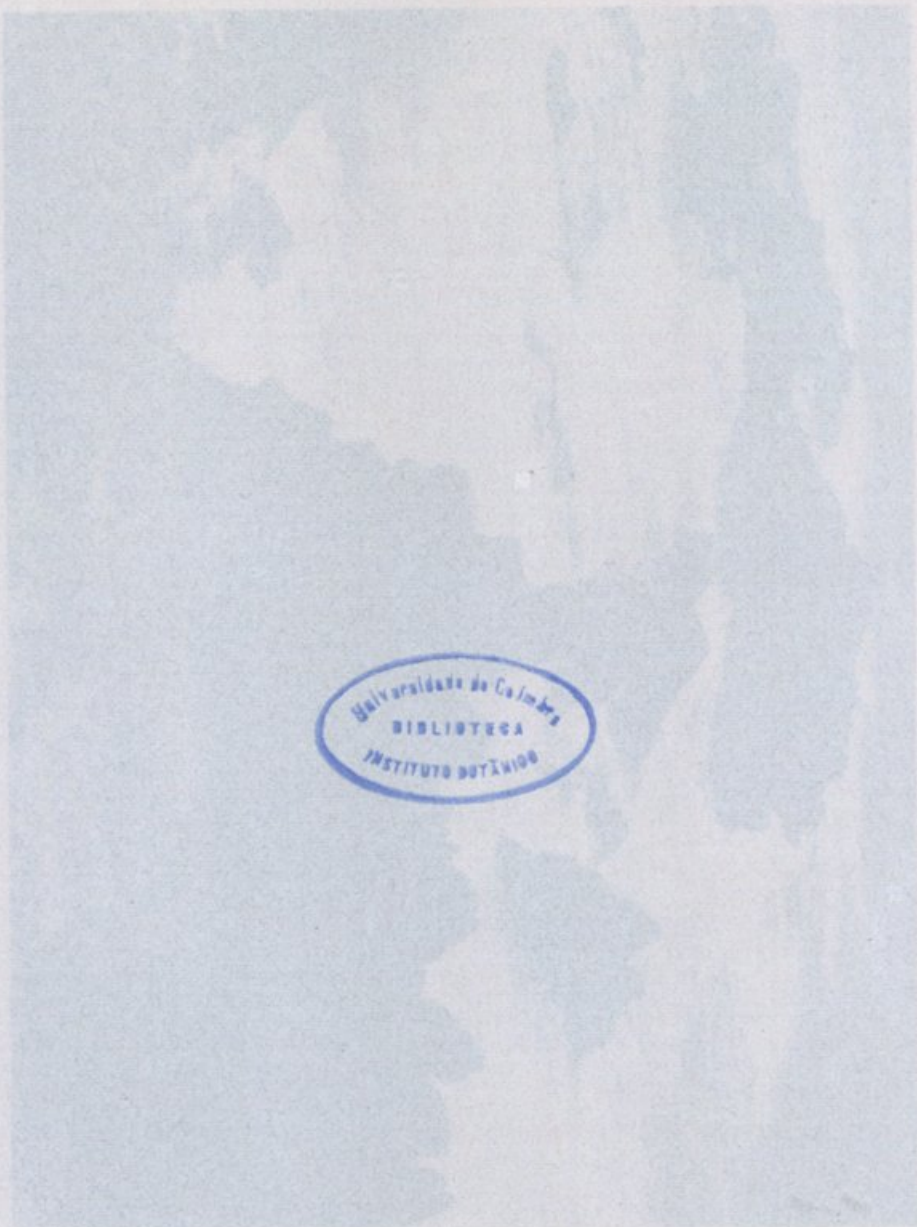
INDEX

FAMILIES

VASCULAR PLANTS

BRYOPHYTES

Fig. I — Rough lava cliffs. Habitats reached by storm waves have no plant cover. Above that limit there is colonization by the coastal zone all. *Festucion petraeae*. Dominants in the foreground are *Festuca petraea* and *Plantago coronopus* (cf. p. 17). Cais do Pico, Ilha do Pico, Azores. VII. 1968.



