

## Marine Algae of Kuei-Shan Dao, Taiwan

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(Manuscript received 8 January, 1999; accepted 24 February, 1999)

**ABSTRACT:** The marine algae collected from Kuei-Shan Dao were identified and listed. A total of 75 species of seaweed, including 2 species of Cyanophyta, 19 of Chlorophyta, 12 of Phaeophyta, and 42 of Rhodophyta, were reported for the first time in this area. Among them, 2 species are new records for the marine flora of Taiwan, 6 species show the extension range in the known phytogeographic patterns. Most of algae in Kuei-Shan Dao are of tropical or subtropical elements. The effects of current on the distribution of algae and the floristic affinity of this island are also discussed.

**KEY WORDS:** Marine algal flora, New record, Phytogeography, Kuei-Shan Dao, Taiwan.

### INTRODUCTION

Kuei-Shan Dao is a small island located about 10 km off seashore of northeastern Taiwan. It has a coastline of approximately 8.7 km and an area of about 2.9 km<sup>2</sup> (Fig. 1). It is a volcanic island, turtle-shape characterized by a 398 m maximum elevation on the northeastern side. Well-developed rocky reefs line the northeastern and southwestern shores. The prevailing northeast wind blows strongly in winter and the warm Kuroshio Current passes northward through this area in summer (Chu, 1971).

The marine algal flora of Taiwan has been studied by several workers (Yamada, 1925a, b, 1936, 1950; Okamura, 1931, 1936; Shen and Fan, 1950; Fan, 1951; Chiang, 1960, 1962a, b, 1972, 1973a, b; Taniguti, 1976; Wang and Chiang, 1977; Chiang and Chou, 1980; Wang and Chen, 1980; Chen and Chiang, 1981a, b; Chou and Chiang, 1981; Yang 1981; Chiang and Chen, 1982, 1983; Yang and Chiang, 1982; Chiang and Wang, 1987; Lewis and Norris, 1987; Chen, 1991; Huang, 1990, 1991; Wang *et al.*, 1993; Wang and Chiang, 1993, 1994; Yang *et al.*, 1994; Huang, 1997, 1998). However, the seaweed flora of Kuei-Shan Dao is poorly known. There is no any publication dealing with the marine algae of this area in the past. This study provides extensive information about the floristic and biogeographic data on the benthic marine algae of Taiwan.

### MATERIALS AND METHODS

Algal specimens were collected from the littoral and sublittoral zones of Kuei-Shan Dao (Fig. 1) during 27-29 May, 1997 and 25-27 July, 1997. Skin and SCUBA diving equipment

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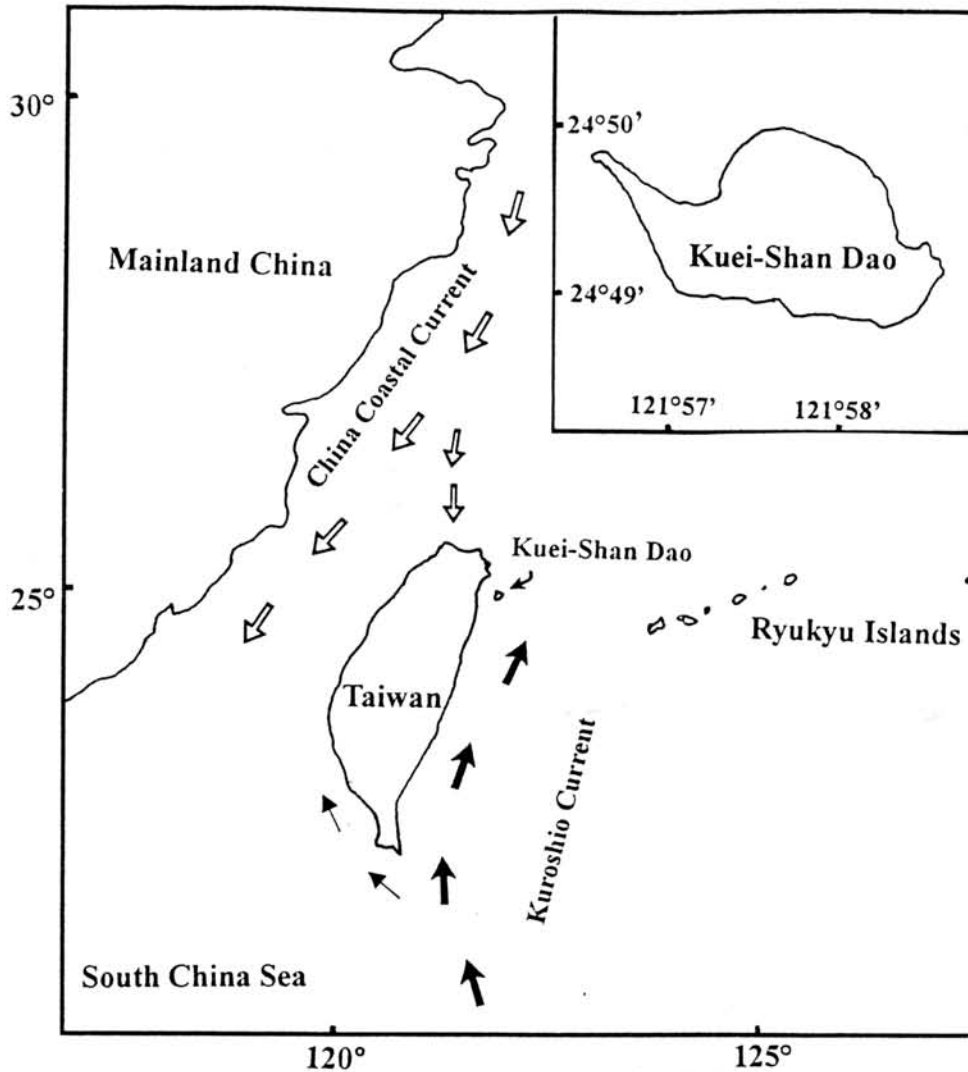


Fig. 1. Map showing geographic position of Kuei-Shan Dao and the adjacent currents.

were used for underwater collections and surveys. Specimens were either dried and mounted, or preserved in 10% formalin seawater. Liquid-preserved and dried herbarium specimens were used for this study. Sections were made by hand or with a freezing microtome. All voucher specimens are deposited in the Herbarium of Taiwan Museum.

## RESULTS

There are a total of 75 species of marine algae identified in this study. They belong to 56 genera and 34 families, and include 2 species of Cyanophyta, 19 species of Chlorophyta, 12 species of Phaeophyta, and 42 species of Rhodophyta (Table 1). They are all reported for the first time from Kuei-Shan Dao. Among them, *Dictyota friabilis* Setchell (Figs. 2, 3, 4) and *Halymenia dilatata* Zanardini (Figs. 5, 6) are new records (\*) for Taiwan. Five species are range extension (#) to the known phytogeographic patterns, such as *Symploca hydroides*, *Dictyota cervicornis*, *Lobophora variegata*, *Asparagopsis taxiformis*, *Galaxaura marginata* and *Tricleocarpa fragilis*, which are previously found only in southern Taiwan.

The structure of algal communities was also analyzed. In general, the flora of the upper wave-washed regions (upper littoral regions) was dominated by green algae, such as *Enteromorpha* spp. and *Ulva* spp. In the middle littoral region, there was a mixture of *Ulva* spp., *Enteromorpha* spp., *Chaetomorpha* spp., *Boergesenia forbesii*, *Dictyosphaeria cavernosa*, *Hinckia mitchellae*, *Colpomenia sinuosa*, *Ishige okamurai*, and *Hypnea* spp. On the exposed rocks of the lower littoral region or subtidal fringe, the scattered patches of *Valoniopsis pachynema*, *Padina* spp., *Caulerpa* spp., *Amphiroa* spp., *Gelidium* spp., *Pterocladia* spp., *Grateloupia filicina*, *Prionitis ramosissima*, *Mastophora rosea*, *Hypnea* spp., *Ahnfeltiopsis flabelliformis* and *Sargassum* spp. In the sublittoral zone, there was a mixture of *Dictyota* spp., *Gelidium* spp., *Pterocladia* spp., *Caulerpa* spp., *Codium* spp., *Liagora* spp., *Dudresnaya japonica*, *Corallina pilulifera*, *Marginisporum aberrans*, *Euclidean serra*, *Meristotheca papulosa*, *Champia parvula*, *Chondria armata*, *Laurencia* spp., *Sarcodia montagneana*, *Tricleocarpa fragilis*, etc. The orders of the floristic list of algae are arranged according to Bold and Wynne (1985), while families, genera and species are arranged alphabetically.

