

Marine Algal Flora of French Polynesia I. Phaeophyceae (Ochrophyta, brown algae)

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Abstract – This first paper in a monographic series on the marine algae of French Polynesia attempts to give a detailed coverage of the species of Phaeophyceae occurring in these islands. A total of 31 taxa are presented. Among these, seven represent new records for French Polynesia. The flora has affinities with neighbouring localities such as the Cook Islands, Hawai'i, Fiji, and Lord Howe Island, and there are taxa represented from both tropical and sub-tropical to temperate regions owing to the wide latitudinal distribution of the islands in French Polynesia, ranging from below the equator to well below the Tropic of Capricorn. New published records for French Polynesia include *Cladosiphon novae-caledoniae*, *Cutleria irregularis*, *C. mollis*, *Hydroclathrus tumulis*, *Padina melemele*, *Sargassum* cf. *S. echinocarpum* and *Styopodium australasicum*, all of which (excepted for *Sargassum* cf. *S. echinocarpum*) are restricted to the cooler waters of the southern Austral Islands (Rapa, Marotiri).

algae / biogeography / distribution / flora / French Polynesia / Phaeophyceae / new records / taxonomy

Résumé – Flore des algues marines de Polynésie française. I. Phaeophyceae (Ochrophyta, algues brunes). Cette première publication dans une série monographique sur la flore marine de la Polynésie française tente de donner une distribution détaillée des espèces de Phéophycées qui sont présentes dans ces îles. Un total de 31 taxons sont présentés, dont sept sont nouveaux pour la Polynésie française. La flore a des affinités avec celles des îles Cook, Hawai'i, Fidji, et Lord Howe, avec une représentation de taxons aussi bien tropicaux que sub-tropicaux à tempérés, du à la large répartition latitudinale des îles de la Polynésie française, couvrant la zone juste en dessous de l'équateur jusqu'à bien en dessous du tropique du Capricorne. Des algues nouvelles pour la Polynésie françaises comprennent *Cladosiphon novae-caledoniae*, *Cutleria irregularis*, *C. mollis*, *Hydroclathrus tumulis*, *Padina melemele*, *Sargassum* cf. *S. echinocarpum* et *Styopodium australasicum*, toutes (sauf *Sargassum* cf. *S. echinocarpum*) étant restreintes aux eaux plus froides du sud de l'archipel des Australes (Rapa, Marotiri).

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INTRODUCTION

French Polynesia (Fig. 1) occupies nearly 5.5 million km² in the southern Pacific Ocean between 7 and 28° S and 134 and 155° W. It is composed of 118 islands, of which 34 are volcanic high islands and 84 are atolls, grouped in 5 archipelagos: Society, Tuamotu, Gambier, Austral and Marquesas. The islands of French Polynesia are oceanic islands which originated from emerged peaks of now extinct volcanoes, which were built up from the ocean floor. Climatic contrast between the Marquesas close to the equator and the subtropical Austral islands, combined with diversity in habitats between high islands and atolls, offers a range of possibilities for the marine flora. Main historical collectors of French Polynesian algae have been Captain H. Moseley (March 1875), Mrs. Josephine

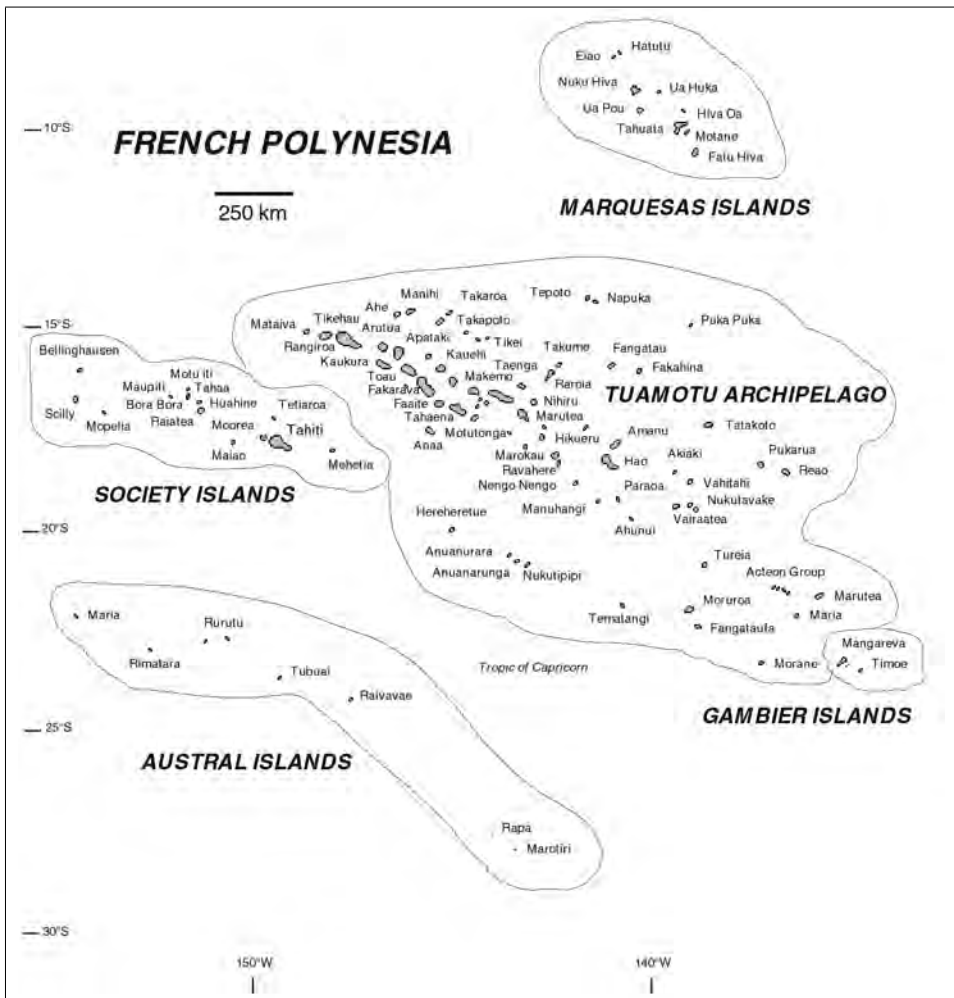


Fig. 1. Map of French Polynesia, showing the five main archipelagos.

Tilden (October 1909), Dr. W. A. Setchell and Mr. H. E. Parks (May-July 1922, published in Setchell, 1926) and Dr. Cyril Crossland (September 1928, February 1931), all from the main island of Tahiti. The recent history of French Polynesian phycological studies was highlighted in Payri & N'Yeurt (1997). The latter publication listed 425 taxa of marine algae, of which 117 were Cyanophyta, 42 Phaeophyceae, 96 Chlorophyta and 170 Rhodophyta; however they were for the most part unverified records based on previously published findings. A few years later, an illustrated guide was published on French Polynesian marine algae and seagrasses (Payri *et al.*, 2000), which contained some new records not published in the 1997 checklist. In the context of ethnobotanical studies, Conte & Payri (2002, 2006) recorded six edible marine green and brown algae from Ua Huka, Marquesas, and also the Austral islands, which are still to date undercollected. More unpublished records are represented by vouchers at the University of French Polynesia herbarium (UPF), and these are included in this study, along with new collections and revision of older records.

MATERIALS AND METHODS

All material was collected using SCUBA, snorkelling or reef-walking. Herbarium specimens were pressed using standard techniques and representative parts of thalli and turf algae stored in buffered 4% formalin in sealed plastic bags packed in a light-proof container, for shipment and later anatomical examination in the laboratory. Herbarium specimens were photographed using a bench-mounted digital camera (NIKON Coolpix 995).

Photomicrographs were obtained using an OLYMPUS C-4040 digital camera fitted atop an OLYMPUS BH2 microscope. Voucher specimens are housed at the Phycological Herbarium of the Université de la Polynésie française in Tahiti (UPF), with “*S” referring to slide collections. “IFR” refers to holdings in the herbarium of the French Institute of Research on Coral Reef Environment (IFRECOR) in Bora Bora, French Polynesia (curated by Mr. Denis Schneider). Where necessary, available French Polynesian herbarium records in BM, UC and UPF have been re-verified in the light of new taxonomic information, either in person or through loan. Unfortunately, herbarium vouchers of algae from Moorea listed in Payri (1987), which contain some taxa not held at UPF, could not be located and are presumed for the majority lost, although some liquid-preserved and pressed duplicates of common species are housed at the Antenne EPHE at Opunohu, Moorea. Consequently, only those records which could be confirmed on the basis of existing collections have been included in this study.

The taxonomy adopted is that of Silva *et al.* (1987, 1996), Reviere (2003), or updated with other sources as cited in the text. Bibliographic distributional records following species binomials are limited to previous French Polynesian, followed by regional, records with illustrations, in order of date of publication. Basionyms are listed for each species where needed, and synonyms are restricted to those having been reported from French Polynesia or nearby localities in the literature used. Asterisks (*) indicate new published records for French Polynesia. A total of 31 taxa are presented.

RESULTS AND OBSERVATIONS

Key to genera of French Polynesian Ochrophyta (Phaeophyceae)

1. Thallus crustose 18
1. Thallus not crustose 2
 2. Thallus filamentous 3
 2. Thallus not filamentous 5
3. Filaments apically tapered; propagules absent; plurilocular sporangia elongate or spherical 4
3. Filaments not apically tapered; triangular propagules sometimes present.
 4. Plurilocular sporangia elongate, filaments straight or curved, but not hooked *Hincksia*
 4. Plurilocular sporangia spherical, filaments generally terminally hooked *Asteronema*
5. Thallus branched in one plane only 6
5. Thallus branched in more than one plane 7
 6. Thallus fan-shaped; uncalcified or calcified on inferior surface; margin inrolled or straight; branching not dichotomous, stipe absent to conspicuous 15
 6. Thallus not fan-shaped or calcified; margin not inrolled; branching dichotomous 8
7. Thallus dichotomously branched 9
7. Thallus irregularly or alternately branched, or unbranched 10
 8. Branches without midrib *Dictyota*
 8. Branches with midrib *Dictyopteris*
 9. Branches soft and hollow *Rosenvingea*
 9. Branches tough and solid *Chnoospora*
 10. Thallus an unbranched hollow or reticulate mass 11
 10. Thallus branched; branches cylindrical, strap-like, leaf-like or obconical 12
11. Thallus membranous, sometimes perforate, but never clathrate; sori with paraphyses *Colpomenia*
11. Thallus clathrate, with perforations, sori lacking paraphyses *Hydroclathrus*
12. Thallus with flattened, strap-like branches *Spatoglossum*
12. Thallus not flattened or strap-like 13
13. Branches lubricous, cylindrical, alternately branched *Cladosiphon*
13. Branches not lubricous, cylindrical or alternately branched 14
 14. Ultimate branchlets leaf-like, not obconical *Sargassum*
 14. Ultimate branchlets obconical *Turbinaria*
15. Thallus lightly to heavily calcified on inferior surface *Padina*
15. Thallus never calcified 17
 16. Thallus soft and thin, never more than 5 cells thick in mature portions, gametangia pedicellate, adheres well to paper on drying, stipe absent *Cutleria* (gametophyte)
 16. Thallus coarse and more than 5 cells thick in mature portions, sporangia in sori, never pedicellate, does not adhere so well to paper on drying, stipe sometimes present 18

17. Blades with concentric zonations, sporangia non-indusiate, central medullary cells irregularly arranged, same size as outer cells, stipe stipose, inconspicuous *Stypodium*
17. Blades without concentric zonations, sporangia indusiate, medullary cells elongate and regularly arranged, much larger than outer cells, stipe if present conspicuous and stipose *Lobophora* (stiped form)
18. Thallus forming overlapping crusts; in cross section cells bilaterally arranged, without a clear central medullary layer of elongate cells *Ralfsia*
18. Thallus not usually overlapping; in cross section medullary cells elongate and in a clear central layer surrounded by smaller cells *Lobophora* (decumbent form)

Division **Ochrophyta**
 Class **Phaeophyceae**
 Order **Cutleriales**
 Family **Cutleriaceae**
 Genus ***Cutleria*** Greville

Key to the French Polynesian species of *Cutleria*

1. Thallus 3 cells thick, margins smooth, not trichothallic *C. irregularis*
 1. Thallus 4-5 cells thick, margins trichothallic, never smooth. *C. mollis*

Cutleria irregularis* Abbott *et* Huisman, 2003: 175, figs 7-15 (type locality: Mauna Lua Bay, O'ahu, Hawaii). Hawaii: Abbott & Huisman, 2004: 226, fig. 87A-D. **(Figs 2-4)

Material examined: MacDonald undersea mount, 09 Nov. 2002, *leg.* IRD, BENTHAUS DW 1891, UPF 2144.

Thallus to 30 mm high and 40 mm wide, composed of thin tristromatic cuneate blades (Fig. 2) 43-57 mm in diameter. In cross section, composed of a single medullary layer of large vertically-oriented rectangular cells 27-34 μm high and 16-29 μm wide flanked on either side by a single layer of smaller subrectangular to cuboid cortical cells 8-12 μm high and 10-26 μm wide (Fig. 3). Margins slightly undulate, not trichothallic, composed of uninterrupted row of apical cells (Fig. 4). Reproduction not seen.

Remarks: Dredged from a depth of 100 metres atop the MacDonald undersea mount hot spot, along with *Microdictyon* sp. The specimens are small and sterile, but the anatomical features are consistently different from *Lobophora variegata* also occurring in the same locality, with which it could be confused. The plant is tristromatic with palisade-like medullary cells, while *L. variegata* (even the youngest blades sectioned) is always at least tetrastromatic with usually brick-like medullary cells. The lack of reproductive data precludes a firm placement of this unusual plant but it is most likely a species of *Cutleria*, very similar to *C. irregularis* Abbott *et* Huisman. It superficially resembles species of *Syringoderma* or *Chlanidophora*, but both of these genera are mono- or distromatic, and do not have the cortical layers and regular cell arrangement of the Polynesian species. The apical cells of *C. irregularis* (Fig. 4) are not elongate as in *Syringoderma* (Matsuyaga & Yamada, 1974) but are more characteristic of *Lobophora*, rather than the trichothallic margin of *Cutleria mollis*.

Cutleria mollis* Allender *et* Kraft, 1983: 122, figs 28-29 (type locality: Neds Beach, Lord Howe Island, Australia). Norfolk Island: Millar, 1999: 493, fig. 8. **(Figs 5-7)

Material examined: Rapa Island, Australs 5 Nov. 2002, *leg. J. L. Menou*, UPF 1965, 3477, 3478.

Gametophytic thallus (Fig. 5) soft and flabellate, golden-yellow and thin-translucent, to 30 mm high and 45 mm broad and 90-120 μm thick, attached to the substratum via basal rhizoids. The growing margins are distinctly lacerate and hair-fringed (trichothallic growth, Fig. 6). Internally composed of 4-5 cells layers, with smaller epidermal cells 8-14 μm wide and 7-10 μm tall, and larger medullary cells to 50 μm high and 75 μm wide. Phaeophyceean hairs to 10 μm in diameter and 120 μm long scattered on surface; female gametangia (Fig. 7) ovoid, to 25 μm wide by 50 μm long, containing up to 12 loculi about 10 μm in diameter.

Remarks: A single, incomplete thallus from 42 m depth. The trichothallic margins are characteristic of the genus, while the golden yellow, thin translucent blades which adhere closely to the paper are distinctive of *C. mollis*, although the concentric arrangements of gametangia as described for the type of the species was not apparent in the Rapa plant, which tends to show more prominent radial lines. However, this could be a variable feature depending on the age of the plant, and where in the thallus the blade fragment came from; in our case the basal parts appear to be lacking and this seems to be where the concentric bands are the most visible (Allender & Kraft, 1983: 124, fig. 29A). It is also reported from Norfolk Island (Millar, 1999: 493, fig. 8) and possibly from Fiji (as *Cutleria* sp.) by Littler & Littler (2003: 176, photograph on p. 177, middle). The photograph of the latter Fijian species shows the *Aglaozonia* sporophyte stage of the plant. This genus appears to be restricted in French Polynesia to the cooler waters of the Australs. Setchell (1926: 90) mentioned a new species in the Cutleriales (*Aglaozonia pacifica*) from Papeete, Tahiti, but from the description (central layer of larger cells surrounded on either side by four layers of flattened cells) it likely was a crustose form of *Lobophora variegata*. Unfortunately, the type material of *A. pacifica* is misplaced in UC and cannot be examined at this time.

