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A floristic island in western Portugal

Abstract

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A description is given of the plant life of the small hill of São Bartolomeu, Nazaré in W Portugal which, because of its steep terrain, retains some features of the country's original vegetation. Lists are given of its vascular plants (c. 150), lichens (c. 68) and bryophytes (c. 17). Its phytogeography with its elements of Mediterranean, Euro-Siberian and Macaronesian phytochoria is discussed; the dominant one is Mediterranean. A brief phytosociological survey is presented. Although most of its plants are not rare, the importance of São Bartolomeu's hill as a compact portuguese refugium for a wide and interesting range of plant forms is emphasised, and the need for a formal protected status is stressed.

Introduction

The Mediterranean area has been so much disrupted and affected by human activities that very little remains of its natural vegetation. A few 'pockets' persist in less accessible areas. In Portugal, such areas are becoming increasingly rare; a high percentage of the country is cultivated, *Pinus pinaster* and *Eucalyptus globulus* are abundant, and much land is destroyed by fire every year. The aim of this paper is to draw attention to and describe one of these important areas in C Portugal, ca 2.7 km E from the fishing village of Nazaré (Prov. Estremadura). São Bartolomeu is a small, steep rocky hill, 154 m at its summit, conspicuous in the flattish surrounding countryside uniformly planted with *Pinus pinaster*. It is not only a geological but also a floristic island with an interesting combination of Mediterranean/Euro-siberian/Macaronesian elements.

The references to the floristic interest of this site are by Fernandes (1954) and Braun-Blanquet & al. (1956). In 1979, an area of 32 ha including the hill became a 'Classified Site' – i.e. a place of special interest meriting limited legal protection.

Geology and climate

The hill, largely surrounded by Pleistocene sand dunes, is like a spine parallel to the

coast runing north-south, tapering towards the south and covering an area of ca. 200 m^2. The W slope facing the sea is exposed to the frequent NW winds. This is the most impressive of all the plugs of eruptive rocks in the typhonic valley running NE-SW from S Leiria to N of São Martinho do Porto. According to the Geological Map of Portugal (Camarate França & Zbyszewski 1963) the rock is a compact, sub-ophitic, sodic-alkaline gabbro of medium to occasionally small grain; the main minerals are labradorite and augite. The soil is mostly sandy; pH = 6.5-6.9 (Braun-Blanquet & al. 1956).

Although falling within the general climatic category of Mediterranean (Tormo & al. 1992), Portugal lies at the verge of several climatic areas. Northern and atlantic influences are stronger in the north, along the coast and during winter; the Mediterranean influence is stronger in the south and at summer time, but is apparent in various degrees from south to north. The climatological data of Fig. 1 refer to Cela, the nearest meteorological station, 4 km further south, 5 km inland. The temperature range is narrow and winters are mild. The dry period is from early May to mid-September, when the plants suffer the greatest shortage of soil water. According to temperature and humidity, the site has been regarded, bioclimatically, as Atlantico-Mediterranean (Gaussen 1931) and Lower Meso-mediterranean with a subhumid character (Rivas-Martínez 1990).

	T	R
J	10,4	117
F	10,7	87
M	12,4	97
A	12,8	60
M	15,7	57
J	17,1	21
J	18,3	6
A	18,2	8
S	17,9	38
O	16,1	79
N	12,5	103
D	10,6	100

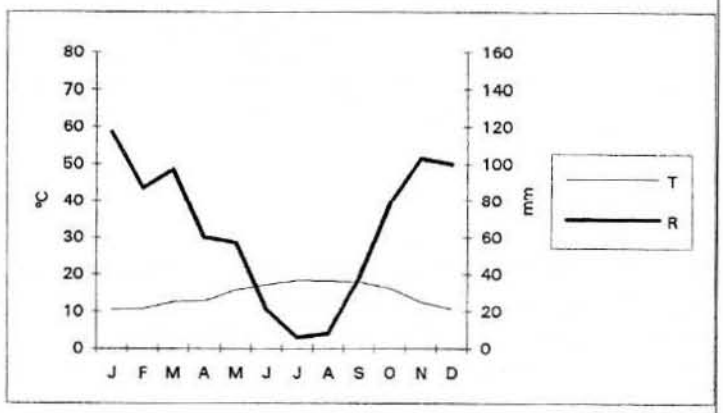

Fig. 1. Thermo-pluviometric graph of Cela, the nearest climatological site to São Bartolomeu. The dry period (PS, according to Gaussen, 1954) is between early June till mid-September which gives the site a strong Mediterranean character. T - temperature; R - rain precipitation.