Table 1. Numbers of algal taxa during studying period in Kuei-Shan Dao.

Phylum	No. of Families	No. of Genera	No. of Species	No. of new records for Taiwan
Cyanopyta	1	2	2	0
Chlorophyta	9	12	19	0
Phaeophyta	5	10	12	1
Rhodophyta	19	32	42	1
Total	34	56	75	2

## CHECKLIST OF SPECIES

\* : new record for Taiwan

# : new distributional  
range for Taiwan

### CYANOPHYTA

#### OSCILLATORIACEAE

##### ***Lyngbya majuscula* (Dillwyn) Harvey**

Chiang, 1962b; Magruder and Hunt, 1979; Tseng, 1983; Silva *et al.*, 1987; Wang and Chiang, 1993; Silva *et al.*, 1996.

Thalli widely expanded on upper to lower intertidal rocks.

##### ***Symploca hydroides* (Harvey) Kützing #**

Magruder and Hunt, 1979; Chiang and Wang, 1987; Huang, 1990; Silva *et al.*, 1987; Silva *et al.*, 1996; Huang, 1998.

Growing on upper intertidal rocks. This species was previously found only in southern Taiwan.

Geographic distribution: Hawaii, Philippines, Indian Ocean.

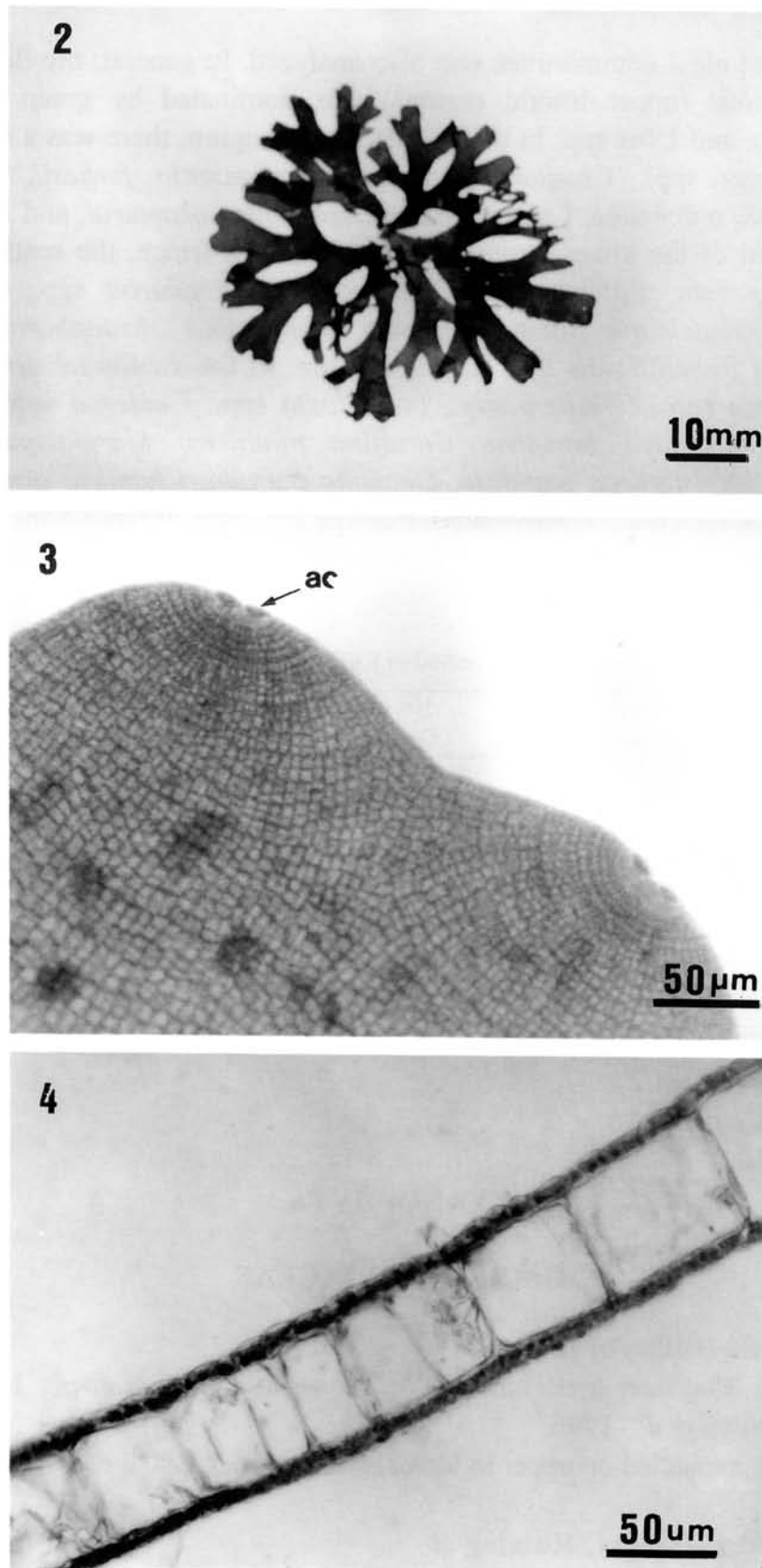


Fig. 2. Outline of *Dictyota friabilis*.

Fig. 3. Apical surface view of *Dictyota friabilis*, showing the apical cell (ac).

Fig. 4. Transverse section of the thallus of *Dictyota friabilis*.

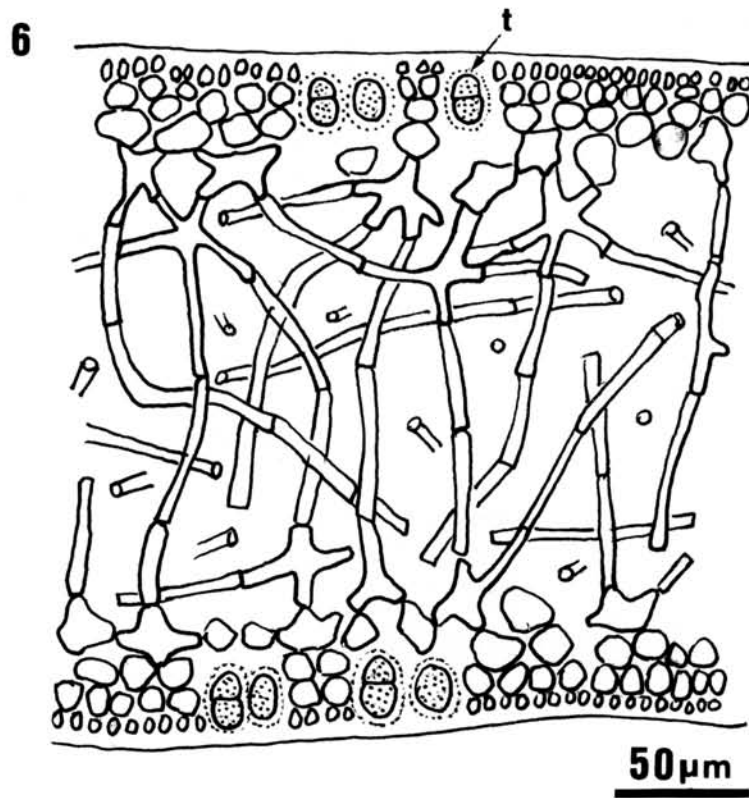
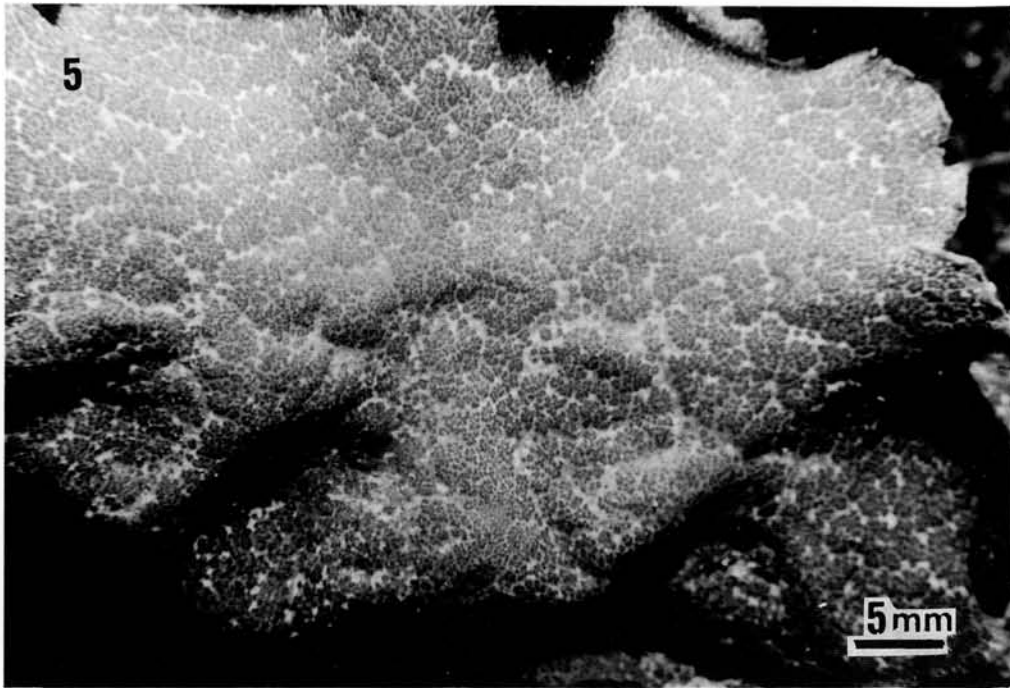


