

The Marine Macroalgae of Lu Tao (Green Island), Taiwan

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ABSTRACT: The species composition, distribution, seasonality of the marine macroalgae of Lu Tao, Taiwan were studied. A total of 146 species were recorded including 2 Cyanobacteria, 51 Chlorophyta, 23 Phaeophyceae and 70 Rhodophyta. Among them, *Laurencia cartilaginea* and *L. intricata* which are newly recorded for Taiwan. The marine macroalgae of Lu Tao are compared with reported floras of Taiwan and its other associated islands.

KEY WORDS: Marine macroalgae, New records, Seasonality, Taiwan.

INTRODUCTION

Lu Tao (Kasyoto or Green Island) is a small volcanic island with an area of 16.24 km², lying 33 km off the southeastern coast of Taiwan. The island is oblong, extending 4 km north-south and 3 km east-west. It is mainly composed of sandstone peaks and low-lying fringing coral reefs. Its coastline is ca. 20.3 km long and, except for sandy beaches in both northwestern and southern tips, is dotted with coral reefs.

The characteristics of the seawater around this island are mainly influenced by the Kuroshio Current which flows north from the eastern Philippines at an average speed of 1.5-2 knots throughout the year (Chu, 1974; Nitani, 1971). In summer the average temperature of the surface seawater is about 28 °C, and in winter, about 24 °C. The salinity of the surface water is in the range of 34.0-34.4 ‰ (Chu, 1961). The prevailing northeast only wind blows strongly from October through April and the south only wind, from May to September. Typhoons and thunderstorms may occur from June to September (Chu, 1971).

Five hundred and fifty-seven species of marine macroalgae have so far been reported for Taiwan (Lewis and Norris, 1987; Huang, 1990; Wang and Chiang, 1993; Wang *et al.*, 1993; Wang and Chiang, 1994; Yang *et al.*, 1994; Huang, 1999a, b; Huang and Chang, 1999). Among them, 18 species (1 Phaeophyceae and 17 Rhodophyta) for Lu Tao were included in Shen and Fan (1950). We collected Lu Tao marine macroalgae five times in 1991. Based on these collections, the species composition, distribution and seasonality of marine macroalgae of Lu Tao are reported. The marine algal flora of this island is also compared with the adjacent regions.

MATERIALS AND METHODS

Collections and observations were made by scuba and free diving at six localities in four areas on the island: western coast (I: Nan-Liao and Kuei-Wan), southwestern coast (II:

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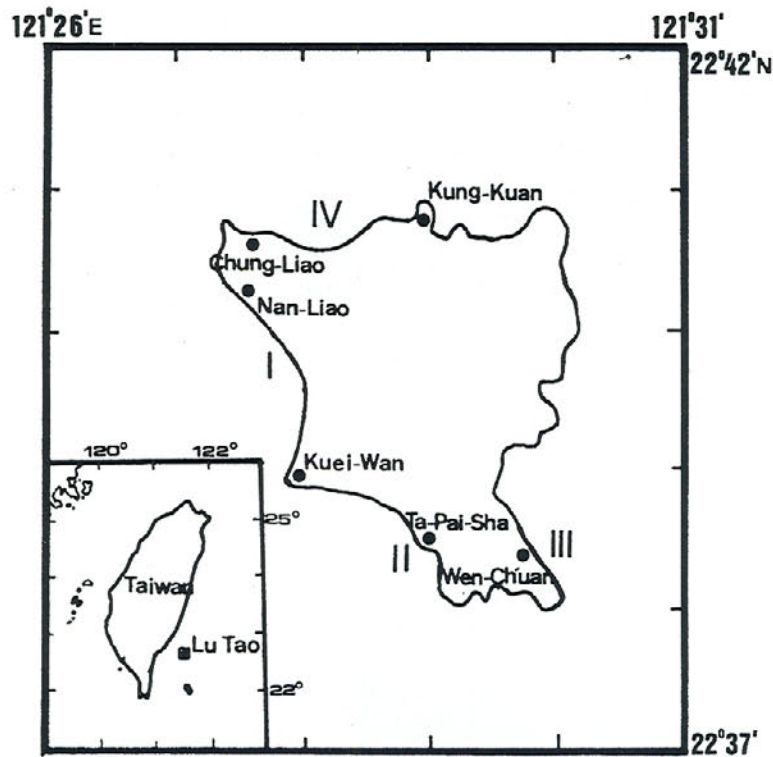


Fig. 1. Collecting localities in Lu Tao, Taiwan. Western part (I): Nan-Liao and Kuei-Wan. Southwestern part (II): Ta-Pai-Sha. Southeastern part (III): Wen-Ch'uan. Northern part (IV): Chung-Liao and Kung-Kuan.

