

## Revisions and additions to *Caulerpa* (Chlorophyta, Caulerpaceae) from the Fiji Islands, South Pacific

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**Abstract.** Twenty-three taxa of *Caulerpa* Lamouroux are listed from the Fiji Islands, including *Caulerpa reniformis* sp. nov. and four taxa newly recorded [*Caulerpa biserrulata* Sonder, *Caulerpa nummularia* Harvey ex J. Agardh, *Caulerpa racemosa* var. *lamourouxii* (Turner) Weber-van Bosse and *Caulerpa webbiana* f. *disticha* Vickers]. A further four taxa are listed as *Species inquirendae* [*C. crassifolia* (C. Agardh) J. Agardh, *C. juniperoides* J. Agardh, *C. mexicana* var. *pluriseriata* W.R. Taylor and *C. remotifolia* Sonder]. A revised key to the species of *Caulerpa* from the Fiji Islands is presented. Verification of records is based on the personal collections of the authors and specimens housed in the Phycological Herbarium, South Pacific Regional Herbarium (SUVA-A), the University of British Columbia (UBC), the Bernice P. Bishop Museum (BISH) and the University of California at Berkeley (UC).

### Introduction

The genus *Caulerpa* Lamouroux (1809a: 136) from Fiji was reviewed by South and N'Yeurt (1993), who recorded a total of 23 taxa at the species, variety and form levels. An additional eight taxa were listed in N'Yeurt *et al.* (1996), bringing the total to 31.

During the past 9 years, collections of *Caulerpa* have been made from many sites, and in this report we provide an update on the status of the genus in the Fiji Islands (excluding Rotuma), including details of herbarium holdings and distributions of representative taxa of *Caulerpa* held in the Phycological Herbarium, South Pacific Regional Herbarium (SUVA-A), the Bernice P. Bishop Museum (BISH), the Phycological Herbarium, University of British Columbia (UBC) and the Herbarium, University of

California at Berkeley (UC). Illustrations are provided for those taxa not illustrated by South and N'Yeurt (1993) and a new species, *Caulerpa reniformis* is described. New collections include four taxa not previously recorded from Fiji. Those taxa for which records cannot be substantiated are listed as *Species inquirendae*.

### Materials and methods

Collections were made by snorkeling or with the use of SCUBA. All collections were prepared by standard herbarium methods, and are held in the Phycological Herbarium, South Pacific Regional Herbarium (SUVA-A), as pressed or liquid-preserved specimens. Details of the collections are stored on the SUVA-A ACCESS database. Digital images were taken with Nikon Coolpix 990 and 995 digital cameras and were processed by using Adobe Photoshop Version 6.

Those taxa marked # represent new records and those marked \* have undergone nomenclatural changes since N'Yeurt *et al.* (1996).

### Revised key to the Fijian taxa of *Caulerpa* (modified from South and N'Yeurt 1993: 110)

1. Stolons and erect branches similar in form, the erect branches bearing verticillate branchlets ..... *C. verticillata*  
Stolons and erect branches of contrasting form ..... 2
2. Erect branches blade-like, divided or undivided, lacking branchlets ..... 3  
Erect branches cylindrical and variously branched, lobed or cleft ..... 4
3. Erect branches simple, membranous, undivided or sparingly divided, margins smooth or more commonly with simple and bifid teeth .....  
..... *C. biserrulata*  
Erect branches divided 1–3 times, thicker, bifid teeth lacking ..... *C. brachypus*
4. Erect branches flattened or compressed ..... 5  
Erect branches neither flattened nor compressed ..... 7
5. Erect branches dichotomously branched, narrow and band-like, either straight or more commonly spirally twisted with a markedly dentate margin ..... *C. serrulata*  
Erect branches otherwise constructed ..... 6

6. Ramelli cylindrical, pinnately arranged, the plant with a feather-like appearance ..... *C. sertularioides*  
 Ramelli flattened, pinnately arranged, sickle-shaped ..... *C. taxifolia*
7. Erect branches fine, terminating in minute bushy ramelli arranged in one plane and branched to 4 or 5 orders ..... *C. filicoides* var. *andamanensis*  
 Erect branches otherwise ..... 8
8. Erect branches angular, with thorn-like or dentate projections; stolons naked ..... *C. urvilleana*  
 Erect branches not angular; stolons naked or tomentose ..... 9
9. Stolons tomentose ..... *C. webbiana*  
 Stolons naked ..... 10
10. Ramelli terete, teeth generally densely arranged in two to several ranks, short ..... *C. cupressoides*  
 Ramelli spherical, clavate, peltate, foliose or otherwise ..... 11
11. Ramelli peltate, margins smooth or crenulate ..... 12  
 Ramelli spherical, clavate, or foliose ..... 13
12. Margins of ramelli smooth ..... *C. peltata*  
 Margins of ramelli crenulate, lobed or scalloped ..... *C. nummularia*
13. Ramelli stalked, foliose, reniform, arranged in spiral series ..... *C. reniformis*  
 Ramelli stalked or sessile, cylindrical, clavate or spherical ..... 14
14. Ramelli usually stalked, the ends generally sharply swollen and varying from nearly cylindrical to clavate or spherical ..... *C. racemosa*  
 Ramelli subsessile, the very short stalks with a definite constriction at the junction between the stalk and the inflated terminal portion of the ramelli ..... 15
15. Ramelli bi-laterally arranged ..... *C. sedoides* f. *geminata*  
 Ramelli scattered or clustered, not bi-laterally arranged ..... *C. microphysa*

## Catalogue of taxa

### Family Caulerpaceae

#### Genus *Caulerpa* Lamouroux

#*Caulerpa biserrulata* Sonder, 1871: 64, pl. 2, figs 10–12. (type locality: Cape York, Queensland, Australia). Coppejans, 1992: 388; Kraft 2000: 595, fig. 32A

*Caulerpa brachypus* Harvey f. *parvifolia* (Harvey) Cribb *sensu* Cribb, 1958: 209, figs 1–7 [= *Caulerpa parvifolia* Harvey, 1860b: pl. CLXXII (type locality: Kiama, New South Wales, Australia)]. N'Yeurt, 2001: 711, fig. 40; South and N'Yeurt 1993: 113, fig. 5; N'Yeurt *et al.*, 1996: 61.

