

# OBSERVATIONS ON THE MARINE ALGAL FLORA OF THE AZORES II: AN ANNOTATED CHECKLIST OF THE CHLOROPHYCOTA FROM THE AZORES

RICHARD A. FRALICK & EDWARD J. HEHRE

## ARQUIPÉLAGO



FRALICK, RICHARD A. & EDWARD J. HEHRE 1990. Observations on the marine algal flora of the Azores II: An annotated checklist of the Chlorophycota from the Azores. - *Arquipélago*. Life and Earth Sciences 8:11-17. Angra do Heroísmo. ISSN 0870-6581.

This paper presents a summary of the marine Chlorophycota, Chlorophyceae from Azores collections made over the past ten years which include 31 species, 7 orders and 10 families. Specimens were collected intertidally and subtidally by snorkeling and SCUBA to a depth of 15 meters. Five new records are cited: *Ernodesmis verticillata*, *Microdictyon calodictyon*, *Derbesia lamourouxii*, *Anadyomene stellata* and *Halimeda tuna*.

FRALICK, RICHARD A. & EDWARD J. HEHRE 1990. Observações sobre a flora de algas marinhas dos Açores II: Lista anotada das Chlorophycota dos Açores. - *Arquipélago*. Ciências da Natureza 8:11-17. Angra do Heroísmo. ISSN 0870-6581.

Uma lista das espécies de algas verdes (divisão Chlorophycota, classe Chlorophyceae) recolhidas no litoral açoreano nos últimos dez anos é apresentada. As colheitas foram feitas na zona intertidal e na zona subtidal até à profundidade de quinze metros, com o auxílio do escafandro autónomo. As trinta e uma espécies encontradas estão distribuídas por sete ordens e dez famílias. São registadas cinco novas ocorrências: *Ernodesmis verticillata*, *Microdictyon calodictyon*, *Derbesia lamourouxii*, *Anadyomene stellata* e *Halimeda tuna*.

Richard A. Fralick, Natural Science Department, Plymouth State College, Plymouth, New Hampshire, 03264 USA. - Edward J. Hehre, Jackson Estuarine Laboratory, University of New Hampshire, Durham, New Hampshire, 03824 USA.

## INTRODUCTION

This paper is the second in a series entitled: "Observations of the Marine Algal Flora of the Azores". Our objective is to present an up to date, annotated check-list of the Chlorophycota based on both valid citations in the literature and our own collections and observations. Similar check-lists for the Phaeophyta and the Rhodophyta will follow in this series, as well as pertinent studies of the Azores marine flora.

The collection of specimens for this project was initiated in 1977 when a study of the economically important red alga *Pterocladia capillacea* was supported with funding from the United States Agency for International

Development (USAID). Substantial collections were made on Terceira throughout the year during 1979-1980. Additional collections were made during summer visits to Faial, Pico, Terceira, Santa Maria, São Miguel, Graciosa, Flores and Corvo. Only minimal observations were conducted on São Jorge in 1980.

The literature provided some interesting and valuable information from earlier algal collections from the Azores. For example, some 42 species were recorded from the Azores by SEUBERT (1844). In 1866, DROUËT completed a catalogue of the Azores Flora. In 1870 the Swedish phycologist J. Agardh visited the Azores. By the late 1800's TRELEASE (1897) had recorded 64 species of marine algae from the

Azores. The most substantial treatment of the Azores algae was produced by O.C. Schmidt in the years 1929-1931. More recently, LEVRING (1974) also made reference to a number of his collections in the Azores in his publication on the marine algae of Madeira. This work cited a number of distributional records.

In addition to the above, French researchers have made collections on several of the Azorean islands, but no publication of these collections has yet come to our attention. A British expedition by Chelsea College informally reported several algal observations which were valuable to our data base.

The classification system used in this paper follows SILVA (in PARKER 1982). Our collections will be distributed to the Plymouth State College Herbarium, to the University of the Azores and the United States Museum of Natural History (Smithsonian) when the project is completed. The authors request that any researchers wishing to collaborate on this project please contact us in order to share resources.

## MATERIALS AND METHODS

The specimens for this study were collected in the intertidal zone, from coastal drift and from the subtidal zone by snorkeling and by SCUBA diving. A maximum depth of 15-20 meters was commonly used. The specimens were transported to the laboratory immediately after collections were made and placed in a herbarium press until dry. The specimens were then transported to the laboratory at Plymouth State College (USA) for final determinations.