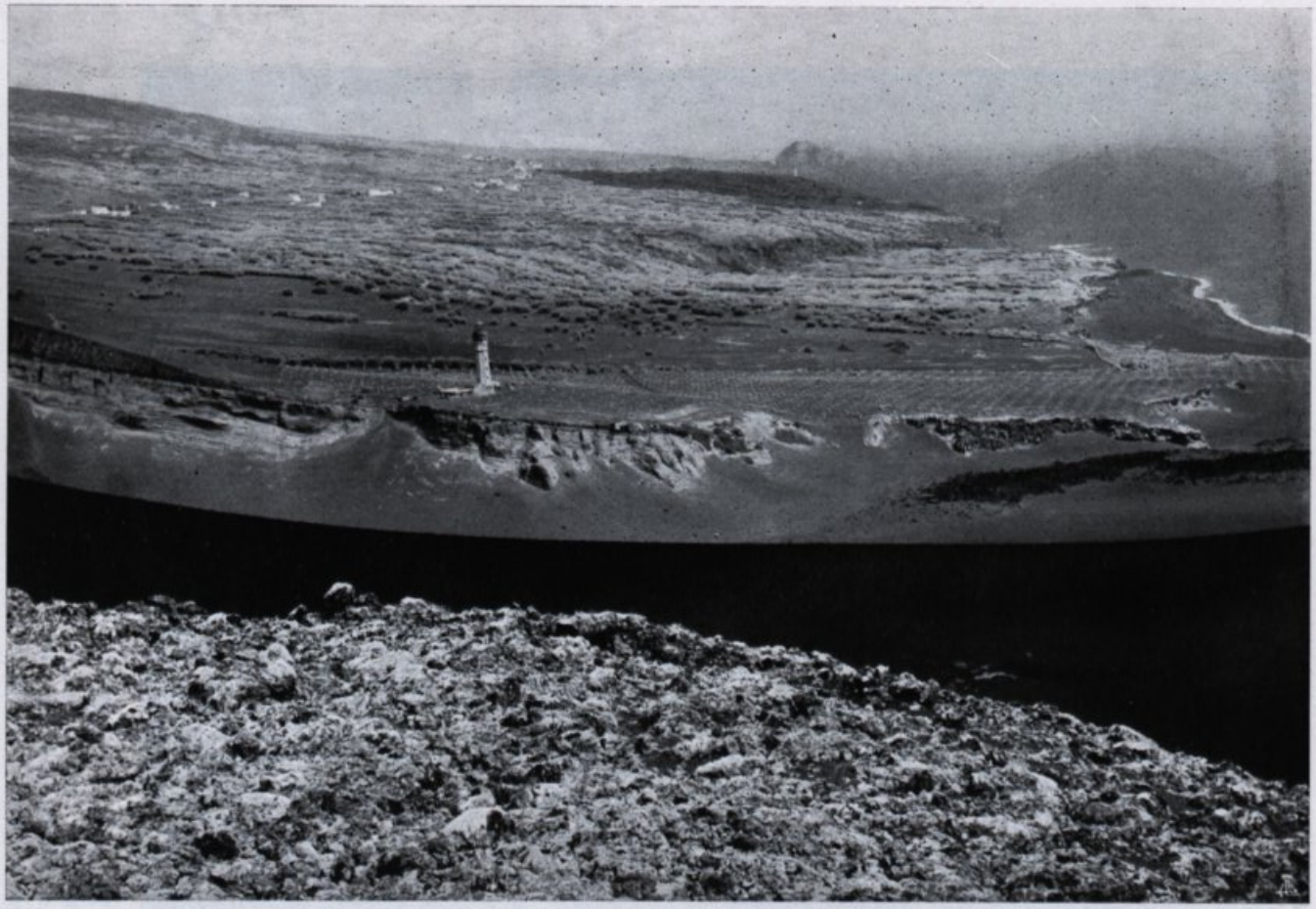


Fig. II — Former coast line on Faial with old lighthouse, seen from rim of caldeira of the Capelinhos volcano, active in 1957-58. In the foreground, sulphur-covered stones. The landscape far behind the lighthouse is covered by loose sand and gravel deposits. To the right the small visible part of a short and narrow lava flow. All this is young volcanic material. No spontaneous colonization by plants was recorded 10 years after the eruption, except a few small localities with *Carpobrotus edulis* and *Trichostomum litorale* (cf. p. 20). — New peninsula of Volcano dos Capelinhos, Faial, Azores. VII. 1968.

Fig. III — Volcanic explosion hole at 1000 m in lava flow of the year 1718. The habitat inside the hole is very well protected from exposure. Dominance of the *Festucetum jubatae* of the *Juniperion brevifolii*. Dominant species are *Juniperus brevifolia, Ilex perado* ssp., *Euphorbia stygiana, Dryopteris* spp. and *Festuca jubata* (cf. p. 35). — Misterio da Sete Cab. do Fogo, Ilha do Pico, Azores. VII. 1968.