Fig. 5. Surface view of *Halymenia dilatata*.

Fig. 6. Transverse section of *Halymenia dilatata*, showing internal organization with tetrasporangia (t).

**CHLOROPHYTA****ULVACEAE*****Enteromorpha compressa* (Linnaeus) Greville**

Yamada, 1925a, 1950; Okamura, 1931, 1936; Shen and Fan, 1950; Chiang, 1960; Tseng, 1983; Silva *et al.*, 1987; Huang, 1990; Silva *et al.*, 1996; Huang, 1998.

Growing on middle to lower intertidal rocks.

***Enteromorpha intestinalis* (Linnaeus) Link *ex* Nees**

Shen and Fan, 1950; Chiang, 1960, 1973b; Tseng, 1983; Silva *et al.*, 1987; Huang, 1990; Yoshida *et al.*, 1990; Silva *et al.*, 1996; Huang, 1998.

Growing on upper intertidal rocks.

***Ulva conglobata* Kjellman**

Shen and Fan, 1950; Chiang, 1960, 1962a; Chiang and Wang, 1987; Tseng, 1983; Silva *et al.*, 1987; Huang, 1990; Silva *et al.*, 1996; Huang, 1998.

Growing on upper and middle intertidal rocks covered with sand.

***Ulva fasciata* Delile**

Shen and Fan, 1950; Chiang, 1960, 1973b; Tseng, 1983; Silva *et al.*, 1987; Chiang and Wang, 1987; Huang, 1990; Silva *et al.*, 1996; Huang, 1998.

Growing on middle intertidal rocks and in rock pools.

***Ulva lactuca* Linnaeus**

Okamura, 1930, 1931; Shen and Fan, 1950; Yamada, 1950; Chiang, 1960, 1973b; Tseng, 1983; Chiang and Wang, 1987; Silva *et al.*, 1987; Huang, 1990; Silva *et al.*, 1996; Huang, 1998.

Growing on middle intertidal rocks and in rock pools.

**ANADYOMENACEAE*****Anadyomene wrightii* Harvey in Gray**

Okamura, 1936; Shen and Fan, 1950; Chiang, 1973b; Tseng, 1983; Silva *et al.*, 1987; Chiang and Wang, 1987; Huang, 1990; Silva *et al.*, 1996; Huang, 1998.

Growing on subtidal rocks 0.5-1 m deep.

**CLADOPHORACEAE*****Chaetomorpha crassa* (C. Agardh) Kützing**

Yamada, 1925a, 1950; Okamura, 1931, 1936; Shen and Fan, 1950; Chiang, 1960, 1973b; Silva *et al.*, 1987; Chiang and Wang, 1987; Huang, 1990; Silva *et al.*, 1996; Huang, 1998.

Growing in shallow rock pools in the upper intertidal zone.

**Chaetomorpha spiralis Okamura**

Chiang, 1960, 1973b; Lewis and Norris, 1987; Silva *et al.*, 1987; Huang, 1990; Yoshida *et al.*, 1990; Silva *et al.*, 1996.

Growing on lower intertidal and subtidal rocks.

**BOODLEACEAE****Boodlea composita (Harvey et Hooker) Brand**

Okamura, 1936; Shen and Fan, 1950; Chiang, 1960, 1973b; Tseng, 1983; Silva *et al.*, 1987; Chiang and Wang, 1987; Huang, 1990; Silva *et al.*, 1996; Huang, 1998.

*B. siamensis* Reinbold

Yamada, 1925a; Okamura, 1931, 1936; Shen and Fan, 1950; Chiang, 1962b.

Thalli forming spongy masses on rocks in the lower intertidal and subtidal zone 0.5-1 m deep.

**SIPHONOCLADACEAE****Boergesenia forbesii (Harvey) J. Feldmann**

Chiang, 1962a, 1973b; Tseng, 1983; Silva *et al.*, 1987; Chiang and Wang, 1987; Yoshida *et al.*, 1990; Huang, 1990; Silva *et al.*, 1996; Huang, 1998.

Growing on middle intertidal sandy bottoms of rock pools.

**Cladophoropsis javanica (Kützinger) P.C. Silva**

Silva *et al.*, 1996.

*Cladophoropsis zollingeri* (Kützinger) Boergesen

Shen and Fan, 1950; Chiang, 1960; Womersley and Bailey, 1970; Tseng, 1983; Chiang and Wang, 1987; Lewis and Norris, 1987; Silva *et al.*, 1987; Huang, 1990; Yoshida *et al.*, 1990.

Thalli forming dense clumps on somewhat muddy mid-lower intertidal rock, preferably by the sides of rock pools.

**VALONIACEAE****Dictyosphaeria cavernosa (Forsskal) Boergesen**

Shen and Fan, 1950; Chiang, 1960, 1973b; Tseng, 1983; Silva *et al.*, 1987; Chiang and Wang, 1987; Huang, 1990; Silva *et al.*, 1996; Huang, 1998.

Growing on middle and lower intertidal to subtidal rocks 1m deep.

**Valoniopsis pachynema (Martens) Boergesen**

Yamada, 1950; Shen and Fan, 1950; Chiang, 1960, 1973b; Tseng, 1983; Silva *et al.*, 1987; Chiang and Wang, 1987; Huang, 1990; Silva *et al.*, 1996.

*Valonia confervoides* Harvey ex J. Agardh

Okamura, 1931, 1936.

Growing on lower intertidal to subtidal rocks.

**BRYOPSIDACEAE*****Bryopsis plumosa* (Hudson) C. Agardh**

Okamura, 1936; Shen and Fan, 1950; Chiang, 1960; Tseng, 1983; Silva *et al.*, 1987; Yoshida *et al.*, 1990; Silva *et al.*, 1996.

Growing on lower intertidal rocks or in rock pools in sheltered places though often exposed to moderate surf.

**CAULERPACEAE*****Caulerpa racemosa* (Forsskal) J. Agardh var. *laete-virens* (Montagne) Weber-van Bosse**

Okamura, 1931, 1936; Shen and Fan, 1950; Chiang, 1960, 1973b; Silva *et al.*, 1987; Chiang and Wang, 1987; Huang, 1990; Silva *et al.*, 1996; Huang, 1998.

Growing on middle intertidal rocks covered with sand.

***Caulerpa peltata* (Lamouroux) Weber-van Bosse**

Okamura, 1931, 1936; Shen & Fan, 1950; Chiang, 1960, 1962b; Womersley & Bailey, 1970; Silva *et al.*, 1996; Phang, 1998.

*C. racemosa* (Forsskal) J. Agardh var. *peltata* (Lamouroux) Eubank  
Lewis and Norris, 1987; Silva *et al.*, 1987; Yoshida *et al.*, 1990.

*C. peltata* Lamouroux var. *typica* Weber-van Bosse  
Tseng, 1983; Chiang and Wang, 1987.

