

**Contributions to a Catalogue of Benthic Marine Algae of Fiji.  
II. *Caulerpa* and *Caulerpella* (Chlorophyta-Caulerpales)**

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**Abstract**—Twenty-three taxa in the genera *Caulerpa* Lamouroux and one species of *Caulerpella* Prud'homme van Reine and Lokhorst are reported from the Fiji Islands (including the island of Rotuma), South Pacific. A key to the species and sub-specific taxa, together with nomenclatural and taxonomic notes, descriptions, illustrations and notes on ecology and distribution are provided. The following five taxa are reported from Fiji and/or Rotuma for the first time: *Caulerpa brachypus* Harvey f. *parvifolia* (Harvey) Cribb; *Caulerpa cupressoides* (Vahl) C. Agardh var. *lycopodium* Weber-van Bosse f. *elegans* (P. Crouan et H. Crouan) Weber-van Bosse; *Caulerpa serrulata* (Forsskål) J. Agardh var. *boryana* (J. Agardh) Gilbert f. *occidentalis* (Weber-van Bosse) Yamada and Tanaka; *Caulerpa racemosa* (Forsskål) J. Agardh var. *occidentalis* (J. Agardh) Børgesen; *Caulerpa racemosa* (Forsskål) J. Agardh var. *turbinata* (J. Agardh) Eubank.

**Introduction**

The genus *Caulerpa* Lamouroux (1809:136) contains more than a hundred species and is found throughout the tropical and subtropical seas of the world; some species are also distributed in warm-temperate oceans of the world. *Caulerpa* is an important contributor to the algal biomass of coral reefs and lagoons. The genus is especially diverse in the Indo-Pacific region where, for example, 54 taxa have been reported from the Philippines (Silva et al. 1987). Species of *Caulerpa* are included in most recent lists of algae from the Pacific Islands (Womersley & Bailey 1970 [Solomon Islands], Tsuda & Wray 1977 [Micronesia], Garrigue & Tsuda 1988 [New Caledonia], South & Yen 1992 [Nauru], Garbary et al. 1991 [Fiji Islands], South & Kasahara 1992 [Fiji Islands], Payri & Meinesz 1985 [French Polynesia], Santelices & Abbott 1987 [Easter Island]). Several authors have published accounts of the genus from specific localities (e.g. Cribb 1958 [South-eastern Queensland], Meinesz et al. 1981 [Takapoto and Moorea, French Polynesia], Coppejans & Meinesz (1988) and Coppejans (1992) [Madang, Papua New Guinea], Coppejans & Prud'homme van Reine 1992b [Indonesia]).

South & Kasahara (1992) listed 22 taxa from Fiji, based on previously published lists; their preliminary list did not include any records from Rotuma, and

did not critically review the taxonomy and nomenclature of the listed species. One of the great difficulties with *Caulerpa* is the high level of morphological plasticity, which has led to the recognition by many authors of taxa at the level of variety and form.

In this report, taxa are recognized to the level of variety and form, where they are sufficiently distinct to warrant recognition. The true taxonomic and ecological significance of these varieties, and forms must await, however, the necessary evaluation of morphological expression in relation to habitat and environment. Such a study was beyond the scope of the present report.

### Materials and Methods

Collections of *Caulerpa* and *Caulerpella* housed in the Phycological Herbarium, South Pacific Regional Herbarium (USP), and in the Phycological Herbarium, University of British Columbia (UBC; Garbary et al. 1991) form the basis of this study, together with a review of previously published records of the genus from the Fiji Islands. Incorporated in the study are the first collections of *Caulerpa* made by one of us (ADRN) from the remote island of Rotuma.

For each taxon a summary of the pertinent nomenclature is provided, together with a list of references relevant to the South Pacific, and to Fiji; wherever possible references including illustrations and descriptions employed in the identification of Fijian species have been cited. Representative material housed at USP and UBC is cited for each taxon, a description is provided, and distribution is given in general terms, for Fiji and Rotuma. Original illustrations have been prepared for most taxa, as well as a key to the species.

### Key to the Fijian Species of *Caulerpa* and *Caulerpella*

1. Stolons and erect branches similar in form, the erect branches bearing verticillate branchlets..... *Caulerpa verticillata* (4)
1. Stolons and erect branches of contrasting form .....2
  2. Erect portions blade-like, lacking branchlets .....3
  2. Erect portions filiform, and variously branched, lobed or cleft .....4
3. Foliose uprights divided 1–3 times ..... *Caulerpa brachypus* (2)
3. Foliose uprights simple, undivided ..... *C. brachypus* f. *parvifolia* (3)
  4. Erect branches flattened or compressed .....5
  4. Erect branches not flattened or compressed .....7
5. Ramelli absent; erect branches dichotomously branched, narrow and band-like, noticeably spirally twisted with a markedly dentate margin, the teeth generally arranged in a single row on the outer edge of the spiral.....
 

*Caulerpa serrulata* (10)
5. Ramelli present, uprights otherwise constructed.....6
  6. Ramelli cylindrical, pinnately arranged, the plant moderately tall, with a feather-like appearance..... *Caulerpa sertularioides* (12)

6. Ramelli flattened, pinnately arranged, sickle-shaped .....  
*Caulerpa taxifolia* (13)
7. Erect branches fine, terminating in minute bushy branchlets arranged in one plane and branched to 4–5 orders ..... *Caulerpa filicoides* f. *andamanensis* (1)
7. Erect branches otherwise ..... 8
8. Erect branches angular, with thorn-like or dentate projections; stolons naked ..... *Caulerpa urvilleana* (15)
8. Erect branches not angular; stolons naked or tomentose ..... 9
9. Stolons tomentose ..... *Caulerpa webbiana* (14)
9. Stolons naked ..... 10
10. Stolon weakly developed, uprights small, usually <2.0 cm, bearing dissimilar vegetative and reproductive branchlets; vegetative branchlets terete, irregularly or pinnately arranged, the tips not swollen, but often terminally forked; zoosporangia, when present, arranged in compact whorls arising from the basal portion of a single lateral branch of limited growth .....  
*Caulerpella ambigua* (24)
10. Plants lacking dissimilar vegetative and reproductive branchlets; stolon and uprights well developed ..... 11
11. Branchlets terete, teeth generally densely arranged in two to several ranks, short ..... *Caulerpa cupressoides* (5)
11. Branchlets spherical, clavate or otherwise distally enlarged; if nearly cylindrical, not pinnately arranged ..... 12
12. Branchlets sessile, the very short stalks with a definite constriction at the summit ..... *Caulerpa microphysa* (16)
12. Branchlets usually stalked, the ends generally sharply swollen, but varying from nearly cylindrical, to clavate, spherical or peltate .....  
*Caulerpa racemosa* (17)

### Catalogue of Species

#### *Caulerpa* Lamouroux

Lamouroux 1809: 136

##### 1. *Caulerpa filicoides* Yamada var. *andamanensis* Taylor

Figures 1, 2

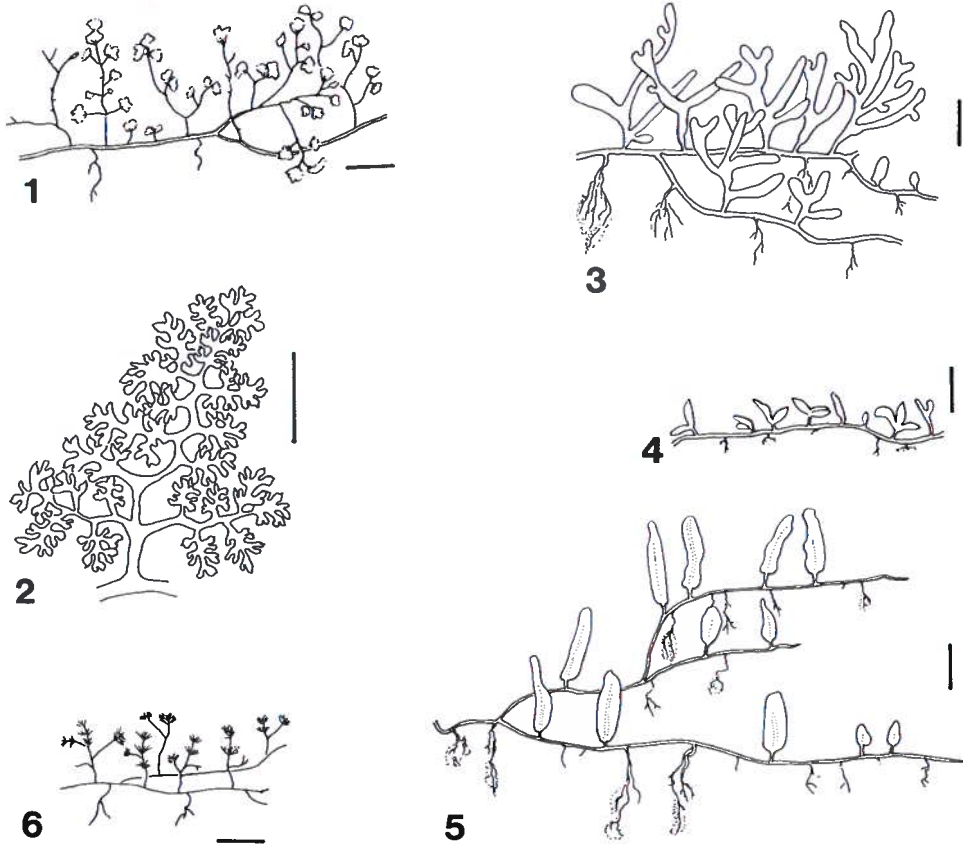
*Caulerpa filicoides* Yamada, 1936: 135, pl. 30, fig. 2.—Silva et al. 1987: 105.

*Caulerpa verticillata* J. Agardh f. *acuta* Yamada 1934: 63, fig. 32.

*Caulerpa acuta* (Yamada) Yamada 1944: 34 [type locality Naha, Ryukyu Archipelago, Japan];—Dawson 1957: 104, figs 6, 7; Tsuda & Wray 1977: 94; Kasahara 1988; South & Kasahara 1992: 49.

*Caulerpa filicoides* Yamada var. *andamanensis* Taylor 1965: 156, fig. 1.—Coppejans & Meinesz 1988: 184, figs. 12–13.

For synonymy see Coppejans and Meinesz (1988). The Fijian specimens examined closely resemble var. *andamanensis* as described by Taylor (1965) and as illustrated in Coppejans and Meinesz (1988, figs. 12–13).



