

# "EXPEDITION AZORES 1989": BENTHIC MARINE ALGAE (SEAWEEDS) RECORDED FROM FAIAL AND PICO

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TITTLE, IAN & ANA I. NETO 1994. "Expedition Azores 1989": Benthic marine algae (seaweeds) recorded from Faial and Pico. *Arquipélago. Life and Marine Sciences* 12A:1-13. Ponta Delgada. ISSN 0870-6581.

This paper is the fourth in a series of investigations on the benthic marine algal flora arising from the "Expedition Azores 1989". It deals with species recorded at 16 sites around Faial and Pico and 8 sites at Monte da Guia which was studied in greater detail. Of the 161 species recorded in total, 40 were new to the Azores, 57 new to Faial and 27 new to Pico.

TITTLE, IAN & ANA I. NETO 1994. "Expedição Açores 1989": Algas marinhas bentónicas registadas no Faial e Pico. *Arquipélago. Ciências Biológicas e Marinhas* 12A: 1-13. Ponta Delgada. ISSN 0870-6581.

Este artigo é o quarto numa série de investigações dirigidas à flora algal dos Açores, no âmbito da "Expedição Açores 1989". Apresenta-se a lista das macroalgas marinhas colectadas em 16 locais à volta do Faial e Pico e em 8 locais da Reserva Natural do Monte da Guia. De entre as 161 espécies assinaladas, 40 são novos registos para os Açores, 57 novos para o Faial e 27 novos para o Pico.

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## INTRODUCTION

Studies on the marine algae of the Azores go back over a century and a half. Although, in comparison to the Atlantic coasts of the European continent, the Azores flora is less well known, its isolated geographical position has encouraged a recent resurgence of algal interest (see NETO 1992, 1994). An opportunity for further algal study was provided by the "Expedition Azores 1989" which took place during June and July 1989 on the islands of Faial and Pico; which had been little studied phycologically. The general objectives of the expedition were to contribute to the understanding and ecology of littoral biotopes of

Faial and Pico and to describe qualitatively and wherever possible quantitatively their communities (MARTINS et al. 1992; PAULA et al. 1992).

This paper, the fourth in a series of algal studies, provides a comprehensive list of algae recorded during the "Expedition Azores 1989" with ecological and habitat information. Other papers in the series deal with introduced species discovered during the expedition (ATHANASIADIS & TITTLE 1994), the structure and zonation of algal turf communities based on intensive studies in the Monte de Guia Nature Reserve (NETO & TITTLE in press), and the biogeographical affinities of the Azores marine algal flora for which many new data were acquired during the expedition (TITTLE & NETO in press).

Contribution No. 17 of the "Expedition Azores 1989".

## METHODS

Algae were recorded and collected in the course of two main studies on the Faial and Pico in July 1989. These studies were (i) an ecological survey of the Monte da Guia Nature Reserve (ii) floristic studies at selected sites on Faial and Pico. At Monte da Guia sampling was undertaken systematically using replicated quadrats positioned along transect lines from the supralittoral fringe down to deep sublittoral levels. Floristic studies were undertaken by means of direct observations. In both cases sublittoral levels were investigated by SCUBA diving. Sampling was destructive; algal samples were brought back to the laboratory for preliminary analysis. The principal algae were tentatively identified and subsamples were preserved in formaldehyde for subsequent detailed investigation. For transect studies all species present were listed and relative abundances estimated using the DAFOR scale (Dominant, Abundant, Frequent, Occasional, Rare). Material was also preserved as dried herbarium specimens and deposited at BM.

Sites investigated (Fig. 1)

### Faial

#### Monte da Guia

A steeply sloping Caldeira in the southeast corner of Faial. Sites around the Caldeira varied in wave exposure from sheltered (Baía de Porto Pim) to extremely exposed (Ponta das Garças); shores in the central lagoon (Caldeira do Inferno) are more sheltered but still subject to swell and wavewash. Porto Pim has a gently sloping rocky shore merging into a sandy sea bed at only a few metres depth whereas other shores are steeply sloping and sandy sea-bed was at depths below 40m. Of the 10 study sites outlined by MARTINS et al. (1992), five were sampled for algae. Algal occurrence and distribution in a sea cave near transect 8 was also investigated.

#### 1. Porto da Horta

An enclosed, sheltered body of water surrounded by harbour breakwaters. These structures and marina pontoons created habitats for algal colonisation. Littoral and sublittoral levels investigated to 10m depth.

#### 2. Horta, Baía entre Montes

A group of rocks projecting from the sandy seabed in the bay between Monte da Guia and the Harbour. Sublittoral levels investigated to 15m depth.

#### 3. Horta, Baía do Porto Pim

A moderately wave-exposed, jagged rocky shore on the south side of the bay which created a range of habitats from those open to full daylight to shaded clefts and crevices. Littoral levels investigated.

#### 4. Feteira

A moderately wave-exposed, extensive intertidal platform which gradually slopes or steps down to low water level. It supports many intertidal pools and is dissected at low levels by surge channels. Littoral and sublittoral levels to 10m depth were investigated.

#### 5. Varadouro (termas)

A moderately wave-exposed, barnacle-dominated rocky shore of jumbled boulders and pools adjacent to a slipway (all investigated); intertidal levels only investigated.

#### 6. Varadouro (rampa de varagem)

A rocky headland with a range of habitats and often vertical or steeply sloping shores. An artificial (tidal) swimming pool was investigated at upper littoral levels, as well as a wave-washed gully and pool at mid to lower littoral levels, and subtidal levels to 10m depth near the landing quay.

#### 7. Cais, Capelinhos

Intertidal rocky shores on either side of a slipway were investigated. A varied shore with a range of

habitats (some sheltered others wave-exposed) including many deep and shallow rock pools and wave-washed gulleys. Much volcanically derived sediment was present at littoral and sublittoral levels (investigated to 10m depth).