Order Scytothamniales

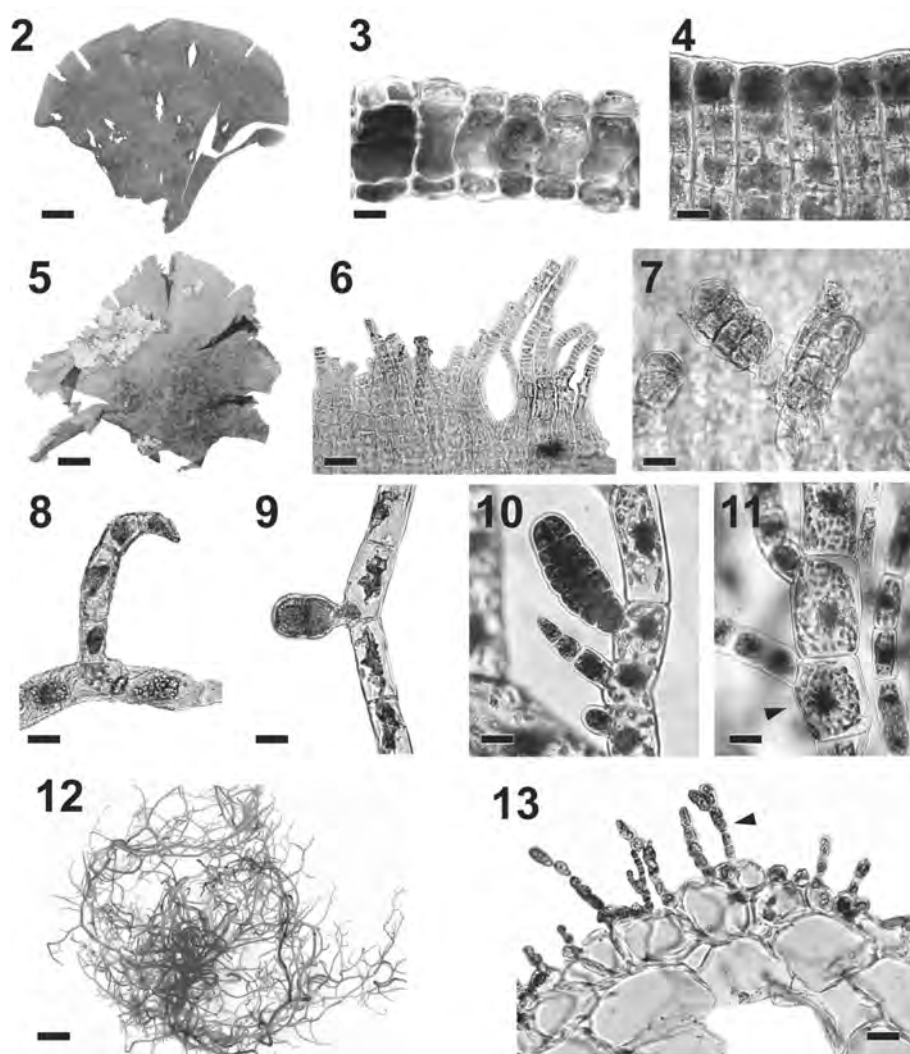
Family Scytothamnaceae

Genus *Asteronema* Trevison

Asteronema breviarticulatum (J. Agardh) Ouriques *et* Bouzon, 2000: 271. Rodrigues Island: Coppejans *et al.*, 2004: 3009, fig. 30; Hawaii: Abbott & Huisman, 2004: 157, fig. 57A. **(Figs 8-9)**

Basionym: *Ectocarpus breviarticulatus* J. Agardh, 1847: 7 (type locality: San Agustín, Oaxaca, Mexico). French Polynesia: Setchell, 1926: 87; Taylor, 1973: 38; Easter Island: Børgesen, 1924: 256, fig. 7; Samoa: Setchell, 1924: 171, fig. 37; Mauritius: Børgesen, 1941: 39, fig. 17; 1948: 45; Vietnam: Dawson, 1954: 398, fig 14a-b; Marshall Islands: Dawson, 1956: 43; Sri Lanka: Durairatnam, 1961: 32, pl. 6 figs 10-11; Guam: Tsuda, 1972: 90, pl. 1 fig. 1, pl. 2 fig. 1).

Homotypic synonyms: *Giffordia breviarticulata* (J. Agardh) Doty *et* Albert (*nomen nudum*) ex. Magruder & Hunt, 1979: 45. - *Hincksia breviarticulata* (J. Agardh) P. C. Silva in Silva *et al.*, 1987: 73. Rotuma: N'Yeurt, 1996: 397, figs 95, 98a-e; French Polynesia: Payri & N'Yeurt, 1997: 875; South Africa: De Clerck *et al.*, 2002: 418, figs 13-15.



Figs 2-13. **2.** *Cutleria irregularis* (UPF 2144), habit of tristromatic blade from deepwater (Scale = 2 mm). **3.** *Cutleria irregularis* (UPF 2144), cross-section of mid thallus showing large middle layer surrounded on either side by single layer of smaller cells (Scale = 15 μ m). **4.** *Cutleria irregularis* (UPF 2144), Surface view of thallus margin, showing row of apical cells each immediately dividing into two cell files below (Scale = 25 μ m). **5.** *Cutleria mollis*, habit of gametophytic blade (UPF 1965) showing flabellate habit (Scale = 5 mm). **6.** *Cutleria mollis* (UPF 1965), detail of trichothallic margin (Scale = 30 μ m). **7.** *Cutleria mollis* (UPF 1965), pedicellate female gametangia with oogonia loculi (Scale = 12 μ m). **8.** *Asteronema breviarticulatum* (UPF 633), habit showing characteristic hooked branchlets (Scale = 25 μ m). **9.** *Asteronema breviarticulatum* (UPF 633), showing spherical plurilocular sporangia (Scale = 25 μ m). **10.** *Hincksia mitchelliae* (UPF 2073) showing elongate plurilocular sporangia (Scale = 20 μ m). **11.** *Hincksia mitchelliae* (UPF 2073), detail of main branch showing stellate-like chloroplast (arrowhead) (Scale = 12 μ m). **12.** *Cladosiphon novae-caledoniae* (UPF 2131). Habit of freshly collected plant (Scale = 10 mm). **13.** *Cladosiphon novae-caledoniae* (UPF 2131). Cross section of thallus showing large subcortical cells and divaricate laterals (arrowhead) (Scale = 20 μ m).

Material examined: Taharaa, Tahiti, 17 Jun. 1922, *leg. W. A. Setchell and H. E. Parks*, BM 840868; Temae, Moorea, 14 Jun. 1984, *leg. C. E. Payri*, UPF 2785, 2800; Aukena, Gambier 21 Sept. 1997, *leg. J. Starmer*, UPF 633; Temae, Moorea 21 Nov. 1995, *leg. A. D. R. N'Yeurt*, UPF 175; Taharaa, Tahiti 14 Apr. 1997, *leg. A. D. R. N'Yeurt*, UPF 176; Matira, Bora Bora 17 Aug. 2002, *leg. A. D. R. N'Yeurt*, UPF 2578.

Plants yellow-brown, tufted, 20-35 mm high, with irregular primary branching and numerous hooked secondary branchlets which hold the filaments in rope-like spongy strands. Filaments about 25 μm thick, composed of rectangular cells about up to 25 \times 50 μm . Secondary hook-like branchlets (Fig. 8) up to 800 μm long and 25 mm broad, arising at 85-90° to main filaments and spaced at 500-700 μm intervals. Plurilocular sporangia (Fig. 9) 40-45 μm high, short and pyriform, containing about eight spores and borne on a stalk cell.

Remarks: Found growing on wave-washed rocks in exposed areas, forming characteristic yellowish-brown wick-like clumps in typical association with *Chnoospora minima*. The association of *Asteronema* and *Chnoospora* is frequent, and reported also from Vietnam (Dawson, 1954), Micronesia and Hawaii (Tsuda, 1972) and the Cook Islands (N'Yeurt & Payri, in prep.). Recent molecular studies (Peters & Clayton, 1998; Draisma *et al.*, 2001; Rousseau *et al.*, 2001) indicate that *Asteronema* is polyphyletic and not related to the Ectocarpales; however the status of *A. breviararticulatum* remains uncertain until it is included in molecular analyses. In French Polynesia, it is found as far south as the Gambier Group, but not reported from the Australs although it was recorded from Easter Island to the southeast (Børgesen, 1924).

Order Ectocarpales

Family Ectocarpaceae

Genus *Hincksia* J. E. Gray

Hincksia mitchelliae (Harvey) P. C. Silva in Silva *et al.*, 1987: 73. French Polynesia: Payri & N'Yeurt, 1997: 875, Payri *et al.*, 2000: 126; Western Australia: Huisman, 2000: 184; Fiji: N'Yeurt, 2001: 734, figs 79, 84. **(Figs 10-11)**

Basionym: *Ectocarpus mitchelliae* Harvey, 1852: 142, pl. 12g (*mitchelliae*) (type locality: Nantucket, Massachusetts, USA). India: Børgesen, 1930: 165, fig. 8a-c; Iran: Børgesen, 1939: 75; Mauritius: Børgesen, 1941: 7, figs 1a-c, 2a-e, 3a-c, 4a-c, 5a-b, 1948: 44, fig. 23; Tasmania: Cribb, 1956: 184, pl. 2 fig. 1; Marshall Islands: Dawson, 1956: 43.

Homotypic synonym: *Giffordia mitchelliae* (Harvey) Hamel, 1939: xiv, fig. 61C. Australia: Clayton, 1974: 779, figs 21A-H, 22A-E; Womersley, 1987: 52, figs 10D, 12E-G.

Misapplied names (given by Womersley & Bailey, 1970): *Ectocarpus indicus* Sonder: Samoa: Setchell, 1924: 169, fig. 34; French Polynesia: Setchell, 1926: 87; Hawaii: Abbott, 1947: 200, fig. 3A-D. - *Feldmannia indica* (Sonder) Womersley *et* Bailey: French Polynesia: Payri & N'Yeurt, 1997: 875.

Material examined: Tahiti, 1909, *leg. J. E. Tilden* (Nr. 32), MO 24676 in UC; Tikehau, Tuamotu 7 Nov. 1995, *leg. A. D. R. N'Yeurt*, UPF 539; Anakaturinako Bay, Rapa Island, Australs, 8 Nov. 2002, *leg. C. E. Payri*, UPF 2073.

Thallus light brown, densely tufted and up to 10 mm high. Branching close and profuse throughout; filaments tapering towards the apex. Main axis 20-22 μm in diameter, with terminal branches 9-16 μm in diameter. Cells of main filaments subquadrate to rectangular, to 20 μm wide and 30 μm high, with a

central pyrenoid and apparently stellate chloroplasts (Fig. 10). Plurilocular sporangia (Fig. 11) cylindrical, up to 61 μm long and 20 μm in diameter; sessile with rounded ends. Locules in rows of 1-2 (3).

Remarks: Epiphytic on other algae (usually *Turbinaria* and *Sargassum*) on the reef crest (Tahiti, Moorea). The status of *H. mitchelliae* within the genus *Hincksia* remains uncertain, as it was not included in studies that transferred the species *H. breviarticulata* to the genus *Asteronema* (Ouriques, pers. com.). Polynesian plants possess stellate chloroplasts; on the other hand Clayton (1974: 779, fig. 23F) reports discoid chloroplasts in southern Australian plants. Plants from American Samoa (Setchell, 1924) and Hawaii (Abbott, 1947) referred to *Ectocarpus indicus* (now *Hincksia indica* (Sonder) J. Tanaka) were found to be conspecific with *H. mitchelliae* (Womersley & Bailey, 1970: 288); however *H. indica*, along with *H. mitchelliae*, are now reported from Hawaii by Abbott and Huisman (2004: 161). The Tahitian record of *E. indicus* (Tilden South Pacific Algae Nr. 32 in French Polynesia: Setchell 1926: 86), now in UC, was examined for this study and the material found to actually represent *H. mitchelliae*. *Hincksia indica* is characterised by very long, straight cylindrical plurilocular sporangia, which contrast to the short, stocky organs of *H. mitchelliae*, as well as by filaments with unbranched apices (Womersley & Bailey, 1970; Abbott and Huisman, 2004).

Order Chordariales

Family Chordariaceae

Genus *Cladosiphon* Kützing, 1843: 329

**Cladosiphon novae-caledoniae* Kylin, 1940: 29, pl. 4 fig. 10 (type locality: Freycinet Island, Nouméa, New Caledonia). New Caledonia: Ajisaka, 1991: 2, figs 2A-D, 3A-F.

(Figs 12-13)

Material examined: Rapa Island, Australs: Rapa Iti, 7 Nov. 2002, leg. J. L. Menou, UPF 2056; Ha'urei, 11 Nov. 2002, leg. J. L. Menou, UPF 2131; 13 Nov. 2002, leg. M. Adjeroud, UPF 2173, leg. J. L. Menou, UPF 2206; 18 Nov. 2002, leg. M. Adjeroud, UPF 2289; Aruroa Pt., 22 Nov. 2002, leg. A. D. R. N'Yeurt, UPF 2245; eastern oceanic slope, 23 Nov. 2002, leg. J. L. Menou, UPF 2331; internal slope of Tauna islet, 27 Nov. 2002, leg. C. E. Payri, UPF 2371; on first green buoy at exit of Ha'urei Bay, 29 Nov. 2002, leg. J. L. Menou, UPF 2422; Akatamiro Bay, 2 Dec. 2002, leg. J. L. Menou, UPF 2353.

Thallus dark golden brown in colour, lubricous, erect and filiform, with irregularly alternately branched cylindrical axes 10-30 cm high and 1 to 1.5 mm in diameter, attached to the substratum via a small discoid holdfast (Fig. 12). Medulla multiaxial, composed of elongated unpigmented and sympodially branched pseudoparenchymatous filaments 80-400 μm long and 40-150 μm in diameter. Subcortical layer 1-2 cell thick, bearing radially extended divaricate laterals 160-300 μm high composed of 10-30 cells 7-10 μm in diameter (Fig. 13), swollen and curved at the apex. Uniseriate hairs 8-10 μm in diameter, hyaline with a basal sheath. Sporangia not seen.

Remarks: Growing on various hard substrata at 10-68 meters depth, so far only found in the southern island of Rapa in the Australs. Kylin (1940) did not provide a description of his new species, but Ajisaka (1991) carefully examined and described the type specimen in LD and compared it with other species in the genus. *Cladosiphon okamuranus* (Tokida, 1942: 87, fig. 4) is superficially similar to *C. novae-caledoniae*, but differs in its smaller medullary cell diameters (20-50 μm) and in having a subcortical layers of 1-3 cells, as opposed to 1-2 only in the Rapa plant

(Ajisaka, 1991: 5, tab. 1). Other morphological features are similar in both species, and perhaps future molecular studies might merge them, but they are kept apart for the time being. Species of *Cladosiphon* have economic potential in the region as a valuable edible commodity for the Japanese market, with successful culture projects in Japan (Toma, 1993), Tonga (Billings, 1996) and New-Caledonia (pers. obs., CEP).

Family **Ralfsiaceae**

Genus **Ralfsia** Berkeley

Ralfsia expansa (J. Agardh) J. Agardh, 1848: 63. French Polynesia: Setchell, 1926: 89; Virgin Islands: Børgesen, 1912: 1, figs 1*a-b*, 2*a-c*; Indonesia: Weber-van Bosse, 1913: 146, fig. 45; Marshall Islands: Dawson, 1956: 43, fig. 33; Caroline Islands: Trono, 1969: 29, pl. 3 figs 7-10; Solomon Islands: Womersley & Bailey, 1970: 289; Amami Islands: Tanaka, 1990: 27, figs 10-11; French Polynesia: Payri & N'Yeurt, 1997: 875; Namibia: Lluch, 2002: 169, figs 186-187; Hawaii: Abbott & Huisman, 2004: 171, fig. 64*A-D*.

Basionym: *Myrionema expansum* J. Agardh, 1847: 7 (type locality: Veracruz, Mexico).

Material examined: Trou du Souffleur, Papenoo, Tahiti, 3 Mar. 2005, *leg.* A. D. R. N'Yeurt & A. Pham, UPF 2969.