*Note:* the separation of *C. biserrulata* from *C. brachypus* is in agreement with the interpretation of Coppejans (1992: 388) and Kraft (2000: 595). The bifid spines are characteristic of *C. biserrulata*, as also are the delicate and thinner fronds compared with those of *C. brachypus*.

*Material examined:* Makuluva I., *D.W. Keats*, 22.x.1994 (SUVA-A 5511); Nukulau I., *B. Carlson*, 20.viii.1972 (SUVA-A 41); Nukulau I., *P.A. Skelton*, 18.viii.1998 (SUVA-A 4702–4703); Sandbank, Suva, *P.A. Skelton*, 3.ii.1998 (SUVA-A 3728); Belcher Rocks, Suva, *D.W. Keats*, 27.xi.1994 (SUVA-A 867); Lomaiviti, *S. Mangubhai*, 29.iv.2001 (SUVA-A 5728).

*Caulerpa brachypus* Harvey, 1860a: 333 (type locality: Tanega-shima, Kagoshima Prefecture, Japan). Previous published records: Chapman, 1971: 166; Kasahara, 1985: 26; South and N'Yeurt, 1993: 113, figs 3, 4; N'Yeurt *et al.*, 1996: 61

*Note:* an apparently rare species: there are no recent collections of this taxon in Fiji. Coppejans (1992) commented that *C. brachypus sensu stricto* has not yet been collected in Papua New Guinea.

*Distribution:* Suva (*in herb.*, H. Kasahara, No. 054); Vatulele I., *B. Carlson*, 4–5.i.1973 (SUVA-A 40); Yanuca I., *B. Carlson*, 12.xi.1972 (SUVA-A 39; as *C. anceps* Harvey).

*Caulerpa cupressoides* (Vahl) C. Agardh, 1817: XXIII. Kasahara, 1988; South and N'Yeurt, 1993: 114, fig. 7; N'Yeurt, 2001: 712

*Fucus cupressoides* Vahl, 1802: 38 (type locality St Croix, Virgin Islands).

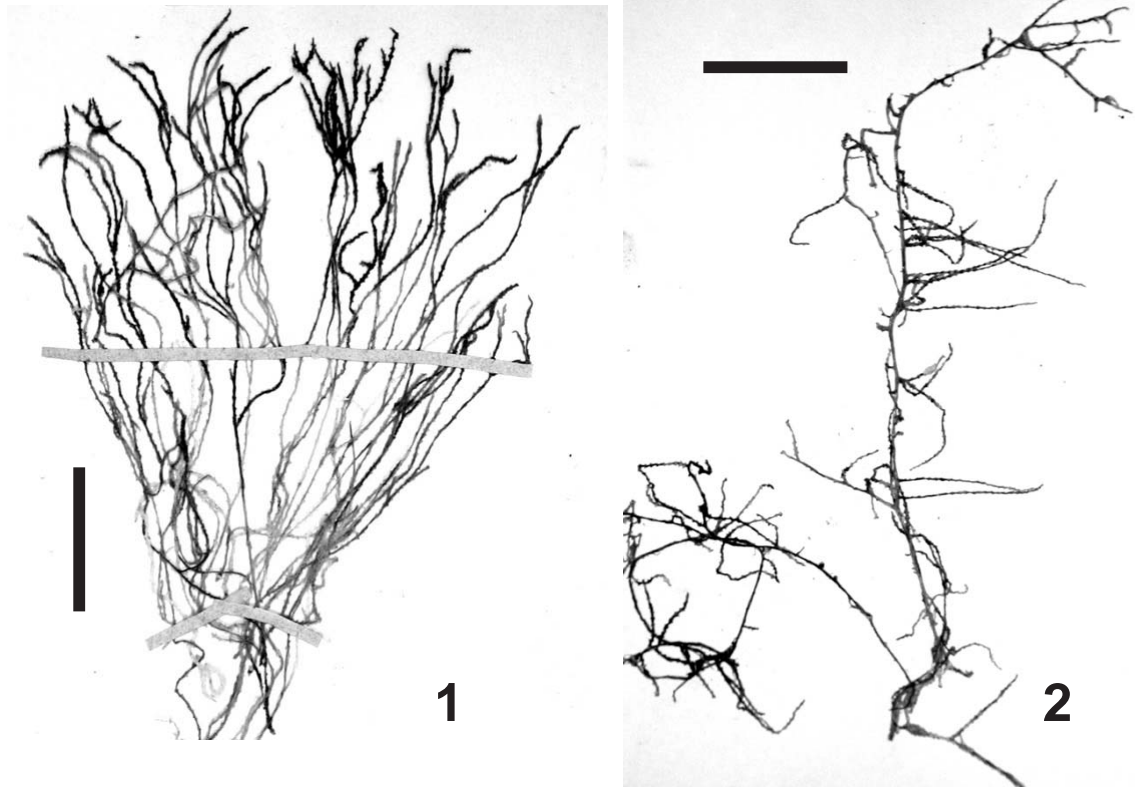
*Caulerpa urvilleana* Montagne var. *vitiensis* Weber-van Bosse, 1898: 319. (type locality: Fiji). Chapman, 1971.

*Note:* we have examined a possible lectotype of *C. urvilleana* var. *vitiensis* (*Dr Graeffe*, Fiji. UC97330; Fig. 1), which is morphologically the same as plants collected from the Phoenix Group, Kiribati and identified as *C. cupressoides* [South *et al.* 2001: Enderbury I., Phoenix Group, Kiribati, *A. Yoshinaga*, 5.vii.2000 (SUVA-A 5605; 5609); Fig. 2]. They closely resemble *C. cupressoides* ead *flabellata* as in Coppejans and Prud'homme van Reine (1992: 676, figs 4A–C, 9A).

