

Review:

## REVIEW OF SPECIES OF CAULERPA AND CAULERPELLA (CHLOROPHYTA, BRYOPSIDALES) FROM VIETNAM

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### ABSTRACT

*Caulerpa* and *Caulerpella*, the two genera belonging to the phylum Chlorophyta, order Bryopsidales distribute generously along the coast and islands of Vietnam. Based on the collected specimens, twenty-seven taxa belonging to the genus *Caulerpa* Lamouroux and one species of *Caulerpella* Prud'homme van Reine and Lokhorst are described and illustrated. The list of species includes: *Caulerpa brachypus*, *C. cupressoides*, *C. fastigiata*, *C. lentillifera*, *C. mexicana*, *C. microphysa*, *C. nummularia*, *C. peltata*, *C. racemosa*, *C. serrulata*, *C. sertularioides*, *C. taxifolia*, *C. urvilliana*, *C. verticillata*, *C. webbliana* and *Caulerpella ambigua*.

**Keywords:** Marine algae, *Caulerpa*, *Caulerpella*, Spratly archipelago, Vietnam.

### INTRODUCTION

The genus *Caulerpa* Lamouroux (1809) contains about hundred species and is found throughout the tropical and subtropical seas of the world. *Caulerpa* is an important contributor to the algal biomass of coral reefs and lagoons. This genus is especially diverse in the Indo-Pacific region.

*Caulerpella ambigua* (Okamura) Prud'homme van Reine et Lokhorst, is separated from *Caulerpa* and placed in a new genus because it is non-holocarpic. Its reproductive branchlets are separated from the main axis by a wall (Prud'homme van Reine and Lokhorst, 1992).

In Vietnam, Dawson (1954) lists 6 species of *Caulerpa* from sites near Nhatrang Bay. Pham Hoang Ho (1969) listed 13 species of *Caulerpa* in the flora of Vietnam, adding 7 species. Specimens of *Caulerpa* are also reported in Nguyen *et al.* (1993). Pham Huu Tri (1996) lists new records for *C. cupressoides*, *C. webbliana f. tomentella* and *C. peltata var. typica* from Spratly Archipelago. Nguyen Huu Dai and Pham Huu Tri (2000) lists *C. crassifolia* (= *C. mexicana*) from Con Dao island, Nguyen Huu Dai and Pham Huu Tri (2002) add two varieties of *C. cupressoides* (*C. cupressoides var. mamillosa*, *C. cupressoides var. lycopodium*) and one of *C.*

*serrulata* (*C. serrulata var. serrulata f. lata*), Le Nhu Hau (2000, 2001) lists 2 new records for *C. mamillosa* and *C. urvilliana* and one variety of *C. brachypus* collected in the Spratly Archipelago. Abbott *et al.* (2002) find *C. macrophysa* (= *C. racemosa var. macrophysa*). Fifteen species of *Caulerpa* and one of *Caulerpella* are currently recognized for the Vietnamese flora.

### MATERIALS AND METHODS

More than 200 herbarium specimens of previous authors and our recently collected materials which are deposited in the herbarium of Institute of Oceanography Nhatrang (ION) have been studied.

Photographs were taken with a Olympus Digital Camera 6.0 and arranged using Photoshop 7.0.

### RESULTS

#### Description of the species

- 1) *Caulerpa brachypus* Harvey, Proc. Amer. Acad. Arts Sci. 4, p. 333, 1860 (Fig. 1)

Pham Hoang Ho, 1969: 503, fig. 4.111.

**Specimens examined:** My Hoa, Phan Rang, southern Vietnam, TR 98500-501.

Plants small, stolons stout 1mm in diameter, bearing erect, shortly stipitate, rather fleshy, ligulate fronds; frond 2-3cm tall with margins irregularly constricted, some completely smooth; fronds apex broadly rounded, blunt or incised.

**Distribution:** along the coast of central Vietnam from Quang Ngai to Vung Tau.

2) *Caulerpa brachypus* f. *parvifolia* (Harvey) Cribb, Univ. Queensland Pap. Bot. 3, p. 209, figs. 4,5 1958 (Fig. 2)

Coppejans and Prud'homme van Reine 1992: 673, fig. 7B.

Robin South and Antoine de Ramon N' Yeurt 1993: 112, 113, fig. 5.

**Specimens examined:** Ninh Hai, Phan Rang, southern Vietnam, TR 98510-12

Stolon very thin, 0,5 mm in diameter, bearing erect, shortly stipitate, simple, elliptic fronds, 5 – 8 mm long and 3 mm broad, with serially placed, relatively well developed, frond apex rounded or blunt.

**Distribution:** My Hoa, Ninh Hai, Ninh Thuan, southern Vietnam.

**Remarks:** The species *Caulerpa minuta* published by Le Nhu Hau (Collection of marine research work, 2000, X: 141-142, fig. 1) as a nov. sp. is a synonym of this species.

3) *Caulerpa cupressoides* (Vahl) C. Agardh, Synopsis algarum Scandinaviae, p. XXIII, 1817 (Fig. 3)

Coppejans and Prud'homme va Reine 1992:172; Pham Huu Tri, 1996, VII :147-162.

**Specimens examined:** Van Phong bay, Khanh Hoa, TR 74280; Ly Son island, Quang Ngai, central Vietnam, TR 21065; Spratly archipelago, TR 94515-20.

Plants up to 3-4 cm tall, assimilators tough, highly variable, irregularly branched. Each branch covered with several rows of short, terete, spiniform, upwardly curved branchlets.

**Distribution:** Common in the islands of central Vietnam from Quang Ngai to Vung Tau and Spratly archipelago, Vietnam.

4) *Caulerpa cupressoides* ( Vahl) C. Agardh ecad *cupressoides* (Fig. 4)

Weber- van Bosse, 1898 : 171-173; Coppejans and Meinez.,1988: 389-390, fig. 1c.

Coppejans and Meinez., 1988: 389-390, fig. 1c.

**Specimens examined:** Ly Son island, Quang Ngai, TR 02600; Phu Quy island, Binh Thuan, TR 060419-26; central Vietnam.

Assimilators rather robust, spiniform branchlets up two times as long as the diameter of the rachis, slightly constricted at the base, generally at least in some assimilators on 3 longitudinal rows.