#### 8. Porto da Fajã

Wave-exposed, abraded rocks at midlittoral levels projecting through an otherwise black sandy beach. Sublittoral levels investigated to 20m depth.

#### 9. Porto do Salão

A wave-washed small headland, vertical to steeply sloping and barnacle covered; small pools, cracks and crevices investigated at intertidal levels only.

#### 10. Ponta da Riberinha

Subtidal investigations to 20m depth.

#### 11. Praia dos Ingleses

A narrow seashore of jumbled boulders and incised rocks providing a range of sheltered and exposed, shaded and open habitats. Littoral levels investigated only.

#### 12. Praia do Almoxarife

Littoral levels of a vertically sloping quayside investigated down to low water level.

#### 13. Baixa do Sul

A steeply sloping submarine seamount between Faial and Pico was investigated down to 56m depth.

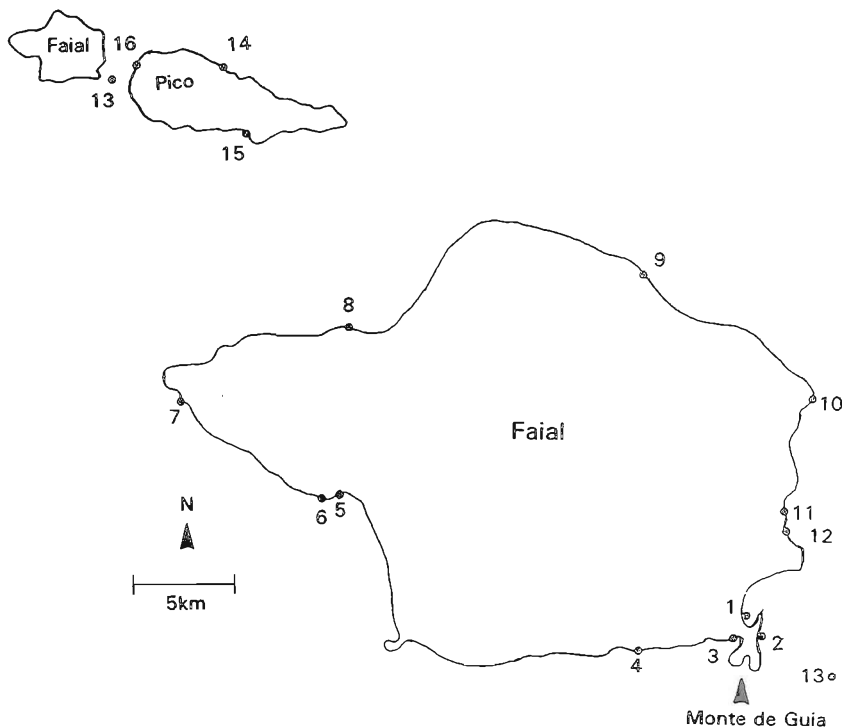


Fig. 1. Collecting sites on Faial and Pico.

## Pico

### 14. Cais do Pico

A small rocky headland adjacent to a tidal swimming pool was investigated at littoral and shallow sublittoral levels (to 2m depth).

### 15. Lajes do Pico

A sea-shore of diverse habitats comprising an extensive intertidal area adjacent to a series of reefs and shallow to deep lagoons; rock-pools present at all levels.

### 16. Ilhéus da Madalena

Rocky pinnacles close by Madelena, Pico investigated to 18m depth.

## RESULTS

Species recorded during the period of field-work are listed below. The list is organised alphabetically by genus and species for the three main groups of algae (Chlorophyta, Phaeophyta, Rhodophyta); for a systematic list see NETO (1994) and SOUTH & TITTLE (1986). For synonyms and other taxonomic and nomenclatural data see the latter publications. Included in the list are records from Faial and Pico in NETO (1994) but not found by the 1989 expedition. A hache (#) indicates species previously recorded from the Azores archipelago, and those recorded previously from Faial are indicated by an asterisk (\*). Question marks indicate identifications in need of further checking. Location numbers (M-prefixed for Monte da Guia transect sites) are those shown in Fig. 1. Twenty-seven species of Chlorophyta, 41 Phaeophyta and 93 Rhodophyta were detected.

## LIST OF SPECIES

### CHLOROPHYTA

*Achrochaete viridis* (Reinke) R.Nielsen #\*

See NETO (1994).

*Anadyomene stellata* (Wulf.) C.Agardh #\*

Littoral, sublittoral to 19m. Among algal turf; occasional to common. 15, M1, M6.

*Blidingia minima* Kützting #\*

Upper littoral. Epilithic; locally common. Zone forming. M4.

*Bryopsis hypnoides* J.V.Lamour. #

Sublittoral at 30m. Among turf samples. Rare. M8. New record for Faial.

*Bryopsis plumosa* (Hudson) C.Agardh #

Littoral, sublittoral to 56m. Epilithic; occasional. In a range of habitats (exposed rock faces, crevices, caves). 11, 13, M1, M2, M6. New record for Faial.

? *Chaetomorpha aerea* (Dillwyn) Kützting #\*

Littoral. Among algal turf; rare. M2.

*Chaetomorpha capillaris* (Kützting) Børgesen

Littoral. Substrate uncertain - entwined among other algae; rare. 11, 12(?). New record for the Azores.

*Chaetomorpha linum* (O.F.Müll.) Kützting #

Littoral, sublittoral to 10m. Epilithic (among *Corallina*); occasional. 8, M1(?), M3, M5.

*Chaetomorpha pachynema* Mont. #\*

Littoral, sublittoral to 10m. Epilithic and among algal turf; common. In a range of habitats (open shores, caves). 3, 8, 14, M1, M2, M3, M4, M5. New record for Pico

? *Cladophora albida* (Huds.) Kützting #\*

Littoral. Among algal turf; rare. M5.