Universidad de Cádiz
BIBLIOTECA

Fig. IV — Rim of the Torrinhas parasitic cone at 1000 m. In the foreground *Euphorbia stygiana* and *Ilex perado* ssp. as outpost of the *Festucetum jubatae* inside the cone. Surrounding pastures with sparse *Erica azorica* scrub. (cf. p. 35). — Torrinhas, N slope of Pico, Ilha do Pico, Azores. VII. 1968.

Fig. V — The Pico volcano (2350 m high) seen from NW, from 1100 m. Cloud zone community *Juniperion brevifolii* in foreground with dominance of *Erica azorica* on the lava flow of Mist. da St. Luzia. The all., with high number of differential species, reaches 1350 m. A low *Calluna-Daboecia-Thymus* carpet covers the lava flow ridges up to 1700 m. Large landslide areas lack vascular plant cover. Parasitic cone at 1450 m to the right (cf. p. 27 ff.). — The Pico volcano, Ilha do Pico, Azores. VII. 1968.

Fig. VI — *Calluna-Daboecia-Thymus* carpet at 1400 m above a landscape with several parasitic cones. In the background, cultivated pastures, more or less improved with leguminous plants and grasses (cf. p. 27). — W slope of Pico, Ilha do Pico, Azores. VII. 1968.

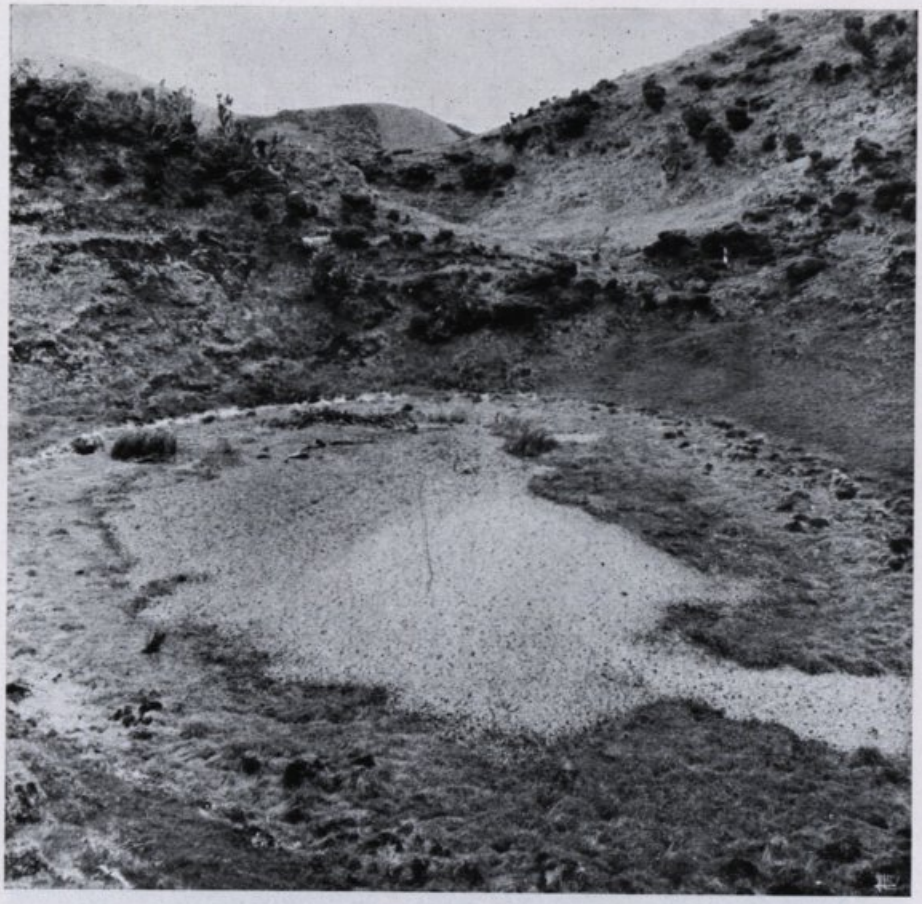


Fig. VII — The landscape E of the road from Cais do Pico to Lajes includes many small crater lakes. The dominant community is the grassland ass. *Anagallidetum tenellae* derived from the shrub ass. *Erico-Myrsinetum*. Lake shore community: *Litorello-Eleocharion* in this locality (900 m) strongly influenced by grazing. *Polytricum commune - Luzula purpureo-splendens* hummocks in the highest microzone just below high water level. Dominance of *Eleocharis multicaulis* in middle microzones. The future incroachment of the lake by vegetation has started with an increase in *Potamogeton polygonifolius* (cf. p. 23 ff.). — Small lake E of Lag. do Landroal, Ilha do Pico. Azores. V. 1965.