The vegetation

The hill is surrounded by a commercial *Pinus pinaster* plantation (outwith its area it extends over a flat coastal sand dune territory of many square kilometres) and the ground vegetation is cleared every year or so. *Halimium* is abundant here. *Corema album* and *Linaria spartea* are common among the pines. *Neotinea maculata* is occasional.

Three floristic areas can be recognised on the hill itself:

a) The low parts where the slope is gentle and the soil basically sandy. There is a mixture of scattered *Pinus pinaster* with ground coverage dominated by most Leguminosae recorded. *Erica umbellata*, a few *Lavandula stoechas* and *Cistus salvifolius* are also here;

b) the south, tapering spine of the hill. In total this is a small area. *Quercus faginea* is represented here by a few specimens and by two specimens on the northern lower part. *Astragalus lusitanicus* is also present;

c) the E & W (warmer) steep rocky slopes. This is the area of greatest interest. There are a few differences between the vegetation on the eastern and western slopes.

On the E slope the most important elements are *Quercus coccifera* (up to 6 m) most variable in leaf shape and size, *Viburnum tinus* (shrubby tree to 5m), *Arbutus unedo* (to 8-9 m), *Erica arborea* (to 5 m). *Pistacia lentiscus* and *Rhamnus alaternus* are present, but far less common than on the W slope; *Phillyrea angustifolia* is present only at the exposed summit. The understorey vegetation is scattered here and grows in permanent shade, scattered amongst leaf litter. A fair number of taxa are absent or very rare on the more exposed W slope with extremely dense vegetation. Some of these are: *Asplenium onopteris*, very common; *Vinca difformis, Luzula campestris, L. forsteri, Scilla monophyllos, Asparagus aphyllus* and *Aristolochia paucinervis,* scattered. *Teucrium scorodonia, Coronilla valentina* subsp. *glauca, Melica minuta, Tamus communis, Rubia peregrina, Ruscus aculeatus* are also present here and grow in some less exposed places of the W side.

The taxa that on the E side are trees or large shrubs are on the W side shrubs only up to a man's height. On the W side, the combination of the various evergreens with small leathery leaves, especially the shrubby spiny *Quercus coccifera* and spiny scrambling lianes, mainly *Smilax aspera*, results in a lower matorral-kind of vegetation extremely difficult to cross.

Some taxa have localized distributions on the hill. *Astragalus* is abundant at the lower parts of the E side and south of the spine. *Davallia* is only on exposed dry rocks. *Myrica*, up to 4 m, is mainly on the west side. *Myrtus* is rare and very scattered. A few small specimens of *Laurus* are rather inaccessible near the summit. The rare *Orobanche clausonis* has a single specimen on the shady E slope but does not appear every year. *Luzula* is at the more humid points of the path on the E slope.

Material and Methods

The site has been visited at different times of the year since 1993 for collecting ferns, conifers and angiosperms. Lichens and bryophytes were collected during 23-24 March 1994, 7 May 1994 and during March 1999. Complementary herbarium specimens are housed at Edinburgh (E).

The methods for surveying the vegetation were adapted from Rodwell (1991). The approach was phytosociological, with the fundamental aim of sampling only homogeneous and natural stands of vegetation; this being done by visual examination. Boundaries between vegetation communities and clearly unrepresentative areas were avoided.

The analysis concentrated on the E & W slopes where two stands were identified and located using a satellite location system. Community W (39° 35' 31-38") on the E slope of the hill dominated by trees, sometimes large shrubs, and community E (39° 35' 21-32") on

the W slope with extremely dense vegetation of mainly large shrubs. Records consisted of a list of all vascular plants found within a standardised quadrat. of 10 ˜ 10 m, as this was found to be the minimal, optimal, size for sampling this woodland. Five quadrats were randomly located within each of these 2 stands and each carefully searched to compile a list of the vascular plants. For each, a quantitative measure of abundance was made using the Domin scale (Dahl & Hadac 1941), the cover of each species being assessed by eye. The scale runs from 1-10: 1 = <4 % few individuals, 2 = <4 % several individuals, 3 = <4 % many individuals, 4 = 4-10 %, 5 = 11-25 %, 6 = 26-33 %, 7 = 34-59 %, 8 = 51-75 %, 9 = 76-90 % and 10 = 91-100 %. Mosses and lichens were given a collective score, as were bare ground and litter. Data from 5 quadrats from each stand allowed a calculation of the frequency of each species on a scale of I to V, following Rodwell (1991): I = 1-20 %, II = 21-40 %, III = 41-60 %, IV = 61-80 % and V = 81-100 %.

Results

1. List of vascular plants

This list is virtually complete. The sequence of families is that adopted in *Flora Europaea*; species in square brackets are not native, being either planted or naturalized; the nomenclature is generally in line with Tutin & al. (1964, 1980, 1993) and Castroviejo & al. (1986-99). The Iberian taxa are marked by an asterisk*.