*Cladophora coelothrix* Kützting #\*

Littoral. Among algal turf, occasional. M2, M3, M5.

*Cladophora laetevirens* (Dillwyn) Kützting #\*

Littoral. Epilithic, occasional. M2, M5.

*Cladophora prolifera* (Roth) Kützting #\*

Littoral, sublittoral to 30m. Among algal turf and epilithic; common. In a range of habitats (open shores, pools and caves). 1, 2, 4, 14, 15, M1, M2, M3, M4, M5, M6. New record for Pico.

*Cladophora weizenbauri* O.C.Schmidt #\*

See NETO (1994).

*Cladophoropsis membranacea* (C.Agardh) Børg. #

Littoral, sublittoral to 20m. Among algal turf and epilithic; occasional. 1, 2, 14, M2, M5. New records for Faial and Pico.

*Codium adhaerens* (Cabr.) C.Agardh #\*  
Littoral, sublittoral to 2m. Epilithic; common. Forms a dense layer over rocks near low water level. 7, 9, 15, M3, M4.

*Codium decorticatum* (Woodw.) Howe #\*  
Littoral, sublittoral to 15m. Epilithic; occasional. 2, 14.

*Codium elisabethae* (Woodw.) Howe #\*  
Lower littoral, sublittoral to 46m. Epilithic, common. 15, M1, M2, M5, M8.

*Codium tomentosum* Stackh. #\*  
Lower littoral. Epilithic; locally common in deep pools. 15.

*Derbesia furcellata* (Zanardini) Ardiss. #\*  
Sublittoral to 9m. Among algal turf. occasional. M1, M4, M5, M6, M8.

*Enteromorpha compressa* (L.) Grev. #\*  
Littoral. Epilithic, rare. 4.

*Enteromorpha intestinalis* (L.) Link #\*  
Littoral. Epilithic; occasional, in pools. 5, 8, M4.

*Enteromorpha linza* (L.) J.Agardh #\*  
Littoral. Epilithic, occasional. 9, M2.

*Enteromorpha prolifera* (O.F.Müll.) J.Agardh #\*  
Littoral. Epilithic; occasional, among other algae. 11, M2.

*Enteromorpha ramulosa* (Sm.) Hook. #\*  
Littoral, shallow sublittoral to 2m. Epilithic and among algal turf; common. 3, 14, 15, M1, M2, M4.

*Microdictyon calodictyon* (Montagne) Decaisne #  
Lower littoral, sublittoral to 30m. Among algal turf; occasional. 2, 4, 7, M1, M2. New record for Faial.

*Pringsheimiella scutata* (Reinke) Marchew  
Littoral. Epiphytic on *Cryptopleura*; rare. 6. New record for the Azores.

*Rhizoclonium africanum* Kützing #\*  
See NETO (1994).

*Ulva lactuca* L. #\*  
See NETO (1994).

*Ulva rigida* C.Agardh #\*  
Littoral, shallow sublittoral. Epilithic, epiphytic on *Pterocladia*. among algal turf; common. 1, 3, 11, 14, 15, M1, M2, M4.

*Valonia utricularis* (Roth) C.Agardh #\*  
Littoral, sublittoral to 56m. Among algal turf, epiphytic on *Corallina*; common. 13, M1, M2, M3, M4, M5, M6.

## PHAEOPHYTA

*Ascophyllum nodosum* (L.) Jolis #\*  
Recorded as drift plants only.

*Carpomitra costata* (Stackh.) Batters #  
Sublittoral at 46m. Epilithic; rare. M8. New record for Faial.

*Cladostephus spongiosus* (Hudson) C.Agardh #\*  
Littoral, sublittoral to 15m. Epilithic and among algal turf; abundant. 1, 2, 6, 7, M1, M4, M5.

*Colpomenia sinuosa* (Roth) Derb. et Sol. #  
Littoral, sublittoral to 46m. Epilithic and epiphytic, widespread but sporadic. In a range of habitats (open-shores, crevices and pools). 2, 4, 7, 15, M1, M3, M4, M5, M8. New record for Faial and Pico.

*Cutleria multifida* (Sm.) Grev.  
Gametophyte stage not found but see NETO (1994) #\*. Sporophyte stage (*Aglaozonia*) #. Sublittoral to 19m. Epilithic and among algal turf; occasional. M1, M2, M5, M6. New record for Faial.

*Cystoseira abies-marina* (S.Gmelin) C.Agardh #\*  
Littoral, sublittoral to 15m. Epilithic; locally common, to occasional. 2, 4, M2, M8.

*Cystoseira foeniculaceus* (L.) Grev. #  
Littoral (upper shore pools). Epilithic; locally common. 7. New record for Faial.

*Cystoseira humilis* Kützing #  
Littoral pools. Epilithic; locally common. 15. New record for Pico.

*Cystoseira* cf. *tamariscifolia* (Huds.) Papenf. #  
Littoral. Epilithic; occasional. 4. New record for Faial.

*Dictyopteris membranacea* (Stackh.) Batters #

Sublittoral at 19m. Epilithic; rare. M1. New record for Faial.

*Dictyota adnata* Zanardini. #

Shallow sublittoral. Among algal turf; rare. M1. New record for Faial.

*Dictyota dichotoma* (Huds.) J.V.Lamour. #\*

Littoral, sublittoral to 52m. Epilithic, among algal turf and epiphytic; abundant. 2, 5, 8, 12, 13, 15, M1, M2, M4, M5, M8. New record for Pico.

*Ectocarpus fasciculatus* Harvey

Littoral. Epiphytic; occasional. 11, 14, 15. New record for the Azores.

*Elachista flaccida* (Dillwyn) Aresch.

Littoral. Epiphytic on *Cystoseira*; occasional. 15. New record for the Azores.