Ta-Pai-Sha), southeastern coast (III: Wen-Ch'uan) and northern coast (IV: Chung-Liao and Kung-Kuan) (Fig. 1). Collections were made five times in 1991 in order to document seasonal differences (January 28-30, April 27-29, June 8-10, September 4-6 and November 8-10).

For taxonomic studies both herbarium specimens and liquid preserved material (fixed in 10% formalin-seawater) were used. Sections were made by hand or with a freezing microtome. Material was stained with 1% aqueous aniline blue solution for 3-4 min, then post-fixed with 1% HCl, and mounted in 100% Karo with phenol added (Tsuda and Abbott, 1985). The material is deposited in the Herbarium of the Institute of Oceanography, National Taiwan University.

For comparing the species composition among the four areas in Lu Tao, the following numerical taxonomic techniques were applied. The presence and absence of the algal species at the above sites were coded as 1 and 0 for binary data matrices. The Sørensen or Dice similarity coefficients ($S=2a/(2a+b+c)$) were calculated among the four areas and then using unweighted pair-group arithmetic average (UPGMA) clustering method in the NTSYS-pc program package (Rohlf, 1992) to construct the dendrogram.

Description of the studied area

In the western coast (I) of the island, including Nan-Liao and Kuei-Wan (Fig. 1), the coastline consists of an emergent limestone platform 20-70 m wide. Many indentations cut into the limestone, perpendicular to the shore. Different size tidal pools exist in the littoral zone. The limestone platform of the littoral zone is very irregularly pitted and deeply indented. At the edge the reef forms a narrow belt with a steep slope. In the sublittoral zone different

sizes of coral heads and rocks are scattered on a sandy bottom. Fringing coral reefs are also well developed here. In the southwestern coast (II), Ta-Pai-Sha (Fig. 1), the coast consists of a short stretch of sandy beach. The littoral zone is occupied by a limestone platform which is irregularly pitted and possesses many shallow furrows perpendicular to the shore. There are also different size of rocks scattered on it. On the southeastern coast (III), Wen-Ch'uan (Fig. 1), the coast consists of a flat emergent limestone platform 20-50 m wide. The limestone in the littoral zone is cut irregularly into many bands perpendicular to the shore with wide and deep furrows which in turn are backed by a high rocky cliff on its southeast side. The outer edge of the reef flat is very steep. The northern coast (IV), Chung-Liao and Kung-Kuan (Fig. 1), is similar to the southeastern part. The limestone of the littoral zone, 40-50 m wide, is cut irregularly into many bands perpendicular to the shore with wide and shallow furrows. There are a few tidal pools in the littoral zone.

RESULTS

One hundred and forty-six species of marine macroalgae were identified from Lu Tao. These are distributed in 84 genera and 44 families, and including 2 species of Cyanobacteria, 51 Chlorophyta, 23 Phaeophyceae and 70 Rhodophyta (Table 1). *Laurencia cartilaginea* and *L. intricata* are recorded for the first time in Taiwan and its offshore islands.

Table 1. Systematic numbers of marine algal taxa in Lu Tao, Taiwan.

Division	No. of Families	No. of Genera	No. of Species	No. of new records for Taiwan
Cyanobacteria	2	2	2	0
Chlorophyta	12	23	51	0
Phaeophyceae	4	7	23	0
Rhodophyta	22	40	70	2
Total	44	85	146	2

The northern part had the largest number of marine algal species (102 taxa), followed by the southwestern part (81 taxa). At the western and the southeastern parts were identified 73 and 74 taxa, respectively (Fig. 2). Most species were found in the middle (104 taxa) and lower (96 taxa) littoral zones (Fig. 3). The distribution and seasonal occurrence of marine seaweeds of Lu Tao is shown in Table 2. Most species are more abundant from April to June, and fewer species in September (Fig. 4).

The similarities of the algal communities among the four areas are shown in Fig. 5. The cluster analysis revealed two groups: group A, consisting of the western (I) and southwestern (II) parts of this island, and group B, the northern (IV) and southeastern (III) parts of this island. There are a few differences in the algal communities of these two groups. Twenty-six taxa such as 17.8 % were found growing in the former group but not found in the latter and 40 taxa such as 27.4% were found growing in the latter group but not found in the former.