Figures 1-6. Figure 1. *Caulerpa filicoides* var. *andamanensis*. Scale = 1 cm. Figure 2. *Caulerpa filicoides* var. *andamanensis*, detail of branchlets. Scale = 1 mm. Figure 3. *Caulerpa brachypus*. Scale = 1 cm. Figure 4. *Caulerpa brachypus*; small plant showing reduced uprights with sparser branching. Scale = 1 cm. Figure 5. *Caulerpa brachypus* f. *parvifolia*. Scale = 1 cm. Figure 6. *Caulerpa verticillata*. Scale = 1 cm.

**REPRESENTATIVE MATERIAL:** Makuluva Island, Suva Lagoon [Carlson, 12 Aug. 1972: USP 938]; Suva [Kasahara, 18 Sept. 1985: USP 037]

**DESCRIPTION:** Plants with rhizomes to 6 cm long, 165–230  $\mu\text{m}$  diam., sparingly or closely covered with spines ca. 65  $\mu\text{m}$  long; hapteral filaments up to 400  $\mu\text{m}$  long, ending in terminal disks, or occasionally longer and rhizoidal. Uprights widely spaced, simple to 0.17–2.0 mm tall, smooth or with numerous spines, divided at the top into broad foliar divisions, simple or once-dichotomous at the base; divisions planar, branching alternate to 2–3, rarely 4 orders, the ultimate ramelli to 45  $\mu\text{m}$  diam., terminally retuse, obtuse or pointed.

**DISTRIBUTION:** Subtropical and tropical Western Pacific.

FIJI: Recorded only from the Suva Lagoon and Barrier Reef. A plant of deep water, in shaded sites and on silt-covered coral.

## 2. *Caulerpa brachypus* Harvey

Figures 3, 4

*Caulerpa brachypus* Harvey 1860a: 333; Agardh 1872: 11 [type locality: Tanegashima, Osumi-gunto, Japan].—Weber-van Bosse 1898: 280, pl. XX, fig. 2; Yamada 1934: 65; Okamura 1936: 96; Gilbert 1942: 9, figs. 1–3; Taylor 1950: 56, pl. 29, fig. 2; Dawson 1957: 104; Valet 1968: 42, pl. 7(2), fig. 1; Chapman 1971: 166; Cordero 1977: 25, figs. 2, 3; Tsuda & Wray 1977: 94; Meñez & Calumpang 1982: 5, pl. 1 fig. 1; Kasahara 1985: 26; Silva et al. 1987: 104; Coppejans & Prud'homme van Reine 1992b: 673, figs. 1A–C, 7A; South & Kasahara 1992: 49.

*Caulerpa anceps* Harvey in J. Agardh 1872: 9 [type locality: Tonga (Friendly Isles: Harvey "List of Friendly Isles Algae No. 67")]. Weber-van Bosse 1898: 281, pl. 22, figs. 6–10, pl. 125, figs. 1–8; Womersley & Bailey, 1970: 279.

REPRESENTATIVE MATERIAL: Yanuca Island, Beqa Lagoon [Carlson, 12 Nov. 1972; USP 039]; Vatulele Is. [Carlson, 4–5 Jan. 1973; USP 040]; Suva [Kasahara 00054, 30 Nov. 1982]; not at USP.

DESCRIPTION: Stolon sturdy, sparingly branched, to 1 mm diameter. Uprights sub-stipitate, leaf-like, regularly to occasionally proliferous, or dichotomously branched, ligulate, obtuse at the apex, up to 50 mm tall, 2–4 mm wide, margins minutely serrate, occasionally entire. A plant of deep water, on soft substrata. There are several unresolved taxonomic problems concerning *Caulerpa brachypus*; in a recent revision of Papua New Guinean *Caulerpa* species Coppejans (1992) referred previous reports of *C. brachypus* from New Guinea (Coppejans and Meinesz, 1988: 184) to *Caulerpa biserrulata* Sonder, since most of the marginal teeth are composed of two or three double spines, while some teeth on the same fronds are simple. Some Fijian material fits *C. biserrulata*, while other specimens have simple teeth, or none. There is presently insufficient Fijian material available to make detailed comparison, but it is possible that more than one taxon, or a broadly variable single taxon, is represented.

DISTRIBUTION: Widely distributed in tropical oceans.

FIJI: Appears to be rare in Fiji, from Viti Levu, Vatulele and Beqa.

## 3. *Caulerpa brachypus* Harvey f. *parvifolia* (Harvey) Cribb

Figure 5

*Caulerpa parvifolia* Harvey 1860b: pl. CLXXII [type locality: Kiama, New South Wales, Australia].

*Caulerpa brachypus* f. *parvifolia* (Harvey) Cribb 1958: 209, figs. 4, 5; Jaasund 1976: 19, fig. 39 (as *Caulerpa brachypus*); Silva et al. 1987: 104; Coppejans & Beeckman 1990: 113, figs. 1–2; Coppejans & Prud'homme van Reine 1992b: 673, fig. 7B (as ecad *parvifolia*).

REPRESENTATIVE MATERIAL: Nukulau Island, Suva Lagoon [Carlson, 20 Aug., 1972; USP 041].

**DESCRIPTION:** Stolons very thin (0.5 mm diam.), regularly branched, bearing erect, shortly stipitate blades; distinguished from the typical form by the simple foliose blades up to 10 (12) mm tall and 3 (5) mm broad, with smooth or slightly toothed margins, the teeth simple.

**DISTRIBUTION:** Widely distributed along the East African coast (Somalia, Tanzania, Mozambique, Kenya), the Philippines, and Australia.

**FIJI:** Not previously reported from Fiji. Possibly more widely distributed, since it is not distinguished from the typical variety by many authors.

#### 4. *Caulerpa verticillata* J. Agardh

##### Figure 6

*Caulerpa verticillata* J. Agardh 1847: 6 [type locality Mexico, in *herb.* Agardh, LD].—Weber-van Bosse 1898: 267, pl. XX, figs. 7–10; Taylor 1950: 54; 1960: 138, pl. 10, figs. 1–3; Dawson 1954: 392, fig. 10b; 1956: 37; Valet 1968: 42, pl. 6(1), fig. 4; Womersley & Bailey 1970: 278; Tsuda & Wray 1977: 95; Meñez & Calumpang 1982: 10, pl. 3A–C; Silva et al. 1987: 111; Coppejans & Meinesz 1988: 194; Kasahara 1988; Coppejans & Beekman 1990: 124, figs. 28–32; Coppejans & Prud'homme van Reine 1992b: 708, fig. 21B; South & Kasahara 1992: 50.

**REPRESENTATIVE MATERIAL:** Momi Bay, Viti Levu [*Kasahara*, 29 Oct., 1985: USP 093]; Wailoaloa Beach, Nadi, Viti Levu [*Seeto*, 29 Nov., 1991: USP 093].

**DESCRIPTION:** Plants filiform, attached to corals or rocks, in dense, soft clumps, up to 50 mm tall; stolon naked, terete, with numerous short, descending branchlets ending with filiform rhizoids. Upright branches usually dense, up to 250  $\mu$ m diam. at the base, simple or irregularly branched and bearing numerous tufts of whorled, determinate branchlets up to 180  $\mu$ m in diameter and branching dichotomously 5–8 times, not constricted at the dichotomies and tapering at the apices; apices with (2) 3–5 terminal teeth.

**DISTRIBUTION:** Very widely distributed in tropical oceans.

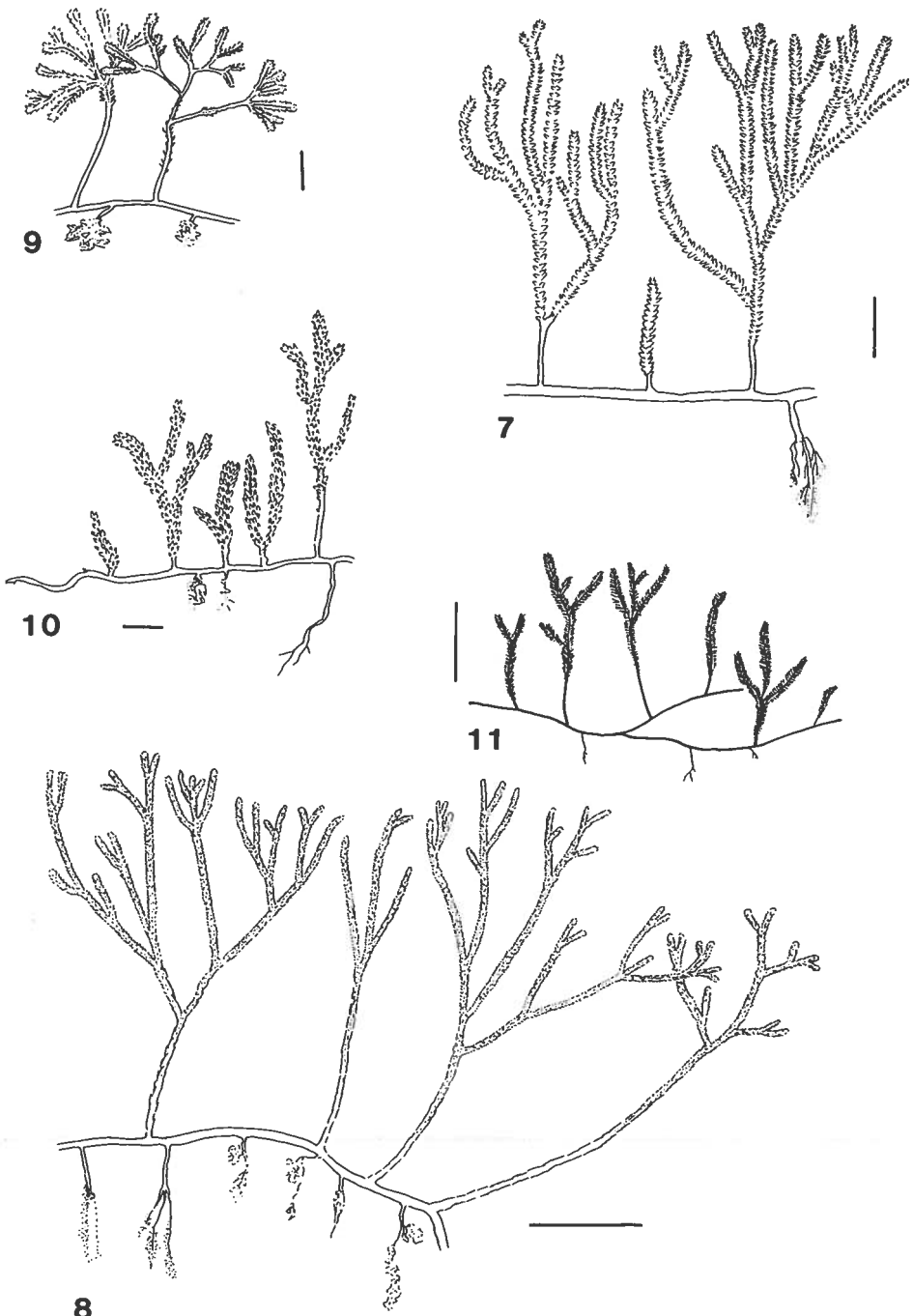
**FIJI:** Probably widely distributed but not much collected owing to its inconspicuous habit compared with other species of *Caulerpa*. Records are currently restricted to the western side of Viti Levu.