*Material examined:* Makuluva I., Suva Lagoon, *J. Faloon*, 22.x.1993 (SUVA-A 770); Serua, *T.D. Pickering*, 27.viii.1996 (SUVA-A 941); Kaba, *T.D. Pickering*, 22.v.1996 (SUVA-A 953); Rakiraki, *H. Kasahara*, 10.xi.1985 (SUVA-A 72); Naviti, *H. Kasahara*, 16.x.1985 (SUVA-A 67); Malevu, *H. Kasahara*, 10.iii.1985 (SUVA-A 68); Savusavu, *N. Nicholson*, 13.vii.1973 (BISH 623627).

### Key to varieties of *C. cupressoides*

*Note:* the value or otherwise of recognising infra-specific combinations of varieties and forms of this most highly variable of all the *Caulerpa* species has been discussed in Coppejans and Beeckman (1990), Coppejans (1992) and Kraft (2000), among others. There would appear to be a continuum of variation, which may be phenotypic in nature. Some of the infra-specific taxa recognised in South and



**Fig. 1.** *Caulerpa urvilleana* var. *vitiensis* collected from Fiji by Dr E. Graeffe, from the collections of A. Grunow (UC97330). Scale bar = 2.0 cm.

**Fig. 2.** *Caulerpa cupressoides*, Enderbury Island, Phoenix Group, Kiribati, A. Yoshinaga, 5.vii.2000 (SUVA-A 5605). Scale bar = 2.0 cm.

N'Yeurt (1993) are excluded here in keeping with the treatment of Silva *et al.* (1996).

1. Plants large, erect axes up to 20 cm tall, sparingly branched; ramelli erect, in several ranks, cylindrical, 2–6 times as long as the axis diameter ..... var. *lycopodium*  
Plants smaller, erect axes shorted and stouter, bushy, with the ramelli arranged in 5 or more ranks and inflated at the base ...  
..... var. *mamillosa*

***Caulerpa cupressoides* (Vahl) C.Agardh var. *lycopodium*** Weber-van Bosse, 1898: 335, pl. XXVII: figs 5–13; pl. XXVIII: figs. 10, 11, 12, 14. Chapman, 1971: 166; Kasahara, 1988; South, 1991: 5; South and N'Yeurt, 1993: 116, fig. 8; N'Yeurt *et al.*, 1996: 61

*Caulerpa lycopodium* J.Agardh, 1847: 6. nom. illeg. (type locality: 'e mari Brasiliae et Indiae Occidentalis'). See Silva *et al.*, 1996: 817 concerning the basionym.

*Note:* two formae of var. *lycopodium* included in Silva *et al.* (1996) and South and N'Yeurt (1993) are not listed separately here, viz: *Caulerpa cupressoides* (Vahl) C.Agardh var. *lycopodium*, forma *disticha* Weber-van Bosse, 1898: 338, pl. XXVII: fig. 14 (syntype localities: Guadeloupe, West Indies; Florida, USA) and *Caulerpa cupressoides* (Vahl) C.Agardh var. *lycopodium* Weber-van Bosse forma *elegans* (P.Crouan & H.Crouan) Weber-van Bosse, 1898: 336, pl.

XXVII: figs 8, 9 [= *Caulerpa plumaris* (Forsskål) C.Agardh var. *elegans* P.Crouan & H.Crouan in Schramm and Mazé, 1865: 39 (type locality: Guadeloupe, West Indies)].

*Material examined:* Rakiraki, H. Kasahara, 10.xi.1985 (SUVA-A 73); Namada, P.A. Skelton & G.R. South, 22.vi.2002 (SUVA-A 7285); Nanu-i-a-lailai, S. Villeneuve, 23.ii.1982 (SUVA-A 3729); Naviti I., T.D. Pickering, 02.vii.1996 (SUVA-A 917); Nasova Bay, H. Kasahara, 19.viii.1985 (SUVA-A 69).

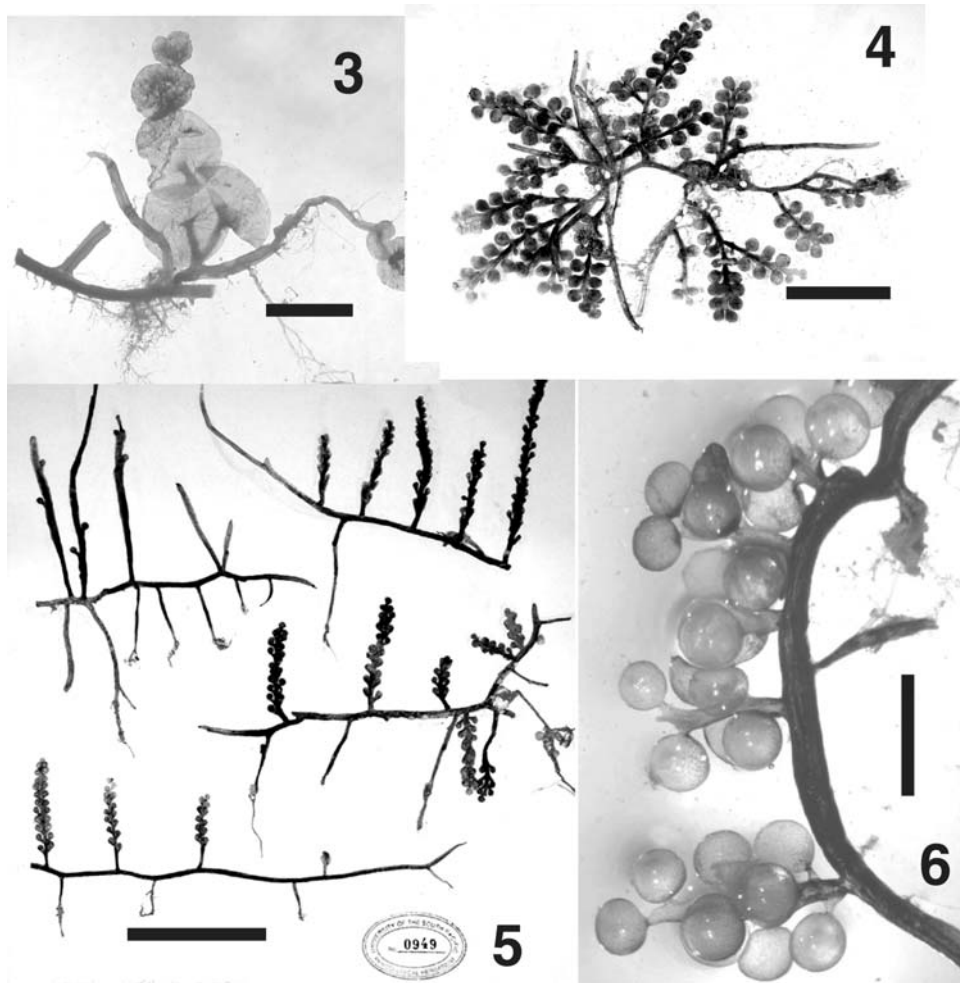
***Caulerpa cupressoides* (Vahl) C.Agardh var. *mamillosa*** (Montagne) Weber-van Bosse, 1898: 332, 333, pl. XXVIII: fig. 6 (f. *typica*). South and N'Yeurt, 1993: 118, fig. 10

