

Endemic Vascular Plants of the Azores: an Updated List

by

Hanno Schäfer , München

Summary: Based on field data obtained between 1998 and 2001 and all available literature, we present an updated list of the endemic taxa of vascular plants of the Azores archipelago including distribution, habitat and estimated population size. Of the 197 indigenous species of the Azorean flora, 70 species, i. e. 35.5 %, are classified as endemic. Half of these taxa are widespread and common, 25 % are endangered and three may be extinct.

Key words: Azores; flora; endemics.

Zusammenfassung: Auf der Grundlage von im Zeitraum 1998-2001 gesammelten Verbreitungsdaten und unter Berücksichtigung sämtlicher zugänglicher Literatur wurde eine aktuelle Liste der endemischen Farn- und Blütenpflanzen der Azoren mit Angaben zu Verbreitung, Habitat und geschätztem Gesamtbestand erarbeitet. Von den 197 indigenen Arten der Azorenflora wurden 70, also 35.5 %, als Azorenendemiten eingestuft. Die Hälfte davon ist weit verbreitet und häufig, ein Viertel gefährdet und drei sind verschollen.

1. Introduction

The Azores archipelago is composed of nine volcanic islands, colonised in the early 15th century. It is located in the Northern Atlantic Ocean close to the middle-Atlantic ridge with a distance of more than 1 000 km to the American and the European coast.

The native flora of the Azores is very poor in species in comparison to the indigenous flora of the closest neighbouring archipelagos: Madeira and the Canaries. In a recent survey of the total flora (SCHÄFER 2003), only 197 species were classified as indigenous taxa (24 %). Whereas the Canarian flora is famous for radiations resulting in large groups of specialised endemics, e. g. in genera like *Aeonium*, *Argyranthemum*, *Pericallis* or *Sonchus*, similar cases are unknown from the Azorean flora and fauna. Instead, many Azorean endemics are characterised by a wide ecological and altitudinal range. *Erica azorica*, one of the most striking examples, can be found from sea level up to 2 300 m a. s. l. on the peak of Pico mountain.

2. Method and Material

Data on distribution and population size of all endemics was collected during a mapping project of the Azorean flora between 1998 and 2001 on all islands of the archipelago. The islands Flores, Faial and Santa Maria were studied in detail for a period of six-seven months each, resulting in 1x1 km² UTM-grid distribution maps for all vascular plant taxa on these islands. The other islands were visited for two-three weeks. The population size of all endemics was estimated from the number of colonised islands and their frequency in the studied UTM squares.

3. Results

A total of 70 endemic species (tab. 1) and eight endemic hybrids (tab. 2) belonging to 34 plant families are recognised for the Azorean flora. Two endemics, *Euphorbia*

Tab. 1: Alphabetical list of the endemic taxa of the Azores, with family (according to STEVENS 2005), distribution within the archipelago (CO - Corvo, FL - Flores, FA - Faial, TE - Terceira, PI - Pico, GR - Graciosa, JO - São Jorge, SM - São Miguel, MA - Santa Maria), most important habitats and estimated population size in the Azores