#### 5. *Caulerpa cupressoides* (Vahl) C. Agardh

##### Figure 7

*Fucus cupressoides* Vahl, 1802: 38 [type locality: St. Croix, Virgin Islands]

*Caulerpa cupressoides* (Vahl) C. Agardh, 1817: XXIII.—Okamura, 1923: 194, pl. 200, fig. 2 [as var. *typica* Weber-van Bosse]; Taylor 1960: 146, pl. 14, figs. 3–4, fig. 6; pl. 15, figs. 1–4; pl. 18, figs. 11–13; Valet, 1968: 44, pl. 11(6), fig. 2; Womersley & Bailey 1970: 274; Chapman 1977: 161; Tsuda & Wray 1977: 94; Meñez & Calumpang 1982: 6, pl. 1 figs. B, C; Tseng 1984: 280, pl. 139, fig. 4; Kasahara 1985: 26; 1988; Silva et al. 1987: 104; Garrigue & Tsuda 1988: 57; Littler et al. 1989: 48; Coppejans & Beekman 1990: 113, figs. 3–7; South 1991: 5; Coppejans 1992: 389, fig. 1C (as ecad *cupressoides*); Coppejans & Prud'homme van Reine,



8  
 Figures 7-11. Figure 7. *Caulerpa cupressoides*. Scale = 1 cm. Figure 8. *Caulerpa cupressoides* var. *lycopodium*. Scale = 2 cm. Figure 9. *Caulerpa cupressoides* var. *mamillosa* f. *disticha*. Scale = 1 cm. Figure 10. *Caulerpa cupressoides* var. *lycopodium*. Scale = 1 cm. Figure 11. *Caulerpa cupressoides* var. *lycopodium* f. *elegans*. Scale = 2 cm.

1992a: 172; Coppejans & Prud'homme van Reine 1992b: 676, fig. 2A, 8A (as ecad *cupressoides*); South & Kasahara 1992: 49; South & Yen 1992: 127.

REPRESENTATIVE MATERIAL: Nasova Bay, Viti Levu [*Kasahara*, 19 Oct. 1985: USP 069]

DESCRIPTION: Plants forming dense aggregations with spreading stolons up to 30 cm long and 3 mm in diameter, anchored by numerous rhizoid-bearing branches spaced at close (0.5–1 cm) intervals. Foliar axes up to 4 cm tall, often strongly forked with subdichotomous branching. Ramelli oppositely pinnate and terete, with upward curving tendency and tapering to a sharp point at the tip, and generally twice as long as the diameter of the supporting axis. The ramelli usually arranged in ranks of threes, sometimes twos or up to five.

This is an extremely variable species (Taylor, 1960; Coppejans and Beekman, 1990) for which numerous varieties and forms have been described. Coppejans and Beekman (1990) were unable to determine any correlation between morphology and ecology of specimens collected from the Kenyan coast, and preferred to avoid assigning them to any variety or form [in Coppejans (1992), they are referred to as ecads (ecophenes)]. Pending the availability of more extensive comparative collections from Fiji, varieties and forms are retained here. DISTRIBUTION: Western tropical Atlantic, tropical Indian Ocean and tropical western Pacific Ocean.

FIJI: Widely distributed.

KEY TO VARIETIES AND FORMS OF *Caulerpa cupressoides*

1. Plants large, erect axes to 20 cm tall, sparingly branched; branchlets erect, in several ranks, cylindrical, 2–6 times as long as the axis diameter.....  
var. *lycopodium* (6)
  1. Plants smaller, erect axes shorter and stouter, bushy, with the branchlets arranged in 5 or more ranks..... var. *mamillosa* (9)
    2. Erect branches naked below, highly branched and ramellate above; branchlets cylindrical and biseriate, opposite, up to 2 × the diameter of the axis..... f. *disticha* (8)
    2. Erect axes dichotomous, branchlets terete, nearly all distichous and opposite, 3–6 times as long as the axis diameter..... f. *elegans* (7)
6. *Caulerpa cupressoides* (Vahl) C. Agardh var. *lycopodium* Weber-van Bosse  
Figure 8

*Caulerpa lycopodium* J. Agardh 1847: 6 [syntype localities: Brazil; West Indies]  
*Caulerpa cupressoides* (Vahl) C. Agardh var. *lycopodium* Weber-van Bosse 1898: 335, pl. 27 figs. 8–13; pl. 28 figs. 10–12, fig. 14.—Taylor 1960: 147, pl. 14 fig. 3; Chapman 1971: 166; Silva et al. 1987: 105; Garrigue & Tsuda 1988: 57; Littler et al. 1989: 48; South 1991: 5; Coppejans & Prud'homme van Reine 1992: 173; South & Kasahara 1992: 49.

REPRESENTATIVE MATERIAL: *Kasahara* (in herb. Kyoto University, Faculty of Agriculture); Rakiraki, Viti Levu [*Kasahara*, 11 Oct. 1985: USP 072, 078]; Rotuma: Hapmafau [*N'Yeurt*, HOP10/USP359, HOP15/USP360].



**DESCRIPTION:** Erect axes up to 14 cm tall, spaced at relatively wide (2–3 cm) intervals along spreading stolon. The ramelli usually in ranks of threes, sometimes twos, oppositely pinnate with mucronate, upward-curving branchlets up to 1 mm long.

**DISTRIBUTION:** Widely distributed in tropical oceans.

**FIJI:** North coast of Viti Levu.

**ROTUMA:** Hapmafau. Found growing in backreef areas, usually attached to vertical faces of rocky platforms which are subject to a fair amount of wave action. Occurs together with other species of *Caulerpa* as well as *Chlorodesmis major* Zanardini and *Halimeda opuntia* (Linnaeus) Lamouroux clumps.

**7. *Caulerpa cupressoides* (Vahl) C. Agardh var. *lycopodium* (Weber-van Bosse) f. *elegans* (P. Crouan and H. Crouan) Weber-van Bosse**

Figure 11

*Caulerpa cupressoides* (Vahl) C. Agardh var. *lycopodium* (Weber-van Bosse) f. *elegans* (P. Crouan and H. Crouan) Weber-van Bosse 1898: 336, pl. 27, figs. 8–9; Okamura, 1923: 194, pl. 200 fig. 3; Taylor 1960: 148, pl. 15, figs. 2–3; Silva et al. 1987: 105; Coppejans 1992: 391, fig. 1A (as ecad *lycopodium-elegans*); Coppejans & Prud'homme van Reine, 1992a: 173; Coppejans & Prud'homme van Reine 1992b: 679, fig. 2E, 11A (as ecad *lycopodium-elegans*).

*Caulerpa plumaris* (Forsskål) C. Agardh v. *elegans* P. Crouan and H. Crouan in Schramm & Mazé 1865: 39 [type locality: Guadeloupe].

**REPRESENTATIVE MATERIAL:** Nuanialilai [*Villeneuve*, 23 Feb, 1982: UBC A21908]; Tavenui [*Villeneuve*, 16 Feb., 1982: UBC A21920]; Rotuma: Hopfamau [*N'Yeurt*, 1992: USP 361]

**DESCRIPTION:** Plants relatively small, the spreading stolon about 1 mm in diameter and vivid-green in color, even after drying. The foliar axes occur at 0.5–1 cm intervals along the creeping stolon, strongly forked with the distance between sub-dichotomies as little as 2 mm in the upper parts of the plant; ramelli thin, oppositely pinnate and in ranks of two along a relatively broad (0.8–1 mm) central axis; branchlets mucronate with apiculate, upward curving tips.

**DISTRIBUTION:** Widely distributed in tropical regions.

**FIJI:** Not previously recorded.

**ROTUMA:** Hapmafau. Found growing in intimate association with *Caulerpa cupressoides* v. *lycopodium*, in backreef areas. Quite rare, and conspicuous by its more fragile-looking habit and vivid-green color.

**8. *Caulerpa cupressoides* (Vahl) C. Agardh var. *lycopodium* Weber-van Bosse f. *disticha* Weber-van Bosse**

Figure 9

*Caulerpa cupressoides* (Vahl). C. Agardh var *lycopodium* f. *disticha* Weber-van Bosse, 1898: 338, pl. XXVII, fig. 14 [syntype localities: Guadeloupe; Florida, USA].—Taylor 1960: 148; Coppejans 1992: 389, fig. 1B (as ecad *lycopodium-distichia*); Coppejans & Prud'homme van Reine 1992b: 676, fig. 2C–D, 10A, B

(as *ecad lycopodium-distichia*); South & Kasahara 1992: 49 [as *Caulerpa cupressoides* (Vahl) C. Agardh f. *disticha* (Weber-van Bosse) Collins].

[As noted by Silva et al. (1987: 105) *Caulerpa cupressoides* (Vahl) C. Agardh var. *lycopodium* f. *disticha* and *C. cupressoides* var. *disticha* are alternative names for the same taxon, since both were used by Weber-van Bosse in the original publication.

REPRESENTATIVE MATERIAL: Nasova Bay, Viti Levu [Kasahara, 19 Oct., 1985: USP 069]

DESCRIPTION: Erect axes naked at the simple base, much branched and ramellate above; branchlets cylindrical and biseriate, opposite, occasionally multiseriate near the apex; except for the lowest branches, twice the axis diameter in length.

DISTRIBUTION: Tropical oceans in general.

FIJI: Viti Levu

**9. *Caulerpa cupressoides* (Vahl) C. Agardh var. *mamillosa* (Montagne) Weber-van Bosse  
Figure 10**

*Caulerpa cupressoides* (Vahl) C. Agardh var. *mamillosa* (Montagne) Weber-van Bosse 1898: 332, pl. 28, figs. 2–7 [type locality: Galega Is. or Mangareva Is.].—Børgesen, 1907: 368, fig. 13; 1913: 135, fig. 108; Setchell 1935: 261, pl. 11–15; Taylor 1960: 148, pl. 15, fig. 4; pl. 18, fig. 11; Womersley & Bailey 1970: 275; South 1991 (as *Caulerpa cupressoides* var. *lycopodium*); Coppejans 1992: 391 (as *ecad mamillosa*); Coppejans & Prud'homme van Reine 1992a: 173; Coppejans & Prud'homme van Reine 1992b: 679, fig. 3A, 8B (as *ecad mamillosa*).