## ANNOTATED CHECKLIST OF CHLOROPHYCEAE FROM THE AZORES

### DINOCAPSALES

#### GLOEODINIACEAE

##### 1. *Urococcus hookerianus* Kützinger

Recorded by TRELEASE (1897). Although this is

generally regarded as a freshwater alga, Trelease notes that the specimens from the Azores were collected in salt or brackish water.

Azores: Flores

### ULOTRICHALES

#### ULOTRICHACEAE

##### 2. *Ulothrix flacca* (Dillwyn) Thuret

Recorded by SCHMIDT (1931), as an epiphyte on *Enteromorpha ramulosa*.

Azores: São Miguel

Distribution: NE coast of North America; Greenland; N Atlantic, Europe to Canary Islands.

### ULVALES

#### MONOSTROMATACEAE

##### 3. *Blidingia minima* (Kützinger) Kylin

A small plant found on rocks in the mid to upper eulittoral zone; probably common throughout the Azores.

Azores: Pico, Faial

Distribution: N Europe to Canary Islands; E & W coasts of North America.

### ULVACEAE

##### 4. *Enteromorpha intestinalis* (Linnaeus) Link

Recorded by TRELEASE (1897) as *E. compressa* including forma *prolifera* from Santa Maria; it probably occurs on all Azorean islands. We have collected this in the sublittoral zone and eulittoral tide pools.

Azores: Santa Maria, São Miguel, São Jorge, Pico, Flores, Graciosa, Faial.

Distribution: Cosmopolitan. Subarctic, temperate, tropical zones.

##### 5. *Enteromorpha linza* (Linnaeus) J. Agardh

Recorded by SCHMIDT (1931) and by TRELEASE, 1897 (as *Ulva linza*). We have found this in eulittoral tidepools and shallow sublittoral zone.

Azores: Santa Maria, Terceira, Pico, Faial.

Distribution: Europe; NE coast of North

America; Caribbean; Alaska; Japan.

6. *Enteromorpha ramulosa* (J.E. Smith) Hooker

Found in both protected and exposed regions in eulittoral tidepools. Common.

Azores: Corvo, São Miguel, Flores, Graciosa, Pico, Faial.

Distribution: Europe to Canary Islands; W coast of North America; Caribbean; Tasmania; New Zealand.

[*Ulva lactuca* L.]

Recorded by TRELEASE (1987) and SCHMIDT (1931). It is unlikely that *U. lactuca* occurs in the Azores, (see BLIDING 1968 and LEVRING 1974) and that *Ulva rigida* is the only *Ulva* species found here.

7. *Ulva rigida* C. Agardh

Recorded by TRELEASE (1987) and SCHMIDT (1931) as *Ulva lactuca* var. *rigida* (C. Ag.) Le Jolis. We have found this plant commonly in the eulittoral zone and it probably occurs on all the Azorean islands.

Azores: Pico, Faial, Terceira, Flores.

Distribution: N Europe to Canary Islands.

CLADOPHORALES

ANADYOMENACEAE

8. *Anadyomene stellata* (Wulfen) C. Agardh

Found once in shallow water at Lajes do Pico; primarily tropical; this is a new record for the Azores.

Azores: Pico.

Distribution: Tropical Americas; Mediterranean; Canary Islands.

CLADOPHORACEAE

9. *Chaetomorpha aerea* (Dillwyn) Kützinger

Recorded by SCHMIDT, 1931 (as *C. fibrosa*). We have found this plant in tidepools in calm areas.

Azores: São Miguel, Faial.

Distribution: NE coast of North America; Europe to Canary Islands.

10. *Chaetomorpha crassa* (C. Agardh) Kützinger

Recorded by SCHMIDT (1931) from the eulittoral zone.

Azores: Terceira.

Distribution: Primarily tropical - Caribbean; Philippines.

11. *Chaetomorpha linum* (O.F. Müller) Kützinger

A free-floating cosmopolitan species which occurs commonly throughout the Azores, usually entangled with other algae. Also recorded by TRELEASE (1897), SCHMIDT (1931) and LEVRING (1974) as *Chaetomorpha capillaris*. See BLAIR (1983).

Azores: São Miguel, Terceira, Flores, Corvo.