**Distribution:** Common in the islands of central Vietnam from Quang Ngai to Vung Tau.

5) *Caulerpa cupressoides* (Vahl) C. Agardh var. *flabellata* Børgesen, Kongel. Danske Vidensk. Selsk. Skrift. 7, p. 368, figs. 18&19, 1907 (Fig. 5)

Coppejans and Prud'homme van Reine, 1992: 676, figs. 4a,b,c.

**Specimens examined:** Hon Thu island, TR 81344 a,b; My Hiep, Phan Rang, TR 96432; Con Dao island, TR 98201; Spratly archipelago, TR 93469. Assimilators with a long 4-5 cm, terete, naked stipe; branchlets reduced to upwardly directed, mucronate, broadly attached teeth.

**Distribution:** Common in the islands of central Vietnam from Ninh Thuan to Con Dao island.

6) *Caulerpa cupressoides* (Vahl) C. Agardh var. *lycopodium* J. Agardh ex Weber-van Bosse, Ann. Jar. Bot. Buitenzorg 15, p. 335, pl. XXXII, figs. 8-13, 1898 (Fig. 6)

Nguyen Huu Dai and Pham Huu Tri, 2002: 150-151, figs.2-3.

**Specimens examined:** CoTo island, northern Vietnam, TR 75075; Ly Son island, central Vietnam, TR 83442, TR 01282; Hon Thu island, southern Vietnam, TR 97301- 2.

Assimilators up to 8-10 cm tall rather slender, branchlets not constricted at the base, on 2 opposite rows. The ramelli usually in ranks of three, sometimes two, oppositely pinnate with mucronate.

**Distribution:** Common in the islands from southern to northern Vietnam.

7) *Caulerpa cupressoides* (Vahl) C. Agardh var. *mamillosa* (Montagne) Weber-van Bosse, Ann. Jar. Bot. Buitenzorg 15, pp. 332-333, pl. XXVIII, figs. 2-7, 1898 (Fig. 7)

Nguyen Huu Dai and Pham Huu Tri, 2002:150-151, fig. 3.

**Specimens examined:** Ly Son island, central Vietnam, TR 01048; Spratly archipelago, TR 270303, 870302, 93107-8, TR 93456.

Assimilators up to 4-6 cm tall, generally stout and densely branched, at least the basal branchlets densely and irregularly packed, markedly inflated, generally not longer than the diameter of the rachis.

**Distribution:** Common in the islands of central Vietnam especially in Spratly archipelago.

**8) *Caulerpa fastigiata* Montagne, Ann. Sci. Nat. Bot., ser. 2, 8, pp. 353-354, 1837 (Fig. 8)**

Dawson, 1954: 392, fig. 9g; Pham Hoang Ho, 1969: 491- 492, fig. 4.98

**Specimens examined:** Van Phong bay, Van Ninh, TR 81890; Song Lo, Nha Trang bay, TR 820305. Plants filamentous, 0,15 - 0,2 mm in diameter, forming mats, with little or no morphological differentiation between stolon and erect parts, except that stolons bear rhizoids, branching irregular to alternate to opposite. Branchlets with blunt tips.

**Distribution:** Common in the coastal Vietnam from Quang Ngai to Vung Tau.

**9) *Caulerpa lentillifera* J. Agardh, Abhandl. gabrete nat. Vol. 2, p. 173, 1873 (Fig. 9)**

Dawson, 1954:1; Pham Hoang Ho, 1969: 499, fig. 4.106.

**Specimens examined:** Phu Quy island, central Vietnam, TR 06415-20; Cam Ranh bay, 07601-05.

Assimilators up to 8-10cm tall, densely covered with several longitudinal rows of subspherical ramelli which conspicuously constricted at the base where the pedicels meets the sphere.

**Distribution:** Phu Quy island, southern Vietnam. Commonly distributed in Cam Ranh bay, Hon Khoi lagoon, Khanh Hoa Prov., Phan Thiet, Binh Thuan Prov., Vietnam.

**Remarks:** Pham Hoang Ho reported this species in 1969, he collected the specimens at Phu Quoc island, but several years later we could not find any specimens at this island. In April, 2006, Pham Huu Tri collected this species at Phu Quy Island, Binh Thuan Prov. but the dimension of the plants is smaller, *C. lentillifera* has been planted in Binh Thuan and Khanh Hoa Province. People eat this alga as fresh vegetable.

**10) *Caulerpa mexicana* Sonder ex Kützing, Species algarum, p. 496, 1849 (Fig. 10)**

Pham Hoang Ho, 1969: 502-503, fig. 4.110; Nguyen Huu Dai and Pham Huu Tri, 2000: 138, fig. 11.

**Specimens examined:** Quang Ninh, northern Vietnam, TR 69453; Nui Thanh, Quang Nam, 060412-14; Con Dao island, TR 98681-86.

Plants up to 2-3 cm tall. Assimilators flattened and featherlike. Branchlets opposite, flat, upcurved, slightly constricted at their bases, tips tapering to acute apices.

**Distribution:** Commonly distributed along the coast and islands in Vietnam.

**Remarks:** Some specimens collected in Quang Ninh, Nui Thanh and Con Dao island were identified as the species *C. crassifolia* (C.Ag.) J.Ag. but that was placed in synonym with *C. mexicana* by Papenfuss(1956).

**11) *Caulerpa microphysa* ( Weber- van Bosse) J. Feldmann, Rev. General de Bot. 62, p. 430, 1955 (Fig. 11)**

Pham Hoang Ho, 1969: 498, fig. 4.105.

**Specimens examined:** Ly Son island, TR 050415-20; Phu Quy island central Vietnam, TR 060420-22.

Assimilators up to 1 - 2 cm tall. Assimilators bear sparse to clustered, small spherical branchlets to 2mm diameter that are clearly constricted at the base where the pedicel meets the sphere.

**Distribution:** along the coast of central Vietnam.

**Remarks:** This species can be confused with *C. lentillifera* but in *C. lentillifera* the pedicels of branchlets are longer than in *C. microphysa*.

**12) *Caulerpa nummularia* Harvey ex. J. Agardh, Till algerne systematik, p.38, 1873 (Fig. 12)**

Le Nhu Hau, 2001: 118, fig. 5.