*Caulerpa mamillosa* Montagne 1842, pl. 6, fig. 3.

REPRESENTATIVE MATERIAL: Naviti, Viti Levu [Kasahara, 16 Oct. 1985: USP 067]; Rakiraki, Viti Levu [Kasahara, 1 Oct., 1986: USP 066]; Dravuni Island, Kadavu [South, 10 April 1991; USP 070]; Rotuma: Hapmafau [N'Yeurt, 1992: HOP14/USP 362; HOP16/USP 363]

DESCRIPTION: Plants stout and bushy, erect foliar axes closely spaced at 0.5–1 cm intervals along a relatively thick spreading stolon up to 2.5 mm in diameter. The foliar axes several times forked very early from the base, bearing mucronate, obovoid ramelli in several ranks.

DISTRIBUTION: Widely distributed in tropical oceans.

FIJI: Viti Levu; Dravuni Island, Kadavu.

ROTUMA: Hapmafau. Found on vertical rocky platforms in backreef locations, at a lower level than other *Caulerpa* species. Plants are conspicuous by their stout appearance and bushy habit.

KEY TO VARIETIES AND FORMS OF *Caulerpa serrulata*

1. Uprights markedly spirally twisted, relatively short-stalked; mucronate teeth on the blade margins about twice as long as broad .....

*Caulerpa serrulata* (10)

1. Uprights less markedly spirally twisted, long-stalked, slender; marginal teeth more distant, smaller, shorter than broad.....

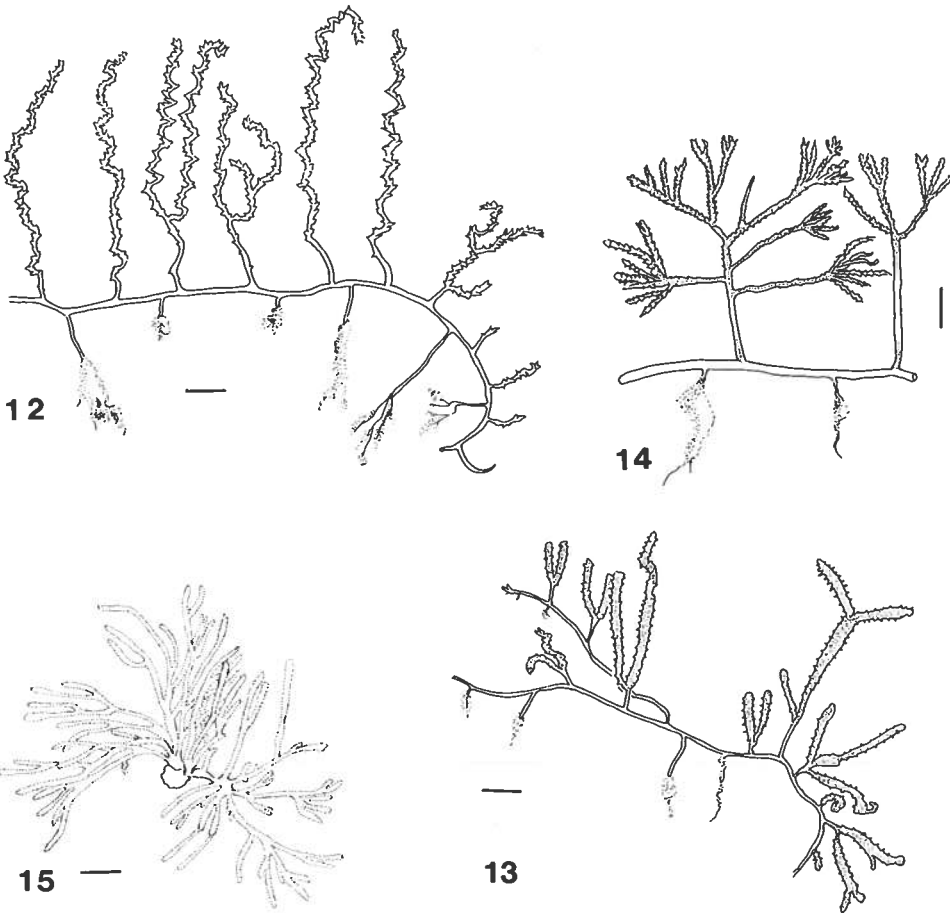
*C. serrulata* var. *boryana* f. *occidentalis* (11)

**10. *Caulerpa serrulata* (Forsskål) J. Agardh**

Figure 12

*Fucus serrulatus* Forsskål, 1775: 189 [Type locality: Mokha, Yemen]

*Caulerpa serrulata* (Forsskål) J. Agardh, 1837: 174.—Eubank 1946: 418, fig. 2h-j; Taylor 1950: 57, pl. 30, fig. 1; Dawson, 1954: 393, fig. 10a; 1956: 38, fig. 23; 1957: 105; Taylor 1960: 145, pl. 14, fig. 5; Valet 1968: 43, pl. 9, fig. 1; Womersley & Bailey 1970: 276; Chapman 1971: 166; Jaasund 1976: 23, fig. 48; Tsuda & Wray 1977: 95; Meñez & Calumpang 1982: 9, pl. 2E; Tseng 1984: 284, pl. 141,



Figures 12-15. Figure 12. *Caulerpa serrulata*. Scale = 1 cm. Figure 13. *Caulerpa serrulata* var. *boryana* f. *occidentalis*. Scale = 1 cm. Figure 14. *Caulerpa urvilliana*. Scale = 1 cm. Figure 15. *Caulerpa webbiana*. Scale = 1 cm.

fig. 1; Kasahara 1985: 26; 1988; Trono 1986: 218, fig. 14; Silva et al. 1987: 108; Garrigue & Tsuda 1988: 58; Coppejans & Meinesz 1988: 191, figs. 25, 26; Coppejans & Beeckman 1989: 120, figs. 24–25; Littler et al. 1989: 44; South 1991: 5; Coppejans & Prud'homme van Reine 1992a: 174; Coppejans & Prud'homme van Reine 1992b: 703, fig. 20B (as *ecad serrulata*); South & Kasahara 1993: 50.

*Caulerpa freycinetii* C. Agardh 1822: 446 [type locality: Mariana Is.]—Weber-van Bosse, 1898: 310, pl. 25, figs. 4–11; pl. 26, fig. 1–6; Børgesen 1932: 5; Okamura 1913: 18, pl. 105 figs. 1–3 [var. *typica* f. *lata* Weber-van Bosse]; Tsuda & Wray 1977: 94.

*Caulerpa hummii* Díaz-Piferrer 1969: 13, fig. 1—Taylor, 1977: 11–12.

REPRESENTATIVE MATERIAL: Nanuyalevu, Yasawa Is. [Carlson, 13 Jul. 1972: USP 077]; Deuba, Viti Levu [Carlson, 8 Oct., 1972: USP 075]; Malololailai [Stein Dec. 1979: UBC A67943]; Taveuni [Villeneuve, 16 Feb. 1982: UBC A 23003]; Bau, Viti Levu [Kasahara, 26 Sept. 1985: USP 078]; Korotoga, Viti Levu [Kasahara, 3 Oct. 1985: USP 076]; Tagage, Coral Coast, Viti Levu [Kasahara, 15 Oct. 1985: USP 080]; Namarai, Viti Levu [Kasahara, 19 Oct. 1985: USP 074; 079]; Dravuni Island, Kadavu [South, 10 April 1991: USP 081]; Rotuma: Isilepi/Motusa [N'Yeurt; I1/USP380]; Lopta [N'Yeurt; L7/USP379]; Maka Bay [N'Yeurt; MAK3/USP377, MAK4/USP378].

DESCRIPTION: Fairly large plants, with spreading stolon up to 20 cm long and 2mm wide, possessing short rhizoid-bearing branches on the underside and foliar branches up to 7 cm tall at 1–4 cm intervals along the spreading stolon. Foliar branches several times dichotomously or irregularly branched, terete below up to the point of dichotomy, the rest compressed (1–2 mm broad) with moderate to strong twisting and serrated margins; the serrations more pronounced on the outwardly facing edge of the twist.

DISTRIBUTION: Widespread in tropical oceans.

FIJI: Yasawa Islands, Viti Levu and Kadavu; probably widespread throughout.

ROTUMA: Isilepi/Motusa; Lopta; Maka Bay. Found on sandy substratum in relatively shallow (20–40cm) waters in the backreef area, typically creeping in the sand with only the erect foliar axes protruding.

**11. *Caulerpa serrulata* (Forsskål) J. Agardh var. *boryana* (J. Agardh) Gilbert f. *occidentalis* (Weber-van Bosse) Yamada & Tanaka**

Figure 13

*Caulerpa freycinetii* (C. Agardh) var. *boryana* f. *occidentalis* Weber-van Bosse, 1898: 315, pl. 25, fig. 11 [Type locality: Guadeloupe].—Okamura 1913: 19, pl. 105 figs. 4–6

*Caulerpa hummii* Díaz-Piferrer 1969: 13, fig. 1 [type locality: Orquilla Is., Venezuela]

*Caulerpa serrulata* (Forsskål) J. Agardh var. *boryana* (J. Agardh) Gilbert f. *occidentalis* (Weber-van Bosse) Yamada & Tanaka 1938: 62; Meñez & Calumpang

1982: 9, pl. 2F; Silva et al. 1987: 109; Coppejans 1992: 403, fig. 7 (as ecad *boryana-occidentalis*).

REPRESENTATIVE MATERIAL: Rotuma: Hapmafau [*N'Yeurt*; (HOP11/USP381)].

DESCRIPTION: Plants up to 10 cm long, the spreading stolon about 1 mm in diameter and possessing numerous rhizoid-bearing branches on the underside, and erect, mostly non-twisted 1–3 times dichotomously branched foliar axes above, flat or compressed and supported by a long, terete stalk. The foliar branches up to 5 cm tall and 4 mm broad, with serrations at 0.5–0.8 mm intervals along the edges. Some vaguely twisted branches may occasionally occur on the same stolon. Plants from Rotuma closely fit the description and illustration in Meñez and Calumpong (1982).

DISTRIBUTION: Tropical Western Pacific Ocean.

FIJI: Not previously recorded.

ROTUMA: Hapmafau. Found on the back-reef, in relatively protected sandy locations, often mixed with other *Caulerpas*.

## 12. *Caulerpa sertularioides* (S. G. Gmelin) Howe

Figure 16

*Fucus sertularioides* S. G. Gmelin, 1768: 151, pl. XV: fig. 4 [type locality “in coralliis americanis”].