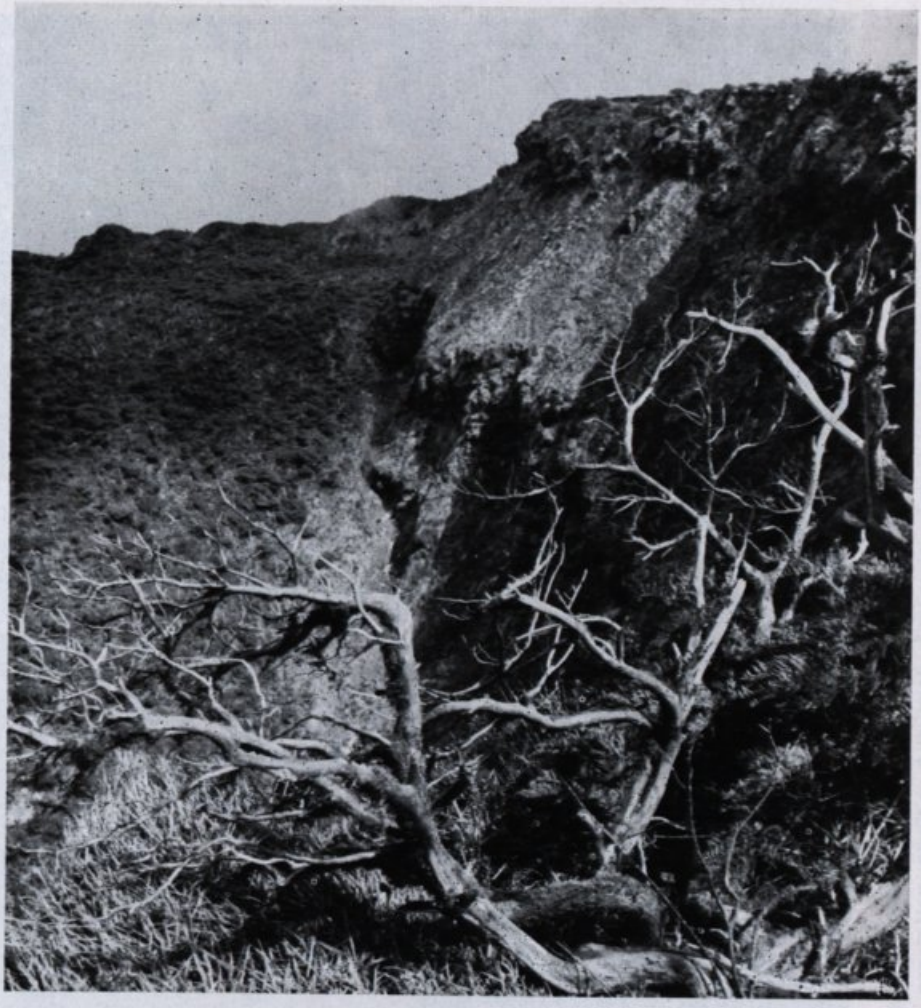
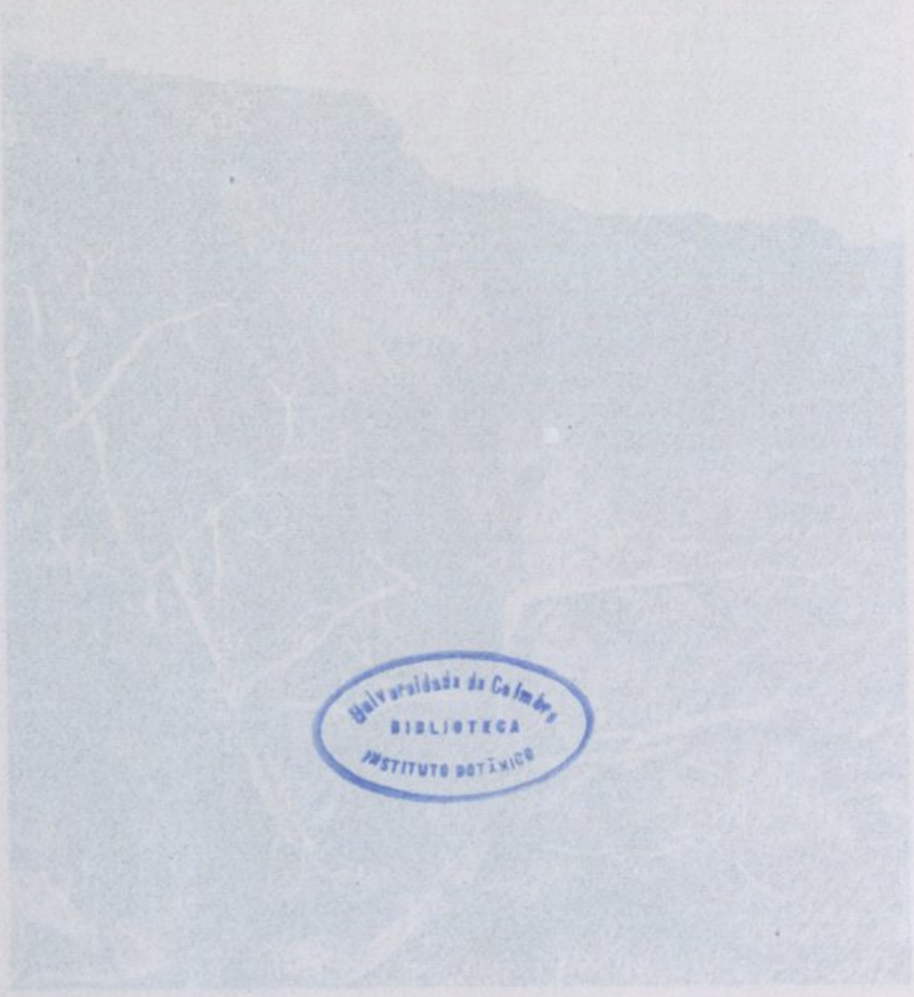