Endemic Taxon	Family	Distrib.	Habitat	Population size
<i>Agrostis azorica</i> (Hochst.) Tutin & E. F. Warburg	Poaceae	CO, FL, FA, TE, PI, GR, JO, SM	high altitude grassland	50 000-100 000
<i>Agrostis congestiflora</i> Tutin & E. F. Warburg	Poaceae	CO, FL, FA, TE, PI, GR, JO, SM	coastal cliffs, steep slopes and rocks	5 000-10 000
<i>Agrostis botelhoi</i> (Rocha Afonso & Franco) comb. nov.	Poaceae	FL, TE	peat bogs and juniper rainforest of high altitudes	< 1 000
<i>Ammi seubertianum</i> (Wats.) Trelease	Apiaceae	FL (?), PI, MA	coastal cliffs	1 000-5 000
<i>Ammi trifoliatum</i> (Wats.) Trelease	Apiaceae	CO, FL, FA, TE, PI, JO, SM	inland cliffs, volcanic craters, juniper rainforest	> 10 000
<i>Angelica lignescens</i> Reduron & Danton	Apiaceae	FL, FA, PI, TE, SM	volcanic craters, juniper rainforest	1 000-2 000
<i>Arceuthobium azoricum</i> D. Wiens & F. G. Hawksworth	Santalaceae	FA, TE, JO, PI	juniper rainforest	> 10 000
<i>Armeria maritima</i> Willd. ssp. <i>azorica</i> Franco	Plumbaginaceae	FL, JO, SM	mountain peaks	no recent records
<i>Asplenium azoricum</i> (Milde) Lovis, Rasbach & Reichst.	Aspleniaceae	all	laurel forest, ravines	> 100 000
<i>Azorina vidalii</i> (Wats.) Feer	Campanulaceae	all	coastal cliffs	5 000-10 000
<i>Bellis azorica</i> Hochst.	Asteraceae	CO, FL, FA, PI, TE, JO, SM	juniper rainforest, volcanic craters	3 000-5 000
<i>Cardamine caldeirarum</i> Guthnick ex Seub.	Brassicaceae	CO, FL, FA, PI, TE, JO, SM, MA	juniper rainforest, volcanic craters, ravines	50 000-100 000
<i>Carex hochstetteriana</i> J. Gay ex Seub.	Cyperaceae	CO, FL, FA, PI, TE, JO, SM, MA	coastal cliffs, Pittosporum forest	> 100 000
<i>Carex pilulifera</i> L. ssp. <i>azorica</i> (J. Gay) Franco & Rocha Afonso	Cyperaceae	FL, FA, PI, TE, JO, SM	natural pastures, volcanic craters, ravines, heathland	40 000-50 000
<i>Carex vulcani</i> Hochst.	Cyperaceae	FL, FA, PI, TE, JO, SM, MA	cliffs, ravines, laurel and Pittosporum forest, juniper rainforest	50 000-100 000
<i>Cerastium azoricum</i> Hochst. ex Seub.	Caryophyllaceae	CO, FL	waterfalls, coastal cliffs, steep slopes	4 000-5 000

Cont. Tab. 1:

Endemic Taxon	Family	Distrib.	Habitat	Population size
<i>Cerastium vagans</i> Lowe var. <i>ciliatum</i> Tutin & E. F. Warburg	Caryophyllaceae	JO, TE	ravines	no recent records
<i>Chaerophyllum azoricum</i> Trelease	Apiaceae	FL, PI, JO, MI	inland cliffs, Pittosporum forest	5 000-10 000
<i>Corema azoricum</i> P. Silva	Ericaceae	FA, PI, GR, JO, SM	coastal basalts, lava flows, Erica shrub	5 000-8 000
<i>Daboecia azorica</i> Tutin & E. F. Warburg	Ericaceae	FA, PI, JO, SM	lava flows, steep slopes, Erica shrub	50 000-100 000
<i>Daucus carota</i> L. ssp. <i>azoricus</i> Franco	Apiaceae	all	pastures, cliffs, cultivated ground	> 100 000
<i>Deschampsia foliosa</i> Hack.	Poaceae	CO, FL, FA, PI, JO, TE, SM	steep slopes, ravines, craters, mountain peaks	> 100 000
<i>Dryopteris azorica</i> (Christ) Alston	Dryopteridaceae	all	forests, hedges, ravines	> 100 000
<i>Dryopteris crispifolia</i> Rasbach, Reichst. & Vida	Dryopteridaceae	FL, FA, PI, TE, SM	slopes, ravines, old <i>Cryptomeria</i> plantations	5 000-10 000
<i>Erica azorica</i> Hochst. ex Seub.	Ericaceae	all	slopes, cliffs, mountain peaks	> 100 000
<i>Euphorbia azorica</i> Hochst. ex Seub.	Euphorbiaceae	all	coastal cliffs	50 000-100 000
<i>Euphorbia stygiana</i> Wats. ssp. <i>stygiana</i>	Euphorbiaceae	CO, FL, FA, PI, JO, TE, SM	volcanic craters, ravines, juniper rainforest	30 000-40 000
<i>Euphorbia stygiana</i> Wats. ssp. <i>santamariae</i> H. Schaefer	Euphorbiaceae	MA	Picconia forest	50-60
<i>Euphrasia azorica</i> Wats.	Orobanchaceae	CO, FL	inland cliffs, waterfalls, steep slopes	10 000-20 000
<i>Euphrasia grandiflora</i> Hochst.	Orobanchaceae	PI, TE	steep slopes, volcanic craters	1 000-2 000
<i>Festuca francoi</i> Fdez. Prieto, C. Aguiar & E. Dias sp. nova ined. (= <i>F. jubata</i> auct., non Lowe)	Poaceae	all	steep slopes, volcanic craters, inland cliffs	> 100 000
<i>Festuca petraea</i> Guthnick ex Seub.	Poaceae	all	coastal cliffs	> 100 000
<i>Gaudinia coarctata</i> (Link) Dur. & Schinz	Poaceae	all	coastal cliffs	40 000-50 000
<i>Grammitis azorica</i> (H. Schaefer) comb. nov.	Grammitidaceae	FL, PI	juniper rainforest	< 100
<i>Hedera azorica</i> Hort. ex Carrière	Araliaceae	all	forests and hedges	> 100 000
<i>Holcus rigidus</i> Hochst. ex Seub.	Poaceae	all	steep slopes, ravines, craters, landslides	> 100 000