ADIANTACEAE: *Annogramma leptophylla* (L.) Link.
ASPLENIACEAE: *Asplenium onopteris* L.
DAVALLIACEAE: *Davallia canariensis* (L.) Sim.
HYPOLEPIDACEAE: *Pteridium aquilinum* (L.) Kuhn.
POLYPODIACEAE: *Polypodium cambricum* L.
PINACEAE: [*Pinus pinaster* Aiton].
MYRICACEAE: *Myrica faya* Aiton.
FAGACEAE: *Quercus coccifera* L.; **Q. faginea* Lam.
MORACEAE: [*Ficus carica* L.].
URTICACEAE: *Parietaria judaica* L.; *Parieteria lusitanica* L.; *Urtica* (*dubia* Forssk.) *membranacea* Poiret
SANTALACEAE: *Osyris alba* L.
ARISTOLOCHIACEAE: **Aristolochia paucinervis* Pomel (*A. longa* auctt. non L.)
RAFFLESIACEAE: *Cytinus hypocistus* (L.) L.
POLYGONACEAE: *Rumex bucephalophorus* L.
AIZOACEAE: [*Carpobrotus edulis* (L.) N.E. Brown, S Africa].
CARYOPHYLLACEAE: *Cerastium glomeratum* Thuill.; *Moehringia trinervia* (L.) Clairv.; *Paronychia argentea* Lam.; *Polycarpon alsinifolium* (Biv.) DC.; *Silene latifolia* Poiret subsp. *alba* (Miller) Greuter & Burdet; *Silene gallica* L.; **Silene scabriflora* Brotero subsp. *scabriflora.*
LAURACEAE: *Laurus nobilis* L.(only a few small specimens).
PAPAVERACEAE: *Fumaria capreolata* L. subsp. *capreolata* ; **Fumaria sepium* Boiss. & Reuter; [*Papaver somniferum* L.].
CRUCIFERAE: *Cardamine hirsuta* L.; *Coincya monensis* (L.) Greuter & Burdet subsp.

cheiranthos (Vill.) Aedo, Leadlay & Muñoz Garm. (subsp. *recurvata* (All.) Leadlay); *Lobularia maritima* (L.) Desv.; *Teesdalia coronopifolia* (J. P. Bergeret) Thell.

CRASSULACEAE: [*Aeonium arboreum* (L.) Webb & Berthel., Morocco]; *Sedum album* L. *s.l.*; *Umbilicus rupestris* (Salisb.) Dandy.

ROSACEAE: *Rubus ulmifolius* Schott s.l.

LEGUMINOSAE: [*Acacia dealbata* Link., *Acacia longifolia* (Andrews) Willd., E Australia] **Astragalus lusitanicus* Lam. subsp. *lusitanicus; Coronilla minima* L.; *Coronilla repanda* (Poir.) Guss.; *Coronilla valentina* L. subsp. *glauca* (L.) Batt.; **Cytisus grandiflorus DC.; Lathyrus clymenum* L.; *Lotus corniculatus* L. *s.l.*; *Medicago italica* (Miller) Steud. *Medicago polymorpha* L.; *Moehringia pentandra* J. Gay; **Ononis subspicata* Lag.; *Ononis natrix* L.; *Ornithopus compressus* L.; *Ornithopus pinnatus* (Miller) Druce; *Pisum sativum* L.; **Stauracanthus genistoides* (Brot.) Samp.; *Trifolium campestre* Schreb.; *Trifolium dubium* Sibth.; *Trifolium resupinatum* L.; **Ulex europaeus* L. subsp. *latebracteata* (Mariz) Rothm.; *Vicia sativa* L.; *Vicia villosa* Roth subsp. *pseudocracca* (Bertol.) P.W. Ball.

OXALIDACEAE: [*Oxalis pes-caprae* L., S Africa]

GERANIACEAE: *Geranium robertianum* L.; *Geranium rotundifolium* L.; *Erodium moschatum* (L.) L'Hérit.

EUPHORBIACEAE: *Euphorbia amygdaloides* L. subsp. *amygdaloides*; *Euphorbia segetalis* L.; *Mercurialis annua* L.

ANACARDIACEAE: *Pistacia lentiscus* L.

RHAMNACEAE: *Rhamnus alaternus* L.

MALVACEAE: *Malva sylvestris* L.

THYMELAEACEAE: *Daphne gnidium* L.

HYPERICACEAE: *Hypericum humifusum* L.

VIOLACEAE: *Viola* sp.