**Specimens examined:** Spratly archipelago, Vietnam, TR 940415-18.

Assimilators bear solitary or clustered, flattened, peltate branchlets with crenate or scalloped margins. Stolon thin, 0,4 - 0,9 mm in diameter.

**Distribution:** Spratly Archipelago, Vietnam.

**Remarks:** This species is often identified as *C. peltata* (or *C. racemosa* var. *peltata*) but upon close examination the species can be easily

distinguished by noting the "not-quite-round" shape of the peltate ramuli as well as the presence of at least some ramuli with clearly crenate margins. Occasionally a new disc arises from the edge of an older disc.

**13) *Caulerpa peltata* Lamouroux, *Nouv. Bull. Sci., Soc. Philomath. Paris* 1, p. 332-333, 1809 (Fig. 13)**

Nguyen Huu Dinh *et al.*, 1993:101, fig.71

**Specimens examined:** Nghe An, northern Vietnam, TR 82651; Con Dao island, southern Vietnam, TR 98010; Spratly archipelago, TR 4105a, b; TR 93405.

Assimilators up to 2-3cm tall, smooth stolons 300-600,¼m in diameter anchored by repeatedly branching, assimilators are peltata, disks 2-7 mm in diameter borne on unbranched stalks 2-5 mm in length.

**Distribution:** along the coast and islands of Vietnam.

**Remarks:** Some specimens of this species have been indentified as *Caulerpa racemosa* var. *peltata* (Lamouroux) Eubank. *C. peltata* seems distinctly different from very similar plants with complex. Kraft (2000) maintained these as 2 distinct species, *C. peltata* and *C. racemosa* var. *peltata*. Although we agree that Kraft is probably correct, we have utilized only the name *C. peltata* for both racemose and non-racemose forms.

**14) *Caulerpa peltata* var. *macrodisca* (Decaisne) Weber- van Bosse, *Ann. Jar. Bot. Buitenzorg*: 15, p. 376, pl. XXVIII, figs. 10, 1898 (Fig. 14)**

Coppejans and Prud'homme van Reine, 1992: 698, fig. 17c.

**Specimens examined:** Ha Tien, southern Vietnam, TR 79403-10.

Plants up to 8-10 cm tall; terete rachis bearing 6-8 randomly placed peltate branchlets with a stipe reaching 5mm in length and discs of 12 mm in diameter.

**Distribution:** along the coast of Ha Tien, southern Vietnam.

**15) *Caulerpa racemosa* (Forsskål) J. Agardh, *Lunds Univ. Arsskriff.* 9 (8), p. 35, 1873 (Fig. 15)**

Pham Hoang Ho, 1969: 495-496, fig. 4.108; Nguyen Huu Dinh *et al.*, 1993:100, fig. 69

**Specimens examined:** Vinh Linh, northern Vietnam, TR 650314-15; Lang Co , Hue, TR 06153-05; Ly Son island, TR 050515-18; My Hiep, Phan Rang, TR 050415-20; Phu Quy island, TR 060415-20.

Plants up to 2-3 cm tall, assimilators bear small, 2-4 mm in diameter, spherical, oval or clavate, inflated branchlets in clusters like bunches of grapes. Stolons usually thick, 2-3 mm in diameter.

**Distribution:** along the coast and islands of Vietnam.

**Remarks:** *Caulerpa racemosa* has a variable morphology, and several varieties have been described.

**16) *Caulerpa racemosa* (Forsskål) J. Agardh. var. *corynephora* (Montagne) Weber -van Bosse, *Ann. Jar. Bot. Buitenzorg* 15,p. 364, pl. XXXIII, figs. 10-14, 1898 (Fig. 16)**

Pham Hoang Ho, 1969: 495-496, fig. 4.108; Nguyen Huu Dinh *et al.*, 1993:100-101, fig. 69.

**Specimens examined:** Quang Ninh, Northern Vietnam, TR 68024, TR 57365; Ly Son island, Quang Ngai, TR 21057, 21017.

Assimilators up to 8 cm tall, branchlets usually stalked, the ends generally sharply swollen, but varying from nearly cylindrical, to clavate, sphaerical.

**Distribution:** along the coast and islands of Vietnam.

**17) *Caulerpa racemosa* (Forsskål) J. Agardh var. *occidentalis* ( J. Agardh) Bprgesen, 1907: 379, figs. 28, 29 (Fig. 17)**

Pham Hoang Ho, 1969: 496, fig. 4.103.

**Specimens examined:** Son Hai, Phan Rang, Ninh Thuan, TR 80580.

Assimilators up to 3 - 4 cm tall, creeping, terete stolon giving off erect branches, simple or rarely branched, bearing ramelli abruptly expanded into subspherical ends, reaching 4 mm in diameter, distichously or arranged on terete rachis.

**Distribution:** along the coast and islands of central Vietnam.

**18) *Caulerpa racemosa* (Forsskål) J. Agardh ecad *racemosa* (Fig. 18)**

Coppejans and Prud'homme van Reine, 1992: 698, figs. 18a,b.

**Specimens examined:** Hon Chong, Nha Trang, Khanh Hoa, TR 21021.

Assimilators up to 2-3 cm tall, terete stolons, generally well branched, attached by numerous, well developed rhizoidal branches; rachis terete, bearing more or less densely packed branchlets.

**Distribution:** along the coast and islands of central Vietnam.

19) *Caulerpa racemosa* (Forsskål) J. Agardh var. *macrophysa* (Sonder ex Kuetzing) Taylor, Pap. Tortugas Lab., Carnegie Inst. Wash., 25, p. 101, pl. 12, fig. 3, 1928 (Fig. 19)

South, G.R. and H. Kasahara, 1992: 50

**Specimens examined:** Hon Tre island, Nha Trang bay, IA 24083; Hon Chong, Nha Trang bay, TR 850315-20.

Assimilators simple or occasionally branched, 2-4 cm tall, axis terete, bearing radially arranged stout ramelli with a sharply expanded hemispherical inflation to 4-8 mm.

**Distribution:** along the coast and islands in the central Vietnam.

**Remarks:** The species *Caulerpa macrophysa* (Sonder ex Kuetzing) G. Murray is considered to be a synonym of *Caulerpa racemosa* var. *macrophysa*.

20) *Caulerpa serrulata* (Forsskål) J. Agardh, Mus. Senckenbergianum 2, p.174, 1837 (Fig. 20)

Coppejans and Prud'homme van Reine, 1992: 703, fig. 20B.