*Caulerpa mamillosa* Montagne, 1842: 13 (syntype localities: Agalega Islands, Mangareva, Îles Gambier, French Polynesia).

*Material examined:* Dravuni I., Kadavu, G.R. South, 04.x.1991 (SUVA-A 70).

***Caulerpa filicoides* Yamada var. *andamanensis*** W.R. Taylor, 1966: 154, 156, fig. 1 (type locality: northeast of Ritchie's Archipelago Andaman Islands); South and N'Yeurt, 1993: 111, figs 1, 2; N'Yeurt, 2001: 713

*Caulerpa acuta* (Yamada) Yamada, 1944: 34. Kasahara, 1988; South and Kasahara, 1992: 49.



**Fig. 3.** *Caulerpa nummularia*, Kadavu, Fiji, *S. Mangubhai*, 2.v.2001 (SUVA-A 6932). Scale bar = 5.0 mm. **Fig. 4.** *Caulerpa sedoides* f. *geminata*, Fish Patch, Suva Barrier Reef, Fiji, *D.W. Keats*, 13.x.1994 (SUVA-A 812). Scale bar = 2.0 cm. **Fig. 5.** *Caulerpa racemosa* var. *Lamourouxii*, Kaba Peninsula, Viti Levu, Fiji, *T.D. Pickering*, 22.v.1996 (SUVA-A 949). Scale bar = 2.0 cm. **Fig. 6.** Fresh specimen of *Caulerpa microphysa*, N. Astrolabe Reef, Kadavu, Fiji, *S. Mangubhai*, 2.v.2001 (SUVA-A 6911). Scale bar = 5.0 mm.

*Material examined:* Makuluva I., *D.W. Keats*, 26.vii.1994 (SUVA-A 5919–5920); Suva Barrier Reef, *H. Kasahara*, 18.ix.1985 (SUVA-A 37); *Knight*, 22.ix.1994 (SUVA-A 813); Makuluva I., *B. Carlson*, 12.viii.1972 (SUVA-A 38).

*Caulerpa microphysa* (Weber-van Bosse) J.Feldmann, 1955: 430. South and N'Yeurt, 1993: 124, fig. 18 (Fig. 6)

*Caulerpa racemosa* (Forsskål) J.Agardh [var. *clavigera*] forma *microphysa* Weber-van Bosse, 1898: 361, 362, pl. XXXIII: fig. 5 [type locality: Macassar (Ujung Pandang) Celebes, Indonesia].

*Note:* this species is similar to *C. fergusonii* but differs by the whorled arrangement of ramelli.

*Distribution:* N. Astrolabe, *S. Mangubhai*, 2.v.2001 (SUVA-A 6911); Namale Plantation, Vanua Levu, *S. Villeneuve*, 18.ii.1982 (SUVA-A 3733); Sandbank Passage, Suva Lagoon, *P.A. Skelton*, 2.ii.1998 (SUVA-A 3731).

*#Caulerpa nummularia* Harvey ex J.Agardh, 1873: 38 (syntype localities: Tonga; Nukahiva, Marquesas Islands). Harvey, 1857: No. 77 (Fig. 3)

*Caulerpa peltata* Lamouroux var. *nummularia* (Harvey ex J. Agardh) Weber-van Bosse, 1898: 376.

*Note:* This species may be confused with *Caulerpa peltata* var. *exigua* Weber-van Bosse (1898: 377). According to Weber-van Bosse (1898: 376), plants with smooth or crenulated margins to the disks, with new disks arising from the borders of the subtending disks (creating a linear series) and with disks 4–5 mm in diameter, represent *C. nummularia*. More delicate plants with discs lacking crenulate margins, with discs of 2 mm in diameter and with new discs usually arising on stalks from the centre of the subtending disc, represent *C. peltata* var. *exigua*. Fijian plants fit the description of *C. nummularia* in Weber-van

Bosse (1898: 376; as *C. peltata* var. *nummularia*). The illustrations of *C. peltata* var. *exigua* in Kraft (2000: fig. 33F) seem to be intermediate between *C. peltata* v. *exigua* and *C. nummularia*, since the disks are approximately 4–5 mm in diameter and have markedly crenulated margins (as in *C. nummularia*), but new disks arise from the centre of the subtending disk and not the margin (as in *C. peltata* var. *exigua*). Coppejans and Prud'homme van Reine (1992: 696) did not consider *C. nummularia* (as *C. racemosa* var. *peltata* f. *nummularia*) as a distinct entity because some stolons bear singly placed as well as grouped peltate disks.

*Material examined:* Kadavu, *S. Mangubhai*, 2.v.2001 (SUVA-A 6932); Marine Studies Aquarium, Suva, *K. Pakoa*, 26.ii.2001 (SUVA-A 6928).

\**Caulerpa peltata* Lamouroux, 1809b: 332 (type locality: Antilles, West Indies); N'Yeurt, 2001: 714

*Note:* Silva *et al.* (1996: 830) retain *C. peltata* as a separate species, with *C. laetevirens* Montagne (= *C. racemosa* v. *laetevirens*; see South and N'Yeurt, 1993: 128, fig. 20) as a synonym. The *laetevirens* morphology, however, may deserve to be recognised at some level and requires re-evaluation as to its status *vis-à-vis* *C. peltata* and the peltate form of *C. racemosa* (South and N'Yeurt, 1993: 130, fig. 23).