CISTACEAE: *Cistus psilosepalus* Sweet; *Cistus salvifolius* L.; **Halimium calycinum* (L.) K. Koch (*H.commutatum* Pau); *Halimium halimifolium* (L.) Willk.; *Tuberaria guttata* (L.) Fourr. (*Xolantha guttata* (L.) Raf.).

MYRTACEAE: *Myrtus communis* L.

UMBELLIFERAE: *Foeniculum vulgare* L.; *Thapsia villosa* L.

ERICACEAE: *Arbutus unedo* L.; *Calluna vulgaris* (L.) Hull; *Erica arborea* L.; **Erica umbellata* L.

EMPETRACEAE: *Corema album* (L.) D. Don

PRIMULACEAE: *Anagallis arvensis* L.; *Asterolinon linum-stellatum* (L.) Duby

OLEACEAE: *Phillyrea angustifolia* L.; *Phillyrea latifolia* L.

APOYCNACEAE: *Vinca difformis* Pourr.

BORAGINACEAE: *Anchusa undulata* L.; *Myosotis ramosissima* Rochel.

ACANTHACEAE: *Acanthus mollis* L.

LABIATAE: *Calamintha sylvatica* Bromf. subsp. *ascendens* (Jordan) P. W. Ball; *Clinopodium vulgare* L.; *Lavandula stoechas* L.; *Teucrium scorodonia* L. s.l.

SOLANACEAE: [*Salpichroa origanifolia* (Lam.) Baillon, S America]; *Solanum nigrum* L.

SCROPHULARIACEAE: *Antirrhinum majus* L.; *Digitalis purpurea* L.; *Linaria spartea* (L.) Willd.; **Orobanche clausonis* Pomel subsp. *hesperina* (J. A. Guim.) M. J. Foley,

[host: *Rubia peregrina*]; *Scrophularia scorodonia* L.; *Verbascum* (cfr. *thapsus* L.)
RUBIACEAE: *Rubia peregrina* L.
PLANTAGINACEAE: *Plantago coronopus* L.
CAPRIFOLIACEAE: *Lonicera periclymenum* L.; *Viburnum tinus* L.
VALERIANACEAE: *Centranthus calcitrapa* (L.) Dufr.
COMPOSITAE: *Aetheorhiza bulbosa* (L.) Cass. subsp. *bulbosa; Andryala integrifolia* L.; [*Arctotheca calendula* (L.) Levyns]; *Carlina corymbosa* L.; **Cheirolophus (Centaurea) sempervirens* (L.) Pomel; *Chrysanthemum coronarium* L.; *Cirsium arvensis* L.; *Senecio gallicus* Vill.; *Senecio lividus* L.; [*Senecio mikanoides* Otto ex Walp., S America]; *Sonchus oleraceus* L.; *Urospermum picroides* (L.) Scop. ex F.W.Schmidt
LILIACEAE: *Asparagus aphyllus* L.; *Polygonatum odoratum* (Miller) Druce; *Ruscus aculeatus* L.; *Scilla monophyllos* Link ; *Smilax aspera* L.
AMARYLLIDACEAE: **Narcissus bulbocodium* L.
DIOSCOREACEAE: *Tamus communis* L.
IRIDACEAE: [*Tritonia* ˜ *crocosmiflora* (Lemoine) G. Nicholson, S Africa]
JUNCACEAE: *Luzula campestris* (L.) DC.; *Luzula forsteri* (Sm.) DC.
COMMELINACEAE: [*Tradescantia fluminensis* Velloso, SE Brasil to Argentine]
GRAMINEAE: *Aira caryophyllea* L. subsp. *caryophyllea; Agrostis castellana* Boiss. & Reuter; *Ammophila arenaria* (L.) Link; *Avena sterilis* L.; *Briza maxima* L.; *Bromus diandrus* Roth var. *rigidus* (Roth) Sales; *Bromus diandrus* Roth s.l.; *Bromus hordaceus* L.; *Bromus sterilis* L.; **Dactylis glomerata* L. subsp. *lusitanica* Stebbins & D. Zohary; *Desmazeria rigida* (L.) Tutin; *Hordeum murinum* L.; *Lagurus ovatus* L.; *Lolium rigidum* Gaudin; *Melica minuta* L.; *Poa annua* L.
ARACEAE: *Arisarum vulgare* Targ.-Tozz.; *Arum italicum* Miller
CYPERACEAE: *Carex distachya* Desf.; *Scirpus holoschoenus* L.
ORCHIDACEAE: *Neotinea maculata* (Desf.) Stearn (numerous plants seen in 1999, but few seen in previous years).