**Specimens examined:** Son Hai, Phan Rang, TR 78231; Ly Son island, Quang Ngai, TR 01060; Hon Thu island, TR 81067; Spratly archipelago, TR 81540.

Assimilators up to 3-4 cm tall with narrow, flattened, foliar branches, rick-rack-shaped (a flat zigzag trim for clothing), sometimes contorted or twisted. Branches stiff with serrate, toothed margins and no branchlets.

**Distribution:** along the coast and islands of central Vietnam.

21) *Caulerpa serrulata* var. *serrulata* f. *lata* (Weber - van Bosse) Tseng, China Mar. Biol. Bull. 1, p.178, 1936 (Fig. 21)

Tseng, 1936, 1(5): 178.

**Specimens examined:** Hon Thu island, TR 81442; Con Dao island, TR 98204; Ly Son island, Quang Ngai, TR 82125.

From stiff, shortly stipitate dichotomous varying from almost plane to extremely strongly spirally twisted; height of the thallus also are very variable from 2 cm to 7 cm; margin coarsely serrate; teeth broadly attached, contiguous, as high as wide, mucronate.

**Distribution:** along the coast and islands of central Vietnam.

22) *Caulerpa sertularioides* (S. G. Gmelin) Howe, Bull. Torr. Bot. Club, 32, p. 576, 1905 (Fig. 22)

Pham Hoang Ho, 1969: 500-501, fig. 4.108.

**Specimens examined:** Ca Na, Phan Rang, Ninh Thuan, TR 280021-30.

Plants up to 8-10 cm tall, terete, branched stolons, bearing pinnate erect branches, varying from 5-12 cm in height, rachis terete, only rarely branched, naked at the base; branchlets on 2 opposite rows in a single plane, terete, upwardly curved, with uniform diameter of 0.5 mm, not constricted at the base, mucronate at the apex.

**Distribution:** along the coast and islands of central Vietnam.

23) *Caulerpa sertularioides* var. *longiseta* (Bory) Svedelius, Ceylon Mar. Biol. Lab.2, pp 114-115, fig. 10 (Fig. 23).

Svedelius, 1906: 114,115

**Specimens examined:** Quang Ninh, TR 68035; Con Dao island, TR 98202.

Characterized by its long, narrow pinnules in close rows, is not uncommon on the shores. It commonly grows at depth of 5-10 m.

**Distribution:** islands of northern and southern Vietnam.

24) *Caulerpa taxifolia* (Vahl) C. Agardh, species *algarum*, p. 435, 1822 (Fig. 24)

Pham Hoang Ho, 1969: 501-502, fig. 4.109; Nguyen Huu Dinh *et al.*, 1993: 100-101, fig. 70.

**Specimens examined:** Quang Ninh, TR 65035; Con Dao island, TR 78202-10

Plants up to 6-8 cm tall, assimilators flattened and shaped like fern fronds, with compressed central axes. Branches with pinnate, flattened, sickle-shaped branchlets. Branchlets curved, usually not

overlapping, tapering towards acuminate apices, constricted at base.

**Distribution:** along the coast and islands of central Vietnam.

**Remarks:** This species can be confused with *C. mexicana* or *C. sertularioides*.

**25) *Caulerpa urvilliana* Montagne, 1845, p. 21 (Fig. 25)**

Coppejans, 1992: 391, fig. 2; Le Nhu Hau, 2001:118-119, fig. 6.

**Specimens examined:** Spratly Archipelago, Vietnam, TR 930515-20.

Plants large, commonly forming colonies on sand, 10-15cm high, the terete stolon to 3,5 mm in diameter, bearing few to many cylindrical; erect branches several times dichotomously or alternately branched, with mamillare, multiseriately disposed protuberances and mucronate tips; these erect branches 20-100 mm tall.

**Distribution:** Spratly archipelago, Khanh Hoa Prov., Vietnam

**26) *Caulerpa verticillata* J. Agardh , öfvers Förh Kongl. Svenska Vetensk. Akad. 4, p. 6, 1847 (Fig. 26)**

Pham Hoang Ho, 1969: 493, fig. 4.100; Nguyen Huu Dinh *et al.*, 1993: 97-98.

**Specimens examined:** Song Lo, Nha Trang bay, TR 820305; Hon Mieu rocks, Nhatrang bay, IA 24104.

Plants filiform, attached to corals or rocks, in dense, soft clumps up to 3 – 4 cm high, stolon snake, terete, with numerous short, descending branchlets ending with filiform rhizoids. Assimilators usually dense, simple or irregularly branched and bearing numerous tufts of whorled, determinate branchlets up to 250µm in diameter and branching dichotomously 5-8 times, not constricted at the dichotomies and tapering at the apices.

**Distribution:** along the coast and islands of central Vietnam.

**27) *Caulerpa webbiana* Montagne f. *tomentella* (Harvey ex J. Agardh) Weber - van Bosse, Ann. Jar. Bot. Buitenzorg 15, pp. 270-271, pl. XXI, fig. 4, 1898 (Fig. 27)**

Nguyen Huu Dai and Pham Huu Tri, 2002:149-158

**Specimens examined:** Spratly Archipelago, Vietnam, TR 93105-10

Plants small, tending to occur in thick cushions on exposed rocks; stolon terete, descending branches naked, bearing branched rhizoids. Assimilators to 1,5-3,0 cm tall, normally irregularly branched 1-5 times, and bearing many whorls of fine branchlets, branchlets less than 1mm long, dischotomously branched, terete at base, flatened at tips.

**Distribution:** Spratly archipelago, Khanh Hoa Prov., Vietnam

**28) *Caulerpella ambigua* (Okamura) Prud'homme van Reine and Lokhorst, Nova Hedwigia 54, p.114, 1992 (Fig. 28)**

Pham Hoang Ho, 1969: 492, fig. 4.99: *Caulerpa ambigua* Okamura.