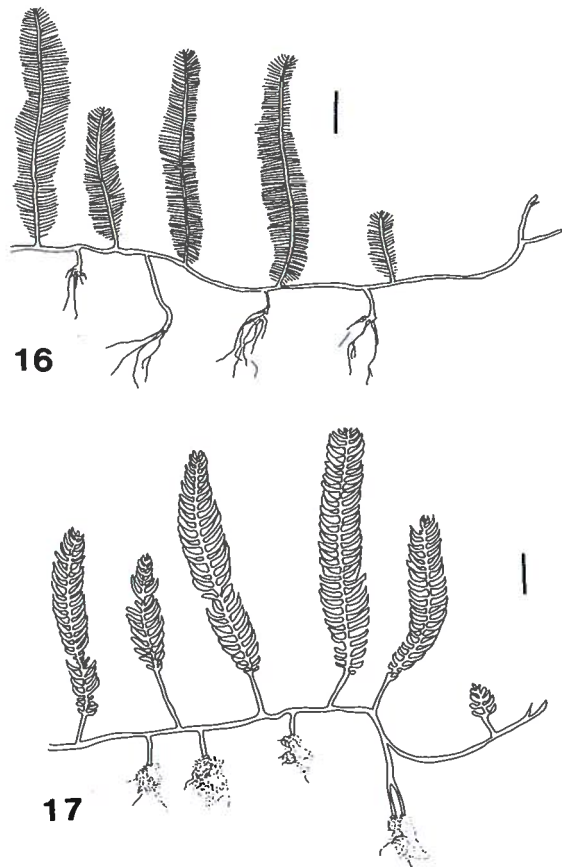
*Caulerpa sertularioides* (S. G. Gmelin) Howe, 1905: 576.—Eubank, 1946: 417, fig. 2d, c; Taylor 1960: 144, pl. 13; Valet 1968: 43, pl. 7(2), fig. 3; Womersley & Bailey 1970: 277; Chapman 1971: 166; Tsuda & Wray 1977: 95; Meñez & Calumpong 1982: 9, pl. 3F; Kasahara 1985: 27; 1988; Coppejans & Meinesz 1988: 192, fig. 29; Coppejans & Beeckman 1990: 120, figs. 26–27; Coppejans & Prud'homme van Reine 1992: 704, fig. 21A; South & Kasahara 1992: 50.

*Fucus plumaris* Forsskål, 1775: 190 [type locality: Mokha, Yemen].

*Caulerpa plumaris* (Forsskål) C. Agardh, 1822: 436.—Dickie, 1876: 245; Weber-van Bosse 1898: 294, pl. 24, figs. 4–6.

REPRESENTATIVE MATERIAL: Vatulele, Viti Levu [*Carlson*, ? 1973: USP 086]; Nanualailai [*Villeneuve*, 23 Feb. 1982: UBC A23016]; Makuluva Island, Viti Levu [*Kasahara*, 22 Sept. 1985: USP 087; *South*, 9 Sept. 1991: USP 088]; Nambuna, Viti Levu [*Kasahara*, 11 Oct., 1985: USP 084]; Rakiraki, Viti Levu [*Kasahara*, 11 Oct. 1985: USP 083]; Malake Is., Rakiraki [*Kasahara*, 24 Oct., 1985: USP 082].

DESCRIPTION: Plants widely spreading and forming loose colonies on rocks and corals; stolons terete, 0.25–(0.5 mm)–1.0 mm diam., bearing rather few, short branches with branched rhizoids. Uprights up to 6 cm (10 cm) tall, simple or occasionally (sub-) dichotomously divided, naked or branched at the base and bearing feather-like, pinnate, undivided branchlets; branchlets cylindrical or slightly compressed, not contracted at the base, to 8 mm long, 200  $\mu$ m in diameter, upcurved, with mucronate tips. Coppejans and Beeckman (1990) described two



Figures 16–17. Figure 16. *Caulerpa sertularioides*. Scale = 1 cm. Figure 17. *Caulerpa taxifolia*. Scale = 2 cm.

distinct forms of *C. sertularioides* from the Kenyan coast (with intermediates), a smaller, slender form, and a longer, stouter form.

**DISTRIBUTION:** Tropical oceans in general.

**FIJI:** Viti Levu; probably widely distributed.

### 13. *Caulerpa taxifolia* (Vahl) C. Agardh

Figure 17

*Fucus taxifolius* Vahl, 1802: 36 [type locality: St. Croix, Virgin Islands].  
*Caulerpa taxifolia* (Vahl) C. Agardh, 1822: 436.—Weber-van Bosse, 1898: 292;  
 Eubank 1946: 417, fig. 2f–g; Dawson 1956: 35, fig. 17; Silva et al. 1987: 111;  
 Coppejans 1992: 406, figs. 8A–B (as ecad *taxifolia*); Coppejans & Prud'homme  
 van Reine 1992b: 706, figs. 6B, 22B (as ecad *taxifolia*); South & Kasahara 1992:  
 50.

REPRESENTATIVE MATERIAL: Nanuya Levu [Carlson, 13 July 1972: USP 090]; Nananuira [Villeneuve, 10 Feb., 1982: UBC A23006 (as *Caulerpa sertularioides*)]; Paradise Point, Koro Levu [R. F. & C. Scagel, 30 July 1980: UBC A23029 (as *Caulerpa sertularioides*)]; Tagage, Viti Levu [Kasahara, 3 Oct., 1985: USP 089].

DESCRIPTION: The description in Kasahara (1985: 27, pl. 4, fig. 3) is not in agreement with this and his records from Dravuni Island, Fiji are excluded here. Plants from Fiji closely fit the description and illustrations in Coppejans and Beeckman (1990: 122, figs. 36–39). Stolon stout, 1.0 mm diam. or more, naked, bearing simple or sparingly divided rhizoidal branches ending in branched rhizoids. Uprights flattened, simple or occasionally branched, linear-lanceolate, up to 10 cm tall, the midrib narrow, bearing distichously arranged, opposite pinnate branchlets narrowed at the base and attenuated at the tip; tips mucronate. *Caulerpa taxifolia* closely resembles *Caulerpa mexicana* Sonder ex Kützing, but differs in that in *C. mexicana* the branchlets are broader and overlap one another. In the absence of good representative material of *C. mexicana*, previous records of this species given in South and Kasahara [1992: 49, as *C. mexicana* var. *pluriseriata* W. R. Taylor, and including *Caulerpa crassifolia* (C. Agardh) C. Agardh according to the synonymy in Silva et al. (1987: 106)] require re-investigation, and are omitted from this list.

DISTRIBUTION: Widely distributed in tropical oceans.

FIJI: Viti Levu. A plant of soft bottoms and protected locations.

#### 14. *Caulerpa urvilliana* Montagne

Figure 14

*Caulerpa urvilliana* Montagne, 1845: 21 [type locality: Toud I. (Warrior Islet), Torres Strait, Australia].—Weber-van Bosse, 1989: 318, pl. 26, figs. 7–12; Taylor 1950: 60, pls. 31 fig. 1, 32 fig. 1; Valet 1968: 44; Womersley & Bailey 1970: 278; Tsuda & Wray 1977: 95; Meñez & Calumpang 1982: 10, pl. 3D, E; Kasahara 1985: 28, pl. 4, fig. 4; 1988; Silva et al. 1987: 111; Coppejans 1992: 391, fig. 2 (as *C. cupressoides* ecad *urvilliana*); Coppejans & Prud'homme van Reine 1992b: 686, figs. 3B, 11B (as *C. cupressoides* ecad *urvilliana*); South & Kasahara 1992: 50. *C. urvilliana* var. *vitiensis* Weber-van Bosse 1898: 319 [syntype localities Fiji and Vanuatu (= New Hebrides)].—Chapman 1971: 166; Silva et al. 1987: 111; Kasahara 1988; South & Kasahara 1992: 50.

[*C. urvilliana* var. *vitiensis* Weber-van Bosse was described from specimens of Sonder and Grunow collected from Fiji and Vanuatu (New Hebrides), and separated from the typical form by minor differences in the size and arrangement of the teeth.]

REPRESENTATIVE MATERIAL: Paradise Point, Koro Levu [R. F. & C. Scagel, 24 Jul., 1980: UBC A23034; 25 Jul., 1980: UBC A23037]; Taveuni [Villeneuve, 16 Feb. 1982: UBC A23045]; Namale Plantation, Vanua Levu [Villeneuve, 18 Feb. 1982: UBC A21962]; Yasawa-i-rara [Villeneuve, 24 Feb., 1982: UBC

A23021]; Toberua Pass, Viti Levu [*Kasahara*, 26 Sept. 1985: USP 091]; Rakiraki, Viti Levu [*Kasahara*, 24 Oct., 1985: USP 092].

**DESCRIPTION:** Plants often large, forming loose populations on sand, the stolon widely spreading, to 3.5 mm diam., bearing cylindrical, descending branches with long, branched rhizoids. Uprights terete, crowded or widely spaced, a few to several times dichotomously branched, or irregularly branched, 5.0 cm up to 15 cm tall, depending on habitat; uprights smooth in the first divisions, terete above, to 2.0–2.5 mm diam., in part compressed, heavily mamillate, the protrusions broad at the base and mucronate at the tip, multiseriate except in compressed portions.

**DISTRIBUTION:** Widely distributed in the tropical western Pacific.

**FIJI:** Widely distributed: Viti Levu, Vanua Levu, Taveuni.

### 15. *Caulerpa webbiana* Montagne

Figure 15

*Caulerpa webbiana* Montagne, 1837: 354 [type locality: Arrecife, Isla Lanzarote, Islas Canarias].—Meñez & Calumpang 1982: 10, Pl. 2G–J; Silva et al. 1987: 111; *Kasahara* 1988; Garbary et al. 1991: 252; South & *Kasahara* 1992: 50.

*Caulerpa tomentella* Harvey in Weber-van Bosse 1898: 270 [type locality: Tonga].

*Caulerpa webbiana* Montagne f. *tomentella* Weber-van Bosse, 1989: 270.—Taylor 1960: 139, pl. 10, fig. 10; *Kasahara* 1985: 28, pl. 5 fig. 5, pl. 14, fig. E.

**REPRESENTATIVE MATERIAL:** Paradise Point, Koro Levu, Viti Levu [*R. F. and C. Scagel*, 27 July, 1980: UBC A23915]; Suva Reef, Viti Levu [*Kasahara*, 16 Sept. 1985: USP 095; 18 Sept. 1985: USP 097; Makuluva Island, Viti Levu [*Kasahara*, 17 Oct. 1985: USP 096].