*Endarachne binghamiae* J.Agardh

Littoral. Epilithic; occasional. On wave-washed rocks and in pools. 8, 9, 11, 12. New record for the Azores and the north Atlantic.

*Feldmannia* cf. *irregularis* (Kützinger) Hamel

Sublittoral at 20m. Substrate uncertain; rare. M2. Possible new record for the Azores.

*Feldmannia* cf. *padinae* (Buffh.) Hamel

Littoral. Epiphytic on *Colpomenia*; rare. 4. Possible new record for the Azores.

*Fucus spiralis* L. #\*

Upper littoral. Epilithic; occasional. 15.

*Halopteris filicina* (Grat.) Kützinger #\*

Littoral, sublittoral to 56m. Epilithic and among algal turf; abundant. 2, 4, 5, 8, 13, M1, M2, M4, M5, M6, M8.

*Halopteris scoparia* (L.) Sauvageau #\*

Littoral, sublittoral to 12m. Epilithic, among algal turf (sometimes dominant component), occasionally forming loose-laying mats; abundant. 1, 2, 7, M1, M2, M4, M5.

*Hecatonema* sp.

Littoral. Epiphytic on *Chaetomorpha linum*; rare. 8.

*Hydroclathrus clathratus* (Bory) Howe #

Littoral. Epilithic, occasional. 7. New record for Faial.

*Leathesia difformis* (L.) Aresch. #\*

Littoral, shallow sublittoral to 2m. Epiphytic; rare. M2, M4.

*Liebmannia leveillei* J.Agardh #

Shallow sublittoral at 3m. Among algal turf; rare. M5. New record for Faial.

*Lobophora variegata* (J.V.Lamour.) Womers. #

Littoral, sublittoral to 56m. Epilithic and among algal turf; common. 8, 13, 14, M1, M2, M8. New record for Faial and Pico.

*Mesogloia* cf. *lanosa* P.Crouan et H.Crouan #

Shallow sublittoral. Substrate uncertain; rare. 1. Possible new record for Azores.

*Myriactula* cf. *stellulata* (Harvey) Levring

Littoral. Epiphytic on *Colpomenia*; rare. 4. Possible new record for Azores.

*Myrionema strangulans* Grev. #\*

Littoral. Epiphytic on *Enteromorpha*, *Lomentaria*, and *Ulva*; locally common. 4, 9, 6, 7, 11.

*Padina pavonica* (L.) J.V.Lamour. #\*

Littoral, sublittoral to 15m. Epilithic; abundant. 13, 15, M1, M5. New record for Pico.

*Petrospongium berkeleyi* (Grev.) Naeg. #

Littoral. Epiphytic on *Ralfsia*; rare 11. New record for Faial.

*Ralfsia* cf. *verrucosa* (Aresch.) J.Agardh

Littoral. Epilithic; occasional. 8, 9, 14, M3, M5. Possible new record for the Azores.

*Sargassum cymosum* C.Agardh #

Littoral. Epilithic; occasional. 4, 15. New records for Faial and Pico.

*Sargassum vulgare* C.Agardh #\*

Littoral, sublittoral 5-15m. Epilithic; locally common. 2, 14. New record for Pico.

*Sargassum* sp. (rosette form)

Littoral, sublittoral to 19m. Epilithic and among algal turf; common. 2, M1, M2, M5.

*Sphacelaria cirrosa* (Roth) C. Agardh #\*

Littoral, sublittoral to 15m. Epiphytic, among algal turf; common (locally dominant). 4, 13, M1, M2, M4, M5, M6. New record for Faial.

***Sphacelaria fusca* (Hudson) S.F.Gray #\***

Littoral, sublittoral to 10m. Common among algal turf and sediment. 7, M1, M2, M5. New record for Faial.

***Sphacelaria* cf. *nana* Kützing**

Littoral. Among algal turf; rare. 15. Possible new record for the Azores.

***Sphacelaria* cf. *plumula* Zanardini #**

Shallow sublittoral, 2-3m. Among algal turf; rare. M4. Possible new record for Faial.

***Sphacelaria rigidula* Kützing**

Littoral, sublittoral to 10m. Among algal turf, epiphytic on *Jania*; rare. M1, M2. New record for the Azores.

***Sphacelaria tribuloides* Menegh. #**

Littoral. Epiphytic on *Codium* and *Cystoseira*; occasional. 8, 15. New record for Faial and Pico.

***Taonia atomaria* (Woodw.) J.Agardh #\***

See NETO (1994).

***Zonaria tournefortii* (J.V.Lamour.) J.Agardh #\***

Lower littoral; sublittoral to 56m. Epilithic and among algal turf; locally common. 4, 13, M1, M2, M6.

## RHODOPHYTA

***Acrosorium uncinatum* (Turn.) Kylin #**

Deep sublittoral at 50m. Epilithic; rare. 13. New record for Faial.

***Acrosymphytum purpuriferum* (J. Agardh) Sjöstedt #\***

See NETO (1994).

***Aglaothamnion byssoides* (Harvey) Hardy-Halos et Rueness #**

Deep sublittoral at 46m. Epilithic; rare. M8. New record for Faial.

***Aglaothamnion hookeri* (Dillwyn) Maggs et L'Hardy-Halos #**

Littoral, sublittoral to 46m. Epilithic, epiphytic, among algal turf. 1, 2, 3, 7, 11, 14, M2(?), M4, M8. New record for Faial and Pico.

***Aglaothamnion* cf. *roseum* (Roth) Maggs et Hardy-Halos #**

Littoral. Epilithic; rare. 11. Possible new record for the Azores.

***Amphiroa beauvoisii* J.V.Lamour. #\***

Littoral, sublittoral to 19m. Epilithic and among algal turf; common. 15, M1, M2, M4(?). New record for Pico.

***Amphiroa cryptarthrodia* Zanardini #\***

Sublittoral to 15m. Among algal turf. M1.