Pham Hoang Ho, 1969: 493- 494, fig. 4.101: *Caulerpa vickersiae* Børgesen

**Specimens examined:** Nha Trang bay, central Vietnam, TR 78050-55 (*Caulerpa vickersiae*) TR 65052-54 (*Caulerpa ambigua*)

Plants small, differentiated into a rhizodal, stoloniferous and erect, branched portion; stolon weakly developed, short, inconspicuous, or long and irregularly branched, often exhibiting a strongly undulating outline; assimilators usually less than 2cm tall, bearing vegetative or reproductive branchlets; vegetative branchlets terete, distichously or irregularly arranged. Fertile branchlets that bear compound whorls of zoosporangia are separated from main axis by a distinct transverse wall.

**Distribution:** along the coast of Khanh Hoa Prov., Vietnam.

**Remarks:** Silva *et al.* (1996) retained this species in the genus *Caulerpa* based on the shared internal trabeculate structure. They thought that non-holocarpic reproduction, as reported by Prud'homme van Reine and Lokhorst (1992) should have infrageneric taxonomic value.

The species *C. ambigua* Okamura and *C. vickersiae* Boergesen are synonymes of this species.

## CONCLUSIONS

There are 27 taxa of *Caulerpa* and 1 species of *Caulerpella* found along the coast and islands of Vietnam waters, The species composition of *Caulerpa* is varied due to the coastlines spread

from the northern to the southern Vietnam with about 3200 km long. Apart from that there are many islands and archipelago situated offshore contributes to the biodiversity of the algal flora of Vietnam.

Among these species, some species seemed to have more restricted distribution such as: *Caulerpa nummularia*, *C. urvilliana*, *C. webbiana*, *C. cupressoides* collected in the Spratly archipelago are closed related to the Philippines algal flora.

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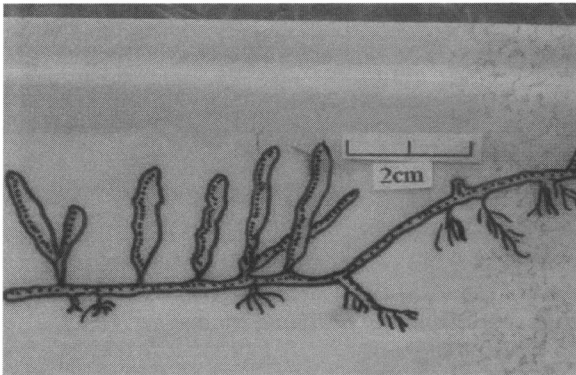
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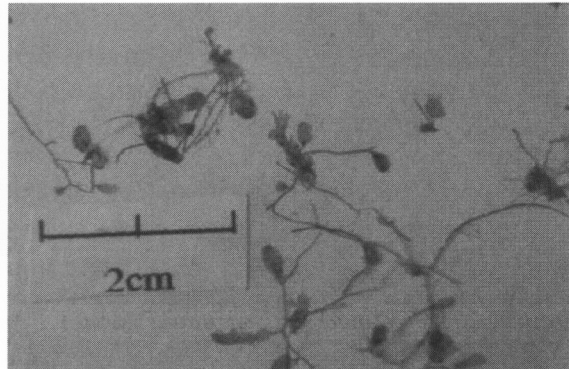
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**APPENDIX 1.**

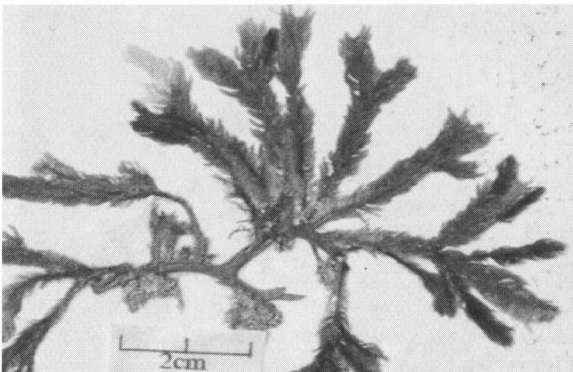
Figures of *Caulerpa* and *Caulerpella* from Vietnam (Figs. 1–30)



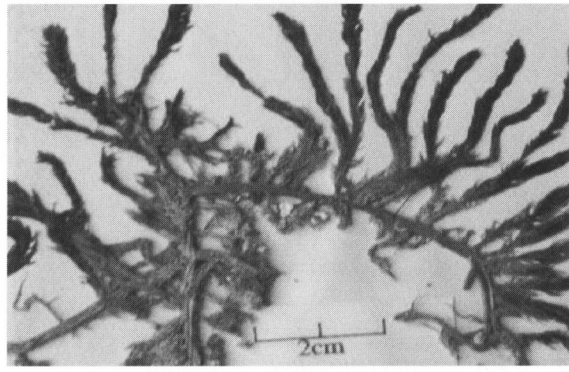
**Figure 1.** *Caulerpa brachypus* Harvey



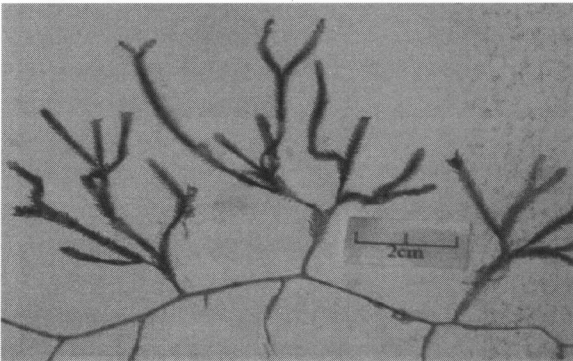
**Figure 2.** *Caulerpa brachypus* f. *parvifolia* (Harvey) Cribb



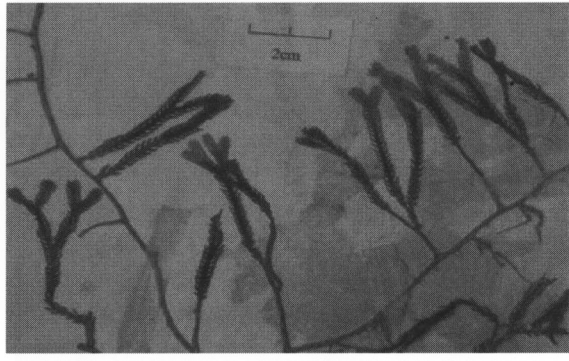
**Figure 3.** *Caulerpa cupressoides* (Vahl) C. Agardh