DISCUSSION

The 146 taxa of marine macroalgae found at Lu Tao constitute about one fourth of the total marine macroalgal taxa currently published for Taiwan (Lewis and Norris, 1987; Huang, 1990; Wang and Chiang, 1993; Wang *et al.*, 1993; Wang and Chiang, 1994; Yang *et al.*, 1994; Huang, 1999a, b; Huang and Chang, 1999). Although Lu Tao is a small volcanic island, its

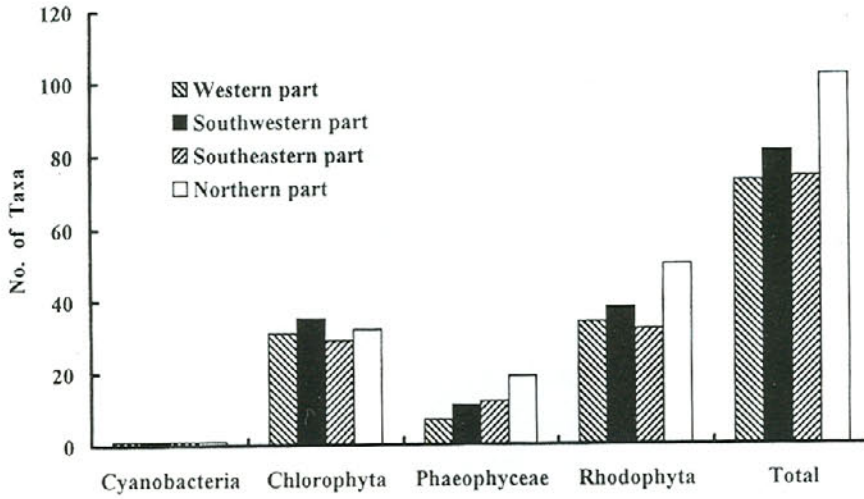


Fig. 2. Occurrence of marine macroalgal taxa of the four areas in Lu Tao.

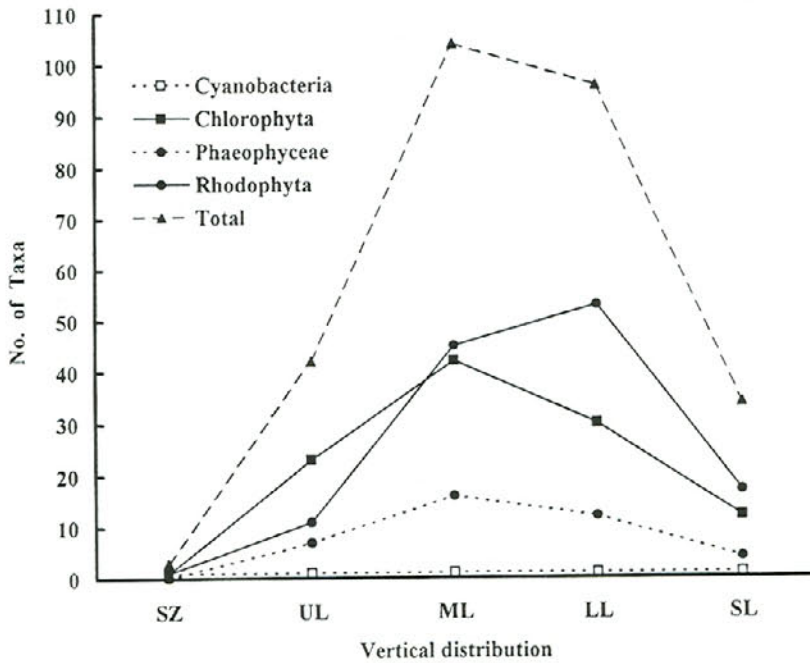


Fig. 3. Vertical distribution of marine macroalgal taxa. SZ: supralittoral zone; UL: upper littoral zone; ML: middle littoral zone; LL: lower littoral zone; SL: sublittoral zone.

marine algal flora is rich.

The marine macroalgal flora of Lu Tao is of tropical flora. Those species such as *Boergesenia forbesii*, *Bornetella nitida*, *Neomeris* spp., *Halimeda opuntia*, *Valonia aegagropila*, *Caulerpa* spp., *Tydemania expeditionis*, *Udotea argentea*, *Avrainvillea* spp., *Codium geppiorum*, *Turbinaria* spp., *Sargassum* spp., *Porphyra vietnamensis*, *Galaxaura* spp., *Gracilaria* spp., *Ceratodictyon spongiosum*, *Claudea batanensis*, *Laurencia* spp. etc are all