Growing on lower intertidal sandy rocks.

**CODIACEAE*****Codium arabicum* Kützing**

Okamura, 1936; Shen and Fan, 1950; Tseng, 1983; Silva *et al.*, 1987; Silva *et al.*, 1996; Huang, 1998.

*C. adhaerens* (Cabrera) C. Agardh  
Okamura, 1936; Chiang, 1960, 1962b; Lewis and Norris, 1987.

Growing on lower intertidal rocks.

***Codium contractum* Kjellman**

Ariga, 1919; Taniguti, 1976; Lewis and Norris, 1987; Silva *et al.*, 1987; Yang *et al.*, 1994; Silva *et al.*, 1996.

Growing on lower intertidal rocks.

***Codium intricatum* Okamura**

Yamada, 1950; Shen and Fan, 1950; Chiang, 1962b, 1973b; Silva *et al.*, 1987; Chiang and Wang, 1987; Yoshida *et al.*, 1990; Huang, 1990, 1998.

Growing on lower intertidal rocks.



**PHAEOPHYTA****ECTOCLADACEAE****Hincksia mitchelliae (Harvey) P.C. Silva**

Silva *et al.*, 1987; Yoshida *et al.*, 1990; Silva *et al.*, 1996.

*Giffordia mitchelliae* (Harvey) Hamel

Tseng, 1983; Lewis and Norris, 1987; Huang, 1990.

*Ectocarpus mitchelliae* Harvey

Okamura, 1936; Shen and Fan, 1950; Chiang, 1960; Tseng, 1983.

Thalli attached on the lower intertidal rocks.

**DICTYOTACEAE****Dictyopteris repens (Okamura) Boergesen**

Tseng, 1983; Lewis and Norris, 1987; Silva *et al.*, 1987; Yoshida *et al.*, 1990; Huang, 1990, 1998.

*Neurocarpus repens* Okamura

Okamura, 1931, 1936; Shen and Fan, 1950.

Thalli creeping on the other marine algae in the lower intertidal rocks and subtidal region 1 m deep.

**Dictyota cervicornis Kützinger #**

Tseng, 1983; Chiang and Wang, 1987; Silva *et al.*, 1987; Yoshida *et al.*, 1990; Huang, 1990; Silva *et al.*, 1996; Huang, 1998.

Thalli growing on lower intertidal rocks. This species was previously found only in southern Taiwan. It was common in the Indo-pacific region.

**Dictyota friabilis Setchell \***

Figs. 2, 3, 4

Dawson, 1954b: 401, fig. 16a, b; Magruder and Hunt, 1979: 43; Tseng, 1983:194; Trono, 1997:109.

A small creeping plant, yellowish brown clumps with blue-green iridescent, dichotomously branching, the segments short, strap-shaped, 3-6 mm in breadth, the apical segment with rounded apex and a distinct apical cell.

It was found growing on other algae or rocky bottoms in shallow subtidal reefs exposed to moderate water movement.

Geographical distribution: Common in the tropics, such as Hawaii, Xisha Islands, Philippines, Malay Archipelago, Tahiti, Fiji, etc.

Collection: H-1342 (May 28, 1997).

**Lobophora variegata (Lamouroux) Womersley #**

Tseng, 1983; Chiang and Wang, 1987; Silva *et al.*, 1987; Yoshida *et al.*, 1990; Huang, 1990; Wang and Chiang, 1993; Silva *et al.*, 1996; Huang, 1998.

Growing on lower intertidal rocks. This species was previously found only in southern Taiwan.

***Padina arborescens* Holmes**

Lewis and Norris, 1987; Silva *et al.*, 1987; Yoshida *et al.*, 1990.

Growing in the subtidal zone 2-10 m deep.

***Padina minor* Yamada**

Okamura, 1931, 1936; Shen and Fan, 1950; Chiang, 1960, 1962a, b, 1973b; Chiang and Wang, 1987; Tseng, 1983; Silva *et al.*, 1987; Wang and Chiang, 1993; Huang, 1990, 1998.

Growing on lower intertidal to subtidal rocks.

**ISHIGEACEAE**

***Ishige okamurai* Yendo**

Okamura, 1936; Shen and Fan, 1950; Chiang, 1960, 1973b; Tseng, 1983; Lewis and Norris, 1987; Yoshida *et al.*, 1990.

Thalli growing on intertidal rocks.

**SCYTOSIPHONACEAE**

***Colpomenia sinuosa* (Mertens ex Roth) Derbes et Solier in Castagne**

Okamura, 1930; Shen and Fan, 1950; Chiang, 1960; Tseng, 1983; Silva *et al.*, 1987; Yoshida *et al.*, 1990; Huang, 1990; Silva *et al.*, 1996; Huang, 1998.

Thalli growing on lower intertidal rocks.

***Endarachne binghamiae* J. Agardh**

Yamada, 1925b; Okamura, 1930, 1936; Shen and Fan, 1950; Chiang, 1960, 1973b; Tseng, 1983; Yoshida *et al.*, 1990.

Thalli growing on middle and lower intertidal rocks.

***Hydroclathrus clathratus* (Bory) Howe**

Okamura, 1936; Shen and Fan, 1950; Yamada, 1950; Chiang, 1960, 1962a, 1973b; Tseng, 1983; Chiang and Wang, 1987; Silva *et al.*, 1987; Huang, 1990; Silva *et al.*, 1996; Huang, 1998.

Growing on lower intertidal and subtidal rocks.

**SARGASSACEAE**

***Sargassum cristaefolium* C. Agardh**

Okamura, 1931, 1936; Shen and Fan, 1950; Chou and Chiang, 1981; Chiang and Wang, 1987; Silva *et al.*, 1987; Huang, 1990; Silva *et al.*, 1996.

Growing on lower intertidal and subtidal rocks.

## RHODOPHYTA

### DERMONEMATACEAE

#### **Dermonema virens (J. Agardh) Pedroche & Vila Orth**

Silva *et al.*, 1996.

*D. frappieri* (Montagne *et* Millardet) Boergesen

Dawson, 1954b; Womersley and Bailey, 1970; Chiang, 1973b; Tseng, 1983; Silva *et al.*, 1987; Yoshida *et al.*, 1990; Wang and Chiang, 1993; Huang, 1998.

*D. dichotomum* Heydrich

Chen and Chiang, 1982.

*D. gracilis* Martens *ex* Weber-van Bosse

Okamura, 1931, 1936; Shen and Fan, 1950; Lewis and Norris, 1987.

Growing on exposed intertidal rocks.

### HELMINTHOCLADIACEAE

#### **Liagora ceranoides Lamouroux**

Cordero, 1977b; Chen and Chiang, 1981a; Tseng, 1983; Chiang and Wang, 1987; Huang, 1990; Silva *et al.*, 1987; Yoshida *et al.*, 1990; Yang *et al.*, 1994; Silva *et al.*, 1996.

Growing in subtidal rocks.

#### **Liagora orientalis J. Agardh**

Okamura, 1936; Shen and Fan, 1950; Chiang and Chen, 1982; Silva *et al.*, 1987; Huang, 1990; Yoshida *et al.*, 1990; Silva *et al.*, 1996.

Growing on lower intertidal to subtidal rocks.

### BONNEMAISONIACEAE

#### **Asparagopsis taxiformis (Delile) Trevisan #**

Tseng, 1983; Chiang and Wang, 1987; Silva *et al.*, 1987; Yoshida *et al.*, 1990; Huang, 1990; Silva *et al.*, 1996; Huang, 1998.

*A. sanfordiana* Harvey

Okamura, 1931, 1936; Shen and Fan, 1950.

Growing on lower intertidal to subtidal rocks. This species was previously found only in southern Taiwan. It was common in the tropics.

### GALAXAURACEAE

#### **Galaxaura marginata (Ellis et Solander) Lamouroux #**

Papenfuss *et al.*, 1982; Lewis and Norris, 1987; Silva *et al.*, 1987; Huang, 1990; Silva *et al.*, 1996; Huang, 1998.

*G. tenera* Kjellman

Chiang, 1973a, 1973b; Chiang and Wang, 1987.

*G. veprecula* Kjellman

Papenfuss, 1968; Tseng, 1983.