2. List of lichens (B. Coppins)

This list is not comprehensive. Synonyms are indented. Location on the hill is given (E = east; W = west; T = summit) as well as substrate (Au = *Arbutus unedo*; Ea = *Erica arborea*; C = on bark; host unspecified; Fc = *Ficus carica*; G = on gabbro; Pha = *Phillyrea angustifolia*; Phl = *Phillyrea latifolia;* Ppin = *Pinus pinaster*; Qco = *Quercus coccifera*; Te = terricolous).

	Location	**Substrata**
Acarospora sp.	T	G
Acrocordia gemmata (Ach.) A. Massal.	E	Au,Qco
Anisomeridium sp. (pycnidia only)	E	Au
Arthonia cinnabarina (DC.) Wallr.	E	Au,Phl
Bacidia absistens (Nyl.) Arnold	E	Qco
Bacidia friesiana (Hepp) Körber	E	Qco
Bacidia incompta (Borrer ex Hooker) Anzi	E	Qco
Buellia aethalea (Ach.) Th.Fr.	W,T	G
Caloplaca aegatica Giralt, Nimis & Poelt	T	Fc,Pha,Qco

Caloplaca crenularia (With.) J. R. Laundon	W,T	G
Caloplaca ferruginea (Huds.) Th. Fr.	T	Fc
Caloplaca sp.	W	G
Candelariella vitellina (Hoffm.) Müll. Arg.	W	G
Chaenotheca brunneola (Ach.) Müll. Arg.	E	Ppin
Chrysothrix candelaris (L.) J. R. Laundon	E	Au,Ea,Ppin, Phl,Qco
Cladonia pyxidata (L.) Hoffm.	E,W	G
Cladonia ramulosa (With.) J. R. Laundon	E	Te
Cladonia rangiformis Hoffm.	W	G
Collema cfr. *ryssoleum* (Tuck.) Schneider	W	G
Dimerella lutea (Dickson) Trevisan	E	Au,Qco
Dirina massilensis f. *sorediata* (Müll. Arg.) Tehler	?	G
Enterographa crassa (DC.) Fée	E	Phl,Qco
Enterographa elaborata (Leighton) Coppins & P. James	E	Phl
Flavoparmelia caperata (L.) Hale	E,T	Fc(T), Qco(E)
Gyalecta derivata (Nyl.) H. Olivier	E	Au
Gyalecta truncigena (Ach.) Hepp	E	Au
Lasallia pustulata (L.) Mérat	T	G
Lecanora campestris (Schaerer) Hue	T	G
Lecidella elaeochroma (Ach.) M. Choisy	T	Fc,Pha
Lepraria jackii Tønsb.	E	Au,Ea, Phl,Te
Lepraria lobificans Nyl.	E	Au,Ea,Te
Leprocaulon microscopicum (Vill.) Gams & D. Hawksw.	W	G
Leptogium cyanescens (Rabenh.) Körber	E	Au
Melanelia glabratula subsp. *fuliginosa* (Fr. ex Duby)	T	G
Neofuscelia pulla (Ach.) Essl.	W	G
Nephroma laevigatum Ach.	E	G
Normandina pulchella (Borrer) Nyl.	E	Au,Ea
Ochrolechia parella (L.) A. Massal.	W,T	G
Opegrapha atra Pers.	T	Pha
Opegrapha varia Pers.	E	Au,Qco
Parmelina tiliacea (Hoffm.) Hale	W	G
Parmotrema chinense (Osbeck) Hale & Ahti	E	Au,Ea
Parmotrema robustum (Degel.) Hale	E	Ea,Qco
Pertusaria amara (Ach.) Nyl.	E,W,T	Qco(E), G(W,T)
Pertusaria excludens Nyl.	T	G
Pertusaria sp.	T	G
Phaeographis dendritica (Ach.) Müll. Arg.	E	Qco
Physcia caesia (Hoffm.) Fürnr.	W	G
Physcia tribacia (Ach.) Nyl.	T	G
Porina borreri (Trevisan) D. Hawksw. & P. James	E	Au,Qco
Porina chlorotica f. *tunuifera* (Nyl.) Swinscow	?	G

Porina coralloidea P. James	E	Ea
Porpidia platycarpoides (Bagl.) Hertel	T	G
Pseudocyphellaria aurata (Ach.) Vainio	E	Ea,Phl,Qco
Pyrenula chlorospila Arnold	E	Qco
Pyxine subcinerea Stirton	W	G
Ramalina implectens Nyl.	E,T	Fc(T),C(E)
Ramalina pusilla Le Prév. ex Duby	E,T	Fc(T), Qco(E)
Ramalina subgeniculata Nyl.	E	Qco
Ramalina sp. [sorediate]	W	Qco
Rimelia reticulata (Taylor) Hale & A. Fletcher	E,W	G(W), Qco(E)
Rinodina atrocinerea (Hook.) Körber	T	G
Rinodina becarriana Bagl.	T	G
Sticta fuliginosa (Hoffm.) Ach.	E	G
Trapelia coarctata (Sm.) M. Choisy	W	G
Usnea rubicunda Stirton	?	Au
Usnea subscabrosa Nyl. ex Motyka	?	Au
Xanthoparmelia sublaevis (Coutinho) Hale	W	G
Xanthoria parietina (L.) Th.Fr.	T	G

3. List of bryophytes (D. Long)

This list is not comprehensive. Location on the hill (E & W) is given, as well as substrate.

