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**THE INTERTIDAL ALGAE OF THE MAINLAND COAST  
IN THE VICINITY OF TOWNSVILLE, QUEENSLAND**

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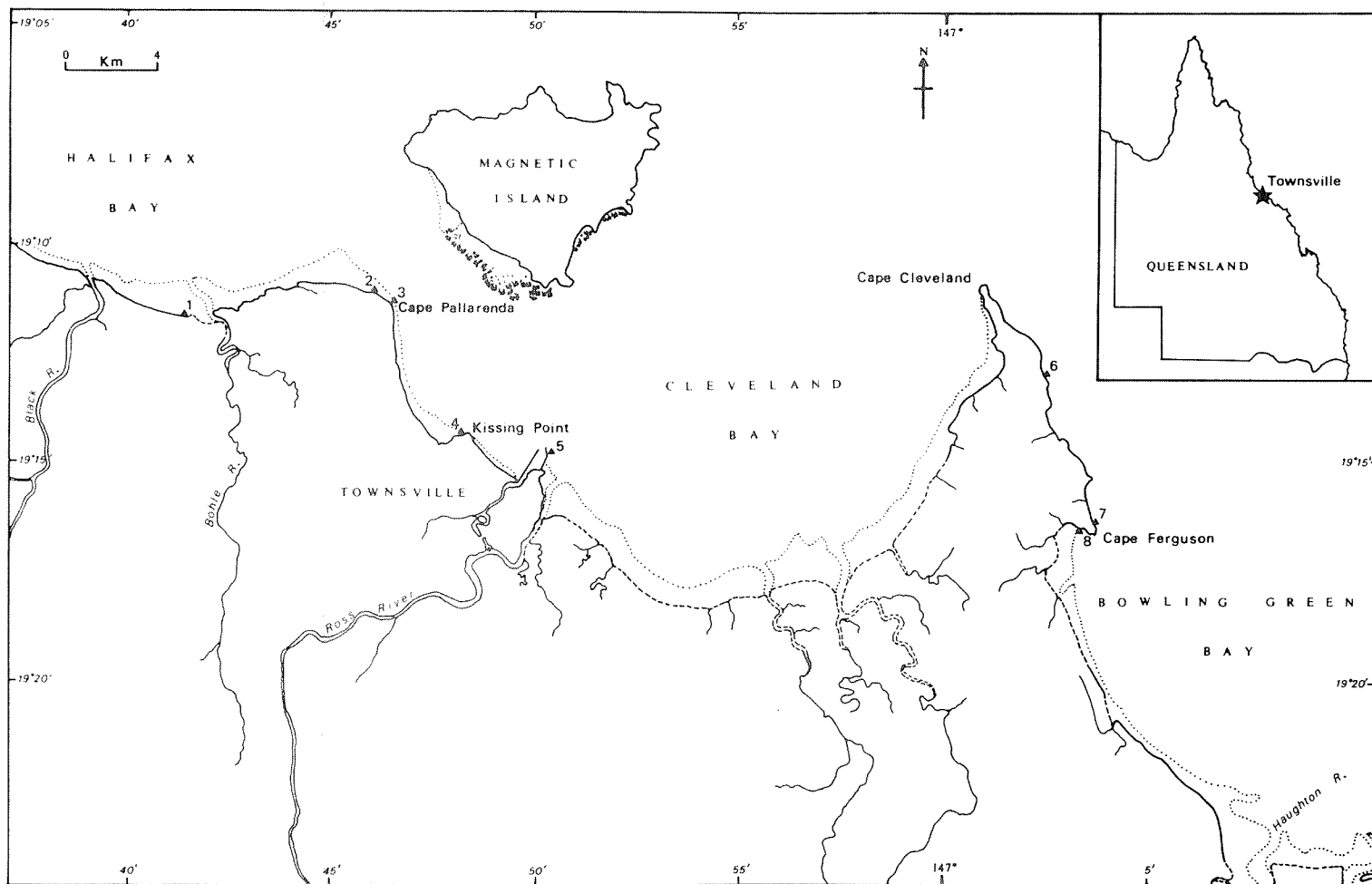


Fig. 1. Map of Townsville region showing location of collecting stations. 1 - Station I, Saunder's Beach; 2 - Station II, NW of Cape Pallarenda; 3 - Station III, Cape Pallarenda; 4 - Station IV, Kissing Point; 5 - Station V, Eastern Breakwater; 6 - Station VI, SE of Cape Cleveland; 7 - Station VII, Cape Ferguson, Turtle Bay; 8 - Station VIII, Cape Ferguson, Ticklebelly Bay.

# THE INTERTIDAL ALGAE OF THE MAINLAND COAST IN THE VICINITY OF TOWNSVILLE, QUEENSLAND

by Yinam Ngan and Ian R. Price<sup>1/</sup>

## ABSTRACT

One hundred and thirty-nine taxa of intertidal marine algae are recorded from eight stations in the vicinity of Townsville, on the north-east tropical coast of Australia. The flora comprises 25 species of Chlorophyta, 19 of Phaeophyta, 89 of Rhodophyta, and 6 of Cyanophyta, most of which are new records for the area.

## INTRODUCTION

The benthic marine algal flora in the Townsville region has remained virtually unstudied to the present time. Only three algal species have been reported previously (Endean *et al.*, 1956). However, some collections and studies have been made in Queensland waters to the north (see Lucas, 1931; Cribb, 1961; Price *et al.*, 1976) and also further south (see Lucas, 1931; May, 1951; Cribb, 1954, 1956, 1958a, 1958b, 1960, 1965a, 1965b, 1966, 1969, 1971, 1972, 1973, 1975). Earlier references relating to the marine algae of north-east Queensland are included in Cribb (1954).

The following list of species includes references to published descriptions and illustrations, which should facilitate and stimulate further studies of the algal flora in tropical Australia. The list includes many widely distributed tropical Indo-West Pacific taxa, and will enable more detailed biogeographical comparisons with other regions.