Growing on subtidal rocks 1-3 m deep. This species was previously found only in southern Taiwan

**Tricleocarpa fragilis (Linnaeus) Huisman et Townsend #**

Huisman *et* Townsend, 1993; Silva *et al.*, 1996.

*Galaxaura oblongata* (Ellis *et* Solander) Lamouroux

Chiang, 1973a, 1973b; Papenfuss *et al.*, 1982; Tseng, 1983; Chiang and Wang, 1987; Silva *et al.*, 1987; Huang, 1990; Yoshida *et al.*, 1990.

*Tricleocarpa oblongata* (Ellis *et* Solander) Huisman *et* Borowitzka  
Huisman *et* Borowitzka, 1990.

Growing on lower intertidal or subtidal rocks (1-5 m deep). This species was previously found only in southern Taiwan.

**Scinaia moniliformis J. Agardh**

Chiang, 1962a; Chiang and Wang, 1987; Silva *et al.*, 1987; Huang, 1990; Yoshida *et al.*, 1990; Wang and Chiang, 1993; Huang, 1998.

Growing on subtidal rocks 1-5 m deep.

**GELIDIACEAE**

**Gelidium amansii (Lamouroux) Lamouroux**

Okamura, 1913, 1930; Tseng, 1983; Lewis and Norris, 1987; Silva *et al.*, 1987; Silva *et al.*, 1996.

*Gelidium elegans* Kützing

Yoshida *et al.*, 1990.

*G. amansii* f. *elegans* Okamura

Fan, 1951; Chiang, 1962a; Lewis and Norris, 1987.

Growing on lower intertidal to subtidal rocks (10 m deep).

**Pterocladia capillacea (S.G. Gmelin) Bornet**

Silva *et al.*, 1987; Yoshida *et al.*, 1990; Silva *et al.*, 1996.

*Pterocladia tenuis* Okamura

Okamura, 1935b, 1936; Shen and Fan, 1950; Chiang, 1962a, b, 1973b; Tseng, 1983; Lewis and Norris, 1987.

Growing on intertidal to subtidal rocks (15 m deep).

**DUMONTIACEAE**

**Dudresnaya japonica Okamura**

Shen and Fan, 1950; Huang, 1990; Yoshida *et al.*, 1990.

Growing on the subtidal rocks (5-10 m deep).

### HALYMENIACEAE

#### **Carpopeltis maillardii (Montagne et Millardet) Chiang**

Chiang and Wang, 1987; Silva *et al.*, 1987; Huang, 1990; Yoshida *et al.*, 1990; Wang and Chiang, 1993; Silva *et al.*, 1996; Huang, 1998.

*C. rigida* (Harvey ex J. Agardh) Schmitz  
Shen and Fan, 1950.

Growing on lower intertidal to subtidal rocks (5 m deep).

#### **Grateloupia filicina (Lamouroux) C. Agardh**

Chiang, 1962a, 1973b; Tseng, 1983; Chiang and Wang, 1987; Silva *et al.*, 1987; Yoshida *et al.*, 1990; Silva *et al.*, 1996.

Growing on lower intertidal to subtidal rocks (2 m deep).

#### **Halymenia dilatata Zanardini \***

Figs. 5, 6

Balakrishnan, 1961: 197; Cordero, 1977b: 109; Trono, 1997: 184.

Fronde is gelatinous-membranous, 10-15 cm tall, attached by small scutate disc. In cross section of blade, cortical region has 3-5 layers of cells; outermost are paired and borne by an inner oblong-ovate cell, 4  $\mu\text{m}$  broad or more. Medullary filaments are cylindrical, with stellate cells, arms to 4  $\mu\text{m}$  broad. Tetrasporangia are embedded in the surface of the frond.

It was growing on the lower intertidal shaded areas or in upper subtidal zone exposed to moderate water movement.

Geographical distribution: Japan, Korea, Philippines, Solomon Islands, Indian, Somalia, South Africa, Sri Lanka, Tanzania.

Collection: H-1518 (May 29, 1997).

#### **Halymenia microcarpa (Montagne) P. C. Silva**

Silva *et al.*, 1987; Wang and Chiang, 1993; Silva *et al.*, 1996, Huang, 1998.

*Halymenia ceylanica* Harvey ex Kützing  
Lewis and Norris, 1987.

*Halymenia durvillaei* Bory var. *ceylanica* (Harvey ex Kützing) Weber-van Bosse  
Okamura, 1936; Shen and Fan, 1950; Chiang, 1962a; Chiang and Wang, 1987; Huang, 1990.

Growing on lower intertidal to subtidal rocks (10 m deep).

#### **Prionitis ramosissima (Okamura) Kawaguchi**

Kawaguchi, 1989; Yoshida *et al.*, 1990.

*Grateloupia ramosissima* Okamura

Shen and Fan, 1950; Chiang, 1962a, 1973a; Tseng, 1983; Silva *et al.*, 1987.

Growing on lower intertidal to subtidal rocks (5 m deep).

### PEYSSONNELIACEAE

#### **Peyssonnelia rubra (Greville) J. Agardh**

Okamura, 1931, 1936; Shen and Fan, 1950; Tseng, 1983; Chiang and Wang, 1987; Silva *et al.*, 1987; Huang, 1990; Wang and Chiang, 1993; Silva *et al.*, 1996.

*Peyssonnelia rubra* (Greville) J. Agardh var. *orientalis* Weber-van Bosse  
Cordero, 1977b; Dawson, 1954a.

Growing on subtidal rocks or old coral fragments (1-5 m deep).

***Peyssonnelia distenta* (Harvey) Yamada**

Okamura, 1936; Shen and Fan, 1950; Chiang, 1962a, b; Chiang and Wang, 1987; Silva *et al.*, 1987; Yoshida *et al.*, 1990; Huang, 1998.

Growing on lower intertidal to subtidal rocks (5 m deep).

**CORALLINACEAE**

***Amphiroa ephedraea* (Lamouroux) Decaisne**

Okamura, 1936; Shen and Fan, 1950; Silva *et al.*, 1987; Huang, 1990; Yoshida *et al.*, 1990; Yang *et al.*, 1994; Silva *et al.*, 1996.

Growing on lower intertidal to subtidal rocks (3 m deep).

***Amphiroa fragilissima* (Linnaeus) Lamouroux**

Dawson, 1954a; Taylor, 1960; Cordero, 1977b; Tseng, 1983; Silva *et al.*, 1987; Yoshida *et al.*, 1990; Yang *et al.*, 1994; Silva *et al.*, 1996.

Growing on middle intertidal rocks.

***Amphiroa pusilla* Yendo**

Okamura, 1936; Shen and Fan, 1950; Cordero, 1977b; Chiang and Wang, 1987; Yoshida *et al.*, 1990; Wang and Chiang, 1993.

Growing on lower intertidal rocks.

***Cheilosporum acutilobum* (Decaisne) Piccone**

Yoshida *et al.*, 1990; Yang *et al.*, 1994; Silva *et al.*, 1996.

*Cheilosporum jungermannioides* Ruprecht ex J. E. Areschoug  
Okamura, 1936; Shen and Fan, 1950; Tseng, 1983; Chiang and Wang, 1987; Lewis and Norris,  
1987; Silva *et al.*, 1987; Huang, 1990.

Growing on lower intertidal to subtidal rocks (3 m deep).

***Cheilosporum anceps* (Kützing) Yendo**

Okamura, 1936; Shen and Fan, 1950; Chiang and Wang, 1987; Huang, 1990; Yoshida *et al.*, 1990; Wang and Chiang, 1993.

Growing on lower intertidal rocks.

***Corallina pilulifera* Postels et Ruprecht**

Okamura, 1936; Chiang, 1962a; Tseng, 1983; Yoshida *et al.*, 1990.

Growing on lower intertidal to subtidal rocks (5 m deep).

**Jania adhaerens Lamouroux**

Shen and Fan, 1950; Chiang, 1962a, b; Tseng, 1983; Chiang and Wang, 1987; Huang, 1990; Yoshida *et al.*, 1990; Silva *et al.*, 1996; Huang, 1998.

*Corallina decussata-dichotoma* Yendo

Okamura, 1931, 1936.

*Jania decussata-dichotoma* (Yendo) Yendo

Okamura, 1936; Shen and Fan, 1950; Chiang, 1962a; Silva *et al.*, 1987.

Thalli are epiphytic on coarser algae or growing on rocks in lower intertidal zone.