Substrata		**Location**
HEPATICAE:		
Fossombronia angulosa (Dichs.) Raddi	E	gabbro
Lejeunea lamacerina (Steph.) Schiffn.	E	gabbro
Targionia hypophylla L.	W	steps
Radula lindenbergiana Hartm. f.	E	*Arbutus unedo*
Reboulia hemisphaerica (L.) Raddi	E	N-facing under rock
ANTHOCEROTAE:		
Phaeoceros laevis (L.) Prosk.	E	N-facing under rock
MUSCI:		
Bryum capillare Hedw.	E	gabbro
Funaria pulchella Philib.	W	
Hypnum cupressiforme Hedw. var. *cupressiforme*	E	gabbro
Neckera complanata (Hedw.) Hueb.	E	*Viburnum tinus*
Neckera complanata (Hedw.) Hueb.	E	gabbro
Plagiomnium affine (Funck) T.Kop.	E	N-facing under rock
Pterogonium gracile (Hedw.) Sm.	E	*Q .coccifera*
Rhynchostegium confertum (Dicks.)R.Br.	E	gabbro
Scleropodium tourettii (Brid.) L. Koch	W	gabbro

Trichostomum brachydontium Bruch	W	gabbro
Zygodon viridissimum (Dicks.) R.Br.	E	gabbro

4. Phytosociology (M. Coleman)
Data for the two communities are in Table 1. Species are ordered into groups according to frequency. The Domin range for each community is provided. Taxa with frequencies II-I are not included, as well as moss/lichen and litter/bare ground, both with frequency V In the two communities.

Discussion

1. Vascular plants
Table 2. summarizes the proportions of the phytogeographical elements of the hill. The Mediterranean taxa have the highest representation in the local flora (36.2%) and taxa that have a Mediterranean component in their distribution represent far more than half (67%); elements with an Atlantic component are relatively high (26.3%); plants exclusively Iberian are poorly represented (3.8%) and taxa with very wide distributions (Euro-Siberian, Holarctic and Cosmopolitan) are quite well represented (17%).
Some of the species with a mainly N European distribution are *Teucrium scorodonia*, *Rubia peregrina*, *Bromus sterilis*, *Hordeum murinum*, *Urospermum picroides*, *Aira caryophyllea*, *Desmarezia rigida* and *Digitalis purpurea*. *Calluna vulgaris* is found only at the base of the hill, in the *Pinus pinaster* plantation.
Two Macaronesian species are present: *Davallia canariensis*, also in W Spain, Açores, Madeira, the Canary and Cape Verde Islands; and *Myrica faya* also in Açores, Madeira and Canary Islands. In continental Portugal, *Myrica faya* is occasional in sites near the coast. Although *Flora Europaea* (Burges 1993) considered it as "naturalized in W Portugal", our own field studies have led us to believe that it is native in various parts of western C & S Portugal.
Religious festivals take place every year on the hill attracting large numbers of people. The introduction of some alien plants may have resulted from such activities. All these invasive species are found in many places out-with the hill, along nearby roads, maritime sand-dunes, etc.
Numerous typical Mediterranean elements that are common elsewhere in Portugal e.g. in the Natural Park of Arrábida, are absent on São Bartolomeu — such as *Rosmarinus officinalis*, *Anagyris foetida*, *Prasium majus* and *Thymus capitatus*.
The best-represented families are Leguminosae (24 species) and Gramineae (16 species).

2. Lichens
The world and European distribution of most lichens is still very imperfectly known. The majority of the species found on the hill are widely distributed in Europe. However, there is a significant number of species with a more restricted distribution. Widely occurring through the Mediterranean region and extending to Macaronesia are *Caloplaca aegatica*, *Collema ryssoleum* and *Ramalina pusilla*, and with a similar distribution but of more localized occurrence (in Europe) are *Pyxine subcinerea*, *Ramalina implectens* and *R. subgeniculata*. The species with the most restricted distribution is *Xanthoparmelia sublaevis*, so far

Table 1. Phytosociological data of the W side of São Bartolomeu's hill (community W) and the E side (community E). Shared constant taxa are indicated by an asterisk. Only taxa with frequencies III-V at least in one of the communities are included. Moss/lichen and litter/bare ground, both with frequency V in the 2 communities, were not included.