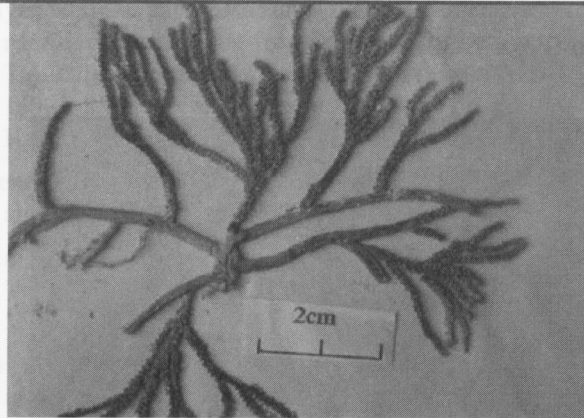
**Figure 4.** *C. cupressoides* (Vahl) C. Agardh ead *cupressoides*



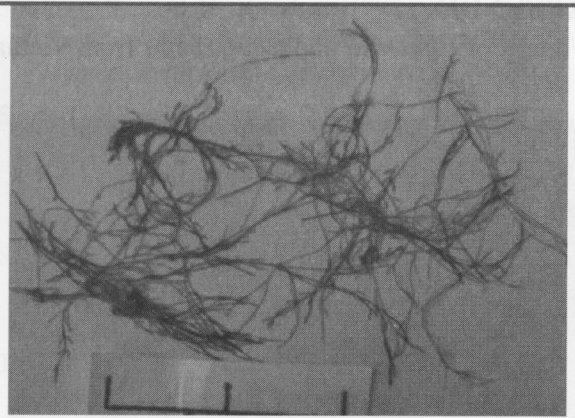
**Figure 5.** *Caulerpa cupressoides* var. *flabellata* Boergesen



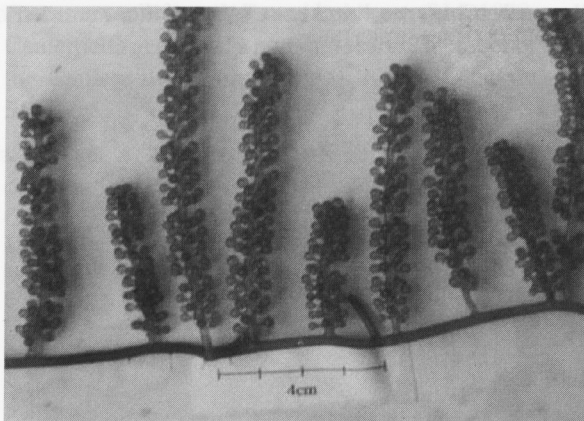
**Figure 6.** *C. cupressoides* var. *lycopodium* Weber- van Bosse



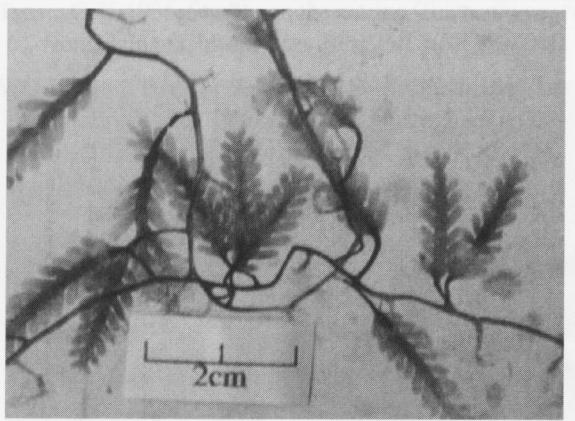
**Figure 7.** *C. cupressoides* var. *mamillosa* (Mont.)  
W. van Bosse



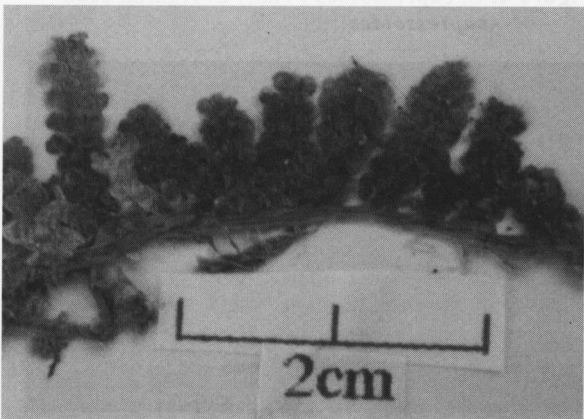
**Figure 8.** *Caulerpa fastigiata* Montagne



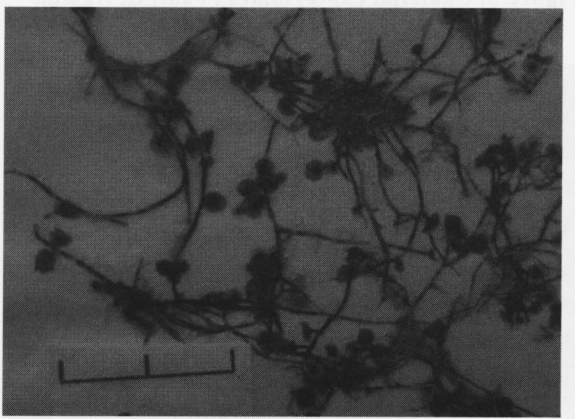
**Figure 9.** *Caulerpa lentillifera* J. Agardh