***Amphiroa* cf. *rigida* J.V.Lamour. #**

Sublittoral to 10m. Among algal turf; occasional to rare. M1, M4, M5. Possible new record for the Faial.

***Anotrichium tenue* (C.Agardh) Näg.**

Sublittoral to 10m. Among algal turf; occasional to rare. 1, M1, M2. New record for the Azores.

***Antithamnion diminutatum* Wollaston**

Littoral, shallow sublittoral to 2m. Among algal turf; rare. Small growths, possibly overlooked. 3, M5. New record for the Azores and eastern Atlantic.

***Antithamnion ogdeniae* Abbot**

Littoral. Among algal turf; rare. Small growths possibly overlooked. M5. New record for the Azores.

***Antithamnion pectinatum* (Montagne) Brauner**

Sublittoral, 5-10m. Epilithic among other algae; rare. Small growths possibly overlooked. M11 (sea-cave). New record for the Azores and the north Atlantic.

***Apoglossum ruscifolium* (Turner) J.Agardh**

Sublittoral at 48m. Epilithic; rare. M8. New record for the Azores.

***Asparagopsis armata* Harvey #\***

Lower littoral, sublittoral to 30m. Epilithic and among algal turf; abundant. Zone forming a low shore levels. 2, 4, 7, 8, 12, M1, M2, M4, M5, M8. Gametophyte (*Asparagopsis*) and tetrasporophyte (*Falkenbergia*) stages both widespread and abundant.

***Bangia atropurpurea* (Roth) C.Agardh #\***

See NETO (1994).

***Bonnemaisonia hamifera* Har.**

Tetrasporophyte stage (*Trailliella*) only. Sublittoral to 48m. Among algal turf; occasional. M1, M2, M6, M8. New record for the Azores (NETO, 1994, includes a record of the gametophyte

- from Graciosa requiring confirmation of identification).
- Callithamnion cf. corymbosum* (Sm.) Lyngbye #  
Littoral. Epilithic; rare. 12, M1, M2. Possible new record for Faial.
- Callithamnion tetragonum* (With.) S.F.Gray #  
Littoral. Epilithic; occasional. 11, 14(?), M2. New record for Faial and probably Pico.
- Callithamnion tetricum* (Dillwyn) S.F.Gray  
Littoral. Epilithic; rare. 8. New record for the Azores.
- Catenella caespitosa* (With.) L.Irvine #\*  
Littoral. Epilithic; rare. Shaded situations only. 3, M2, M3.
- Caulacanthus ustulatus* (Turner) Kützinger #\*  
Sublittoral. Epilithic; rare. South side of Monte da Guia.
- Centroceras clavulatum* (C. Agardh) Montagne #  
Littoral, sublittoral to 20m. Epilithic, among algal turf, sand-binding; abundant. 7, 8, 11, 12, 14, 15, M1, M2, M3, M4, M5, M8. New record for Faial and Pico.
- Ceramium ciliatum* (Ellis) Ducluz. #  
Littoral, sublittoral to 8m. Among algal turf; locally common. 4, M1, M2, M3, M4, M5. New record for Faial.
- Ceramium diaphanum* Agg. #\*  
Littoral, sublittoral to 19m. Among algal turf, epiphytic; common. 4, 5, 8, 14, 15, M1, M2, M3, M4, M5, M6, M8.
- Ceramium echinotum* J.Agardh #\*  
Littoral, sublittoral to 19m. Among algal turf; locally common. M1, M2, M3, M4, M5.
- Ceramium rubrum* Agg. #  
Littoral. Epilithic, among algal turf; occasional. 8, 12, 14, M2, M3, M5. New record for Faial.
- Champia parvula* (C.Agardh) Harvey #  
Littoral, sublittoral to 10m. Among algal turf; occasional. 8, 14, M1, M4, M5, M6. New record for Faial and Pico.
- Chondria dasyphylla* (Woodw.) C.Agardh #  
Littoral, shallow sublittoral to 2m. Epilithic; locally common to rare. 4, 8, 15. M1, M2, M4, M5. New record for Faial and Pico.
- Chondria tenuissima* (Gooden. & Woodw.) C. Agardh #  
Littoral. Among algal turf; occasional. M2. New record for Faial.
- Chrysomenia bulbosa* Levring  
See NETO (1994).
- Corallina elongata* Ellis et Sol. #  
Littoral. Epilithic, among algal turf; rare, probably overlooked. M2. New record for Faial.
- Corallina officinalis* L. #\*  
Littoral, sublittoral to 15m. Epilithic, turf-forming; abundant. 4, 8, 9, 14, 15, M1, M2, M3, M4, M5, M6.
- Crouania attenuata* (C.Agardh) J.Agardh #  
Littoral, sublittoral to 46m. Among algal turf, epiphytic. 8, 9, M1, M4, M5, M6, M8. New record for Faial.
- Cryptopleura ramosa* (Hudson) Newton #  
Littoral, sublittoral to 48m. Epilithic, epiphytic, among algal turf; common in small amounts. 2, 3, 5, 8, 12, 14, M1, M2, M5, M6, M8. New record for Faial and Pico.
- Dasya corymbifera* J.Agardh #  
Littoral, sublittoral to 5m. Epilithic, among algal turf; rare. 15, M1. New record for Faial and Pico.
- Dasya cf. Harvey*  
Sublittoral at 10m. Among algal turf; rare. M1. Possible new record for the Azores.
- Dasya ocellata* (Grat.) Harvey #  
Littoral, sublittoral to 12m. Among algal turf; occasional. 2, 14, M1, M5. New record for Faial and Pico.
- Erythrodermis traili* (Holmes ex Batters) Guiry & Garbary #  
Littoral. Epilithic; rare. M3. New record for Faial.
- Erythrotrichia carnea* (Dillwyn) J.Agardh  
Littoral, sublittoral to 20m. Epiphytic; occasional. 1, 4, 7, 13, 14, M1, M2, M4, M5, M6. New record for the Azores.
- Gastroclonium cf. clavatum* (Rothpletz) Ardiss.  
Littoral. Epilithic; rare. 12. Possible new record for the Azores.
- Gastroclonium ovatum* (Huds.) Papenf. #  
Littoral. Epilithic; rare. M2, M5. New record for Faial.