The check-list relates chiefly to rocky intertidal areas along the mainland coast. It is based on collections at eight different stations (Fig. 1) over a two-year period (February 1975 - November 1977), as part of a detailed ecological study of the intertidal algal communities. Stations III, IV, V and VII were sampled monthly throughout this period.

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A total of 139 taxa, comprising 25 Chlorophyta, 19 Phaeophyta, 89 Rhodophyta and 6 Cyanophyta, is reported. The arrangement of orders and families in the Divisions Chlorophyta, Phaeophyta, Rhodophyta, and Cyanophyta generally follows those of Womersley and Bailey (1970), Papenfuss (1951), Kylin (1956), and Desikachary (1973) respectively. In each family, genera and species are listed in alphabetical order.

Voucher specimens of all species listed are deposited in the Herbarium of the Botany Department, James Cook University of North Queensland, Townsville, Queensland, Australia (JCT), and an incomplete set of duplicates is housed in the Herbarium of the Botany Department, University of Queensland, Brisbane, Queensland, Australia (BRIU). Voucher specimen numbers (YN...) are given in parentheses in the station listing for each taxon.

#### LOCATION AND DESCRIPTION OF THE STATIONS

The study area is located approximately midway along the eastern coast of the State of Queensland, between latitudes  $19^{\circ}10'$  and  $19^{\circ}17'$  S, and longitudes  $146^{\circ}37'$  and  $147^{\circ}04'$  E (Fig. 1). This dry tropical zone fits essentially into the Aw category in the Köppen scheme (Dick, 1975), with a prolonged and intense drought in the low-sun period of the hemisphere, followed by substantial rainfall during the warmer part of the year (December to March).

The shoreline consists generally of alternating granitic rocky headlands and sandy beaches, and includes the estuaries of rivers such as the Bohle, Ross and Haughton. Mangrove vegetation occurs at numerous places along the coast. The study area is sheltered from oceanic swell from the south-west Pacific Ocean by the Great Barrier Reef system.

The tides are semi-diurnal with significant diurnal inequality (Easton, 1970). The mean tidal range is 2.5m at spring and 0.8m at neap periods (Queensland Department of Harbours and Marine, 1977).

The south-east trade winds prevail for much of the year. The occasional passage of tropical cyclones in summer is generally accompanied by torrential rain, storm surge, and high wave energy.

Station I (Saunder's Beach): Gently sloping sandy beach with occasional patches of pebbles and shell-fragments; the latter is the only type of substratum available to larger algae in this unstable habitat. Algae were also collected in the neighbouring estuary of Saunder's Creek.

Station II (NW of Cape Pallarenda): Rocky point with frequent sand and silt covered boulders at higher intertidal levels. A very gently sloping sand flat occurs at lower intertidal levels.

Station III (Cape Pallarenda): Similar to station II, but the shore densely covered with boulders except at the lowest intertidal levels.

Station IV (Kissing Point): Rocky point consisting in the intertidal of a mass of sediment covered boulders and rocks, with a sandy floor at the lowest intertidal levels. The Point is bounded to the east by a sandy beach, and to the west by a small, shallow, muddy bay containing sparse mangrove vegetation near the shoreline and extensive lag gravels at lower levels.

Station V (Eastern Breakwater): Artificial harbour wall consisting of relatively smooth granitic rocky surfaces at higher intertidal levels, and irregular boulders at lower levels. Conditions inside the breakwater are sheltered (and heavily silted) in comparison with the exposed outer face.

Station VI (SE of Cape Cleveland): Steeply sloping rocky shore consisting of sediment free boulders above and pebbles below.

Station VII (Cape Ferguson, Turtle Bay): Steeply sloping rocky shore consisting mostly of large boulders providing numerous shaded situations, with some sandy patches at lower levels.

Stations VIII (Cape Ferguson, Ticklebelly Bay): Rocky shore varying from large boulders to a gently sloping muddy beach with occasional boulders, and adjacent to extensive mangrove vegetation.

The stations listed above may be divided into two groups. The area between Capes Cleveland and Ferguson, which includes Stations VI and VII, is characterized by steeply sloping sandy beaches and rocky outcrops, higher wave energy, and generally less turbid water. In contrast, stations to the west of Cape Cleveland (I, II, III, IV and V) and to the south of Cape Ferguson (VIII) generally slope more gently, are more sheltered, and the water is usually more turbid. These differences in environmental conditions are reflected in the composition of the intertidal algal flora of these two groups of stations, as will be discussed in detail in a subsequent publication.

## DIVISION CHLOROPHYTA

## Order ULOTRICHALES

## Family Ulvaceae

*Enteromorpha clathrata* (Roth) J. Agardh. Bliding 1963: 107, fig. 67.  
Station IV (YN 12).

*E. flexuosa* (Wulfen ex Roth) J. Agardh. Bliding 1963: 73, fig. 38.  
Station II, III, IV (YN 373), V, VI, VII (YN 93).

*E. ralfsii* Harvey. Bliding 1963: 43, fig. 18.  
Station IV (YN 390).  
Occasional lateral proliferations are present as in  
*E. chaetomorphoides* Boergesen (1913: 5, fig. 1), but the cells  
contain 2-4 pyrenoids.

*Ulva rigida* C. Agardh. Bliding 1968: 546, figs. 6-10.  
Stations III, IV (YN 112, YN 367), V, VI, VII.

## Order CLADOPHORALES

## Family Cladophoraceae

*Chaetomorpha antennina* (Bory) Kuetzing. Boergesen 1913: 16, figs.  
4-5; 1940: 37. Cribb 1954: 17, pl. 1, fig. 6. Dawson 1954: 386,  
fig. 61.  
Stations III, IV, V, VI (YN 155), VII.

*C. spiralis* Okamura 1912: 162, pl. 95. Segawa 1968: 11, fig. 49.  
Stations IV, VII (YN 389).  
Comparison with authentic Japanese material is required.

*Chaetomorpha* sp.  
Stations III, IV (YN 393).