Thallus forming tightly adhering, dark brown, overlapping crusts 10-30 mm in diameter and 250 to 2000 µm thick, with golden margins. Cells in cross section bilaterally arranged; basal layer 3-4 cells thick, thallus more than 30 layers thick. Unilocular sporangia pedicellate on 2-4 stalk cells, borne in a lateral position and surrounded by paraphyses. Individual mature sporangia about 25 µm in diameter and up to 80 µm long. Plurilocular organs in two rows of 8-12 fertile cells, in sunken sori on separate plants from unilocular organs.

Remarks: growing on rock faces and coral debris in the upper littoral, and up to 5 m deep. We follow Womersley (1987) and Abbott & Huisman (2004) in referring this species to the order Chordariales. The related genus *Hapalospongidion* Saunders is distinguished from *Ralfsia* by discrete crusts less than 12 layers thick, embedded plurilocular sporangia, and free unilocular organs with conspicuous paraphyses (Abbott & Huisman, 2004: 170).

Order **Sphacelariales**

Family **Sphacelariaceae**

Genus **Sphacelaria** Lyngbye

Key to the French Polynesian species of *Sphacelaria*

1. Propagules triangular, knobby, with short basally tapered pedicel. *S. tribuloides*
1. Propagules Y-shaped, with extended arms and long non-tapered pedicel.
 *S. rigidula*

Sphacelaria rigidula Kützing, 1843: 292 (type locality: Red Sea). French Polynesia: Payri & N'Yeurt, 1997: 876; South Australia: Womersley, 1987: 166, figs 51*D*, 54*A-G*; Rotuma: N'Yeurt, 1996: 398, fig. 99*a-b*; Senegal: Harper & Garbary, 1997: 132, fig. 10; China: Draisma *et al.*, 1998: 188, figs 20, 25; Western Australia: Huisman, 2000: 186; Hawaii: Abbott & Huisman, 2004: 190, fig. 72*C*. **(Fig. 14)**

Heterotypic synonym: *Sphacelaria furcigera* Kützing, 1855: 27, pl. 90 fig. 11 (Type locality: Karak (Khark) Island, Iran) (*vide* Prud'homme van Reine, 1982: 203,

figs 508-554; Silva *et al.*, 1987: 74). French Polynesia: Setchell, 1926: 86; Mauritius: Børgesen, 1941: 46, fig. 21; Vietnam: Dawson, 1954: 400, fig. 14h; Sri Lanka: Durairatnam, 1961: 31, pl. 6 figs 4-7; Guam: Tsuda, 1972: 93, pl. 1 fig. 4.

Material examined: Punaruu Pass, Tahiti, 11 Jul. 1922, *leg. W. A. Setchell and H. E. Parks*, BM 840779, 840783; Punaauia, Tahiti, 19 Sept. 1995, *leg. A. D. R. N'Yeurt*, UPF 484; Rukuaga Pt., Rapa Island, Australs, 30 Nov. 2002, *leg. J. L. Menou*, UPF 2427.

Thallus light-brown, 7-10 mm high, epiphytic, forming erect penicillate tuft; basal holdfast discoid. Branching sparse to frequent, at irregular narrow angles. Main axis linear and two cells thick, 30-35 μm in diameter with rectangular cells about 15 \times 35 μm . Propagules abundant, Y-shaped with paired slender and slightly tapering arms 100-250 μm long and 15-20 μm broad with an approximate angle of 120° between them, borne on a pedicel 230-260 μm long and with a convex lenticular apical cell rising to 7.5-18 μm . Lateral unilocular sporangia subsphaerical and shortly pedicellate, 37-40 μm in diameter.

Remarks: Epiphytic on other algae. The long, Y-shaped propagules are characteristic for this species.

Sphacelaria tribuloides Meneghini, 1840: 2 (lectotype locality: La Spezia, Italy). Mauritius: Børgesen, 1941: 41, fig. 18a-c; Guam: Tsuda, 1972: 93, pl. 1 figs 6-9, pl. 2 fig. 4; South Australia: Womersley, 1987: 160, figs 45G, 52A-C; Belize: Littler & Littler, 1997: 71, fig. 89; French Polynesia: Payri & N'Yeurt, 1997: 876; China: Draisma *et al.*, 1998: 189, fig. 22; Hawaii: Abbott & Huisman, 2004: 190, fig. 72D-E. **(Fig. 15)**

Heterotypic synonym (given by Prud'homme van Reine, 1982: 187): *Sphacelaria taitensis* Setchell, 1926: 86, pl. 13 figs 1-3 (type locality: Punaruu, Tahiti). French Polynesia: Payri *et al.*, 2000: 126.

Material examined: Punaauia, Tahiti, 10 Oct. 1995, *leg. A. D. R. N'Yeurt*, UPF 483.

Thallus to 15 mm high, brownish-green and tufted, composed of irregularly branched segmented axes 40-100 μm in diameter. Triangular propagules 30-40 μm in diameter, with a pair of short knobby horns and pronouncedly tapered base occur on the sides of the main branches.

Remarks: Forming extended patch covers on reef surface. The knobby propagules with tapered bases are characteristic of this species.

Order Dictyotales

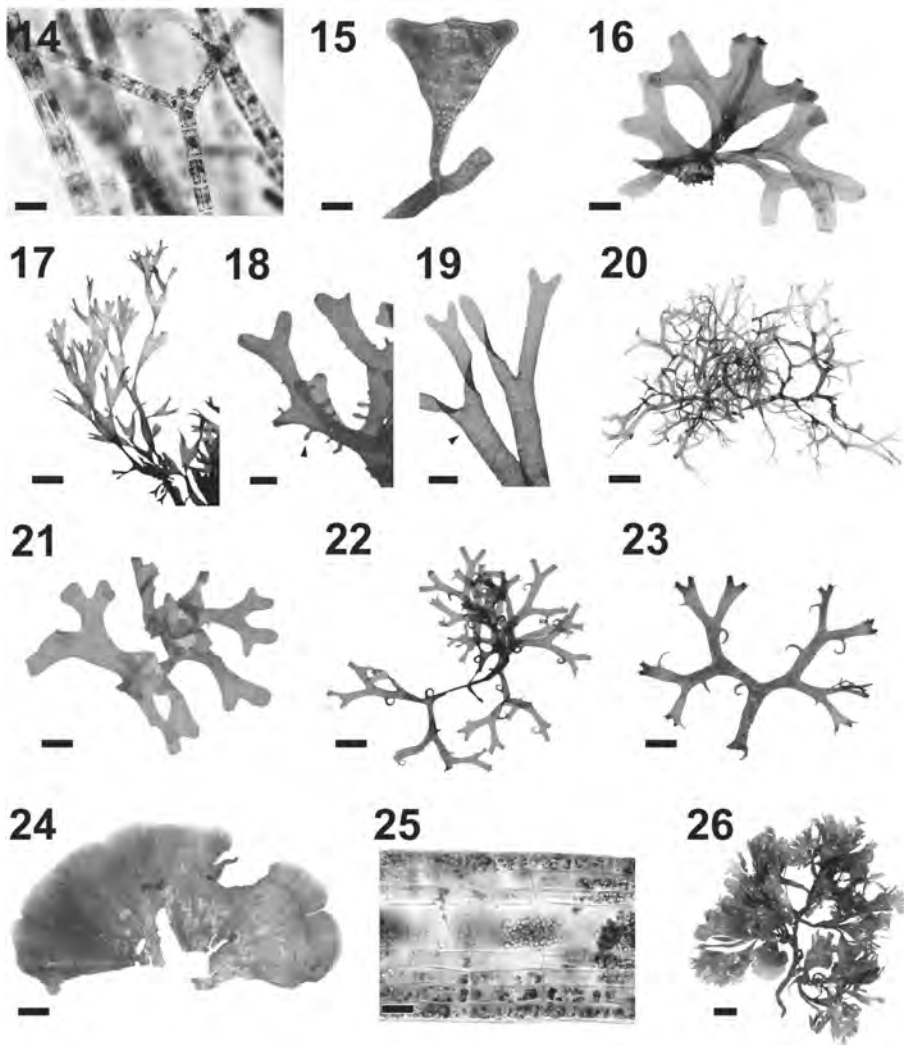
Family Dictyotaceae

Genus *Dictyopteris* Lamouroux

Dictyopteris repens (Okamura) Børgesen, 1924: 265, fig. 13 (type locality: Easter Island). French Polynesia: Payri & N'Yeurt, 1997: 876; Payri *et al.*, 2000: 128; Guam: Tsuda, 1972: 94, pl. 3 fig. 1; Lord Howe Island: Allender & Kraft, 1983: 107, figs 19 A-B; Papua New Guinea: Coppejans *et al.*, 1995b: 178, figs 3-4; Rotuma: N'Yeurt, 1996: 399, figs 91-92; Norfolk Island: Millar, 1999: 491; Australia: Phillips, 2000: 312, fig. 10g-h; Solomon Islands: Littler & Littler, 2003: 166; Hawaii: Abbott & Huisman, 2004: 197, fig. 75E-F; Samoa: Skelton & South, 2004: 295, figs 2-3. **(Fig. 16)**

Basionym: *Haliseris repens* Okamura, 1916: 8, fig. 3; pl. 1, figs 7-18 (type locality: Truk Island, Caroline Island).

Material examined: Punaauia, Tahiti 5 Oct. 1995, *leg. A. D. R. N'Yeurt*, UPF 436; Motu Nono, Afaahiti, Tahiti, 8 Jun. 1997, *leg. A. D. R. N'Yeurt*, UPF 161; Matira, Bora Bora 15 Aug. 2002, *leg. A. D. R. N'Yeurt*, IFR 128.



Figs 14-26. **14.** *Sphacelaria rigidula* (UPF 2427) showing Y-shaped propagule on long pedicel (Scale = 25 μ m). **15.** *Sphacelaria tribuloides* (UPF 483), triangular knobby propagule on short pedicel (Scale = 13 μ m). **16.** *Dictyopteris repens* (In herb. UPF), habit showing characteristic midrib (Scale = 3 mm). **17.** *Dictyota acutiloba* (UPF 2360) showing distally crowded dichotomies of thallus (Scale = 5 mm). **18.** *Dictyota bartayresiana* (UPF 166), typical habit showing marginal proliferations (arrowhead) (Scale = 4 mm). **19.** *Dictyota bartayresiana* (UPF 2089), specimen from Rapa Island showing more elongate branches, with characteristic banding pattern (arrowhead) (Scale = 3 mm). **20.** *Dictyota ceylanica* (UPF 2029), habit, showing widely divaricate dichotomies (Scale = 5 mm). **21.** *Dictyota friabilis* (UPF 191), Habit (Scale = 3 mm). **22.** *Dictyota hamifera* (UPF 173), general habit (Scale = 3 mm). **23.** *Dictyota hamifera* (UPF 173), detail showing characteristic hooked side-branchlets (arrowheads) (Scale = 3 mm). **24.** *Lobophora variegata* (UPF 2234), crustose form (Scale = 3 mm). **25.** *Lobophora variegata* (UPF 1840), cross section of stiped form, showing large central cells surrounded on either side by four layers of flattened cells (Scale = 20 μ m). **26.** *Lobophora variegata* (UPF 1887), habit of stiped form from Rapa Island (Scale = 10 mm).

Fronds recumbent, up to 3 cm long, branching dichotomous with branches 1-3 mm broad; thallus distromatic, 65 µm thick, with a prominent midrib 4-8-cells thick. Sporangia in sori, on either side of the midrib.

Remarks: Growing on coral rubble along the reef crest, and subtidally on the reef slope. The French Polynesian material lacks any marginal thickenings, which distinguishes it from similar-looking *D. delicatula* Lamouroux. It has been suggested (Taylor, 1960: 227; Tsuda, 1972: 94; Allender & Kraft, 1983: 108; Coppejans *et al.*, 1995: 178; N'Yeurt, 2001: 742; Wysor & De Clerck, 2003: 152) that *D. delicatula* and *D. repens* are variants of the same entity. On the other hand, Phillips (2000: 304) reported that *D. repens* has oogonia external to the thallus, whereas in *D. delicatula* they are embedded in the thallus. No oogonia were seen in French Polynesian plants.

Genus *Dictyota* Lamouroux

Key to the French Polynesian species of *Dictyota*

1. Main branches with curved, hook-like side branchlets *D. hamifera*
1. Main branches without curved, hook-like side branchlets 2
 2. Branches 0.3-1.5 mm wide, branching at an angle of 100-120° *D. ceylanica*
 2. Branches 2-5 mm wide, branching at an angle of less than 90° 3
3. Thallus translucent and strongly adherent, branches thin and friable, 2-3 mm wide, marginal proliferations absent *D. friabilis*
3. Thallus not translucent or adherent, branches relatively tough, 0.4-5 mm wide, marginal proliferations sometimes 4
 4. Thallus 3-4 cm long, dichotomies regularly spaced, branches generally not undulating; transverse bands present; sporangia with involucre *D. bartayresiana*
 4. Thallus to 7 cm long, dichotomies crowded distally; branches wavy and undulating; transverse bands absent; sporangia lacking involucre *D. acutiloba*

Dictyota acutiloba J. Agardh, 1848: 91 (type locality: Hawaii). French Polynesia: Setchell, 1926: 93, Payri & N'Yeurt, 1997: 876; Lord Howe Island: Allender & Kraft, 1983: 110, figs 21 A-B; Hawaii: Abbott & Huisman, 2004: 200, fig. 76A-D. **(Fig. 17)**
Material examined: Rapa Island, Australs: between Patagaora and Mei Pts, 18 Nov. 2002, leg. C. E. Payri, UPF 2220; Akatamiro Bay, 2 Dec. 2002, leg. C. E. Payri, UPF 2358; Iri Bay, 16 Nov. 2002, leg. J. L. Menou, UPF 2360.

Thallus to 15 cm high and to 140 µm thick, with cervicorn branches dichotomously branched at angles of less than 90°. The dichotomies are lax below and crowded distally, with characteristically wavy undulating outlines. Peculiar small, dark blotches common along the middle portions of the thallus. Sporangia non-indusiate.

Remarks: Found so far in French Polynesia only at Rapa Island, Australs group. A common species growing on hard substratum or epiphytic mixed with other brown algae in the *Sargassum* bed, intertidal to 25 m depth. This characteristic species can be distinguished from *D. bartayresiana* by its more filiform, undulating thallus with distally crowded dichotomies and central blotchy areas. It differs from the similar-looking *Dictyota cervicornis* Kützinger by the absence of an indusium surrounding the sporangia, and the absence of surface proliferations (De Clerck, 2003: 51). Setchell (1926: 93) reports *D. acutiloba*, with some doubt, to occur in Tahiti in the Society group, but recent collections have not confirmed this, and its distribution is presently restricted to the cooler waters of the southern Australs.

Dictyota bartayresiana Lamouroux, 1809: 331 (type locality: West Indies). French Polynesia: Payri *et al.*, 2000: 132, Payri & N'Yeurt, 1997: 876; Sri Lanka: Durairatnam, 1961: 37; Guam: Tsuda, 1972: 95, pl. 3 figs 2-3; Lord Howe Island: Allender & Kraft, 1983: 112, figs 22 *D*, 23 *A-C*; Fiji: Ajisaka & Enomoto, 1985: 38, fig. 1 *K-L*; Papua New Guinea: Coppejans *et al.*, 1995b: 180, fig. 8; Indian Ocean: De Clerck, 2003: 37, figs 9*A-D*, 10*A-G*; Hawaii: Abbott & Huisman, 2004: 202, fig. 77*A*. **(Figs 18-19)**

Material examined: Maate'a, Moorea, 12 Jun. 1984, *leg. C. E. Payri*, UPF 2791; Punaauia, Tahiti, 9 May 1997, *leg. C. E. Payri*, UPF 165, 166; Taapuna, Tahiti, 7 May 1997, *leg. C. E. Payri*, UPF 164; Papeari, Tahiti, 11 May 1997, *leg. A. D. R. N'Yeurt*, UPF 163; Opunohu, Moorea, 1 Jul. 1997, *leg. A. D. R. N'Yeurt*, UPF 162; Matira, Bora Bora, 15 Aug. 2002, *leg. A. D. R. N'Yeurt*, UPF 2496, 2515; Motu Marara, Bora Bora 16 Aug. 2002, *leg. A. D. R. N'Yeurt*, UPF 2535; Karapoo, Rapa Island, Australs, 1 Nov. 2002, *leg. C. E. Payri*, UPF 1847.