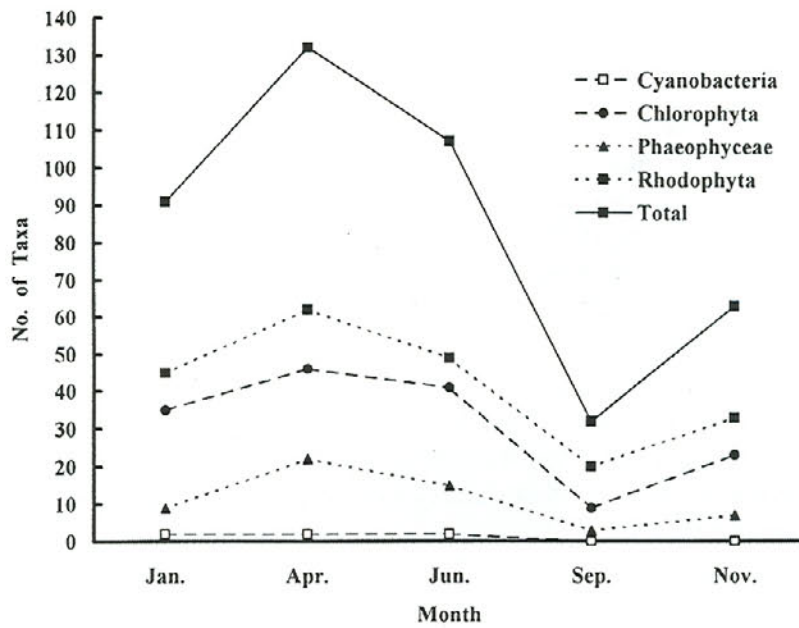


Fig. 4. Seasonal variation of number of marine macroalgal taxa.

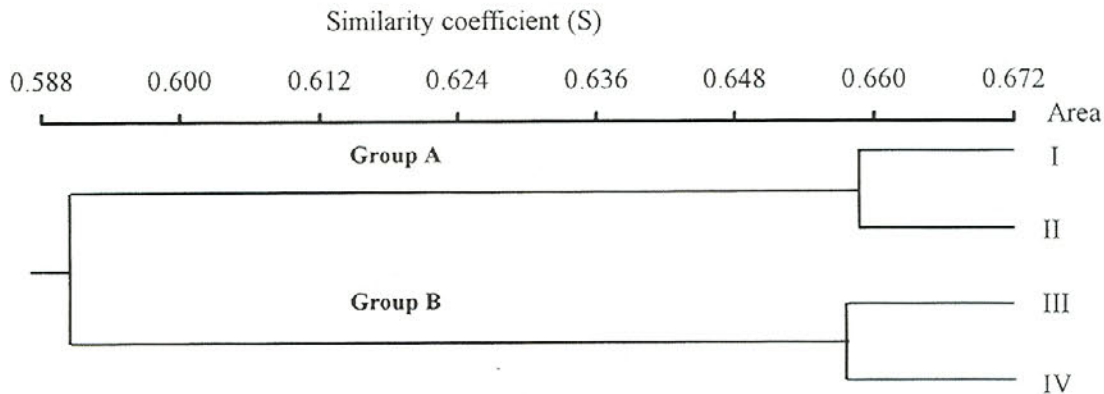


Fig. 5. Floristic similarity of collecting areas revealed by clustering of species records using UPGMA. I: Western part, II: Southwestern part, III: Southeastern part, IV: Northern part.

widely distributed in tropical waters. Based on the present and previous studies (Shen and Fan, 1950), the ratio of Rhodophyta and Chlorophyta to Phaeophyceae (R+C/P) of Lu Tao is 5.65. It indicates that the algal flora of Lu Tao is similar to that of Lan Yu. Lu Tao is geologically similar, and located close to Lan Yu. Furthermore, the marine algal flora of Lan Yu is characteristic of tropical nature (Wang and Chiang, 1993). It can be said that marine algal flora of Lu Tao is also a tropical flora.

Quantitative comparisons of the floristic composition of the four areas of Lu Tao revealed two distinct assemblages (Fig. 5). It is thought to be related to different wind directions: the prevailing northeastern wind in winter and the southern wind in summer. In addition, difference in the algal communities might also be related to difference in coral communities. According to Dai's personal communications (National Taiwan University), most of species distributed in the northern and eastern coasts of Lu Tao were of stone corals, while those

distributed in the western and southwestern coasts were of soft corals.

From this study we found that the topography, water temperature fluctuation, and the species composition of the marine macroalgal flora of Lu Tao is closely related to those of southern Taiwan (Yamada, 1950; Chiang, 1973b; Chou and Chiang, 1981; Yang, 1981; Chiang and Chen, 1982; Chiang and Wang, 1987; Wang *et al.*, 1993; Wang and Chiang, 1994; Huang and Chang, 1999), Hsiao-Liuchiu Island (Huang, 1990; Huang and Chang, 1999), Lan Yu (Okamura, 1931; Ishijima, 1941, 1942; Shen and Fan, 1950; Wang and Chiang, 1993; Wang *et al.*, 1993; Huang and Chang, 1999) and the Ryukyu Islands (Tsuda, 1991). Lu Tao shares 111 taxa (68.9 %), 90 taxa (55.9 %), 105 taxa (65.2 %) and 115 taxa (71.9 %) of marine algae with the latter areas. The marine macroalgal flora of Lu Tao differs significantly from that of northern Taiwan (Okamura, 1931, 1936; Chiang, 1960, 1962, 1973a; Chou and Chiang, 1981; Yang, 1981; Chen, 1991; Wang *et al.*, 1993; Huang, 1999a, b; Huang and Chang, 1999). Only 62 taxa (35.8 %) are common to these two areas. The differences in the composition of the marine flora of these areas could be due to topography, water temperatures and dispersal vectors (current).