*Cladophora fascicularis* (Mertens ex C. Agardh) Kuetzing 1853: 26,  
pl. 90, fig. 2. Boergesen 1940: 34, fig. 10. Pham-hoang 1969:  
433, fig. 4.38.  
Stations III, IV, V, VI, VII (YN 94).

*C. rugulosa* von Martens. Okamura 1910: 103, pl. 80, figs. 1-7.  
Sakai 1964: 67, figs. 31-2, pl. 15, fig. 1. Pham-hoang 1969:  
431, fig. 4.36.  
Stations III, IV, V, VI (YN 151), VII.

*Rhizoclonium capillare* Kuetzing. Cribb 1965b: 262, pl. 1, figs. 1-8.  
Stations III (YN 272), IV.  
Cribb considers that the transfer of *R. capillare* to *Chaetomorpha*  
by Boergesen (1925: 45, fig. 13) on the basis of the number of  
nuclei is not justified.

- R. implexum* (Dillwyn) Kuetzing. Cribb 1965b: 264.  
*R. kochianum* Kuetzing. Boergesen 1913: 19, fig. 7.  
 Stations III (YN 309), IV.
- R. riparium* (Roth) Harvey. Taylor 1960: 76. Dawson 1964: 11, pl. 8,  
 figs. B-E. Pham-hoang 1969: 413, fig. 4.18.  
 Stations III (YN 296), IV, VII, VIII.

## Family Anadyomenaceae

- Microdictyon okamurai* Setchell. Yamada 1934: 40, figs. 6-7.  
 Taylor 1950: 46, pl. 27, fig. 1. Dawson 1956: 32, fig. 11a.  
 Pham-hoang 1969: 439, fig. 4.43.  
 Station VII (YN 313).  
 The cell wall thickness is about 2  $\mu$ m and shows little variation.

## Order SIPHONOCCLADALES

## Family Valoniaceae

- Valonia aegagropila* C. Agardh. Egerod 1952: 348, pl. 29, fig. b.  
 Dawson 1954: 388, fig. 8j. Cribb 1960: 13.  
 Station IV (YN 320).

## Family Siphonocladaceae

- Cladophoropsis herpestica* (Montagne) Howe. Dawson 1954: 390, fig. 8h.  
 Cribb 1960: 10, pl. 4, figs. 5-6.  
 Station IV, V, VI (YN 154), VII.

## Family Boodleaceae

- Boodlea composita* (Harvey) Brand. Boergesen 1940: 21, fig. 6;  
 1946: 15, fig. 5. Dawson 1954: 390, fig. 9c-d. Cribb 1960: 14  
 Station VII (YN 392).

- Struvea anastomosans* (Harvey) Piccone & Grunow ex Piccone.  
 Boergesen 1913: 54, fig. 39. Dawson 1954: 390, fig. 8g.  
 Cribb 1960: 13.  
 Stations III, IV, V, VI (YN 153), VII.

## Order CODIALES

## Family Bryopsidaceae

- Bryopsis indica* Gepp & Gepp 1908: 169, pl. 22, figs. 10-11.  
 Boergesen 1953: 6, fig. 1. Cribb 1954: 18. Dawson 1956: 34,  
 fig. 14.  
 Stations IV (YN 27), V.

## Order CAULERPALES

## Family Caulerpaceae

- Caulerpa lentillifera* J. Agardh. Weber-van Bosse 1898: 380, pl. 34, figs. 1-2. Cribb 1958b: 213, pl. 4, figs. 1-4, pl. 5, figs. 1-17. Station VII (YN 260).
- C. racemosa* var. *laetevirens* (Montagne) Weber-van Bosse 1898: 366, pl. 33, figs. 8, 16-22. Cribb 1958b: 212, pl. 3, figs. 1-7. Stations III, IV (YN 69), V, VII.
- C. taxifolia* (Vahl) C. Agardh. Boergesen 1913: 131, figs. 104-105. Cribb 1958b: 210, pl. 1, figs. 8-11, pl. 2, figs. 1-5. Stations III, IV, V, VII (YN 95).
- C. verticillata* J. Agardh. Weber-van Bosse 1898: 267, pl. 20, figs. 7-10. Boergesen 1913: 121, figs. 95-98. Dawson 1954: 392, fig. 10b. Station V (YN 409).

## Family Udoteaceae

- Chlorodesmis hildebrandtii* Gepp & Gepp 1911: 16, 137, figs. 74-75. Ducker 1967: 164, pls. 6, 16. Station III (YN 391). Ducker (1967: 163) queried the occurrence in Queensland of this species, which occupies an intermediate position between *C. major* and *C. fastigiata* (given as *C. comosa*, but see Ducker 1969: 17).
- Udotea flabellum* (Ellis & Solander) Howe. Gepp & Gepp 1911: 131, pl. 3, figs. 26-28. Lucas 1931: 49. Durairatnam 1961: 25, pl. 20, fig. 2. Stations III (YN 399), IV.

## Order DASYCLADALES

## Family Dasycladaceae

- Acetabularia calyculus* Quoy & Gaimard. Valet 1969: 617, pl. 44, figs. 7-9. Stations III, IV (YN 72).

## DIVISION PHAEOPHYTA

## Order ECTOCARPALES

## Family Ectocarpaceae

- Bachelotia antillarum* (Grunow) Gerloff 1959: 37. Cardinal 1964: 10. *Pylaiella antillarum* (Grunow) De Toni. Blomquist 1958: 25, figs. 1-17. Station V (YN 407).



*Feldmannia irregularis* (Kuetzing) Hamel 1939: XVII, fig. 61f.  
 Cardinal 1964: 54, fig. 29.  
*Ectocarpus irregularis* Kuetzing. Boergesen 1941: 23, figs. 8-11.  
 Dawson 1954: 398, fig. 14e-f.  
 Station III (YN 297).

*Giffordia mitchellae* (Harvey) Hamel 1939: x, fig. 61c.  
*Ectocarpus mitchellae* Harvey. Boergesen 1941: 7, figs. 1-5.  
 Dawson 1954: 400, fig. 14c-d.  
 Stations III, IV (YN 117), VII.