Fig. VIII — *Festucetum jubatae* on slope, strongly influenced by earlier felling. Future survival of ass. outside ravines threatened because of slow or absent regeneration of shrubs. High degrees of cover of *Sphagnum* even on vertical slope. On rim of caldeira, dominance of *Luzula purpureo-splendens* (cf. p. 35). — South inside slope of the Caldeira do Santa Barbara, Terceira, Azores. VI. 1968



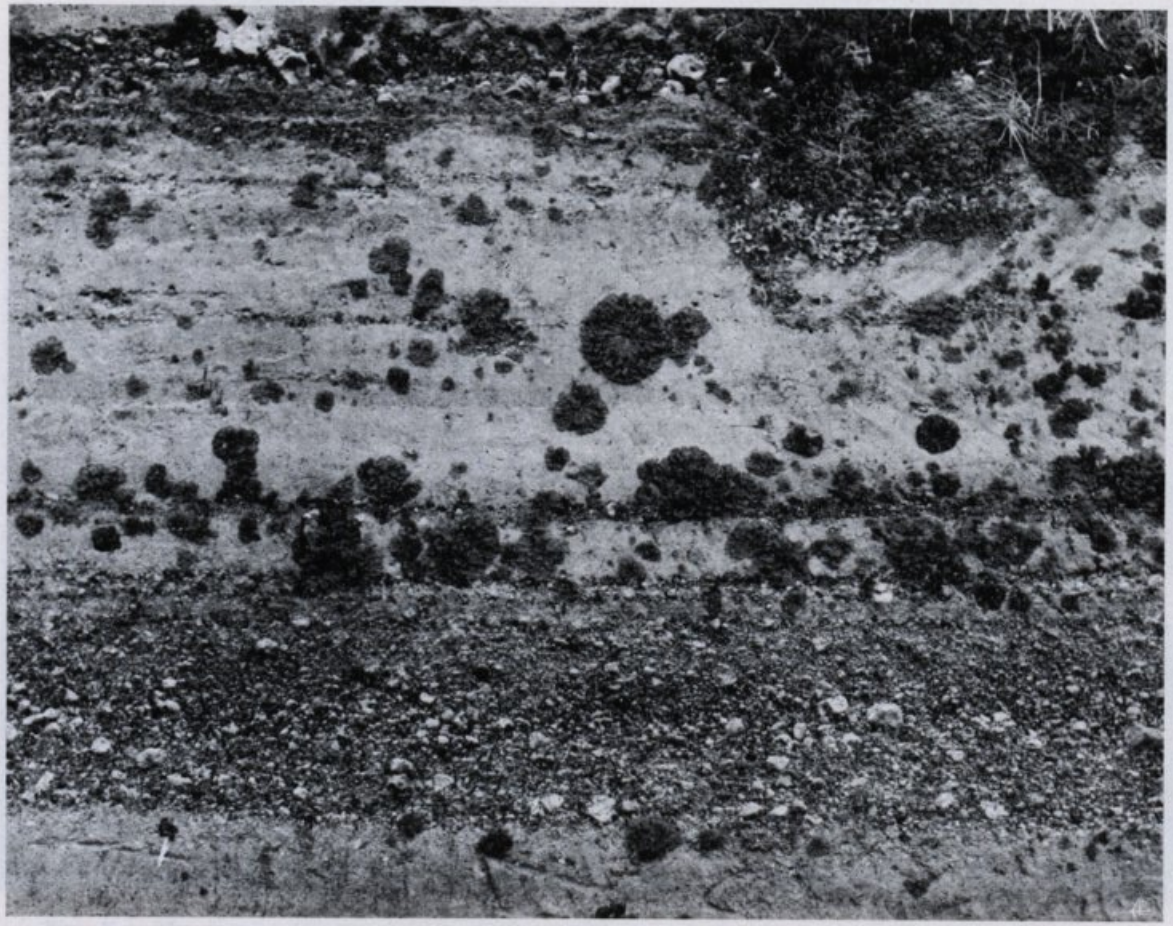


Fig. IX — Vertical cutting at 400 m through volcanic deposits. Weak exposure towards the north. Surrounding vegetation weakly developed *Juniperion brevifolii*. Primary stage of colonization with bryophytes. Dominant species *Anthoceros punctatus* and *Philonotis rigida* on fine sand layers. Colonization of the bare soil starts after about 4 years at this altitude (annual precipitation about 1400 mm (cf. p. 28). — Sete Cidades, S. Miguel, Azores. IV. 1965.

Fig. X — The large caldeira seen from the south rim. Large areas on the interior slopes are after cutting now only sparsely covered by *Juniperus brevifolia* and *Erica azorica*. Where cutting has been intensive there has been a potent invasion of *Pteridium aquilinum* into the grass carpet. On the slopes, predominating *Erico-Myrsinetum* with *Festucetum jubatae* in the ravines. On the bottom of the caldeira, *Litorello-Eleocharion* (cf. p. 26 ff.) around the lakes. Areas above high water level covered by dense *Erica azorica* scrub. — Caldeira do Faial, Faial, Azores. VII. 1968