Distribution: NE coast of North America from Nova Scotia to Florida; Caribbean; Europe (Mediterranean S to Canary Islands).

12. *Chaetomorpha pachynema* Montagne

Recorded by BØRGENSEN (1925) and SCHMIDT (1931). Found commonly in eulittoral and sublittoral zones - often small and tufted when growing in exposed regions.

Azores: Faial and Terceira.

Distribution: Canary Islands; Cape Verde.

13. *Cladophora albida* (Hudson) Kützinger

Recorded by SCHMIDT (1929) as *Cladophora theotonii* sp. nov. (C. van den Hoek, pers. comm.). Common in upper eulittoral zone tidepools.

Azores: São Miguel, Terceira and Faial.

Distribution: NE coast of North America; UK; Mediterranean.

14. *Cladophora coelothrix* Kützinger

Recorded by SCHMIDT as *Cladophora weizenbaueri* sp. nov. (1929) and *Cladophora repens* (1931) and by LEVRING (1974). Common in tidepools in the lower eulittoral zone.

Azores: Santa Maria, Faial, Terceira.

Distribution: Coast of Europe S to Madeira; Mediterranean; West Indies; Panama; Indian

Ocean.

15. *Cladophora laetevirens* (Dillwyn) Kützinger

Recorded by SCHMIDT (1931) as *Cladophora catenata*. We have recorded this from the shallow sublittoral zone and eulittoral tidepools. Azores: Santa Maria, Terceira, Faial. Distribution: West Indies; Brazil; Mediterranean S to Canary Islands.

[*Cladophora michaelense*] O.C. Schmidt

Described by SCHMIDT (1929) as a new species endemic to the Azores. This is probably the basal portion of some unidentifiable species (C. van den Hoek, pers. comm.).

16. *Cladophora prolifera* (Roth) Kützinger

Recorded by TRELEASE (1897) as a bushy plant of the eulittoral and protected shallow sublittoral regions. Plant turns dark brown when dried and possesses rhizoids with distinct annular rings.

Azores: Corvo.

Distribution: Europe; West Indies; China.

17. *Rhizoclonium hookeri* Kützinger

Recorded by SCHMIDT (1931) from the eulittoral zone, entangled in coarse algae (e.g. *Gelidium*).

Azores: São Miguel, Faial.

Distribution: Widely distributed in both Atlantic and Pacific Oceans (West Indies, Europe, Galapagos Islands).

CHAETOPHORALES

CHAETOPHORACEAE

18. *Entocladia viridis* Reinke

Recorded by SCHMIDT (1929) as *Entoderma viridis* (Reinke) Lagerheim; endophytic in tissues of *Cladophora michaelense*.

Azores: São Miguel.

Distribution: N Atlantic from Canadian Maritimes to Caribbean; Europe; W Africa; Pacific North America; Australia.

19. *Ulvella lens* Crouan

Recorded by SCHMIDT (1929) as an epiphyte on *Cladophora michaelense*.

Azores: São Miguel.

Distribution: Atlantic and Pacific coasts of North America; Europe.

BRYOPSIDALES

BRYOPSIDACEAE

20. *Bryopsis plumosa* (Hudson) C. Agardh

Found in the shallow sublittoral zones in exposed regions, as well as sheltered tidepools. Another species, *Bryopsis penicillata*, was described from the Azores by SUHR in SEUBERT (1844). SCHMIDT (1931) notes that this may represent depauperate forms of *Bryopsis plumosa*. Our findings concur in that *Bryopsis plumosa* is the only one we have seen.

Azores: São Miguel, Flores, Terceira.

Distribution: Atlantic and Pacific oceans from subarctic to tropical waters.

21. *Derbesia lamourouxii* (J. Agardh) Solier

Found once on a breakwater in the upper sublittoral zone at Lajes do Pico; a new record for the Azores.

Azores: Pico.

Distribution: SW France to Morocco, Mediterranean, Madeira, California.

CODIACEAE

22. *Codium adhaerens* (Cabrera) C. Agardh

Very common prostrate species found on rocks and shells in the shallow sublittoral and eulittoral pools. It is the most common species of *Codium* in the Azores and indistinguishable from *Codium intertextum* of the tropical W Atlantic.

Azores: Santa Maria, Terceira, Faial, Flores, Pico, Graciosa, São Jorge.

Distribution: N Atlantic, Europe S to Canary Islands; W Africa; Japan; Australia; Hawaii; West Indies.