Thallus ribbon-like, to 45 mm high, brownish-orange, 2-5 mm wide, with relatively tough, flattened, complanate axes regularly dichotomously branched at an angle of 70-80°. Branch tips are usually blunt and rounded, but can occasionally also be acute. Small proliferations 0.5-1 mm long sometimes occur on thallus margins (Fig. 18). Thallus not iridescent; characteristic transverse bands common, composed of darkly pigmented cell inclusions (Fig. 19). Medulla unilayered, without wall thickenings. Sporangia to 120 µm in diameter and with a single stalk cell, occurring singly on both surfaces of the thallus, lacking an involucre.

Remarks: Commonly found growing in dense patches or balls to 15 cm across, on coral rubble in the lagoon (Tahiti, Moorea). The habit can be highly polymorphic, from elongate sparsely dichotomously branched thalli in deep water to densely overlapping tiers of blades wedged in coral in the lagoon. Tsuda (1972: 95) suggested that longer internodes in this plant are a result of habitats with limited light intensity, such as deeper turbid waters.

****Dictyota ceylanica*** Kützing, 1859: 11, pl. 25 fig. 1 (type locality: Sri Lanka). Sri Lanka: Børgesen, 1936: 78, fig. 7; Indian Ocean: De Clerck, 2003: 52, figs 15*A-F*, 16*A-F*; Papua New Guinea: Littler & Littler, 2003: 168; Hawaii: Abbott & Huisman, 2004: 202, fig. 77*B*. **(Fig. 20)**

Misapplied name (given by De Clerck, 2003): *Dictyota divaricata* Lamouroux, 1809: 331. French Polynesia: Payri & N'Yeurt, 1997: 876; Payri *et al.*, 2000: 134; Marshall Islands: Dawson, 1957: 110, fig. 14*b*; Guam: Tsuda, 1972: 96, pl. 4 fig. 2; Lord Howe Island: Allender & Kraft, 1983: 112, figs 21*C-D*, 22*B-C*; Fiji: Ajisaka & Enomoto, 1985: 37, fig. 1*H-I*; Papua New Guinea: Coppejans *et al.*, 1995: 182, fig. 19.

Material examined: Taapuna, Tahiti, 7 May 1995, *leg. A. D. R. N'Yeurt*, UPF 169, 170; Atituiti, Mangareva, 18 Nov. 2000, *leg. A. D. R. N'Yeurt*, UPF 778; Matira, Bora Bora 19 Aug. 2002, *leg. A. D. R. N'Yeurt*, UPF 2596.

Thallus thin and ribbon-like, colour brownish-green, with a bluish iridescence on the surface; to 15 mm high, with dichotomous branches 0.3-1.5 mm wide, strongly divaricate at an angle of 100-120°; tapered gradually towards the apices which are very fine and filiform. Medulla unilayered, cells 25-50 µm in diameter, commonly with cell wall thickenings. Sporangia pedicellate, occurring singly on both sides of the thallus, often distributed in a narrow line in middle portions of branches. Involucre absent.

Remarks: Present throughout the year, forming entangled masses several centimetres across, attached to hard substrata such as coral rubble in shallow

lagoon areas (Moorea, Tahiti). The narrow, widely divaricate filiform axes with acuminate tips make this species easily distinguishable from other *Dictyota* species. This species was previously reported from Pacific localities under the name *Dictyota divaricata* Lamouroux. The absence of interbreeding between European, tropical Atlantic, and possibly Pacific populations strongly suggested that two species were involved (De Clerck & Coppejans, 1997: 413). The name *Dictyota ceylanica*, initially described from tropical Sri Lanka, has been used for Indian Ocean (De Clerck, 2003), Papua New-Guinean (Littler & Littler, 2003) and Hawaiian (Abbott & Huisman, 2004) populations previously listed under *D. divaricata*, and is a most likely choice for South Pacific members of the complex pending further studies (De Clerck, pers. com.).

Dictyota friabilis Setchell, 1926: 91, pl. 13, figs 4-7, pl. 20 (type locality: Tafaa Point, Tahiti). French Polynesia: Payri *et al.*, 2000: 132; Vietnam: Dawson, 1954: 401, fig. 16a-b; Guam: Tsuda, 1972: 96, pl. 4 fig. 3; Fiji: Ajsaka & Enomoto, 1985: 37, fig. 1J, N'Yeurt 2001: 742, Littler & Littler, 2003: 168; Rotuma: N'Yeurt, 1996: 400, figs 93-94, 100-101; Indian Ocean: De Clerck, 2003: 89, figs 28A-F, 29A-E; Hawaii: Abbott & Huisman, 2004: 205, fig. 77E. **(Fig. 21)**

Material examined: Tafaa Point, Tahiti, 19 May 1922, *leg. W. A. Setchell and H. E. Parks*, BM 519435, 562827, 562828; Outumaoro, Tahiti, 15 Jul. 1922, *leg. W. A. Setchell and H. E. Parks*, BM 841286; Arue, Tahiti, 24 Sep. 1928, *leg. C. Crossland*, BM 841297; Tikehau, Tuamotu, 4 Nov. 1995, *leg. A. D. R. N'Yeurt*: UPF 171; Mangareva, Gambier 27 Sep. 1997, *leg. J. Starmer*, UPF 628; Atituiti, Mangareva 19 Nov. 2000, *leg. A. D. R. N'Yeurt*: UPF 898; Matira, Bora Bora 15 Aug. 2002, *leg. A. D. R. N'Yeurt*, UPF 2516; 19 Aug. 2002, *leg. A. D. R. N'Yeurt*, UPF 2583.

Thallus imbricating, prostrate and friable, spreading to 3 cm in diameter, closely adherent to substratum. Colour yellowish green, translucent. Apices rounded, with prominent paired apical cells. Branching unequally dichotomous to irregular; angle of branching about 45-100°; segments up to 5 mm broad, tapered at base, often with hair tufts. Contiguous segments mutually attached by bundles of rhizoids. Thallus tristromatic, about 125 µm thick with epidermal cells 25 µm tall and medullary cells 75 µm tall with lenticular thickenings. Sporangia 55-60 µm in diameter, singly pedicellate, scattered along middle portion of the upper surface of thallus. Involucrum absent.

Remarks: The thin, greenish iridescent and striated blades that form densely imbricated, closely adherent mats on coral debris and hard surfaces are characteristic of this species. Common, epilithic or epiphytic, often mixed with turfs in both intertidal and subtidal habitats.

Dictyota hamifera Setchell, 1926: 92, pl. 14 figs 1-6 (type locality: between Papenoo and Huau, Tahiti). French Polynesia: Payri & N'Yeurt, 1997: 876, Payri *et al.*, 2000: 134; Papua New Guinea: Coppejans *et al.*, 1995: 182, figs 11-12; South Africa: De Clerck *et al.*, 2002: 415, fig. 7; Indian Ocean: De Clerck, 2003: 101, figs 33A-F, 34A-E; Solomon Islands: De Clerck, 2003; Panama: Wysor & De Clerck, 2003: 156, fig. 16; Samoa: Skelton & South, 2004: 295, fig. 4. **(Figs 22-23)**

Material examined: Maraa, Tahiti, 28 Sep. 1928, *leg. C. Crossland*, BM 841311; Taharaa, Tahiti, 14 Apr. 1997, *leg. C. E. Payri and A. D. R. N'Yeurt*, UPF 173, 174; Afaahiti, Tahiti, *leg. A. D. R. N'Yeurt*, 7 Jun. 1997, UPF 172; 3 Sep. 2003, UPF 2683; 16 Nov. 2004, UPF 2907; Matira, Bora Bora 17 Aug. 2002, *leg. A. D. R. N'Yeurt*, UPF 2554.

Thallus to 25 mm high, yellowish brown, composed of dichotomously branched axes 1-2 mm wide. Medulla unilayered, composed of large cells 50-200 μm high. Curved, hook-like falcate side branchlets to 1 mm long commonly occur on the main axes, and are the result of an asymmetric division of the apical cell. Sporangia non-indusiate, on a single stalk cell, occurring singly scattered on both surfaces. Branch tips are truncate, with a pair of prominent apical cells.

Remarks: Grows as entangled masses on the exposed fringing reef, associated with *Sargassum* beds (Taharaa, Tahiti). This characteristic species with hooked branchlets is distinctive within the genus.

Genus *Lobophora* J. Agardh

Lobophora variegata (Lamouroux) Womersley ex Oliveira, 1977: 217. French Polynesia: Payri & N'Yeurt, 1997: 876, Payri *et al.*, 2000: 136; Guam: Tsuda, 1972: 97, pl. 5 fig. 1; Lord Howe Island: Allender & Kraft, 1983: 81, figs 4 *G-H*, 5 *A-B*; Rotuma: N'Yeurt, 1996: 401, figs 105-106; Belize: Littler & Littler, 1997: 79, fig. 99*a-b*; Western Australia: Huisman, 2000: 193; Samoa: Skelton & South, 2002: 158, fig. 18*C-D*, *G*; Fiji: Littler & Littler, 2003: 172; Hawaii: Abbott & Huisman, 2004: 209, fig. 80*A-C*. **(Figs 24-26)**

Basionym: *Dictyota variegata* Lamouroux, 1809: 331 (type locality: Antilles).

Homotypic synonyms: *Pockockiella variegata* (Lamouroux) Papenfuss, 1943: 467, figs 1-15. Vietnam: Dawson, 1954: 400, fig. 14*k*; Sri Lanka: Durairatnam, 1961: 34, pl. 7 fig. 9; Mexico: Earle, 1969: 173, figs 53, 70; Caroline Islands: Trono, 1969: 32, pl. 2 figs 3-5. - *Zonaria variegata* (Lamouroux) C. Agardh, 1817: XX. French Polynesia: Setchell, 1926: 93; Virgin Islands: Børgesen, 1914: 197, figs 151*a-c*, 152; Easter Island: Børgesen, 1924: 266, fig. 14*a-c*. - ? *Aglaozonia pacifica* Setchell, 1926: 90 (type locality: Papeete, Tahiti). - *Zonaria obscura* Dickie, 1877: 31 (type locality: Mangaia, Cook Islands).

Material examined: Mangaia, Cook Islands, n.d., *leg. W. W. Gill*, BM 563329; Tikehau, Tuamotu, Nov. 1995, *leg. A. D. R. N'Yeurt*, UPF 181; Afaahiti, Tahiti, 7 Jun. 1997, *leg. A. D. R. N'Yeurt*, UPF 184; Punaauia, Tahiti, 19 Mar. 1998, *leg. C. E. Payri*, UPF 582; Atituiti, Mangareva, 18 Nov. 2000, *leg. A. D. R. N'Yeurt*, UPF 823; Matira, Bora Bora 15 Aug. 2002, *leg. A. D. R. N'Yeurt*, UPF 2495, 2500, 2504, 2514; Karapoo rahi, Rapa Island, Australs, 1 Nov. 2002, *leg. J. L. Menou*, UPF 1839.

Thallus composed of flabellate, deltoid to ovoid, loosely to strongly decumbent blades (Fig. 24), to 10.5 cm high, 9.5 mm broad and 125 μm thick. In the cooler southern French Polynesian waters (Rapa, Marotiri) it usually assumes a stipitate habit (Fig. 26), with multiple fan-like blades arising from a stupose holdfast. Colour yellowish-brown. The blades are irregularly lacerate, with smooth straight edges and faint, parallel lines running perpendicular to the growing edge. Internal structure cellular, with a central row of rectangular cells about 25 \times 50 μm surrounded on both sides by two layer of smaller, cuboid to rectangular cells 12-25 μm in diameter (Fig. 25). Triangular to ovate sori of indusiate sporangia are scattered on both surfaces of the blade.

Remarks: Usually found on rocks or coralline surfaces, from the surface to 70 meters deep. The decumbent form is a common feature of the lagoon flora in the atolls of the Tuamotu, where it attains large sizes (Tahiti, Tuamotu). Very common in the southern Australs (Rapa, Marotiri, McDonald) where it forms with the *Sargassum* and *Dictyota* spp a dominant cover in many habitats. In the latter localities, the dominant form of the species assumes a stipitate, erect habit

(Fig. 26) which is otherwise anatomically identical with the decumbent form. These two distinct morphological forms of the species seem to be related to the depth and degree of exposure of the habitat (Lord Howe Island: Allender & Kraft, 1983: 82). According to the description in Setchell (1926) *Aglaozonia pacifica* from Tahiti would be conspecific with *Lobophora variegata*, but this could not be ascertained since the type specimen is apparently misplaced in UC (P. C. Silva, pers. com.). The synonymy of *Zonaria obscura* Dickie was given by N'Yeurt & Payri (in prep.).

Genus *Padina* Adanson

Key to the French Polynesian species of *Padina*

1. Thallus 2-cells thick; sporangia non-indusiate 2
1. Thallus 3-cells thick; sporangia indusiate *P. pavonica*
 2. Thallus inferior surface lightly to moderately calcified, superior surface dull brownish yellow, creeping stage present, usually intertidal *P. boryana*
 2. Thallus inferior surface bright white, moderately to heavily calcified, superior surface bright yellow, creeping stage absent, exclusively subtidal *P. melemele*

Padina boryana Thivy in W. R. Taylor, 1966: 355, fig. 2 (type locality: Tonga). French Polynesia: Payri & N'Yeurt, 1997: 876, Payri *et al.*, 2000: 138; Hawaii: Abbott *et al.*, 2004: 213, fig. 81D-F. **(Fig. 27)**

Misapplied names (given by Silva *et al.* 1996): *Padina tenuis* Bory, 1827: 590. Guam: Tsuda, 1972: 98, pl. 5 fig. 4; Thailand: Egerod, 1974: 150, fig. 84; Lord Howe Island: Allender & Kraft, 1983: 83, figs 5D-E, 6A; Rotuma: N'Yeurt, 1996: 402, fig. 108f. - *Padina commersonii* Bory, 1828: 144, pl. 21 fig. 2. French Polynesia: Setchell, 1926: 93; Indonesia: Weber-van Bosse, 1913: 178, fig. 51; Marshall Islands: Taylor, 1950: 100, pl. 54 fig. 1; Mauritius: Børgesen, 1953: 13, fig. 4a-b; Vietnam: Dawson, 1954: 401, fig. 17; Inhaca Island: Isaac, 1956: 177, text-fig. 13, pl. 40; Sri Lanka: Durairatnam, 1961: 36, pl. 7 figs 1-3, pl. 25; Japan: Tanaka & Nozawa, 1962: 180, text-fig. 2, pl. 2A; Kenya: Isaac & Isaac, 1968: 23, pl. 3B.

Heterotypic synonyms (proposed by Cribb, 1951; Fan, 1953): *Dilophus radicans* Okamura, 1916: 7, pl. 1 figs 1-6, text figs 1-2 (type locality: Ponape, Caroline Islands). Rotuma: N'Yeurt, 1996: 400, figs 102-104. - *Vaughaniella rupicola* Børgesen, 1950: 9, figs 1-8 (type locality: Pointe aux Sables, Mauritius).

Material examined: Tafaa Point, Tahiti, 19 May 1922, *leg. W. A. Setchell and H. E. Parks*, BM 840888, 840898; Maate'a, Moorea, 12 Jun. 1984, *leg. C. E. Payri*, UPF 2896, 2897; Temae, Moorea, 25 Nov. 1995, *leg. A. D. R. N'Yeurt*, UPF 190; Maeva Beach, Faa'a, 7 May 1997, *leg. C. E. Payri*, UPF 194; Punaauia, Tahiti, 10 May 1997, *leg. A. D. R. N'Yeurt*, UPF 197; Papeari, Tahiti, 11 May 1997, *leg. A. D. R. N'Yeurt*, UPF 195; Taapuna, Tahiti, 16 May 1997, *leg. C. E. Payri*, UPF 193; Mokoto, Mangareva, 27 Sep. 1997, *leg. J. Starmer*, UPF 631; Matira, Bora Bora 15 Aug. 2002, *leg. A. D. R. N'Yeurt*, UPF 2517; Povai, Bora Bora 16 Aug. 2002, *leg. A. D. R. N'Yeurt*, UPF 2543; Afaahiti, Tahiti, 3 Sep. 2003, *leg. A. D. R. N'Yeurt*, UPF 2682.

Thallus flabelliform, to 5 cm high, entire to deeply incised, basally attached by rhizoids. Colour light brownish yellow, hidden by a light coat of whitish calcium carbonate on inferior surface. Apical margin revolute and inrolled to the inferior or inner surface; blade 2-cells thick. Superior surface of thallus with

concentric rows of fine hairs alternating with rows of non-indusiate unilocular sporangia. Slender, terete to compressed, '*Dictyerpa* or *Vaughaniella*' creeping form variously abundant at the base of the thallus (Fig. 27). The tortuous taxonomy of this species is discussed in Silva *et al.* (1996: 603).