**Figure 10.** *Caulerpa mexicana* Sonder ex Kützing



**Figure 11.** *Caulerpa microphysa* (W. van Bosse) J.  
Feldmann



**Figure 12.** *Caulerpa nummularia* Harvey ex J.  
Agardh

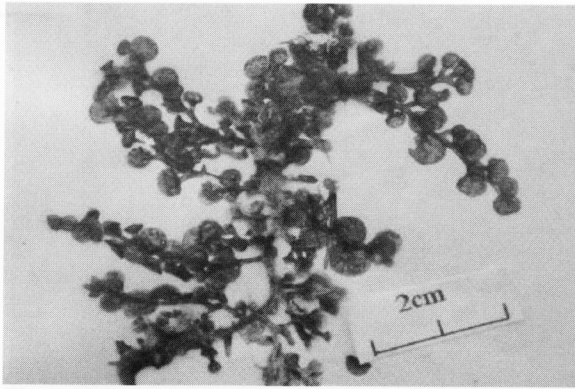


Figure 13. *Caulerpa peltata* Lamouroux

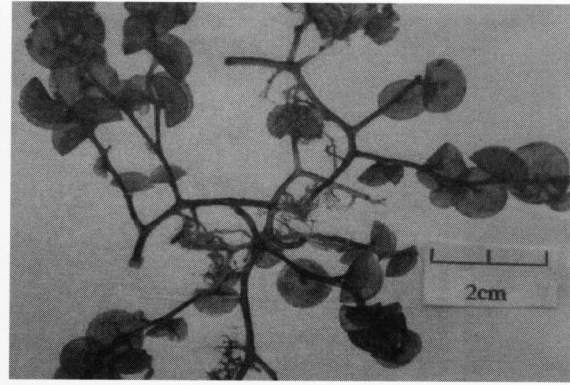


Figure 14. *C. peltata* var. *macrodisca* (Decn.)  
W. van Bosse

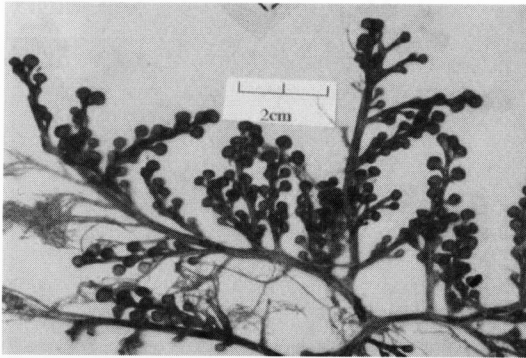


Figure 15. *Caulerpa racemosa* J. Agardh

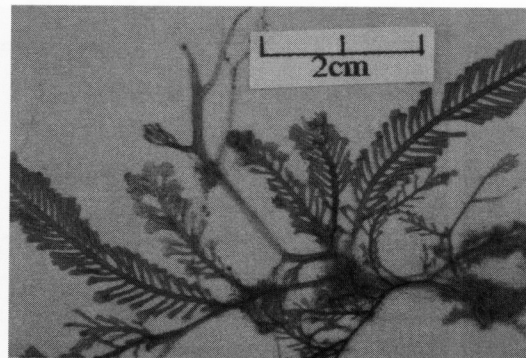


Figure 16. *C. racemosa* var. *corynephora*  
(Montagne) Weber-van Bosse

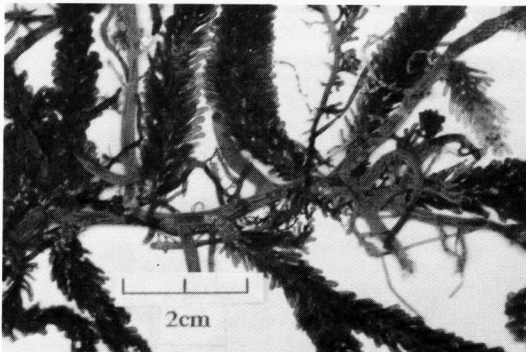


Figure 17. *C. racemosa* var. *occidentalis* (Mont.)  
Weber-van Bosse

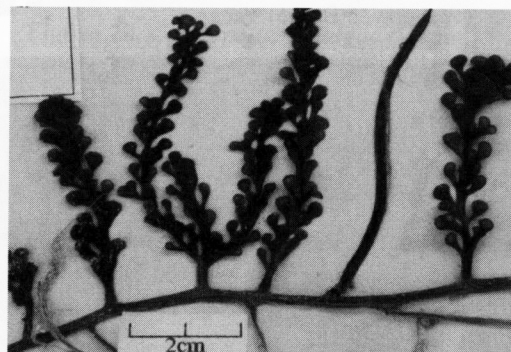


Figure 18. *Caulerpa racemosa* var. *racemosa*  
Weber-van Bosse

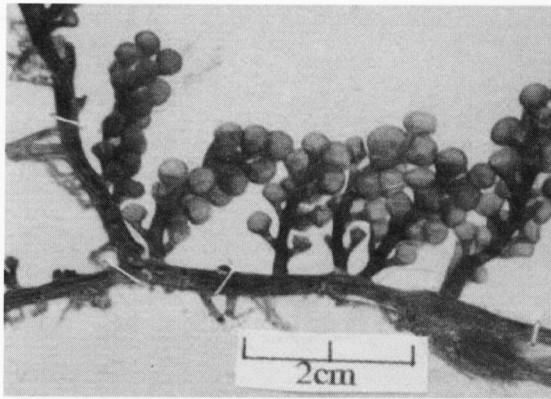


Figure 19. *C. racemosa* var. *macrophysa* Taylor

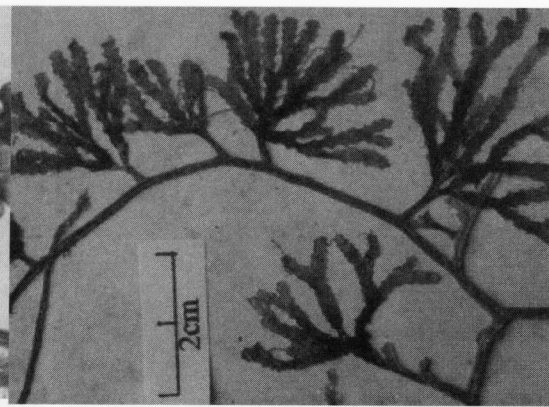