Cont. Tab. 1:

Endemic Taxon	Family	Distrib.	Habitat	Population size
<i>Hypericum foliosum</i> Aiton	Hypericaceae	all	coastal cliffs, hedges, slopes, juniper rainforest	> 100 000
<i>Ilex perado</i> Aiton ssp. <i>azorica</i> (Loes.) Tutin	Aquifoliaceae	CO, FL, FA, PI, JO, TE, SM, MA	laurel forest, volcanic craters, ravines, juniper rainforest	> 100 000
<i>Isoëtes azorica</i> Durieu ex Milde	Isoëtaceae	FL, FA	crater lakes	2 000-3 000
<i>Juniperus brevifolia</i> (Seub.) Antoine	Cupressaceae	all	cliffs, ravines, volcanic craters, mountain slopes	> 100 000
<i>Lactuca watsoniana</i> Trelease	Asteraceae	FA, PI, TE, JO, SM	volcanic craters, steep slopes, ravines	500-1 000
<i>Leontodon filii</i> (Hochst. ex Seub.) Paiva & Ormonde	Asteraceae	PI, TE, JO, SM	volcanic craters, steep slopes, ravines	5 000-10 000
<i>Leontodon</i> sp. <i>nova</i> ined.	Asteraceae	PI, TE, SM	volcanic craters, steep slopes, ravines	< 1 000
<i>Leontodon rigens</i> (Dryand. in Aiton) Paiva & Ormonde	Asteraceae	CO, FL	volcanic craters, steep slopes, ravines	4 000-5 000
<i>Limonium eduardi-diasii</i> Fdez. Prieto & C. Aguiar sp. <i>nova</i> . ined. (= <i>L. vulgare</i> auct., non Miller)	Plumbaginaceae	SM, MA	coastal rocks	50 000-100 000
<i>Lotus azoricus</i> P. W. Ball	Fabaceae	FL, PI, JO, SM, MA	coastal cliffs, steep slopes	10 000-20 000
<i>Luzula purpureo-splendens</i> Seub.	Juncaceae	CO, FL, FA, PI, JO, TE, SM	slopes, ravines, craters, Erica shrub, laurel forest	> 100 000
<i>Lysimachia azorica</i> Hornem. ex Hook.	Primulaceae	CO, FL, FA, PI, JO, TE, SM, MA	laurel and juniper forest, slopes, craters	> 100 000
<i>Marsilea azorica</i> Launert & Paiva	Marsileaceae	TE	small pond in pastures	500-1 000 in 1 location
<i>Myosotis azorica</i> Wats.	Boraginaceae	CO, FL	volcanic craters, inland cliffs, waterfalls	500
<i>Myosotis maritima</i> Hochst. ex Seub.	Boraginaceae	CO, FL, FA, PI, JO, TE, SM, MA	coastal cliffs	50 000-100 000
<i>Myrsine retusa</i> Aiton	Myrsinaceae	all	coastal cliffs, slopes, ravines, laurel forest, juniper rainforest	> 100 000
<i>Pericallis malvifolia</i> (L'Hér.) B. Nord. ssp. <i>malvifolia</i>	Asteraceae	FA, PI, JO, TE, SM, MA	coastal cliffs	> 100 000
<i>Pericallis malvifolia</i> (L'Hér.) B. Nord. ssp. <i>caldeirae</i> H. Schaefer	Asteraceae	FA, TE	volcanic craters, ravines	400-500