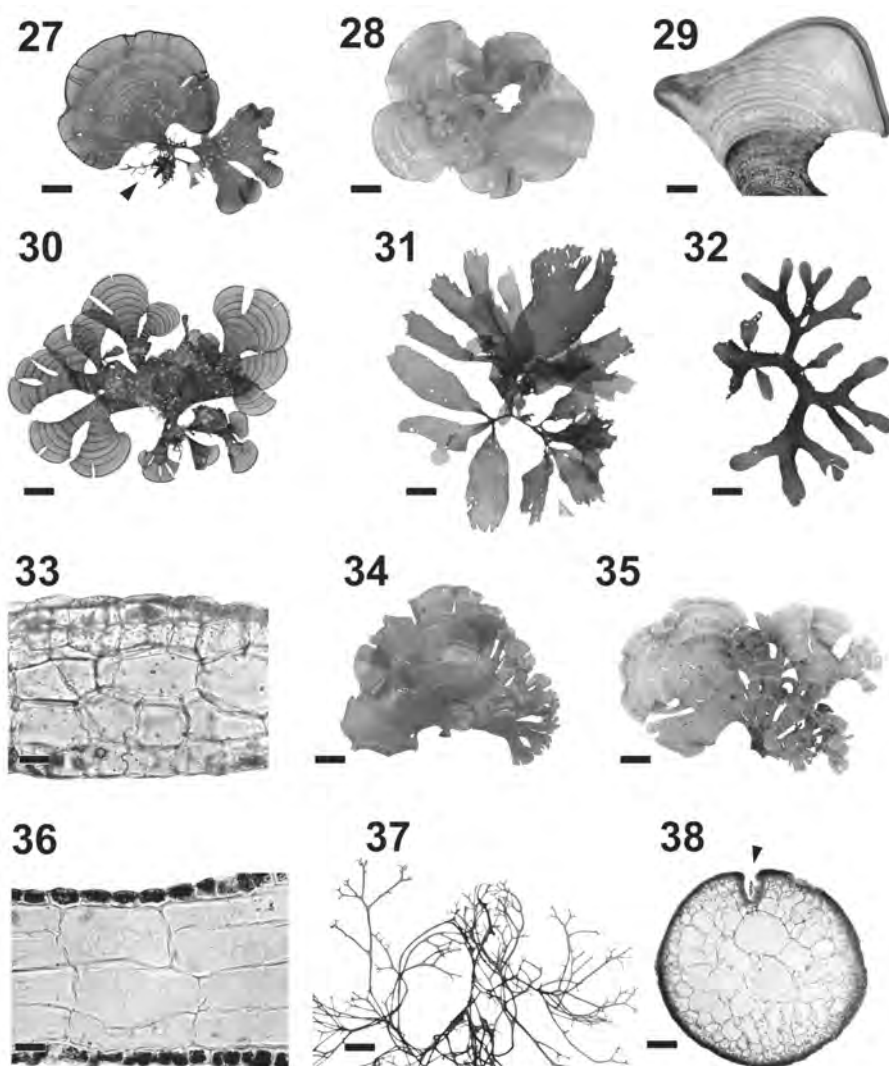
Remarks: The commonest *Padina* species in the Society Islands, present throughout the year, on coral rubble in shallow waters of the lagoon (Tahiti, Moorea) and fringing reefs. Absent from the southern Austral islands (e.g. Rapa). The associated, terete (or filamentous) creeping form of gametophytic or sporophytic plants is diagnostic of the species, and is so morphologically different from the flabellate form that it was once described as a separate genus and species (*Vaughaniella rupicola*, Børgesen 1950). The connection between *Vaughaniella* and *Padina* was first made by Cribb (1951). A similar confusion arose with *Dilophus radicans* Okamura (1916) from the Caroline Islands in the tropical North Pacific; Fan (1953) showed that it was also the prostrate juvenile form of *Padina boryana*. In some instances, especially after periods of heavy swells or hurricanes, the flabellate forms of *Padina* are ripped off the reef and only the creeping form (if any) remains, a situation which might have confused past collectors. Farrant & King (1989) report indusiate sori in Australian plants referred to as *Padina tenuis*, but indusia were not seen in French Polynesian plants.

Padina melemele* Abbott *et* Magruder in Abbott, 1996: 143, figs 1-3 (type locality: Ilio Point, Moloka'i Island, Hawai'i). Papua New Guinea: Coppejans *et al.*, 1995: 184, fig. 24 ("*Padina* sp."), Coppejans *et al.*, 2001: 29; Wynne, 1998: 287; Wallis Island: Payri *et al.*, 2002: 48, pl. 3 fig. 3; N'Yeurt & Payri, 2004: 377; Solomon Islands: Littler & Littler, 2003: 174; Hawaii: Abbott *et al.*, 2004: 217, fig. 83A. **(Figs 28-29)

Material examined: Rapa Island, Australs: Karapoo Rahi, 1 Nov. 2002, *leg. J. L. Menou*, UPF 1835; Akananue Bay, 2 Nov. 2002, *leg. C. E. Payri*, UPF 1880; Tauna Islet, 4 Nov. 2002, *leg. C. E. Payri*, UPF 1979; Anakaturinako Bay, 8 Nov. 2002, *leg. C. E. Payri*, UPF 2059; southeast edge of oceanic plateau, 8 Nov. 2002, *leg. J. L. Menou*, UPF 2086; Rarapai Island, 12 Nov. 2002, *leg. J. L. Menou*, UPF 2160; Ha'urei Bay, 11 Nov. 2002, *leg. J. L. Menou*, UPF 2173; Ha'urei Bay, 13 Nov. 2002, *leg. J. L. Menou*, UPF 2188; Aruroa Pt., 22 Nov. 2002, *leg. A. D. R. N'Yeurt*, UPF 2241, 2242, 2243; north slope Rapa Iti, 28 Nov. 2002, *leg. J. L. Menou*, UPF 2418.

Thallus fan-shaped and to 7 cm across, distromatic, 40-60 µm thick. Superior surface (Fig. 28) bright yellow; inferior or inner surface (Fig. 29) brilliant white and smooth, moderately to heavily calcified. Blade usually entire, rarely incised. Sporangia not seen in French Polynesian plants, but reported as non-indusiate, on inferior surface, with hair rows on either side for Hawaiian material (Abbott 1996), and as embedded in calcareous deposits for New Caledonian plants (CEP, pers. obs.). Creeping stage not present.

Remarks: Growing exclusively subtidally, on coral rubble, 10-50 m depth at Rapa Island, where it represents the only species of its genus. This deepwater species of *Padina* is characterised by a bright yellow to orange superior surface and a bright white calcified inferior or inner surface (surface towards which margin is curled; see Wynne 1998: 273). It is also reported from Fiji (N'Yeurt, unpubl.) and New Caledonia (Payri, unpubl.). *Padina melemele* may thus be quite widespread in the tropical Pacific, but undercollected because of its inconspicuous subtidal habitat. Interestingly, it has yet to be found north of Rapa Island in French Polynesia.



Figs 27-38. **27.** *Padina boryana* (UPF 197), habit, showing characteristic *Dictyera* creeping stage (arrowhead) (Scale = 5 mm). **28.** *Padina melemele* (UPF 1979), Habit, showing bright-yellow superior surface and non-laciniate blades (Scale = 5 mm). **29.** *Padina melemele* (UPF 2188), detail of bright white calcified inferior surface of blade (Scale = 3 mm). **30.** *Padina pavonica* (UPF 700), habit of deeply lacinate, tristromatic thallus (Scale = 5 mm). **31.** *Spatoglossum asperum* (UPF 208), habit of large foliose thallus from shallow water (Scale = 10 mm). **32.** *Spatoglossum asperum* (UPF 209), habit of strap-shaped thallus from deeper water (Scale = 5 mm). **33.** *Spatoglossum asperum* (*In Herb.* UPF), cross-section of shallow-water thallus from Tahiti Island (Scale = 30 μ m). **34.** *Styopodium australasicum* (UPF 1837), habit of thallus (Scale = 5 mm). **35.** *Styopodium australasicum* (UPF 1848), habit of cleft thallus (Scale = 5 mm). **36.** *Styopodium australasicum* (UPF 1836), cross-section of thallus showing 3-4 layers of large irregularly tiered rectangular cells (Scale = 40 μ m). **37.** *Choospora implexa* (UPF 914), habit of densely dichotomous, entangled thallus (Scale = 5 mm). **38.** *Choospora implexa* (UPF 747), cross-section of thallus, showing hair pit (arrowhead) (Scale = 50 μ m).

Padina pavonica (Linnaeus) Thivy in W. R. Taylor, 1960: 234-235. French Polynesia: Payri & N'Yeurt, 1997: 877, Payri *et al.*, 2000: 138; Belize: Littler & Littler, 1997: 81, fig 102; Fiji: N'Yeurt, 2001: 744, figs 83, 91-93, 102. **(Fig. 30)**

Basionym: *Fucus pavonicus* Linnaeus, 1753: 1162 (type locality: "In Mari Europae australis").

Synonym: *Padina pavonia* Lamouroux, 1816: 304. Morocco: Gayral, 1958: 230, 231 pl. 34; Sri Lanka: Durairatnam, 1961: 36, pl. 26 fig. 2; Lord Howe Island: Allender & Kraft, 1983: 84, fig. 6F.

Material examined: Tahiti, Mar. 1875, *leg. H. Moseley*, BM 840901; Tahiti, Oct. 1909, *leg. J. E. Tilden*, BM 840908; Trou du Souffleur, Tahiti, 18 Nov. 1995, *leg. A. D. R. N'Yeurt*, UPF 187; Taharaa, Tahiti, 14 Apr. 1997, *leg. C. E. Payri and A. D. R. N'Yeurt*, UPF 198, 531; Maeva Beach, Tahiti 7 May 1997, *leg. C. E. Payri*, UPF 201, 202; 5 Jun. 1997, *leg. A. D. R. N'Yeurt*, UPF 200; Taharaa, Tahiti, 30 Mar. 1998, *leg. A. D. R. N'Yeurt*, UPF 700, 701; Afaahiti, Tahiti, 16 Nov. 2004, *leg. A. D. R. N'Yeurt*, UPF 2905.

Fronds dark brown, 76-82 μm thick, tristromatic but sometimes tetrastromatic in basal portions; lightly calcified. Outer cells subquadrate, 30-32 μm long and 34-36 μm high, smaller than cells of two lower layers, which are rectangular and measure 62-69 μm long and 21-23 μm high. Sporangia persistently indusiate, on either side of hair bands; hair bands alternate on upper and lower surface of thallus. Creeping stage not observed.

Remarks: Growing on the fringing reef flats, in tide pools. Also found in turbid, calm waters of estuaries and bays, where it assumes a larger, heavily lacerated habit and is usually covered with diatoms (Tahiti). The iridescent, hair-fringed margins of the plant are quite noticeable in the field. It also feels coarser, and is usually darker in colour, than *P. boryana*.

Genus *Spatoglossum* Kützing

Spatoglossum asperum J. Agardh, 1894a: 36 (type locality: Sri Lanka). French Polynesia: Payri & N'Yeurt, 1997: 877; India: Børgesen, 1935: 35, pl. V; Mauritius: Børgesen, 1941: 48, pl. I; 1957: 5, figs 1-2; New Caledonia: Garrigue & Tsuda, 1988: 63. **(Figs 31-33)**

Misapplied name: *Spatoglossum solieri* (Chauvin *ex* Montagne) Kützing. French Polynesia: Payri *et al.*, 2000: 140.

Material examined: Punaauia, Tahiti, 5 Oct. 1995, *leg. A. D. R. N'Yeurt*, UPF 213, 214; Taharaa, Tahiti, 18 May 1996, *leg. C. E. Payri*, UPF 688, 689, 690; Punaauia, Tahiti, 16 May 1997, *leg. C. E. Payri and J. Orempuller*, UPF 208, 209, 212, 215, 216; Afaahiti, Tahiti, 7 Jun. 1997, *leg. A. D. R. N'Yeurt*, UPF 210, 211; Vairao, Tahiti, 20 Mar. 1998, *leg. J. Orempuller*, UPF 592; Punaauia, Tahiti, 5 Apr. 1998, *leg. A. D. R. N'Yeurt*, UPF 685; Punaauia, Tahiti, 23 Oct. 2000, *leg. A. D. R. N'Yeurt*, formalin-preserved in UPF; Akamaru, Gambiers, 17 Nov. 2000, *leg. A. D. R. N'Yeurt*, UPF 815; Mangareva, Gambiers, 19 Nov. 2000, *leg. A. D. R. N'Yeurt*, UPF 827; Afaahiti, Tahiti, 3 Sep. 2003, *leg. A. D. R. N'Yeurt*, UPF 2685.

Thallus to 20 cm high, yellowish-brown, composed of ovoid to elongate, rough, irregularly dichotomous blades to 9-20 (25) cm long and 3-8 (9) cm wide, and 150 μm thick (Figs 31-32). The living blades are leathery in texture, with broadly rounded ends and are more or less irregularly perforated with holes to 6 mm in diameter. Blade margins with numerous conspicuous marginal teeth, which can become eroded in older plants. Internal structure composed of 3 to

4 layers of irregularly quadrate to rectangular cells 68-128 × 48-88 μm (Fig. 33). Blade margins with aggregations of relatively smaller cells. Sporangia dark brown, ovoid, 72-92 × 60-88 μm, in a lateral-basal position, with a small stalk cell, not protruding from the blade surface. Does not adhere well to paper on drying.

Remarks: Commonly found at the base of coral heads in the lagoon 0.5-2 m depth, or forming extensive beds at depths of 15 to 20 meters on the outer slope (Tahiti). Older plants in calm waters can attain large sizes and are heavily epiphytised by crustose coralline algae (e.g. *Pneophyllum* spp., *Hydrolithon farinosum*) and turf such as *Hincksia mitchelliae*, *Ceramium* spp., *Heterosiphonia* spp. The Mediterranean species *S. solieri* differs from *S. asperum* in its entire, never denticulate margins and smaller (22-76 × 18-94 μm) and more regularly arranged medullary cells (J. R. Lluich, pers. com.). The Central and Western Pacific species *S. macrodontum* J. Agardh (Allender & Kraft, 1983: 100, figs 15, 16; Farrant & King, 1989; Abbott & Huisman, 2004: 222, fig. 85A-D) differs from *S. asperum* by the presence of deeply dentate margins, and narrower thallus branches 0.3-1 (2.5) cm wide. The French Polynesian plants are in excellent morphological agreement with Mauritius material of *S. asperum* described and illustrated in Børgesen, 1941: 48, pl. I, although reproductive information for that species is lacking (J.R. Lluich, pers. com.). *Spatoglossum* plants from New Caledonia are also similar to the French Polynesian species (pers. obs.). The genus is in need of revision as there are over 19 species described worldwide (Tanaka, 1992).

Genus *Stypopodium* Kützing

**Stypopodium australasicum* (Zanardini) Allender *et* Kraft, 1983: 94, figs 10 C-E, 11 A-C. Norfolk Island: Millar, 1999: 493; Western Australia: Huisman, 2000: 198.

(Figs 34-36)

Basionym: *Zonaria australasica* Zanardini, 1874: 487 (type locality: Lord Howe Island, Australia).

Material examined: St. Paul's Pools, Pitcairn Island, 1 Sept. 1997, *leg. J. Starmer*, UPF 661; Marotiri, Australs, St. DW1879, *leg. IRD*, UPF 2107; Rapa Island, Australs: Karapoo Rahi, 1 Nov. 2002, *leg. J. L. Menou*, UPF 1836, 1837, 1838, RPS 163; Ha'urei Bay, 5 Nov. 2002, *leg. J. L. Menou*, UPF RPS 162 (sporangial); Karapoo, 1 Nov. 2002, *leg. C. E. Payri*, UPF 1848; Tematapi Pt., 1 Nov. 2002, *leg. J. L. Menou*, UPF 1871, 1872; Akananue Bay, 2 Nov. 2002, *leg. C. E. Payri*, UPF 1889; base of cliffs, Rapa Iti, 4 Nov. 2002, *leg. C. E. Payri*, UPF 1940; Tarakoi Islet, 5 Nov. 2002, *leg. C. Payri*, UPF 1986, 1991, 1992, 2002, 2003, 2045, RPS 160; off Tarakoi Islet, 6 Nov. 2002, *leg. C. E. Payri*, UPF 2043; Anakaturinako Bay, 8 Nov. 2002, *leg. C. E. Payri*, UPF 2060, 2061, 2062, 2063; southeast edge of oceanic plateau, 8 Nov. 2002, *leg. J. L. Menou*, UPF 2085; between Matarepe and Takaraotara Pt., 9 Nov. 2002, *leg. C. E. Payri*, UPF 2092; Ha'urei Bay, 11 Nov. 2002, *leg. J. L. Menou*, UPF 2138, 2139; Ha'urei Bay, 13 Nov. 2002, *leg. J. L. Menou*, UPF 2205; inner slope, Tauna Islet, 27 Nov. 2002, *leg. C. E. Payri*, UPF 2238, 2349; Aruroa Pt., 22 Nov. 2002, *leg. A. D. R. N'Yeurt*, UPF 2291; eastern oceanic slope, 23 Nov. 2002, *leg. J. L. Menou*, UPF 2311, 2312, 2313.