#### Family Ralfsiaceae

*Ralfsia* sp.  
 Stations II, III, IV (YN 413), V, VI, VII.

#### Order SPHACELARIALES

#### Family Sphacelariaceae

*Sphacelaria furcigera* Kuetzing 1855: 27, pl. 90, fig. 2. Dawson  
 1954: 400, fig. 14g.  
 Stations III (YN 292), IV, VII.

*S. tribuloides* Meneghini. Boergesen 1941: 41, fig. 18. Dawson 1954:  
 400, fig. 14i-j.  
 Station VII (YN 281)

#### Order DICTYOTALES

#### Family Dictyotaceae

*Dictyopteris delicatula* Lamouroux. Boergesen 1914: 60, figs. 40-41.  
 Yamada 1950: 187, figs. 5-6. Pham-hoang 1969: 333, fig. 3.32.  
 Station VII (YN 256).

*D. woodwardii* (Brown ex Turner) Schmitz. Durairatnam 1961: 35, pl. 23.  
 Misra 1966: 151, fig. 79.  
*Haliseris woodwardii* (Brown) J. Agardh. Kuetzing 1859: 22, pl. 53,  
 fig. 2.  
 Station VII (YN 331).

*Dictyota bartayresii* Lamouroux. Cribb 1954: 20. pl. 3, fig. 6.  
 Stations III, IV (YN 397), V, VII.  
 Some specimens are similar to *D. bartayresii* Lamouroux *sensu*  
 Vickers (see Jaasund 1970: 72, figs. 1D, 2C).

*D. ciliolata* Kuetzing. Womersley 1958: 148, pl. 1. Taylor 1960: 223,  
 pl. 32, fig. 3, pl. 59, fig. 1. Jaasund 1970: 76, fig. 2A.  
 Stations III, IV, V (YN 249), VII.

*D. dichotoma* var. *intricata* (C. Agardh) Greville. Cribb 1954: 20,  
 pl. 3, fig. 4.  
 Stations III (YN 395), IV.

- Lobophora variegata* (Lamouroux) Womersley 1967: 221. Womersley & Bailey 1970: 292.  
*Pocockiella variegata* (Lamouroux) Papenfuss 1943: 467, figs. 1-14.  
 Dawson 1954: 400, fig. 14k.  
 Stations IV, VII (YN 97).
- Padina tetrastrumatica* Hauck. Boergesen 1930a: 172, fig. 10, pl. 2;  
 1935: 35. Gaillard 1967: 447, figs. 1-6.  
 Stations III, IV (YN 113), V, VII.
- Spatoglossum asperum* J. Agardh. Boergesen 1935: 35, pl. 5; 1937b: 313;  
 1941: 48. Durairatnam 1961:34. Misra 1966: 160, fig. 85.  
 Station VII (YN 335).

## Order DICTYOSIPHONALES

## Family Punctariaceae

- Colpomenia sinuosa* (Roth) Derbès & Solier. Okamura 1907b: 86, pl. 19,  
 figs. 11-12, pl. 20, figs. 10-12. Boergesen 1914: 20, fig. 12.  
 Clayton 1975: 187, figs. 5-7, 12-13.  
 Stations III, IV (YN 414), V, VII.
- Rosewingea orientalis* (J. Agardh) Boergesen 1914: 26; 1930a: 168;  
 1937a: 25. Cribb 1954: 24, pl. 2, fig. 3. Misra 1966: 126.  
 Station IV (YN 396).

## Order FUCALES

## Family Cystoseiraceae

- Cystoseira trinodis* (Forsskål) C. Agardh. Papenfuss & Jensen 1967: 21,  
 figs. 1-2. Jaasund 1976: 53, fig. 108.  
 Stations IV (YN 400), V, VII.

## Family Sargassaceae

- Sargassum oligocystum* Montagne. Womersley & Bailey 1970: 299, fig. 8,  
 pl. 25, fig. 16.  
*S. binderi* Sonder ex J. Agardh. Sonder 1871: 11, J. Agardh 1889:  
 87, pl. 26, fig. 2. Jaasund 1976: 57, fig. 112, pl. 4.  
 Stations IV, V, VII (YN 372).  
 The specimens show many of the characters described for  
*S. oligocystum* by other authors, although the branches are only  
 slightly compressed. Spines occur on the very short leaf petiole.

*Sargassum* sp.

- Station VII (YN 401).  
 The material shows a number of the features of *S. polycystum*  
 C. Agardh as described by Durairatnam (1961: 46, pl. 10, figs.  
 14-18) and Jaasund (1976: 57, fig. 115), for example muricate  
 branches, but fertile specimens have not been found.

## DIVISION RHODOPHYTA

## Order NEMALIALES

## Family Helminthocladiaceae

*Liagora* sp.

Station VII (YN 354).

## Family Chaetangiaceae

*Galaxaura oblongata* (Ellis & Solander) Lamouroux. Boergesen 1927: 71, figs. 39-41. Chou 1947: 7, pls. 2-3, 9. Papenfuss & Chiang 1969: 310, fig. 5. Stations IV (YN 394), VII.

*Scinaia moretonensis* Levring 1953: 509, figs. 39-40. Womersley 1958: 153. Stations IV, VII (YN 356).

## Family Bonnemaisioniaceae

*Asparagopsis taxiformis* (Delile) Trevisan.

Boergesen 1919: 352, fig. 347-351. Dawson 1953: 57. Station IV, V (YN 415).

*Falkenbergia hillebrandii* (Bornet) Falkenberg. Boergesen 1919: 331, figs. 332-333. Dawson 1954: 414, fig. 257. Stations IV, V (YN 46).

## Order GELIDIALES

## Family Gelidiaceae

*Gelidium corneum* (Hudson) Lamouroux. Boergesen 1920: 114, fig. 124. Sreenivasa Rao 1970: 71, fig. 5A-E, pl. 2, fig. h. Taylor 1928: 142, pl. 28, fig. 2. Stations IV, V (YN 342), VII. Further comparative studies are required to confirm this identification.