*Material examined:* Tavua, *G.R. South*, 9.ix.1991 (SUVA-A 584); Rakiraki, Viti Levu, *H. Kasahara*, 11.x.1985 (SUVA-A 56); Namada, *P.A. Skelton & G.R. South*, 22.vi.2002 (SUVA-A 7282); Dravuni I., *G.R. South*, 4.x.1991 (SUVA-A 52, 55); Rakiraki, *H. Kasahara*, 24.x.1985 (SUVA-A 47); Suva, *H. Kasahara*, 18.ix.1985 (SUVA-A 49); Leleuvia I., *H. Kasahara*, 26.ix.1985 (SUVA-A 51, 54); Kadavu, *S. Mangubhai*, 2.v.2001 (SUVA-A 6927); N. Astrolabe Reef, *S. Mangubhai*, 2.v.2001 (SUVA-A 6914); Herald Passage, Astrolabe, *S. Mangubhai*, 1.v.2001 (SUVA-A 6933); Nukulau Channel, *P.A. Skelton*, 18.viii.1998 (SUVA-A 4700); Namale Plantation, Vanua

Levu, *S. Villeneuve*, 18.ii.1982 (SUVA-A 3736); Belcher Rocks, Suva Barrier Reef, *D.W. Keats*, 27.xi.1992 (SUVA-A 1167); Vatuaililai, Viti Levu, *H. Kasahara*, 16.x.1991 (SUVA-A 63); Naukacuru I., *S. Villeneuve*, 25.i.1982 (SUVA-A 3737); Tagage, Coral Coast, *H. Kasahara*, 3.x.1985 (SUVA-A 46).

\**Caulerpa racemosa* (Forsskål) J.Agardh, 1873: 35, 36. Kasahara, 1988; South, 1993: 335; South and N'Yeurt, 1993: 126, fig. 19; N'Yeurt, 2001: 714

*Fucus racemosus* Forsskål, 1775: 191 (type locality: Suez, Egypt).

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

*Caulerpa racemosa* (Forsskål) J.Agardh var. *clavifera* (Turner) Weber-van Bosse, 1898: 361, 362, pl. XXXIII: figs 1–3 (including forma *typica*).

*Caulerpa uvifera* C.Agardh, 1817: XXIII (*C. racemosa* var. *uvifera* (C.Agardh) J.Agardh, 1873: 35. Chapman, 1971: 166; Kasahara, 1985: 31; South, 1991: 5.

*Material examined:* Namara, *B. Carlson*, 12.x.1972 (SUVA-A 60); Cakaulevu, Dama, Vanua Levu, *T.D. Pickering*, 4.ii.1997 (SUVA-A 5475); Yasawa I., *T.D. Pickering*, 7.ii.1996 (SUVA-A 1357–1359); Makuluva I., *A.D.R. N'Yeurt*, 11.viii.1997 (SUVA-A 1154); Dravuni I., *T.D. Pickering*, 22.x.1996 (SUVA-A 955); Dravuni I., *G.R. South*, 11.v.1990 (SUVA-A 924); Nukulau I., *D.W. Keats*, 27.xi.1994 (SUVA-A 5536); Nabuna I., *H. Kasahara*, 10.xi.1985 (SUVA-A 61); Serua, *T.D. Pickering*, 27.v.1996 (SUVA-A 944); Nukulau I., *H. Kasahara*, 17.x.1985 (SUVA-A 62); Sigatoka, *W. Greenwood*, v.1941 (UC 776132; 776139); Suva, *H.E. Parks*, v.1926 (W.A. Setchell 17747, in UC); ex Suva Market, *G.R. South*, 26.x.1991 (SUVA-A 934). Rakiraki, Viti Levu, *H. Kasahara*, 24.x.1985 (SUVA-A 47); Momi Bay, Coral Coast, *H. Kasahara*, 29.x.1985 (SUVA-A 53); Dravuni I., Kadavu, *T.D. Pickering*, 22.x.1996 (SUVA-A 954); Makuluva I., *H. Kasahara*, 17.x.1985 (SUVA-A 62); Namara I., *B.C. Carlson*, 12.x.1972 (SUVA-A 60); Dravuni I., Kadavu, *G.R. South*, 4.x.1991 (SUVA-A 55).

### Key to varieties of *C. racemosa*

Note: varieties of *C. racemosa* are retained here in accordance with the treatment in Silva *et al.* (1996).

- Uprights unbranched or scarcely so, rachis flattened; ramelli, if present, bi-laterally arranged. . . . . var. *lamourouxii*  
Uprights generally profusely branched, rachis terete, ramelli radially arranged, the ends swollen, varying from nearly cylindrical to clavate, subspherical or terminally flattened. . . . . 2
- Ramelli crowded, radially to somewhat distichously arranged, tapering to a subspherical apex up to 2 mm in diam., borne on stalks at least as long as the terminally inflated portion. . . . . var. *occidentalis*  
Ramelli with inflated ends, sharply expanded. . . . . 3
- Ends of ramelli trumpet-shaped, flattened up to 1–3 mm in diam., densely radially arranged. . . . . var. *turbinata*  
Ramelli few to several per rachis, the ends constricted and then sharply expanded to hemispherical inflations 4–8 mm in diam. var. *macrophyssa*

#*Caulerpa racemosa* (Forsskål) J.Agardh var. *lamourouxii* (Turner) Weber-van Bosse, 1898: 368, 369, pl. XXXII: figs 1–4 ('forma *typica*') (Fig. 5)

*Fucus lamourouxii* Turner, 1811–1819: 79, 80, pl. 229 (type locality: Red Sea).

*Note:* the range of variation in this variety in Fiji compares exactly with that described from Papua New Guinea by

Coppejans (1992: 399, fig 5) and Coppejans and Prud'homme van Reine (1992: 693, fig. 15B, as ecad *lamourouxii*).