Thallus 20-80 mm high, composed of palmate segments to 15 mm wide, or of flabellate fronds 30-70 mm wide, attached to the substratum via a single stupose holdfast (Figs 34-35). Colour yellow-brown, sometimes with greenish-blue iridescence, becoming dark brown on drying, with prominent concentric hair lines irregularly separated by 4-6 mm. Blade margins usually smooth, but frequently lacerate and with small lenticular perforations throughout the thallus. Thallus 181-272 μm and 4-6 cells thick, in upper regions with 2-3 rows of clear rectangular

medullary cells 41-82 μm long and 40-50 μm wide, and in basal regions with 4 rows of medullary cells mostly about 80 by 50 μm (Fig. 36). Epidermal cells small and densely pigmented, 18-45 μm long and 18-23 μm wide. Sporangia discrete, spherical and non-indusiate, 68-90 μm in diameter, borne atop 2 stalk cells resulting from the division into two tiers of the epidermal cell below.

Remarks: Restricted in French Polynesia to the southern Austral islands (Rapa, Marotiri) where it can form large dominant covers. There are three species of *Styopodium* commonly reported from the Indo-Pacific, which are (in decreasing order of frequency): *S. zonale* (Lamouroux) Papenfuss 1940: 205 (type locality Dominican Republic), *S. flabelliforme* Weber-van Bosse 1913: 176 (syntype localities Indonesia, Philippines) and *S. australasicum* (Zanardini) Allender & Kraft 1983: 94 (type locality Lord Howe Island, South Pacific). A fourth species, *S. hawaiiensis* (Doty *et* Newhouse) Abbott 1977: 6 (type locality Hawaii) is likely conspecific with *S. flabelliforme* (Abbott & Huisman, 2004: 224; O. De Clerck, pers. com.). The distinction between *S. zonale* and *S. australasicum* seems to be based on vague and variable characters (Mayhoub & Billard, 1991). Coppejans *et al.* (1995b) reported *Styopodium zonale* from Papua New Guinea, seeing no difference between the Pacific plants and the Indian Ocean *S. zonale* they were familiar with (O. De Clerck, pers. com.). The French Polynesian plants are identical to those reported from Lord Howe Island (Allender & Kraft, 1983). *Styopodium flabelliforme* differs from *S. australasicum* mainly by the absence of a stupose stipe, the presence of marginal rhizoids, and a smaller thallus with overlapping blades (Allender & Kraft, 1983). A specimen of *S. australasicum* has been identified by us from Pitcairn Island in the south-eastern Pacific.

Order Dictyosiphonales

Family Chnoosporaceae

Genus *Chnoospora* J. Agardh

Key to the French Polynesian species of *Chnoospora*

1. Thallus erect, attached and laxly dichotomous, growing in exposed habitats *C. minima*
1. Thallus in entangled, unattached masses, densely dichotomous, growing in calm habitats *C. implexa*

Chnoospora implexa J. Agardh, 1848: 172 (type locality: near Tor, Sinai Peninsula, Egypt). French Polynesia: Payri & N'Yeurt, 1997: 877; Payri *et al.*, 2000: 142; Vietnam: Dawson, 1954: 404, fig. 20a-b; Guam: Tsuda, 1972: 101, pl. 6 fig. 4; Japan: Kogame, 2001; Fiji: N'Yeurt, 2001: 737, figs 87-88; Hawaii: Abbott & Huisman, 2004: 176, fig. 66A-B; Rodrigues Island: Coppejans *et al.*, 2004: 3004, figs 27-28. **(Figs 37-38)**

Material examined: Tahiti, n.d., *leg. Anonymous*, BM 658674; Mangareva, Gambiers, 27 Sep. 1997, *leg. J. Starmer*, UPF 622; Tubuai, Australs, 18 Oct. 2000, *leg. V. Clouard*, UPF 749; Punaauia, Tahiti, 28 Oct. 2000, *leg. A. D. R. N'Yeurt*, UPF 747, 748, 750; Matira, Bora Bora 15 Aug. 2002, *leg. A. D. R. N'Yeurt*, UPF 2499, 2512.

Thallus composed of terete to compressed axes, forming extensive compact to lax yellow-brown unattached masses, up to 30 cm in diameter, wiry. Branching divaricately dichotomous, with branches 0.5-1 mm in diameter. Forking distant below, and becoming denser above (up to the sixth order), axes slightly

broadened at dichotomies (Fig. 37). In cross-section, subterete to oval, with a medulla of irregularly ovoid to subrectangular cells 42-100 µm in diameter, and a central region of small circular cells with thickened cell walls (Fig. 38). Life history heteromorphic and diphasic, alternating between an erect gametophyte and a discoid sporophyte.

Remarks: Found growing entangled with *Sargassum* spp in the lagoon of high islands. This seasonal species is present mostly between September and December, after the cool season and at the onset of the warmer season (Payri, 1987). *Chnoospora implexa* favours calm, lagoon conditions, unlike the related species *C. minima*, which is found in exposed habitats. A direct-type life history has been shown to sometimes occur in the culture of sexual strains of *C. implexa* (Kogame, 2001).

Chnoospora minima (Hering) Papenfuss, 1956: 69. French Polynesia: Payri & N'Yeurt, 1997: 877; Payri *et al.*, 2000: 142; Conte & Payri, 2002: 166, fig. 2; Guam: Tsuda, 1972: 101, pl. 6 fig. 5; Rotuma: N'Yeurt, 1996: 403, figs 96, 107; American Samoa: Littler & Littler, 2003: 176; Hawaii: Abbott & Huisman, 2004: 177, fig. 66C-D. **(Fig. 39)**

Basionym: *Fucus minimus* Hering, 1841: 92 (type locality: "Port Natal" (Durban), South Africa).

Heterotypic synonyms: *Chnoospora fastigiata* J. Agardh var. *pacifica* J. Agardh, 1848: 171. Easter Island: Børgesen, 1924: 263, figs 11, 12a-d; Sri Lanka: Durairatnam, 1961: 33, pl. 6 figs 8-9, pl. 22 fig. 1. - *Chnoospora pacifica* J. Agardh, 1847: 7. French Polynesia: Setchell, 1926: 89; Vietnam: Dawson, 1954: 405, fig. 20c.

Material examined: Tahiti, n.d., leg. *Anonymous*, BM 637862; Arue Point, Tahiti, 19 May 1922, leg. *W. A. Setchell and H. E. Parks*, BM 610803; Temae, Moorea, 14 Jun. 1984, leg. *C. E. Payri*, UPF 2798, 2888; Papeete, Tahiti, 23 Mar. 1997, leg. *A. D. R. N'Yeurt*, UPF 157, 158; Taharaa, Tahiti, 14 Apr. 1997, leg. *A. D. R. N'Yeurt*, UPF 156; 22 Apr. 1998, leg. *C. E. Payri*, UPF 717; Ua Huka, Marquesas, Aug. 1999, leg. *E. Conte and C. E. Payri*, UPF 817; Rapa Island, Australs, Tarakoi Islet, 5 Nov. 2002, leg. *C. E. Payri*, UPF 1989, 1990.

Plants to 40 mm tall, dull brown in colour, with main axis repeatedly and fastigiately dichotomously branched. Branches 0.5-1 mm broad, broadened and flattened at points of division. Cryptoblasts 9 mm broad and up to 53 mm long present on older branches. Attached to the substratum by a small discoid holdfast.

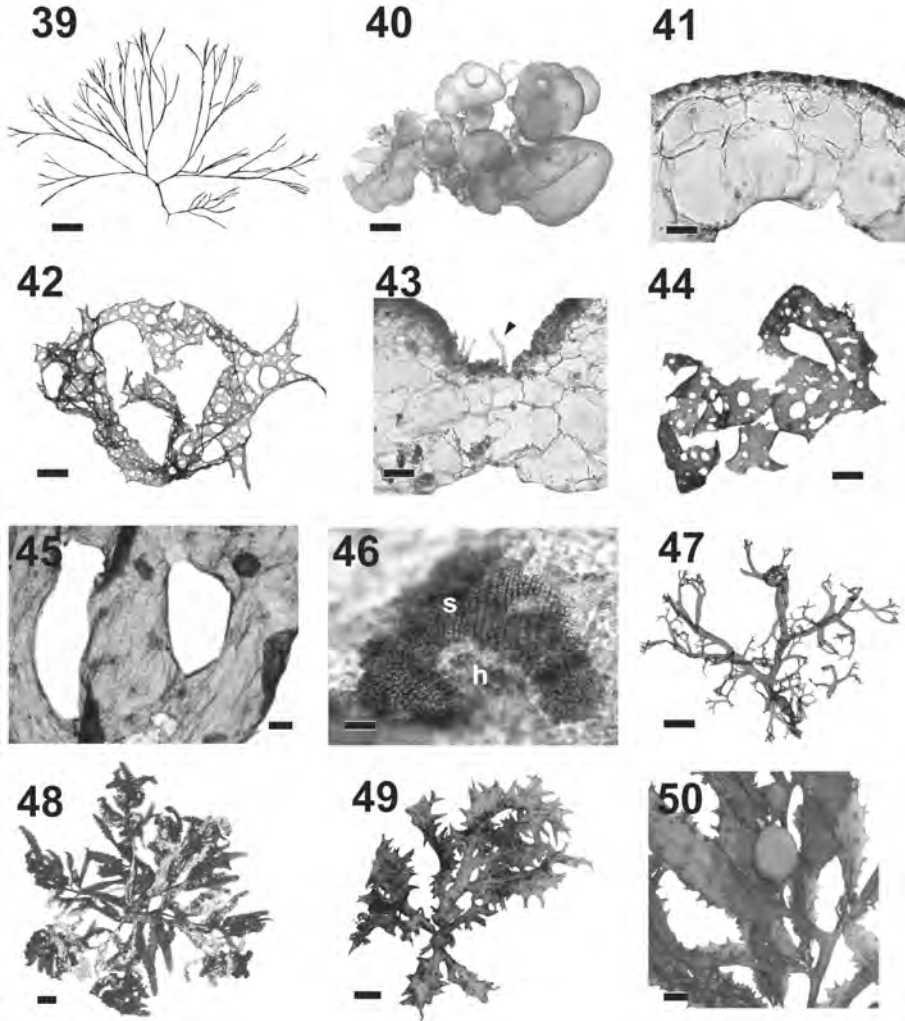
Remarks: Found on the reef crest of the high islands, in exposed locations; typically occurring as clumps on the wave-washed rocks or hidden within red algal mats. Usually associated with the filamentous brown alga *Asteronema breviarticulatum*. This is an edible species, being consumed in French Polynesia in the Marquesas (Conte & Payri, 2002).

Order Scytosiphonales

Family Scytosiphonaceae

Genus *Colpomenia* (Endlicher) Derbès *et* Solier

Colpomenia sinuosa (Mertens ex Roth) Derbès *et* Solier *in* Castagne, 1851: 95. French Polynesia: Setchell, 1926: 88, Payri & N'Yeurt, 1997: 877, Payri *et al.*, 2000: 144; Easter Island: Børgesen, 1924: 262; Morocco: Gayral, 1958: 213, fig. 30, 214 pl. 27; Vietnam: Dawson, 1954: 402, figs 18a, c-d; Sri Lanka: Durairatnam, 1961: 32, fig. 1; Mexico: Earle, 1969: 200, figs 100-101; Guam: Tsuda, 1972: 99, pl. 6 fig. 1; Australia: Clayton, 1975: 188, figs 5-7, 12-13, Womersley, 1987: 297, figs 107A, 108E-F; Pakistan: Nizamuddin & Begum, 1978: 318, figs 1-6, pl. I; New Zealand:



Figs 39-50. **39.** *Chnoospora minima* (UPF 156), habit of laxly dichotomous, erect thallus (Scale = 5 mm). **40.** *Colpomenia sinuosa* (UPF 2367), habit of unattached, hollow thallus (Scale = 5 mm). **41.** *Colpomenia sinuosa* (UPF 2684), cross-section of thallus (Scale = 50 μ m). **42.** *Hydroclathrus clathratus* (UPF 2513), habit of reticulate thallus (Scale = 5 mm). **43.** *Hydroclathrus clathratus* (UPF RPS 192), cross-section of thallus, showing hair pit with phaeophycean hairs (arrowhead) (Scale = 50 μ m). **44.** *Hydroclathrus tumulis* (UPF 2065), habit of pressed thallus (Scale = 5 mm). **45.** *Hydroclathrus tumulis* (UPF 2065), detail of sparse perforations (Scale = 3 mm). **46.** *Hydroclathrus tumulis* (UPF 2065), angular plurangial sori (s) adjacent to hair primordia (h) (Scale = 20 μ m). **47.** *Rosenvingea intricata* (UPF 2082), habit of pressed thallus (Scale = 3 mm). **48.** *Sargassum* cf. *S. echinocarpum* (UPF 780), habit of pressed thallus (Scale = 10 mm). **49.** *Sargassum* cf. *S. echinocarpum* (UPF 1981), habit of freshly-collected stunted thallus (Scale = 5 mm). **50.** *Sargassum* cf. *S. echinocarpum* (UPF 780), detail of large air vesicle (Scale = 3 mm).

Parsons, 1982: 291, figs 2, 3, 11, 12; Papua New Guinea: Coppejans *et al.*, 1995: 177; Fiji: N'Yeurt, 2001: 737, figs 85-86, 96; Hawaii: Abbott & Huisman, 2004: 179, fig. 67A-B. **(Figs 40-41)**

Basionym: *Ulva sinuosa* Mertens ex Roth, 1806: 327, pl. XI (type locality: near Cádiz, Spain).

Material examined: Tikehau Tuamotu, 4 Nov. 1995, *leg. A. D. R. N'Yeurt*, UPF 159; Taharaa, Tahiti, 14 Apr. 1997, *leg. C. E. Payri and A. D. R. N'Yeurt*, UPF 160; Mangareva, Gambiers, 27 Sep. 1997, *leg. J. Starmer*, UPF 627; Taharaa, Tahiti, 30 Mar. 1998, *leg. V. Stiger*, UPF 682; Raivavae Australs, 18 Oct. 2000, *leg. V. Clouard*, UPF 758; Tubuai, Australs, 18 Oct. 2000, *leg. V. Clouard*, UPF 757; Afaahiti, Tahiti, 3 Sep. 2003, *leg. A. D. R. N'Yeurt*, UPF 2684; 16 Nov. 2004, UPF 2906; Matira, Bora Bora 17 Aug. 2002, *leg. A. D. R. N'Yeurt*, UPF 2548, 2549; Rapa, Australs, 22 Nov. 2002, *leg. J. L. Menou*, UPF 2930.

Thallus 10-30 cm in diameter, yellow to golden-brown, hollow, of irregularly globular or convoluted shape (Fig. 40), texture firm but brittle; epilithic or epiphytic and sessile. Sometimes perforate, although never reticulate. Internal structure consisting of a surface layer of pigmented cuboid cells 5.5-6 µm across, and 4-6 layers of progressively larger subcortical and clear medullary cells 50-215 µm in diameter (Fig. 41). Phaeophycean hairs 31-43 µm long commonly occur in scattered pits on the surface of the thallus. Plurilocular reproductive organs are usually uniseriate, and occur in punctuate surface sori around hair groups; clavate unicellular paraphyses accompany the loculi.

Remarks: A seasonal species predominantly abundant during the cooler months. Growing on the reef flats and in the lagoon, often epiphytic on other brown algae such as *Turbinaria*. Found on both high islands and atolls, as far south as Rapa in the Australs. Can form very large unattached masses to 30 cm in diameter in the lagoons following destructive heating up of the stagnant water mass (such as that which occurred in Bora Bora in 2002, pers. obs.)