**DESCRIPTION:** Plants small, tending to occur in thick cushions on exposed rocks; stolon terete, descending branches naked, bearing branched rhizoids. Uprights to 1.5–3.0 cm tall, normally irregularly branched 1–5 times, and bearing many whorls of fine branchlets, with mucronate tips; the small, fine branchlets give the uprights a “furry” appearance, distinguishing this species from all others occurring in Fiji.

**DISTRIBUTION:** Widely distributed in the western tropical region.

**FIJI:** Viti Levu, and probably on other island groups.

### 16. *Caulerpa microphysa* (Weber-van Bosse) J. Feldmann

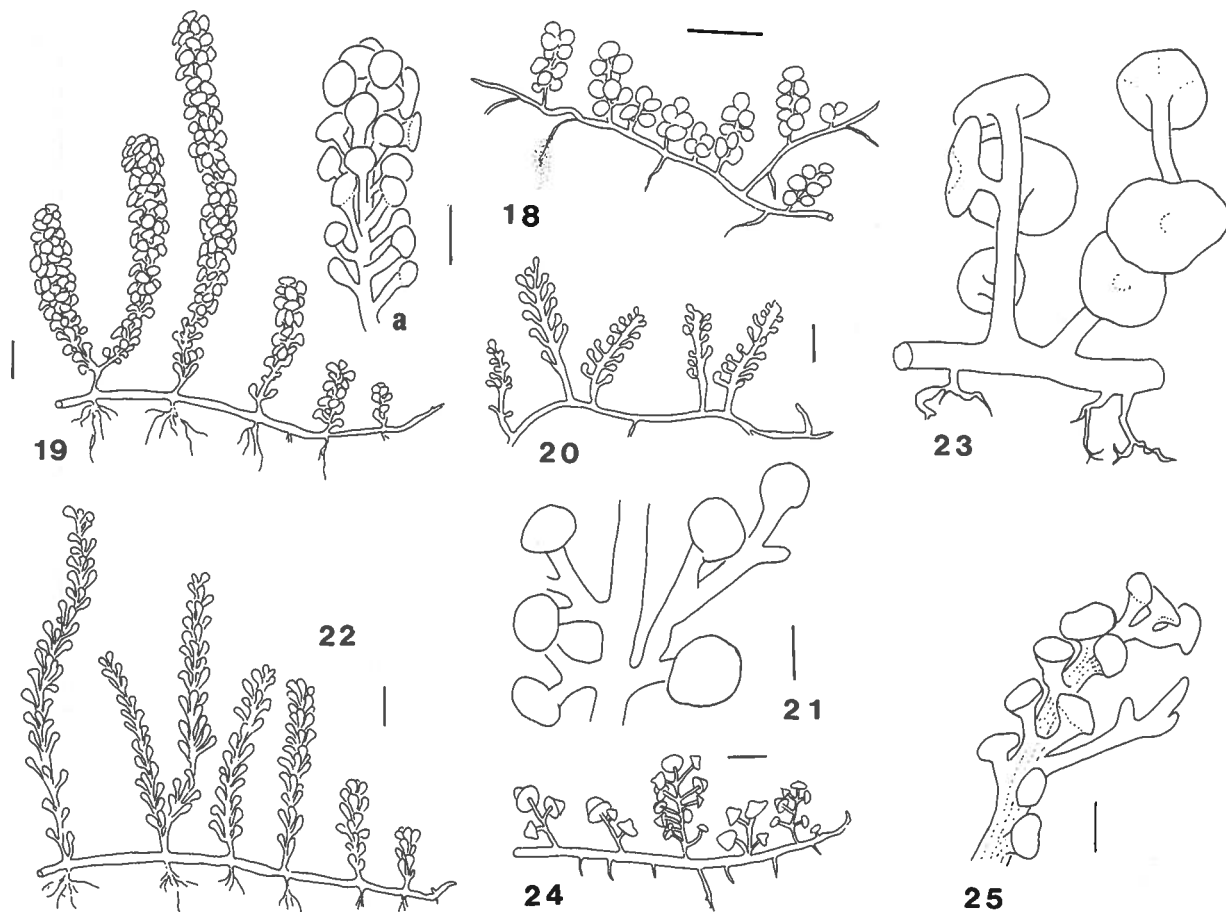
Figure 18

*Caulerpa racemosa* (Forsskål) J. Agardh var. *clavifera* (Turner) Weber-van Bosse f. *microphysa* Weber-van Bosse, 1898: 361, pl. 23, fig. 5 [type locality: Macassar, Celebes, Indonesia].

*Caulerpa microphysa* (Weber-van Bosse) J. Feldmann, 1955: 430.—Meñez & Calumpang 1982: 7, pl. 2L; Coppejans & Meinesz 1988: 190, figs. 15, 16; Coppejans & Prud'homme van Reine 1992b: 692; South & *Kasahara* 1992: 50.

**REPRESENTATIVE MATERIAL:** Nananuira [*Villeneuve*, 10 Feb., 1982: UBC A21924]; Taveuni, Koro Levu [*Villeneuve*, 16 Feb., 1982: UBC A21904].





Figures 18–25. Figure 18. *Caulerpa microphysa*, details of branchlets. Scale = 1 mm. Figure 19. *Caulerpa racemosa* (“uvifera” type). Scale = 1 cm. A. Detail of branchlets. Scale = 2 mm. Figure 20. *Caulerpa racemosa* var. *laetevirens*. Scale = 1 cm. Figure 21. *Caulerpa racemosa* var. *macrophysa*. Detail of branchlets. Scale = 1 mm. Figure 22. *Caulerpa racemosa* var. *occidentalis*. Scale = 1 cm. Figure 23. *Caulerpa racemosa* var. *peltata*. Details of branchlets. Scale = 1 mm. Figure 24. *Caulerpa racemosa* var. *turbinata*. Scale = 1 cm. Figure 25. Intermediate form between *Caulerpa racemosa* vars *turbinata* and *peltata*. Scale = 2 mm.

**DESCRIPTION:** Fijian plants closely resemble the figures in Meñez & Calumpong (1982, pl. 2L) and Coppejans and Meinesz (1988, figs. 15, 16). Stolons are 0.5–1.0 mm diam., sparsely branched and bear short-stalked uprights normally less than 1.0 cm tall, composed of 1–6 spherical branchlets to 2.0 mm diam. Occurs on sand and muddy substrata, or dead coral in sheltered habitats.

**DISTRIBUTION:** Widely distributed in tropical oceans.

FIJI: Viti Levu.

### 17. *Caulerpa racemosa* (Forsskål) J. Agardh

#### Figure 19

*Caulerpa racemosa* (Forsskål) J. Agardh, 1873: 35—Egerod 1952: 369; Taylor 1960: 151, pl. 17 figs. 1, 3–4, 6–7; pl. 18, figs. 2–5, fig. 7; Chapman 1977: 161; Tsuda & Wray 1977: 95; Meñez & Calumpong 1982: 7; Kasahara 1985: 29; 1988; Silva et al. 1987: 106; Coppejans & Meinesz 1988: 191, figs. 22, 23 (as var. *clavifera*); Garrigue & Tsuda 1988: 57; Coppejans & Beeckman 1989: 384; Coppejans 1992: 401, figs. 4C, D (as ecad *racemosa*); Coppejans & Prud'homme van Reine 1992b: 698, figs. 18A, B (as ecad *racemosa*); South & Kasahara 1992: 49. *Fucus racemosus* Forsskål, 1775: 191 [type locality: Suez, Egypt]

*Fucus clavifer* Turner 1808: 126, pl. 57 [type locality: Red Sea].

*Chauvinia clavifera* (Turner) Bory de Saint-Vincent 1829 [1826–1829]: 207.

*Caulerpa clavifera* (Turner) C. Agardh 1817: XXIII.

*Caulerpa racemosa* (Forsskål) J. Agardh var. *clavifera* (Turner) Weber-van Bosse 1898: 361, pl. 33 figs. 1–3; Okamura 1913: 66, pl. 119 fig. 1 [f. *macrophysa* Weber-van Bosse]; Dawson 1957: 106, fig. 9c; Taylor 1960: 152, pl. 17 fig. 7 Chapman 1971: 166; Jaasund 1976: 25, fig. 50; Meñez & Calumpong 1982: 7, pl. 2A; Tseng 1984: 282, pl. 140 fig. 4; Coppejans & Meinesz 1988: 191, figs. 22, 23 (as var. *clavifera*); Garrigue & Tsuda 1988: 57; Coppejans & Beeckman 1989: 384, fig. 4; Coppejans 1992: 401, figs. 4C, D (as ecad *racemosa*); Coppejans & Prud'homme van Reine 1992b: 698, figs. 18A, B (as ecad *racemosa*); South & Kasahara 1992: 49.

*Fucus uvifera* Turner 1816 [1815–1819]: 81, pl. 230 [Type locality: Red Sea].

*Caulerpa uvifera* C. Agardh 1817: XXIII.—Weber-van Bosse 1898: 362, pl. 33, figs. 6–7; fig. 23; Taylor 1928: 102, pl. 12, fig. 6; pl. 13, fig. 3; 1960: 153, pl. 17, fig. 3; pl. 18, fig. 4; Valet 1968: 45, pl. 7(2), fig. 2; Womersley & Bailey 1970: 276; Chapman 1971, 166; Meñez & Calumpong 1982: 9, pl. 2D; Garrigue & Tsuda 1988: 58; South 1991: 5; South and Kasahara 1992: 50.

*Caulerpa racemosa* (Forsskål) J. Agardh var. *uvifera* (C. Agardh) J. Agardh 1873: 35; Silva et al. 1987: 107; Kasahara 1985: 31. [According to Silva et al. (1987), who recognized the synonymy of *C. racemosa* (Forsskål) J. Agardh as proposed by Papenfuss and Egerod (1957: 88), *Fucus uvifer* Turner, the intended basionym of *Caulerpa uvifera* (and other combinations), is a later homonym of *F. uvifer* Forsskål (1775: 192) and thus is not priorable. Silva et al. (1987) therefore treat *Caulerpa uvifera* C. Agardh as a *nomen novum* in accordance with Article 72, Note 1, of the International Code of Botanical Nomenclature.]

*Caulerpa racemosa* is a very common and notoriously highly plastic species, with many described varieties and forms. Many authors have suggested that the

variation may be due to environmental factors (e.g. light, habitat, depth, etc.), but often the same stolon may bear quite dissimilar uprights (see discussion in Coppejans and Beeckman, 1989). Experimental work (e.g. Peterson, 1972; Calvert, 1976) has provided evidence supporting the influence of environment on morphology in this species. Ohba and Enomoto (1987) have confirmed that light and temperature influence the morphology of *C. racemosa*, certainly between var. *laetevirens*, var. *peltata*, and the intermediate var. *turbinata*. There is increasing evidence that some of the varieties and forms of *C. racemosa* should be considered as ecological phenotypes and not as genotypes (Peterson, 1972; Coppejans and Beeckman, 1989).