*Material examined:* Kaba Peninsula, Viti Levu, *T.D. Pickering*, 22.v.1996 (SUVA-A 948–949); Nakalawaca, Namara, *M. Tuiwawa* 25.iii.1993 (SUVA-A 557); Serua I., *T.D. Pickering*, 27.viii.1996 (SUVA-A 944); Malake I., Ra, *T.D. Pickering*, 22.ix.1996 (SUVA-A 951); Namara, Viti Levu, *M. Tuiwawa*, 29.iv.1993 (SUVA-A 596);

Nukulau Channel, Suva Reef, *P.A. Skelton & A.D.R. N'Yeurt*, 18.viii.1998 (SUVA-A 4705); Tavua, *H. Kasahara*, 10.xi.1985 (SUVA-A 48).

***Caulerpa racemosa*** (Forsskål) J.Agardh var. ***macrophysa*** (Sonder ex Kützing) W.R.Taylor 1928: 101. Chapman, 1971: 166; Kasahara, 1985: 30; South, 1991: 5; South and N'Yeurt, 1993: 129, fig. 21.

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

*Caulerpa macrophysa* (Sonder ex Kützing) G.Murray, 1887: 38.

*Material examined*: (fide Kasahara, 1985) Suva, Dravuni I., Sigatoka.

***Caulerpa racemosa*** (Forsskål) J.Agardh var. ***occidentalis*** (J.Agardh) Børgesen, 1907: 379, figs 28, 29. South and N'Yeurt, 1993: 129, fig. 22

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

*Material examined*: Nadi Market, *G.R. South*, 9.xi.1991 (SUVA-A 438).

***Caulerpa racemosa*** (Forsskål) J.Agardh var. ***turbinata*** (J.Agardh) Eubank, 1946: 420, 421, figs. 2o–q. South and N'Yeurt, 1993: 131, fig. 24

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

*Material examined*: Dravuni I., *J. Würtz*, 4.ix.1992 (SUVA-A 439); Astrolabe Reef, *S. Mangubhai*, 2.v.2001 (SUVA-A 5727).

#### #*Caulerpa reniformis* sp. nov. (Figs 7–10)

Thalli subvirides, molles celeriter putrescentesque, olivascentes ut arescentes; stolo crassus, ad 5 mm diametro, irregulariter ramosus et succum evanescenter luteo-aurantium ut effractus exsudans; rami descendentes abrupte attenuati, rhizoidea ramosa sparsa ferentes; rami ascendentes congesti, saepe binatim orientes, simplices, 1.5–5.0 cm alti, ramulos confertim in seriebus spiralibus et tetrastiche ad apicem dispositos ferentes; ramuli e rhachidi ad angulum circa 90° prodientes, tum adaxialiter flexi, tum ad laminas terminales reniformes incurvasque ad 6.0 mm latas × 4.0 mm altas abrupte expansi, imbricati; laminae terminales ramulorum marginibus leviter tumidae et fortiores coloratae interdum crenulatae. Species in profunditate 3.0 m ad oram exteriorem corallii avena obducti in habitatione magnopere exposita crescens.

*Description*: Thalli pale green, soft and quickly decomposing, becoming olive-green on drying; stolon stout, up to 5 mm in diameter, irregularly branched and exuding a fleetingly yellow–orange sap when broken; descending branches abruptly attenuated, bearing sparse branched

rhizoids; ascending branches crowded, frequently arising in pairs, cylindrical, up to 1 mm in diameter, bearing ramuli arranged densely in spiral rows and tetrastichously at the apex; ramuli emerging from the rachis at an angle of about 90°, then adaxially flexed, then expanded abruptly to a terminal incurved reniform lamina up to 6.0 mm wide × 4.0 mm tall, overlapping; terminal laminae of ramuli with margins slightly swollen, more darkly coloured and sometimes crenulate. Species growing at 3.0-m depth at the outer edge of the reef front in sand-covered coral in a highly exposed habitat.

*Etymology*: the epithet is derived from the kidney-shaped ramelli.

*Type locality*: Namada, Coral Coast, Viti Levu, Fiji Islands. Holotype: *P.A. Skelton* 22.vi.2002 (SUVA-A 7286).

*Discussion*: The distinguishing features of this species are its markedly pale colour in the field, the presence of an orange–yellow sap when the rhizome is broken and the tetrastichously arranged, reniform ramelli borne on cylindrical, jointed stalks. *C. reniformis* is easily distinguished from varieties of *C. racemosa* by the fact that the stalks bearing the flattened ramelli are basal and not central or excentric, and similarly from *C. peltata* where the flattened ramelli have a central stalk. No other populations of this species have been found. Between June and August 2002, when the site was visited twice, the original clump of plants had expanded and a second, smaller clump had arisen distant from the first. The exposed habitat, which is accessible only on a few days in the year, may be one reason why this species has not been collected before.

\****Caulerpa sedoides* f. *geminata*** (Harvey) Weber-van Bosse, 1898: 387, 388. Coppejans *et al.* 1998: 131–137, figs 1–14 (Fig. 4)

*Caulerpa geminata* Harvey, 1855: 565 (type locality: Rottneest Island, Western Australia).

*Caulerpa sedoides* C.Agardh var. *geminata* (Harvey) Harvey, 1859: pl. LXXII, figs 3, 4.

*Misapplied name*: *Caulerpa fergusonii* G.Murray, 1891: 212, pl. LIII: figs 1, 2 (type locality: Sri Lanka). N'Yeurt, 2001: 712.

*Material examined*: Fish Patch, Suva Barrier Reef, *D.W. Keats*, 13.x.1994 (SUVA-A 812), 18.x.1994 (SUVA-A 826–829); Sandbanks, Suva Barrier Reef, *P.A. Skelton*, 2.ii.1998 (SUVA-A 3730).