Genus *Hydroclathrus* Bory de Saint-Vincent

Key to the French Polynesian species of *Hydroclathrus*

1. Plant netlike; perforations numerous and close together (< 2 mm), phaeophycean hairs born in depression; sporangial sori extensively spread and irregular, not angular. *H. clathratus*
1. Plant membranous, not netlike, with large and small perforations separated by wide membranous areas (> 2 mm); phaeophycean hairs not arising in depressions; sporangial sori discrete, often with angular arrangement *H. tumulis*

Hydroclathrus clathratus (C. Agardh) Howe, 1920: 590; French Polynesia: Setchell, 1926: 89, Payri & N'Yeurt, 1997: 877, Payri *et al.*, 2000: 144; Vietnam: Dawson, 1954: 403, fig. 18*b*; Sri Lanka: Durairatnam, 1961: 33; Kenya: Isaac & Isaac, 1968: 23, pl. 3 fig. *E*; Mexico: Earle, 1969: 202, fig. 103; Guam: Tsuda, 1972: 100, pl. 6 fig. 2; Pakistan: Nizamuddin & Begum, 1978: 324, pl. V; South Australia: Womersley, 1987: 300, figs 109A, 110A-B; Papua New Guinea: Coppejans *et al.*, 1995: 178, fig. 1; Western Australia: Huisman, 2000: 204; Fiji: N'Yeurt, 2001: 738, fig. 80; Littler & Littler, 2003: 178; Hawaii: Kraft & Abbott, 2003: 246, figs 2-11, Abbott & Huisman, 2004: 183, fig. 68C-D. **(Figs 42-43)**

Basionym: *Encoelium clathratum* C. Agardh, 1823 (1822-1823): 412 (type locality Belle-Île, France according to Womersley, 1987: 300.)

Heterotypic synonym: *Hydroclathrus cancellatus* Bory de Saint-Vincent, 1825: 419. Easter Island: Børgesen, 1924: 263.

Material examined: Tahiti, Oct. 1909, *leg. J. E. Tilden*, BM 840837; Arue Point, Tahiti, 14 May 1922, *leg. W. A. Setchell and H. E. Parks*, BM 840836; Tahiti, Feb. 1931, *leg. C. Crossland*, BM 840835; Tiahura, Moorea, 13 Jun. 1984, *leg. C. E. Payri*, UPF 2790, 2887; Moorea, 24 Nov. 1995, *leg. A. D. R. N'Yeurt*, UPF 177; Taapuna, Tahiti, 7 May 1997, *leg. C. E. Payri and A. D. R. N'Yeurt*, UPF 178, 179; Taharaa, Tahiti, 30 Mar. 1998, *leg. V. Stiger*, UPF 683; Mangareva, Gambiers, 18 Nov. 2000, *leg. A. D. R. N'Yeurt*, UPF 775; Matira, Bora Bora 15 Aug. 2002, *leg. A. D. R. N'Yeurt*, UPF 2513, 2498; 17 Aug. 2002, *leg. A. D. R. N'Yeurt*, UPF 2567; Rapa Island, Australs, Agairoa Bay, 2 Nov. 2002, *leg. C. E. Payri*, UPF 1906; Akananue Bay, 2 Nov. 2002, *leg. C. E. Payri*, UPF 1890; Tarakoi Islet, 5 Nov. 2002, *leg. C. E. Payri*, UPF RPS 192; Tiahura, Moorea, *leg. A. D. R. N'Yeurt*, 28 Sep. 2004, UPF 2937; 30 Sep. 2004, UPF 2954.

Thallus forming entangled masses to 15 cm across, dark brown, consisting of an expanded, torn and irregularly lobed net-like membrane with abundant ovoid to spherical holes 3-11 mm in diameter (Fig. 42). Attachment vague and diffuse, by means of rhizoids. Medulla 3-5 layered, of large clear cells 90-135 μm in diameter and cortex 1-2 cell thick, of isodiametric pigmented cells 6-10 μm in diameter. Phaeophyceyan hairs 5-8 cell long, abundant in depressions on surface of thallus (Fig. 43). Plurilocular reproductive organs are uni- or biseriate, in surface sori, without accompanying paraphyses.

Remarks: A seasonal species commonly found in the lagoon of high islands, either loosely attached to coral heads or unattached in balls on the bottom (Tsuda, 1974; Payri, 1987); also occurs on the reef crest of high islands and atolls. It sometimes can be confused with perforate thalli of *Colpomenia sinuosa*, but the latter are thinner and lighter in colour, and rarely become clathrate as *Hydroclathrus*. However, in some instances there appears to be a continuum of morphotypes between non-clathrate “*Colpomenia*-like” and clathrate “*Hydroclathrus*-like” forms, which raises questions as to the generic affinities of the material; the only criteria to differentiate *Colpomenia* from *Hydroclathrus* in that instance being the presence (in the former) or absence (in the latter) of paraphyses among the reproductive sori.

**Hydroclathrus tumulis* Kraft *et* Abbott, 2003: 254, figs 30-39 (type locality: Maro Reef, Hawaiian Islands). Hawaii: Abbott & Huisman, 2004: 184, fig. 68E-G.

(Figs 44-46)

Material examined: Rapa Island, Australs: inner slope, Tauna Islet, 27 Nov. 2002, *leg. C. E. Payri*, UPF 2397; Tarakoi Islet, 05 Sep. 2002, *leg. C. E. Payri*, UPF 1987; Anakaturinako Bay, 8 Nov. 2002, *leg. C. E. Payri*, UPF 2064, 2065; southeast oceanic plateau, 8 Nov. 2002, *leg. J. L. Menou*, UPF 2084.

Thallus forming slimy, membranous light brown sheets 25 to 90 mm in diameter at widest and 110 to 250 μm thick; margins curled or folded (Fig. 44). Perforations rare or sometimes absent, 2 to 20 mm in diameter, separated from each other by membranous areas 2.5 to 30 mm wide (Fig. 45). Phaeophyceyan hairs occurring singly or up to 6 together, not borne in depressions. Internal structure composed of a medulla of 2-4 clear, ovoid cells to 250 μm in diameter, surrounded by small, usually papillate pigmented cortical cells 8-10 \times 10-14 μm . Plurangular sori adjacent to hair primordia, discrete with angular outlines, 40-250 \times 30-200 μm , with loosely aggregated plurangia in palisade layers (Fig. 46).

Remarks: Growing together with *Colpomenia sinuosa*, –15 to –52 m depth. In French Polynesia, to date only distributed in the cooler waters of Rapa, Australs, where it could be mistaken for perforate thalli of *Colpomenia sinuosa*. However, the sharply angular plurangia sori of *H. tumulis* distinguishes it from the discrete, circular sori of *Colpomenia*. The angular plurangial sori, widely separated perforations and papillate cortical cells separate *H. tumulis* from *H. clathratus*. In the field, however, sterile material of all three species can look very similar and are quite difficult to distinguish.

Genus *Rosenvingea* Børghesen

Rosenvingea intricata (J. Agardh) Børghesen, 1914: 26. French Polynesia: Payri & N'Yeurt, 1997: 877, Payri *et al.*, 2000: 146; India: Børghesen, 1930: 167, fig. 9; Marshall Islands: Dawson, 1957: 111, fig. 1; Sri Lanka: Durairatnam, 1961: 32, pl. 7 fig. 6, pl. 22 fig. 2; Mexico: Earle, 1969: 207, figs 108-112; Guam: Tsuda, 1972: 100, pl. 6 fig. 3; Western Australia: Huisman, 2000: 205; Fiji: N'Yeurt, 2001: 740, figs 81, 94-95; Hawaii: Abbott & Huisman, 2004: 185, fig. 69A-C. **(Fig. 47)**

Basionym: *Asperococcus intricatus* J. Agardh, 1847: 7 (type locality: Veracruz, Mexico).

Material examined: Tikehau, Tuamotu, 7 Nov. 1995, *leg. A. D. R. N'Yeurt*, UPF 203; Taapuna, Tahiti, 16 May 1997, *leg. C. E. Payri*, UPF 204; Matira, Bora Bora, 17 Aug. 2002, *leg. A. D. R. N'Yeurt*, UPF 2551; Rapa Island, Australs, southeast edge of oceanic plateau, 8 Nov. 2002, *leg. J. L. Menou*, UPF 2082; Tiahura, Moorea, 29 Sep. 2004, *leg. A. D. R. N'Yeurt*, UPF 2964.

Thallus forming soft golden brown entangled cushions 3-10 cm in diameter, with hollow branches 2-5 mm in diameter. Branching wide angled, irregular to irregularly dichotomous, with tapered subacute to truncated apices. Medulla of large irregularly shaped clear cells 22-71 µm in diameter. Cortex single-layered, with subrectangular to cuboid pigmented cells 7-11 µm in diameter and 8-15 µm high.

Remarks: forming loose unattached balls on the lagoon floor of high islands and atolls. This is a seasonal species, usually abundant in May to November.

Order Fucales

Family Sargassaceae

Genus *Sargassum* C. Agardh

Setchell (1926) credits four species of *Sargassum* to French Polynesia, but so far only two of these (*S. mangarevense* and *S. sociale*) have been confirmed on the basis of molecular taxonomy (Stiger *et al.*, 2000). A further species has been recorded for French Polynesia since Setchell's publication, and several others are in the process of molecular investigation (Mattio & Payri, pers. com.).

Key to the French Polynesian species of *Sargassum*

1. Leaves thick and coarse, spines numerous and in a double row..... *Sargassum* cf. *S. echinocarpum*
1. Leaves thinner, spines absent to less conspicuous and in a single row 2
 2. Vesicles with filiform extension, pedicel of vesicle often broadly foliaceous, cryptostomata relatively large and few, confined to either side of the leaf midrib..... *S. sociale*
 2. Vesicles lacking filiform extension, pedicel terete to flattened but not especially foliaceous, cryptostomata small and numerous, randomly distributed throughout leaf *S. mangarevense*

Sargassum* cf. *S. echinocarpum* J. Agardh, 1848: 327 (type locality: Hawaiian Islands). Taiwan: Yamada, 1950: 190, fig. 7; Hawaii: Abbott & Huisman, 2004: 236, figs 92A-B. **(Figs 48-51)

Material examined: Aukena, Gambiers, 21 Sep. 1997, leg. J. Starmer, UPF 606; Mangareva, Gambiers, 27 Sep. 1997, leg. J. Starmer, UPF 624; Rurutu, Australs, 18 Aug. 2000, leg. C. E. Payri, UPF 736, 741, 742, 743; Mangareva, Gambiers, 18 Nov. 2000, UPF 780; 19 Nov. 2000, leg. A. D. R. N'Yeurt, UPF 832; Rapa Island, Australs, Ha'urei Bay, 13 Nov. 2002, leg. J. L. Menou, UPF 2207; Tauna Islet, 4 Nov. 2002, leg. C. E. Payri, UPF 1981; Tarakoi Islet, 5 Nov. 2002, leg. C. E. Payri, UPF 2612.

Thallus to 30 cm high, with a clearly apparent and smooth main axis 1-1.5 mm in diameter; attached to the substratum via a single discoid holdfast (Figs 48-49). Leaves 4-6 mm wide and 17-40 mm long, coriaceous, ovate, with numerous marginal spines often in a double-row (Fig. 51). Cryptostomata relatively large, randomly distributed about leaf. Air vesicles (Fig. 50) to 5 mm in diameter, spherical on a terete pedicel, without filiform extension. Plants androgynous; cymose receptacles 2-3 mm long, with spiny margins.

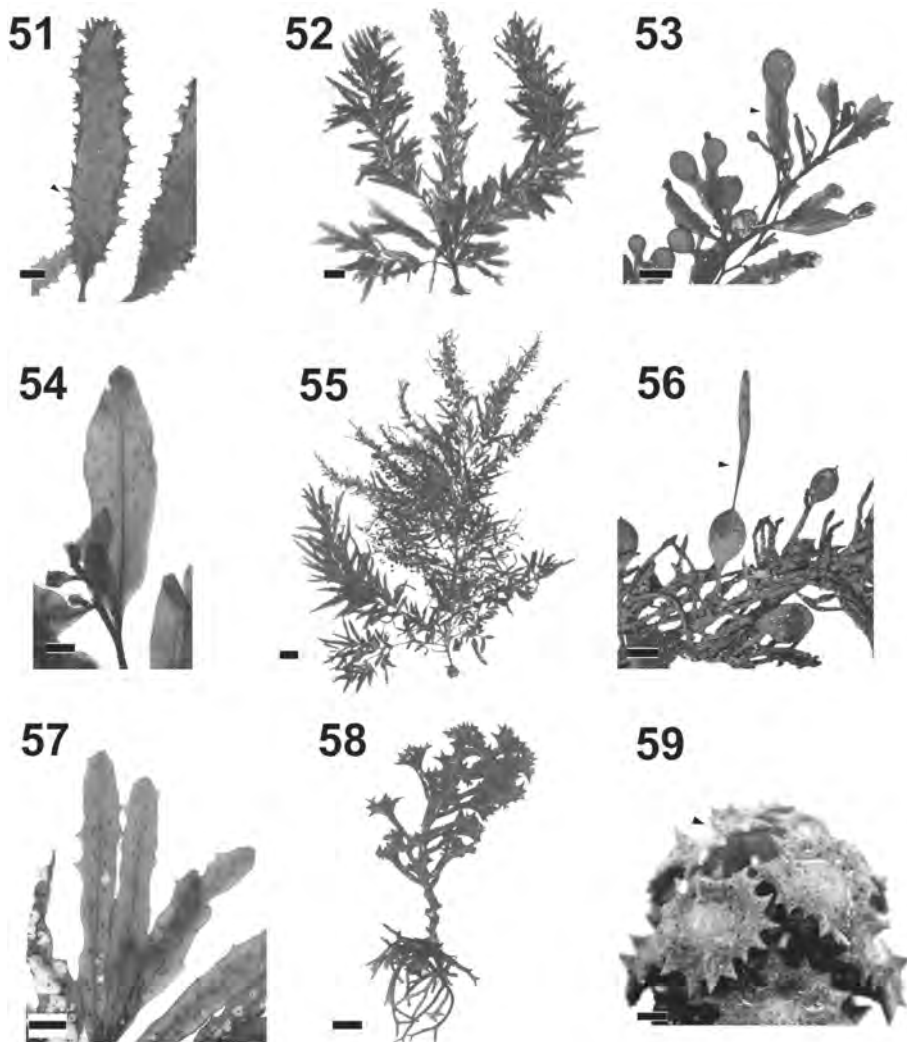
Remarks: This species usually grows close to the shoreline, and can be readily distinguished in the field by its coriaceous oval leaves with double-rows of marginal teeth. In French Polynesia, it is so far only reported from the Gambiers and the Australs groups, and apparently absent from the Society group; it was hence not mentioned by Setchell (1926). This species, along with others, is the subject of ongoing molecular investigations (Mattio & Payri, pers. com.).

Sargassum mangarevense (Grunow) Setchell, 1926: 96, pl. 15 fig. 6; pl. 16 figs 1-5. French Polynesia: Noro & Abbott, 1994: 34, Payri & N'Yeurt, 1997: 878, Payri *et al.*, 2000: 146. **(Figs 52-54)**

Basionym: *Sargassum vulgare* var. *mangarevense* Grunow, 1916: 44 (type locality: Mangareva Island, Gambier archipelago, French Polynesia).

Material examined: Taharaa, Tahiti, 17 Jun. 1922, leg. W. A. Setchell and H. E. Parks, BM 841277; Arue, Tahiti, 27 Jun. 1922, leg. W. A. Setchell and H. E. Parks, UC 261347; Punaruu Pass, Tahiti, 11 Jul. 1922, leg. W. A. Setchell and H. E. Parks, UC 261315; Maate'a, Moorea, 12 Jul. 1984, leg. C. E. Payri, UPF 2792, 2879, 2880, 2882, 2889, 2890, 2891, 2892, 2893, 2894, 2895, 2899; Atimaono, Tahiti, 16 May 1991, leg. C. E. Payri, UPF 2934; Paea, Tahiti, 16 May 1991, leg. C. E. Payri, UPF 2933; Tipaerui, Tahiti, 16 May 1991, leg. C. E. Payri, UPF 2932, 2935; Taapuna, Tahiti, Apr. 1997, leg. V. Stiger, UPF 207; Afaahiti, Tahiti, 8 Jun. 1997, leg. A. D. R. N'Yeurt, UPF 206; Mangareva, Gambier, 22 Nov. 2000, leg. A. D. R. N'Yeurt, UPF 812; Matira, Bora Bora, 17 Aug. 2002, leg. A. D. R. N'Yeurt, UPF 2563; Tiahura, Moorea, 1 Oct. 2004, leg. A. D. R. N'Yeurt, UPF 2936.