Cont. Tab. 1:

Endemic Taxon	Family	Distrib.	Habitat	Population size
<i>Picconia azorica</i> (Tutin) Knobl.	Oleaceae	CO, FL, FA, PI, JO, TE, SM, MA	coastal cliffs, laurel forest	> 100 000
<i>Platanthera azorica</i> Schlecht.	Orchidaceae	FL, FA, PI, SM	volcanic craters, steep slopes	500-1 000
<i>Platanthera micrantha</i> (Hochst. ex Seub.) Schlecht.	Orchidaceae	CO, FL, FA, PI, JO, TE, SM, MA	volcanic craters, juniper rainforest	50 000-70 000
<i>Polypodium azoricum</i> (Vasc.) R. Fern.	Polypodiaceae	all	laurel forest, walls, ravines, juniper rainforest	> 100 000
<i>Prunus lusitanica</i> L. ssp. <i>azorica</i> (Mouill.) Franco	Rosaceae	FL, FA, PI, JO, TE, SM	laurel forest, ravines, volcanic craters	500-1 000
<i>Rostraria azorica</i> Henderson	Poaceae	MA	coastal cliffs, roadsides	> 1 000
<i>Rubia agostinhoi</i> Dans. & P. Silva	Rubiaceae	CO, FL, FA, PI, JO, TE, SM, MA	juniper rainforest, laurel forest	> 100 000
<i>Rubus hochstetterorum</i> Seub.	Rosaceae	all	hedges, ravines, juniper rainforest	> 100 000
<i>Rumex azoricus</i> Rech. fil.	Polygonaceae	CO, FA, JO, TE, SM	ravines, volcanic crater	1 000-1 500
<i>Sanicula azorica</i> Guthnick ex Seub.	Apiaceae	FA, PI, JO, TE, SM, MA	laurel and Pittosporum forest, volcanic crater	3 000-5 000
<i>Scabiosa nitens</i> Roem. & Schult.	Dipsacaceae	CO, FL, FA, PI, JO, TE, SM, MA	coastal cliffs	50 000-70 000
<i>Silene uniflora</i> Roth ssp. <i>cratericola</i> (Franco) Franco	Caryophyllaceae	FA, PI	mountain peak	< 100
<i>Spergularia azorica</i> (Kinb.) Lebel	Caryophyllaceae	all	coastal cliffs	> 100 000
<i>Tolpis azorica</i> (Nutt.) P. Silva	Asteraceae	CO, FL, FA, PI, JO, TE, SM	peat bogs, volcanic craters, steep slopes, juniper rainforest	10 000-20 000
<i>Vaccinium cylindraceum</i> J. E. Sm.	Ericaceae	CO, FL, FA, PI, JO, TE, SM, MA	Erica shrub, laurel forest, juniper rainforest	> 100 000
<i>Veronica dabneyi</i> Hochst. ex Seub.	Plantaginaceae	CO, FL, FA	volcanic craters, inland cliffs, waterfalls	250-500
<i>Viburnum tinus</i> L. ssp. <i>subcordatum</i> (Trelease) P. Silva	Caprifoliaceae	CO, FL, FA, PI, JO, TE, SM, MA	ravines, laurel forest, juniper rainforest	50 000-100 000
<i>Vicia dennesiana</i> Wats.	Fabaceae	SM	steep slopes	no recent records