Figure 20. *Caulerpa serrulata* (Forsk.) J. Agardh

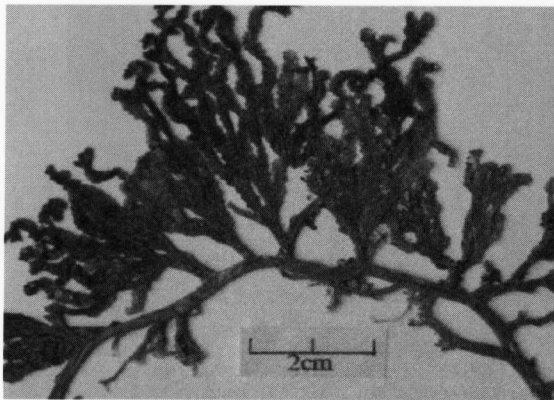


Figure 21. *C. serrulata* var. *serrulata* f. *lata* (Weber-van Bosse) Tseng

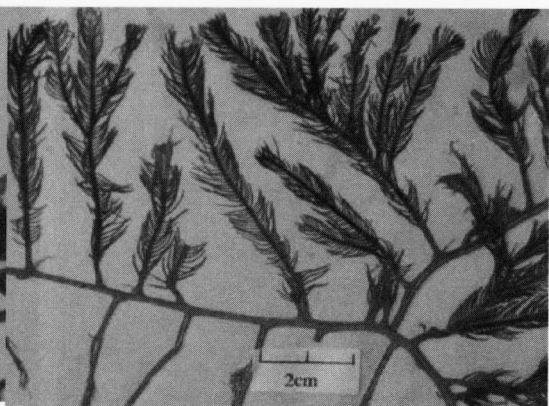


Figure 22. *Caulerpa sertularioides* (Gmel.) Howe

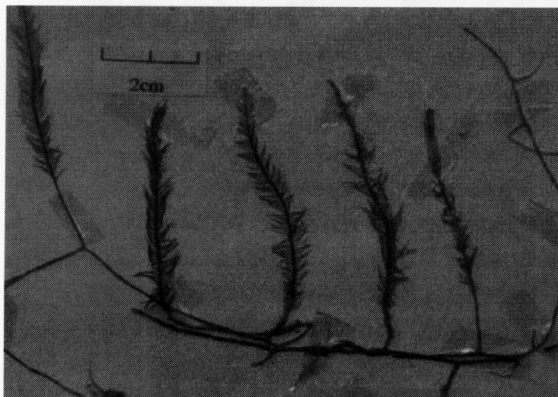


Figure 23. *Caulerpa sertularioides* var. *longiseta* J. Agardh

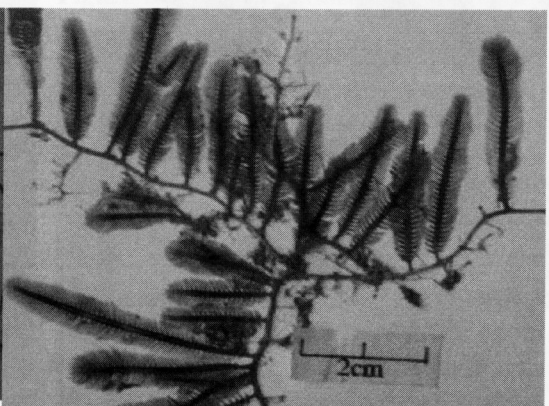


Figure 24. *Caulerpa taxifolia* (Vahl) C. Agardh

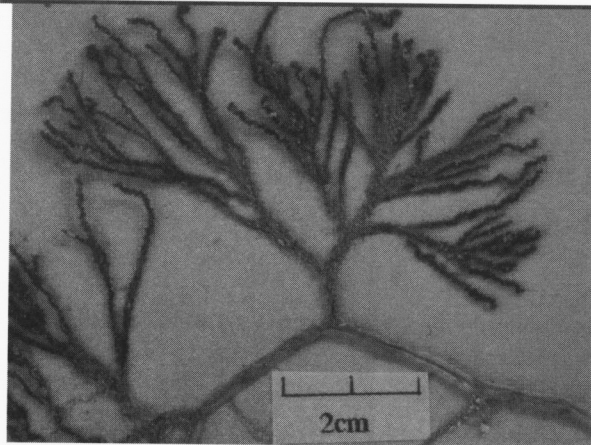


Figure 25. *Caulerpa urvilliana* Montagne

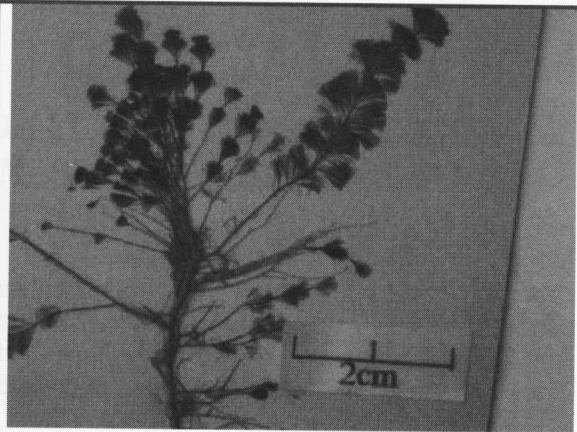


Figure 26. *Caulerpa verticillata* J. Agardh

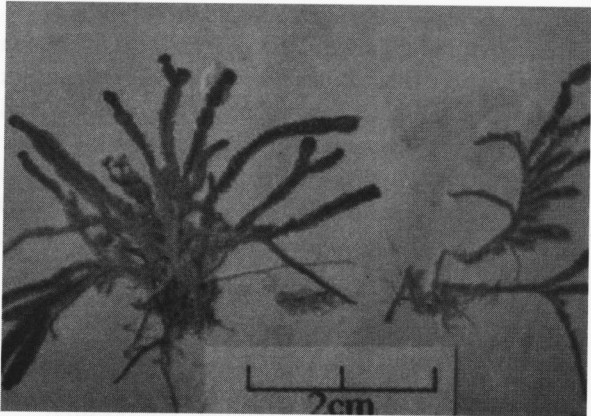


Figure 27. *Caulerpa webbliana* f. *tomentella*  
Weber-van Bosse

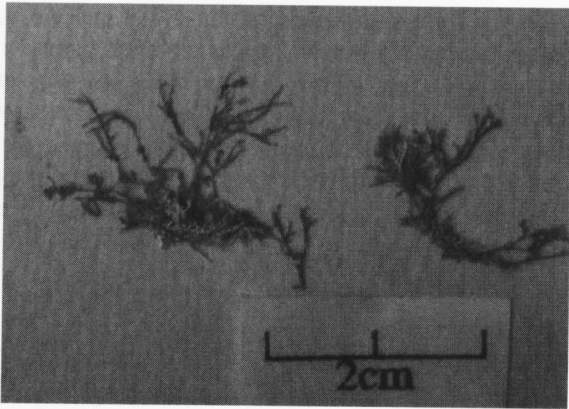


Figure 28. *Caulerpella ambigua* (Okam.)  
Prud'homme & Lokhorst

## APPENDIX 2.

Figure 31. Map showing the collecting stations in Vietnam