Table 2. Floristic list, vertical distribution and seasonal change of Lu Tao marine algae collected by the authors.

Taxa	Study Areas				Vertical distribution					Seasonal Occurrence				
	I	II	III	IV	HZ	UL	ML	LL	SL	Jan	Apr	Jun	Sep	Nov
CYANOBACTERIA														
Oscillatoriaceae														
<i>Lyngbya majuscula</i> (Dillwyn) Harvey	+		+	+		x	x	x	x	+	+	+		
Mastigocladaceae														
<i>Brachytrichia quoyi</i> (C. Agardh) Bornet & Flahault			+			x				+	+	+		
CHLOROPHYTA														
Monostromataceae														
<i>Monostroma latissimum</i> Wittrock	+	+		+		x				+	+			+
Ulvaceae														
<i>Enteromorpha intestinalis</i> (Linnaeus) Nees	+	+	+	+		x	x	x		+	+	+		+
<i>Enteromorpha linza</i> (Linnaeus) J. Agardh	+	+	+	+		x	x			+	+	+	+	+
<i>Ulva conglobata</i> Kjellman	+	+	+	+		x	x			+	+	+	+	+
<i>Ulva fasciata</i> Delile		+	+			x	x			+	+	+		
<i>Ulva japonica</i> (Holmes) Papenfuss				+	+		x	x			+	+		
<i>Ulva lactuca</i> Linnaeus	+	+	+	+		x	x	x		+	+	+	+	+
<i>Ulva pertusa</i> Kjellman		+		+		x	x			+	+			
Anadyomenaceae														
<i>Anadyomene wrightii</i> Harvey ex J. Gray	+					x	x			+				
<i>Microdictyon nigrescens</i> (Yamada) Setchell				+			x	x			+	+		
Cladophoraceae														
<i>Chaetomorpha antennina</i> (Bory de Saint-Vincent) Kützing		+	+			x	x				+			
<i>Chaetomorpha crassa</i> (C. Agardh) Kützing	+	+	+	+		x	x			+	+	+		+
<i>Chaetomorpha linum</i> (O. F. Müller) Kützing		+	+	+		x	x			+	+	+		+
<i>Chaetomorpha spiralis</i> Okamura	+	+	+			x	x			+	+	+		+
<i>Cladophora patentiramea</i> (Montagne) Kützing	+	+	+	+		x	x	x			+	+		
<i>Cladophora sibogae</i> Reinbold		+	+				x	x			+	+		

Table 2. Continued.

Taxa	Study Areas				Vertical distribution					Seasonal Occurrence				
	I	II	III	IV	HZ	UL	ML	LL	SL	Jan	Apr	Jun	Sep	Nov
Siphonocladaceae														
<i>Boergesenia forbesii</i> (Harvey) J. Feldman	+	+	+	+	x	x				+	+	+	+	+
<i>Boodlea composita</i> (Harvey) Brand	+	+	+	+	x	x	x			+	+	+		+
<i>Boodlea vanbosseae</i> Reinbold			+	+	x	x	x			+	+			+
<i>Ventricaria ventricosa</i> (J. Agardh) Olsen et J. West	+	+							x	+	+	+		
Valoniaceae														
<i>Dictyosphaeria cavernosa</i> (Forsskål) Børgesen	+	+	+	+	x	x	x			+	+	+		+
<i>Struvea anastomosans</i> (Harvey) Piccone et Grunow ex Piccone	+				x	x				+				
<i>Valonia aegagropila</i> C. Agardh	+	+	+	+	x	x	x			+	+	+		+
<i>Valoniopsis pachynema</i> (Martens) Børgesen	+	+	+	+	x	x	x			+	+	+	+	+
Bryopsidaceae														
<i>Bryopsis pennata</i> var. <i>secunda</i> (Harvey) Collines et Harvey			+	+			x	x			+	+		
<i>Bryopsis plumosa</i> (Hudson) C. Agardh	+	+					x	x		+	+	+		
Caulerpaceae														
<i>Caulerpa brachypus</i> f. <i>parvifolia</i> (Harvey) Cribb	+		+						x	+	+	+		
<i>Caulerpa racemosa</i> f. <i>macrophysa</i> (Sonder ex Kützinger) W. R. Taylor	+	+	+	+			x	x		+	+	+	+	+
<i>Caulerpa microphysa</i> (Weber-van Bosse) J. Feldmann	+	+	+	+			x	x		+	+	+		+
<i>Caulerpa peltata</i> Lamouroux.	+	+	+	+			x	x		+	+	+	+	+
<i>Caulerpa serrulata</i> f. <i>lata</i> (Weber-van Bosse) Tseng	+								x	+	+	+		
<i>Caulerpa verticillata</i> J. Agardh	+	+		+					x	+	+	+		
<i>Caulerpa webbiana</i> f. <i>tomentella</i> (Harvey ex J. Agardh) Weber-van Bosse	+		+	+			x	x		+	+	+		
Codiaceae														
<i>Codium arabicum</i> Kützinger			+	+			x	x			+	+		
<i>Codium barbatum</i> Okamura				+			x	x			+	+		
<i>Codium edule</i> P. Silva			+	+			x	x			+	+		
<i>Codium geppiorum</i> O. C. Schmidt	+		+	+			x	x			+	+		
<i>Codium saccatum</i> Okamura				+			x	x			+	+		
Halimedaceae														
<i>Halimeda discoidea</i> Decaisne	+	+					x	x	x		+	+		
<i>Halimeda opuntia</i> (Linnaeus) Lamouroux	+	+	+				x	x	x	x	+	+	+	+
Udoteaceae														
<i>Avrainvillea erecta</i> (Berkeley) A. Gepp et E. Gepp			+	+			x	x			+	+		
<i>Avrainvillea lacerata</i> Harvey ex J. Agardh				+			x	x						+
<i>Chlorodesmis caespitosa</i> J. Agardh		+		+			x	x		+	+	+		+
<i>Chlorodesmis fastigiata</i> (C. Agardh) Ducker				+			x	x		+	+	+		+
<i>Rhipidosiphon javensis</i> Montagne		+							x		+	+		
<i>Tydemania expeditionis</i> Weber-van Bosse	+								x	+	+			
<i>Udotea argentea</i> Zanardini	+								x	+				
<i>Udotea fragilifolia</i> Tseng et Dong		+		+			x	x	x		+	+		