	COMMUNITY W		COMMUNITY E	
SPECIES	**Domin**	**Freq**	**Domin**	**Freq**
Cistus salvifolius	(2-6)	V	(2)	I
Cytisus grandiflorus	(3-4)	V	—	—
Phillyrea latifolia *	(2-4)	V	(1-9)	V
Pteridium aquilinum	(3-8)	V	—	—
Quercus coccifera *	(7-8)	V	(4-8)	V
Rubia peregrina *	(2-3)	V	(2)	V
Smilax aspera *	(2-4)	V	(2-4)	V
Viburnum tinus *	(1-6)	V	(1-5)	V
Vicia villosa	(2)	V	—	—
Cistus psilosepalus	(1-4)	IV	—	—
Geranium robertianum	(2)	IV	—	—
Lathyrus clymenum	(2-3)	IV	—	—
Phillyrea angustifolia	(1-4)	IV	(2-3)	IV
Ruscus aculeatus	(1-2)	IV	(2-3)	V
Arbutus unedo	(1-4)	III	(4-8)	V
Asplenium onopteris	(2)	III	(2-3)	V
Davallia canariensis	(2)	III	(2)	III
Scrophularia scorodonia	(2)	III	—	—
Teucrium scorodonia	(2-3)	III	(1-2)	V
Lonicera periclymenum	(1-2)	II	(2)	V
Polypodium cambricum	(2)	II	(2)	III
Umbilicus rupestris	(2)	II	(2-3)	III
Tamus communis	(2)	I	(1-2)	V
Pistacia lentiscus	(3)	I	(1-5)	IV
Arisarum vulgare	—	—	(2)	III
Asparagus aphylluss	(1)	I	(1-2)	III
Erica arborea	(1)	I	(1-5)	III

Table 2. The phytogeographical elements of the flora of São Bartolomeu and their proportions within the vascular vegetation of the hill. Atl = Atlantic province; Bor = Boreal province; Cosm = Cosmopolitan; Eur-Sib = Euro-Siberian region; Hola = Holarctic; Medit = Mediterranean region; M-Eur = Medio European province; W Medit = West Mediterranean subregion; W M-Eur = West Medio European province.(Zohary & al. 1980).

	Medit	W Medit	Medit Atl	Atl	M.-Eur Atl Bor	Cosm	Eur - Sib	Hola	Iberian	Medit Atl W M.-Eur
Taxa no.	47	22	14	8	8	8	7	7	5	4
%	36.2	16.9	10.8	6.2	6.2	6.2	5.4	5.4	3.8	3.1

known only from the Iberian Peninsula and Sardinia.

A SW European - Macaronesian element of mainly oceanic to suboceanic species, with a northern limit in the British Isles, is well-represented. Included here are *Enterographa elaborata*, *Parmotrema robustum*, *Phaeographis dendritica*, *Physcia tribacia*, *Porina borreri*, *P. coralloidea*, *Pseudocyphellaria aurata*, *Pyrenula chlorospila*, *Rimelia reticulata*, *Rinodina beccariana*, *Usnea rubicunda* and *U. subscabrosa*. More widely distributed, but still with a strong SW European bias, are the suboceanic species *Dimerella lutea*, *Enterographa crassa*, *Leptogium cyanescens*, *Nephroma laevigatum*, *Normandina pulchella* and *Sticta fuliginosa*.

The check-list clearly shows a marked difference between the lichen flora found on the top (22 species) and W side of the hill (18) compared with that on the E side (33); 4 species were not localised. The more open, drier and better illuminated W side and summit area have a preponderance of species favouring such conditions, including most of the 'Mediterranean' element. The lichen flora of the E side of the hill is much richer in species and is indicative of more stable and humid conditions. It is where the suboceanic elements are concentrated. Most of these species are epiphytic on trees or shrubs, but *Nephroma laevigatum* and *Sticta fuliginosa* occur here only on mossy rocks, although they are often found as epiphytes in other localities.

Because there is no modern checklist of Portuguese lichens, it is difficult to ascertain if any of the finds represent new records for the country. A preliminary search of the literature has included most of the papers by A. X. Pereira Coutinho, G. Sampaio and C. N. Tavares. To date, previous records have not been found for five of the species. *Pyrenula chlorospila* is so widely distributed in southern and western Europe that it is certain to have been previously reported; more likely to be new additions are the more poorly known *Bacidia friesiana* and *Porina borreri*, and the recently described *Lepraria jackii* and *Porina coralloidea*.