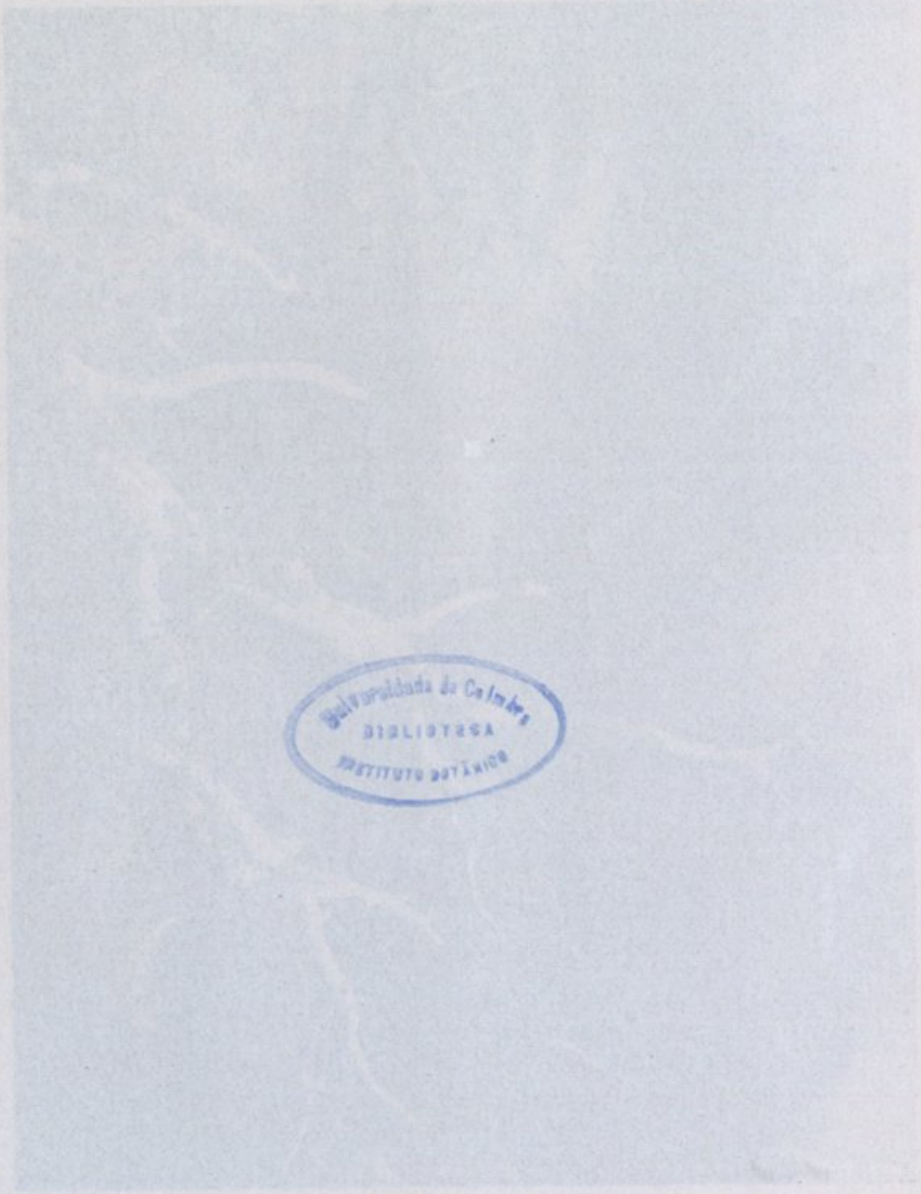


Fig. XI — Sparse *Juniperion brevifolii* scrub at 900 m. Scrub vegetation: *Erico-Myrsinetum*. In open glades: *Anagallidetum tenellae* with dominance of *Eleocharis multicaulis, Juncus effusus, Anagallis tenella*. The glade on slightly sloping ground in the locality has been cleared by cutting and grazing. It will be recolonized by the *Erico-Myrsinetum* if not too heavily grazed. This recolonization will probably start from hummocks colonized by *Calluna vulgaris* (cf. p. 26 ff.). — To the north of Torrinhas, Ilha do Pico, Azores. VII. 1968.