Table 2. Continued.

Taxa	Study Areas				Vertical distribution					Seasonal Occurrence				
	I	II	III	IV	HZ	UL	ML	LL	SL	Jan	Apr	Jun	Sep	Nov
Dasycladaceae														
<i>Bornetella nitida</i> Sonder	+	+				x	x			+				+
<i>Neomeris annulata</i> Dickie	+	+		+			x	x	x	+	+	+		+
<i>Neomeris van-bosseae</i> Howe			+	+			x	x	x	+	+	+		+
PHAEOPHYCEAE														
Dictyotaceae														
<i>Dictyopteris undulata</i> Holmes				+				x	x			+	+	
<i>Dictyota cervicornis</i> Kützinger				+			x				+	+		
<i>Dictyota dichotoma</i> (Hudson) Lamouroux		+	+	+			x			+	+	+		
<i>Dictyota divaricata</i> Lamouroux				+			x				+	+		
<i>Lobophora variegata</i> (Lamouroux) Womersley ex Oliveria				+			x	x	x		+	+		
<i>Padina minor</i> Yamada	+	+	+	+			x	x		+	+	+	+	+
<i>Zonaria flabellata</i> (Okamura) Papenfuss				+					x		+	+		
<i>Zonaria stipitata</i> Tanaka et Nozawa				+					x		+	+		
Chnoosporaceae														
<i>Chnoospora implexa</i> J. Agardh	+	+					x	x		+	+			+
<i>Chnoospora minima</i> (Hering) Papenfuss				+			x	x			+			
Scytosiphonaceae														
<i>Hydroclathrus clathratus</i> (C. Agardh) Howe		+	+				x	x		+	+		+	+
<i>Hydroclathrus tenuis</i> Tseng et Lu			+	+			x	x			+			
Sargassaceae														
<i>Sargassum carpophyllum</i> J. Agardh				+					x		+			
<i>Sargassum crassifolium</i> J. Agardh	+	+	+	+			x	x	x	+	+	+		+
<i>Sargassum cristaefolium</i> C. Agardh	+	+	+	+			x	x			+	+		
<i>Sargassum glaucescens</i> J. Agardh			+	+					x	+	+			+
<i>Sargassum ilicifolium</i> (Turner) C. Agardh		+	+	+					x		+	+		
<i>Sargassum polycystum</i> C. Agardh			+	+			x	x		+	+			+
<i>Sargassum siliquosum</i> J. Agardh	+		+	+					x		+	+		
<i>Turbinaria conoides</i> (J. Agardh) Kützinger	+	+	+	+			x	x		+	+	+		
<i>Turbinaria ornata</i> (Turner) J. Agardh	+	+	+	+			x	x		+	+	+	+	+
<i>Turbinaria trialata</i> (J. Agardh) Kützinger		+					x	x			+			
Cystoseiraceae														
<i>Hormophysa cuneiformis</i> (J. Gmelin) P. Silva				+			x	x			+	+		
RHODOPHYTA														
Bangiaceae														
<i>Porphyra crispata</i> Kjellman				+			x	x		+				+
<i>Porphyra vietnamensis</i> T. Tanaka et Pham-Hoàng Hô				+			x	x		+				+
Galaxauraceae														
<i>Actinotrichia fragilis</i> (Forsskål) Børgesen	+								x	x	+	+		+
<i>Galaxaura marginata</i> (Ellis et Solander) Lamouroux	+	+	+	+			x	x	x	+	+	+	+	+
<i>Tricleocarpa cylindrica</i> (Ellis et Solander) Huisman et Borowitzka	+			+					x	x		+	+	

Table 2. Continued.