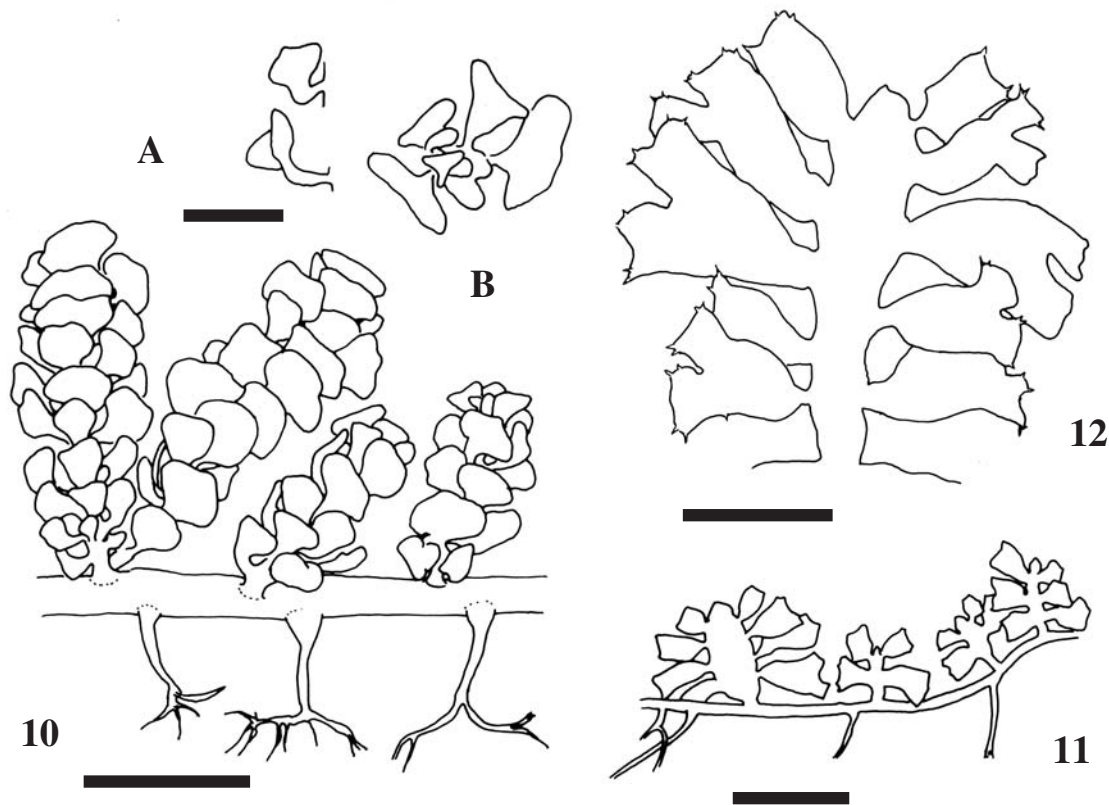
*Note*: Fijian collections closely resemble the illustrations of *C. sedoides* f. *geminata* in Coppejans *et al.* (1998: figs 3–9).

***Caulerpa serrulata*** (Forsskål) J.Agardh, 1837: 174. South and N'Yeurt, 1993: 119, fig. 12; N'Yeurt, 2001: 715

*Fucus serrulatus* Forsskål, 1775: 189 (type locality: Mokha, Yemen).



**Figs 7–9.** *Caulerpa reniformis* sp. nov. **Fig. 7.** End-on view of apex of upright of living specimen, showing tetrastrichous arrangement of ramelli and the origin of new ramelli. Namada, Fiji, *P.A. Skelton*, 22.vi.2001. Scale bar = 5.0 mm. **Fig. 8.** Detail of uprights of living specimen, showing serial, spiral arrangement of ramelli and their distinctive reniform shape, some with crenulate margins. Namada, Fiji, *P.A. Skelton*, 22.vi.2002. Scale bar = 5.0 mm. **Fig. 9.** Holotype. Namada, Coral Coast, Fiji, *P.A. Skelton* 22.vi.2002 (SUVA-A 7286). Scale bar in centimetres.



**Fig. 10.** Drawing of *Caulerpa reniformis* sp. nov., with an individual ramella in lateral view (A) and a splayed-out view of the branch-tip showing emerging ramelli (B). Scale bar = 2.0 cm; A and B = 5.0 mm. **Fig. 11.** Habit of *Caulerpa webbiana* f. *disticha*, Wakaya Island, Fiji, S. Manubhai, 30.iv.2001 (in herb. SUVA-A, fj 88). Scale bar = 1.0 cm. **Fig. 12.** Detail of branch of *Caulerpa webbiana* f. *disticha* showing bifurcate tips. Collection details as for Fig. 11. Scale bar = 5.0 mm.

*Note:* Coppejans and Prud'homme van Reine (1992: 686) discussed the difficulties of distinguishing between varieties of *C. cupressoides* and *C. serrulata*, noting that 'as soon as the rachis becomes compressed to complanate, we consider the specimens as belonging to an ecad of *C. serrulata*.'

*Material examined:* Taveuni, Koro Levu, S. Villeneuve, 16.ii.1982 (SUVA-A 3740); Denarau, S. Villeneuve, 26.ii.1982 (SUVA-A 3739); Makuluva I., J. Faloon, 22.x.1993 (SUVA-A 775); Bau I., H. Kasahara, 26.ix.1985 (SUVA-A 78); Savusavu, M.-L. Schläppy, 24.viii.2001 (SUVA-A 7131); Dravuni I., G.R. South, 4.x.1991 (SUVA-A 81); Tagage, Coral Coast, H. Kasahara, 15.x.1985 (SUVA-A 80); Namarai, H. Kasahara, 19.x.1985 (SUVA-A 74, 79); Namada, P.A. Skelton & G.R. South, 22.vi.2002 (SUVA-A 7300); Narikoso, Lomaiviti, S. Mangubhai, 1.v.2001 (SUVA-A 5724).

*Caulerpa sertularioides* (S.Gmelin) Howe, 1905: 576. Chapman, 1971: 166; Kasahara, 1985: 27, 1988; South and N'Yeurt, 1993: 121, fig. 16; N'Yeurt, 2001: 716

*Fucus sertularioides* S.Gmelin, 1768: 151 (type locality: 'in coralliis americanis').