- Gelidiella* cf. *acerosa* (Forssk.) J.Feldm. et Hamel  
Littoral. Epilithic and among algal turf; occasional. 4, 8, 9(?), 11(?), 13(?), 14. Possible new record for the Azores.
- Gelidiella* cf. *tenuissima* J.Feldmann et Hamel  
Littoral. Epilithic, among algal turf; rare. M2. Possible new record for the Azores.
- Gelidium latifolium* (Grev.) Bornet et Thuret. ##  
Littoral. Epilithic; occasional. 4, 11, 12, 14, M6(?).
- Gelidium microdon* Kützing ##  
Littoral. Epilithic; occasional. 3, 4, 6, M3, M4.
- Gelidium pusillum* (Stackh.) Le Jolis #  
Littoral. Epilithic; occasional. 4, 8, M2, M4, M5. New record for Faial.
- Gelidium sesquipedale* (Turner) Thur. #  
Littoral. Epilithic; rare. 15. New record for Pico.
- Gigartina acicularis* (Roth) Lamouroux ##  
Midlittoral, shallow sublittoral. Epilithic, among algal turf; common. 4, 7, 8, 9, 12, M1, M2, M3, M4, M5, M6.
- Gigartina teedii* (Roth) J.V.Lamour. #  
Littoral. Epilithic; locally common. 11, M2. New record for Faial.
- Griffithsia* cf. *globulifera* Harvey  
Littoral. Epilithic; rare. Monte da Guia Caldeira. Possible new record for the Azores.
- Griffithsia phyllamphora* J.Agardh ##  
Sublittoral to 10m. Among algal turf, small growths; rare. M1, M4.
- Grateloupia dichotoma* J.Agardh #  
Littoral. Epilithic; locally common especially in wave-washed situations. 5, 7, 8, 9, 14(?). New record for Faial and Pico.
- Gymnogongrus crenulatus* (Turner) J.Agardh #  
Littoral. Epilithic, rare. M3. New record for Faial.
- Gymnogongrus griffithsiae* (Turner) Mart. #  
Littoral. Epilithic; occasional. 7, 8(?). New record for Faial.
- Gymnogongrus tenuis* (Turner) J.Agardh  
Littoral. Epilithic; rare. 11, 14(?). New record for the Azores.
- Gymnothamnion elegans* (C.Agardh) J.Agardh ##  
Littoral. Epilithic; occasional to locally common. 12, Monte da Guia cave.
- Haliptylon squamatum* (L.) H.W.Johans., L.M.Irvine & A.Webster ##  
See NETO (1994).
- Haliptylon virgatum* (Zanardini) Garbary et H.W.Johans. ##  
Littoral, sublittoral to 10m. Epilithic, turf-forming; locally dominant. 2, 3, 4, 13, M1, M2, M5, M6, M8.
- Herposiphonia secunda* (C.Agardh) Falkenb.  
Littoral, sublittoral to 15m. Among algal turf; common. 6, 8, 14, M1, M2. New record for the Azores.
- Hildenbrandia rubra* (Sommerf.) Menegh.  
Littoral. Epilithic; rare, shaded situations. 3. New record for the Azores.
- Hypnea arbuscula* P.Dangeard ##  
See NETO (1994).
- Hypnea cervicornis* J.Agardh #  
Littoral, sublittoral to 15m. Epilithic; occasional. 15; M1, M3, M4(?), M5. New record for Faial.
- Hypnea musciformis* (Wulf.) J.V. Lamour ##  
Littoral. Epilithic; occasional to locally common. 4, 11, 14, 15, M5(?). New record for Pico.
- Hypoglossum hypoglossoides* (Stackh.) F.Collins #  
Sublittoral to 46m. Among algal turf; occasional. 2, M1, M2, M8. New record for Faial.
- Jania adhaerens* J.V.Lamour. #  
Littoral, sublittoral to 46m. Epilithic; among algal turf. 13, M2(?), M6, M8(?). Difficult to distinguish easily from other *Jania* spp. New record for Faial.
- Jania* cf. *corniculata* (L.) J.V.Lamour.  
Shallow sublittoral to 3m. Among algal turf; rare. M4. Difficult to distinguish easily from other *Jania* spp. Possible new record for the Azores.
- Jania crassa* J.V.Lamour. ##  
See NETO (1994).
- Jania rubens* (L.) J.V.Lamour. ##  
Littoral, sublittoral to 30m. Epilithic, turf-forming; abundant. 2, 8, M1, M2, M4, M5, M6, M8.

*Kallymenia reniformis* (Turner) J.Agardh #

Littoral, sublittoral to 15m. Epilithic; rare. 2, 11.  
New record for Faial.

*Laurencia hybrida* (DC) Duby #

Littoral, shallow sublittoral. Epilithic, among algal turf; occasional. 4, M2, M4, M5, M6. New record for Faial.

*Laurencia obtusa* (Huds.) J.V.Lamour. #\*

Littoral, shallow sublittoral to 2m. Epilithic, among algal turf; common. 7, 8, 14, 15, M1, M2, M3, M4, M5. New record for Pico.

*Laurencia pinnatifida* (Huds.) J.V.Lamour. #

Littoral, shallow sublittoral to 2m. Epilithic, among algal turf; common. M2, M4, M5. New record for Faial.

*Liagora distenta* (Mert.) C.Agardh

Littoral. Epilithic; occasional in upper shore pools. 14. New record for the Azores.