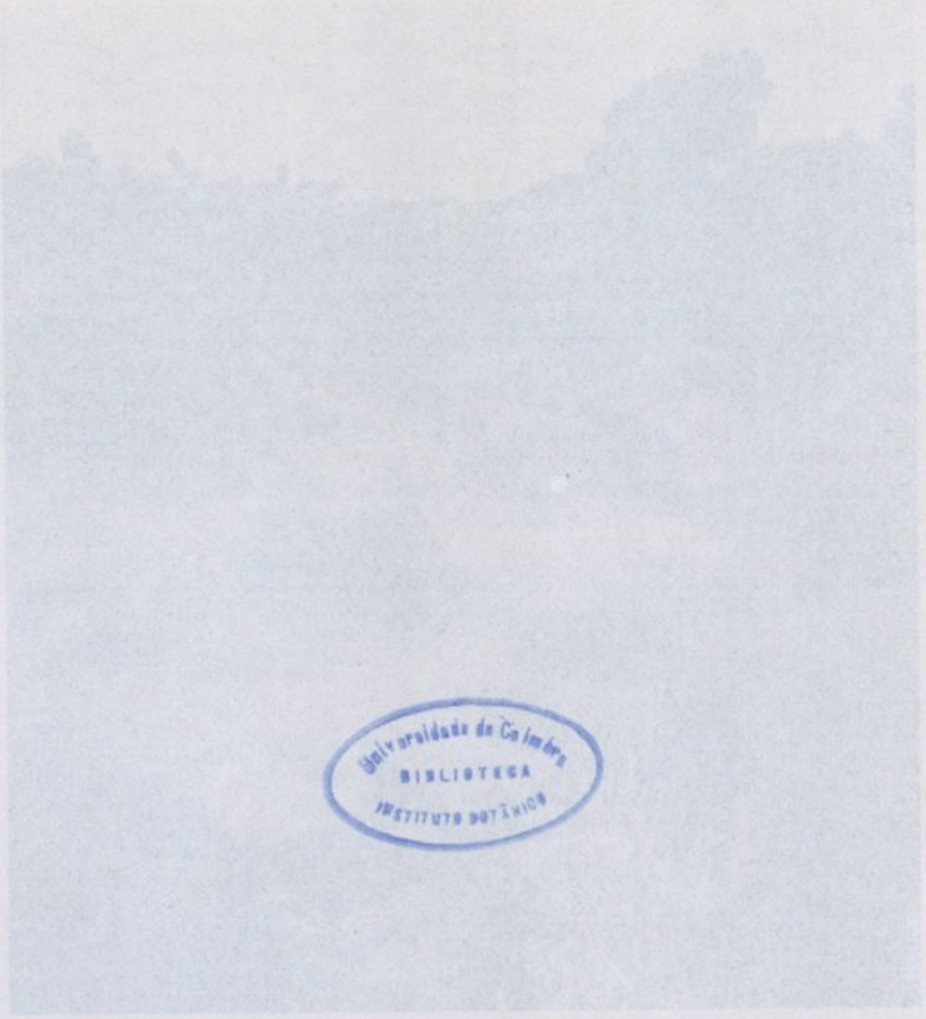


Fig. XII — Grassland landscape derived from the *Erico-Myrsinetum*, not improved. Overgrazing of the pastures on coarse volcanic deposits has induced erosion and the formation of long horizontal hummocks on the slope. Recolonization of bare soil deprived of plant cover at the base of the slope has started with dominant *Polytrichum commune* and *Campylopus* spp. The erosion has become accentuated close to the streams visible on the photo (cf. p. 32). — Slope to the S of Lag. do Paul, Ilha do Pico, Azores. VII. 1968.