REPRESENTATIVE MATERIAL: Nama Island [Carlson, 10 Dec. 1972: USP 060]; Mololailai, Plantation Village, Nadi, Viti Levu [Stein, Dec. 1979: UBC 67940]; Nanuialailai [Villeneuve, 23 Feb., 1982: UBC 22479]; Makuluva Island, Suva Lagoon [Kasahara, 17 Oct. 1985: USP 062]; Rakiraki [Kasahara, 24 Oct. 1985: USP 047]; Mami Bay, Coral Coast, Viti Levu [Kasahara, 29 Oct. 1985: USP 053]; Dravuni Island, Kadavu [South, 10 April 1991: USP 052; 055]; Deuba, Viti Levu [Carlson, 8 Oct. 1972: USP 058]; Suva, Viti Levu [Kasahara, 18 Sept., 1985: USP 049]; Nabuna, Viti Levu, [Kasahara, 11 Oct., 1985: USP 61]; Rotuma: Fapufa [N'Yeurt (F4/USP412)]; Hapmafau [N'Yeurt (HOP13/USP366, HOP26/USP368)]; Lopta [N'Yeurt (L6/USP375, L12/USP376, L2/USP365, L5/USP370)]; Maka Bay [N'Yeurt (MAK2/USP364, MAK6/USP367, MAK10/USP414)].

DESCRIPTION: Plants up to 15 cm tall with spreading stolon 3 mm in diameter, with rhizoids borne on ventral branches. Uprights bear up to 15 radially disposed stipitate ramelli with subspherical inflated ends 2–4 mm diam; color dark to light green, the larger plants noticeably paler in hue. Some plants (especially found in sandy locations) are provided with extensive rhizoids up to 15 mm long, covering some 30% of the spreading stolon. On Rotuma, found in relatively sheltered, preferably sandy locations in the backreef or epiphytic on large *Halimeda opuntia* clumps or coral heads. At Isilepi, extensive growth of this *Caulerpa* occurs on sand-covered coral heads, together with *Caulerpa serrulata*. Smaller plants can be found concealed within coral rubble on the middle reef, or within thick *Chlorodesmis* or *Dictyota* mats. Mainly found in backreef locations such as Hapmafau and Maka Bay, where they attain large sizes. Plants of the “*uvifera*” type form clumps up to 15 cm in diameter, composed of numerous small spreading stolons with relatively short (1–1.5 cm) erect foliar axes densely beset with imbricate ramelli up to 1.5 mm diam., disposed radially around the foliar axis; ramelli club to trumpet shaped, with a semi-hemispherical and somewhat flattened end borne on a distinct stalk up to 2.3 mm long. This dense arrangement of small ramelli imparts a distinctive grape-like appearance to the clusters of plants. The “*uvifera*” form occurring on Rotuma is found in generally exposed locations, growing in dense circular clumps on the outer reef, often epizoic on living soft-coral heads. The “*uvifera*” form dominates the outer reef face at Rotuma, sometimes forming a cover several square meters in area, as at Lopta.

KEY TO THE VARIETIES OF *Caulerpa racemosa*

1. Ends of branchlets terminating abruptly in a peltate disk, or with trumpet-shaped branchlets with concave, flattened ends .....2
1. Ends of branchlets generally swollen, varying from nearly cylindrical to clavate, subspherical or terminally flattened.....3
  2. Ends of branchlets terminating abruptly in a peltate disk, plants small; branchlets few ..... var. *peltata* (21)
  2. Ends of branchlets trumpet-shaped, flattened to 1–3 mm diam., densely radially arranged ..... var. *turbinata* (22)  
[intermediates between var. *peltata* and var. *turbinata* are not uncommon: see (23)]
3. Branchlets few to several per axis, the ends constricted and then sharply expanded to hemispherical inflations 4–8 mm diam..... var. *macrophysa* (19)
3. Branchlets otherwise .....4
  4. Branchlets cylindrical to clavate; erect axes with many densely imbricate branchlets ..... var. *laetevirens* (18)
  4. Branchlets now crowded, radially to somewhat distichously arranged; tapering to a subspherical apex up to 2 mm diam., borne on stalks at least as long as the terminally inflated portion ..... var. *occidentalis* (20)

**18. *Caulerpa racemosa* (Forsskål) J. Agardh var. *laetevirens* (Montagne)**

Weber-van Bosse

Figure 20

*Caulerpa laetevirens* Montagne 1842: 13 [type locality: Toud I. (Warrior Islet), Torres Strait, Australia].

*Caulerpa racemosa* (Forsskål) J. Agardh var. *laetevirens* (Montagne) Weber-van Bosse 1898: 366, pl. 33, figs. 16–22.—Taylor 1950: 64; 1960: 153, pl. 17, fig. 4, pl. 18, fig. 7; Cribb 1958: 212, pl. 3, figs. 1–7; Kasahara 1985: 29; Silva et al. 1987: 107; Coppejans & Beeckman 1989: 386, figs. 21–23; Coppejans 1992: 397 (as ecad *laetevirens*); Coppejans & Prud'homme van Reine 1992a: 173; Coppejans & Prud'homme van Reine 1992b: 693, fig. 16A–C (as ecad *laetevirens*); South & Kasahara 1992: 50.

REPRESENTATIVE MATERIAL: Suva [in Kasahara, 1985; 1 Dec. 1982 (not in USP)]; Tavua, Viti Levu [Kasahara, 11 Oct. 1985: USP 048].

DESCRIPTION: Thallus forming dense patches, with richly branched stolons bearing crowded branchlets; plant (0.5)2(15) cm tall, with uprights densely covered with generally radially arranged, clavate to narrowly pear-shaped branches 3–5 mm long and up to 1.0–1.5 mm broad, with a rounded to slightly tangentially compressed apex.

[There is a gradation between var. *laetevirens* and vars. *uvifera*, *occidentalis* and *turbinata* of *Caulerpa racemosa*. According to Coppejans and Beeckman (1989: 386) material from the Kenyan Coast agrees with illustrations in Chapman (1961: 147, fig. 174) and Meñez and Calumpang (1982: 9, pl. 2D) identified as *Caulerpa racemosa* var. *uvifera*, while some Kenyan plants with almost cylindrical

branchlets agree with *Caulerpa racemosa* var. *laetevirens* f. *cylindracea* (Sonder) Weber-van Bosse as illustrated in Cribb (1958: 218, pl. 3, fig. 2). They also note that Jaasund's (1976: 26, fig. 52) *Caulerpa occidentalis* should be called *C. racemosa* var. *laetevirens*. Coppejans and Beeckman (1989: 386) also report on intermediates between var. *laetevirens* and var. *turbinata*. Given this gradation, and the accepted polymorphism within *C. racemosa*, the validity of assigning taxonomic status to the various forms and varieties is questionable, and requires experimental substantiation.]

DISTRIBUTION: Tropical oceans in general.

FIJI: Viti Levu.

**19. *Caulerpa racemosa* (Forsskål) J. Agardh var. *macrophysa* (Sonder ex Kützing) W. R. Taylor**  
Figure 21

*Chauvinia macrophysa* Sonder ex Kützing, 1857: 6, pl. 15, fig. II [type locality: Central America].

*Caulerpa racemosa* (Forsskål) J. Agardh var. *macrophysa* (Sonder ex Kützing) Taylor 1928: 101, pl. 12, fig. 3; pl. 13, fig. 9.—Taylor 1950: 63; Chapman 1971: 166; Meñez & Calumpong 1982: 8, pl. 2C; Kasahara 1985: 30; Silva et al. 1987: 107; South & Kasahara 1992: 50.

REPRESENTATIVE MATERIAL: Yasawa Is. [Villeneuve, 25 Feb. 1982: UBC coll. No. 33375].

DESCRIPTION: Plants of moderate size, the stolons 4–12 mm diam., with numerous rhizoidal branches. Uprights simple or occasionally branched, 3–10 cm tall; axis terete, bearing radially arranged stout ramelli with a sharply expanded hemispherical inflation to 4–8 mm diam. Occurs in shallow, sheltered habitats.

DISTRIBUTION: Tropical oceans in general.

FIJI: Yasawa Is.

**20. *Caulerpa racemosa* (Forsskål) J. Agardh var. *occidentalis* (J. Agardh) Børgesen**  
Figure 22

*Caulerpa chemnitzia* (Esper) Lamouroux var. *occidentalis* J. Agardh, 1873: 37 [type locality: upper Gulf of Mexico to Recife, Brazil].

*Caulerpa racemosa* (Forsskål) J. Agardh var. *occidentalis* (J. Agardh) Børgesen, 1907: 379, figs. 28, 29.—Meñez & Calumpong, 1982: 8, pl. 2B; Silva et al. 1987: 108; Coppejans & Beeckman 1989: 384, figs 5, 6; Coppejans 1992: 399, fig. 4B (as ecad *occidentalis*).

REPRESENTATIVE MATERIAL: Yasawa Islands (Nadi Municipal Market) [South, Nov. 11, 1991, USP 438].

DESCRIPTION: A distinctive variety, collected and marketed in Fiji as “nama” (South, unpubl.). The stolons bear numerous rhizoidal holdfasts, and numerous slender, erect axes up to 14 cm tall. Branchlets are uncrowded, small and pear-

shaped with a diameter of 1–2 mm at the rounded tip, and borne on stalks at least as long as the terminally inflated portion; branchlets generally in two rows, alternate, sub-opposite or irregularly arranged. Fijian plants green with the illustrations in Chapman (1961, fig. 173) and Coppejans and Beeckman (1989, figs. 5, 6). Coppejans and Beeckman (1989) regard this as one of the less variable of the varieties of *C. racemosa* from the Kenyan Coast.

DISTRIBUTION: Tropical Indo-Pacific, East Africa and the Caribbean.

FIJI: Yasawa Islands. Not previously reported.