3. Bryophytes

The bryophyte collection includes 5 *Hepaticae*, 1 *Anthocerotae* and 11 *Musci* species. The most interesting group of species is the Mediterranean element which includes 3 of the 4 species from the W side of the hill where the two most noteworthy species are more oceanic: *Lejeunea lamacerina* and *Fossombronia angulosa*, which may reflect local micro-habitats with continuous shelter and high humidity.

The remainder of the species are more widespread European taxa, although *Phaeoceros lae-*

vis, in common with other hornworts, is suffering a steady decline over much of its range.

4. Phytosociology

The two communities share constant species: 5 of the 9 constants in community W were also constant in community E (Table 1). These shared species were either woody (*Phillyrea latifolia, Quercus coccifera* and *Viburnum tinus*) or scrambling plants (*Rubia peregrina* and *Smilax aspera*). It is important to note that 4 of these 9 species recorded from one community are present in the other, just failed to attain a frequency of IV or more. The 2 communities differ in 6 constant species present only in community E (*Arbutus unedo, Asplenium onopteris, Lonicera periclymenum, Teucrium scorodonia, Tamus communis* and *Pistacia lentiscus*) and 3 constant species in community W (Table 1). The much greater canopy height in community E (8-10 m as opposed to 2-4 m in community W) creates a much more shaded and humid microclimate. This situation is reflected by the constancy of shade tolerant species in community E such as *Teucrium scorodonia* and humidity dependent species such as *Asplenium onopteris*. On the other hand many of the light-demanding herbs and small shrubs constant in community W are absent or present at low frequency in community E (i.e. *Cistus salvifolius, Cytisus grandiflorus, Cistus psilosepalus, Geranium robertianum, Lathyrus clymenum, Pteridium aquilinum* and *Vicia villosa*).

A previous phytosociological study of the W slope of the hill only by Braun-Blanquet & al. (1956) has a few differences in relation to present-day data. The 29 taxa mentioned then are still present except *Cistus hirsutus* (=*Helianthemum hirtum*) and *Lonicera etrusca*, records which may have been based on misidentifications. *Asplenium adiantum-nigrum* (probably a misidentification of *A. onopteris*) was then given a high presence value and *Quercus coccifera* a low one, an inversion of the present-day situation. Another major change in the floristic composition of the hill since then relates to *Quercus faginea* and records of its past high frequency/presence (Vasconcellos & Franco 1954, Braun-Blanquet & al. 1956) contrast with the few specimens of today.

Now, the number of omni-mediterranean vascular taxa in both communities is almost the same (community E 15, community W 16). In community W they are part of a much more diverse community and represent 15.3% less in than in community E. Two omni-mediterranean species (*Arbutus unedo* and *Erica arborea*) are locally abundant in the two communities.

Conclusions

The combination of data from bryophytes, lichens, conifers, phanerogams and the phytosociological survey has been especially illuminating in better understanding the interest of the flora of São Bartolomeu. The dominant floristic vascular elements are Mediterranean. The lichen flora is mainly European with many oceanic/sub-oceanic elements with various links with Macaronesia. The bryophyte flora is also mainly European, with Mediterranean elements in the more exposed areas.

It is interesting to compare the vascular plants on the hill with a site in Sardinia (Bocchieri & Giani 1998). They share some thermo-pluviometric similarities. Circa 1/3 of the taxa at São Bartolomeu are also at the Sardinian site. More than fi of these are either Steno-Mediterranean or Euri-Mediterranean (Pignatti 1982). The total of 67% of taxa with a

Mediterranean component at the hill compares with 66.7% in Sardinia. Interestingly, the purely Atlantic taxa are similarly represented at both sites (hill 6%, Sardinia 6.8%). The percentage of totally non-Mediterranean taxa is also similar in both sites (hill 23.2%, Sardinia 19.7%). Although most of the taxa in both sites are different, the phytogeographical composition is remarkably similar.

The phytosociology survey showed that the communities studied were representative of a single floristic unit. The differences between the various areas of the hill are related to local conditions merely reflecting different stages in the successional development of the sclerophyllous forest. There is some evidence that the W slope is more exposed, warmer and drier than at the time of previous surveys (Vasconcellos & Franco 1954; Braun-Blanquet & al. 1956).

The total of c. 150 flowering plants, c. 68 lichens and 17 bryophytes in such a small area is substantial. Most of these species are quite common, but scattered, in Portugal. Because of its physically isolated position and its steep, often inaccessible slopes it is a fascinating living laboratory with its vegetation still retaining original features. It is a more important site, floristically and phytogeographically, than has been previously recognised. It does merit a higher conservation status than merely a "Classified Site".

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