23. *Codium bursa* (Linnaeus) J. Agardh

Recorded by SCHMIDT (1931). We have yet to see this species of *Codium*. All of our specimens with ball-shaped morphology are *Codium elisabethae*.

Azores: Santa Maria.

Distribution: Europe S to Canary Islands.

24. *Codium decorticatum* (Woodward) Howe

A large branched species of *Codium*, often having two distinct morphologies present on the same plant (see TAYLOR, 1960). Found growing in the shallow sublittoral zone (to 3 m).

Azores: Pico, Faial, Terceira

Distribution: West Indies; Caribbean; E coast of South America; Canary Islands; Europe.

25. *Codium elisabethae* O. C. Schmidt

Described by SCHMIDT (1929). Totally indistinguishable from *Codium bursa* in external morphology, but with mucronate utricles (Dr. Paul Silva, pers. comm.). It is found to a depth of 4-5 m and frequently washes ashore.

Azores: Faial, Pico, Terceira

Distribution: Endemic to the Azores.

26. *Codium tomentosum* (Hudson) Stackhouse

Small branched species found in deep tidepools and in the upper sublittoral zone.

Azores: Faial, Pico, Terceira.

Distribution: UK; Mediterranean; S to Madeira and the Canary Islands; Caribbean.

27. *Halimeda tuna* (Ellis & Solander) Lamouroux

Found once in a tidepool on Flores. The influence of the Gulf Stream on this island probably accounts for the presence of *Halimeda* here. This is a new record for the Azores.

Azores: Flores.

Distribution: E coast of tropical and subtropical N & S America; Mediterranean, and the Canary Islands.

28. *Pseudochlorodesmis furcellata* (Zanardini) Børgesen

Recorded by SCHMIDT (1931) as *Derbesia furcellata* (Zanardini) Ardissonne and by LEVRING (1974) in the sublittoral zone.

Azores: Faial.

Distribution: Atlantic Ocean; W Mediterranean; Azores, S to Madeira and the Canary Island.

SIPHONOCCLADIALES

VOLONIACEAE

29. *Ernodesmis verticillata* (Kützinger) Børgesen

Found in shallow water and shaded eulittoral tidepools. New record for the Azores.

Azores: Terceira.

Distribution: Florida; Bermuda; Caribbean; Brazil; Madeira; Canary Islands.

30. *Microdictyon calodictyon* (Montagne) Duchesne

Collected once in the sublittoral zone (5-10 m). Also recorded by BØRGESSEN (1925) from the Canary Islands. New record for the Azores.

Azores: Terceira.

Distribution: Canary Islands.

31. *Valonia utricularis* (Roth) C. Agardh

Common in the shallow sublittoral zone, forming a turf on stones and shells (e.g. *Patella*).

Azores: Faial, Terceira.

Distribution: Caribbean; Tropical America; Europe; Mediterranean; S to Madeira and the Canary Islands.

ALPHABETICAL LISTING OF SPECIES OF CHLOROPHYCOTA FROM THE AZORES

\* *Anadyomene stellata* (Wulfen) C. Agardh

*Blidingia minima* (Kützinger) Kylin

*Bryopsis plumosa* (Hudson) C. Agardh

*Chaetomorpha aerea* (Dillwyn) Kützinger

*Chaetomorpha crassa* (C. Agardh) Kützinger

*Chaetomorpha linum* (O.F. Muller) Kützinger  
*Chaetomorpha pachynema* Montagne  
*Cladophora albida* (Hudson) Kützinger  
*Cladophora coelothrix* Kützinger  
*Cladophora laetevirens* (Dillwyn) Kützinger  
*[Cladophora michaelensis]* O. C. Schmidt  
*Cladophora prolifera* (Roth) Kützinger  
*Codium adhaerens* (Cabrera) C. Agardh  
*Codium bursa* (Linnaeus) J. Agardh  
*Codium decorticatum* (Woodward) Howe  
+ *Codium elisabethae* O. C. Schmidt  
*Codium tomentosum* (Hudson) Stackhouse  
\* *Derbesia lamourouxii* (J. Agardh) Solier  
*Enteromorpha intestinalis* (Linnaeus) Link  
*Enteromorpha linza* (Linnaeus) J. Agardh  
*Enteromorpha ramulosa* (J.E. Smith) Hooker  
*Entocladia viridis* Reinke  
\* *Ernodesmis verticillata* (Kützinger) Børgesen  
\* *Halimeda tuna* (Ellis & Solander) Lamouroux  
\* *Microdictyon calodictyon* (Montagne) Duchesne  
*Pseudochlorodesmisf urcellata* (Zanardini) Børgesen  
*Rhizoclonium hookeri* Kützinger  
*Ulothrix flacca* (Dillwyn) Thuret  
*[Ulva lactuca* Z.]  
*Ulva rigida* C. Agardh  
*Ulvella lens* Crouan  
*Urococcus hookerianus* Kützinger  
*Valonia utricularis* (Roth) C. Agardh