**Marginisporum aberrans (Yendo) Johansen et Chihara**

Cordero, 1977b; Tseng, 1983; Yoshida *et al.*, 1990.

*Amphiroa aberrans* Yendo

Okamura, 1936.

Growing on lower intertidal rocks.

**Mastophora rosea (C. Agardh) Setchell**

Chiang, 1973; Tseng, 1983; Chiang and Wang, 1987; Silva *et al.*, 1987; Huang, 1990; Silva *et al.*, 1996; Huang, 1998.

*M. macrocarpa* Montagne

Okamura, 1931, 1936; Shen and Fan, 1950; Chiang, 1962a.

Growing on lower intertidal to subtidal rocks (5 m deep).

**GIGARTINACEAE****Chondracanthus intermedius (Suringar) Hommersand**

Hommersand *et al.*, 1993; Yang *et al.*, 1994; Huang, 1998.

*Gigartina intermedia* Suringar

Shen and Fan, 1950; Chiang, 1962a; Tseng, 1983; Chiang and Wang, 1987; Yoshida *et al.*, 1990.

Growing on middle to lower intertidal rocks.

**GRACILARIACEAE****Gracilaria vieillardii P. C. Silva**

Silva *et al.*, 1987; Yoshida *et al.*, 1990; Silva *et al.*, 1996.

*G. denticulata* Kützting

Okamura, 1931, 1936; Chiang, 1962a; Yang and Chiang, 1982; Huang, 1990.

Growing on lower intertidal to subtidal rocks (5 m deep).

**HYPNEACEAE****Hypnea cervicornis J. Agardh**

Taylor, 1960; Dawson, 1961; Tseng, 1983; Chiang and Wang, 1987; Littler *et al.*, 1989; Huang, 1990; Yoshida *et al.*, 1990; Trono, 1997.

Growing on lower intertidal to subtidal rocks (5 m deep).

**Hypnea japonica Tanaka**

Shen and Fan, 1950; Chiang, 1962a; Tseng, 1983; Silva *et al.*, 1987; Yoshida *et al.*, 1990.

Growing on lower intertidal to subtidal rocks (10 m deep).

**Hypnea pannosa J. Agardh**

Okamura, 1936; Shen and Fan, 1950; Dawson, 1961; Tseng, 1983; Chiang and Wang, 1987; Huang, 1990; Silva *et al.*, 1996; Trono, 1997; Huang, 1998.

*H. nidulans* Setchell

Okamura, 1931, 1936; Shen and Fan, 1950.

Growing on lower intertidal to subtidal rocks (10 m deep).

**PHYLLOPHORACEAE**

**Ahnfeltiopsis flabelliformis (Harvey) Masuda**

Masuda, 1993; Wang and Chiang, 1993.

*Gymnogongrus flabelliformis* Harvey

Shen and Fan, 1950; Tseng, 1983; Yoshida *et al.*, 1990.

Growing on lower intertidal rocks or in rock pools.

**RHIZOPHYLLIDACEAE**

**Portieria hornemannii (Lyngbye) Silva**

Silva *et al.*, 1996; Trono, 1997; Huang, 1998.

*Desmia hornemannii* Lyngbye

Chiang, 1962a, 1973b.

*Chondrococcus hornemannii* (Mertens) Schmitz

Shen and Fan, 1950; Tseng, 1983; Chiang and Wang, 1987; Huang, 1990.

Growing on lower intertidal to subtidal rocks (5 m deep).

**SARCODIACEAE**

**Sarcodia montagneana (J. Hooker et Harvey) J. Agardh**

Silva *et al.*, 1996; Huang, 1998.

*Sarcodia ceylanica* Harvey *ex* Kützing

Shen and Fan, 1950; Chiang, 1962a; Chiang and Wang, 1987; Huang, 1990; Yoshida *et al.*, 1990.

Growing on middle intertidal to subtidal rocks (10 m deep).



**SOLIERIACEAE*****Eucheuma serra* J. Agardh**

Shen and Fan, 1950; Chiang, 1962a, 1973b; Chiang and Wang, 1987; Huang, 1990; Silva *et al.*, 1987; Silva *et al.*, 1996; Huang, 1998.

Growing on subtidal rocks (3-10 m deep).

***Meristotheca papulosa* (Montagne) J. Agardh**

Okamura, 1936; Chiang, 1962a; Tseng, 1983; Chiang and Wang, 1987; Huang, 1990; Silva *et al.*, 1987; Silva *et al.*, 1996; Huang, 1998.

Growing on subtidal rocks (5-10 m deep).

**CHAMPIACEAE*****Champia parvula* (C. Agardh) Harvey**

Okamura, 1931, 1936; Shen and Fan, 1950; Chiang, 1962a; Tseng, 1983; Chiang and Wang, 1987; Silva *et al.*, 1987; Huang, 1990; Silva *et al.*, 1996.

Growing on lower intertidal to subtidal rocks (1-2 m deep).

**CERAMIACEAE*****Centroceras clavulatum* (C. Agardh) Montagne**

Okamura, 1931, 1936; Shen and Fan, 1950; Chiang, 1962a, b; Tseng, 1983; Chiang and Wang, 1987; Huang, 1990; Silva *et al.*, 1987; Silva *et al.*, 1996; Huang, 1998.

Growing on lower intertidal to subtidal rocks (5 m deep).

**RHODOMELACEAE*****Chondria armata* (Kützing) Okamura**

Okamura, 1931, 1936; Shen and Fan, 1950; Chiang, 1962a, 1973b; Tseng, 1983; Chiang and Wang, 1987; Silva *et al.*, 1987; Huang, 1990; Silva *et al.*, 1996; Huang, 1998.

Growing on lower intertidal to subtidal rocks (10 m deep).

***Laurencia brongniartii* J. Agardh**

Cordero, 1977b; Chiang and Wang, 1987; Silva *et al.*, 1987; Yoshida *et al.*, 1990; Silva *et al.*, 1996; Huang, 1998.

Growing on subtidal rocks (2-10 m deep).

***Laurencia intermedia* Yamada**

Tseng, 1983; Chiang and Wang, 1987; Silva *et al.*, 1987; Huang, 1990; Yoshida *et al.*, 1990; Silva *et al.*, 1996.

Growing on lower intertidal to subtidal rocks (10 m deep).

***Laurencia papillosa* (C. Agardh) Greville**

Okamura, 1931; Shen and Fan, 1950; Huang, 1990; Yoshida *et al.*, 1990; Silva *et al.*, 1996; Trono, 1997; Huang, 1998.

Growing on subtidal rocks (5 m deep).

## DISCUSSION

In the records of seaweeds of Taiwan (Yamada, 1925a, b, 1936, 1950; Okamura, 1931, 1936; Shen and Fan, 1950; Fan, 1951; Chiang, 1960, 1962a, b, 1972, 1973a, b; Taniguti, 1976; Wang and Chiang, 1977; Chiang and Chou, 1980; Wang and Chen, 1980; Chen and Chiang, 1981a, b; Chou and Chiang, 1981; Yang 1981; Chiang and Chen, 1982, 1983; Yang and Chiang, 1982; Chiang and Wang, 1987; Lewis and Norris, 1987; Chen, 1991; Huang, 1990, 1991; Wang *et al.*, 1993; Wang and Chiang, 1993, 1994; Yang *et al.*, 1994; Huang, 1997, 1998), there are about 500 species of marine algae listed. There are 75 species of marine algae registered in this study. Among them, two species are new to Taiwan, and six species are new distributional range to Taiwan. Though Kuei-Shan Dao has an area of only 2.9 km<sup>2</sup>, its marine algal flora is rather complicated.