*Liagora viscida* (Forssk.) C.Agardh #

Littoral. Epilithic; locally common in pools. 7. New record for Faial.

*Lithophyllum azorum* Me Lemoine #\*

See NETO (1994).

*Lithophyllum bipartitum* Me Lemoine #\*

See NETO (1994).

*Lithophyllum esperi* Me Lemoine #\*

See NETO (1994).

*Lithophyllum vickersii* Me Lemoine #\*

See NETO (1994).

*Lomentaria articulata* (Hudson) Lyngbye #\*

Littoral. Epilithic; occasional. In shaded situations. 3, 8, 9, 11, 14, 15, M2, M3. New record for Pico.

*Lophosiphonia reptabunda* (Suhr) Kylin

Littoral. Among algal turf; occasional (possibly overlooked). 15, M3. New record for the Azores.

*Lophosiphonia subadunca* (Kützinger) Falkenb.

Littoral. Among algal turf; occasional (possibly overlooked). 6, 8(?), M3. New record for the Azores.

*Melobesia membranacea* (Esper) J.V.Lamour. #

See NETO (1994).

*Nemalion helminthoides* (Velley) Batters #\*

Littoral. Epilithic; occasional. 6, 8, 14. New record for Faial.

*Nitophyllum punctatum* (Stackh.) Grev. #\*

See NETO (1994).

*Peyssonnelia squamaria* (S.Gmelin) Dcne #\*

Littoral, sublittoral to 48m. Epilithic on stones and shells; common. 2, 8, M1, M8.

*Phymatolithon lenormandii* (Aresch.) W.H.Adey #\*

See NETO (1994).

*Plocamium cartilagineum* (L.) P.Dixon #\*

Littoral, sublittoral to 46m. Among algal turf; occasional. 2, 8, 11, 15, M1, M2, M4, M5, M6, M8. New record for Pico.

*Polysiphonia atlantica* Kapraun et J.N.Norris #

Littoral. Epilithic; rare. 8. New record for Faial.

*Polysiphonia brodiaei* (Dillwyn) Sprengel

Littoral. Epilithic; occasional. 8(?), 6, 15, M2, M5. New record for the Azores.

*Polysiphonia flosculosa* (C.Agardh) Kützinger #\*

See NETO (1994).

*Polysiphonia fruticulosa* (Wulfen) Spreng. #

Littoral, shallow sublittoral to 2m. Epilithic, among algal turf. 4, M4. New record for Faial.

*Polysiphonia opaca* (C.Agardh) Mor. et De Not. #\*

See NETO (1994).

*Polysiphonia urceolata* (Dillwyn) Grev. #

Littoral. Among algal turf; occasional to common. 1(?), 3, 8(?), 15, M2, M5, M6(?). New record for Faial and Pico.

*Polysiphonia* spp.

Littoral, sublittoral. Among algal turf. Common. Two as yet unidentified species were widely recorded on Faial and Pico. One is a dark plant which has four pericentral cells, pseudodichotomous branching, main axes 100µ diameter, pericentral cells 200µ long, corticate at the base. The other has 10 pericentral cells and upright branches arise from a prostrate system from which rhizoids grow down. Upright axes corticate almost to the apices; trichoblasts present.

*Porolithon onkodes* (Heydr.) Foslie #\*

See NETO (1994).

*Porphyra umbilicalis* (L.) J.Agardh #

Littoral. Epilithic; rare. 2. New record for Faial.

*Predaea feldmanii* Børgesen #\*

See NETO (1994).

*Pterocladia capillacea* (S.Gmelin) Bornet et Thuret #\*

Littoral. Epilithic; common. 6, 8, 11, 12, 14, 15, M2, M5.

*Pterothamnion crispum* (Ducl.) Näg.

Sublittoral. Small plants among algal turf; rare. M1. New record for the Azores.

*Rhodomenia holmesii* Ardiss. #

Littoral. Epilithic; occasional. 5, 11. New record for Faial.

*Rhodomenia pseudopalmata* (Lamouroux) Silva #\*

Littoral. Epilithic; occasional. 12(?), Monte da Guia cave.

*Scageliopsis patens* Wollaston

Sublittoral to 41m. Small plants among algal turf; occasional. M6, M8. First record for the northern hemisphere! (North Atlantic).

*Scinaia turgida* Chemin #\*

See NETO (1994).

*Schimmelmannia ornata* Schousboe #

See NETO (1994).

*Schizymenia dubyi* (Duby) J.Agardh #\*

Littoral. Epilithic; rare. 11.

*Seirospora* sp.

Sublittoral at 19m. Among algal turf; occasional. M1.

*Sphaerococcus coronopifolius* Stackh. #

Sublittoral at 10m. Epilithic; rare. 4. New record for Faial

*Sphondylothamnion multifidum* (Huds.) Näg.

Sublittoral to 10m. Among algal turf; rare. M1. New record for the Azores.

*Spyridia filamentosa* Harvey

Littoral, sublittoral to 15m. Among algal turf; occasional. M1, M5. New record for the Azores.

*Stylonema alsidii* (Zanardini) Drew #\*

Littoral, sublittoral to 20m. Epiphytic; occasional. 4, M1, M2, M4, M5, M6.

*Symphycladia marchantioides* (Harvey) Falkenb. #\*

Littoral, sublittoral to 48m. Epilithic, epiphytic, among algal turf; common. 4, 7, 11, 12, 15, M1, M2, M4, M5, M8.

*Taenioma nanum* (Kützinger) Papenf.

Littoral, sublittoral to 10m. Among algal turf; rare. 4, M1, M5. New record for the Azores.

*Taenioma perpusillum* (J.Agardh) J.Agardh

Shallow sublittoral to 5m. Among algal turf; rare. M5. New record for the Azores and north Atlantic.