*G. crinale* (Turner) Lamouroux. Feldmann & Hamel 1936: 240, fig. 22. Station III (YN 277; YN 370). The vegetative and reproductive (cystocarpic and tetrasporic) structure fits that described by Feldmann and Hamel.

*G. crinale* var. *perpusillum* Piccone & Grunow. Weber-van Bosse 1921: 225. Dawson 1954: 421, fig. 3le-f. Stations II, III (YN 337), IV.

*G. heteroplatos* Boergesen 1934: 3, fig. 3. Jaasund 1976: 73, fig. 145. Stations III, IV (YN 202), V, VII (YN 279).

Certain specimens referred to this species show some features of *G. spathulatum* (Kuetzing) Bornet (see Pham-hoang 1969: 123, fig. 2.53).

*G. pusillum* (Stackhouse) Le Jolis. Boergesen 1924: 279, fig. 26,  
Dawson 1954: 420, fig. 31a-c. Taylor 1960: 354, pl. 45, fig. 4.  
Stations III, IV (YN 119), V, VII (YN 161).

*Gelidium* sp. 1

Station V (YN 411).

The shape and arrangement of the cystocarps, and the anatomy of the thallus are similar to those described for *G. heteroplatus*. However the rather short and somewhat terete thalli and the form of the tetrasporangial stichidia seem distinct.

*Gelidium* sp. 2.

Station IV (YN 198, YN 326).

The specimens superficially resemble those referred to *Gelidium corneum*, but they are more slender and less cartilaginous.

Rhizines are confined to the inner cortex, but as female material has not been collected the generic relationships remain uncertain.

#### Order CRYPTONEMIALES

##### Family Rhizophyllidaceae

*Chondrococcus hornemanni* (Lyngbye) Schmitz. Weber-van Bosse 1921: 255.  
Womersley & Bailey 1970: 305.  
*Desmia hornemanni* Lyngbye. Kylin 1956: 166, fig. 113.  
Station VII (YN 374).

##### Family Hildenbrandtiaceae

*Hildenbrandtia prototypus* Nardo. Dawson 1953: 95, pl. 7, fig. 4;  
1954: 424, fig. 36a-b.  
Stations II, III, IV, V, VI (YN 152), VII, VIII.

##### Family Corallinaceae

*Amphiroa fragilissima* (Linnaeus) Lamouroux. Weber-van Bosse 1904:  
89, pl. 16, figs. 1-2, 5. Dawson 1954: 430, fig. 40g-h. Taylor  
1960: 403, pl. 47, figs. 1-2.  
Stations III, IV (YN 118), V, VII.

*Cheilosporum spectabile* Harvey ex Grunow. Weber-van Bosse 1904: 106.  
Boergesen 1935: 51, fig. 23. Pham-hoang 1969: 146, fig. 2.75.  
Womersley & Bailey 1970: 314, fig. 22, pl. 26.  
Station VII (YN 378).

*Jania adhaerens* Lamouroux. Boergesen 1917: 195, figs. 184-7.  
Pham-hoang 1969: 142, fig. 2.71. Jaasund 1976: 77, fig. 154.  
Stations IV, V, VII (YN 416).

*Jania* sp.

Station VII (YN 255).

The conceptacle morphology is identical to that described for *J. rubens* (Linnaeus) Lamouroux by Kuetzing (1857: 40, pl. 84, figs. 2-3) and Pham-hoang (1969: 140, fig. 2.68). The branching pattern is very variable in our material and further confirmation is required.

Family Grateloupiaceae

*Grateloupia divaricata* Okamura 1915: 55, pls. 116, 117, figs. 12-18; 1942: 99.

Stations III (YN 307), IV (YN 196), V, VII (YN 162).

The morphology of this species is highly variable. Comparison with authentic Japanese material is required.

Order GIGARTINALES

Family Gracilariaceae

*Ceratodictyon spongiosum* Zanardini. Okamura 1909: 1, pls. 51-52.

Dawson 1954: 438, fig. 48c.

Stations III, IV (YN 408).

*Gelidiopsis scoparia* (Montagne & Millardet) Schmitz. Boergesen 1952:

26, figs. 13-14; 1954: 22, fig. 7. Pham-hoang 1969: 178, fig. 2.108.

Station VII (YN 376).

*G. variabilis* (Greville ex J. Agardh) Schmitz. Weber-van Bosse 1928:

426. Pham-hoang 1969: 177, fig. 2.107. Jaasund 1976: 87, fig. 176.

Station IV (YN 357), VII.

*Gracilaria crassa* Harvey ex J. Agardh. Boergesen 1936: 86, fig. 8.

Dawson 1954: 438, fig. 48b. Ohmi 1958: 25, fig. 11, pl. 5,

figs. D-E. Jaasund 1976: 85, fig. 170.

Stations III, IV (YN 115), V, VII.

*G. edulis* (Gmelin) Silva. Ohmi 1958: 16, fig. 6, pl. 3, fig. B.

Durairatnam 1961: 62, pl. 14, figs. 4-5. Jaasund 1976: 85,

fig. 172.

Stations IV (YN 199), V, VII (YN 310).

*G. purpurascens* (Harvey) J. Agardh. Weber-van Bosse 1928: 437.

Ohmi 1958: 30, fig. 14, pl. 6, figs. C-D.

Stations IV (YN 365), VII (YN 375).

*G. rhodotricha* (Dawson) Papenfuss 1966: 100.

*Gracilariopsis rhodotricha* Dawson 1949: 47, pl. 19, figs. 3-7.

Ohmi 1958: 47, fig. 23, pl. 10, figs. A-B.

Stations III (YN 193, YN 371), IV.

Papenfuss includes *Gracilariopsis rhodotricha* in the genus *Gracilaria*. The similarity of our material to the descriptions given by Dawson and Ohmi is striking. However, the plants from this area are smaller and more slender, and male reproductive organs have not been found.