Most of marine algae in Kuei-Shan Dao are red algae (56%). Other algae are green algae (25%), brown algae (16%), and blue algae (3%). Based on the (R+C)/P hypothesis of Cheney (Cheney, 1977; Wang and Chiang, 1993), the ratio of red and green to brown algae of Kuei-Shan Dao is 5.1, indicating a characteristic tropical nature. This agrees with the fact that most of algae in Kuei-Shan Dao are of tropical or subtropical species. Species such as *Symploca* sp., *Boergesenia forbesii*, *Caulerpa* spp., *Codium* spp., *Dictyota cervicornis*, *Lobophora variegata*, *Liagora* spp., *Galaxaura* spp., *Gracilaria* sp., *Cheilosporum* spp., *Asparagopsis taxiformis*, *Tricleocarpa fragilis* are widely distributed in tropical seas (Dawson, 1956; Kamura, 1963; Thoi, 1969; Silva, *et al.*, 1987; Silva, *et al.*, 1996; Callumpong and Menez, 1997; Trono, 1997; Critchley and Ohno, 1998). Especially, the occurrence of *Symploca hydroides*, *Dictyota cervicornis*, *Lobophora variegata*, *Galaxaura marginata*, *Tricleocarpa fragilis*, and *Asparagopsis taxiformis* are found only in the southern Taiwan previously (Chiang and Chen, 1982; Chiang and Wang, 1987; Huang, 1990, 1998). They are never found in the northern Taiwan (Okamura, 1936; Chiang, 1960, 1962a, 1973a). It seems that the macroalgal distribution in Kuei-Shan Dao does not correlate with latitudinal change.

It is well known that water temperature and current seem to be the principal factors regulating the phytogeographical distribution of marine algae (Lobban *et al.*, 1985). Chiang (1973a) first pointed out that northern Taiwan flora was distinct from its southern counterpart due to the influence of the warm Kuroshio Current. The Kuroshio Current brings warm water from the Philippines and the equatorial region toward southern Taiwan (Chu 1963, 1971; Chern and Wang, 1990). The current along eastern coast of Taiwan in a NNE direction is the main flow of Kuroshio (Fig. 1). The Kuei-Shan Dao located on the way of Kuroshio. This is possibly the reason why it shares many tropical algal genera with southern Taiwan.

## ACKNOWLEDGEMENTS

I wish to extend my deep gratitude to the following people for their helps: the station troops of Kuei-Shan Dao, for supplying of accommodation; Dr. Lawrence M. Liao, Dept. of Biology, University of San-Carlos, Philippines, for kindly checking the list of species; Mr. Kuo-Ching Hsia, for his assistance in the field work.

## LITERATURE CITED

- Ariga, K. 1919. Taiwan Kaiso saishu nisshi. [An Account of Taiwan Algae Collections.] Transaction of the Natural History Society of Taiwan **9**: 10-13.
- Balakrishnan, M. S. 1961. Studies on Indian Cryptonemiales III *Halymenia*. C. A. Ag. J. Madras Univ. B. **32**: 183-217.
- Bold, H. C. and M. J. Wynne. 1985. Introduction to the algae: structure and reproduction. Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 720 pp.
- Callumpong P. H. and F. G. Menez. 1997. Field Guide to the common mangroves, seagrasses and algae of the Philippines. Bookmark, Philippines. 197 pp.
- Chen, C. and Y.-M. Chiang. 1981a. On the Helminthocladiaceae of Taiwan. Chinese Biosci. **18**: 53-56. (in Chinese).
- Chen, C. and Y.-M. Chiang. 1981b. Morphological studies on the family Helminthocladiaceae (Nemaliales, Rhodophycophyta) of Taiwan. I. *Helminthocladia*. Biol. Bull. Natl. Taiwan Normal Univ. **16**: 27-32. (in Chinese).
- Chen, H.-K. 1991. The taxonomic studies of *Laurencia* Lamouroux (Rhodophyta, Ceramiales) of Taiwan. M. S. thesis, Inst. of Oceanogr., National Taiwan Univ. 108pp. (in Chinese).
- Cheney, D. F. 1977. R&C/P--a new and improved ratio for comparing seaweed floras. J. Phycol. **13** (suppl.): 12.
- Chern, C.-S. and J. Wang. 1990. On the Kuroshio branch current north of Taiwan. Acta Oceanogr. Taiwanica **25**: 5-64.
- Chiang, Y.-M. 1960. Marine algae of northern Taiwan (Cyanophyta, Chlorophyta, Phaeophyta). Taiwanica **7**: 51-75.
- Chiang, Y.-M. 1962a. Marine algae of northern Taiwan (Rhodophyta). Taiwanica **8**: 167-180.
- Chiang, Y.-M. 1962b. Marine algae collected from Penghu (Pescadores). Taiwanica **8**: 167-180.
- Chiang, Y.-M. 1970. Morphology studies of red algae of the family Cryptonemiaceae. Vol. 58. Univ. of California Press, Berkeley, 95 pp.
- Chiang, Y.-M. 1972. Key to the genera of marine algae of Taiwan. Taiwanica **17**: 8-13.
- Chiang, Y.-M. 1973a. Studies on the marine flora of southern Taiwan. Bull. Jap. Soc. Phycol. **21**: 97-102.
- Chiang, Y.-M. 1973b. Notes on marine algae of Taiwan. Taiwanica **18**: 13-17.
- Chiang, Y.-M. and C. Chen. 1982. The genus *Liagora* of Taiwan. Acta Oceanogr. Taiwanica **13**: 181-196.
- Chiang, Y.-M. and C. Chen. 1983. Studies on *Dotyophycus yamadae* (Ohmi et Itono) Abbott et Yoshizaki (Nemaliales, Rhodophycophyta) from southern Taiwan. Jap. J. Phycol. **31**: 132-149.
- Chiang, Y.-M. and H.-N. Chou. 1980. The occurrence of *Zonaria stipitata* on the southern coasts of Taiwan. Jap. J. Phycol. **28**: 165-167.
- Chiang, Y.-M. and W.-L. Wang. 1987. Distribution of seaweeds of the Hengchun Peninsula. Taiwan. In: Chang, K.-H. (ed.) Marine Science. Nat. Sci. Coun. Symp. series **10**: 71-87.
- Chou, H.-N. and Y.-M. Chiang. 1981. The *Sargassum* of Taiwan. Acta Oceanogr. Taiwanica. **12**: 132-149.

- Chu, T.-Y. 1963. The oceanography of the surrounding waters of Taiwan. Inst. Fish. Biol., Taiwan Univ. Report **1**: 29-44. (in Chinese)
- Chu, T.-Y. 1971. Environmental study of the surrounding waters of Taiwan. Acta Oceanogra. Taiwanica Sci. Rep., Taiwan Univ. **1**: 15-32.
- Cordero, P. A. 1977a. The marine algae of Batan Island, northern Philippines. II. Chlorophyceae. J. Fish. Res., Philippines. **2**: 12-55.
- Cordero, P. A. 1977b. Studies on Philippines marine red algae. Seto Mar. Biol. Lab. Ser. IV. No.632, 265 pp.
- Critchley A. T. and M. Ohno. 1998. Seaweed resources of the world. Japan International Cooperation Agency, 431 pp.
- Dawson, E. Y. 1954a. Marine red algae of Pacific Mexico Part. 2. Cryptonemiales. Univ. of Southern California Press.
- Dawson, E. Y. 1954b. Marine plants in the vicinity of the institute Oceanographique de Nha Trang, Viet Nam. Pac. Sci. **8**: 373-481.
- Dawson, E. Y. 1956. Some marine algae of the southern Marshall Islands. Pac. Sci. **10**: 140-153.
- Dawson, E. Y. 1961. Marine red algae of Pacific Mexico Part. 4. Gigartinales. Pac. Nat., **2**: 191-375.
- Fan, K.-C. 1951. The genera *Gelidium* and *Pterocladia* of Taiwan. Taiwan Fish. Res. Inst., Lab. Biol. Rep., **2**: 1-22.
- Fan, K.-L. 1982. A study of water masses in Taiwan Strait. Acta Oceanogr. Taiwanica. **13**: 140-153.
- Guan, B. 1983. A sketch of the current structures and eddy characteristics in the East China Sea. In: Acta Oceanologia Sinica, Beijing, China, (ed.) Proceedings of International Symposium on Sedimentation on the Continental Shelf, with Special Reference to the East China Sea. China Ocean Press, Beijing. pp. 52-73.
- Huang, S.-F. 1990. The marine algal flora of Hsiao-Liuchiu Island. Bot. Bull. Acad. Sinica **32**: 245-255.
- Huang, S.-F. 1991. Additions to the marine algal flora of Taiwan. Jap. J. Phycol. **39**: 263-269.
- Huang, S.-F. 1997. The resource of seaweeds and their use in Taiwan. J. of Taiwan Nat. Sci. **15**: 76-87. (in Chinese)
- Huang, S.-F. 1998, Guide book of seaweeds of southern Taiwan. Ping-tung County Museum of Natural History, 141 pp. (in Chinese)
- Huisman, J. M. and M. A. Borowitzka. 1990. A revision of the Australian species of *Galaxaura* (Rhodophyta, Galaxauraceae), with a description of *Tricleocarpa* gen. nov. Phycologia **29**: 150-172.
- Huisman, J. M. and R. A. Townsend. 1993. An examination of Linnaean and pre-linnaean taxa referable to *Galaxaura* and *Tricleocarpa* (Galaxauraceae, Rhodophyta). Bot. J. Linn. Soc., Lond **113**: 95-101.
- Humm, H. J. and S. R. Wicks. 1980. Introduction and guide to the marine blue green algae. Wiley Intersci. Pub., New York, 194 pp.
- Ishijima, W. 1942. On the coralline algae from the Ryukyu limestone of Kotosho (Botel Tobago Island). Taiwan Tigaku Kizi **13**: 78-84. (in Japanese).
- Kamura, S. 1963. Notes on some marine algae from the southern Ryukyu Islands (II). Bull. Jap. Soc. Phycol. **11**: 103-109.