Taxa	Study Areas				Vertical distribution					Seasonal Occurrence				
	I	II	III	IV	HZ	UL	ML	LL	SL	Jan	Apr	Jun	Sep	Nov
<i>Tricleocarpa fragilis</i> (Linnaeus) Huisman <i>et</i> Townsend	+	+	+	+	x	x	x			+	+	+	+	+
Liagoraceae														
<i>Liagora boergesenii</i> Yamada				+					x		+	+		
<i>Yamadaella cenomyce</i> (Decaisne) Abbott	+	+		+	x	x				+	+	+	+	+
Gelidiaceae														
<i>Pterocladia capillacea</i> (S. Gmelin) Bornet		+						x			+	+		
<i>Ptilophora</i> sp.	+							x		+				
Gelidiellaceae														
<i>Gelidiella acerosa</i> (Forsskål) J. Feldmann <i>et</i> G. Hamel	+	+	+	+			x	x	x	+	+	+	+	+
Gracilariaceae														
<i>Gracilaria euclideanoides</i> Harvey	+	+	+	+			x	x		+	+	+	+	+
<i>Gracilaria salicornia</i> (C. Agardh) Dawson	+			+			x	x		+	+	+		
Bonnemaisoniaceae														
<i>Asparagopsis taxiformis</i> (Delile) Trevisan				+				x			+	+		
Halymeniaceae														
<i>Carpopeltis formosana</i> Okamura	+		+	+			x	x		+	+	+		+
<i>Carpopeltis maillardii</i> (Montagne <i>et</i> Millardet) Chiang	+	+		+			x	x		+	+	+	+	+
<i>Carpopeltis prolifera</i> (Holmes) Kawaguchi <i>et</i> Masuda			+	+			x	x			+	+		
<i>Halymenia microcarpa</i> (Montagne) P. Silva	+			+				x	x	+	+	+	+	+
<i>Prionitis filiformis</i> Kylin			+	+			x	x			+	+		
Peyssonneliaceae														
<i>Peyssonnelia distenta</i> (Harvey) Yamada		+	+	+			x	x	x	+	+	+		
<i>Peyssonnelia rubra</i> (Greville) J. Agardh		+							x	+	+			
Rhizophyllidaceae														
<i>Portieria hornemannii</i> (Lyngbye) P. Silva	+	+		+			x	x	x	+	+	+	+	+
Hildenbrandiaceae														
<i>Hildenbrandia rubra</i> (Sommerfelt) Meneghini				+					x		+			
Corallinaceae														
<i>Amphiroa foliacea</i> Lamouroux			+	+			x	x			+	+		
<i>Amphiroa fragilissima</i> (Linnaeus) Lamouroux	+	+		+			x	x		+	+	+		+
<i>Amphiroa valonioides</i> Yendo			+	+			x	x		+	+	+		+
<i>Arthrocardia anceps</i> (Yendo) Johansen				+			x	x		+	+	+		
<i>Cheilosporum acutilobum</i> (Decaisne) Piccone	+	+	+	+			x	x		+	+	+		
<i>Jania adhaerens</i> Lamouroux			+				x	x	x	+	+	+	+	+
<i>Mastophora rosea</i> (C. Agardh) Setchell	+	+	+	+			x	x		+	+	+	+	+
<i>Mesophyllum mesomorphum</i> (Foslie) Adey			+	+			x	x	x	+	+	+	+	+
Gigartinaceae														
<i>Chondracanthus intermedius</i> (Suringar) Hommersand	+	+	+				x	x		+	+			
Hypneaceae														
<i>Hypnea spinella</i> (C. Agardh) Kützting	+	+	+	+			x	x	x	+	+	+		+
<i>Hypnea charoides</i> Lamouroux	+	+	+	+			x	x		+	+			+

Table 2. Continued.