- G. textorii* (Suringar) De Toni. Weber-van Bosse 1928: 438. May 1948: 41. Ohmi 1958: 40, figs. 20-21.  
Stations III, IV (YN 350), VII (YN 96).
- G. verrucosa* (Hudson) Papenfuss. Dawson 1954: 438, fig. 49. Ohmi 1958: 6, figs. 1-2, pl. 1, figs. A-D.  
Stations III (YN 192), IV.  
This species is often difficult to distinguish from *G. rhodotricha* in the field, but can be recognized by the three-layered cortex, the hemispherical cystocarps with numerous nutritive filaments, and the many-layered pericarp.

## Family Sphaerococcaceae

- Caulacanthus ustulatus* (Mertens) Kuetzing 1868: 3, pl. 8. Boergesen 1933b: 115; 1950: 19, figs. 5-6. Feldman & Hamel 1936: 256, figs. 31-33.  
Stations III (YN 274), IV (YN 203), V (YN 351), VII.  
A very variable species in this area, and may include *C. indicus* Weber-van Bosse (1921: 222, fig. 67).

## Family Solieriaceae

- Sarconema filiiforme* (Sonder) Kylin 1932: 22. Papenfuss & Edelstein 1974: 31, figs. 1-3, 13, 20-25.  
Station IV (YN 321, YN 369).
- Solieria mollis* (Harvey) Kylin 1932: 20, pl. 6, fig. 12. Segawa 1968: 84, fig. 397. Pham-hoang 1969: 189, fig. 2.121.  
*Rhabdonia mollis* Harvey 1863, synop.: 41.  
Stations III (YN 269; YN 301), IV.  
The specimens agree well with the original description given by Harvey and appear to be distinct from *S. robusta*.
- S. robusta* (Greville) Kylin 1932: 18. Boergesen 1950: 13.  
Jaasund 1976: 93, fig. 188.  
Stations III (YN 270), IV.

## Family Rhabdoniaceae

- Catenella nipae* Zanardini. Tseng 1942: 143, fig. 2. Dawson 1954: 443, fig. 52f.  
Stations II, III (YN 276), IV (YN 157), VII, VIII.

## Family Hypneaceae

- Hypnea boergesenii* Tanaka 1941: 233, figs. 6-8, pl. 53, fig. 1.  
Dawson 1954: 436, fig. 46K.  
Stations III, IV (YN 346), VII.
- H. cenomyce* J. Agardh. Tanaka 1941: 250, fig. 21. Pham-hoang 1969: 197, fig. 2.129  
Stations V, VI (YN 165).

- H. cervicornis* J. Agardh. Tanaka 1941: 240, fig. 13. Pham-hoang 1969: 192, fig. 2.123.  
Stations III (YN 340), IV (YN 347), VII.
- H. cornuta* (Kuetzing) J. Agardh. Tanaka 1941: 242, fig. 14.  
Dawson 1954: 436, fig. 46c. Jaasund 1976: 99, fig. 200.  
Station IV (YN 360).
- H. esperi* Bory. Kuetzing 1868: 9, pl. 26, figs. A-C. Tanaka 1941: 243, fig. 15. Dawson 1954: 436, fig. 46h-j.  
Stations III, IV (YN 345), VII.
- H. pannosa* J. Agardh. Kuetzing 1868: 9, pl. 27, figs. i-k.  
Weber-van Bosse 1928: 445, fig. 193. Tanaka 1941: 247, fig. 20.  
Jaasund 1976: 97, fig. 196.  
Stations V, VII (YN 384).
- H. valentiae* (Turner) Montagne. Dawson 1954: 436, figs. 46l, 47.  
*H. charoides* Lamouroux. Kuetzing 1868: 8, pl. 22, figs. a-b.  
Stations IV (YN 344), VII.

## Family Dicranemaceae

- Dicranema rosaliae* Setchell & Gardner 1924: 745, pl. 22, fig. 6.  
Dawson 1957: 115, figs. 22a, 23a.  
Station VII (YN 304).  
Our specimens, like those of Setchell and Gardner and of Dawson,  
are sterile.

## Family Phylloporaceae

- Gymnogongrus griffithsiae* (Turner) Martens. Kuetzing 1869: 24,  
pl. 65, figs. e-g. Gayral 1958: 398, pl. 107. Pham-hoang 1969:  
206, fig. 2.138.  
Stations IV (YN 13), V, VII.
- G. pygmaeus* J. Agardh. Kuetzing 1869: 24, pl. 64, figs. c-d. Dawson  
1954: 440, fig. 51c.  
Stations III, IV (YN 349), V (YN 250), VII.

## Family Gigartinaceae

- Gigartina* sp.  
Stations IV, V (YN 383), VII.

## Order RHODYMENTALES

## Family Rhodymeniaceae

- Coelothrix indica* Boergesen 1944: 14, figs. 9-11; 1950: 40, figs.  
20-21.

Stations IV (YN 377), VII.

Dawson (1957: 115) suggests that *C. indica* is conspecific with *C. irregularis* Boergesen (1920: 389, figs. 373-4), but our specimens agree better with Boergesen's description of the Mauritius species.

*Rhodymenia leptophylla* J. Agardh. Weber-van Bosse 1928: 461.

Kylin 1931: 20, pl. 6, fig. 16. Chapman & Dromgoole 1970: 134, pl. 44.

Station VII (YN 282).

This species has been considered endemic to New Zealand (Chapman & Dromgoole, 1970). However, Dawson (1941: 144, pl. 20, fig. 18; pl. 27, fig. 39) described *C. leptophylloides* as a very closely related and possibly identical species from Hawaii.

#### Family Lomentariaceae

*Champia parvula* (C. Agardh) Harvey. Boergesen 1920: 407, figs. 392-393.

Dawson 1954: 443, fig. 52C. Womersley & Bailey 1970: 321.

Stations III, IV, VII (YN 353).

#### Order CERAMIALES

#### Family Ceramiaceae

*Centroceras clavulatum* (C. Agardh) Montagne. Dawson 1954: 466, fig. 54h. Womersley & Bailey 1970: 323.