- Kawaguchi, S. 1989. The genus *Prionitis* (Halymeniaceae, Rhodophyta) in Japan. Jap. Faculty Sci., Hokkaido Univ. Ser. V. **14**: 193-257.
- Lee, R.-E., Y.-M. Lin and S.-Y. Hwang. 1989. Report on Fisheries and Oceanographic Investigation along Taiwan Coast. Taiwan Fish. Resear. Inst., Keelung, Taiwan.
- Lewis, J. and J. N. Norris. 1987. A history and annotated account of the benthic marine algae of Taiwan. Smithsonian Contri., Mari. Sci. **29**: 1-38.
- Li, H.-W. 1991. Geostrophic current and associated vertical motion off northeastern Taiwan. In: K. Takano (ed.) Oceanography of Asian Marginal Seas. Amsterdam, Elsevier. pp. 335-344.
- Lobban, C. S., P. J. Harrison and M. J. Duncan. 1985. The Physiological Ecology of Seaweeds. Cambridge Univ., 366 pp.
- Magruder W. H. and J. W. Hunt. 1979. Seaweeds of Hawaii: a photographic identification guide. The Oriental Pub. Co., Honolulu, 116 pp.
- Masuda, M. 1993. *Ahnfeltiopsis* (Gigartinales, Rhodophyta) in the western Pacific. Jap. J. Phycol. **41**: 1-6.
- Okamura, K. 1907-1935. Icones of Japanese Algae. Vol. I-VIII. Published by the author, Tokyo.
- Okamura, K. 1931. On the marine algae from Kotosho (Botel Tobago). Bull. Biogeogr. Soci. Japan **2**: 95-122.
- Okamura, K. 1936. Nippon Kaiso-si (Description of Japanese Algae) . Uchi-da-ro-kaku-ho, Tokyo, 964 pp.
- Papenfuss, G. F. 1968. Notes on South African marine algae. V. J. S. Afr. Bot. **34**: 267-287.
- Papenfuss, G. F., K. E. Mshigeni, and Y. M. Chiang. 1982. Revision of the red algal genus *Galaxaura* with special reference to the species occurring in the western Indian Ocean. Bot. Mar. **25**: 401-444.
- Shen, Y.-F. and K.-C. Fan. 1950. Marine algae of Formosa. Taiwania **1**: 317-345.
- Silva, P. C., E. C. Menez, and R. L. Moe. 1987. Catalog of the benthic marine algae of the Philippines. Smithsonian Contri. Mar. Sci. **27**: 1-179.
- Silva, P. C., P. W. Basson, and R. L. Moe. 1996. Catalogue of the benthic marine algae of the Indian Ocean. Univ. of California Press, Berkeley. 1259 pp.
- Tanaka, T. and P. H. Ho. 1962. Notes on some marine algae from Vietnam I. Mem. Fac. Fish. Kagoshima Univ. **11**: 24-40.
- Taniguti, M. 1976. Phytosociological study of marine algae in Taiwan. Bull. of Mie Univ. **27**: 51-57.
- Taylor, W. R. 1960. Marine algae of the eastern tropical and subtropical coasts of the Americas. Univ. of Michigan Press. 870pp.
- Thoi, L. V. 1969. Marine algae of southern Vietnam. Trung-Tam, 558pp.
- Trono, G. C. Jr. 1997. Field guide and atlas of the seaweed resources of the Philippines. Bookmark Inc., Philippines, 306pp.
- Tseng, C. K. 1983. Common Seaweeds of China. Science Press. Beijing, 316 pp.
- Tsuda, R. T. 1991. Catalog of the marine benthic algae from the Ryukyu Islands. Japan. Galaxea **10**: 35-64.
- Wang, C.-C. and C.-S. Chen. 1980. Study on the community structure of intertidal macroflora on rocky shore at northeastern part of Taiwan. J. Fish. Soc. Taiwan. **7**: 1-12.
- Wang, J.-C. and Y.-M. Chiang. 1977. Notes on marine algae of Taiwan. II. The genus

- Porphyra*. *Taiwania* **22**: 105-112.
- Wang, W.-L., H.-K. Chen and Y.-M. Chiang. 1993. Notes on marine algae new to Taiwan. *Bot. Mar.* **36**: 545-553.
- Wang, W.-L. and Y.-M. Chiang. 1993. Marine algae of Lan Yu (Orchid Island), Taiwan. *Acta Oceanog. Taiwanica* **31**: 83-100.
- Wang, W.-L. and Y.-M. Chiang. 1994. Potential Economic Seaweeds of Hengchun Peninsula, Taiwan. *Econo. Bot.* **48**: 182-189.
- Womersley, H. B. S. and A. Bailey. 1970. Marine algae of the Solomon Islands. *Phil. Trans. Roy. Soc. Land.* **B259**: 257-352.
- Yamada, Y. 1925a. Studien über die Merresalgen von der Insel Formosa. 1. Chlorophyceae. *Bot. Mag. Tokyo.* **39**: 77-95.
- Yamada, Y. 1925b. Studien über die Merresalgen von der Insel Formosa. 2. Phaeophyceae. *Bot. Mag. Tokyo.* **39**: 239-254.
- Yamada, Y. 1930-1944. Notes on some Japanese algae I-X. *J. Fac. Sci., Hokkaido Imp. Univ., Ser. V.* vol. 1-2.
- Yamada, Y. 1936. The species of *Eucheuma* from Ryukyu and Formosa. *Sci. Pap. Inst. Algol. Res. Fac. Sci. Hollaido Imp. Univ.* **1**: 119-134.
- Yamada, Y. 1950. A list of marine algae from Ryukyusho, Formosa. I: Chlorophyceae and Phaeophyceae. *Sci. Pap. Inst. Algol. Res. Fac. Sci., Hokkaido Imp. Univ.* **3**: 173-194.
- Yang, H.-N. 1981. Taxonomical study on the articulated coralline algae of Taiwan. M.S. thesis, Depart. of Botany, Taiwan Univ. 118pp. (in Chinese )
- Yang, H.-N. and Y.-M. Chiang. 1982. Taxonomical study on the *Gracilaria* of Taiwan. *J. Fish. Soc. Taiwan.* **9**: 55-71.
- Yang, H.-N. , W.-L. Wang and L.-M. Liao. 1994. Marine algal flora of Pengchia Yu and its special place in the marine phytogeography of Taiwan. *Bot. Mar.* **37**: 419-432.
- Yoshida, T., Y. Nakajuma and N. Yoshikazu. 1990. Check-list of marine algae of Japan. *Jap. J. Phycol.* **38**: 269-320.

## 龜山島海藻之研究

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(收稿日期：1999年1月8日；接受日期：1999年2月24日)

### 摘 要

本文為一九九七年間在臺灣東北部海域之龜山島進行海藻的採集及調查研究，共採了75種海藻，包括藍藻2種，綠藻19種，褐藻12種，紅藻42種。這些藻類皆為龜山島的首次記錄，其中有2種為臺灣地區的新記錄種，另外有6種則在海藻植物地理分佈上有擴張現象。在海藻組成上，龜山島具有印度—西太平洋特有之熱帶性海藻，有關洋流對本區海藻相之影響亦在本文中討論。

關鍵詞：海藻相，新記錄種，植物地理，龜山島，臺灣。

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