stygiana and *Pericallis malvifolia* occur in two subspecies each. Only one genus is endemic to the Azores: the monotypic *Azorina* (*Campanulaceae*), probably a very old Gondwana relict (EDDIE 1997). The most important families among the endemics are *Poaceae* (nine endemic species), *Asteraceae* (seven endemic species) and *Apiaceae* (six endemic species). About half of the endemics are common or very common species, occurring on most of the islands in forests, hedges and cliffs, and forming a total population of up to or more than 100 000 individual plants. To this group belong the very important trees *Erica azorica*, *Ilex perado* ssp. *azorica*, and *Juniperus brevifolius*. About 25 % of the endemics occur on several islands in populations of 10 000 or more individuals and thus are also not endangered. The remaining endemics are all endangered as they are restricted to few islands and their population size is less than 10 000 plants. Three taxa have not been recorded in recent years and might be extinct: *Armeria maritima* Willd. ssp. *azorica* Franco, *Cerastium vagans* Lowe var. *ciliatum* Tutin & E. F. Warburg, *Vicia dennesiana* Wats. (see HOOKER 1887 for a detailed account on this species). The endemic hybrids are mostly ferns that occur as single plants between their parental species (see FRASER-JENKINS 1982 for an account on the *Dryopteris* hybrids).

3.1 Nomenclatorial remarks

Agrostis reuteri ssp. *botelhoi* Rocha Afonso & Franco is upgraded to *Agrostis botelhoi* (Rocha Afonso & Franco) comb. nov.; *Grammitis marginella* L. ssp. *azorica* H. Schäfer is upgraded to *Grammitis azorica* (H. Schäfer) comb. nov. (see FRANCO & ROCHA AFONSO 1997 and SCHÄFER 2001 for detailed descriptions).

Publications with descriptions for the following three new taxa are in press (C. Aguiar, pers. comm.): *Festuca francoi* Fdez. Prieto, C. Aguiar & E. Dias, sp. nov. ined. (= *F. jubata* auct., non Lowe); *Leontodon* sp. nov. ined.; *Limonium eduardi-diasii* Fdez. Prieto & C. Aguiar sp. nov. ined. (= *L. vulgare* auct., non Miller). A putative endemic hybrid of the genus *Holcus* is currently studied at the University of Madeira (Sequeira, pers. comm.).

Daucus carota L. ssp. *azoricus* Franco is a doubtful subspecies and might be only of lower taxonomical rank but a detailed revision is missing. *Polypodium azoricum* (Vasc.) R. Fern. is perhaps a synonym of *P. macaronesicum* A. Bobrov.

The following taxa cannot be accepted: *Smilax divaricata* Sol. ex Wats., nom. nud. is a synonym of *Smilax canariensis* Brouss. ex Willd.; *Sonchus azoricus* Rivas-Martinez et al., nom. ined., is a synonym of *Sonchus tenerrimus* L.; *Ammi huntii* H. C. Watson is here included into *A. trifoliatum* (H. C. Wats.) Trelease. *Daphne azorica* Rivas-Martinez et al., nom. ined. is a synonym of *Daphne laureola*. The species of the genus *Taraxacum* that occur in the Azores are still awaiting a detailed revision.

Tab. 2: Endemic hybrids of the Azores (abbreviations: see Tab. 1).