Stations III, IV, V, VI (YN 147), VII.

*Ceramium fastigiatum* (Roth) Harvey. Boergesen 1918: 241, fig. 231.

Taylor 1928: 191, pl. 27. Nakamura 1965: 129, fig. 4. Pham-hoang 1969: 237, fig. 2.169.

Station III (YN 363).

*C. gracillimum* var. *byssoideum* (Harvey) Mazoyer. Dawson 1954: 448, fig. 55e-f. Nakamura 1965: 136, fig. 6. Itono 1972: 76, figs. 2-3.

Stations III, IV (YN 380), V, VII.

*C. maryae* Weber-van Bosse 1923: 324, figs. 117-118. Dawson 1954: 448, fig. 56g-i.

Station IV (YN 364).

*C. mazatlanense* Dawson 1950: 130, pl. 2, figs. 14-15; 1954: 448, fig. 55g-j. Itono 1972: 82, fig. 11 B-C.

Station VII (YN 379).

*Ceramium* sp.

Station VII (YN 352).

The specimens have forcipate tips, cortical bands with a central whorl of larger periaxial cells, and whorled tetrasporangia. They approach *C. marshallense* Dawson (1957: 20, fig. 27a-b), but differ in their broader branches (200  $\mu$ m), unequal dichotomies, and wider cortical bands (130  $\mu$ m).



*Griffithsia* sp.

Station VII (YN 382).

*Pleonosporium* sp.

Station IV (YN 319), V (YN 412).

Rhizoids occur on the lower parts of the main axes, and polysporangia are present.

*Spyridia filamentosa* (Wulfen) Harvey. Boergesen 1917: 233, figs.

222-6. Dawson 1954: 444, fig. 54i. Jaasund 1976: 111, fig. 224.

Station IV (YN 381).

## Family Delesseriaceae

*Caloglossa bombayensis* Boergesen 1933b: 127, figs. 10-12.

Stations II, III, IV (YN 280).

The status of this species in relation to *C. ogasawaraensis* Okamura has been discussed by Tseng (1945: 163) and Post (1943: 139; 1955: 371).

*C. leprieurii* var. *hookeri* (Harvey) Post 1943: 127, figs. 3-5, 24.

Taylor 1960: 544.

Stations I, II, III, IV (YN 158), V, VI, VIII.

## Family Dasyaceae

*Heterosiphonia multiceps* (Harvey) Falkenberg 1901: 654.

*Dasya multiceps* Harvey. Kuetzing 1863: 27, pl. 77.

Station IV (YN 368).

*H. wurdemanni* var. *laxa* Boergesen 1919: 324, figs. 327-8.

Dawson 1956: 57, fig. 60; 1963: 404, pl. 129, fig. 1.

Station IV (YN 325).

## Family Rhodomelaceae

*Acanthophora muscoides* (Linnaeus) Bory. Okamura 1907a: 38, pl. 8,

fig. 8-10. Taylor 1960: 619, pl. 72, fig. 3. Jaasund 1976: 137, fig. 278.

Stations III (YN 191), IV, VII.

*A. spicifera* (Vahl) Boergesen 1918: 259, figs. 235-8. Weber-van Bosse

1923: 347, figs. 131-2. Dawson 1954: 456, fig. 61a-b.

Stations III (YN 190), IV (YN 110), V, VII.

*Acrocystis nana* Zanardini. Okamura 1907a: 23, pls. 6-7. Dawson 1954:

461, fig. 63b-c. Jaasund 1976: 143, fig. 291.

Station VII (YN 334).

*Bostrychia binderi* Harvey 1847: 68, pl. 28. Tseng 1943a: 177, pl. 1,

figs. 7-8.

Stations III (YN 317), IV (YN 159), VII, VIII.

- B. kelanensis* Grunow ex Post 1936: 20; 1955: 356; 1957: 90.  
Tseng 1943a: 169, pl. 2, figs. 1-5.  
Station IV (YN 402).
- B. radicans* (Montagne) Montagne. Post 1936: 13. Tseng 1943a: 168,  
pl. 1, figs. 1-3. Dawson 1954: 452, fig. 59d-e. Jaasund 1976:  
127, fig. 257.  
Stations I, II, III, IV (YN 156, YN 252), V, VII, VIII.
- B. tenella* (Vahl) J. Agardh. Boergesen 1918: 300, figs. 299-303.  
Tseng 1943a: 176, pl. 1, fig. 6. Jaasund 1976: 127, fig. 258.  
Stations III (YN 275), IV.
- Chondria dasyphylla* (Woodward) C. Agardh. Taylor 1928: 170, pl. 34,  
fig. 1. Jaasund 1976: 135, fig. 274, pl. 9.  
Stations III (YN 303), IV.
- C. rainfordii* Lucas 1927, 560, pls. 45, 47, fig. 2.  
Stations III (YN 189), IV.
- Chondria* sp. 1.  
Station VII (YN 386).  
The specimens superficially resemble *C. dasyphylla*, although  
cystocarpic and tetrasporic plants are only 1-2 cm tall.  
Branch tips are truncate, but with a projecting apical region.  
The walls of internal cells are markedly thickened over their  
whole surface.
- Chondria* sp. 2.  
Station VII (YN 385).  
The specimens show good agreement with the descriptions of  
*C. collinsiana* Howe given by Taylor (1960: 617) and Jaasund  
(1976: 135, fig. 275), except that the pericentral cell walls  
are strongly thickened over their whole surface.
- Herposiphonia insidiosa* (Greville ex J. Agardh) Falkenberg.  
Okamura 1930: 25, pl. 264, figs. 10-16. Dawson 1954: 452,  
figs. 58h-i.  
Station VII (YN 362).
- H. tenella* forma *secunda* (C. Agardh) Hollenberg 1968: 556.  
*H. secunda* (C. Agardh) Falkenberg. Boergesen 1918: 469,  
fig. 428.  
Stations III, IV (YN 404), V, VII.
- Laurencia dotyi* Saito 1969: 154, figs. 9 A-C, 10 A-B.  
Station VII (YN 257).
- L. gracilis* Hooker & Harvey. Yamada 1931: 212, fig. M, pl. 12,  
fig. b.  
Stations IV (YN 358), VII.