Taxa	Study Areas				Vertical distribution					Seasonal Occurrence				
	I	II	III	IV	HZ	UL	ML	LL	SL	Jan	Apr	Jun	Sep	Nov
<i>Hypnea pannosa</i> J. Agardh	+	+	+	+			x	x	x	+	+	+	+	+
Nemastomataceae														
<i>Titanophora pulchra</i> Dawson				+					x		+	+		
Phylloporaceae														
<i>Ahnfeltiopsis flabelliformis</i> (Harvey) Masuda		+					x	x		+	+			
<i>Ahnfeltiopsis paradoxus</i> (Suringar) Masuda	+			+			x	x			+	+		
Sarcodiaceae														
<i>Sarcodia montagneana</i> (J. Hooker et Harvey) J. Agardh	+		+	+			x	x		+	+	+	+	+
Solieriaceae														
<i>Meristotheca coacta</i> Okamura			+	+			x	x			+	+		
Plocamiaceae														
<i>Plocamium serratum</i> Okamura			+	+					x		+	+		
Champiaceae														
<i>Champia parvula</i> (C. Agardh) Harvey		+					x	x		+	+	+		
Rhodymeniaceae														
<i>Botryocladia skottsbergii</i> (Børgesen) Levring		+	+	+			x				+			
<i>Ceratodictyon spongiosum</i> Zanardini	+	+		+					x	+	+	+		+
<i>Gelidiopsis repens</i> (Kützinger) Weber-van Bosse	+	+	+	+			x	x		+	+	+		+
Ceramiaceae														
<i>Centroceras clavulatum</i> (C. Agardh) Montagne		+	+	+			x	x	x	+	+		+	+
Dasyaceae														
<i>Dayphlia plumarioides</i> Yendo	+						x	x			+	+		
<i>Dictyurus purpurascens</i> Bory de Saint-Vincent	+								x	+	+			
Delesseriaceae														
<i>Claudea batanensis</i> Tanaka	+	+					x	x		+				+
<i>Martensia flabelliformis</i> Harvey ex J. Agardh	+	+							x	+	+			+
Rhodomelaceae														
<i>Acanthophora muscoides</i> (Linnaeus) Bory de Saint-Vincent				+			x	x				+		
<i>Acanthophora spicifera</i> (Vahl) Børgesen	+	+	+	+			x	x		+	+	+	+	+
<i>Acrocystis nana</i> Zanardini	+	+	+				x			+	+	+	+	+
<i>Amansia rhodantha</i> (Harvey) J. Agardh	+	+	+						x	+	+	+	+	+
<i>Bostrychia tenella</i> (Vahl) J. Agardh				+			x			+	+	+		+
<i>Chondria armata</i> (Kützinger) Okamura		+					x	x	x	+	+		+	+
<i>Laurencia brongniartii</i> J. Agardh			+	+					x		+	+		
<i>Laurencia cartilaginea</i> Yamada			+	+					x			+		
<i>Laurencia flexilis</i> var. <i>tropica</i> (Yamada) Xia et Zhang	+	+	+	+			x	x		+	+	+		+
<i>Laurencia intricata</i> Lamouroux		+		+			x	x			+	+		
<i>Laurencia obtusa</i> var. <i>densa</i> Yamada			+	+					x		+	+		
<i>Laurencia pannosa</i> Zanardini				+			x	x	x		+	+		
<i>Laurencia parvipapillata</i> Tseng	+	+							x	+				
<i>Laurencia pinnata</i> Yamada		+					x	x			+			
<i>Laurencia undulata</i> Yamada			+	+			x	x		+	+			

Table 2. Continued.

Taxa	Study Areas				Vertical distribution					Seasonal Occurrence				
	I	II	III	IV	HZ	UL	ML	LL	SL	Jan	Apr	Jun	Sep	Nov
<i>Laurencia venusta</i> Yamada	+		+	+			×	×				+	+	
<i>Laurencia</i> sp.1			+					×				+		
<i>Laurencia</i> sp.2				+				×				+		
<i>Leveillea jungermannioides</i> (Hering et Martens) Harvey		+					×	×		+			+	+
<i>Neurymenia fraxinifolia</i> (Mertens ex Turner) J. Agardh			+	+				×	×			+	+	+

I (Western part): Nan-Liao and Kui-Wan; II (Southwestern part): Ta-Pai-Sha; III (Southeast part): Wen-Ch'uan; IV (Northern part): Chung-Liao and Kung-Kuan.

HZ: Supralittoral zone; UL: Upper littoral zone; ML: Middle littoral zone; LL: Lower littoral zone; SL: Sublittoral zone.

+ and ×: Presence.

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綠島的大型海藻

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摘 要

綠島為一火山島，位於臺灣的東南海域中，距臺灣東部海岸最近距離約 33 公里。本研究於民國八十年一月、四月、六月、九月及十一月，以浮潛及水肺潛水的方式調查綠島海藻種類的組成、分佈及季節性變化，計有 146 種海藻，包括藍藻 2 種，綠藻 51 種，褐藻 23 種，紅藻 70 種。其中 *Laurencia cartilaginea* 和 *L. intricata* 為台灣新紀錄種。文中亦將綠島的大型海藻與台灣及其附近離島的大型海藻做一比較。

關鍵詞：大型海藻，新紀錄，季節變化，臺灣。

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