*Tenarea tortuosa* (Esper) Me Lemoine #

See NETO (1994).

*Titanoderma pustulatum* (J.V.Lamour) Woelk. #\*

See NETO (1994).

## DISCUSSION

Much of the effort of the expedition was focussed on the transect studies in the Monte da Guia Nature Reserve where most of the material collected from lower littoral and sublittoral levels was of algal turf. Algal turfs are growths of either diminutive algae or diminutive forms of larger species forming dense compact stands rarely more than 2 - 3cm high. Turf assemblages appear externally visually uniform but vary in species composition. Algal turfs were often dominated by articulated Corallinaceae, and comprised a taxonomically complex mixture of small algae and smaller forms of larger algae, often present only in vegetative form and lacking the reproductive structures important for determination. We therefore had considerable difficulties with the identification of many of the constituent species. A more detailed analysis of turf algal communities is given in NETO & TITTLE (in press). There remains further work to be done on *Polysiphonia* and related genera, and also the crustose Corallinaceae which also present considerable taxonomic difficulty.

Sea-shores on the Azores at both littoral and sublittoral levels show an absence of the often dominant brown macroalgae (*Fucus*, *Laminaria*, *Saccorhiza*) on northern European shores. *Fucus spiralis* was occasionally found, otherwise

*Cystoseira* and *Sargassum* were the principal large brown algae present but recorded mainly in sheltered intertidal pools or wavewashed runnels. At lower subtidal levels in the turf, only diminutive rosette forms of *Sargassum* were detected. At greater depths, the brown algae *Lobophora* and *Zonaria* were more common. Most sea-shores were moderately to severely wave-washed and algae generally were therefore either small, or restricted to sheltered, shaded clefts and crevices. The period of investigation, July, when insolation was at maximum, air temperatures highest, and the sea was most calm, meant that the upper littoral green algal growths of winter-spring were missed, as were other ephemerals.

The expedition contributed much new information to our knowledge of the marine algal flora of the Azores. This included 40 new species records (including possibles) for the Azores, additionally 57 new species records for Faial and 27 new species records for Pico. Sites on Faial and Pico varied considerably in species richness; Cais de Pico and Lajes de Pico supported diverse algal floras but were only superficially investigated subtidally. The detailed transect studies on Monte da Guia revealed 107 species present.

Noteworthy among the new records is the brown alga *Endarachne binghamiae* (Punctariaceae/Scytosiphonaceae) originally described from California but subsequently found in China and Japan. More recently it has been confirmed from Australia, Pakistan and South Africa (NIZAMUDDIN & FAROOQI 1968), Brazil (YONESHIGUE 1985) and St Helena (LAWSON et al. 1993). *Endarachne* has been known for the Azores since 1980 but not reported in the literature; the Lisbon Herbarium (LIS) holds material collected from two locations on Terceira in March and April 1980 by R. Fralick, and determined to genus by F. Andrade and F. Ardre. The plant closely resembles *Petalonia fascia* and is distinguished from it by its filamentous medulla. The small rosette-like plants of *Sargassum* in the turf grew to reproductive maturity with receptacles formed on centrally

arising stalks; however, we are not sure whether this represents a distinct species or a turf ecotype. The other new brown and green algal records are of species generally widespread in the north Atlantic.

Noteworthy among the records of red algae new to the Azores are members of the Antithamniae (Ceramiaceae; see ATHANASIADIS & TITTLE 1995). *Antithamnion diminutum* was originally described from southern Australia and subsequently recorded from South Africa. On Faial small growths occurred at intertidal levels among an algal turf dominated by species of *Corallina* and *Jania*. *Antithamnion pectinatum* also grew among a coralline algal turf at lower littoral levels. The species was first described from New Zealand, and is widespread in warm temperate regions of the Pacific and was first reported in Europe from Mediterranean France in 1989 and from the American coast (Long Island Sound) in 1985. *Scageliopsis patens* was found only at sublittoral levels over a wide depth range. It was first described from South Australia. ATHANASIADIS & TITTLE (1994) suggested that the species were introductions. The tetrasporophyte stage of *Bonnemaisonia hamifera* (an introduced species now widespread in the North Atlantic) was found at sublittoral levels on Monte da Guia for the first time; NETO (1994) includes a record of the gametophyte from Graciosa requiring confirmation of identification. Another noteworthy introduction to the Azores, *Symphyocladia marchantioides*, (ARDRE et al. 1974) was found widely on Faial and Pico at lower littoral and sublittoral levels.

Other new records are commonly known in the North Atlantic; some examples include *Callithamnion tetricum* which occurs in Spain and Portugal and further afield, *Erythrotrichia carnea* and *Hildenbrandia rubra* which are widespread in the North Atlantic (America and Europe), *Gelidiella tenuissima* and *Herposiphonia secunda* which occur in Spain, Portugal and northern West Africa. *G. acerosa* and *Hypnea cervicornis* however are known from West Africa and America. *Taenioma nanum* is known in the north Atlantic only from southern

Spain/Portugal and from West Africa; *T. perpusillum* is not known from Europe but occurs in Africa and America. *Sphondylothamnion multifidum* is widely known in the eastern North Atlantic, while *Spyridia filamentosa* is widespread in the North Atlantic, West Africa and North America.

## ACKNOWLEDGEMENTS

We wish to thank Dr Paddy Moss for her considerable help in the field and with the preliminary sorting of material. Thanks also to the many expedition divers who collected material. Linda Irvine, Jim Price of the Natural History Museum, Dr Bill Farnham of Portsmouth University, and Dr A. Athanasiadis of the University of Göteborg are acknowledged for their help with identifications. The Department of Oceanography, University of the Azores provided field and laboratory facilities. The British Council, Lisbon, is gratefully thanked for financial support enabling the authors to undertake collaborative visits to London and Ponta Delgada.

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Accepted 12 August 1994.