Endemic Hybrid	Family	Distrib.	Habitat	No. of Ind.
<i>Asplenium</i> × <i>diasii</i> H. Schaefer et al. (<i>A. azoricum</i> × <i>A. onopteris</i>)	Aspleniaceae	MA	ravines	< 100
<i>Asplenium</i> × <i>santamariae</i> H. Schaefer et al. (<i>A. azoricum</i> × <i>A. scolopendrium</i>)	Aspleniaceae	MA	ravines	1
<i>Dryopteris</i> × <i>madalena</i> Fraser-Jenk. (<i>D. crispifolia</i> × <i>D. azorica</i>)	Dryopteridaceae	PI	volcanic craters, steep slopes	?
<i>Dryopteris</i> × <i>martinsiae</i> Fraser-Jenk. (<i>D. aemula</i> × <i>D. crispifolia</i>)	Dryopteridaceae	FL, PI, JO	volcanic craters, steep slopes	few
<i>Dryopteris</i> × <i>picoensis</i> Fraser-Jenk. (<i>D. affinis</i> ssp. <i>affinis</i> × <i>D. azorica</i>)	Dryopteridaceae	PI	volcanic craters, steep slopes	few
<i>Dryopteris</i> × <i>telesii</i> Fraser-Jenk. (<i>D. crispifolia</i> × <i>D. dilatata</i>)	Dryopteridaceae	PI	volcanic craters, steep slopes	few
<i>Dryopteris</i> × <i>sjoegrenii</i> Fraser-Jenk. (<i>D. dilatata</i> × <i>D. azorica</i>)	Dryopteridaceae	PI	volcanic craters, steep slopes	few
<i>Rumex</i> × <i>caldeirarum</i> Rech. fil. (<i>R. azoricus</i> × <i>R. obtusifolius</i>)	Polygonaceae	SM	ravines	few

4. Discussion and Conclusions

With more than one third of the indigenous species being endemic to the archipelago, the Azorean flora is another nice example for speciation on isolated islands. Although the archipelago is probably less than five Mio. years old (SCHÄFER 2003) this high percentage of endemics makes its flora unique and conservation a must. The 30-40 common endemics with a wide ecological range do not need special programs like seed exchange and cultivation in botanical gardens. However, the habitats of all of them have been drastically reduced in the past. The stands of temperate juniper rainforest are still being destroyed to create pastures and construct new roads in the central regions of the islands. The low altitude habitats on all of the islands are rapidly invaded by exotic plant species like the Himalayan *Hedy-chium gardneranum*, the Australian *Pittosporum undulatum*, and the American *Lantana camara*, an important threat to native flora and vegetation. All endemics with populations smaller than 10 000 individuals need special conservation programs to survive the next few decades. They should be propagated in local and foreign botanical gardens and reintroduced to appropriate habitats under the control of the local conservation department. Endemic hybrids will occur wherever their parents are common and thus do not need special protection. Further taxonomic work in the Azores will most likely reveal a few more endemic taxa that have been overlooked until now. However, as some of the tentatively accepted taxa might turn out to be synonymies of widespread species, the overall number of endemics in the vascular plant flora of the Azores will not augment drastically in future.

Acknowledgements

Many thanks to P. Schönfelder for his guidance and continuous support and to C. Aguiar and M. Sequeira for information on unpublished taxa. Fieldwork in the Azores was made possible through a Ph.D. grant of the German National Merit Foundation.

References

- EDDIE, W. M. (1997): A global reassessment of the generic relationships in the bellflower family (Campanulaceae) – Ph.D. Thesis. Univ. of Edinburgh.
- FRANCO, J. do Amaral & ROCHA AFONSO, M da Luz. (1997): Notas do Herbário da Estação Florestal Nacional (LISFA) – Fasc. V. Silva Lusitana 5(1): 141-143.
- FRASER-JENKINS, C. R. (1982): *Dryopteris* (Pteridophyta: Dryopteridaceae) on Pico Island in the Azores Arquipélago – Life and Marine Science 2: 83-101.
- HOOKE, J. D. (1887): *Vicia dennesiana* – Curtis's Bot. Mag. 43: t. 6967.
- SCHÄFER, H. (2001): The Grammitidaceae, Pteridophyta, of Macaronesia – Feddes Repert. 112(7/8): 509-523.
- SCHÄFER, H. (2003): Chorology and Diversity of the Azorean Flora. Diss. Bot. 374.
- STEVENS, P. F. (2005): Angiosperm Phylogeny Website, Version 6: URL: <http://www.mobot.org/MOBOT/research/APweb/>).

Submitted 21.07.2005