+ -- Endemic to Azores

\* -- New record for Azores

## ACKNOWLEDGEMENTS

Many of our collections were made using SCUBA and we acknowledge the assistance of George Leaf, Ken Salem, Linda Beroldi and Ray Broderick for this purpose. Additional assistance was provided by Francisco Andrade and Luíz Saldanha from the Museo Bocage in Lisbon.

We are especially grateful to the Department of Oceanography and Fisheries, University of

the Azores on Faial, where we were willingly provided with laboratory space and other forms of logistical support during 10 visits over the past 10 years. We thank Ana Neto and Heather Baldwin for their assistance with field collections, and also appreciate the typing by April O'Keefe.

## REFERENCES

- ARDRÉ, F. 1970. Contribution à l'étude des algues marines du Portugal. - *Portugalie Acta biologica*, (B) 10: 1-423.  
 BLAIR, S. 1983. Taxonomic treatment of the *Chaetomorpha* and *Rhizoclonium* species (Cladophorales, Chlorophyta) in New England. - *Rhodora* 85 (842): 175-211.  
 BLIDING, C. 1963. A critical survey of European taxa in Uvaes. Part I. - *Opera Botanica*: 8 (3): 1-160.  
 BLIDING, C. 1963. A critical survey of European taxa in Uvaes. Part II. - *Botaniska Notiser* 121: 535-629.  
 BØRGESSEN, F. 1925. Marine algae from the Canary Islands I. Chlorophyceae. - *Kongelige Danske Videnskabernes Selskab Biologiske Meddelelser* 5 (3): 1-123.  
 DROUËT, H. 1866. Catalogue de la flore des îles Açores précédés de l'itinéraire d'un voyage dans cet Archipel. - *Mémoires Société Académique de l'Aube* 30: 81-233.  
 FRALICK, R., E. HEHRE & A. C. MATHIESON 1985. Observations of the marine algal flora of the Azores I: Notes on the epizoid algae occurring on the marine mollusc *Patella* spp. - *Arquipélago* 6: 39-43.  
 HOEK, C. VAN DEN 1963. *Revision of the European species of Cladophora*. Leiden. VII + 248 pp.  
 LAWSON, G.W. & J. H. PRICE 1989. Seaweeds of the western coast of tropical Africa and adjacent islands, I, Chlorophyta. - *Botanical Journal of the Linnean Society* 62: 279-346.  
 LEVRING, T. 1974. The marine algae of the Archipelago of Madeira. - *Boletim do Museu Municipal do Funchal* 28 (125): 1-111.  
 MENEZ, E.G. & A.C. MATHIESON 1981. The

- marine algae of Tunisia. - *Smithsonian Contribution to the Marine Sciences* 10: 1-59.
- SCHMIDT, O.C. 1929. Beiträge zur kenntniss der Meeres Algen der Azoren I. - *Hedwigia* 69: 95-133.
- SCHMIDT, O.C. 1931. Die Marine Vegetation der Azoren. - *Bibliotheca Botanica* 102: 1-116.
- SEUBERT, M. 1844. *Flora Azorica*. Bonn. 50 pp., 15 plates.
- SILVA P.C. 1982. Chlorophycota. Pp. 133-164 in: PARKER, S.P. (Ed.) *Synopsis and Classification of Living Organisms*, 1. McGraw Hill Book Company.
- TAYLOR, W. R. 1960. *Marine Algae of the Eastern Tropical and Subtropical Coasts of the Americas*. - University of Michigan Press, Ann Arbor, Mich. 870 pp.
- TRELEASE, W. 1897. Botanical observations on the Azores. - *8th Annual Report of the Missouri Botanical Garden*. Pp. 195-198.

Accepted 10 April 1989.