*Material examined:* Malake I., Rakiraki, H. Kasahara, 24.x.1985 (SUVA-A 82), 11.x.1985 (SUVA-A 83); Makuluva I., *Phycology Class*, 9.ix.1991 (SUVA-A 88); H. Kasahara, 22.ix.1985 (SUVA-A 87);

Saweni Beach, P.A. Skelton & G.R. South, 11.xi.1998 (SUVA-A 7113–7114); Nabuna, H. Kasahara, 11.x.1985 (SUVA-A 84); Vatulele, B. Carlson, 1972 (SUVA-A 86); Kaba, T.D. Pickering, 22.v.1996 (SUVA-A 950); Serua I., T.D. Pickering, 27.viii.1996 (SUVA-A 942); 23.ii.1982 (SUVA-A 3742); Toberua Pass, A.D.R. N'Yeurt, 18.viii.1997 (SUVA-A 1185); Namara, M. Tuiwawa, 29.iv.1993 (SUVA-A 599); Nukubuco Passage, Suva Lagoon, S. Malimali, J. Amoe, T. Tuatai, 10.iv.2000 (SUVA-A 5555).

*Caulerpa taxifolia* (Vahl) C.Agardh, 1817: XXII. Kasahara, 1985: 24, pl. 4, fig. 3, 1988; South, 1991: 5; South and N'Yeurt, 1993: 122, fig. 17

*Fucus taxifolius* Vahl, 1802: 36 (type locality: St Croix, Virgin Islands).

*Material examined:* Yasawa I., T.D. Pickering, 7.ii.1996 (SUVA-A 1360–1362); Nanuyalevu, Yasawa, B. Carlson, 13.vii.1972 (SUVA-A 90); Sandbank Passage, Suva Lagoon, P.A. Skelton., 29.i.1998 (SUVA-A 1244); 2.ii.1998 (SUVA-A 3744); Yaqeta I., J. Würtz, 17.ix.1992 (SUVA-A 925); Nukulau I., P.A. Skelton, 18.viii.1998 (SUVA-A 4701); Great Astrolabe Reef, S. Mangubhai, 2.v.2001 (SUVA-A 6913; 6910); Tagage, H. Kasahara, 3.x.1985 (SUVA-A 89); Namada, P.A. Skelton & G.R. South, 22.vi.2002 (SUVA-A 7301); Buliya, S. Mangubhai, 1.iv.2001 (SUVA-A 5723); Nananu-i-ra, S. Villeneuve, 10.ii.1982 (SUVA-A 3743); Vakawaitaci Point, Naviti I., T.D. Pickering, 2.vii.1996 (SUVA-A 918–919).



***Caulerpa urvilleana*** Montagne, 1845: 21 [type locality: Toud Island (Warrior Islet), Torres Strait, Australia]. South, 1991: 5; South and N'Yeurt, 1993: 123, fig. 14; N'Yeurt, 2001: 716

*Material examined:* Toberua Pass, *H. Kasahara*, 26.ix.1985 (SUVA-A 91); Nana-nu-ira, *S. Villeneuve*, 13.ii.1982 (SUVA-A 3745); Rakiraki, *H. Kasahara*, 24.x.1985 (SUVA-A 92); Nanuyalevu I., Yasawas, *B. Carlson*, 13.vii.1972 (SUVA-A 77); Deuba, *B. Carlson*, 8.x.1972 (SUVA-A 75).

*Note:* the status of *C. urvilleana* is questionable. Specimens are often confused with varieties of *C. cupressoides* [vars. *lycopodium*, *disticha* and *mamillosa*]. Coppejans (1992: 391) and Coppejans and Prud'homme van Reine (1992: 686) treated it as an ecad of *C. cupressoides*.

***Caulerpa verticillata*** J. Agardh, 1847: 6 [type locality not specified (West Indies *fide* J. Agardh, 1873: 7)]. Kasahara, 1988; South and N'Yeurt, 1993: 114, fig. 6

*Material examined:* Momi Bay, Viti Levu, *H. Kasahara*, 29.x.1985 (SUVA-A 94); Vailoaloa Beach, Nadi, *J. Seeto*, 29.xi.1991 (SUVA-A 93).

***Caulerpa webbiana*** Montagne, 1837: 354 (type locality: Arrecife, Isla Lanzarote, Islas Canarias). Kasahara, 1985: 28, pl. 5, fig., pl. 14, fig. E; Garbary *et al.* 1991: 252; South and N'Yeurt, 1993: 124, fig. 15; N'Yeurt, 2001: 718

*Material examined:* Suva Barrier Reef, *H. Kasahara*, 16.ix.1985 (SUVA-A 95); 18.ix.1985 (SUVA-A 97); Makuluva I., *H. Kasahara*, 17.x.1985 (SUVA-A 96).

#***Caulerpa webbiana*** Montagne f. *disticha* Vickers, 1896: 300 (type locality: Canary Islands?). Kraft, 2000: 607, Fig. 35D (Figs 11, 12)

*Distribution:* Lions Den, Wakaya I. *S. Mangubhai*, 36.iv.2001 (*in herb.* SUVA-A).

*Note:* our material closely resembles the description in Coppejans (1992: 406, fig. 9; as *C. webbiana* ecad *disticha*). Plants are distinguished by the presence of ramelli with mucronate apices.

### Species inquirendae

The following taxa are not represented in SUVA-A or other collections of Fijian algae examined by the authors in UBC (except *C. remotifolia*), BISH and UC, and require further investigation.

***Caulerpa crassifolia*** (C. Agardh) J. Agardh, 1873: 13, 14 (type locality: Florida and East Indies). Chapman (1971: 166); Meñez and Calumpuog (1982: 6, pl. 1D, E)

***Caulerpa juniperoides*** J. Agardh, 1873: 26 (type locality: 'ad insulas Indiae occidentalis In. St. Crucis'). Askenasy, 1888; Chapman, 1971. Possibly = *C. cupressoides* v. *typica* Weber-van Bosse

***Caulerpa mexicana*** Sonder ex Kützing in Taylor, 1960: 142 (type locality: Mexico). See also Silva *et al.*, 1996: 825, 826

*Note:* the Fijian record in Chapman (1971) may be a mis-identification of *C. taxifolia*. As Chapman's voucher specimens could not be located at AKU, it is impossible to verify his record.

***Caulerpa mexicana*** Sonder ex Kützing, 1849: 496. var. *pluriseriata* W.R. Taylor. Kasahara, 1988

***Caulerpa remotifolia*** Sonder, 1853: 660 (type locality: 'ad oras Novae Hollandiae australes'). Chapman, 1971: 166

*Distribution:* Fiji, *E. Graeffe* [n.d.] (UC97326).

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