Thallus to 20 cm high, irregularly and densely branched (Fig. 52). Lateral branches bearing numerous leaf like, lanceolate blades with a smooth or serrated margin to 30 mm long and 6 mm wide. Upper surface of the blades spotted by numerous cryptostomata randomly distributed about the midrib (Fig. 54). Vesicles shortly pedicellate, spherical to oblong to 4-6 mm wide, lacking leaf like projections and generally non foliose below (Fig. 53). Branches growing from a stipe to 2 mm wide, naked below, arising from a discoid holdfast. Plants monoecious; fertile receptacles elongate, present all the year round.



Figs 51-59. **51.** *Sargassum* cf. *S. echinocarpum* (UPF 780), detail of leaves, showing randomly distributed cryptostomata and double row of marginal teeth (arrowhead) (Scale = 3 mm). **52.** *Sargassum mangarevense* (UPF 206), habit of pressed thallus (Scale = 15 mm). **53.** *Sargassum mangarevense* (UPF 206), detail of air vesicles, showing foliose pedicel (arrowhead) (Scale = 3 mm). **54.** *Sargassum mangarevense* (UPF 206), detail of leaf, showing randomly distributed cryptostomata (Scale = 2 mm). **55.** *Sargassum sociale* (UPF 2679), habit of pressed thallus (Scale = 15 mm). **56.** *Sargassum sociale* (UPF 2679), detail of air vesicles, showing non-foliose pedicel and filiform extension (arrowhead) (Scale = 2 mm). **57.** *Sargassum sociale* (UPF 2679), detail of leaves, showing cryptostomata confined to either side of midrib (Scale = 2 mm). **58.** *Turbinaria ornata* (In Herb. UPF), habit of freshly-collected thallus, showing stilt-like haptera and obpyramidal leaves atop terete axis (Scale = 10 mm). **59.** *Turbinaria ornata* (In Herb. UPF), detail of leaves, showing second row of inwardly-directed teeth (arrowhead) (Scale = 5 mm).

Remarks: Common in the lagoon, growing in patches on coral heads (Tahiti, Moorea). Setchell (1926) noted the absence of foliose pedicels in the vesicles of *S. mangarevense*, however these were observed in our specimens (Fig. 53). The larger diameter, smooth basal leaves and randomly distributed cryptostomata are characteristic for this species.

Sargassum sociale (Grunow) Setchell, 1926: 95, pl. 15 figs 3-4. French Polynesia: Payri & N'Yeurt, 1997: 878. **(Figs 55-57)**

Basionym: *Sargassum vulgare* var. *socialis* Grunow, 1916: 44 (type locality: Tahiti).

Material examined: Arue Point, Tahiti, 19 May 1922, leg. W. A. Setchell and H. E. Parks, BM 841278; Papeete, Tahiti, 26 May 1922, leg. W. A. Setchell and H. E. Parks, BM 841279, 841280, UC 261312; Temae, Moorea, 25 Nov. 1995, leg. A. D. R. N'Yeurt, UPF 205; Afaahiti, Tahiti, 3 Sep. 2003, leg. A. D. R. N'Yeurt, UPF 2679.

Thallus to 25 cm tall, with branches up to 8 cm long, attached to the substratum via a single holdfast (Fig. 55). Leaves sharply toothed, acute or obtuse, 1-4 cm long (Fig. 57). Cryptostomata sparse, confined to double rows either side of the midrib. Vesicles pedicellate, often foliaceous, toothed with cryptostomata present, and with characteristic filiform extensions (Fig. 56). Plants monoecious; receptacles cymose, to 4 mm long.

Remarks: An intertidal species, restricted to the outer part of the barrier reef, while *S. mangarevense* grows throughout the lagoon. Setchell (1926) separated this species on the basis of its more elongate, sharply toothed leaves with cryptostomata in double rows on either side of the midrib, features which were confirmed in our specimens, along with common filiform extensions of the vesicles. However, the foliaceous nature of the vesicle pedicel was found to be a highly variable character. It is clearly apparent in some specimens (e.g. UC 261347) but not so clear in others. The same applies for the distribution in double rows of cryptostomata, which in some plants is not so apparent.

Genus *Turbinaria* Lamouroux

Turbinaria ornata (Turner) J. Agardh, 1848: 266. French Polynesia: Setchell, 1926: 94, Payri & N'Yeurt, 1997: 878, Payri *et al.*, 2000: 148; Vietnam: Dawson, 1954: 405, fig. 21; Sri Lanka: Durairatnam, 1961: 40, pl. 27; Taylor, 1964: 483, pl. 3 figs 1-6; Guam: Tsuda, 1972: 103, pl. 8 figs 1-3; Papua New Guinea: Coppejans *et al.*, 1995: 192, fig. 38, Littler & Littler, 2003: 186; Western Australia: Huisman, 2000: 226; Fiji: N'Yeurt, 2001: 745; Oman: Wynne, 2001: 365, fig. 32; Samoa: Skelton & South, 2002: 160, fig. 19E; Hawaii: Abbott & Huisman, 2004: 242, fig. 95. **(Figs 58-59)**

Basionym: *Fucus turbinatus* Linnaeus var. *ornata* Turner, 1807-1808: 50-53, pl. 24, figs c, d (type locality unknown).

Misapplied name: *Turbinaria condensata* Sonder in Kützing, 1860: 25, pl. 69 fig. II (type locality: China Sea). French Polynesia: Taylor, 1973: 38.

Material examined: Tahiti, Mar. 1875, leg. H. Moseley, BM 701488; Punaruu, Tahiti, 11 Jul. 1922, leg. W. A. Setchell and H. E. Parks, BM 701526; Arue Point, Tahiti, 19 May 1922, leg. W. A. Setchell and H. E. Parks, BM 701487; Tafaa Point, Tahiti, 19 May 1922, leg. W. A. Setchell and H. E. Parks, BM 841266; Tahiti, 29 Sep. 1928, leg. C. Crossland, BM 701486; Tikehau, Tuamotu, 4 Nov. 1995, leg. A. D. R. N'Yeurt, UPF 217; Taharaa, Tahiti, 14 Apr. 1997, leg. C. E. Payri and A. D. R. N'Yeurt, UPF 219; 6 Jun. 1997, leg. A. D. R. N'Yeurt, UPF 218; Raivavae,

Australs, 13 Aug. 1999, *leg. R. Moranay*, UPF 829; 18 Oct. 2000, *leg. V. Clouard*, UPF 753; Matira, Bora Bora, 15 Aug. 2002, *leg. A. D. R. N'Yeurt*, UPF 2497; Afaahiti, Tahiti, 23 May 2002, *leg. A. D. R. N'Yeurt*, in Herb. UPF.

Plants light brown to yellow, to 3-10 cm tall and 5 cm broad, coarse and firm, with monopodial axes attached to the substratum by stilt-like haptera up to 2 mm in diameter and 25 mm long (Fig. 58). Axes radially branched, with laterals generally concave, 1-2 cm in diameter, with terete stalks for about half their length, terminally distended in a rounded to obpyramidal manner with obtuse ridges; a large air vesicle usually occupying the central portion; intramarginal teeth up to 3 mm high present (Fig. 59). Up to 13 marginal crown teeth on periphery of leaves, and up to 6 often paired erect teeth arranged at about 120° angle over the peripheral surface of the blades. Receptacles short and densely branched, adaxial on stalks of laterals.

Remarks: Commonly found growing in the lagoons and on the reefs. The presence of intramarginal teeth currently distinguishes *T. ornata* from superficially similar *T. conoides*, which is so far not reported east of the Cook Islands in the South Pacific (Chapman, 1977, N'Yeurt & Payri, 2004b). Some of the Polynesian plants are stocky and no more than 4 cm high, showing the environmentally-induced form of dwarfism in exposed habitats, described by Payri (1984) and also reported from Oman (Wynne, 2002: 285), Guam (Taylor, 1964) and French Polynesia (Taylor, 1973). In calm lagoon habitats of French Polynesia, the typical form of this species has a more lax and less robust habit, individual axes reaching up to 15 cm and at times once or twice dichotomously divided near the base (Payri, 1984). Together with *Sargassum* spp, detached thalli of *T. ornata* have the tendency to form large drifting rafts on the ocean surface, which can travel between islands and retain reproductive potential (French Polynesia: Payri *et al.*, 2000: 148, photo with caption). In French Polynesia, *T. ornata* has become invasive in recent years, spreading to atolls of the Tuamotu and Australs and disrupting the natural ecological balance of the habitats of these islands (Stiger & Payri, 1999).

DISCUSSION

The distribution of the species among the five main archipelagoes of French Polynesia (Tab. 1), shows that a few species are ubiquitous and occur in almost all groups, such as *Colpomenia sinuosa* and *Lobophora variegata*. On the other hand, *Dictyopteris repens* and *Dictyota hamifera* have been only recorded from Society and Marquesas, and 20% of the species are apparently specific to the Australs, such as *Cladosiphon novae-caledoniae*, *Cutleria mollis*, *C. irregularis*, *Hydroclathrus humilis*, *Padina melemele* and *Stypopodium australasicum* and five species are recorded from the island of Rapa. These distribution patterns could be explained by temperature barriers (which prevent cooler water, southerly species from implanting in warmer localities to the north) and other as yet unstudied ecological factors, perhaps linked to the availability of certain specific habitats. The occurrence of only two species of Phaeophyceae in the Marquesas is likely an artefact of under sampling in that phycologically little-known archipelago, rather than a true representation of distribution patterns. If the possibilities of comparing are hence limited, the data (Tab. 1) indicate that the Society and Australs are the richest archipelagoes, which may reflect the larger variety of

Table 1. Distribution of species of Phaeophyceae among the various archipelagos and affinities to Pacific and Indo-Pacific regions.

<i>Archipelagos</i>	<i>Australs</i>	<i>Gambier</i>	<i>Marquesas</i>	<i>Society</i>	<i>Tuamotu</i>	<i>Pacific species</i>	<i>Indo-Pacific species</i>
<i>Asteronema breviarticulatum</i>		+		+		+	+
<i>Chnoospora implexa</i>	+	+		+		+	+
<i>Chnoospora minima</i>	+		+	+		+	+
<i>Cladosiphon novae-caledoniae*</i>	+					+	
<i>Colpomenia sinuosa</i>	+	+		+	+	+	+
<i>Cutleria irregularis</i>	+					+	
<i>Cutleria mollis*</i>	+					+	
<i>Dictyopteris repens</i>				+		+	+
<i>Dictyota acutiloba*</i>	+					+	+
<i>Dictyota bartayresiana</i>	+			+		+	+
<i>Dictyota ceylanica</i>		+		+		+	+
<i>Dictyota friabilis</i>		+		+	+	+	+
<i>Dictyota hamifera</i>			+	+		+	+
<i>Hincksia mitchelliae</i>	+				+	+	+
<i>Hydroclathrus clathratus</i>	+	+		+		+	+
<i>Hydroclathrus tumulis*</i>	+					+	
<i>Lobophora variegata</i>	+	+		+	+	+	+
<i>Padina boryana</i>		+		+		+	+
<i>Padina melemele*</i>	+					+	
<i>Padina pavonica</i>				+		+	
<i>Ralfsia expansa</i>				+		+	
<i>Rosenvingea intricata</i>	+			+	+	+	+
<i>Sargassum</i> cf. <i>S. echinocarpum</i>	+	+				+	+
<i>Sargassum mangarevense</i>		+		+		+	
<i>Sargassum sociale</i>				+		+	
<i>Spatoglossum asperum</i>		+		+		+	
<i>Sphacelaria rigidula</i>	+			+		+	+
<i>Sphacelaria tribuloides</i>				+		+	+
<i>Styopodium australasicum*</i>	+					+	+
<i>Turbinaria ornata</i>	+			+	+	+	+
Total	18	11	2	21	6	31(64.5%)	20(35.5%)

* Species present only on Rapa island.

Table 2. Number and percentages of French Polynesian brown algal species in common with several tropical and subtropical-temperate localities.

<i>Localities</i>	<i>Number of species shared with FP</i>	<i>%</i>	<i>Sorensen index</i>	<i>References</i>
Guam, Pohnpei, Ant atoll and Micronesia	21	70	0.33	Lobban & Tsuda, 2003; Hodgson & McDermid, 2000
Fiji and Rotuma	20	67	0.34	N'Yeurt <i>et al.</i> , 1996; Littler & Littler, 2003; South & Skelton, 2003
Hawaii	18	60	0.28	Abbott & Huisman, 2004
Rarotonga and Cook Islands	18	60	0.40	Chapman, 1977; N'Yeurt & Payri, 2004
Samoa	18	60	0.33	Skelton & South, 1999, 2002; Littler & Littler, 2003
Lord Howe Island	15	50	0.25	Millar & Kraft, 1994
Solomon Islands	11	37	0.27	Womersley & Bailey, 1970; Littler & Littler, 2003
Kermadec	9	30	0.20	Nelson & Adams, 1984
Norfolk Island	8	27	0.18	Millar, (1999)

benthic habitats and ecological environments. The Australs's high richness and originality may be due to their geographic extension over the Tropic of Capricorn, and the southernmost position (27°S) of Rapa and Marotiri Islands close to cooler waters (19-22°C). The Rapa flora appears particularly interesting, with six species only recorded in French Polynesia from this locality (Tab. 1), including species such as *Cutleria irregularis* and *Hydroclathrus tumilis* recently described as Hawaiian endemics (Abbott & Huisman, 2003), or *Padina melemele* and *Sargassum* cf. *S. echinocarpum* which are in contrast, more widely distributed in the tropical Pacific. Another two species, *Cutleria mollis* and *Styopodium australasicum*, are known from temperate South Pacific islands such as Lord Howe Island, Norfolk and Kermadec. These unexpected species are indicative of a sort of continuum in the dispersal of species within the temperate South Pacific region, and it is not surprising that temperate species can establish themselves in the southern Austral islands. The record of *Cladosiphon novae-caledoniae* considerably extends the eastern distribution of this species in relation to its type locality. On the other hand, the absence from other areas of French Polynesia, and in particular from the Society group where few habitats remain unexplored, of *Padina melemele*, a species widely distributed in the Western and Central Pacific, remains a mystery.

Conversely, the case of the invasive brown alga *Turbinaria ornata* is of particular interest, since that species has been gradually propagating to atolls of the Tuamotu Group (Stiger & Payri, 1999), but has not yet reached the Gambier or the Marquesas, which are at opposite extremes of the presumed centre of distribution (Society). In the Australs, *T. ornata* has reached as far south as Raivavae, but not as yet the cooler waters of Rapa. The Sargassaceae, which are

widely distributed in the lagoons of high islands in the Society, Gambier and Austral groups are totally absent in the Marquesas and Tuamotu. However, current global warming trends and increasing sea temperatures, if left unchecked, could change that picture, with the possible eradication of Polynesian cool-temperate brown algal beds (e.g. *Styopodium australasicum*, stiped *Lobophora variegata*) and the introduction of such undesirable invasive species as *T. ornata* in Rapa waters, with consequential negative effects on local fish populations associated with those algal beds.

At the Indo-Pacific scale, the largest number of the French Polynesian Phaeophyceae (64.5%) is found throughout the Pacific, while the remaining 35.5% belong to the Indo-Pacific biogeographic province, which contains species known from both Pacific and Indian Oceans. Comparison of the French Polynesian flora with phycologically better-known Pacific regions (Tab. 2) shows that most of the species are typical of those found in the Central Pacific. The greatest number of species is shared with the Micronesia and Fiji groups (70 and 66% respectively; Tab. 2) which may be due to a comparable combined high island – atoll environments and habitats in these regions. However, the degree of similarity calculated using Sorensen's Index (Legendre & Legendre, 1992) indicates that the brown algal flora of French Polynesia is more similar to its nearest neighbouring archipelago the Cook Islands, than to the more distant group of islands. Despite the fact that the species of Phaeophyceae known from French Polynesian have increased, this region remains less rich than the areas located in the Western Pacific, reflecting the west-to-east decrease of richness well documented for corals by Veron (1995) and other faunal groups.

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