- L. majuscula* (Harvey) Lucas 1935: 223. Saito & Womersley 1974: 819, figs. 1A, 6.  
Station VII (YN 92, YN 283, YN 329).
- L. nidifica* J. Agardh. Yamada 1931: 202. Boergesen 1945: 47, figs. 21-24. Cribb 1958a: 168, pl. 5, fig. 12, pl. 6, figs. 1-3.  
Saito 1969: 152, fig. 5.  
Stations III, IV (YN 253), VII.
- L. papillosa* (C. Agardh) Greville. Yamada 1931: 190, pl. 1, figs. a-b.  
Dawson 1954: 458, fig. 61i. Cribb 1958a: 169, pl. 7, figs. 6-8.  
Saito 1969: 158.  
Stations III (YN 146), IV, VII.
- L. perforata* (Bory) Montagne. Kuetzing 1865: 18, pl. 49, figs. e-g.  
Boergesen 1930b: 69, fig. 26. Yamada 1931: 193, figs. A-B, pl. 3, fig. b. Cribb 1958a: 164, pl. 3, figs. 1-2.  
Stations IV (YN 201), VII (YN 287).
- L. pygmaea* Weber-van Bosse 1913: 122, pl. 12, fig. 6. Dawson 1954: 458, fig. 62k. Cribb 1958a: 166, pl. 4, figs. 1-6.  
Stations IV (YN 70), V, VII.
- L. succisa* Cribb 1958a: 163, pl. 1, figs. 1-3. Saito 1969: 157.  
Stations VII (YN 288, YN 327, YN 359).
- L. tenera* Tseng 1943b: 200, pl. 1, fig. 6, pl. 2, figs. 5-6.  
Dawson 1954: 458, fig. 62b-c. Cribb 1958a: 167, pl. 5, figs. 1-10. Saenger 1973: 25, figs. 12-13.  
Station VII (YN 289, YN 333).  
The specimens agree very well with the detailed descriptions of the sterile and tetrasporic materials given by Tseng. However, no peripheral haptera are present in our specimens.
- Laurencia* sp.  
Station VII (YN 388).  
This species belongs to the subgenus *Chondrophycus* (see Saito 1969: 148), and approaches *L. cartilaginea* Yamada (1931: 230, fig. 0, pl. 19a) in anatomy (see Saito 1967: 53, fig. 43).  
However, our material appears to be more slender (to 1 mm broad at the base), more or less cylindrical throughout, and the ultimate branchlets are not densely arranged on the upper branches.
- Leveillea jungermannioides* (Martens & Hering) Harvey. Falkenberg 1901: 392, pl. 6, figs. 1-13, pl. 14, figs. 18-27. Dawson 1954: 461, fig. 63a.  
Station VII (YN 355).
- Polysiphonia coacta* Tseng 1944: 71, pl. 2. Pham-hoang 1969: 258, fig. 2.189.  
Station IV (YN 361), VII (YN 343).

- P. fragilis* Suringar. Okamura 1929: 7, pl. 255. Dawson 1954: 452, fig. 60a-b.  
Station III (YN 338).
- P. subtilissima* Montagne. Kuetzing 1863: 10, pl. 28, fig. 1a-e.  
Tseng 1944: 70, pl. 1. Pham-hoang 1969: 255, fig. 2.185.  
Stations III (YN 300), IV, V, VII.
- Tolypiocladia glomerulata* (C. Agardh) Schmitz. Falkenberg 1901: 177, pl. 21, figs. 27-29. Dawson 1954: 452, fig. 59b-c.  
*Roschera glomerulata* (C. Agardh) Schmitz. Weber-van Bosse 1923: 359.  
Stations III, IV (YN 403), VII.
- Vidalia fimbriata* (R. Brown) J. Agardh. Falkenberg 1901: 430, pl. 7, fig. 19. Boergesen 1945: 44, fig. 20. Jaasund 1976: 133, fig. 269.  
Station VII (YN 330).

## DIVISION CYANOPHYTA

## Order NOSTOCALES

## Family Oscillatoriaceae

- Lyngbya majuscula* (Dillwyn) Harvey ex Gomont. Dawson 1954: 380, fig. 3d. Umezaki 1961: 54, pl. 8, fig. 3.  
Stations II, III, IV (YN 299), V, VII (YN 295), VIII.  
Drouet (1968: 263) refers this taxon to *Microcoleus lyngbyaceus* (Kuetzing) Crouan.
- Microcoleus chthonoplastes* Thuret ex Gomont. Desikachary 1959: 343, pl. 60, figs. 7-9. Umezaki 1961: 37, pl. 5, fig. 2. Pham-hoang 1969: 22, figs. 1-16.  
Stations III, IV (YN 291), V.  
Drouet (1968: 109) refers this taxon to *Schizothrix arenaria* (Berkeley) Gomont.

## Family Rivulariaceae

- Calothrix crustacea* Thuret ex Bornet & Thuret. Dawson 1957: 127, fig. 31e. Umezaki 1961: 95, pl. 17, fig. 2, pl. 18, fig. 1.  
Stations II, III (YN 286), IV, V, VI, VII, VIII.
- C. pilosa* Harvey. Dawson 1954: 379, fig. 3e. Umezaki 1961: 97, pl. 18, fig. 2.  
Stations III, IV, V, VIII (YN 398).
- Kyrtuthrix maculans* (Gomont) Umezaki 1961: 85, pl. 14, fig. 1.  
Stations II, III, IV (YN 406), V, VI, VII, VIII.

## Order STIGONEMATALES

## Family Mastigocladaceae

*Brachytrichia quoyi* (C. Agardh) Bornet & Flahault. Dawson 1954: 380,  
fig. 3k-1. Umezaki 1961: 82, pl. 13.  
Stations III, IV (YN 298), V, VII.

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