Fig. XIII — The original natural landscape of the caldeira with dominance of the *Erico-Myrsinetum* is now almost completely transformed directly or indirectly by man, except in deep narrow ravines. This change probably required only about 150 years of overgrazing and cutting, which was followed by the invasion of recently introduced plants and by very severe erosion, as seen in the foreground (cf. p. 32). — Sete Cidades, S. Miguel, Azores. V. 1965.

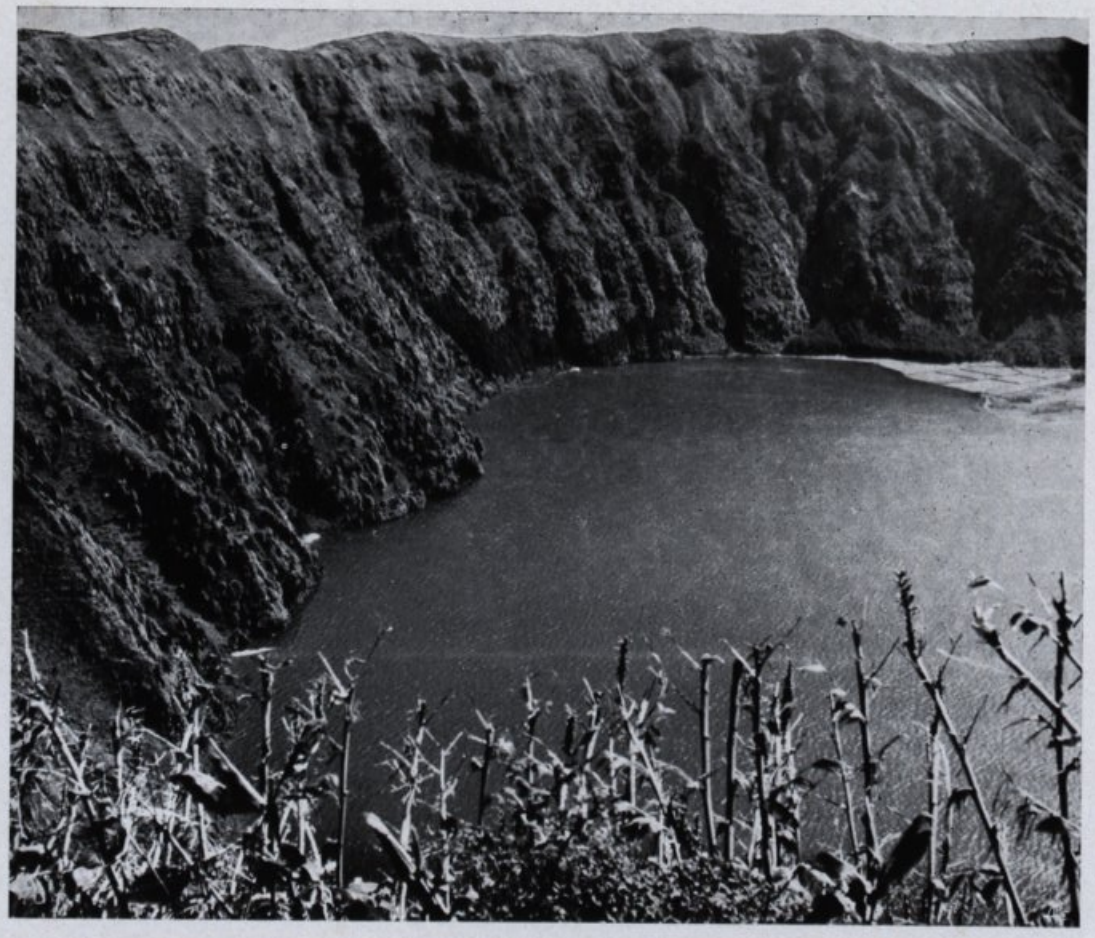


Fig. XIV — The interior slopes of the caldeira have recently been almost completely invaded by the introduced ornamental flower *Hedychium gardnerianum*, now spontaneously colonizing severely exploited landscape on several islands. *Hedychium* forms an almost impenetrable carpet, where recolonization of the *Juniperion brevifolii* is hardly probable (cf. p. 29). — Sete Cidades, S. Miguel, Azores. V. 1965.