**21. *Caulerpa racemosa* (Forsskål) J. Agardh var. *peltata* (Lamouroux) Eubank  
Figure 23**

*Caulerpa peltata* Lamouroux 1809: 332 [type locality: Antilles].—Weber-van Bosse, 1898: 373, pl. 31 fig. 9; Okamura, 1932: 60, pl. 280 figs. 10–12; Eubank 1946: 421, fig. 2r, s; Dawson 1956: 35, fig. 16b; 1957: 106; Taylor 1960: 155, pl. 17 fig. 2; pl. 18 fig. 1; Chapman 1971: 166; Womersley & Bailey 1970: 275; Jaasund 1976: 27, fig. 53; Tsuda & Wray 1977: 94; Silva et al. 1987: 108; Garrigue & Tsuda 1988: 58;

*Caulerpa racemosa* (Forsskål) J. Agardh var. *peltata* (Lamouroux).—Meñez & Calumpang 1982: 8, pl. 2K; Tseng 1984: 282, pl. 140 fig. 3; Kasahara 1985: 30; Coppejans & Meinesz 1988: 191, fig. 24; Coppejans & Beeckman 1989: 388, figs. 27–29; Littler et al. 1989: 46; South 1991: 5; Coppejans & Prud'homme van Reine 1992a: 173; Coppejans & Prud'homme van Reine 1992b: 696, fig. 17B (as *ecad peltata*); South & Yen 1992: 127; South & Kasahara 1992: 50.

*Caulerpa peltata* Lamouroux f. *nummularia* (Harvey) Dawson 1957: 106, fig. 10.—Kasahara 1988; South & Kasahara 1992: 50.

*Caulerpa peltata* Lamouroux var. *nummularia* (Harvey) Weber-van Bosse 1898: 376 [type locality: Tonga].

*Caulerpa nummularia* Harvey in J. Agardh, 1873.

REPRESENTATIVE MATERIAL: Yasawa Is. [*Villeneuve*, 25 Feb., 1982: UBC A22476; A24627]; West Coast of Viti Levu [*Garbary*, Aug. 1981: UBC 21923]; Namale Plantation, Vanua Levu [*Villeneuve*, 18 Feb., 1982: UBC A15692; A21897]; Leluvia, Viti Levu [*Kasahara*, 26 Sept. 1985: USP 051, 054]; Tagage, Coral Coast, Viti Levu [*Kasahara*, 3 Oct., 1985: USP 046; 15 October, 1985: USP 044]; Vatualailai, Coral Coast, Viti Levu [*Kasahara*, 16 Oct., 1985: USP 063]; Rotuma: Hapmafau [*N'Yeurt* (HOP8/USP372)]; Lopta [*N'Yeurt* (L8)]; Maka Bay [*N'Yeurt* (MAK1/USP371, MAK5/USP369)].

DESCRIPTION: Plants typically small and occurring as single stolons up to 1 mm in diameter, occasionally forming clumps 5–10 cm across, of densely intermingled plants, each about 8 cm long and sparingly provided with short rhizoidal branches. Stolon spreading, and bearing short cylindrical erect foliar axes 1–1.5 cm long at 2–3 mm intervals, these producing thin peltate discs 3–5 mm diam., either singly at the end, or bearing several discs axially arranged around the main foliar branches.

[This variety exhibits considerable polymorphism, with the consistent character being the presence of peltate disks at the distal ends of the short branchlets. The same plant may bear, however, peltate, spherical and turbinate branchlets; there are also several variations on how the peltate disks may be borne, either directly from the stolon or from the uprights. According to Coppejans & Beeckman (1989), with diminishing light intensity *Caulerpa racemosa* vars. *clavifera* and *laetevirens* can tend towards var. *peltata*, with an intermediate var. *turbinata*. It was also noted by Meñez & Calumpang (1982) that the more depauperate forms assigned to this variety were found in rocky, exposed situations where they show a high degree of polymorphism. While the line of distinction between these forms varies amongst authors, the variety described here occupies the peltate extreme of the range, with unmistakable thin disc-like ramelli]. On Rotuma, typically found in cryptic locations, such as creeping over staghorn coral rubble or hidden under rocks on inner reef. Where it occurs in sheltered back-reef sites (e.g. Hapmafau, Maka Bay) it can form distinct clumps or mats up to 15 cm diameter over sand-covered rocks or smooth substrata. Many plants examined showed distinct dent-like grazing marks on the disc edges.

DISTRIBUTION: Widely distributed in tropical oceans.

FIJI: Widespread on Viti Levu, and probably elsewhere.

ROTUMA: Hapmafau; Lopta; Maka Bay.

**22. *Caulerpa racemosa* (Forsskål) J. Agardh var. *turbinata* (J. Agardh) Eubank  
Figure 24**

*Caulerpa clavifera* (Turner) C. Agardh var. *turbinta* J. Agardh, 1837: 173 [type locality: near Tor, Sinai Peninsula, Egypt].

*Caulerpa racemosa* (Forsskål) J. Agardh var. *turbinata* (J. Agardh) Eubank 1946: 420, fig. 20q.—Dawson 1956: 35, fig. 16a; Silva et al. 1987: 108; Coppejans & Beeckman 1989: 386, figs. 24–26; Coppejans 1992: 401 (as ecad *turbinata*); Coppejans & Prud'homme van Reine 1992a: 174; Coppejans & Prod'homme van Reine 1992b: 698, figs 19A, B (as ecad *turbinata*).

*Fucus chemnitzia* Esper 1800: 167 [given as "127"], pl. LXXXVIII [Type locality: Malabar Coast, India]

*Caulerpa racemosa* (Forsskål) J. Agardh var. *chemnitzia* (Esper) Weber-van Bosse 1898: 370, pl. 31, figs. 5–8.

REPRESENTATIVE MATERIAL: Dravuni Is. Kadavu [*Würtz*, 4 Sept., 1992; USP 439]; Rotuma: Lopta [*N'Yeurt*: (L3/USP374, L13/USP373, L22/USP413)]

DESCRIPTION: Plants characteristically lacking a well-defined spreading stolon, the ramelli up to 1.5 mm long and trumpet-shaped with concave, flattened ends 1–3 mm in diameter and radially disposed in dense fashion around foliar branches up to 25 mm in length. This variety is intermediate between vars. *clavifera* (included under *C. racemosa* in this report), and *peltata*. On Rotuma, found in relatively exposed locations.

DISTRIBUTION: Widely reported in tropical oceans.

FIJI: Western Viti Levu; not previously reported.

ROTUMA: Lopta.

**23. intermediate variety between var. *Caulerpa racemosa* vars. *turbinata* and *peltata*.**

Figure 25

Coppejans & Beeckman 1989: 391, pl. 4, fig. 29 Coppejans 1992: 403; Coppejans & Prud'homme van Reine 1992b: 701, fig. 17A (as *ecad laetevirens/turbinata/peltata*).

REPRESENTATIVE MATERIAL: Rotuma: Lopta [*N'Yeurt* (L9/USP442)].

DESCRIPTION: Plants up to 3 cm long, with no distinct spreading stolon; the foliar branches bearing peltate to sub-discoid or turbinate, terminally inflated ramelli, often on the same branch. There exists a great variety of intermediate forms between the ramelli on a single plant, from characteristically dentate and undulated discs 1.3–1.5 mm diam., to turbinate, trumpet-shaped ramelli up to 1 mm in diameter. However, the peltate ramelli are slightly thicker than in var. *peltata*, while the turbinate ramelli have somewhat more flattened ends than occur in var. *turbinata*. Hence, it appears to be a distinct intermediate variety, with branchlets numerous on a single upright axis. Generally found on the outer reef, together with *Caulerpa racemosa* vars. *uvifera* and *turbinata*, where it is more abundant than the latter.

***Caulerpella* Prud'homme van Reine and Lokhorst**

Prud'homme van Reine and Lokhorst, 1992

**24. *Caulerpella ambigua* (Okamura) Prud'homme van Reine and Lokhorst**  
Figures 26, 27

*Caulerpa ambigua* Okamura 1897: 4, pl. 1, figs. 3–12 [type locality: Ogasawara-gunto (Bonin Is.), Japan].—Weber-van Bosse 1898: 388; Tsuda & Wray 1977: 94; Silva et al. 1987: 104; Garbary et al. 1991: 252; South & Kasahara 1992: 49.

*Caulerpella ambigua* (Okamura) Prud'homme van Reine and Lokhorst 1992: 114, figs. 1–4, 6, 7.

*Caulerpa vickersiae* Børgesen 1911: 129, fig. 94.—Womersley & Bailey 1970: 278.

*Caulerpa vickersiae* Børgesen var. *luxurians* Taylor 1928: 104, pl. 12, fig. 20, pl. 13, fig. 12.

*Caulerpa vickersiae* Børgesen var. *furcifolia* Taylor 1993: 396, pl. 36.

*Caulerpa ambigua* Okamura var. *dichotoma* Eubank 1946: 414, pl. 22, figs. b, c.

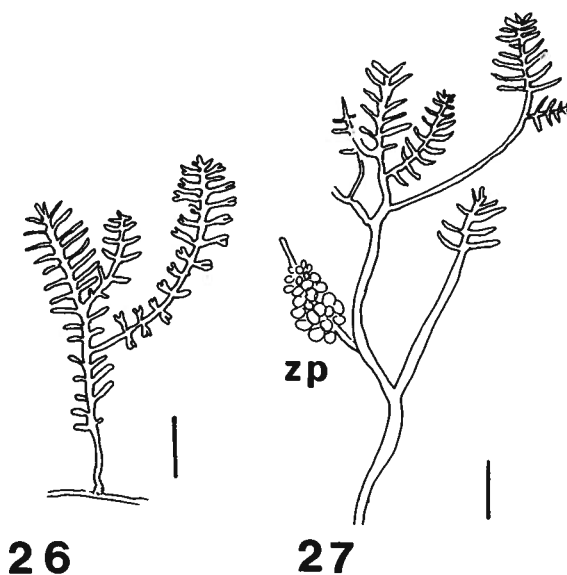
*Caulerpa ambigua* var. *simplex* Eubank 1946: 413, pl. 22, fig. a.

*Caulerpa biloba* Kemperman & Stegenga 1983: 271, fig. 1–7.

REPRESENTATIVE MATERIAL: Taveuni [*Villeneuve*, 16 Feb., 1982: UBC A3431; A14949].

DESCRIPTION: Plants small, differentiated into a rhizoidal, stoloniferous and erect, branched portion; stolon weakly developed, short, inconspicuous, or long and irregularly branched, often exhibiting a strongly undulating outline; erect





Figures 26–27. Figure 26. *Caulerpella ambigua*, sterile plant showing branchlets with forked tips. Scale = 2 mm. Figure 27. *Caulerpella ambigua*, fertile plant showing vegetative branchlets and a branchlet bearing zoosporangia (zp). Scale = 2 mm.

branches usually <2.0 cm tall, bearing vegetative or reproductive branchlets; vegetative branchlets terete, distichously or irregularly (radially) arranged, of rather uniform length, simple or terminally forked, the tips not mucronate; fertile branchlets of limited growth, bearing compound whorls of zoosporangia arising from the basal portion; fertile branchlets separated from the main axis by a distinct transverse wall.

**DISTRIBUTION:** Widely distributed in tropical oceans.

**FIJI:** Taveuni, apparently rare.

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